Dr.M.G.R.
Educational and Research Institute
(DEEMED TO BE UNIVERSITY)
(An ISO Certified Institution)
University with Graded Autonomy Status
Maduravoyal , Chennai - 600 095

# DEPARTMENT OF CHEMICAL ENGINEERING

## B.Tech –Chemical Engineering (Full Time)

## Curriculum and Syllabus

## 2018 Regulation

| I SEMESTER | | | | | | | |
|---|---|---|---|---|---|---|---|
| **S.NO.** | **SUBJECT CODE** | **SUBJECT NAME** | **Ty / Lb/ ETL** | **L** | **T / SLr** | **P/ R** | **C** |
| 1 | BEN18001 | Technical English –I | Ty | 1 | 0/0 | 2/0 | 2 |
| 2 | BMA18001 | Mathematics – I | Ty | 3 | 1/0 | 0/0 | 4 |
| 3 | BPH18001 | Engineering Physics –I | Ty | 2 | 0/1 | 0/0 | 3 |
| 4 | BCH18001 | Engineering Chemistry –I | Ty | 2 | 0/1 | 0/0 | 3 |
| 5 | BES18001 | Basic Electrical & Electronics Engineering | Ty | 2 | 0/1 | 0/0 | 3 |
| 6 | BES18002 | Basic Mechanical & Civil Engineering | Ty | 2 | 0/1 | 0/0 | 3 |
| **PRACTICALS*** | | | | | | | |
| 1 | BES18L01 | Basic Engineering Workshop | Lb | 0 | 0/0 | 2/0 | 1 |
| 2 | BES18ET1 | Orientation To Entrepreneurship & Project Lab | ETL | 0 | 0/0 | 2/0 | 1 |

**Credits Sub Total: 20**

| II SEMESTER | | | | | | | |
|---|---|---|---|---|---|---|---|
| **S.NO.** | **SUBJECT CODE** | **SUBJECT NAME** | **Ty / Lb/ ETL** | **L** | **T / SLr** | **P/ R** | **C** |
| 1 | BMA18003 | Mathematics – II | Ty | 3 | 1/0 | 0/0 | 4 |
| 2 | BPH18002 | Engineering Physics –II | Ty | 2 | 0/1 | 0/0 | 3 |
| 3 | BCH18002 | Engineering Chemistry – II | Ty | 2 | 0/1 | 0/0 | 3 |
| 4 | BES18003 | Environmental Science* | Ty | NON CREDIT COURSE | | | |
| **PRACTICALS*** | | | | | | | |
| 1 | BEN18ET1 | Communication Lab | ETL | 1 | 0/0 | 2/0 | 1 |
| 2 | BES18ET2 | Basic Engineering Graphics | ETL | 1 | 0/0 | 2/0 | 2 |
| 3 | BES18L02 | Integrated Physical Science Lab | Lb | 0 | 0/0 | 2/0 | 1 |
| 4 | BES18ET3 | C Programming and Lab | ETL | 1 | 0/0 | 2/0 | 2 |

**Credits Sub Total: 16**
**TOTAL CREDITS: 36**

C: Credits L: Lecture T: Tutorial S.Lr: Supervised Learning P: Problem / Practical R: Research
Ty/Lb/ETL: Theory /Lab/Embedded Theory and Lab * Internal Evaluation

## DEPARTMENT OF CHEMICAL ENGINEERING

| III SEMESTER | | | | | | | |
|---|---|---|---|---|---|---|---|
| **S.NO.** | **SUBJECT CODE** | **SUBJECT NAME** | **Ty / Lb/ ETL** | **L** | **T / SLr** | **P/ R** | **C** |
| 1 | BMA18009 | Mathematics III For Chemical Engineers | Ty | 3 | 1/0 | 0/0 | 4 |
| 2 | BCT18007 | Mechanical Operations | Ty | 3 | 1/0 | 0/0 | 4 |
| 3 | BCT18005 | Chemical Technology | Ty | 3 | 0/0 | 0/0 | 3 |
| 4 | BCT18003 | Chemical Engineering Thermodynamics | Ty | 3 | 0/0 | 0/0 | 3 |
| 5 | BCE18I04 | Environmental Engineering | Ty | 3 | 0/0 | 0/0 | 3 |
| **PRACTICALS*** | | | | | | | |
| 1 | BCT18L01 | Technical Analysis Lab I | Lb | 0 | 0/0 | 3/0 | 1 |
| 2 | BCT18L03 | Mechanical Operation Lab | Lb | 0 | 0/0 | 3/0 | 1 |
| 3 | BCE18IL1 | Environmental Engineering Lab | Lb | 0 | 0/0 | 3/0 | 1 |

**Credits Sub Total: 20**

| IV SEMESTER | | | | | | | |
|---|---|---|---|---|---|---|---|
| **S.NO.** | **SUBJECT CODE** | **SUBJECT NAME** | **Ty / Lb/ ETL** | **L** | **T / SLr** | **P/ R** | **C** |
| 1 | BCT18004 | Process Control And Dynamics | Ty | 3 | 1/0 | 0/0 | 4 |
| 2 | BCT18008 | Chemical Process Calculation | Ty | 3 | 1/0 | 0/0 | 4 |
| 3 | BCT18006 | Fluid Mechanics | Ty | 3 | 0/0 | 0/0 | 3 |
| 4 | BCS18I03 | Computer Application In Chemical Engineering | Ty | 3 | 0/0 | 0/0 | 3 |
| 5 | BHS18NC1/ BHS18NC2 | The Indian Constitution*/ The Indian Traditional Knowledge* | Ty | 2 | 0/0 | 0/0 | NC |
| **PRACTICALS*** | | | | | | | |
| 1 | BCT18ET1 | Fertilizer Technology | ETL | 1 | 0/1 | 3/0 | 3 |
| 2 | BCT18L02 | Technical Analysis Lab II | Lb | 0 | 0/0 | 3/0 | 1 |
| 3 | BCT18L04 | Process Simulation Software(CHEM CAD) | Lb | 0 | 0/0 | 3/0 | 1 |
| 4 | BCS18IL3 | Computer Programming Lab | Lb | 0 | 0/0 | 3/0 | 1 |
| 5 | BCT18TS1 | Technical Skill 1 | Lb | 0 | 0/0 | 3/0 | 1 |
| 6 | BEN18SK1 | Soft Skill I (Career & Confidence Building) | ETL | 0 | 0/0 | 3/0 | 1 |

**Credits Sub Total: 22**

C: Credits L: Lecture T: Tutorial S.Lr: Supervised Learning P: Problem / Practical
R: Research Ty/Lb/ETL: Theory /Lab/Embedded Theory and Lab * Internal Evaluation

## DEPARTMENT OF CHEMICAL ENGINEERING

| V SEMESTER | | | | | | | |
|---|---|---|---|---|---|---|---|
| **S.NO.** | **SUBJECT CODE** | **SUBJECT NAME** | **Ty / Lb/ ETL** | **L** | **T / SLr** | **P/ R** | **C** |
| 1 | BCT18013 | Mass Transfer I | Ty | 3 | 1/0 | 0/0 | 4 |
| 2 | BBT18I01 | Bio-Chemical Principles | Ty | 3 | 0/0 | 0/0 | 3 |
| 3 | BXX18EXX | Elective I | Ty | 3 | 0/0 | 0/0 | 3 |
| 4 | BXX18OEX | Open Elective | Ty | 3 | 0/0 | 0/0 | 3 |
| **PRACTICALS*** | | | | | | | |
| 1 | BCT18ET2 | Polymer Technology | ETL | 1 | 0/1 | 3/0 | 3 |
| 2 | BCT18L05 | Fluid Mechanics Lab | Lb | 0 | 0/0 | 3/0 | 1 |
| 3 | BCT18L06 | Process Control Lab | Lb | 0 | 0/0 | 3/0 | 1 |
| 4 | BBT18IL1 | Biochemical Lab For Chemical Engineers | Lb | 0 | 0/0 | 3/0 | 1 |
| 5 | BCT18TS2 | Technical Skill 2 | Lb | 0 | 0/0 | 3/0 | 1 |

**Credits Sub Total: 20**

| VI SEMESTER | | | | | | | |
|---|---|---|---|---|---|---|---|
| **S.NO.** | **SUBJECT CODE** | **SUBJECT NAME** | **Ty / Lb/ ETL** | **L** | **T / SLr** | **P/ R** | **C** |
| 1 | BCT18014 | Mass Transfer II | Ty | 3 | 1/0 | 0/0 | 4 |
| 2 | BCT18009 | Heat Transfer | Ty | 3 | 1/0 | 0/0 | 4 |
| 3 | BXX18EXX | Elective II | Ty | 3 | 0/0 | 0/0 | 3 |
| 4 | BXX18OEX | Open Elective | Ty | 3 | 0/0 | 0/0 | 3 |
| **PRACTICALS*** | | | | | | | |
| 1 | BCT18ET4 | Chemical Process Equipment Design & Drawing Lab | ETL | 1 | 0/1 | 3/0 | 3 |
| 2 | BCT18L07 | Mass Transfer Lab | Lb | 0 | 0/0 | 3/0 | 1 |
| 3 | BCT18L08 | Heat Transfer Lab | Lb | 0 | 0/0 | 3/0 | 1 |
| 4 | BEN18SK2 | Soft Skill II (Qualitative and Quantitative Skills) | ETL | 0 | 0/0 | 3/0 | 1 |
| 5 | BCT18L09 | Mini Project/In plant Training/Industrial training | Lb | 0 | 0/0 | 3/0 | 1 |
| 6 | BCT18TS3 | Technical Skill 3 | Lb | 0 | 0/0 | 3/0 | 1 |

**Credits Sub Total: 22**

C: Credits L: Lecture T: Tutorial S. Lr : Supervised Learning P : Problem / Practical

