

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA**  
**KAKINADA – 533 003, Andhra Pradesh, India**

**PHARMACEUTICAL ENGINEERING**

**COURSE STRUCTURE AND SYLLABUS**

**For UG – R20**

**B. TECH - PHARMACEUTICAL ENGINEERING**

*(Applicable for batches admitted from 2020-2021)*



**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA**  
**KAKINADA - 533 003, Andhra Pradesh, India**

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA**  
**KAKINADA – 533 003, Andhra Pradesh, India**

**PHARMACEUTICAL ENGINEERING**

**COURSE STRUCTURE**

| <b>I-Year I-Semester</b> |                                                        |            |          |          |          |             |
|--------------------------|--------------------------------------------------------|------------|----------|----------|----------|-------------|
| <b>S.No</b>              | <b>Course Title</b>                                    | <b>CAT</b> | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b>    |
| 1                        | Communicative English                                  | HS         | 3        | -        | -        | 3           |
| 2                        | Mathematics-I<br>(Calculus and Differential Equations) | BS         | 3        | -        | -        | 3           |
| 3                        | Engineering Physics                                    | BS         | 3        | -        | -        | 3           |
| 4                        | Engineering Chemistry                                  | BS         | 3        | -        | -        | 3           |
| 5                        | Programming for Problem Solving using C                | ES         | 3        | -        | -        | 3           |
| 6                        | Programming for Problem Solving using C<br>Laboratory  | ES         | -        | -        | 3        | 1.5         |
| 7                        | Engineering Physics Lab                                | BS         | -        | -        | 3        | 1.5         |
| 8                        | Engineering Chemistry Lab                              | BS         | -        | -        | 3        | 1.5         |
| 9                        | Rural Sensitization(Activity Based Learning)           | MC         | -        | -        | 2        | -           |
|                          | <b>Total</b>                                           |            |          |          |          | <b>19.5</b> |

| <b>I-Year II-Semester</b> |                                                           |            |          |          |          |             |
|---------------------------|-----------------------------------------------------------|------------|----------|----------|----------|-------------|
| <b>S.No</b>               | <b>Course Title</b>                                       | <b>CAT</b> | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b>    |
| 1                         | Pharmaceutical Chemistry                                  | BS         | 3        | -        | -        | 3           |
| 2                         | Mathematics –II<br>(Linear Algebra and Numerical Methods) | BS         | 3        | -        | -        | 3           |
| 3                         | Engineering and Solid Mechanics                           | BS         | 3        | -        | -        | 3           |
| 4                         | Engineering Drawing                                       | ES         | 1        | -        | 4        | 3           |
| 5                         | Basic Electrical & Electronics Engineering                | ES         | 3        | -        | -        | 3           |
| 6                         | Basic Electrical & Electronics Engineering Lab            | ES         | -        | -        | 3        | 1.5         |
| 7                         | English Communication Skills Laboratory                   | HS         | -        | -        | 3        | 1.5         |
| 8                         | Engineering Workshop                                      | ES         | 0        | -        | 3        | 1.5         |
| 9                         | Environmental Science                                     | MC         | -        | -        | 2        | -           |
|                           | <b>Total</b>                                              |            |          |          |          | <b>19.5</b> |

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA**  
**KAKINADA – 533 003, Andhra Pradesh, India**

**PHARMACEUTICAL ENGINEERING**

| <b>II-Year I-Semester</b> |                                                         |            |           |          |           |             |
|---------------------------|---------------------------------------------------------|------------|-----------|----------|-----------|-------------|
| <b>S.NO</b>               | <b>Course Title</b>                                     | <b>CAT</b> | <b>L</b>  | <b>T</b> | <b>P</b>  | <b>C</b>    |
| 1                         | Pharmacology                                            | PC         | 3         | -        | -         | 3           |
| 2                         | Material and Energy Balance Computations                | PC         | 3         | -        | -         | 3           |
| 3                         | Fluid Mechanics and Mechanical Unit Operations          | PC         | 3         | -        | -         | 3           |
| 4                         | Thermodynamics for pharmaceutical engineers             | PC         | 3         | -        | -         | 3           |
| 5                         | Mathematics – III (Vector Calculus, Transforms and PDE) | BS         | 3         | -        | -         | 3           |
| 6                         | Basic Pharmaceutical Engineering Lab                    | PC         | -         | -        | 3         | 1.5         |
| 7                         | Fluid Mechanics and Mechanical Unit Operations Lab      | PC         | -         | -        | 3         | 1.5         |
| 8                         | Communication lab                                       | HS         | -         | -        | 3         | 1.5         |
| 9                         | Foundation Skills in Information Technology             | MC         | -         | -        | 2         | -           |
| <b>Total</b>              |                                                         | -          | <b>15</b> | -        | <b>11</b> | <b>19.5</b> |

| <b>II-Year II-Semester</b> |                                                   |            |           |          |           |             |
|----------------------------|---------------------------------------------------|------------|-----------|----------|-----------|-------------|
| <b>S.NO</b>                | <b>Course Title</b>                               | <b>CAT</b> | <b>L</b>  | <b>T</b> | <b>P</b>  | <b>C</b>    |
| 1                          | Heat Transfer for Pharmaceutical Engineers        | PC         | 3         | -        | -         | 3           |
| 2                          | Physical Pharmaceutics                            | PC         | 3         | -        | -         | 3           |
| 3                          | Principles of Microbiology and Biochemistry       | PC         | 3         | -        | -         | 3           |
| 4                          | Reaction Engineering for Pharmaceutical Engineers | PC         | 3         | -        | -         | 3           |
| 5                          | Anatomy and Physiology                            | PC         | 3         | -        | -         | 3           |
| 6                          | Physical Pharmaceutics Lab                        | PC         | -         | -        | 3         | 1.5         |
| 7                          | Microbiology lab                                  | PC         | -         | -        | 3         | 1.5         |
| 8                          | Gender Sensitization                              | MC         | -         | -        | 2         | -           |
| 9                          | Minor project                                     | PW         | -         | -        | 3         | 1.5         |
| <b>Total</b>               |                                                   | -          | <b>15</b> | -        | <b>11</b> | <b>19.5</b> |



**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA**  
**KAKINADA – 533 003, Andhra Pradesh, India**

**PHARMACEUTICAL ENGINEERING**

|                              |  |          |          |          |          |
|------------------------------|--|----------|----------|----------|----------|
| <b>I Year – I Sem</b>        |  | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|                              |  | <b>3</b> | <b>-</b> | <b>-</b> | <b>3</b> |
| <b>COMMUNICATIVE ENGLISH</b> |  |          |          |          |          |

### Introduction

The course is designed to train students in receptive (listening and reading) as well as productive and interactive (speaking and writing) skills by incorporating a comprehensive, coherent and integrated approach that improves the learners' ability to effectively use English language in academic/ workplace contexts. The shift is from *learning about the language* to *using the language*. On successful completion of the compulsory English language course/s in B.Tech., learners would be confident of appearing for international language qualification/proficiency tests such as IELTS, TOEFL, or BEC, besides being able to express themselves clearly in speech and competently handle the writing tasks and verbal ability component of campus placement tests. Activity based teaching-learning methods would be adopted to ensure that learners would engage in actual use of language both in the classroom and laboratory sessions.

### Course Objectives

- Facilitate effective listening skills for better comprehension of academic lectures and English spoken by native speakers
- Focus on appropriate reading strategies for comprehension of various academic texts and authentic materials
- Help improve speaking skills through participation in activities such as role plays, discussions and structured talks/oral presentations
- Impart effective strategies for good writing and demonstrate the same in summarizing, writing well organized essays, record and report useful information
- Provide knowledge of grammatical structures and vocabulary and encourage their appropriate use in speech and writing

### Learning Outcomes

At the end of the module, the learners will be able to

- understand social or transactional dialogues spoken by native speakers of English and identify the context, topic, and pieces of specific information
- ask and answer general questions on familiar topics and introduce oneself/others
- employ suitable strategies for skimming and scanning to get the general idea of a text and locate specific information
- recognize paragraph structure and be able to match beginnings/endings/headings with paragraphs
- form sentences using proper grammatical structures and correct word forms



**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA**  
**KAKINADA – 533 003, Andhra Pradesh, India**

**PHARMACEUTICAL ENGINEERING**

**Unit 1:**

**Lesson-1: A Drawer full of happiness** from “**Infotech English**”, Maruthi Publications

**Lesson-2: Deliverance by Premchand** from “**The Individual Society**”, Pearson Publications. (Non-detailed)

**Listening:** Listening to short audio texts and identifying the topic. Listening to prose, prose and conversation.

**Speaking:** Asking and answering general questions on familiar topics such as home, family, work, studies and interests. Self-introductions and introducing others.

**Reading:** Skimming text to get the main idea. Scanning to look for specific pieces of information.

**Reading for Writing:** Paragraph writing (specific topics) using suitable cohesive devices; linkers, sign posts and transition signals; mechanics of writing - punctuation, capital letters.

**Vocabulary:** Technical vocabulary from across technical branches (20) GRE Vocabulary (20) (Antonyms and Synonyms, Word applications) Verbal reasoning and sequencing of words.

**Grammar:** Content words and function words; word forms: verbs, nouns, adjectives and adverbs; nouns: countable and uncountable; singular and plural basic sentence structures; simple question form - wh-questions; word order in sentences.

**Pronunciation:** Vowels, Consonants, Plural markers and their realizations

**Unit 2:**

**Lesson-1: Nehru’s letter to his daughter Indira on her birthday** from “**Infotech English**”, Maruthi Publications

**Lesson-2: Bosom Friend by Hira Bansode** from “**The Individual Society**”, Pearson Publications (Non-detailed)

**Listening:** Answering a series of questions about main idea and supporting ideas after listening to audio texts, both in speaking and writing.

**Speaking:** Discussion in pairs/ small groups on specific topics followed by short structured talks. Functional English: Greetings and leave takings. **Reading:** Identifying sequence of ideas; recognizing verbal techniques that help to link the ideas in a paragraph together.

**Reading for Writing:** Summarizing - identifying main idea/s and rephrasing what is read; avoiding redundancies and repetitions.

**Vocabulary:** Technical vocabulary from across technical branches (20 words). GRE Vocabulary Analogies (20 words) (Antonyms and Synonyms, Word applications)

**Grammar:** Use of articles and zero article; prepositions.

**Pronunciation:** Past tense markers, word stress-di-syllabic words

**Unit 3:**

**Lesson-1: Stephen Hawking-Positivity ‘Benchmark’** from “**Infotech English**”, Maruthi Publications



**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA**  
**KAKINADA – 533 003, Andhra Pradesh, India**

**PHARMACEUTICAL ENGINEERING**

**Lesson-2: Shakespeare's Sister by Virginia Woolf** from "The Individual Society", Pearson Publications(Non-detailed)

**Listening:** Listening for global comprehension and summarizing what is listened to, both in speaking and writing.

**Speaking:** Discussing specific topics in pairs or small groups and reporting what is discussed. Functional English: Complaining and Apologizing.

**Reading:** Reading a text in detail by making basic inferences - recognizing and interpreting specific context clues; strategies to use text clues for comprehension. Critical reading.

**Reading for Writing:** Summarizing - identifying main idea/s and rephrasing what is read; avoiding redundancies and repetitions. Letter writing-types, format and principles of letter writing. Email etiquette, Writing CV's.

**Vocabulary:** Technical vocabulary from across technical branches (20 words). GRE Vocabulary (20 words) (Antonyms and Synonyms, Word applications) Association, sequencing of words

**Grammar:** Verbs - tenses; subject-verb agreement; direct and indirect speech, reporting verbs for academic purposes.

**Pronunciation:** word stress-poly-syllabic words.

**Unit 4:**

**Lesson-1: Liking a Tree, Unbowed: Wangari Maathai-biography** from "Infotech English", Maruthi Publications

**Lesson-2: Telephone Conversation-Wole Soyinka** from "The Individual Society", Pearson Publications(Non-detailed)

**Listening:** Making predictions while listening to conversations/ transactional dialogues without video (only audio); listening to audio-visual texts.

**Speaking:** Role plays for practice of conversational English in academic contexts (formal and informal) - asking for and giving information/directions. Functional English: Permissions, Requesting, Inviting.

**Reading:** Studying the use of graphic elements in texts to convey information, reveal trends/patterns/relationships, communicative process or display complicated data.

**Reading for Writing:** Information transfer; describe, compare, contrast, identify significance/trends based on information provided in figures/charts/graphs/tables. Writing SOP, writing for media.

**Vocabulary:** Technical vocabulary from across technical branches (20 words) GRE Vocabulary (20 words) (Antonyms and Synonyms, Word applications) Cloze Encounters.

**Grammar:** Quantifying expressions - adjectives and adverbs; comparing and contrasting; degrees of comparison; use of antonyms

**Pronunciation:** Contrastive Stress



**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA**  
**KAKINADA – 533 003, Andhra Pradesh, India**

**PHARMACEUTICAL ENGINEERING**

**Unit 5:**

**Lesson-1: Stay Hungry-Stay foolish** from “**Infotech English**”, Maruthi Publications

**Lesson-2: Still I Rise** by **Maya Angelou** from “**The Individual Society**”, Pearson Publications.(Non-detailed)

**Listening:** Identifying key terms, understanding concepts and interpreting the concepts both in speaking and writing.

**Speaking:** Formal oral presentations on topics from academic contexts - without the use of PPT slides. Functional English: Suggesting/Opinion giving.

**Reading:** Reading for comprehension. RAP Strategy Intensive reading and Extensive reading techniques.

**Reading for Writing:** Writing academic proposals- writing research articles: format and style.

**Vocabulary:** Technical vocabulary from across technical branches (20 words) GRE Vocabulary (20 words) (Antonyms and Synonyms, Word applications) Coherence, matching emotions.

**Grammar:** Editing short texts – identifying and correcting common errors in grammar and usage (articles, prepositions, tenses, subject verb agreement)

**Pronunciation:** Stress in compound words

**Prescribed text books for theory for Semester-I:**

1. “**Infotech English**”, Maruthi Publications. (Detailed)

2. “**The Individual Society**”, Pearson Publications(Non-detailed)

**Prescribed text book for Laboratory for Semesters-I & II:**

1. “**Infotech English**”, Maruthi Publications. (with Compact Disc)

**Reference Books:**

- Bailey, Stephen. *Academic writing: A handbook for international students*. Routledge, 2014.
- Chase, Becky Tarver. *Pathways: Listening, Speaking and Critical Thinking*. Heinley ELT; 2nd Edition, 2018.
- Skillful Level 2 Reading & Writing Student's Book Pack (B1) Macmillan Educational.
- Hewings, Martin. *Cambridge Academic English (B2)*. CUP, 2012.

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA**  
**KAKINADA – 533 003, Andhra Pradesh, India**

**PHARMACEUTICAL ENGINEERING**

|                                                                      |  |          |          |          |          |
|----------------------------------------------------------------------|--|----------|----------|----------|----------|
| <b>I Year – I Sem</b>                                                |  | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|                                                                      |  | <b>3</b> | <b>-</b> | <b>-</b> | <b>3</b> |
| <b>MATHEMATICS-I</b><br><b>(Calculus and Differential Equations)</b> |  |          |          |          |          |

**Course Objectives:**

- To familiarize a variety of well-known sequences and series, with a developing intuition about the behavior of new ones.
- To enlighten the learners in the concept of differential equations and multivariable calculus.
- To equip the students with standard concepts and tools at an intermediate to advanced level mathematics to develop the confidence and ability among the students to handle various real-world problems and their applications.

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

- utilize mean value theorems to real life problems (L3)
- solve the differential equations related to various engineering fields (L3)
- familiarize with functions of several variables which is useful in optimization (L3)
- apply double integration techniques in evaluating areas bounded by region (L3)
- students will also learn important tools of calculus in higher dimensions. Students will become familiar with 2- dimensional and 3-dimensional coordinate systems(L5)

**UNIT – I: Sequences, Series and Mean value theorems: (10hrs)**

Sequences and Series: Convergences and divergence – Ratio test – Comparison tests – Integral test – Cauchy’s root test – Alternate series– Leibnitz’s rule.

Mean Value Theorems (without proofs): Rolle’s Theorem – Lagrange’s mean value theorem – Cauchy’s mean value theorem – Taylor’s and Maclaurin’s theorems with remainders, Problems and applications on the above theorem.

**UNIT – II: Differential equations of first order and first degree: (10hrs)**

Linear differential equations– Bernoulli’s equations –Exact equations and equations reducible to exact form. Applications: Newton’s Law of cooling– Law of natural growth and decay– Orthogonal trajectories– Electrical circuits.





**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA**  
**KAKINADA – 533 003, Andhra Pradesh, India**

**PHARMACEUTICAL ENGINEERING**

**UNIT – III: Linear differential equations of higher order: (10hrs)**

Homogeneous and Non-homogeneous differential equations of higher order with constant coefficients – with non-homogeneous term of the type  $e^{ax}$ ,  $\sin ax$ ,  $\cos ax$ , polynomials in  $x^n$ ,  $e^{ax}V(x)$  and  $x^nV(x)$  – Method of Variation of parameters, Cauchy and Legendre's linear equations.

Applications: LCR circuit, Simple Harmonic motion.

**UNIT – IV: Partial differentiation: (10hrs)**

Introduction – Homogeneous function – Euler's theorem– Total derivative– Chain rule– Jacobian – Functional dependence – Taylor's and MacLaurin's series expansion of functions of two variables.

Applications: Maxima and Minima of functions of two variables without constraints and Lagrange's method.

**UNIT – V: Multiple integrals: (8 hrs)**

Double and Triple integrals – Change of order of integration in double integrals – Change of variables to polar, cylindrical and spherical coordinates.

Applications: Finding Areas and Volumes.

**Text Books:**

1. B. S. Grewal, Higher Engineering Mathematics, 44<sup>th</sup> Edition, Khanna Publishers, 2018
2. B. V. Ramana, Higher Engineering Mathematics, 6<sup>th</sup> Edition, Tata Mc. Graw Hill Education, 2007.

**Reference Books:**

1. Erwin Kreyszig, Advanced Engineering Mathematics, 10<sup>th</sup> Edition, Wiley-India, 2011.
2. Joel Hass, Christopher Heil and Maurice D. Weir, Thomas calculus, 14<sup>th</sup> Edition, Pearson, 2017.
3. Lawrence Turyn, Advanced Engineering Mathematics, CRC Press, 2013.
4. Srimantha Pal, S C Bhunia, Engineering Mathematics, Oxford University Press, 2015.

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA**  
**KAKINADA – 533 003, Andhra Pradesh, India**

**PHARMACEUTICAL ENGINEERING**

|                           |  |          |          |          |          |
|---------------------------|--|----------|----------|----------|----------|
| <b>I Year – I Sem</b>     |  | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|                           |  | <b>3</b> | <b>-</b> | <b>-</b> | <b>3</b> |
| <b>ENGINEERINGPHYSICS</b> |  |          |          |          |          |

**Unit-I: Wave Optics**

**12hrs**

**Interference:** Principle of superposition – Interference of light - Interference in thin films (Reflection Geometry) & applications - Colors in thin films- Newton’s Rings- Determination of wavelength and refractive index.

**Diffraction:** Introduction - Fresnel and Fraunhofer diffraction - Fraunhofer diffraction due to single slit, double slit - N-slits(Qualitative) – Grating - Dispersive power and resolving power of Grating(Qualitative).

**Polarization:** Introduction-Types of polarization - Polarization by reflection, refraction and Double refraction - Nicol’s Prism -Half wave and Quarter wave plates.

**Unit Outcomes:**

***The students will be able to***

- **Explain** the need of coherent sources and the conditions for sustained interference(L2)
- **Identify** engineering applications of interference(L3)
- **Analyze** the differences between interference and diffraction with applications(L4)
- **Illustrate** the concept of polarization of light and its applications(L2)
- **Classify** ordinary polarized light and extraordinary polarized light(L2)

**Unit-II: Lasers and Fiber optics**

**10hrs**

**Lasers:** Introduction – Characteristics of laser – Spontaneous and Stimulated emissions of radiation – Einstein’s coefficients – Population inversion – Lasing action- Pumping mechanisms – Ruby laser – He-Ne laser - Applications of lasers.

**Fiber optics:** Introduction – Principle of optical fiber- Acceptance Angle-Numerical Aperture- Classification of optical fibers based on refractive index profile and modes – Propagation of electromagnetic wave through optical fibers - Applications.

**Unit Outcomes:**

***The students will be able to***

- **Understand** the basic concepts of LASER light Sources(L2)
- **Apply** the concepts to learn the types of lasers(L3)
- **Identifies** the Engineering applications of lasers(L2)
- **Explain** the working principle of optical fibers(L2)
- **Classify** optical fibers based on refractive index profile and mode of propagation(L2)
- **Identify** the applications of optical fibers in various fields(L2)



**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA**  
**KAKINADA – 533 003, Andhra Pradesh, India**

**PHARMACEUTICAL ENGINEERING**

**UNIT III:EngineeringMaterials**

**8hrs**

**DielectricMaterials:** Introduction - Dielectric polarization - Dielectric polarizability, Susceptibility and Dielectric constant - Types of polarizations- Electronic (Quantitative), Ionic (Quantitative) and Orientation polarizations (Qualitative) - Lorentz internal field- Clausius-Mossotti equation-Piezoelectricity.

**Magnetic Materials:** Introduction - Magnetic dipole moment - Magnetization-Magnetic susceptibility and permeability - Origin of permanent magnetic moment - Classification of magnetic materials: Dia, para, Ferro, antiferro& Ferrimagnetic materials - Domain concept for Ferromagnetism & Domain walls (Qualitative) - Hysteresis - soft and hard magnetic materials- Eddy currents- Engineering applications.

**Unit Outcomes:**

***The students will be able to***

- **Explain** the concept of dielectric constant and polarization in dielectric materials(L2)
- **Summarize** various types of polarization of dielectrics(L2)
- **Interpret** Lorentz field and Clausius- Mosotti relation indielectrics(L2)
- **Classify** the magnetic materials based on susceptibility and their temperature dependence (L2)
- **Explain** the applications of dielectric and magnetic materials(L2)
- **Apply** the concept of magnetism to magnetic devices(L3)

**Unit-IV: AcousticsandUltrasonics**

**10hrs**

**Acoustics:** Introduction – requirements of acoustically good hall– Reverberation – Reverberation time– Sabine’s formula (Derivation using growth and decay method) - Absorption coefficient and its determination – Factors affecting acoustics of buildings and their remedial measures.

**Ultrasonics:** Introduction - Properties - Production by magnetostriction and piezoelectric methods – Detection - Acoustic grating - Non-Destructive Testing – pulse echo system throughtransmission and reflection modes -Applications.

**Unit Outcomes:**

***The students will be able to***

- **Explain** how sound is propagated in buildings(L2)
- **Analyze** acoustic properties of typically used materials in buildings(L4)
- **Recognize** sound level disruptors and their use in architectural acoustics(L2)
- **Identify** the use of ultrasonics in different fields(L3)



**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA**  
**KAKINADA – 533 003, Andhra Pradesh, India**

**PHARMACEUTICAL ENGINEERING**

**Unit-V: Crystallography and X-ray diffraction**

**8hrs**

**Crystallography:** Space lattice, Basis, Unit Cell and lattice parameters – Bravais Lattice – crystal systems (3D) – coordination number - packing fraction of SC, BCC & FCC - Miller indices – separation between successive (hkl) planes.

**X-Ray diffraction:** Bragg's law - X-ray Diffractometer – crystal structure determination by Laue's and powder methods.

**Unit Outcomes:**

***The students will be able to***

- **Classify** various crystal systems(L2)
- **Identify** different planes in the crystal structure(L3)
- **Analyze** the crystalline structure by Bragg's X-ray diffractometer(L4)
- **Apply** powder method to measure the crystallinity of a solid(L4)

**Text books:**

1. Engineering Physics – Dr. M.N. Avadhanulu & Dr. P.G. Kshirsagar, S. Chand and Company
2. Engineering physics – D.K. Battacharya and Poonam Tandon, Oxford University press.
3. Engineering Physics by P.K.Palanisamy SciTech publications.

**Reference Books:**

1. Fundamentals of Physics – Halliday, Resnick and Walker, John Wiley & Sons
2. Engineering Physics – M.R.Srinivasan, New Age Publications
3. Engineering Physics – D K Pandey, S. Chaturvedi, Cengage Learning
4. Engineering Physics - Sanjay D. Jain, D. Sahasrambudhe and Girish, University Press



**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA**  
**KAKINADA – 533 003, Andhra Pradesh, India**

**PHARMACEUTICAL ENGINEERING**

|                              |  |          |          |          |          |
|------------------------------|--|----------|----------|----------|----------|
| <b>I Year – I Sem</b>        |  | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|                              |  | <b>3</b> | <b>-</b> | <b>-</b> | <b>3</b> |
| <b>ENGINEERING CHEMISTRY</b> |  |          |          |          |          |

Knowledge of basic concepts of Chemistry for Engineering students will help them as professional engineers later in design and material selection, as well as utilizing the available resources.

**COURSE OBJECTIVES**

- **Importance** of usage of plastics in household appliances and composites (FRP) in aerospace and automotive industries.
- **Outline** the basics for the construction of electrochemical cells, batteries and fuel cells. Understand the mechanism of corrosion and how it can be prevented.
- **Express** the increases in demand as wide variety of advanced materials are introduced; which have excellent engineering properties.  
*Classify and discuss* the materials used in major industries like steel industry, metallurgical industries and construction industries and electrical equipment manufacturing industries. Lubrication is also *summarized*.
- **Relate** the need of fuels as a source of energy to any industry, particularly industries like thermal power stations, steel industry, fertilizer industry etc., and hence introduced.
- **Explain** the importance and usage of water as basic material in almost all the industries; *interpret* drawbacks of steam boilers and also how portable water is supplied for drinking purposes.

**UNIT I: POLYMER TECHNOLOGY**

**8 hrs**

**Polymerization:** -Introduction, methods of polymerization (emulsion and suspension), mechanical properties.

**Plastics:** Compounding, fabrication (compression, injection, blown film and extrusion), preparation, properties and applications (PVC, polycarbonates and Bakelite), mention some examples of plastic materials used in electronic gadgets, recycling of e-plastic waste (waste to wealth).

**Elastomers:** - Introduction, preparation, properties and applications (Buna S, thiokol and polyurethanes).

**Composite materials:** Fiber reinforced plastics, conducting polymers, biodegradable polymers, biopolymers, biomedical polymers.

**Course Outcomes:** *At the end of this unit, the students will be able to*

- **Analyze** the different types of composite plastic materials and *interpret* the mechanism of conduction in conducting polymers.

**UNIT II: ELECTROCHEMICAL CELLS AND CORROSION**

**10 hrs**

Single electrode potential, electrochemical series and uses of series, standard hydrogen electrode, calomel electrode, construction of glass electrode, batteries (Dry cell, Li ion battery and zinc air cells), fuel cells (H<sub>2</sub>-O<sub>2</sub>, CH<sub>3</sub>OH-O<sub>2</sub>, phosphoric acid and molten carbonate).

**Corrosion:** -Definition, theories of corrosion (chemical and electrochemical), galvanic corrosion, differential aeration corrosion, stress corrosion, galvanic series, factors influencing rate of corrosion, corrosion control (proper designing and cathodic protection), Protective coatings (surface preparation, cathodic coatings, anodic coatings, electroplating and electroless plating [nickel]), Paints (constituents, functions and special paints).



**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA**  
**KAKINADA – 533 003, Andhra Pradesh, India**

**PHARMACEUTICAL ENGINEERING**

**Course Outcomes:** *At the end of this unit, the students will be able to*

- *Utilize* the theory of construction of electrodes, batteries and fuel cells in redesigning new engineering products and *categorize* the reasons for corrosion and study methods to control corrosion.

**UNIT III: CHEMISTRY OF MATERIALS**

**10 hrs**

**Part- A:**

**Nano materials:** - Introduction, sol-gel method, characterization by (Brunauer Emmet Teller [BET]), (scanning electron microscopy [SEM]) and (transmission electron microscopy [TEM]) with example (TiO<sub>2</sub>), applications of graphene and fullerenes, carbon nanotubes (types, preparation and applications)

**Thermal analysis techniques:** Instrumentation and applications of thermogravimetric analysis (TGA), differential thermal analysis (DTA), differential scanning calorimetry (DSC).

**Part-B:**

**Refractories:** - Definition, classification, properties (refractoriness, refractoriness under load, porosity and thermal spalling), failure of refractories.

**Lubricants:** - Definition, mechanism of lubricants, properties (definition and importance).

**Cement:** - Constituents, manufacturing, parameters to characterize the clinker formation: lime saturation factor (LSF), silica ratio (SR) and alumina ratio (AR), chemistry of setting and hardening, deterioration of cement.

**Course Outcomes:** *At the end of this unit, the students will be able to*

- *Synthesize* nanomaterials for modern advances of engineering technology.
- *Summarize* the techniques that detect and measure changes of state of reaction.
- *Illustrate* the commonly used industrial materials.

**UNIT IV: FUELS**

**10 hrs**

Introduction, calorific value, higher calorific value, lower calorific values, problems using Dulong's formula, proximate and ultimate analysis of coal sample and their significance, numerical problems, petroleum (refining-cracking), synthetic petrol (Fischer Tropsch and Bergius), petrol knocking, diesel knocking, octane and cetane ratings, anti-knocking agents, Introduction to alternative fuels (Bio-diesel, ethanol, methanol, natural gas, liquefied petroleum gas, compressed natural gas), Flue gas analysis by Orsat apparatus, rocket fuels.

**Course Outcomes:** *At the end of this unit, the students will be able to*

- *Differentiate* petroleum, petrol, synthetic petrol and have knowledge how they are produced.
- *Study* alternate fuels and *analyze* flue gases.

**UNIT V: WATER TECHNOLOGY**

**8 hrs**

Hardness of water, determination of hardness by complexometric method, boiler troubles (priming and foaming, scale formation, boiler corrosion, caustic embrittlement), internal treatments, softening of hard water (zeolite process and related sums, ion exchange process), treatment of industrial waste water, potable water and its specifications, steps involved in purification of water, chlorination, break point chlorination-desalination (reverse osmosis and electro dialysis).

**Course Outcomes:** *At the end of this unit, the students will be able to*

- *Analyze* the suitable methods for purification and treatment of hard water and brackish water.