R : Research Ty/Lb/ETL: Theory/Lab/Embedded Theory and Lab * Internal evaluation

## DEPARTMENT OF CHEMICAL ENGINEERING

| VII SEMESTER | | | | | | | |
|---|---|---|---|---|---|---|---|
| **S.NO.** | **SUBJECT CODE** | **SUBJECT NAME** | **Ty / Lb/ ETL** | **L** | **T / SLr** | **P/ R** | **C** |
| 1 | BCT18010 | Chemical Reaction Engineering | Ty | 3 | 1/0 | 0/0 | 4 |
| 2 | BCT18011 | Transport Phenomena | Ty | 3 | 0/0 | 0/0 | 3 |
| 3 | BXX18EXX | Elective III | Ty | 3 | 0/0 | 0/0 | 3 |
| 4 | BMG18001 | Total Quality Management for Chemical Engineers | Ty | 3 | 0/0 | 0/0 | 3 |
| **PRACTICALS*** | | | | | | | |
| 1 | BCT18ET3 | Petroleum Technology | ETL | 1 | 0/1 | 3/0 | 3 |
| 2 | BCT18L10 | Instrumental Methods of Analysis Lab | Lb | 0 | 0/0 | 3/0 | 1 |
| 3 | BCT18L11 | Chemical Reaction Engineering Lab | Lb | 0 | 0/0 | 3/0 | 1 |
| 4 | BCT18L12 | Project Phase – 1 | Lb | 0 | 0/0 | 3/3 | 2 |
| 5 | BHS18FLX | Foreign Language | Lb | 0 | 0/0 | 3/0 | 1 |
| 6 | BXX18OLX | Open Lab | Lb | 0 | 0/0 | 3/0 | 1 |

**Credits Sub Total: 22**

| VIII SEMESTER | | | | | | | |
|---|---|---|---|---|---|---|---|
| **S.NO.** | **SUBJECT CODE** | **SUBJECT NAME** | **Ty / Lb/ ETL** | **L** | **T / SLr** | **P/ R** | **C** |
| 1 | BCT18012 | Safety in Chemical Process Industries | Ty | 3 | 1/0 | 0/0 | 4 |
| 2 | BXX18EXX | Elective IV | Ty | 3 | 0/0 | 0/0 | 3 |
| 3 | BXX18EXX | Elective V | Ty | 3 | 0/0 | 0/0 | 3 |
| **PRACTICALS*** | | | | | | | |
| 1 | BCT18L13 | Project (Phase – II) | Lb | 0 | 0/0 | 12/12 | 8 |

**Credits Sub Total: 18**

C: Credits L: Lecture T: Tutorial S.Lr: Supervised Learning P: Problem / Practical R: Research
Ty/Lb/ETL: Theory /Lab/Embedded Theory and Lab * Internal Evaluation

**CREDIT SUMMARY**

**Semester 1 : 20**
**Semester 2 : 16**
**Semester 3 : 20**
**Semester 4 : 22**
**Semester 5 : 20**
**Semester 6 : 22**
**Semester 7 : 22**
**Semester 8 : 18**

**Total Credits : 160**

## ELECTIVES

| SEMESTER 5 | | | | | | | |
|---|---|---|---|---|---|---|---|
| **S.NO.** | **SUBJECT CODE** | **SUBJECT NAME** | **Ty / Lb/ ETL** | **L** | **T/ SLr** | **P/R** | **C** |
| 1 | BCT18E01 | Food Technology | Ty | 3 | 0/0 | 0/0 | 3 |
| 2 | BCT18E02 | Industry Pollution Prevention and Control | Ty | 3 | 0/0 | 0/0 | 3 |
| 3 | BCT18E03 | Chemistry of Polymer and Composite Materials | Ty | 3 | 0/0 | 0/0 | 3 |

| SEMESTER 6 | | | | | | | |
|---|---|---|---|---|---|---|---|
| **S.NO.** | **SUBJECT CODE** | **SUBJECT NAME** | **Ty/ Lb/ ETL** | **L** | **T/ SLr** | **P/R** | **C** |
| 1 | BCT18E04 | Green Chemistry and Engineering | Ty | 3 | 0/0 | 0/0 | 3 |
| 2 | BCT18E05 | Modern Separation Processes | Ty | 3 | 0/0 | 0/0 | 3 |
| 3 | BCT18E06 | Renewable Energy Engineering | Ty | 3 | 0/0 | 0/0 | 3 |

| SEMESTER 7 | | | | | | | |
|---|---|---|---|---|---|---|---|
| **S.NO.** | **SUBJECT CODE** | **SUBJECT NAME** | **Ty/ Lb/ ETL** | **L** | **T/ SLr** | **P/R** | **C** |
| 1 | BCT18E07 | Computational Fluid Dynamics | Ty | 3 | 0/0 | 0/0 | 3 |
| 2 | BCT18E08 | Frontiers Of Chemical Engineering | Ty | 3 | 0/0 | 0/0 | 3 |
| 3 | BCT18E09 | Industrial Management | Ty | 3 | 0/0 | 0/0 | 3 |
| 4 | BCT18E10 | Drugs And Pharmaceutical Technology | Ty | 3 | 0/0 | 0/0 | 3 |

| SEMESTER 8 | | | | | | | |
|---|---|---|---|---|---|---|---|
| **S.NO.** | **SUBJECT CODE** | **SUBJECT NAME** | **Ty/ Lb/ ETL** | **L** | **T/ SLr** | **P/R** | **C** |
| 1 | BCT18E11 | Professional Ethics In Engineering | Ty | 3 | 0/0 | 0/0 | 3 |
| 2 | BCT18E12 | Industrial Instrumentation | Ty | 3 | 0/0 | 0/0 | 3 |
| 3 | BCT18E13 | Process Optimization | Ty | 3 | 0/0 | 0/0 | 3 |

| OPEN ELECTIVES | | | | | | | |
|---|---|---|---|---|---|---|---|
| **S.NO.** | **SUBJECT CODE** | **SUBJECT NAME** | **Ty/ Lb/ ETL** | **L** | **T/ SLr** | **P/R** | **C** |
| 1 | BCT18OE1 | Fundamentals of Nanoscience | Ty | 3 | 0/0 | 0/0 | 3 |
| 2 | BCT18OE2 | Electrochemical Engineering | Ty | 3 | 0/0 | 0/0 | 3 |
| 3 | BCT18OE3 | Alternative Fuels And Energy System | Ty | 3 | 0/0 | 0/0 | 3 |
| 4 | BCT18OE4 | Petrochemical Unit Processes | Ty | 3 | 0/0 | 0/0 | 3 |
| 5 | BCT18OE5 | Principles of Desalination Technologies | Ty | 3 | 0/0 | 0/0 | 3 |
| 6 | BCT18OE6 | Piping Design Engineering | Ty | 3 | 0/0 | 0/0 | 3 |
| 7 | BCT18OE7 | E-Waste Management | Ty | 3 | 0/0 | 0/0 | 3 |

| OPEN LAB | | | | | | | |
|---|---|---|---|---|---|---|---|
| **S.NO.** | **SUBJECT CODE** | **SUBJECT NAME** | **Ty/ Lb/ ETL** | **L** | **T/ SLr** | **P/R** | **C** |
| 1 | BCT18OL1 | Chemical Separation Lab | Lb | 0 | 0/0 | 3/0 | 1 |
| 2 | BCT18OL2 | Chemical Composition Analysis Lab | Lb | 0 | 0/0 | 3/0 | 1 |
| 3 | BCT18OL3 | Alternate Fuel Lab | Lb | 0 | 0/0 | 3/0 | 1 |
| 4 | BCT18OL4 | Food Testing Laboratory | Lb | 0 | 0/0 | 3/0 | 1 |

**SEMESTER - I (THEORY)**

| Subject Code : BEN18001 | Subject Name : Technical English - I | Ty / Lb/ ETL | L | T / SLr | P/ R | C |
|---|---|---|---|---|---|---|
| | Prerequisite : None | Ty | 1 | 0/0 | 2/0 | 2 |

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory / Lab / Embedded Theory and Lab

**OBJECTIVES :**

- Strengthen their vocabulary in both technical and business situations
- Get practice in functional grammar
- Learn the effective way of corresponding with officials
- Learn to give instructions, suggestions, recommendations and comprehend and infer the information from the given passages.
- Train learners in organized academic and professional writing

**COURSE OUTCOMES (Cos) : (3 – 5)**

Students completing the course would be able to

| | |
|---|---|
| **CO1** | Strengthen their active and technical vocabulary |
| **CO2** | Understand functional grammar and gain proficiency in technical writing |
| **CO3** | Learn the appropriate technique of writing formal and business letters; interpret the advertisements and prepare the resume relevantly |
| **CO4** | Learn to give instructions, suggestions, recommendations and comprehend and infer the information from the given passages/ reports |
| **CO5** | Focus on academic and technical writing |

**Mapping of Course Outcomes with Program Outcomes (POs)**

| COs/POs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | | | | H | | | | | | H | | H |
| CO2 | | | | H | | | | | | H | | H |
| CO3 | | | | H | | M | | | H | H | | H |
| CO4 | | | | H | | | | | H | H | | H |
| CO5 | | | | H | | | | | H | H | | H |

**H/M/L indicates strength of correlation H – High, M – Medium, L – Low**

| Category | Basic Sciences | Engg Sciences | Humanities & Social Sciences | Program core | Program Electives | Open Electives | Practical / Project | Internships / Technical Skills | Soft Skills |
|---|---|---|---|---|---|---|---|---|---|
| | | | √ | | | | | | |

| BEN18001 | TECHNICAL ENGLISH - I | 1 | 0/0 | 2/0 | 2 |
|---|---|---|---|---|---|

**UNIT I VOCABULARY BUILDING 6HRS**

The concept of Word Formation-Root words and affixes from foreign languages and their use in English to form derivatives.-Homophones- Words often confused-Verbal analogy

**UNIT II BASIC WRITING SKILLS 6HRS**

Using Idioms and phrases in sentences-Sentence structures: statements, interrogative and imperative-Use of Conditional/if' clauses in sentences-Importance of proper punctuation-Creating coherence with sentence markers-Organizing coherent paragraphs in essays