**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA**  
**KAKINADA – 533 003, Andhra Pradesh, India**

**PHARMACEUTICAL ENGINEERING**

**Standard Books:**

1. P.C. Jain and M. Jain “**Engineering Chemistry**”, 15/e, Dhanpat Rai & Sons, Delhi, (Latest edition).
2. Shikha Agarwal, “**Engineering Chemistry**”, Cambridge University Press, New Delhi, (2019).
3. S.S. Dara, “**A Textbook of Engineering Chemistry**”, S.Chand& Co, (2010).
4. Shashi Chawla, “Engineering Chemistry”, Dhanpat Rai Publications Co. (Latest edition).

**Reference:**

1. K. Seshamaheshwaramma and Mridula Chugh, “**Engineering Chemistry**”, Pearson India Edn.
2. O.G. Palana, “**Engineering Chemistry**”, Tata McGraw Hill Education Private Limited, (2009).
3. CNR Rao and JM Honig (Eds) “**Preparation and characterization of materials**” Academic press, New York (latest edition)
4. B. S. Murthy, P. Shankar and others, “**Textbook of Nanoscience and Nanotechnology**”, University press (latest edition)

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA**  
**KAKINADA – 533 003, Andhra Pradesh, India**

**PHARMACEUTICAL ENGINEERING**

|                                                |          |          |          |          |
|------------------------------------------------|----------|----------|----------|----------|
| <b>I Year – I Sem</b>                          | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|                                                | <b>3</b> | <b>-</b> | <b>-</b> | <b>3</b> |
| <b>PROGRAMMING FOR PROBLEM SOLVING USING C</b> |          |          |          |          |

**Course Objectives:**

- To learn about the computer systems, computing environments, developing of a computer program and Structure of a C Program
- To gain knowledge of the operators, selection, control statements and repetition in C
- To learn about the design concepts of arrays, strings, enumerated structure and union types. To learn about their usage.
- To assimilate about pointers, dynamic memory allocation and know the significance of Preprocessor.
- To assimilate about File I/O and significance of functions

**UNIT I**

**Introduction to Computers:** Creating and running Programs, Computer Numbering System, Storing Integers, Storing Real Numbers

**Introduction to the C Language:** Background, C Programs, Identifiers, Types, Variable, Constants, Input/output, Programming Examples, Scope, Storage Classes and Type Qualifiers.

**Structure of a C Program:** Expressions Precedence and Associativity, Side Effects, Evaluating Expressions, Type Conversion Statements, Simple Programs, Command Line Arguments.

**UNIT II**

**Bitwise Operators:** Exact Size Integer Types, Logical Bitwise Operators, Shift Operators.

**Selection & Making Decisions:** Logical Data and Operators, Two Way Selection, Multi-way Selection, More Standard Functions

**Repetition:** Concept of Loop, Pretest and Post-test Loops, Initialization and Updating, Event and Counter Controlled Loops, Loops in C, Other Statements Related to Looping, Looping Applications, Programming Examples

**UNIT III**

**Arrays:** Concepts, Using Array in C, Array Application, Two Dimensional Arrays, Multidimensional Arrays, Programming Example – Calculate Averages

**Strings:** String Concepts, C String, String Input / Output Functions, Arrays of Strings, String Manipulation Functions String/ Data Conversion, A Programming Example – Morse Code

**Enumerated, Structure, and Union:** The Type Definition (Type def), Enumerated Types, Structure, Unions, and Programming Application

**UNIT IV**

**Pointers:** Introduction, Pointers to pointers, Compatibility, L value and R value

**Pointer Applications:** Arrays, and Pointers, Pointer Arithmetic and Arrays, Memory Allocation Function, Array of Pointers, Programming Application

**Processor Commands:** Processor Commands

**UNIT V**

**Functions:** Designing, Structured Programs, Function in C, User Defined Functions, Inter-Function Communication, Standard Functions, Passing Array to Functions, Passing Pointers to Functions, Recursion

**Text Input / Output:** Files, Streams, Standard Library Input / Output Functions, Formatting Input / Output Functions, Character Input / Output Functions





**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA**  
**KAKINADA – 533 003, Andhra Pradesh, India**

**PHARMACEUTICAL ENGINEERING**

**Binary Input / Output:** Text versus Binary Streams, Standard Library, Functions for Files, Converting File Type.

**Course Outcomes:**

After the completion of the course the student should be able:

- To write algorithms and to draw flowcharts for solving problems
- To convert flowcharts/algorithms to C Programs, compile and debug programs
- To use different operators, data types and write programs that use two-way/ multi-way selection
- To select the best loop construct for a given problem
- To design and implement programs to analyze the different pointer applications
- To decompose a problem into functions and to develop modular reusable code
- To apply File I/O operations

**Text Books:**

1. Programming for Problem Solving, Behrouz A. Forouzan, Richard F.Gilberg, 1<sup>st</sup> edition, Cengage, 2019.
2. The C Programming Language, Brian W.Kernighan, Dennis M. Ritchie, 2 edition, Pearson, 2015.

**References:**

1. Computer Fundamentals and Programming, Sumithabha Das, 1<sup>st</sup> edition, McGraw Hill, 2018.
2. Programming in C, Ashok N. Kamthane, Amit Kamthane, 3<sup>rd</sup> edition, Pearson, 2015.
3. Computer Fundamentals and Programming in C, PradipDey, ManasGhosh, 2<sup>nd</sup> edition, Oxford, 2013.

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA**  
**KAKINADA – 533 003, Andhra Pradesh, India**

**PHARMACEUTICAL ENGINEERING**

|                                                           |  |          |          |          |          |
|-----------------------------------------------------------|--|----------|----------|----------|----------|
| <b>I Year – I Sem</b>                                     |  | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|                                                           |  | -        | -        | 3        | 1.5      |
| <b>PROGRAMMING FOR PROBLEM SOLVING USING C LABORATORY</b> |  |          |          |          |          |

**Course Objectives:**

- Apply the principles of C language in problem solving.
- To design flowcharts, algorithms and knowing how to debug programs.
- To design & develop of C programs using arrays, strings pointers & functions.
- To review the file operations, preprocessor commands.

**Exercise 1:**

- Write a C program to print a block F using hash (#), where the F has a height of six characters and width of five and four characters.
- Write a C program to compute the perimeter and area of a rectangle with a height of 7 inches and width of 5 inches.
- Write a C program to display multiple variables.

**Exercise 2:**

- Write a C program to calculate the distance between the two points.
- Write a C program that accepts 4 integers p, q, r, s from the user where r and s are positive and p is even. If q is greater than r and s is greater than p and if the sum of r and s is greater than the sum of p and q print "Correct values", otherwise print "Wrong values".

**Exercise 3:**

- Write a C program to convert a string to a long integer.
- Write a program in C which is a Menu-Driven Program to compute the area of the various geometrical shape.
- Write a C program to calculate the factorial of a given number.

**Exercise 4:**

- Write a program in C to display the n terms of even natural number and their sum.
- Write a program in C to display the n terms of harmonic series and their sum.  $1 + 1/2 + 1/3 + 1/4 + 1/5 \dots 1/n$  terms.
- Write a C program to check whether a given number is an Armstrong number or not.

**Exercise 5:**

- Write a program in C to print all unique elements in an array.
- Write a program in C to separate odd and even integers in separate arrays.
- Write a program in C to sort elements of array in ascending order.

**Exercise 6:**

- Write a program in C for multiplication of two square Matrices.
- Write a program in C to find transpose of a given matrix.

**Exercise 7:**

- Write a program in C to search an element in a row wise and column wise sorted matrix.
- Write a program in C to print individual characters of string in reverse order.

**Exercise 8:**

- Write a program in C to compare two strings without using string library functions.

- Write a program in C to copy one string to another string.

**Exercise 9:**

- Write a C Program to Store Information Using Structures with Dynamically Memory Allocation
- Write a program in C to demonstrate how to handle the pointers in the program.

**Exercise 10:**

- Write a program in C to demonstrate the use of & (address of) and \*(value at address) operator.
- Write a program in C to add two numbers using pointers.



**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA**  
**KAKINADA – 533 003, Andhra Pradesh, India**

**PHARMACEUTICAL ENGINEERING**

**Exercise 11:**

- Write a program in C to add numbers using call by reference.
- Write a program in C to find the largest element using Dynamic Memory Allocation.

**Exercise 12:**

- Write a program in C to swap elements using call by reference.
- Write a program in C to count the number of vowels and consonants in a string using a pointer.

**Exercise 13:**

- Write a program in C to show how a function returning pointer.
- Write a C program to find sum of n elements entered by user. To perform this program, allocate memory dynamically using malloc( ) function.

**Exercise 14:**

- Write a C program to find sum of n elements entered by user. To perform this program, allocate memory dynamically using calloc( ) function. Understand the difference between the above two programs
- Write a program in C to convert decimal number to binary number using the function.

**Exercise 15:**

- Write a program in C to check whether a number is a prime number or not using the function.
- Write a program in C to get the largest element of an array using the function.

**Exercise 16:**

- Write a program in C to append multiple lines at the end of a text file.
- Write a program in C to copy a file in another name.
- Write a program in C to remove a file from the disk.

**Course Outcomes:**

After the completion of the course the student should be able to:

- Gains Knowledge on various concepts of a C language.
- Draw flowcharts and write algorithms.
- Design and development of C problem solving skills.
- Design and develop modular programming skills.
- Trace and debug a program

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA**  
**KAKINADA – 533 003, Andhra Pradesh, India**

**PHARMACEUTICAL ENGINEERING**

|                                       |  |          |          |          |          |
|---------------------------------------|--|----------|----------|----------|----------|
| <b>I Year – I Sem</b>                 |  | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|                                       |  | -        | -        | 3        | 1.5      |
| <b>ENGINEERING PHYSICS LABORATORY</b> |  |          |          |          |          |

(Any 10 of the following listed experiments)

**List of Applied Physics Experiments:**

1. Determination of thickness of thin object by wedgemethod.
2. Determination of radius of curvature of a given plano convex lens by Newton'srings.
3. Determination of wavelengths of different spectral lines in mercury spectrumusing diffraction grating in normal incidence configuration.
4. Determination of dispersive power of theprism.
5. Determination of dielectric constant using charging and dischargingmethod.
6. Study the variation of B versus H by magnetizing the magnetic material (B-Hcurve).
7. Determination of numerical aperture and acceptance angle of an opticalfiber.
8. Determination of wavelength of Laser light using diffractiongrating.
9. Estimation of Planck's constant using photoelectriceffect.
10. Determination of the resistivity of semiconductor by four probemethod.
11. To determine the energy gap of a semiconductor using p-n junctiondiode.
12. Magnetic field along the axis of a current carrying circular coil by Stewart & Gee's Method
13. Determination of Hall voltage and Hall coefficient of a given semiconductor usingHall Effect.
14. Measurement of resistance of a semiconductor with varyingtemperature.
15. Resistivity of a Superconductor using four probe method & Meissnereffect.

**References:**

1. S. Balasubramanian, M.N. Srinivasan "A Text Book of Practical Physics"- S Chand Publishers,2017.

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA**  
**KAKINADA – 533 003, Andhra Pradesh, India**

**PHARMACEUTICAL ENGINEERING**

| I Year – I Sem                          |  | L | T | P | C   |
|-----------------------------------------|--|---|---|---|-----|
|                                         |  | - | - | 3 | 1.5 |
| <b>ENGINEERING CHEMISTRY LABORATORY</b> |  |   |   |   |     |

Introduction to Chemistry laboratory – Molarity, normality, primary, secondary standard solutions, volumetric titrations, quantitative analysis

1. Determination of HCl using standard Na<sub>2</sub>CO<sub>3</sub> solution.
2. Determination of alkalinity of a sample containing Na<sub>2</sub>CO<sub>3</sub> and NaOH.
3. Determination of Mn<sup>+2</sup> using standard oxalic acid solution.
4. Determination of ferrous iron using standard K<sub>2</sub>Cr<sub>2</sub>O<sub>7</sub> solution.
5. Determination of Cu<sup>+2</sup> using standard hypo solution.
6. Determination of temporary and permanent hardness of water using standard EDTA solution.
7. Determination of Fe<sup>+3</sup> by a colorimetric method.
8. Determination of the concentration of acetic acid using sodium hydroxide (pH-metry method).
9. Determination of iso-electric point of amino acids using pH-metry method/conductometric method.
10. Determination of the concentration of strong acid vs strong base (by conductometric method).
11. Determination of strong acid vs strong base (by potentiometric method).
12. Determination of Mg<sup>+2</sup> present in an antacid.
13. Determination of CaCO<sub>3</sub> present in an egg shell.
14. Estimation of Vitamin C.
15. Determination of phosphoric content in soft drinks.
16. Adsorption of acetic acid by charcoal.
17. Preparation of nylon-6, 6 and Bakelite (demonstration only).

Of the above experiments at-least 10 assessment experiments should be completed in a semester.

**Outcomes:** The students entering into the professional course have practically very little exposure to lab classes. The experiments introduce volumetric analysis; redox titrations with different indicators; EDTA titrations; then they are exposed to a few instrumental methods of chemical analysis. Thus at the end of the lab course, the student is exposed to different methods of chemical analysis and use of some commonly employed instruments. They thus acquire some experimental skills.

**Reference Books**

1. A Textbook of Quantitative Analysis, Arthur J. Vogel.



**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA**  
**KAKINADA – 533 003, Andhra Pradesh, India**

**PHARMACEUTICAL ENGINEERING**

|                                                          |  |          |          |          |          |
|----------------------------------------------------------|--|----------|----------|----------|----------|
| <b>I Year – I Sem</b>                                    |  | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|                                                          |  | -        | -        | <b>2</b> | -        |
| <b>RURAL SENSITIZATION<br/>(Activity based Learning)</b> |  |          |          |          |          |

**COURSE OBJECTIVES:** The course objectives are:

1. To make the students understand important features of Agriculture.
2. To inculcate the habits of good health and Hygiene.
3. To introduce students to the concept of Local Governance and related issues.
4. To create awareness on Village Empowerment.

**Agriculture and Animal Husbandry:**

Types of Soils-Ground Water Sources- Important features of Agriculture -Vegetable Crops-Field Crops-Horticulture-Fruit Crops -Flowery Culture-Green House-Poly House-Poultry-Sheep -Study of Cattle

**Activities:** Field Visit, Presentations

**Health and Hygiene:**

Personal Hygiene-Sanitation-Proper Sewage Disposal-Safe Drinking Water- balanced and Nutritious Diet-Cleanliness are Godliness-Awareness of Contagious Diseases/ Epidemics-Effects of Smoking and Drinking.

**Activities:** Awareness Camps, Visit to the nearby Hospitals (Field Work)

**Local Governance:**

Know your village-Role of Sarpanch-GramaPanchayathi-Mandal Parishad- Panchayathi raj-Advantages and disadvantages of Local Governance - Literacy-Basic Amenities-Schools-Banks-Hospitals-Library-Connectivity-Roads and Rails-Social Responsibility.

**Activities:** Profile, Awareness Camps, Role Play, Presentations

**Empowering Villages:**

Jugaad-Adopting Latest Developments-Rural Technologies-Solar Energy-Wind Energy-Strategies-Value Addition-Marketing the Products

**Activities:** Field Visit, Group Discussion

**COURSE OUTCOMES:** Upon the successful completion of the course, the students will

1. Summarize the importance and role of a farmer in agriculture
2. Create better awareness of health and hygiene.
3. Demonstrate the Local Governance and its importance.
4. Outline role of Technology in empowering villages.