**UNIT III IDENTIFYING COMMON ERRORS IN WRITING 6 HRS**

Subject-verb agreement-Noun-pronoun agreement- Misplaced modifiers-Articles-Prepositions- Redundancies and Clichés

**UNIT IV WRITING PRACTICE- NATURE AND STYLE OF TECHNICAL WRITING 6HRS**

Describing Gadgets- Defining Concepts-Classifying data-Comprehension-Essay Writing-Informal and Formal Letter Writing:

**UNIT V ORAL COMMUNICATION AND INTERACTIVE LEARNING 6HRS**

(This unit involves interactive practice sessions in Language Lab)

Activities to develop knowledge in Word formation, Vocabulary and analytical thinking-Instructions and –Recommendations-Formal and Informal Registers in Speech-Listening and taking notes

**Total no. of periods : 30Hrs**

**TEXT BOOK:**

1. *Quest : A Textbook of Communication Skills, Vijay Nicole, 2017.*
2. *Pushkala, R, Padmasani Kannan S, Anuradha V, Chandrasena M Rajeswaran*

**SUGGESTED READINGS:**

1. *Practical English Usage. Michael Swan. OUP. 1995.*
2. *Remedial English Grammar. F.T. Wood. Macmillan.2007 (iii)On Writing Well. William Zinsser. Harper Resource Book. 2001*
3. *Study Writing. Liz Hamp-Lyons and Ben Heasly. Cambridge University Press. 2006.*
4. *Communication Skills. Sanjay Kumar and Pushp Lata. Oxford University Press. 2011.*
5. *Exercises in Spoken English. Parts. I-III. CIEFL, Hyderabad. Oxford University Press*
6. *Pronunciation in Use ,Mark Hancock. Cambridge University Press. 2012*

| Subject Code : BMA18001 | Subject Name : Mathematics – I | L | T / SLr | P/ R | C |
|---|---|---|---|---|---|
| | Prerequisite : None | 3 | 1/0 | 0/0 | 4 |

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory / Lab / Embedded Theory and Lab

**OBJECTIVES :**

- Apply the Basic concepts in Algebra
- Use the Basic concepts in Matrices
- Identify and solve problems in Trigonometry
- Understand the Basic concepts in Differentiation
- Apply the Basic concepts in Functions of Several variables

**COURSE OUTCOMES (Cos) : (3 – 5)**
Students completing the course were able to

| | |
|---|---|
| **CO1** | Find the summation of the given series of binomial, exponential & logarithmic |
| **CO2** | Transform a non – diagonal matrix into an equivalent diagonal matrix using orthogonal transformation. |
| **CO3** | Find expansion of trigonometric function into an infinite series and to separate a complex function into real and imaginary parts. |
| **CO4** | Apply knowledge and concepts in finding the derivative of given function and to find the maxima / minima of the given function. |
| **CO5** | Evaluate the partial / total differentiation and maxima / minima of a function of several variables. |

**Mapping of Course Outcomes with Program Outcomes (POs)**

| COs/POs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | H | H | | | M | M | | | H | H | | H |
| CO2 | H | H | | | H | L | | | | | | H |
| CO3 | H | H | | | M | | | | M | H | | L |
| CO4 | H | H | | | L | | | | M | H | | M |
| CO5 | H | H | | | | M | | | M | M | | H |

**H/M/L indicates strength of correlation H – High, M – Medium, L – Low**

| Category | Basic Sciences | Engg Sciences | Humanities & Social Sciences | Program core | Program Electives | Open Electives | Practical / Project | Internships / Technical Skills | Soft Skills |
|---|---|---|---|---|---|---|---|---|---|
| | √ | | | | | | | | |

| BMA18001 | MATHEMATICS – I | 3 | 1/0 | 0/0 | 4 |
|---|---|---|---|---|---|

**UNIT I ALGEBRA 12HRS**

Binomial, Exponential, Logarithmic Series (without proof of theorems) – Problems on Summation, Approximation and Coefficients.

**UNIT II MATRICES 12HRS**

Characteristic equation – Eigen values and Eigen vectors of a real matrix – Properties of Eigen values – Cayley - Hamilton theorem(without proof) – Orthogonal reduction of a symmetric matrix to Diagonal form.

**UNIT III TRIGONOMETRY 12HRS**

Expansions of Sin nθ, Cos nθ in powers of Sinθ and Cosθ – Expansion of Tan nθ – Expansions of $\text{Sin}^n\theta$ and $\text{Cos}^n\theta$ in terms of Sines and Cosines of multiples of θ – Hyperbolic functions – Separation into real and imaginary parts.

**UNIT IV DIFFERENTIATION 12HRS**

Basic concepts of Differentiation – Elementary differentiation methods – Parametric functions – Implicit function – Leibnitz theorem(without proof) – Maxima and Minima – Points of inflection.

**UNIT V FUNCTIONS OF SEVERAL VARIABLES 12HRS**

Partial derivatives – Total differential – Differentiation of implicit functions – Taylor's expansion – Maxima and Minima by Lagrange's Method of undetermined multipliers – Jacobians.

**Total no. of periods : 60Hrs**

**TEXT BOOKS**

1. *Kreyszig E., Advanced Engineering Mathematics (10 th ed.), John Wiley & Sons, (2011).*
2. *Veerarajan T., Engineering Mathematics (for first year), Tata McGraw Hill Publishing Co., (2008).*

**REFERENCES**

1. *Grewal B.S., Higher Engineering Mathematics, Khanna Publishers, (2012).*
2. *John Bird, Basic Engineering Mathematics (5th ed.), Elsevier Ltd, (2010).*
3. *P.Kandasamy, K.Thilagavathy and K. Gunavathy, Engineering Mathematics Vol. I (4th Revised ed.), S.Chand& Co., Publishers, New Delhi (2000).*
4. *John Bird, Higher Engineering Mathematics (5th ed.), Elsevier Ltd, (2006).*

| Subject Code : BPH18001 | Subject Name : Engineering Physics - I | L | T / SLr | P/ R | C |
|---|---|---|---|---|---|
| | Prerequisite : None | 2 | 0/1 | 0/0 | 3 |

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory / Lab / Embedded Theory and Lab

**OBJECTIVES :**

- Outline the relation between Science, Engineering & Technology.
- Demonstrate competency in understanding basic concepts.
- Apply fundamental laws of Physics in Engineering & Technology.
- To identify & solve problems using physics concepts.
- Produce and present activities associated with the course through effective technical communication

**COURSE OUTCOMES (Cos) : (3 – 5)**
Students completing this course were able to

| | |
|---|---|
| **CO1** | Demonstrate competency in understanding basic concepts. |
| **CO2** | Utilize scientific methods for formal investigations & demonstrate competency with experimental methods and verify the concept to content knowledge. |
| **CO3** | Identify and provide solutions for engineering problems. |
| **CO4** | Relate the technical concepts to day to day life and to practical situations. |
| **CO5** | Think analytically to interpret concepts. |

**Mapping of Course Outcomes with Program Outcomes (POs)**

| COs/POs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | H | H | | M | M | M | | | | | | |
| CO2 | H | H | M | M | M | M | | | M | M | | |
| CO3 | H | H | H | M | M | M | | | | M | | M |
| CO4 | H | H | M | M | | M | | | M | M | | M |
| CO5 | H | H | M | | | M | | M | | | | L |

**H/M/L indicates strength of correlation H – High, M – Medium, L – Low**

| Category | Basic Sciences | Engg Sciences | Humanities & Social Sciences | Program core | Program Electives | Open Electives | Practical / Project | Internships / Technical Skills | Soft Skills |
|---|---|---|---|---|---|---|---|---|---|
| | √ | | | | | | | | |

| BPH18001 | ENGINEERING PHYSICS – I | 2 | 0/1 | 0/0 | 3 |
|---|---|---|---|---|---|

**UNIT I MECHANICS & PROPERTIES OF MATTER 9HRS**

**Mechanics** : Introduction- scalar and vector quantities - rigid body - moment of inertia - forces in nature - Newton's laws of motion - derivation of Newton's second law of motion - motion of rocket – dynamical concepts - kinematics - conservation of energy and momentum - conservative and non-conservative forces - mechanics of continuous media - friction and its applications.

**Properties of Matter:** Elasticity - stress, strain and Hook's law - Poisson's ratio - three moduli of elasticity - twisting couple on a wire - viscosity - flow of liquid through a narrow tube: Poiseuille's law - Ostwald`s viscometer- flow of blood in human body.

**UNIT II SHM AND ACOUSTICS 9HRS**

**SHM**: Simple harmonic motion - differential equation of SHM - graphical representation of SHM - average kinetic energy of vibration - total energy of vibration - free and forced vibrations - damped and undamped vibrations - resonance - transverse wave on a string - law of transverse vibration of string - verification of the laws of transverse vibration of string - standing waves.

**Acoustics :** Fundamentals of acoustics - reverberation- reverberation time - factors affecting acoustics Ultrasonics - Production of ultrasonic waves - detection of ultrasonic waves - acoustic grating - application of ultrasonic waves.

**UNIT III WAVE OPTICS 9HRS**

Huygen`s principle - interference of light - wavefront splitting and amplitude - airwedge - Newton`s rings - Michelson interferometer and its applications - Fraunhofer diffraction from a single slit - Rayleigh criterion for limit of resolution - diffraction grating and resolving power of a telescope.

**UNIT IV ELECTROMAGNETIC THEORY 9HRS**

Electric field - coulomb`s law - alternating emf - rms and average value of an alternating current & voltage - resistors, capacitors and inductor - energy stored in a capacitor - LCR circuit & resonance – magnetism- definition - types - Biot Savart law - energy stored in a magnetic field - Domain theory - electromagnetic induction - self and mutual inductance - Faraday`s law of electromagnetic induction -Lenz law.

**UNIT V LASER 9HRS**

Laser principle and characteristics - amplification of light by population inversion - properties of laser beams: mono-chromaticity, coherence, directionality and brightness - different types of lasers - Ruby laser-Nd-YAG laser- He-Ne laser-$CO_2$ laser - semiconductor laser - applications of lasers in science, engineering and medicine.

**Total No of Periods : 45HRS**

**TEXT BOOKS**

1. *Brijlal, M. N. Avadhanulu & N. Subrahmanyam, Text Book of Optics, S. Chand Publications, 25th edition, 2012*
2. *R. Murugeshan, Electricity and Magnetism, S.Chand Publications, 10th edition, 2017*
3. *R. Murugeshan & Kiruthiga Sivaprasath, Modern Physics, S.Chand Publications, 2016*

**REFERENCE BOOKS**

1. *Dr. Senthil Kumar Engineering Physics I VRB Publishers, 2016*
2. *N Subrahmanyam & Brijlal, Waves and Oscillations, Vikas Publications, New Delhi,1988*
3. *N Subrahmanyam & Brijlal, Properties of Matter, S. Chand Co., New Delhi, 1982*
4. *N Subrahmanyam & Brijlal, Text book of Optics, S. Chand Co., New Delhi, 1989*
5. *R. Murugeshan, Electricity and Magnetism, S.Chand & Co., New Delhi, 1995*
6. *Thygarajan K & Ajay Ghatak, Laser Theory and Applications, Macmillan, New Delhi, 1981*

| Subject Code : BCH18001 | Subject Name : Engineering Chemistry-I | L | T / SLr | P/ R | C |
|---|---|---|---|---|---|
| | Prerequisite : None | 2 | 0/1 | 0/0 | 3 |

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits T/L/ETL : Theory / Lab / Embedded Theory and Lab

**OBJECTIVES :**

- Providing an insight into basic concepts of chemical thermodynamics.
- To create awareness about the water quality parameters, water analysis and softening of water from industrial perspective.
- Imparting fundamentals of emf, storage and fuel cells.
- Creating awareness about corrosion and its control methods.
- Introducing modern materials such as composites along with basic concepts of polymer chemistry and plastics.

**COURSE OUTCOMES (Cos) : (1– 5)**

| | |
|---|---|
| **CO1** | Gain a clear understanding of the basics of chemical thermodynamics which include concepts such as Enthalpy, Entropy and Free energy. |
| **CO2** | Obtain an overall idea of Water quality parameters, Boiler requirements, problems, Water softening and Domestic Water treatment. |
| **CO3** | Improving the basic knowledge in electrical conductance and emf and also understand the chemical principles of storage devices. |
| **CO4** | Observe the information about corrosion and understand the mechanisms of corrosion and the methods of corrosion control. |
| **CO5** | Articulate the science of polymers and composites. |

**Mapping of Course Outcomes with Program Outcomes (POs)**

| COs/POs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | H | H | | | | | | | | | | M |
| CO2 | H | H | M | H | | H | H | | | | | M |
| CO3 | H | M | H | | | | L | | | | | L |
| CO4 | H | | L | H | | | | | | | | L |
| CO5 | H | | | | | | | | | | | M |

**H/M/L indicates strength of correlation H – High, M – Medium, L – Low**

| Category | Basic Sciences | Engg Sciences | Humanities & Social Sciences | Program core | Program Electives | Open Electives | Practical / Project | Internships / Technical Skills | Soft Skills |
|---|---|---|---|---|---|---|---|---|---|
| | √ | | | | | | | | |

| BCH18001 | ENGINEERING CHEMISTRY – I | 2 | 0/1 | 0/0 | 3 |
|---|---|---|---|---|---|

**UNIT I CHEMICAL THERMODYNAMICS 8HRS**

Introduction, Terminology in thermodynamics –System, Surrounding, State and Path functions, Extensive and intensive properties. Laws of thermodynamics – I and II laws-Need for the II law. Enthalpy, Entropy, Gibbs free energy, Helmholtz free energy - Spontaneity and its criteria. Maxwell relations, Gibbs -Helmholtz equation (relating E & A) and (relating H & G), Van't Hoff equations.

**UNIT II TECHNOLOGY OF WATER 9HRS**

Water quality parameters – Definition and expression. Analysis of water – alkalinity, hardness and its determination (EDTA method only). Boiler feed water and Boiler troubles-Scales and sludges, Caustic embrittlement, Priming and Foaming and Boiler corrosion. Water softening processes – Internal and external conditioning – Lime soda, Zeolite, Demineralisation methods. Desalination processes-RO and Electrodialysis
.Domestic water treatment.

**UNIT III ELECTROCHEMISTRY AND ENERGY STORAGE DEVICES 10HRS**

Conductance – Types of conductance and its Measurement. Electrochemical cells – Electrodes and electrode potential, Nernst equation – EMF measurement and its applications. Types of electrodes- Reference electrodes-Standard hydrogen electrode- Saturated calomel electrode-Quinhydrone electrode – Determination of $P^H$ using these electrodes. Reversible and irreversible cells– Fuel cells- $H_2$–$O_2$ fuel cell, Batteries-Lead storage battery,Nickel–Cadmium and Lithium-Battery.

**UNIT IV CORROSION AND PROTECTIVE COATING 9HRS**

Introduction–Causes of Corrosion–Consequences- Factors affecting corrosion. Theories of corrosion-Chemical corrosion and Electrochemical corrosion. Methods of corrosion control – corrosion inhibitors, Sacrificial anode and Impressed current cathodic protection. Protective coatings- Metallic coatings- Chemical conversion coatings-paints-Constituents and functions.

**UNIT V POLYMERS AND COMPOSITES 9HRS**

Monomers – Functionality – Degree of polymerization-Tacticity.Polymers – Classification, Conducting Polymers,Biodegradable polymers- Properties and applications.Plastics – Thermoplastics and thermosetting plastics,Compounding of plastics – Compression moulding, injection moulding and extrusion processes. Polymer composites-introduction-Types of composites-particle reinforced-fiber reinforced-structural composites-examples. Matrix materials, reinforcement materials-Kevlar, Polyamides, fiber glass, carbon fibers, ceramics and metals .

**Total number of periods : 45Hrs**

**TEXTBOOKS**

1. *S.Nanjundan & C.SreekuttanUnnithan, "Applied Chemistry", Sreelakshmi Publications, (2007)*
2. *Dr.R.Sivakumar and Dr.N.Sivakumar" Engineering Chemistry" Tata McGraw Hill Publishing Company Ltd, Reprint 2013.*

**REFERENCES**

1. *P.C. Jain & Monika Jain, "Engineering Chemistry", Dhanpat Rai publishing Co., (Ltd.) (2013).*
2. *J. C. Kuriacose & J. Rajaram, "Chemistry in Engineering & Technology", Tata Mc Graw Hill (1996).*
3. *B.R.Puri, L.R.Sharma & M.S.Pathania, "Principles of Physical Chemistry", Vishal publishing co., (2013).*

| Subject Code : BES18001 | Subject Name : Basic Electrical & Electronics Engineering | L | T / SLr | P/ R | C |
|---|---|---|---|---|---|
| | Prerequisite : None | 2 | 0/1 | 0/0 | 3 |

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory / Lab / Embedded Theory and Lab

**OBJECTIVES :**

- Understand the concepts of circuit elements, circuit laws and coupled circuits.
- Acquire knowledge on conventional &non conventional energy production.
- Gain information on measurement of electrical parameters.
- Identify basic theoretical principles behind the working of modern electronic gadgets.
- Demonstrate digital electronic circuits and assemble simple devices.

**COURSE OUTCOMES (Cos) : (3 – 5)**
Students completing the course were able to

| | |
|---|---|
| **CO1** | Students understand Fundamental laws and theorems and their practical applications |
| **CO2** | Predict the behavior of different electric and magnetic Circuits. |
| **CO3** | Identify conventional and Non-conventional Electrical power Generation, Transmission and Distribution. |
| **CO4** | Identify & Apply schematic symbols and understand the working principles of electronic devices |
| **CO5** | Analyze basics of digital electronics and solving problems and design combinational circuits |

**Mapping of Course Outcomes with Program Outcomes (POs)**

| COs/POs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | **H** | **H** | **H** | **H** | | | | | | | **M** | **L** |
| **CO2** | **H** | **H** | **H** | **M** | **M** | | **M** | | | | **M** | |
| **CO3** | **H** | **M** | **H** | **M** | **H** | | **M** | | **M** | | | **L** |
| **CO4** | **H** | **M** | | **M** | | | **M** | | | | **M** | **L** |
| **CO5** | **H** | **M** | **H** | **M** | **H** | | | | **M** | | **M** | **L** |

**H/M/L indicates strength of correlation H – High, M – Medium, L – Low**

| Category | Basic Sciences | Engg Sciences | Humanities & Social Sciences | Program core | Program Electives | Open Electives | Practical / Project | Internships / Technical Skills | Soft Skills |
|---|---|---|---|---|---|---|---|---|---|
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| BES18001 | BASIC ELECTRICAL & ELECTRONICS ENGINEERING | 2 | 0/1 | 0/0 | 3 |
|---|---|---|---|---|---|

**UNIT I ELECTRIC CIRCUITS 9HRS**

Electrical Quantities – Ohms Law – Kirchhoff's Law – Series and Parallel Connections – Current Division and Voltage Division Rule - Source Transformation – Wye (Y) – Delta (Δ) , Delta (Δ) – Wye (Y) Transformation – Rectangular to Polar and Polar to Rectangular.

**UNIT II MACHINES & MEASURING INSTRUMENTS 9HRS**

Construction & Principle of Operation of DC motor & DC Generator – EMF equation of Generator – Torque Equation of Motor – Construction & Principle of operation of a Transformer – PMMC – Moving Iron types of meter – Single Phase Induction Type Energy Meter.

**UNIT III BASICS OF POWER SYSTEM 9HRS**

Generation of Electric Power (Thermal, Hydro, Wind and Solar) – Transmission & Distribution of Electric Power – Types of Transmission & Distribution Schemes – Representation of Substation.

**UNIT IV ELECTRON DEVICES 9HRS**

Passive Circuit Components-Classification of Semiconductor-PN Junction Diode-Zener diode- Construction and Working Principle –Applications--BJT-Types of configuration-JFET.