**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA**  
**KAKINADA – 533 003, Andhra Pradesh, India**

**PHARMACEUTICAL ENGINEERING**

|                                 |  |          |          |          |          |
|---------------------------------|--|----------|----------|----------|----------|
| <b>I Year – II Sem</b>          |  | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|                                 |  | <b>3</b> | <b>-</b> | <b>-</b> | <b>3</b> |
| <b>PHARMACEUTICAL CHEMISTRY</b> |  |          |          |          |          |

**COURSE OBJECTIVES:** To learn

1. Basic knowledge of reactive intermediates.
2. The core concepts of organic chemistry i.e. resonance, hyper conjugation, inductive effect etc. and their application.
3. Knowledge of the increasingly important role played by organic and transition metals reagents with their corresponding proposed reaction mechanisms
4. The mechanism of attack of electrophiles and nucleophiles.
5. The concepts of optical isomerism, geometrical isomerism and conformational isomerism
6. The information about most of drugs containing various heterocyclic moieties.

**Unit-I: Reactive Intermediates & Polar Effects**

Concepts of aromaticity- Huckel's Rule, benzenoid (Naphthalene) and non-benzenoid (Azulene) aromatic compounds.

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

Inductive effect, electrometric effect, resonance effect, hyper conjugation, steric inhibition of resonance-examples. The influence of these effects on the acidity and basicity of organic compounds.

**Unit-II: Reagents in Organic Synthesis**

Synthesis and application of Grignard reagent, LDA, DIBAL, Zn-Hg/HCl, DCC.

**Unit-III: Mechanisms of Organic Reactions**

Mechanism of alkyl and aryl halides, mechanism of aromatic electrophilic and nucleophilic substitution - alcohols, aldehydes, ketones, carboxylic acids.

Organic named reactions

Friedel-Craft reaction, Beckmann rearrangement, Aldol condensation, Benzoin condensation, Hofmann rearrangement, Fries rearrangement.

**Unit-IV: Stereochemistry**

Introduction, stereoisomerism, geometrical isomerism, E-Z system of nomenclature, Optical isomerism, Symmetry and chirality. Optical isomerism in lactic acid and tartaric acid, Enantiomers, diastereomers, conformational analysis of 1,2 dichloride Ethane and Cyclohexane.



**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA**  
**KAKINADA – 533 003, Andhra Pradesh, India**

**PHARMACEUTICAL ENGINEERING**

**Unit-V: Chemistry of Heterocyclic Compounds**

Introduction, classification, nature, nomenclature, preparation and important reactions of pyrrole, furan, thiophene, pyridine and structural elucidation of medicinal compounds- Paracetamol, Ciproflaxin, Ranitidine.

**TEXT BOOKS:**

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.

**COURSE OUTCOMES**

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

1. Discuss various types of reactive intermediates and factors affecting their stability.
2. Relate the polar effects with acidity and basicity of organic compounds.
3. Illustrate the applications of organic reagents.
4. Apply the fundamental principles of organic chemistry and derive mechanism of various types of organic reactions.
5. Explain the concepts of optical isomerism, geometrical isomerism and conformational isomerism.
6. Illustrate properties and reactions for the most important heterocyclic as well as different systems of nomenclature.



**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA**  
**KAKINADA – 533 003, Andhra Pradesh, India**

**PHARMACEUTICAL ENGINEERING**

|                                                                        |  |          |          |          |          |
|------------------------------------------------------------------------|--|----------|----------|----------|----------|
| <b>I Year – II Sem</b>                                                 |  | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|                                                                        |  | <b>3</b> | <b>-</b> | <b>-</b> | <b>3</b> |
| <b>MATHEMATICS-II</b><br><b>(Linear Algebra and Numerical Methods)</b> |  |          |          |          |          |

**Course Objectives:**

- To instruct the concept of Matrices in solving linear algebraic equations
- To elucidate the different numerical methods to solve nonlinear algebraic equations
- To disseminate the use of different numerical techniques for carrying out numerical integration.
- To equip the students with standard concepts and tools at an intermediate to advanced level mathematics to develop the confidence and ability among the students to handle various real-world problems and their applications.

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

- develop the use of matrix algebra techniques that is needed by engineers for practical applications (L6)
- solve system of linear algebraic equations using Gauss elimination, Gauss Jordan, Gauss Seidel (L3)
- evaluate the approximate roots of polynomial and transcendental equations by different algorithms (L5)
- apply Newton's forward & backward interpolation and Lagrange's formulae for equal and unequal intervals (L3)
- apply numerical integral techniques to different Engineering problems (L3)
- apply different algorithms for approximating the solutions of ordinary differential equations with initial conditions to its analytical computations (L3)

**UNIT – I: Solving systems of linear equations, Eigen values and Eigen vectors: (10hrs)**

Rank of a matrix by echelon form and normal form – Solving system of homogeneous and non-homogeneous linear equations – Gauss Elimination method – Eigen values and Eigen vectors and properties (article-2.14 in text book-1).

**UNIT – II: Cayley–Hamilton theorem and Quadratic forms: (10hrs)**

Cayley-Hamilton theorem (without proof) – Applications – Finding the inverse and power of a matrix by Cayley-Hamilton theorem – Reduction to Diagonal form – Quadratic forms and nature of the quadratic forms – Reduction of quadratic form to canonical forms by orthogonal transformation.

Singular values of a matrix, singular value decomposition (text book-3).



**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA**  
**KAKINADA – 533 003, Andhra Pradesh, India**

**PHARMACEUTICAL ENGINEERING**

**UNIT – III: Iterative methods:**

**(8 hrs)**

Introduction– Bisection method–Secant method – Method of false position– Iteration method – Newton-Raphson method (One variable and simultaneous equations) – Jacobi and Gauss-Seidel methods for solving system of equations numerically.

**UNIT – IV: Interpolation:**

**(10 hrs)**

Introduction– Errors in polynomial interpolation – Finite differences– Forward differences– Backward differences –Central differences – Relations between operators – Newton’s forward and backward formulae for interpolation – Interpolation with unequal intervals – Lagrange’s interpolation formula– Newton’s divide difference formula.

**UNIT – V: Numerical differentiation and integration, Solution of ordinary differential equations with initial conditions:**

**(10 hrs)**

Numerical differentiation using interpolating polynomial – Trapezoidal rule– Simpson’s 1/3<sup>rd</sup> and 3/8<sup>th</sup> rule– Solution of initial value problems by Taylor’s series– Picard’s method of successive approximations– Euler’s method – Runge-Kutta method (second and fourth order).

**Text Books:**

1. B. S. Grewal, Higher Engineering Mathematics, 44<sup>th</sup> Edition, Khanna Publishers, 2018
2. B. V. Ramana, Higher Engineering Mathematics, 6<sup>th</sup> Edition, Tata McGraw Hill Education, 2007
3. David Poole, Linear Algebra- A modern introduction, 4<sup>th</sup> Edition, Cengage, 2015

**Reference Books:**

1. Steven C. Chapra, Applied Numerical Methods with MATLAB for Engineering and Science, Tata McGraw Hill Education, 4<sup>th</sup> Edition, 2018
2. M. K. Jain, S.R.K. Iyengar and R.K. Jain, Numerical Methods for Scientific and Engineering Computation, New Age International Publications, 3<sup>rd</sup> Edition, 2020.
5. Lawrence Turyn, Advanced Engineering Mathematics, CRC Press, 1<sup>st</sup> Edition 2014.



**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA**  
**KAKINADA – 533 003, Andhra Pradesh, India**

**PHARMACEUTICAL ENGINEERING**

|                                        |  |          |          |          |          |
|----------------------------------------|--|----------|----------|----------|----------|
| <b>I Year – II Sem</b>                 |  | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|                                        |  | <b>3</b> | <b>-</b> | <b>-</b> | <b>3</b> |
| <b>ENGINEERING AND SOLID MECHANICS</b> |  |          |          |          |          |

**PRE-REQUISITES:** None

**COURSE OBJECTIVES:**

1. Understand particle, body, rigid body, concept of force, analysis of forces acting on a rigid body
2. Understand moment and the principle of moments
3. Understand friction concept of center of gravity and moment of inertia
4. Understanding kinematics parts of machines
5. Understand the simple stresses and strains
6. Understand torsion of circular shafts and thin cylindrical members

**UNIT I: STATICS OF PARTICLES AND RIGID BODIES**

**Equilibrium of Particles:** Fundamental concepts and principles of engineering mechanics -Forces on particles –vector addition- Concurrent forces in a plane - Resolution of forces - Resultant of several concurrent forces - Free body diagram – Equilibrium of rigid bodies: Principles of transmissibility

**UNIT II:**

**Moment of a force** - Varignon's theorem - Equivalent system of forces - Reduction of system of forces into single force and couple - Equilibrium of rigid bodies in two dimensions- Equilibrium of a two, three force body, statically determinate and indeterminate structures.

**UNIT III: FRICTION**

Friction: Introduction-Types of friction-laws of Friction-Limiting Friction-Cone of limiting friction-static and Dynamic Frictions

**PROPERTIES OF SURFACES AND VOLUMES**

Centre of Gravity: Centroids of lines, areas, and volumes

Moment of Inertia: Determination of moment of inertia of an area- Radius of gyration-Parallel and perpendicular axis theorems.

**UNIT IV:KINEMATICS: SIMPLE STRESSES & STRAINS**

Rectilinear motion-uniform velocity and uniformly accelerated motion-Rectangular components of velocity and acceleration, Variable acceleration, Curvilinear Motion-Normal and tangential components-Motion of Projectile.

Elasticity and plasticity – Types of stresses & strains–Hooke’s law– stress – strain diagram for mild steel – Working stress – Factor of safety – Lateral strain, Poisson’s ratio & volumetric strain –Elastic moduli & the relationship between them – Bars of varying section – composite bars – Temperature stresses.

**UNIT V:**

**TORSION OF CIRCULAR SHAFTS:** Theory of pure torsion – Derivation of Torsion equations:  $T/J = q/r = N\theta/L$  – Assumptions made in the theory of pure torsion – Torsional moment of resistance – Polar section modulus.

**THIN CYLINDERS:** Thin seamless cylindrical shells – Derivation of formula for longitudinal and circumferential stresses – hoop, longitudinal and volumetric strains – changes in diameter, and volume of thin cylinders.



**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA**  
**KAKINADA – 533 003, Andhra Pradesh, India**

**PHARMACEUTICAL ENGINEERING**

**COURSE OUTCOMES:**

The students will be able to:

1. Explain the free body diagram of a body acted upon by a system of forces
2. Analyze the forces acting on a body and write the equations of equilibrium
3. Apply the concept of friction to different surfaces and determine the centroid, center of gravity and moment of inertia of various surfaces.
4. Find the particles displacement, velocity and acceleration under rectilinear and curvilinear translations.
5. Find stress and strains in deformable bodies and properties of materials.
6. Apply the concept of torsion to shafts and able to find its rigidity, torque, angle of twist etc. and properties of thin cylinders.

**TEXT BOOKS:**

1. Timoshenko and Young, Engineering Mechanics, 3rdEd, McGraw HillPublishers,2006.
2. Engineering Mechanics of Solids/EgorP .Popov/2<sup>nd</sup> Edition/ PHI

**REFERENCES:**

1. Engineering Mechanics -Statics and Dynamics A K Tayal /Umesh Publications/2008.
2. Engineering Mechanics/ Rajasekaran.S, &Sankarasubramanian.G/3rd/Vikas Publishing House/2004.
3. A Text book of Engineering Mechanics/ Dr.Bansal.R.K, & Sanjay Bansal /8th/Lakshmi publications/2014.
4. A Text book of Engineering Mechanics/ S. S. Bhavakatti /2nd/New age international/2014.
5. Strength of Materials/S. Ramamrutham/14<sup>th</sup> Edition / DhanapatRai
6. Mechanics of Materials/ B.C.Punmia/1<sup>st</sup> Edition / Laxmi Publications/2001.
7. Strength of Materials/S.S.Rattan/2<sup>nd</sup> Edition /Tata McGraw Hill/2011



**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA**  
**KAKINADA – 533 003, Andhra Pradesh, India**

**PHARMACEUTICAL ENGINEERING**

|                            |  |          |          |          |          |
|----------------------------|--|----------|----------|----------|----------|
| <b>I Year – II Sem</b>     |  | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|                            |  | <b>1</b> | <b>-</b> | <b>4</b> | <b>3</b> |
| <b>ENGINEERING DRAWING</b> |  |          |          |          |          |

**Course Objective:** Engineering drawing being the principal method of communication for engineers, the objective is to introduce the students, the techniques of constructing the various types of polygons, curves and scales. The objective is also to visualize and represent the 3D objects in 2D planes with proper dimensioning, scaling etc.

**Unit I**

**Objective:** To introduce the students to use drawing instruments and to draw polygons, Engg. Curves.

**Polygons:** Constructing regular polygons by general methods, inscribing and describing polygons on circles.

**Curves:** Parabola, Ellipse and Hyperbola by general and special methods, cycloids, involutes, tangents & normals for the curves.

**Scales:** Plain scales, diagonal scales and vernier scales

**Unit II**

**Objective:** To introduce the students to use orthographic projections, projections of points & simple lines. To make the students draw the projections of the lines inclined to both the planes.

**Orthographic Projections:** Reference plane, importance of reference lines, projections of points in various quadrants, projections of lines, line parallel to both the planes, line parallel to one plane and inclined to other plane.

Projections of straight lines inclined to both the planes, determination of true lengths, angle of inclination and traces.

**Unit III**

**Objective:** The objective is to make the students draw the projections of the plane inclined to both the planes.

Projections of planes: regular planes perpendicular/parallel to one reference plane and inclined to the other reference plane; inclined to both the reference planes.

**Unit IV**

**Objective:** The objective is to make the students draw the projections of the various types of solids in different positions inclined to one of the planes.

Projections of Solids – Prisms, Pyramids, Cones and Cylinders with the axis inclined to both the planes.

**Unit V**

**Objective:** The objective is to represent the object in 3D view through isometric views. The student will be able to represent and convert the isometric view to orthographic view and vice versa.

Conversion of isometric views to orthographic views; Conversion of orthographic views to isometric views.

Computer Aided Design, Drawing practice using Auto CAD, Creating 2D&3D drawings of objects using Auto CAD

**Note:** In the End Examination there will be no question from CAD.



**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA**  
**KAKINADA – 533 003, Andhra Pradesh, India**

**PHARMACEUTICAL ENGINEERING**

**TEXTBOOKS:**

1. Engineering Drawing by N.D. Butt, Chariot Publications
2. Engineering Drawing by Agarwal & Agarwal, Tata McGraw Hill Publishers

**REFERENCE BOOKS:**

1. Engineering Drawing by K.L.Narayana& P. Kannaiah, Scitech Publishers
2. Engineering Graphics for Degree by K.C. John, PHI Publishers
3. Engineering Graphics by PI Varghese, McGrawHill Publishers
4. Engineering Drawing + AutoCad – K Venugopal, V. Prabhu Raja, New Age

**Course Outcome:** The student will learn how to visualize 2D & 3D objects.



**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA**  
**KAKINADA – 533 003, Andhra Pradesh, India**

**PHARMACEUTICAL ENGINEERING**

|                                                     |  |          |          |          |          |
|-----------------------------------------------------|--|----------|----------|----------|----------|
| <b>I Year – II Sem</b>                              |  | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|                                                     |  | <b>3</b> | <b>-</b> | <b>-</b> | <b>3</b> |
| <b>BASIC ELECTRICAL AND ELECTRONICS ENGINEERING</b> |  |          |          |          |          |

**Preamble:**

This course covers the topics related to analysis of various electrical circuits, operation of various electrical machines and electronic components to perform well in their respective fields.