**UNIT V DIGITAL SYSTEM 9HRS**

Number System – Binary, Decimal, Octal, Hexadecimal – Binary Addition Subtraction, Multiplication & Division– Boolean Algebra – Reduction of Boolean Expressions – Logic Gates - De-Morgan's Theorem , Adder – Subractor.

**Total no of Periods : 45HRS**

**TEXT BOOKS**

1. *D P Kothari, I J Nagrath, Basic Electrical Engineering, Second Edition, , Tata McGraw-Hill Publisher*
2. *A Course In Electrical And Electronic Measurements And Instrumentation,A.K. Sawhney, publisher DHANPAT RAI & CO*
3. *Text Book of Electrical Technology: Volume 3: Transmission, Distribution and Utilization,B.L.Theraja, A.K.Theraja, publisher S.CHAND*
4. *Morris Mano, M. (2002) Digital Logic and Computer Design. Prentice Hall of India*
5. *Millman and Halkias1991, Electronic Devices and Circuits , Tata McGraw Hill,*

**REFERENCES**

1. *R.Muthusubramanian, S.Salivahanan, K A Muraleedharan, Basic Electrical, Electronics And Computer Engineering, Second Edition, ,Tata McGraw-Hill publisher.*

| Subject Code : BES18002 | Subject Name : Basic Mechanical & Civil Engineering | L | T / SLr | P/ R | C |
|---|---|---|---|---|---|
| | **Prerequisite : None** | 2 | 0/1 | 0/0 | 3 |

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory / Lab / Embedded Theory and Lab

**OBJECTIVES :**

- Learn Basics of Internal Combustion Engines, power plants and boilers
- Demonstrate How metals are formed, joined, using machining operations Lathe, Milling and Drilling machines
- To identify & solve problems in Engineering Mechanics
- Learn basics of Building materials and construction
- Know the basic process of concrete, types of masonry Construction of Roads , Railways, Bridges and Dams

**COURSE OUTCOMES (Cos) : (3 – 5)**
Students completing the course were able to

| | |
|---|---|
| **CO1** | Demonstrate the working principles of power plants, IC Engines and boilers.. |
| **CO2** | Utilize the concept of metals forming, joining process and apply in suitable machining process |
| **CO3** | Identify and provide solutions for problems in engineering mechanics |
| **CO4** | Utilize the concept of Building materials and construction able to perform concrete mix and masonry types |
| **CO5** | Demonstrate how Roads, Railways, dams, Bridges have been constructed |

**Mapping of Course Outcomes with Program Outcomes (POs)**

| COs/POs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | **H** | | | | | **M** | | **H** | **H** | **H** | | **H** |
| **CO2** | **H** | | | | **L** | **M** | | **M** | **M** | **M** | | **M** |
| **CO3** | **H** | **H** | | | **L** | **L** | | **M** | **M** | **M** | | **M** |
| **CO4** | **H** | | | | **L** | **L** | | | **M** | **M** | | **M** |
| **CO5** | **H** | | | | **L** | **L** | | **M** | **M** | **M** | | **M** |

**H/M/L indicates strength of correlation H – High, M – Medium, L – Low**

| Category | Basic Sciences | Engg Sciences | Humanities & Social Sciences | Program core | Program Electives | Open Electives | Practical / Project | Internships / Technical Skills | Soft Skills |
|---|---|---|---|---|---|---|---|---|---|
| | | √ | | | | | | | |

| BES18002 | BASIC MECHANICAL & CIVIL ENGINEERING | 2 | 0/1 | 0/0 | 2 |
|---|---|---|---|---|---|

**UNIT I THERMAL ENGINEERING 9HRS**

Classification of internal combustion engine – two stroke, four stroke petrol and diesel engines. Classification of Boilers – Cochran boiler – Locomotive boilers – Power plant classification – Working of Thermal and Nuclear power plant.

**UNIT II MANUFACTURING PROCESS 13HRS**

Metal forming processes – Rolling, forging, drawing, extrusion and sheet metal operations- fundamentals only. Metal Joining processes – Welding - arc and gas welding, Soldering and Brazing. Casting process – Patterns - Moulding tools - Types of moulding - Preparation of green sand mould -Operation of Cupola furnace. Basics of metal cutting operations – Working of lathe- parts-Operations performed. Drilling machine – Classification – Radial drilling machine - Twist drill nomenclature.

**UNIT III MECHANICS 9HRS**

Stresses and Strains – Definition – Relationship – Elastic modulus – Centre of gravity – Moment of Inertia – Problems. (Simple Problems Only).

**UNIT IV BUILDING MATERIALS AND CONSTRUCTION 7HRS**

**Materials**:Brick - Types of Bricks - Test on bricks - Cement – Types, Properties and uses of cement – Steel - Properties and its uses – Ply wood and Plastics.

**Construction**:Mortar – Ingredients – Uses – Plastering - Types of mortar - Preparation – Uses – Concrete – Types – Grades – Uses – Curing – Introduction to Building Components (foundation to roof) – Masonry – Types of masonry (Bricks & Stones)

**UNIT V ROADS, RAILWAYS, BRIDGES & DAMS 7HRS**

Roads – Classification of roads – Components in roads – Railways -Components of permanent way and their function – Bridges – Components of bridges – Dams – Purpose of dams – Types of dams.

**Total No. of Periods : 45HRS**

**TEXT BOOKS**

1. *S. Bhaskar, S. Sellappan, H.N.Sreekanth,, (2002), "Basic Engineering" –Hi-Tech Publications*
2. *K. Venugopal, V. Prabhu Raja, (2013-14), "Basic Mechanical Engineering", Anuradha Publications.*
3. *K.V. Natarajan (2000), Basic Civil Engineering,Dhanalakshmi Publishers*
4. *S.C. Sharma(2002),Basic Civil Engineering,Dhanpat Raj Publications*

**REFERENCES**

1. *PR.SL. Somasundaram, (2002), "Basic Mechanical Engineering" –, Vikas Publications.*
2. *S.C. Rangawala(2002), Building Material and Construction, S. Chand Publisher*

**SEMESTER - I (PRACTICAL)**

| **Subject Code : BES18L01** | **Subject Name :Basic Engineering Workshop** | **L** | **T / SLr** | **P/ R** | **C** |
|---|---|---|---|---|---|
| | **Prerequisite : None** | 0 | 0/0 | 2/0 | 1 |

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory / Lab / Embedded Theory and Lab

**OBJECTIVES :**

- Familiarize the plumbing tools, fittings, carpentry tools, etc.
- Identify basic electrical wiring and measurement of electrical quantities.
- Identify Electronic components ,logic gates and soldering process
- Display simple fabrication techniques
- Execute a project independently and make a working model

**COURSE OUTCOMES (Cos) : (3 – 5)**
Students completing the course were able to

| | |
|---|---|
| **CO1** | Demonstrate fitting tools and carpentry tools, & Perform the process of Filing, Chipping, Cutting. |
| **CO2** | Perform the process of fabrication of tray, cones and funnels, Tee Halving Cross, Lap Joint Martise& Joints |
| **CO3** | Demonstrate various types of wirings and other equipments. |
| **CO4** | Measure fundamental parameters using the electronic instruments |

**Mapping of Course Outcomes with Program Outcomes (POs)**

| **COs/POs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | **H** | **H** | **H** | **M** | **M** | | | **L** | **M** | | | **L** |
| **CO2** | **H** | | **H** | **L** | **M** | | | **L** | **L** | | | |
| **CO3** | **H** | | **M** | **L** | | | | **L** | **L** | | | |
| **CO4** | **H** | **H** | **M** | **L** | | | | **L** | **L** | | | **M** |
| **CO5** | | | | | | | | | | | | |

**H/M/L indicates strength of correlation H – High, M – Medium, L – Low**

| Category | Basic Sciences | Engg Sciences | Humanities & Social Sciences | Program core | Program Electives | Open Electives | Practical / Project | Internships / Technical Skills | Soft Skills |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | √ | | |

| BES18L01 | BASIC ENGINEERING WORKSHOP | 0 | 0/0 | 2/0 | 1 |
|---|---|---|---|---|---|

## MEP PRACTICE

### 1. FITTING :

Study of fitting tools and Equipments – Practicing, filing, chipping and cutting – making V-joints, half round joint, square cutting and dovetail joints.

### 2. CARPENTRY:

Introduction – Types of wood – Tools – Carpentry processes – Joints – Planning practice – Tee Halving Joint – Cross Lap Joint – Maritse and Tenon Joint – Dovetail Joint

### 3. SHEET METAL:

Study of tools and equipments – Fabrication of tray, cones and funnels.

## CIVIL ENGINEERING PRACTICE

1. Study of Surveying and its equipments
2. Preparation of plumbing line sketches for water supply and sewage lines
3. Basic pipe connection using valves, laps, couplings, unions, reduces and elbows in house hold fittings

## ELECTRICAL ENGINEERING PRACTICE

1. Measurement of electrical quantities – voltage, current, power & power factor in RLC circuit.
2. Measurement of energy using single phase energy meter.
3. Measurement of resistance to earth of an electrical equipment.
4. Residential house wiring using switches, fuse, indicator, lamp and energy meter.
5. Fluorescent lamp wiring.
6. Stair case wiring

## ELECTRONIC ENGINEERING PRACTICE

1. Study of Electronic components and equipments – Resistor, colour coding measurement of AC signal parameter (peak- peak, rms period, frequency) using CRO
2. Soldering practice – Components Devices and Circuits – Using general purpose P

| Subject Code : BES18ET1 | Subject Name : Orientation To Entrepreneurship & Project Lab | L | T / SLr | P/ R | C |
|---|---|---|---|---|---|
| | **Prerequisite : None** | 0 | 0/0 | 2/0 | 1 |

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory / Lab / Embedded Theory and Lab

**OBJECTIVES :**

- Understand how entrepreneurship Education transforms individuals into successful leaders.
- Identify individual potential &S have career dreams
- Understand difference between ideas & opportunities
- Identify components & create action plan.
- Use brainstorming in a group to generate ideas.

**COURSE OUTCOMES (Cos) : (3 – 5)**
Students completing the course were able to

| | |
|---|---|
| **CO1** | Develop a Business plan & improve ability to recognize business opportunity |
| **CO2** | Do a self analysis to build a entrepreneurial career. |
| **CO3** | Articulate an effective elevator pitch. |
| **CO4** | Analyze the local market environment & demonstrate the ability to find an attractive market |
| **CO5** | Identify the required skills for entrepreneurship & develop |

**Mapping of Course Outcomes with Program Outcomes (POs)**

| COs/POs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | | M | M | H | M | M | M | | M | M | M | L |
| CO2 | H | M | | H | M | H | M | H | H | H | M | M |
| CO3 | | M | M | M | | H | | H | H | H | | |
| CO4 | | H | M | M | M | M | | H | M | M | H | |
| CO5 | | M | M | H | M | M | H | H | M | M | H | L |

**H/M/L indicates strength of correlation H – High, M – Medium, L – Low**

| Category | Basic Sciences | Engg Sciences | Humanities & Social Sciences | Program core | Program Electives | Open Electives | Practical / Project | Internships / Technical Skills | Soft Skills |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | ✓ | | |

| BES18ET1 | ORIENTATION TO ENTREPRENEURSHIP & PROJECT LAB | 0 0/0 2/0 1 |
|---|---|---|

**UNIT I CHARACTERISTICS OF A SUCCESSFUL ENTREPRENEUR**

Introduction to entrepreneurship education – Myths about entrepreneurship – How has entrepreneurship changed the country – Dream it. Do it - Idea planes - Some success stories – Global Legends – Identify your own heroes –

**UNITII ENTREPRENEURIAL STYLE**

Entrepreneurial styles – Introduction, concept & Different types - Barrier to Communication – Body language speaks louder than words

**UNIT III DESIGN THINKING**

Introduction to Design thinking – Myth busters – Design thinking Process - Customer profiling – Wowing your customer – Personal selling – concept & process – show & tell concept – Introduction to the concept of Elevator Pitch

**UNIT IV RISK MANAGEMENT**

Introduction to risk taking & Resilience – Managing risks (Learning from failures, Myth Buster) – Understanding risks through risk takers – Why do I do? – what do I do ?

**UNIT V PROJECT**

How to choose a topic – basic skill sets necessary to take up a project – creating a prototype – Pitch your project – Project presentation.

**Total No. of Periods : 15HRS**

**SEMESTER - II (THEORY)**

| Subject Code : BMA18003 | Subject Name : Mathematics – II | L | T / SLr | P/ R | C |
|---|---|---|---|---|---|
| | **Prerequisite : None** | 3 | 1/0 | 0/0 | 4 |

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory / Lab / Embedded Theory and Lab

**OBJECTIVES :**

- Understand the Basic concepts in Integration
- Identify the Basic concepts in Multiple integrals
- Use the Basic concepts in Ordinary Differential equations
- Apply the Basic concepts of Analytical Geometry
- Analyze the Basic concepts of Vector Calculus

**COURSE OUTCOMES (Cos) : (3 – 5)**
Students completing the course were able to

| | |
|---|---|
| **CO1** | Integrate given function by using methods of integration and to find the area under curve and the volume of a solid by revaluation. |
| **CO2** | Evaluate the multiple integrals / area /volume and to change the order of integration. |
| **CO3** | Solve the ordinary differential equation and to solve Eulers differential equation. |
| **CO4** | Find the equation of planes, lines and sphere and to find the shortest distance between to skew lines. |
| **CO5** | Find the gradient, maximum directional derivative and work done by a force and to verify Green/ Stokes/ Gauss divergence theorem |

**Mapping of Course Outcomes with Program Outcomes (POs)**

| COs/POs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | **H** | **H** | | | **M** | **M** | | | **M** | **M** | | **H** |
| **CO2** | **H** | **H** | | | **M** | **H** | | | **H** | **H** | | **M** |
| **CO3** | **H** | **H** | | | **M** | **H** | | | **H** | **H** | | **M** |
| **CO4** | **H** | **H** | | | **L** | **M** | | | **M** | **H** | | **M** |
| **CO5** | **H** | **H** | | | **M** | **M** | | | **M** | **H** | | **M** |

**H/M/L indicates strength of correlation H – High, M – Medium, L – Low**

| Category | Basic Sciences | Engg Sciences | Humanities & Social Sciences | Program core | Program Electives | Open Electives | Practical / Project | Internships / Technical Skills | Soft Skills |
|---|---|---|---|---|---|---|---|---|---|
| | √ | | | | | | | | |

| BMA18003 | MATHEMATICS – II | 3 1/0 0/0 4 |
|---|---|---|

**UNIT I INTEGRATION 12HRS**

Basic concepts of Integration – Methods of Integration– Integration by substitution – Integration by parts – Definite integrals– Properties of definite integrals – Problems on finding Area and Volume using single integrals (simple problems).

**UNIT II MULTIPLE INTEGRALS 12HRS**

Double integral in Cartesian and Polar Co-ordinates – Change of order of integration – Triple integral in Cartesian Co-ordinates – Spherical Polar Co-ordinates – Change of variables (simple problems).

**UNIT III ORDINARY DIFFERENTIAL EQUATIONS 12HRS**

First order differential equations – Second and higher order linear differential equations with constant coefficients and with RHS of the form: $e^{ax}$, $x^n$, Sin ax, Cos ax, $e^{ax}f(x)$, x f(x) where f(x) is Sin bx or Cos bx – Differential equations with variable coefficients (Euler's form) (simple problems).

**UNIT IV THREE DIMENSIONAL ANALYTICAL GEOMETRY 12HRS**

Direction Cosines and Ratios – Equation of a straight line – Angle between two lines – Equation of a plane – Co-planar lines – Shortest distance between skew lines – Sphere – Tangent plane.

**UNIT V VECTOR CALCULUS 12HRS**

Scalar and Vector functions – Differentiation – Gradient, Divergence and Curl – Directional derivatives – Irrotational and Solenoidal fields– Line, Surface and Volume integrals – Green's, Stoke's and Gauss divergence theorems (statement only) – Verification.

**Total no. of periods : 60HRS**

**TEXTBOOKS**

1. Kreyszig E., *Advanced Engineering Mathematics (10th ed.)*, John Wiley & Sons, (2011).
2. Veerarajan T., *Engineering Mathematics (for first year)*, Tata McGraw Hill Publishing Co., (2008).

**REFERENCES**

1. *Grewal B.S., Higher Engineering Mathematics, Khanna Publishers, (2012).*
2. *John Bird, Basic Engineering Mathematics (5th ed.), Elsevier Ltd, (2010).*
3. *P.Kandasamy, K.Thilagavathy and K. Gunavathy, Engineering Mathematics Vol. I (4th Revised ed.), S.Chand& Co.,Publishers, New Delhi (2000).*
4. *John Bird, Higher Engineering Mathematics (5th ed.), Elsevier Ltd, (2006).*

| Subject Code : BPH18002 | Subject Name : Engineering Physics – II | L | T / SLr | P/ R | C |
|---|---|---|---|---|---|
| | Prerequisite : None | 2 | 0/1 | 0/0 | 3 |

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory / Lab / Embedded Theory and Lab

**OBJECTIVES :**

- Design, conduct experiment and analyze data.
- Develop a Scientific attitude at micro and nano scale of materials
- Understand the concepts of Modern Physics
- Apply the science of materials to Engineering & Technology

**COURSE OUTCOMES (Cos) : (3 – 5)**
**Students completing the course were able to**

| | |
|---|---|
| **CO1** | Demonstrate skills necessary for conducting research related to content knowledge and laboratory skills. |
| **CO2** | Apply knowledge and concepts in advanced materials and devices. |
| **CO3** | Acquired Analytical, Mathematical skills for solving engineering problems. |
| **CO4** | Ability to design and conduct experiments as well as function in a multi disciplinary teams. |
| **CO5** | Generate analytical thought to interpret results & place them within a broader context |

**Mapping of Course Outcomes with Program Outcomes (POs)**

| COs/POs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | H | H | M | M | M | L | | | | M | | L |
| CO2 | H | H | | M | M | | | | | | | L |
| CO3 | H | H | H | H | M | | | | | M | | |
| CO4 | H | H | H | H | M | | | | H | M | | L |
| CO5 | H | M | M | M | M | L | | | M | M | | L |

**H/M/L indicates strength of correlation H – High, M – Medium, L – Low**

| Category | Basic Sciences | Engg Sciences | Humanities & Social Sciences | Program core | Program Electives | Open Electives | Practical / Project | Internships / Technical Skills | Soft Skills |
|---|---|---|---|---|---|---|---|---|---|
| | √ | | | | | | | | |

| BPH18002 | ENGINEERING PHYSICS - II | 2 0/1 0/0 3 |
|---|---|---|

**UNIT I QUANTUM PHYSICS 9HRS**

Quantum free electron theory - deBroglie waves - derivation of deBroglie waves - Davisson and Germer experiment - uncertainty principle - electron microscope - scanning electron microscope - physical significance of wave function - Schrodinger wave equation and its applications - Fermi energy- effective mass - phonons - Fermi function-density of states - origin of bandgap in solids - 1D scattering of electrons in periodic potential.

**UNIT II SEMICONDUCTORS 9HRS**

Introduction - properties of semiconductors - classification of semiconductor - effect of temperature in semiconductor - hole current - carrier concentration in intrinsic semiconductor (electron and hole density) - variation of Fermi energy level and carrier concentration with temperature in an intrinsic semiconductor - carrier transport - diffusion - drift - mobility - Hall effect - determination of Hall coefficient and its applications - diodes.

**UNIT III LIGHT SEMICONDUCTOR INTERACTION 9HRS**

Types of electronic materials: metals, semiconductors and insulators - qualitative analysis of extrinsic semiconductor & its applications - optical transition in bulk semiconductors: absorption, spontaneous and stimulated emission - exciton and its types - traps and its types - colour centers and its types and importance - luminescence - classifications of luminescence based on excitation - optical loss and gain - Photovoltaic effect - Photovoltaic potential - spectral response - solar energy converters - solar cells.