**Learning Objectives:**

- To learn the basic principles of electrical circuit law's and analysis of networks.
- To understand principle of operation and construction details of DC machines.
- To understand principle of operation and construction details of transformers, alternator and 3-Phase induction motor.
- To study operation of PN junction diode, half wave, full wave rectifiers and OP-AMPs.
- To learn operation of PNP and NPN transistors and various amplifiers.

**Unit – I: Electrical Circuits**

Basic definitions – types of network elements – Ohm's Law – Kirchhoff's Laws – inductive networks – capacitive networks – series – parallel circuits – star-delta and delta-star transformations. -Numerical Problems.

**Unit – II: DC Machines**

Principle of operation of DC generator – EMF equation – types of DC machines – torque equation characteristics of DC motors – applications – three-point starter – speed control methods of DC motor – Swinburne's Test-Brake test on DC shunt motor-Numerical problems.

**Unit – III: AC Machines:**

**Transformers**

Principle of operation and construction of single-phase transformers – EMF equation – Losses – OC & SC tests – efficiency and regulation-Numerical Problems.

**AC Rotating Machines**

Principle of operation and construction of alternators – types of alternators, applications, principle of operation of 3-Phase induction motor –characteristics – applications.

**Unit IV: Rectifiers & Linear ICs**

PN junction diodes – diode applications (half wave and bridge rectifiers). Characteristics of operation amplifiers (OP-AMP) – application of OP-AMPs (inverting, non-inverting, integrator and differentiator)-Numerical Problems.

**Unit V: Transistors**

PNP and NPN junction transistor, transistor as an amplifier– frequency response of CE amplifier – Basic concepts of feedback amplifier-Numerical problems.

**Learning Outcomes:**

The student should be able to:

- Analyze various electrical networks.
- Understand operation of DC generators,3-point starter and DC machine testing by Swinburne's Test and Brake test.
- Analyze performance of single-phase transformer and acquire proper knowledge and working of 3-phase alternator and 3-phase induction motors.
- Analyze operation of half wave, full wave bridge rectifiers and OP-AMPs.
- Understanding operations of CE amplifier and basic concept of feedback amplifier.



**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA**  
**KAKINADA – 533 003, Andhra Pradesh, India**

**PHARMACEUTICAL ENGINEERING**

**Text Books:**

1. Electrical Technology by Surinder Pal Bali, Pearson Publications.
2. Electronic Devices and Circuits by R.L. Boylestad and Louis Nashelsky, 9<sup>th</sup> edition, PEI/PHI 2006.

**Reference Books:**

1. Electrical Circuit Theory and Technology by John Bird, Routledge Taylor & Francis Group
2. Basic Electrical Engineering by M.S.Naidu and S.Kamakshiah, TMH Publications
3. Fundamentals of Electrical Engineering by Rajendra Prasad, PHI Publications, 2<sup>nd</sup> edition
4. Basic Electrical Engineering by Nagsarkar, Sukhija, Oxford Publications, 2<sup>nd</sup> edition
5. Industrial Electronics by G.K. Mittal, PHI





**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA**  
**KAKINADA – 533 003, Andhra Pradesh, India**

**PHARMACEUTICAL ENGINEERING**

|                                                                  |  |          |          |          |          |
|------------------------------------------------------------------|--|----------|----------|----------|----------|
| <b>I Year – II Sem</b>                                           |  | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|                                                                  |  | -        | -        | 3        | 1.5      |
| <b>BASIC ELECTRICAL &amp; ELECTRONICS ENGINEERING LABORATORY</b> |  |          |          |          |          |

**Learning Objectives:**

- To predetermine the efficiency of dc shunt machine using Swinburne's test.
- To predetermine the efficiency and regulation of 1-phase transformer with O.C and S.C tests.
- To obtain performance characteristics of DC shunt motor & 3-phase induction motor.
- To find out regulation of an alternator with synchronous impedance method.
- To control speed of dc shunt motor using Armature voltage and Field flux control methods.
- To find out the characteristics of PN junction diode & transistor
- To determine the ripple factor of half wave & full wave rectifiers.

**Section A: Electrical Engineering:**

The following experiments are required to be conducted as compulsory experiments:

1. Swinburne's test on D.C. Shunt machine (predetermination of efficiency of a given D.C. shunt machine working as motor and generator).
2. O.C and S.C tests on single phase transformer (predetermination of efficiency and regulation at given power factors).
3. Brake test on 3-phase Induction motor (determination of performance characteristics)
4. Speed control of D.C. Shunt motor by
  - a) Armature Voltage control
  - b) Field flux control method
5. Brake test on D.C. Shunt Motor.

**Section B: Electronics Engineering:**

The following experiments are required to be conducted as compulsory experiments:

1. PN junction diode characteristics a) Forward bias b) Reverse bias (Cut in voltage and resistance calculations)
2. Transistor CE characteristics (input and output)
3. Half wave rectifier with and without filters.
4. Full wave rectifier with and without filters.
5. CE amplifiers.
6. OP- amp applications (inverting, non-inverting, integrator and differentiator)

**Learning Outcomes:**

The student should be able to:

- Compute the efficiency of DC shunt machine without actual loading of the machine.
- Estimate the efficiency and regulation at different load conditions and power factors for single phase transformer with OC and SC tests.
- Analyze the performance characteristics and to determine efficiency of DC shunt motor & 3-Phase induction motor.
- Pre-determine the regulation of an alternator by synchronous impedance method.
- Control the speed of dc shunt motor using Armature voltage and Field flux control methods.
- Draw the characteristics of PN junction diode & transistor
- Determine the ripple factor of half wave & full wave rectifiers.



**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA**  
**KAKINADA – 533 003, Andhra Pradesh, India**

**DEPARTMENT OF PHARMACEUTICAL ENGINEERING**

|                                                |          |          |          |          |
|------------------------------------------------|----------|----------|----------|----------|
| <b>I Year – II Sem</b>                         | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|                                                | -        | -        | 3        | 1.5      |
| <b>ENGLISH COMMUNICATION SKILLS LABORATORY</b> |          |          |          |          |

**TOPICS**

**UNIT I:**

Vowels, Consonants, Pronunciation, Phonetic Transcription, Common Errors in Pronunciation,

**UNIT II:**

Word stress-di-syllabic words, poly-syllabic words, weak and strong forms, contrastive stress (Homographs)

**UNIT III:**

Stress in compound words,rhythm, intonation,accent neutralization.

**UNIT IV:**

Listening to short audio texts and identifying the context and specific pieces of information to answer a series of questions in speaking.

**UNIT V:**

Newspapers reading;Understanding and identifying key terms and structures useful for writing reports.

**Prescribed text book:** “**Infotech English**”, Maruthi Publications.

**References:**

1. Exercises in Spoken English Part 1,2,3,4, OUP and CIEFL.
2. English Pronunciation in use- Mark Hancock, Cambridge University Press.
3. English Phonetics and Phonology-Peter Roach, Cambridge University Press.
4. English Pronunciation in use- Mark Hewings, Cambridge University Press.
5. English Pronunciation Dictionary- Daniel Jones, Cambridge University Press.  
English Phonetics for Indian Students- P. Bala Subramanian, Mac Millan Publications.



**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA**  
**KAKINADA – 533 003, Andhra Pradesh, India**

**DEPARTMENT OF PHARMACEUTICAL ENGINEERING**

|                             |  |          |          |          |          |
|-----------------------------|--|----------|----------|----------|----------|
| <b>I Year – II Sem</b>      |  | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|                             |  | -        | -        | 3        | 1.5      |
| <b>ENGINEERING WORKSHOP</b> |  |          |          |          |          |

**Course Objective:**

To impart hands-on practice on basic engineering trades and skills.

**Note:** At least two exercises to be done from each trade.

**ENGINEERING WORKSHOP:**

**Trade:**

- |                        |                                                                                                                                            |
|------------------------|--------------------------------------------------------------------------------------------------------------------------------------------|
| <b>1. Carpentry</b>    | 1. T-Lap Joint<br>2. Cross Lap Joint<br>3. Dovetail Joint<br>4. Mortise and Tenon Joint                                                    |
| <b>2. Fitting</b>      | 1. Vee Fit<br>2. Square Fit<br>3. Half Round Fit<br>4. Dovetail Fit                                                                        |
| <b>3. Black Smithy</b> | 1. Round rod to Square<br>2. S-Hook<br>3. Round Rod to Flat Ring<br>4. Round Rod to Square headed bolt                                     |
| <b>4. House Wiring</b> | 1. Parallel / Series Connection of three bulbs<br>2. Stair Case wiring<br>3. Florescent Lamp Fitting<br>4. Measurement of Earth Resistance |
| <b>5. Tin Smithy</b>   | 1. Taper Tray<br>2. Square Box without lid<br>3. Open Scoop<br>4. Funnel                                                                   |



**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA**  
**KAKINADA – 533 003, Andhra Pradesh, India**

**DEPARTMENT OF PHARMACEUTICAL ENGINEERING**

|                              |  |          |          |          |          |
|------------------------------|--|----------|----------|----------|----------|
| <b>I Year – II Sem</b>       |  | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|                              |  | -        | -        | 2        | -        |
| <b>ENVIRONMENTAL SCIENCE</b> |  |          |          |          |          |

**Learning Objectives:**

The objectives of the course are to impart:

- Overall understanding of the natural resources.
- Basic understanding of the ecosystem and its diversity.
- Acquaintance on various environmental challenges induced due to unplanned anthropogenic activities.
- An understanding of the environmental impact of developmental activities.
- Awareness on the social issues, environmental legislation and global treaties.

**UNIT-I:**

**Multidisciplinary nature of Environmental Studies:** Definition, Scope and Importance – Sustainability: Stockholm and Rio Summit–Global Environmental Challenges: Global warming and climate change, acid rains, ozone layer depletion, population growth and explosion, effects; Role of information technology in environment and human health.

**Ecosystems:** Concept of an ecosystem. - Structure and function of an ecosystem; Producers, consumers and decomposers. - Energy flow in the ecosystem - Ecological succession. - Food chains, food webs and ecological pyramids; Introduction, types, characteristic features, structure and function of Forest ecosystem, Grassland ecosystem, Desert ecosystem, Aquatic ecosystems.

**UNIT-II:**

**Natural Resources:** Natural resources and associated problems.

Forest resources: Use and over – exploitation, deforestation – Timber extraction – Mining, dams and other effects on forest and tribal people.

Water resources: Use and over utilization of surface and ground water – Floods, drought, conflicts over water, dams – benefits and problems.

Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources.

Food resources: World food problems, changes caused by non-agriculture activities-effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity.

Energy resources: Growing energy needs, renewable and non-renewable energy sources use of alternate energy sources.

Land resources: Land as a resource, land degradation, Wasteland reclamation, man induced landslides, soil erosion and desertification; Role of an individual in conservation of natural resources; Equitable use of resources for sustainable lifestyles.

**UNIT-III:**

**Biodiversity and its conservation:** Definition: genetic, species and ecosystem diversity-classification - Value of biodiversity: consumptive use, productive use, social-Biodiversity at national and local levels. India as a mega-diversity nation - Hot-spots of biodiversity - Threats to biodiversity: habitat loss, man-wildlife conflicts. - Endangered and endemic species of India – Conservation of biodiversity: conservation of biodiversity.



**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA**  
**KAKINADA – 533 003, Andhra Pradesh, India**

**DEPARTMENT OF PHARMACEUTICAL ENGINEERING**

**UNIT – IV Environmental Pollution:** Definition, Cause, effects and control measures of Air pollution, Water pollution, Soil pollution, Noise pollution, Nuclear hazards. Role of an individual in prevention of pollution. - Pollution case studies, Sustainable Life Studies. Impact of Fire Crackers on Men and his well-being.

**Solid Waste Management:** Sources, Classification, effects and control measures of urban and industrial solid wastes. Consumerism and waste products, Biomedical, Hazardous and e – waste management.

**UNIT – V Social Issues and the Environment:** Urban problems related to energy -Water conservation, rain water harvesting - Resettlement and rehabilitation of people; its problems and concerns. Environmental ethics: Issues and possible solutions. Environmental Protection Act -Air (Prevention and Control of Pollution) Act. –Water (Prevention and control of Pollution) Act -Wildlife Protection Act -Forest Conservation Act-Issues involved in enforcement of environmental legislation. -Public awareness.

**Environmental Management:** Impact Assessment and its significance various stages of EIA, preparation of EMP and EIS, Environmental audit. Ecotourism, Green Campus – Green business and Green politics.

The student should Visit an Industry / Ecosystem and submit a report individually on any issues related to Environmental Studies course and make a power point presentation.

**Text Books:**

1. Environmental Studies, K. V. S. G. Murali Krishna, VGS Publishers, Vijayawada
2. Environmental Studies, R. Rajagopalan, 2<sup>nd</sup> Edition, 2011, Oxford University Press.
3. Environmental Studies, P. N. Palanisamy, P. Manikandan, A. Geetha, and K. Manjula Rani; Pearson Education, Chennai

**Reference:**

1. Text Book of Environmental Studies, Deeshita Dave & P. UdayaBhaskar, Cengage Learning.
2. A Textbook of Environmental Studies, Shaashi Chawla, TMH, New Delhi
3. Environmental Studies, Benny Joseph, Tata McGraw Hill Co, New Delhi
4. Perspectives in Environment Studies, Anubha Kaushik, C P Kaushik, New Age International Publishers, 2014



**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA**  
**KAKINADA – 533 003, Andhra Pradesh, India**

**DEPARTMENT OF PHARMACEUTICAL ENGINEERING**

|                        |  |          |          |          |          |
|------------------------|--|----------|----------|----------|----------|
| <b>II Year - I Sem</b> |  | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|                        |  | <b>3</b> | <b>0</b> | <b>0</b> | <b>3</b> |
| <b>PHARMACOLOGY</b>    |  |          |          |          |          |

**PRE-REQUISITES:** Anatomy and physiology

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

**UNIT-I**

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

**UNIT-II**

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

**UNIT-III**

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

**Pharmacology of CVS, Respiratory System & Digestive System:** Antihypertensive drugs, Antianginal drugs, Antiarrhythmics, Antihyperlipidemics, anticoagulants, Fibrinolytics & antiplatelet Drugs. Anti-asthmatic drugs, Anti-tussives & Expectorants, Antacids and Antiulcer drugs, Laxatives and anti-diarrheal Agents, Emetics and antiemetic.

**UNIT-IV**

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

**UNIT-V**

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



**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA**  
**KAKINADA – 533 003, Andhra Pradesh, India**

**DEPARTMENT OF PHARMACEUTICAL ENGINEERING**

Macrolides. Chemotherapy of Parasitic infections, Tuberculosis, Leprosy, Malaria, Fungal infections, Viral Diseases (hepatitis, AIDS) Chemotherapy of Cancer.

**COURSE OUTCOMES:**

1. Identify theoretical concepts surrounding pharmacology, such as the pharmacokinetics and pharmacodynamics of drugs, and the Concepts surrounding pharmacotherapy.
2. Explain general principles of drug and classification of various drugs, pharmacodynamic and pharmacokinetic aspects.
3. Describe the adverse effects, uses, dose, and route of administration, precautions, contraindications and interaction with other drugs.

**TEXT BOOKS:**

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

**References:**

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



**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA**  
**KAKINADA – 533 003, Andhra Pradesh, India**

**DEPARTMENT OF PHARMACEUTICAL ENGINEERING**

|                                                 |  |          |          |          |          |
|-------------------------------------------------|--|----------|----------|----------|----------|
| <b>II Year - I Sem</b>                          |  | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|                                                 |  | <b>3</b> | <b>0</b> | <b>0</b> | <b>3</b> |
| <b>MATERIAL AND ENERGY BALANCE COMPUTATIONS</b> |  |          |          |          |          |

**PRE-REQUISITES:** Chemistry and Mathematics

**OBJECTIVE:**

To develop the basic knowledge for performing the material and energy balances for a given system.

**UNIT I**

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

**UNIT II**

Material Balance: Introduction, solving material balance problems without chemical reaction, with chemical reaction, Concept of stoichiometry and mole balances, examples, including combustion

**UNIT III**

Material Balances with recycle, bypass and purge. Kirchhoff's equation, enthalpy concentration change, calculation of theoretical and actual flame temperatures.

**UNIT IV**

Energy balance: open and closed system, heat capacity, calculation of enthalpy changes. Energy balances with chemical reaction: Heat of reaction, Heat of combustion

**UNIT V**

Crystallization, Dissolution. Humidity and Saturation, humid heat, humid volume, dew point, humidity chart and its use.

**COURSE OUTCOMES:** Upon the successful completion of the course, the student will be able to:

1. Develop mastery over process calculations relevant to chemical engineering processes
2. Handle elementary flow-sheeting, material and energy balance calculations without chemical reactions, and involving concepts like recycle, bypass and purge.
3. Understand concepts like recycle bypass and purge.
4. Familiar with equations of state and properties of gases and liquids, including phase transition
5. Perform combustion calculations.
6. Understand the basic concepts of crystallization and humidification.





**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA**  
**KAKINADA – 533 003, Andhra Pradesh, India**

**DEPARTMENT OF PHARMACEUTICAL ENGINEERING**

**TEXT BOOKS:**

1. Himmelblau, D. M., Riggs, J. B. “Basic Principles and Calculations in Chemical Engineering”, Eighth Ed., Pearson India Education Services, 2015.
2. Hougen, O. A., Watson, K. M., Ragatz, R. A., “Chemical Process Principles, Part-I Material & Energy Balances”, Second Edition, CBS Publishers & Distributors, 2004

**REFERENCES:**

1. Felder, R. M.; Rousseau, R. W., “Elementary Principles of Chemical Processes”, Third Edition, John Wiley & Sons, 2000
2. Venkataramani, V., Anantharaman, N., Begum, K. M. Meera Sheriffa, “Process Calculations” , Second Edition, Prentice Hall of India.
3. Sikdar, D. C., “Chemical Process Calculations”, Prentice Hall of India.
4. Bhatt, B. I., Vora, S. M., “Stoichiometry”, Fourth Edition, Tata McGraw Hill Publishing Company Ltd, 2004.



**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA**  
**KAKINADA – 533 003, Andhra Pradesh, India**

**DEPARTMENT OF PHARMACEUTICAL ENGINEERING**

|                                                       |  |          |          |          |          |
|-------------------------------------------------------|--|----------|----------|----------|----------|
| <b>II Year - I Sem</b>                                |  | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|                                                       |  | <b>3</b> | <b>0</b> | <b>0</b> | <b>3</b> |
| <b>FLUID MECHANICS AND MECHANICAL UNIT OPERATIONS</b> |  |          |          |          |          |

**PRE-REQUISITES:** Engineering mechanics and mathematics

**COURSE OBJECTIVES:** To introduce the students to basic concept of fluid flow conversation laws of transport phenomena, and different size reduction principles and equipment, separation techniques, agitation and mixing.

### UNIT-I

Dimensions and units-physical properties of fluids, Classification of fluids – Newtonian & non-Newtonian fluids and their rheological equations. Stream line, path line and streak lines and stream tube, classification of flows-steady & unsteady, uniform & nonuniform, laminar & turbulent, rotational & irrotational flows-equation of continuity for one dimensional flow and three-dimensional flows.

### UNIT-II

Surface and body forces –Euler’s and Bernoulli’s equations for flow along a stream line, momentum equation and its application on 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, friction from changes in velocity or direction.

### UNIT-III

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

Fluidization, Types of fluidization, Applications of fluidization, continuous fluidization, slurry and pneumatic transport.

**Transportation and Metering of fluids-** pumps – characterization and classification, specifications, characteristics of centrifugal pumps, selection of pumps, Measurement of flowing fluids- variable head meters- Orifice meter, Venturi meter, Pitot tube; Area meters- Rota meter.

### UNIT-IV

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, Equipment operation. Laws of crushing: Kick’s law, Bond’s law, Rittinger’s law. Screening, Industrial screening equipment, Effectiveness of the screen, differential & cumulative analysis.



**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA**  
**KAKINADA – 533 003, Andhra Pradesh, India**

**DEPARTMENT OF PHARMACEUTICAL ENGINEERING**

**UNIT-V**

Filtration, cake filters, centrifugal filters, Principles of cake filtration. Separations based on motion of particles through fluids, gravity settling processes and centrifugal settling processes.

**COURSE OUTCOMES:** The student will be able

1. To apply the concept of hydrostatic equilibrium
2. To have knowledge on fluid flow phenomena
3. To determine engineering design parameter for laminar and turbulent flows.
4. To have knowledge on various mechanical separation operations used in pharma industry.
5. To have knowledge on different separation techniques used in process industries.
6. To realize the need for mechanical operations in pharmaceutical industry.

**TEXT BOOKS:**

1. Unit Operations of Chemical Engineering by W.L.McCabe, J.C.Smith & Peter Harriot, McGraw-Hill, 7<sup>th</sup> ed, 2007.
2. Chemical Engg. Fluid Mechanics by Ron Darby, CRC Press, 2<sup>nd</sup> Edition, 2001.
3. Hydraulics, fluid mechanics and Hydraulic machinery MODI and SETH

**REFERENCES:**

1. Transport processes and unit operations by Christie J. Geankoplis, PHI
2. Unit operations, Vol-1 –Chattopadhyaya, Khanna publishers
3. Principles of Unit Operations, Foust *et al*, 2<sup>nd</sup> ed., John Wiley, 1999
4. Chemical Engineering, Vol-I, Coulson and Richardson, Pergamon Press



**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA**  
**KAKINADA – 533 003, Andhra Pradesh, India**

**DEPARTMENT OF PHARMACEUTICAL ENGINEERING**

|                                                    |  |          |          |          |          |
|----------------------------------------------------|--|----------|----------|----------|----------|
| <b>II Year - II Sem</b>                            |  | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|                                                    |  | <b>3</b> | <b>0</b> | <b>0</b> | <b>3</b> |
| <b>THERMODYNAMICS FOR PHARMACEUTICAL ENGINEERS</b> |  |          |          |          |          |

**PRE-REQUISITES:** Material and Energy Balance Computations.

**COURSE OBJECTIVES:** To study the basic concepts of laws of thermodynamics, thermodynamic properties and phase and chemical equilibrium.

**UNIT-I**

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

**UNIT-II**

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

**UNIT-III**

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.

**UNIT-IV**

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

**UNIT-V**

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

Statistical thermodynamics: Distribution of molecular states, internal energy and entropy; Partition function; Estimation of mean energies, heat capacities, equation of state, residual entropies, and equilibrium constant.

**COURSE OUTCOMES:** The student will be able

1. Describe laws of thermodynamics and their applications.
2. Evaluate different types of property including entropy and its calculation.



**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA**  
**KAKINADA – 533 003, Andhra Pradesh, India**

**DEPARTMENT OF PHARMACEUTICAL ENGINEERING**

3. Evaluate the thermodynamic properties of ideal and non-ideal solutions.
4. Analyze the procedures for estimating the thermodynamic properties and perform thermodynamic calculations oriented to the analysis of chemical equilibrium reactions.

**TEXT BOOKS:**

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

**REFERENCES:**

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

**Web References:**

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

**E-TEXT BOOKS:**

1. <http://nptel.ac.in/downloads/103101004/>
2. <http://www.cpp.edu/~lllee/TK303.pdf>
3. [https://www.researchgate.net/publication/228381252\\_Introductory\\_Chemical\\_Engineering\\_Thermodynamics](https://www.researchgate.net/publication/228381252_Introductory_Chemical_Engineering_Thermodynamics)
4. <http://www.zuj.edu.jo/download/chemical-engineering-thermodynamics-solution-manual-pdf/>



**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA**  
**KAKINADA – 533 003, Andhra Pradesh, India**

**DEPARTMENT OF PHARMACEUTICAL ENGINEERING**

|                                                                        |  |          |          |          |          |
|------------------------------------------------------------------------|--|----------|----------|----------|----------|
| <b>II Year - I Sem</b>                                                 |  | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|                                                                        |  | <b>3</b> | <b>0</b> | <b>0</b> | <b>3</b> |
| <b>MATHEMATICS-III</b><br><b>(Vector Calculus, Transforms and PDE)</b> |  |          |          |          |          |

**Course Objectives:**

- To familiarize the techniques in partial differential equations
- To furnish the learners with basic concepts and techniques at plus two level to lead them into advanced level by handling various real-world applications.

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

- interpret the physical meaning of different operators such as gradient, curl and divergence (L5)
- estimate the work done against a field, circulation and flux using vector calculus (L5)
- apply the Laplace transform for solving differential equations (L3)
- find or compute the Fourier series of periodic signals (L3)
- know and be able to apply integral expressions for the forwards and inverse Fourier transform to a range of non-periodic waveforms (L3)
- identify solution methods for partial differential equations that model physical processes (L3)

**UNIT –I: Vector calculus:**

**(10 hrs)**

Vector Differentiation: Gradient– Directional derivative – Divergence– Curl– Scalar Potential.

Vector Integration: Line integral – Work done – Area– Surface and volume integrals – Vector integral theorems: Greens, Stokes and Gauss Divergence theorems (without proof) and problems on above theorems.

**UNIT –II: Laplace Transforms:**

**(10 hrs)**

Laplace transforms – Definition and Laplace transforms of some certain functions– Shifting theorems – Transforms of derivatives and integrals – Unit step function –Dirac’s delta function Periodic function – Inverse Laplace transforms– Convolution theorem (without proof).

Applications: Solving ordinary differential equations (initial value problems) using Laplace transforms.

**UNIT –III: Fourier series and Fourier Transforms:**

**(10 hrs)**

Fourier Series: Introduction– Periodic functions – Fourier series of periodic function – Dirichlet’s conditions – Even and odd functions –Change of interval– Half-range sine and cosine series.

Fourier Transforms: Fourier integral theorem (without proof) – Fourier sine and cosine integrals – Sine and cosine transforms – Properties (article-22.5 in text book-1)– inverse transforms – Convolution theorem (without proof) – Finite Fourier transforms.



**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA**  
**KAKINADA – 533 003, Andhra Pradesh, India**

**DEPARTMENT OF PHARMACEUTICAL ENGINEERING**

**UNIT –IV: PDE of first order: (8 hrs)**

Formation of partial differential equations by elimination of arbitrary constants and arbitrary functions – Solutions of first order linear (Lagrange) equation and nonlinear (standard types) equations.

**UNIT – V: Second order PDE and Applications: (10 hrs)**

Second order PDE: Solutions of linear partial differential equations with constant coefficients – Non-homogeneous term of the type  $e^{ax+by}$ ,  $\sin(ax + by)$ ,  $\cos(ax + by)$ ,  $x^m y^n$ .

Applications of PDE: Method of separation of Variables– Solution of One-dimensional Wave, Heat and two-dimensional Laplace equation.

**Text Books:**

1. **B. S. Grewal**, Higher Engineering Mathematics, 44<sup>th</sup> Edition, Khanna Publishers.
2. **B. V. Ramana**, Higher Engineering Mathematics, 2007 Edition, Tata Mc. Graw Hill Education.

**Reference Books:**

1. **Erwin Kreyszig**, Advanced Engineering Mathematics, 10<sup>th</sup> Edition, Wiley-India.
2. **Dean. G. Duffy**, Advanced Engineering Mathematics with MATLAB, 3<sup>rd</sup> Edition, CRC Press.
3. **Peter O' Neil**, Advanced Engineering Mathematics, Cengage.
4. **Srimantha Pal, S C Bhunia**, Engineering Mathematics, Oxford University Press.



**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA**  
**KAKINADA – 533 003, Andhra Pradesh, India**

**DEPARTMENT OF PHARMACEUTICAL ENGINEERING**

|                                             |  |          |          |          |            |
|---------------------------------------------|--|----------|----------|----------|------------|
| II Year I Sem                               |  | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b>   |
|                                             |  | <b>0</b> | <b>0</b> | <b>3</b> | <b>1.5</b> |
| <b>BASIC PHARMACEUTICAL ENGINEERING LAB</b> |  |          |          |          |            |

**PRE-REQUISITES:** Pharmaceutical Chemistry

**COURSE OBJECTIVES:** The lab provides knowledge on identification of functional groups and limit tests.

**Lab Experiments**

1. Functional group test like Phenols, Amides/ Urea, Carbohydrates, Amines, Carboxylic acids.
2. Functional group test like Aldehydes and Ketones, Alcohols, Esters, Aromatic and halogenated Hydrocarbons, Nitro compounds and Anilides.
3. Limit test for the iron.
4. Limit test for the sulphates.
5. Limit test for the chlorides.
6. Identification test for sodium
7. Identification test for of Magnesium.
8. Identification test for calcium.
9. Preparation and purification of any sodium compound.
10. Determination of melting point.