**UNIT IV OPTO ELECTRONIC DEVICES 9HRS**

Photodetectors - photoconductors - photodiodes principle, construction, working and characteristics - Phototransistors - Laser diodes - LED theory, construction and working - seven segment display, advantages of LED - LCD theory, construction and working.

**UNIT V ENGINEERED MATERIALS 9HRS**

Classification of engineered materials - nano phase materials - its synthesis and properties - shape memory alloys and its applications - biomaterials - non linear materials - metallic glasses - metamaterials - homo and hetero junction semiconductors - semiconducting materials for optoelectronic devices - quantum wells, wires and dots.

**Total no. of Periods: 45Hrs**

**TEXT BOOKS**

1. *P.K. Palanisamy, Semiconductor Physics and Optoelectronics, Scitech Publications, 2010*
2. *Jyoti Prasad Bandyopadhyay, Semicoductor Devices, S. Chand Publications, 2014*
3. *Charles Kittal, Introduction to Solid State Physics, Wiley Publications, 2012*

**REFERENCE BOOKS**

1. *S. Shubhashree, S. Bharathi Devi & S. Chellammal Madhusudanan, Engineering Physics, Sree Lakshmi Publications, 2004*
2. *G. Senthil Kumar, N. Iyandurai, & G. Vijayakumar, Material Science, VRB Publishers, 2017*
3. *R.Murugeshan & Kiruthigasivaprakash, Modern Physics, 14th edition, S. Chand & Co, 2008*
4. *Pallab Bhattacharya, Semiconductor optoelectronic devices, second edition, Pearson Education, 2003*
5. *V Rajendran & A. Marikani, Materials Science, Tata McGraw- Hill, New Delhi, 2004*

| Subject Code : BCH18002 | Subject Name : Engineering Chemistry – II | L | T / SLr | P/ R | C |
|---|---|---|---|---|---|
| | Prerequisite : None | 2 | 0/1 | 0/0 | 3 |

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory / Lab / Embedded Theory and Lab

**OBJECTIVES :**

- Imparting the basic concepts of phase rule and apply the same to one and two component systems.
- Introducing the chemistry of engineering materials such as cement, lubricants,abrasives, refractories, alloys and nano materials.
- To impart a sound knowledge on the principles of chemistry involving different application oriented topics
- Introducing salient features of fuels and combustion.
- To give an overview on modern analytical techniques

**COURSE OUTCOMES (Cos) : (1 – 5)**
Students completing the course were able to

| | |
|---|---|
| **CO1** | Understand the science of phase equilibria and apply the phase rule to different systems. |
| **CO2** | Gain an overview of Engineering Materials such as Lime, Cement, Lubricants, Abrasives, Refractories,Alloys and Nanomaterials. |
| **CO3** | Recognize the essential information about consumer products such as Soaps and Detergents,also gaining the basic knowledge about Explosives and Propellants. |
| **CO4** | Discover the fuel Chemistry and Combustion process. |
| **CO5** | Inferring few important Analytical Techniques and their applications. |

**Mapping of Course Outcomes with Program Outcomes (POs)**

| COs/POs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | **H** | | | | | | | | | | | **L** |
| **CO2** | **H** | | **H** | | | **L** | **H** | | | | | **L** |
| **CO3** | **H** | | | | | **H** | | | | | | **L** |
| **CO4** | **H** | **M** | **H** | **H** | | | **H** | | | | | **M** |
| **CO5** | **H** | | | | **M** | | | | | | | **H** |

**H/M/L indicates strength of correlation H – High, M – Medium, L – Low**

| Category | Basic Sciences | Engg Sciences | Humanities & Social Sciences | Program core | Program Electives | Open Electives | Practical / Project | Internships / Technical | Soft Skills |
|---|---|---|---|---|---|---|---|---|---|
| | √ | | | | | | | | |

| BCH18002 | ENGINEERING CHEMISTRY – II | 2 0/1 0/0 3 |
|---|---|---|

**UNIT I PHASE EQUILIBRIA 8HRS**

Introduction – Definition of terms involved in phase rule. Derivation of Gibbs phase rule – Applications to one component system – water system. Binary system – Eutectic system – Pb – Ag system, Bi – Cd system .Thermal analysis – Cooling curves.

**UNIT II MATERIAL CHEMISTRY 10HRS**

Cement – Manufacture, Chemistry of setting and hardening .Lubricants – Requirements of good lubricants, Mechanism, Properties of lubricants, Classification – Examples. Abrasives–Classification –Moh's scale-Hard and soft abrasives, Preparation of artificial abrasives (silicon carbide, boron carbide), Applications of abrasives. Refractories – Classification, Properties-Refractoriness, RUL, Porosity, Thermal spalling Alloys Classification of alloys – Purpose of making alloys - Ferrous and non-Ferrous alloys - Heat treatment Nano materials – properties, carbon nano tubes – properties, fabrication – carbon arc method, laser vapourization method.

**UNIT III APPLIED CHEMISTRY 9HRS**

Soaps and detergents : Soaps – Saponification of oils and fats, manufacture of soaps, classification of soap – soft soap, medicated soap, herbal soap, shaving soap and creams. Detergents – Anionic detergents – manufacture and applications, Comparison of soaps and detergents. Rocket propellants and explosives: Rocket propellants – characteristics, solid and liquid propellants – examples. Explosives- Introduction, characteristics, classification, Oxygen balance , preparation, properties and uses of detonators, low explosives and high explosives, Dynamites, Gun cotton, Cordite. Food adulterants- Common adulterants in different foods – milk and milk products, vegetable oils, and fats, spices and condiments, cereals, pulses, sweetening agents and beverages, Contamination with toxic chemicals – pesticides and insecticides.

**UNIT IV FUELS & COMBUSTION 9HRS**

Introduction to Fuels – classification – Calorific value – GCV, LCV. Solid Fuels–Coal-Proximate Analysis, Metallurgical Coke–Manufacture of Metallurgical Coke – Liquid Fuel–Refining of Petrol, Synthetic Petrol–Manufacturing Process–Hydrogenation of Coal, Polymerization, Cracking–Knocking–Octane Number–Leaded Petrol (or) Anti–knocking – Cetane Number–Ignition Lag–Gaseous fuels–CNG–LPG–Water Gas, Producer gas–Biogas- Combustion– Flue Gas analysis– Orsat's method.

**UNIT V ANALYTICAL AND CHARACTERIZATION TECHNIQUES 9HRS**

Electron microscopes: Scanning electron microscope & Transmission electron microscope, instrumentation and applications Absorption and Emission Spectrum - Beer - Lambert's law. Visible and UV Spectroscopy – instrumentation – Block diagram - working. IR Spectroscopy – instrumentation - Block diagram – molecular vibrations – stretching and bending – $H_2O$, $CO_2$. –Characterization of some important organic functional groups. Chromatographic techniques – column, thin layer and paper.

**Total number of periods : 45HRS**

**TEXTBOOKS**

1. *C. S.Unnithan, T. Jayachandran& P. Udhayakala, "Industrial Chemistry", Sreelakshmi Publications (2009).*
2. *Dr.R.Sivakumar and Dr.N.Sivakumar" Engineering Chemistry" Tata McGraw Hill Publishing Company Ltd, Reprint 2013.*

**REFERENCES**

1. *P.C. Jain & Monika Jain, "Engineering Chemistry", DhanpatRai publishing Co., (Ltd.) (2013).*
2. *B. R. Puri ,L.R. Sharma &M.S.Pathania, "Principles of Physical Chemistry", Vishal publishing co., (2013).*

| Subject Code : BES18003 | Subject Name : Environmental Science (Non- Credited) | L | T / SLr | P/ R | C |
|---|---|---|---|---|---|
| | Prerequisite : None | - | - | - | - |

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory / Lab / Embedded Theory and Lab

**OBJECTIVES :**

- To acquire knowledge of the Environment and Ecosystem & Biodiversity
- To acquire knowledge of the different types of Environmental pollution
- To know more about Natural Resources
- To gain understanding of social issues and the Environment
- To attain familiarity of human population and Environment

**COURSE OUTCOMES (Cos) : (3 – 5)**
Students completing the course were able to

| | |
|---|---|
| **CO1** | To known about Environment and Ecosystem & Biodiversity |
| **CO2** | To clearly comprehend air, water, Soil, Marine, Noise, Thermal and Nuclear Pollutions and Solid Waste management and identify the importance of natural resources like forest, water, and food resources |
| **CO3** | To discover water conservation and watershed management |
| **CO4** | To identify its problems and concerns climate change, global warming, acid rain, ozone layer depletion etc., |
| **CO5** | To explain family welfare programmes and role of information technology in human health and environment |

**Mapping of Course Outcomes with Program Outcomes (POs)**

| COs/POs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | | | | | | M | H | M | | | | M |
| CO2 | | | | | | M | H | | | M | | M |
| CO3 | | | | | | M | H | M | | | | M |
| CO4 | | | | | | M | H | M | | M | | M |
| CO5 | | | | | | M | H | | | M | | M |

**H/M/L indicates strength of correlation H – High, M – Medium, L – Low**

| Category | Basic Sciences | Engg Sciences | Humanities & Social Sciences | Program core | Program Electives | Open Electives | Practical / Project | Internships / Technical Skills | Soft Skills |
|---|---|---|---|---|---|---|---|---|---|
| | | | √ | | | | | | |

| BES18003 | ENVIRONMENTAL SCIENCE |
|---|---|

**UNIT I ENVIRONMENT AND ECOSYSTEM**

Definition, Scope and Importance of environment – need for public awareness – concept, structure and function of an ecosystem - producers, consumers and decomposers – energy flow in the ecosystem. Biodiversity at national and local levels – India

**UNIT II ENVIRONMENT POLLUTION**

Definition – causes, effects and control measures of: (a) Air pollution (b) Water pollution (c) Soil pollution (d) Marine pollution (e) Noise pollution (f) Nuclear hazards (g) E-Wastes and causes, effects and control measures

**UNIT III NATURAL RESOURCES**

Forest resources: Use and over-exploitation, deforestation. Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems. Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems.