**COURSE OUTCOMES:** The student will be able to

1. Judge the purity of different inorganic salts used in pharmaceutical industry.
2. Perform Limit Tests for compounds used in pharmaceutical industry.
3. Perform identification Tests for compounds used in pharmaceutical industry

**TEXT BOOKS:**

1. *Vogel's Textbook of Practical Organic Chemistry* 5th Edition
2. *Advanced Organic Chemistry- Reactions, Mechanisms and Structure* by J. A. March, M. B. Smith

**REFERENCES:**

1. *Advanced Organic Chemistry, Part A: Structure and Mechanisms* by F.A. Carey and R.A. Sundberg
2. *Advanced Organic Chemistry, Part B: Reactions and Synthesis* by F.A. Carey and R.A. Sundberg.
3. *Modern Methods of Organic Synthesis*, by W. Carruthers and I. Coldham.
4. *Strategic Applications of Named Reactions in Organic Synthesis* by L. Kurti and B. Czako
5. *Organic Syntheses Based on Name Reactions* by A. Hassner and C. Stummer





**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA**  
**KAKINADA – 533 003, Andhra Pradesh, India**

**DEPARTMENT OF PHARMACEUTICAL ENGINEERING**

|                                                           |  |          |          |          |            |
|-----------------------------------------------------------|--|----------|----------|----------|------------|
| II Year - I Sem                                           |  | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b>   |
|                                                           |  | <b>0</b> | <b>0</b> | <b>3</b> | <b>1.5</b> |
| <b>FLUID MECHANICS AND MECHANICAL UNIT OPERATIONS LAB</b> |  |          |          |          |            |

**PRE-REQUISITES:** Fluid Mechanics and Mechanical Unit Operations

**COURSE OBJECTIVES:** to provide knowledge on flow measuring devices, pumps, and various mechanical unit operations.

**LIST OF EXPERIMENTS**

1. Identification of laminar and turbulent flows, Major equipment - Reynolds apparatus
2. Verification of Bernoulli's equation, Major equipment – Bernoulli's Apparatus
4. Calibration of Rotameter, Major equipment – Rotameter Assembly
5. Variation of Orifice coefficient with Reynolds Number Major equipment - Orifice meter Assembly
6. Determination of Venturi coefficient, Major equipment – Venturi meter Assembly
7. Friction losses in Fluid flow in pipes, Major equipment - Pipe Assembly with provision for Pressure measurement
8. Calculation of surface area using pressure drop in a packed bed for different fluid velocities Major equipment - Packed bed with Pressure drop measurement
9. Calculation of minimum fluidization velocity and void fraction in a fluidized bed. Major equipment - Fluidized bed with Pressure drop measurement
10. Studying the Characteristics of a centrifugal pump Major equipment - Centrifugal Pump
11. Determining the time of grinding in a ball mill. Major equipment - Ball mill Apparatus, Sieve shaker, Different sizes of sieves, weighing balance.
12. Calculation of the minimum thickener area using batch sedimentation. Major equipment- Sedimentation apparatus
13. Determining the specific cake resistance and filter medium resistance of a slurry in plate and frame filter press. Major equipment - Plate and frame filter press.
14. Verifying Stoke's law. Major equipment – Stoke's law apparatus

**COURSE OUTCOMES:** The student will be able to

1. Estimate the flow rate using flow measuring devices.
2. Estimate average particle diameter for size reduction using different size reduction equipment.
3. Estimate terminal settling velocity.



**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA**  
**KAKINADA – 533 003, Andhra Pradesh, India**

**DEPARTMENT OF PHARMACEUTICAL ENGINEERING**

| II Year - I Sem          |  | L | T | P | C   |
|--------------------------|--|---|---|---|-----|
|                          |  | 0 | 0 | 3 | 1.5 |
| <b>COMMUNICATION LAB</b> |  |   |   |   |     |



**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA**  
**KAKINADA – 533 003, Andhra Pradesh, India**

**DEPARTMENT OF PHARMACEUTICAL ENGINEERING**

|                                                    |  |          |          |          |          |
|----------------------------------------------------|--|----------|----------|----------|----------|
| I Year - I Sem                                     |  | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|                                                    |  | <b>0</b> | <b>0</b> | <b>2</b> | <b>0</b> |
| <b>FOUNDATION SKILLS IN INFORMATION TECHNOLOGY</b> |  |          |          |          |          |

**PRE-REQUISITES:**

1. Basic Knowledge on Computers Networking
2. Programming in C
3. Basic Programming Concepts

**COURSE OBJECTIVES:**

1. To understand the functionalities of various Hardware, Software & Networking concepts
2. To understand the environments of different types of Operating systems like UNIX/LINUX.
3. To understand the basic concepts of Web Technologies, Designing Web Pages
4. To understand the Object-Oriented Programming concepts in C++
5. To understand the Database concepts and writing SQL queries.
6. To understand the Development Life Cycle of the Software Project

**Module I:**

Identification of Peripherals of PC & its functions, Assembling & Disassembling of PC.  
 Software installation and settings

- a) Installation of Linux, Installation of Oracle Installation of MySQL.
- b) Finding MAC address & IP address of a system, Creating Log record of a remote PC.

**Module II:**

a) Word Orientation: an overview of Microsoft (MS) office 2007/ 10: Importance of MS office 2007/10, overview of toolbars, saving files, Using help and resources, rulers, format painter. Table of Content, Newspaper columns, Images from files and clipart, Drawing toolbar and Word Art, Formatting Images, Textboxes, Paragraphs and Mail Merge in word.

b) Using Word to create project certificate. Features to be covered: -Formatting Fonts in word, Drop Cap in word, Applying Text effects, Using Character Spacing, Borders and Colors, Inserting Header and Footer, Using Date and Time option in Word & Formatting Styles, inserting table, Bullets and Numbering, Changing Text Direction, Cell alignment, Footnote, Hyperlink, Symbols, Spell Check, Track Changes.

c) Excel Orientation: The importance of MS office 2007/10 tool Excel as a Spreadsheet tool, Accessing, overview of toolbars, saving excel files, Using help and resources.

Creating a Scheduler - Features to be covered: - Gridlines, Format Cells, Summation, auto fill, Formatting Text

d) Calculating GPA - Features to be covered:- Cell Referencing, Formulae in excel – average, std. deviation, Charts, Renaming and Inserting worksheets, Hyper linking, Count function, LOOKUP/VLOOKUP, Sorting, Conditional formatting .

**Module III:**

- a) Basic power point utilities and tools which helpful to create basic power point



**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA**  
**KAKINADA – 533 003, Andhra Pradesh, India**

**DEPARTMENT OF PHARMACEUTICAL ENGINEERING**

presentation. Topic covered during this includes PPT Orientation, Slide Layouts, Inserting Text, Word Art, Formatting Text, Bullets and Numbering, Auto Shapes, Lines and Arrows in both Latex and Power point.

b) Documentation creation using LaTeX

**Learning UNIX/LINUX Commands**

a) Basic commands execution like general - purpose, processing, file-related commands, Directory commands.

b) Vi editor operation, how to write & run simple C programs.

**Module IV:**

Working with LINUX Environment.

a) Write a C program on arithmetic operations

b) Write function to check given number is prime number or not.

Introduction to Classes, Objects and implementing programs using C++

a) Program for class and objects.

b) Program for complex number.

Introduction to polymorphism, example programs using polymorphism in C++

Working with web Technologies:

Introduction to basic tags and creation of webpage using HTML.

**Module V:**

Introduction to DHTML, CSS.

a) Write a program for inserting an image using DHTML

b) Write a program to create a button and textfield using CSS for prescribed size

Introduction to SQL Commands in DDL and DML: like Insertion, Deletion, Updation of a table

Introduction to Software Engineering Concepts, Software Development Life Cycle, SRS.

**COURSE OUTCOMES:**

1. Ability to understand the advanced computer peripherals and operating systems.
2. Improve the Ability to understand the C concepts in Linux environment.
3. Ability to understand web technologies.
4. The course objective ensures the development of students learning OOPs concepts.
5. Understand the basic software engineering concepts.

**TEXT BOOKS:**

1. Fundamentals of Computers - Rajaraman V., Eastern Economic Edition, PHI
2. Computer Fundamentals - Pradeep Sinha, Priti Sinha, 6th Edition, BPB PUBLICATIONS
3. Unix system programming using C++, T.Chan, PHI
4. Web Technologies, Uttam K Roy, Oxford University Press.

**REFERENCES:**

1. Linux System programming, Robert Love O' Reilly, SPD
2. Unix Network Programming, W, R Stevens, PHI
3. Unix Internals, U. Vahalia, Pearson Education

Web Programming, building internet applications, Chris Bates 2nd Edition, Wiley Dreamtech.



**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA**  
**KAKINADA – 533 003, Andhra Pradesh, India**

**DEPARTMENT OF PHARMACEUTICAL ENGINEERING**

|                                                   |  |          |          |          |          |
|---------------------------------------------------|--|----------|----------|----------|----------|
| <b>II Year -II Sem</b>                            |  | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|                                                   |  | <b>3</b> | <b>0</b> | <b>0</b> | <b>3</b> |
| <b>HEAT TRANSFER FOR PHARMACEUTICAL ENGINEERS</b> |  |          |          |          |          |

**PRE-REQUISITES:** Material and energy balance computations

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

**UNIT-I**

**Introduction:** Nature of heat flow, conduction, convection, natural and forced convection, radiation.

**Heat transfer by conduction in Solids:** Fourier's law, thermal conductivity, steady state conduction in plane wall & composite walls, compound resistances in series, heat flow through a cylinder, conduction in spheres

**UNIT-II**

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

**UNIT-III**

**Heat Transfer to Fluids without Phase change:** Regimes of heat transfer in fluids, thermal boundary layer, heat transfer by forced convection in laminar flow, heat transfer by forced convection in turbulent flow, the transfer of heat by turbulent eddies and analogy between transfer of momentum and heat, heat transfer to liquid metals, heating and cooling of fluids in forced convection outside tubes.

**Natural convection:** Natural convection to air from vertical shapes and horizontal planes, effect of natural convection in laminar-flow heat transfer

**UNIT-IV**

**Heat Transfer to Fluids with Phase change:** heat transfer from condensing vapors, heat transfer to boiling liquids.

**Heat exchange equipment:** General design of heat exchange equipment, heat exchangers, condensers, boilers and calorifiers, extended surface equipment, heat transfer in agitated vessels, scraped surface heat exchangers, heat transfer in packed beds, heat exchangers effectiveness (NTU method)



**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA**  
**KAKINADA – 533 003, Andhra Pradesh, India**

**DEPARTMENT OF PHARMACEUTICAL ENGINEERING**

**UNIT-V**

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

**Radiation:** Introduction, properties and definitions, black body radiation, real surfaces and the gray body, absorption of radiation by opaque solids, radiation between surfaces, radiation shielding, radiation to semitransparent materials, combined heat transfer by conduction, convection and radiation.

**COURSE OUTCOMES:** The student will be able to

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

**TEXT BOOKS:**

1. Unit Operations of Chemical Engineering, 6<sup>th</sup> ed., W.L. McCabe, J.C. Smith and P. Harriot, McGraw-Hill, New York, 2001

**REFERENCES:**

1. Process Heat Transfer, D.Q. Kern, Tata McGraw-Hill, New Delhi, 1997.
2. Heat Transfer, J.P. Holman, 9th Edition, Tata McGraw-Hill, 2008
3. A Text Book on Heat Transfer, S.P. Sukhatme, 5th Edition, Universities Press (India) Pvt. Ltd., 2005.
4. Heat Transfer: Principles and Applications, Binay Dutta, K., 1st Edition, Phi Learning, 2000



**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA**  
**KAKINADA – 533 003, Andhra Pradesh, India**

**DEPARTMENT OF PHARMACEUTICAL ENGINEERING**

|                               |  |          |          |          |          |
|-------------------------------|--|----------|----------|----------|----------|
| <b>II Year -II Sem</b>        |  | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|                               |  | <b>3</b> | <b>0</b> | <b>0</b> | <b>3</b> |
| <b>PHYSICAL PHARMACEUTICS</b> |  |          |          |          |          |

**PRE-REQUISITES:** Physics and Chemistry

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

**UNIT-I**

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

**UNIT-II**

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

**UNIT-III**

Interfacial phenomenon: Definition, method of determination. Significance in Pharmacy. Liquid interfaces, adsorption at liquid interfaces. Surface active agent's classification, properties, applications HLB. Adsorption at solid interfaces. Electric properties at interfaces – Zeta potential and its importance.

Complexation: Types of complexes, metal, organic and inclusion complexes, methods of analysis.

Colloids: classification, purification, protective colloid action, properties.

**UNIT-IV**

Coarse dispersions: Suspensions – interfacial properties of suspended particles, settling in suspensions. Formulation and evaluation, rheological properties of suspensions.

Emulsions: Theories of emulsification, physical stability of emulsions, preservation of emulsions, rheological properties of emulsions.

Semisolids: classification, properties.

Gels: classification, concept of syneresis and swelling.



**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA**  
**KAKINADA – 533 003, Andhra Pradesh, India**

**DEPARTMENT OF PHARMACEUTICAL ENGINEERING**

**UNIT-V**

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

**COURSE OUTCOMES:** To student will be able to

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

**TEXT BOOKS:**

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

**REFERENCES:**

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





**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA**  
**KAKINADA – 533 003, Andhra Pradesh, India**

**DEPARTMENT OF PHARMACEUTICAL ENGINEERING**

|                                                    |  |          |          |          |          |
|----------------------------------------------------|--|----------|----------|----------|----------|
| <b>II Year -II Sem</b>                             |  | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|                                                    |  | <b>3</b> | <b>0</b> | <b>0</b> | <b>3</b> |
| <b>PRINCIPLES OF MICROBIOLOGY AND BIOCHEMISTRY</b> |  |          |          |          |          |

**PRE-REQUISITES:** Biology and Chemistry

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

### UNIT-I

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

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

### UNIT -II

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

### UNIT-III

**Application of Microbes in Pharmaceutical Industry:**

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

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

**C.** sampling of the air in clean house in classified areas.

### UNIT-IV

**Introduction to Biochemistry:** Biomembranes: Structure and molecular constituents of membrane, models proposed, function and properties of membrane, transport hypothesis: Active and Passive, facilitated transport, Na<sup>+</sup>, K<sup>+</sup>, H<sup>+</sup> pumps. Glucose transport, osmoregulation.



**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA**  
**KAKINADA – 533 003, Andhra Pradesh, India**

**DEPARTMENT OF PHARMACEUTICAL ENGINEERING**

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

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

**UNIT-V**

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

**Lipids:** Definition, Classification, Functions, Types of fatty acids and its biological role. Metabolism: Alpha, Beta, Gamma & Omega oxidations of fatty acids, bio-synthesis of fatty acids, cholesterol.

**Nucleic acids:** Structure, classification, cell and biological functions, chemical composition, as genetic.

**COURSE OUTCOMES:** The student will be able to

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

**TEXT BOOKS:**

1. Pelczar and Reid, Text Book of Microbiology, 3<sup>rd</sup> Edition, McGraw-Hill, 1971.
2. Anantha Narayan and Jayram Panikar, Text Book of Microbiology, Orient Longman, Delhi. N.K. Jain, Pharmaceutical Microbiology
3. Guyton, A.C. and Hall, J.E. "Textbook of Medical Physiology", 11th Edition, Saunders, 2006.
4. Ganong, W.F. "Review of Medical Physiology", 22nd Edition (A Lange Medical book series) McGraw – Hill (International Ed.) 2005.
5. Khurana, Indu "A Textbook of Medical Physiology" Elsevier, 2006. 4. Johnson, L.R. "Essential



**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA**  
**KAKINADA – 533 003, Andhra Pradesh, India**

**DEPARTMENT OF PHARMACEUTICAL ENGINEERING**

**References:**

1. Heritage, J Introductory Microbiology, published by the press syndicate of the university of Cambridge, 2000.
2. Nester, Anderson, Roberts, Pearsall, Microbiology, McGraw-Hill, 4<sup>th</sup> edition, McGraw HillPublisher.
3. Hugo, W B Pharmaceutical Microbiology, 8<sup>th</sup> edition, published: wiley-blackwell.
4. Waugh, Anne and Allison Grant “Ross and Wilson Anatomy and Physiology in Health and Illness”, 10th Edition, Churchill – Livingstone / Elsevier), 2006.
5. Carola, R., J.P. Harley and C.R. Noback. “Human Anatomy & Physiology”, 2nd Edition, McGraw – Hill, 1992.
6. Vander, A.J., J.H. Sherman and D.S. Luciano “Human Physiology: The Mechanisms of BodyFunction”, 5th Edition, McGraw – Hill, 1990.
7. Lodish, Harvey etal., “Molecular Cell Biology,” 6th Edition. W.H.Freeman, 2008.
8. Alberts, Bruce, “Molecular Biology of Cell”, 5th Edition, Garland Science, 2008



**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA**  
**KAKINADA – 533 003, Andhra Pradesh, India**

**DEPARTMENT OF PHARMACEUTICAL ENGINEERING**

|                                                          |  |          |          |          |          |
|----------------------------------------------------------|--|----------|----------|----------|----------|
| <b>II Year - II Sem</b>                                  |  | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|                                                          |  | <b>3</b> | <b>0</b> | <b>0</b> | <b>3</b> |
| <b>REACTION ENGINEERING FOR PHARMACEUTICAL ENGINEERS</b> |  |          |          |          |          |

**PRE-REQUISITES:** Thermodynamics for pharmaceutical Engineers

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

### UNIT-I

**Overview of chemical reaction engineering:** Classification of reactions, variables affecting the rate of reaction definition of reaction rate. Kinetics of homogenous reactions- concentration dependent term of rate equation, Temperature dependent term of rate equation, searching for a mechanism, predictability of reaction rate from theory. **Interpretation of batch reactor data-** constant volume batch reactor: Analysis of total pressure data obtained in a constant-volume system, the conversion, Integral method of analysis of data—general procedure, irreversible unimolecular type first order reactions, irreversible bimolecular type second order reactions, irreversible trimolecular type third order reactions,

### UNIT-II

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

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

### UNIT-III

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

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



**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA**  
**KAKINADA – 533 003, Andhra Pradesh, India**

**DEPARTMENT OF PHARMACEUTICAL ENGINEERING**

mixed flow reactors-A special problem, multiple reactions.

**UNIT-IV**

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

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

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

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

**UNIT-V**

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

**COURSE OUTCOMES:** The student will be able to

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

**TEXT BOOKS:**

1. Chemical Reaction Engineering, 3rd ed., O. Levenspiel, John Wiley & Sons, 1999

**REFERENCES:**

1. Elements of Chemical Reaction Engineering, 2nd ed., H.S. Fogler, PHI Learning Pvt. Ltd., New Delhi, 2010.
2. Chemical Engineering Kinetics, 3rd ed., J.M. Smith, McGraw-Hill, New York, 1981



**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA**  
**KAKINADA – 533 003, Andhra Pradesh, India**

**DEPARTMENT OF PHARMACEUTICAL ENGINEERING**

|                         |                               |          |          |          |          |
|-------------------------|-------------------------------|----------|----------|----------|----------|
| <b>II Year - II Sem</b> |                               | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|                         | <b>ANATOMY AND PHYSIOLOGY</b> | <b>3</b> | <b>0</b> | <b>0</b> | <b>3</b> |

**PRE-REQUISITES:** Biology

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

**UNIT I:**

**Introduction to Cell:** Structure and Function of Cell, Subcellular Organelles and Cell Division -Mitosis, Meiosis. Transport Across Cell Membrane: Passive and Active Transport, Ion channels, Ligand gated / voltage gated channels. Tissues-Anatomy and Physiology of various tissues, epithelial tissue, Connective tissue, Muscle tissue, Nervous tissue, Organ systems and Homeostasis.

**UNIT II:**

**Skeletal System & Respiratory System:** Structure, composition & functions of skeleton. Physiology  
 Of skeletal muscle contraction, Classification of joints, Types of joints. Anatomy & function of respiratory structures, Mechanism of respiration, regulation of respiration.

**UNIT III:**

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

**UNIT IV:**

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

**UNIT-V:**

**Nervous System:** Functions of different parts of brain and spinal cord. Cranial nerves and functions. Neurohumoral transmission in the central nervous system, reflex action, specialized functions of the brain. Autonomic Nervous System: Physiology and functions of the autonomic nervous system. Sense Organs: Basic anatomy and physiology of the eye, ear, taste buds, nose, and skin.



**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA**  
**KAKINADA – 533 003, Andhra Pradesh, India**

**DEPARTMENT OF PHARMACEUTICAL ENGINEERING**

**Endocrine System & Reproductive System:** Anatomy & Physiology of pituitary, thyroid, parathyroid, adrenal, pancreas, control of hormone secretion. Male & Female reproductive system, Menstruation.

**COURSE OUTCOMES:** The student will be able

1. Identify the anatomical terms related to the human body.
2. Illustrate the anatomical location of the systems and explain their function.
3. Explain the Physiology of all the major systems within the human body.
4. Describes the structure and functions of various organs of the human body and mechanisms in the maintenance of normal functioning and disease state are knows.

**TEXT BOOKS:**

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

**References:**

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



**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA**  
**KAKINADA – 533 003, Andhra Pradesh, India**

**DEPARTMENT OF PHARMACEUTICAL ENGINEERING**

|                                   |  |          |          |          |            |
|-----------------------------------|--|----------|----------|----------|------------|
| <b>II Year -II Sem</b>            |  | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b>   |
|                                   |  | <b>0</b> | <b>0</b> | <b>3</b> | <b>1.5</b> |
| <b>PHYSICAL PHARMACEUTICS LAB</b> |  |          |          |          |            |

**PRE-REQUISITES:** Physical Pharmaceutics

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

**Lab Experiments**

**Hours: 36**

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

**COURSE OUTCOMES:**

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





**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA**  
**KAKINADA – 533 003, Andhra Pradesh, India**

**DEPARTMENT OF PHARMACEUTICAL ENGINEERING**

|                         |  |          |          |          |            |
|-------------------------|--|----------|----------|----------|------------|
| II Year -II Sem         |  | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b>   |
|                         |  | <b>0</b> | <b>0</b> | <b>3</b> | <b>1.5</b> |
| <b>MICROBIOLOGY LAB</b> |  |          |          |          |            |

**PRE-REQUISITES:** Principles of Microbiology and Biochemistry

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

**Lab Experiments**

**Hours: 36**

1. Microscopy; Scientific Inquiry; Mounting Microorganism and Study morphology and structure of different microbes.
2. Perform all physical sterilization Techniques mandated in Biosafety class-II laboratory
3. Preparation of various culture media
4. Cultivation of microbes and observation of colony characteristics.
5. Characterization of microbes by Gram staining technique
6. Characterization of microbes by Acid fast staining technique
7. Characterization of microbes through Indole, Methyl Red test
8. Characterization of microbes through Voges Proskauer test, Starch hydrolysis test
9. Evaluation of Commercial disinfectant by phenol-coefficient test
10. Assay of antibiotic
11. Assay of Vitamins
12. Assay of amino acids

**COURSE OUTCOMES:** The student

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

**TEXT BOOKS:**

1. Microbiology: A Laboratory Manual, James G. Cappuccino
2. Microbiology: An Introduction, 12th Edition, Gerard J. Tortora, Berdell R. Funke and Christine



**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA**  
**KAKINADA – 533 003, Andhra Pradesh, India**

**DEPARTMENT OF PHARMACEUTICAL ENGINEERING**

|                             |  |          |          |          |          |
|-----------------------------|--|----------|----------|----------|----------|
| <b>II Year -II Sem</b>      |  | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|                             |  | <b>0</b> | <b>0</b> | <b>2</b> | <b>0</b> |
| <b>GENDER SENSITIZATION</b> |  |          |          |          |          |

**COURSE OBJECTIVES:**

1. To develop students' sensibility with regard to issues of gender in contemporary India.
2. To provide a critical perspective on the socialization of men and women.
3. To introduce students to information about some key biological aspects of genders.
4. To expose the students to debates on the politics and economics of work.
5. To help students reflect critically on gender violence.
6. To expose students to more egalitarian interactions between men and women.

**Unit I: UNDERSTANDING GENDER:**

Gender: Why should we study It?(Towards a world of Equals: Unit-1)

Socialization: Making Women, making Men(Towards a world of Equals:Unit-2)

Introduction. Preparing for Womanhood. Growing up male, First lessons in /caste, Different Masculinities. Just Relationships: Being Together as Equals(Towards a World of Equals:Unit-12)

Mary Kom and Onler, Love and Acid just do not Mix, Love Letters, Mothers and Fathers, Further Reading: Rosa Parks-The Brave Heart.

**Unit II: GENDER AND BIOLOGY:**

Missing Women: Sex Selection and its Consequences (Towards a World of Equals: Unit-4)

Declining Sex Ratio, Demographic Consequences. Gender Spectrum: Beyond the Binary(Towards a World of Equals: Unit-10) Two or Many? Struggles with Discrimination Additional Reading: Our Bodies, Our Bodies, Our Health(Towards a World of Equals: Unit-13)

**Unit III: GENDER AND LABOUR:**

Housework: the Invisible Labour(Towards a World of Equals: Unit-3)

“ My Mother doesn't Work.” “ Share the Load” Women's Work: Its Politics and Economics(Towards a World of Equals: Unit-7)

Fact and Fiction Unrecognized and Unaccounted work. Further Reading: Wages and Conditions of Work.

**Unit IV: ISSUES OF VIOLENCE:**

Sexual Harassment: Say No! (Towards a World of Equals: Unit-6)

Sexual Harassment,not-eve-teasing-coping with everyday harassment-further Reading: “ Chupulu”. Domestic Violence: Speaking Out (Towards a World of Equals: Unit-8)

**GENDER STUDIES:**

Knowledge: Through the Lens of Gender (Towards a World of Equals: Unit-5)

Point of View, Gender and the Structure of Knowledge. Further Reading :Unacknowledged Women Artists of Telangana. Whose History? Questions for Historians and others (Towards a World of Equals: Unit-9) Reclaiming a Past. Writing other Histories. Further Reading: Missing Pages from Modern Telangana History.



**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA**  
**KAKINADA – 533 003, Andhra Pradesh, India**

**DEPARTMENT OF PHARMACEUTICAL ENGINEERING**

**Unit V:** Is Home a safe Place?-When Women Unite(Film). Rebuilding Lives. Further Reading: New Forums for Justice. Thinking about Sexual Violence (Towards a World of Equals: Unit-11)

Blaming the Victim-“I fought for my Life...”- Further Reading: The Caste Face of Violence  
 Essential Reading : All The Units in the Textbook, “Towards a World of Equals: A Bilingual Textbook on Gender” written by A. Suneetha, Uma Bhrugubanda, Duggirala Vasanta, Rama Melkote, Vasudha Nagaraj, Asma Rasheed, GoguShyamala, Deepa Sreenivas and Susie Tharu.

Note: Since it is interdisciplinary Course, Resource Persons can be drawn from the fields of English Literature or Sociology or Political Science or any other qualified faculty who has expertise in this field.

**COURSE OUTCOMES:**

1. Students will have developed a better understanding of important issues related to gender in contemporary India.
2. Students will be sensitized to basic dimensions of the biological, sociological, psychological and legal aspects of gender. This will be achieved through discussion of materials derived from research, facts, everyday life, literature and film.
3. Students will attain a finer grasp of how gender discrimination works in our society and how to counter it.
4. Students will acquire insight into the gendered division of labour and its relation to politics and economics.
5. Men and Women students and professionals will be better equipped to work and live together as equals.
6. Students will develop a sense of appreciation of women in all walks of life.
7. Through providing accounts of studies and movements as well as the new laws that provide protection and relief to women the course will empower students to understand and respond to gender violence.

**References:**

1. Sen, Amartya, “ More than One Million Women are Missing,” New York Review of Books 37.20(20 December 1990) Print ‘ We were Making History...’ Life Stories of Women in Telangana Peoples Struggle , New Delhi: Kali for Women,1989.
2. TriptiLahiri “ By the Numbers: Where Indian Women Work “ Womens Studies Journal (14 November 2012) Available Online at: [http://blogs.wsj.com/India\\_real\\_time/2012/11/14/by-the-numbers-where-Indian-women-work/](http://blogs.wsj.com/India_real_time/2012/11/14/by-the-numbers-where-Indian-women-work/)>
3. K. Satyanarayana and Susie Tharu(Ed) Steel Nibs are Sprouting: New Dalit Writing from South India, Dossier 2: Telugu And Kannada <http://harpercollins.co.in/BookDetail.asp?BookCode-3732>
4. Vimala ‘Vantillu( The Kitchen)’ Women Writing in India:600 BC to the Present Volume II: The 20th Century.Ed.SusieTharu and K. Lalita Delhi: Oxford University Press,1995 559-601
5. Shatrughuna, Veena et al Womens Work and its Impact on child Health and Nutitution, Hydeabad, National Institute of Nutrition, India Council of Medical Research,1993.



**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA**  
**KAKINADA – 533 003, Andhra Pradesh, India**

**DEPARTMENT OF PHARMACEUTICAL ENGINEERING**

2. Stree Shakti Sanghatana “We were making history...’ Life Life Stories of Women in Telangana Peoples Struggle , New Delhi: Kali for Women,1989.
3. Menon, Nivedita Seeing like a feminist, New Delhi: Zubaan-Penguin Books,2012.
4. Jayaprabha, A. ‘Chupulu(stares), Women Writing in India:600 BC to the Present Volume II: The 20th Century.Ed.SusieTharu and K. Lalita Delhi: Oxford University Press,1995 596-697
5. Javeed, Shayan and Anupam Manuhaar“ Women and Wage Discrimination in India: A Critical Analysis”International Journal of Humanities and social science Invention2.4(2013)
6. Gautam, Liela and Gita Ramaswamy “ A Conversation between a Daughter and a mother” Broadsheet on Contemporary Politics, Special Issue on Sexuality and Harassment : Gender Politics on Campus Today Ed Madhumeeta Sinha and Asma Rasheed Hyderabad: Anveshi Research Center for Women’s Studies 2014
7. Abdulali Sohaila “I fought for my life and Won” Available online at :<http://www.thealterative.in/lifestyle/i-fought-for-my-lifeand-won-sohaila-abdulal/>
8. JeganathanPradeep,Partha Chatterjee (ED) “ CommUnity, Gender and Violence Subaltern Studies Xf Permanent Black and Ravi Dayal Publishers, New Delhi,2000.
9. K. Kapadia, The Violence of Development: The Politics of Identity, Gender and Social Inequalities in India London: Zed Books,2002
10. S. Benhabib, Situating the Self: Gender, CommUnity and Post modernism in contemporary Ethics, London: Routledge,1992
11. Virginia Woolf, A Room of One’s own Oxford: Black Swan 1992
12. T. Banuri and M. Mahmood , Just Development: Beyond Adjustment with a Human Face, Karachi: Oxford University Press,1997.



**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA**  
**KAKINADA – 533 003, Andhra Pradesh, India**

**DEPARTMENT OF PHARMACEUTICAL ENGINEERING**

|                      |  |          |          |          |            |
|----------------------|--|----------|----------|----------|------------|
| II Year - II Sem     |  | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b>   |
|                      |  | <b>0</b> | <b>0</b> | <b>2</b> | <b>1.5</b> |
| <b>MINOR PROJECT</b> |  |          |          |          |            |

**COURSE OBJECTIVES:**

1. To enhance creative thinking in engineering.
2. To conceptualise an idea/technique.
3. To appreciate the multi-disciplinary environment.
4. To grow skills in managing and implementing a project.

A multidisciplinary project in the areas of manufacturing and quality control of pharmaceutical products to be taken up by a team of students. By using the knowledge gained during the semester, the students will initiate creativity in developing a minor project. A combined report is to be submitted. A presentation is to be made for the reviewers on the work done by the candidate.

**COURSE OUTCOMES:**

The student will be able to:

1. Perform creatively and correlate the subjects learnt so far.
2. Conceptualise a simple engineering problem.
3. Understand the ways of executing a multi-disciplinary problem
4. Exhibit interpretational skills