**UNIT IV SOCIAL ISSUES AND THE ENVIRONMENT**

From unsustainable to sustainable development – urban problems related to energy – water conservation, rain water harvesting, watershed management – resettlement and rehabilitation of people; its problems and concerns climate change, global warming, acid rain, ozone layer depletion, nuclear accidents ,central and state pollution control boards- Public awareness.

**UNIT V HUMAN POPULATION AND THE ENVIRONMENT**

Population growth, variation among nations – population explosion, environment and human health – human rights – value education – HIV/AIDS – women and child welfare – role of information technology in environment and human health

**TEXT BOOKS**

1. *Gilbert M.Masters, 'Introduction to Environmental Engineering and Science', 2nd edition, Pearson Education (2004).*
2. *Benny Joseph, 'Environmental Science and Engineering', Tata McGrawHill,NewDelhi, (2006).*

**REFERENCES**

1. *Vairamani, S. and Dr. K. Sankaran. Elements of Environmental and Health Science.Karaikudi: KPSV Publications, 5th Edition, July, 2013.*
2. *Ifthikarudeen, Etal, Environmental Studies, Sooraj Publications,2005.*
3. *R.Murugesan, Environmental Studies, Millennium Publishers and Distributors, 2nd Edition, July, 2009.*

**SEMESTER - II (PRACTICAL)**

| Subject Code: BEN18ET1 | Subject Name : Communication Lab | L | T / SLr | P/ R | C |
|---|---|---|---|---|---|
| | Prerequisite : None | 1 | 0/0 | 2/0 | 1 |

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory / Lab / Embedded Theory and Lab

**OBJECTIVES :**

The students should be able to

- Use appropriate vocabulary and structure for effective interpersonal and academic communication
- Interpret charts, diagrams, advertisements, etc.
- Participate in group discussions and present projects effectively
- Present projects and ideas effectively
- Attend interviews

**COURSE OUTCOMES (Cos) : (3 – 5)**

**Students completing the course were able to**

| | |
|---|---|
| **CO1** | Use appropriate vocabulary and structure for effective interpersonal and academic communication. |
| **CO2** | Interpret charts, diagrams, advertisements, etc. |
| **CO3** | Participate in group discussions and present projects effectively |
| **CO4** | Present projects and ideas effectively |
| **CO5** | Attend interviews |

**Mapping of Course Outcomes with Program Outcomes (POs)**

| COs/POs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | | | | | | | | | | **H** | | |
| **CO2** | | | | | | | | | | **H** | | |
| **CO3** | | | | | | | | | | **H** | | |
| **CO4** | | | | | | | | | | **H** | | |
| **CO5** | | | | | | | | | | **H** | | |

**H/M/L indicates strength of correlation H – High, M – Medium, L – Low**

| Category | Basic Sciences | Engg Sciences | Humanities & Social Sciences | Program core | Program Electives | Open Electives | Practical / Project | Internships / Technical Skills | Soft Skills |
|---|---|---|---|---|---|---|---|---|---|
| | | | √ | | | | | | |

| BEN18ET1 | COMMUNICATION LAB | 1 0/0 2/0 1 |
|---|---|---|

**UNIT I** **6Hrs**

Listening and Speaking –Informal and Formal contexts

**UNIT II** **6Hrs**

Interpretation of charts/Diagrams- Group Discussion

**UNIT III** **6Hrs**

Compeering-Welcomes Speech-Vote of Thanks

**UNIT IV** **6Hrs**

Formal Presentation-Power point presentation-Poster presentation

**UNIT V** **6Hrs**

Interview

**Total No. of Periods : 30HRS**

**SUGGESTED READINGS**:

1. *Practical English Usage. Michael Swan. OUP. 1995*
2. *Remedial English Grammar F.T.Wood. Macmillan. 2007*
3. *Study Writing. Liz Hamp-Lyons and Ben Heasly. Cambridge University Press.2006*
4. *Communication skills. Sanjay Kumar and Pushp Lata. Oxford University Press 2011*
5. *Exercises in Spoken English. Parts. I-III. CIEFL, Hyderabad. . Oxford University Press*
6. *Pronunciation in Use, Mark Hancook. Cambridge University Press. 2012*

| Subject Code: BES18ET2 | Subject Name : Basic Engineering Graphics | L | T / SLr | P/ R | C |
|---|---|---|---|---|---|
| | Prerequisite : None | 1 | 0/0 | 2/0 | 2 |

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory / Lab / Embedded Theory and Lab

**OBJECTIVES :**

- Learn to know what kind of pencils to be used to sketch lines, numbers, Letters and Dimensioning in drawing sheet.
- Draw Projection of points, line, planes and solids using Drafters
- To identify the angle of projection and development of surfaces, isometric projection and Orthographic projection
- Know the basics of elevation and plan of building.
- Learn the basics of Drafting using Auto CAD Software

**COURSE OUTCOMES (Cos) : (3 – 5)**
**Students completing the course were able to**

| | |
|---|---|
| **CO1** | Utilize the concept of Engineering Graphics Techniques to draft letters, Numbers, Dimensioning in Indian Standards |
| **CO2** | Demonstrate the drafting practice visualization and projection skills useful for conveying ideas in engineering applications. |
| **CO3** | Identify basic sketching techniques of engineering equipments |
| **CO4** | Demonstrate the projections of Points, Lines, Planes and Solids. |
| **CO5** | Draw the sectional view of simple buildings and utilize Auto CAD Software. |

**Mapping of Course Outcomes with Program Outcomes (POs)**

| COs/POs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | H | H | H | M | M | M | | | H | H | | H |
| CO2 | H | H | H | M | M | M | | | H | H | | H |
| CO3 | H | H | H | L | | M | | | M | M | | M |
| CO4 | H | H | M | M | | H | | M | H | H | | H |
| CO5 | H | H | H | M | H | L | | M | H | H | | H |

**H/M/L indicates strength of correlation H – High, M – Medium, L – Low**

| Category | Basic Sciences | Engg Sciences | Humanities & Social Sciences | Program core | Program Electives | Open Electives | Practical / Project | Internships / Technical Skills | Soft Skills |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | √ | | |

| BES18ET2 | BASIC ENGINEERING GRAPHICS | 1 0/0 2/0 2 |
|---|---|---|

**CONCEPTS AND CONVENTIONS (Not for examination)** **3HRS**

Introduction to drawing, importance and areas of applications – BIS standards – IS: 10711 – 2001 : Technical products Documentation – Size and layout of drawing sheets – IS 9606 – 2001: Technical products Documentation – Lettering – IS 10714 & SP 46 – 2003: Dimensioning of Technical Drawings – IS : 15021 – 2001 : Technical drawings – Projections Methods – drawing Instruments, Lettering Practice – Line types and dimensioning – Border lines, lines title blocks Construction of polygons – conic sections – Ellipse, Parabola, Hyperbola and cyloids.

**UNIT I PROJECTION OF POINTS, LINES AND PLANE SURFACES** **6HRS**

Projection of points and straight lines located in the first quadrant – Determination of true lengths and true inclinations – projection of polygonal surface and circular lamina in simple position only.

**UNIT II PROJECTION OF SOLIDS** **6HRS**

Projection of simple solids like prism, pyramid, cylinder and cone in simple position sectioning of above solids in simple vertical position by cutting plane inclined to one reference plane and perpendicular to the other.

**UNIT III DEVELOPMMENT OF SURFACES AND ISOMETRIC PROJECTION** **6HRS**

Development of lateral surfaces of simple and truncated solids – prisms, pyramids, cylinders, and cones. Principles of isometric projection – isometric scale – isometric projections of simple solids, like prisms pyramids, cylinders and cones.

**UNIT IV ORTHOGRAPHICS PROJECTIONS** **6HRS**

Orthographic projection of simple machine parts – missing views

**BUILDING DRAWING**

Building components – front, Top and sectional view of a security shed.

**UNIT V COMPUTER AIDED DRAFTING** **3HRS**

Introduction to CAD – Advantages of CAD – Practice of basic commands – Creation of simple components drawing using CAD software.

**Total No. of periods:30HRS**

**Note:First angle projection to be followed.**

**TEXT BOOKS**

1. *Bhatt, N.D. and Panchal, V.M. (2014) Engineering Drawing Charotar Publishing House*
2. *Gopalakrishnan, K.R. (2014) Engineering Drawing (Vol.I& II Combined) Subhas Stores, Bangalore.*

| Subject Code : BES18L02 | Subject Name : Integrated Physical Science Lab | L | T / SLr | P/ R | C |
|---|---|---|---|---|---|
| | Prerequisite : None | 0 | 0/0 | 2/0 | 1 |

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory / Lab / Embedded Theory and Lab

**OBJECTIVES :**

- Demonstrate the ability to make physical measurements & understand the limits of precision in measurements.
- Display the ability to measure properties of variety of electrical, mechanical, optical systems.
- To help learners measure conductivity and EMF using electrical equipment.
- To understand the analytical skills through chromatography & viscometry
- To familiarize the concepts of cheminformatics

**COURSE OUTCOMES (Cos) : (3 – 5)**
**Students completing the course were able to**

| | |
|---|---|
| **CO1** | Recognize the correctness and precision in the results of measurements. |
| **CO2** | Construct and compare the properties of variety of mechanical, optical, electrical and electronic systems. |
| **CO3** | Familiarizing the titration methods using conductometry & potentiometry |
| **CO4** | Developing the Research spirit through the knowledge of Cheminformatics & Analytical skills. |

**Mapping of Course Outcomes with Program Outcomes (POs)**

| COs/POs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | H | H | L | H | H | | | | | | | |
| CO2 | H | H | M | H | H | | | | | M | | |
| CO3 | H | H | M | H | H | | | | H | | | |
| CO4 | H | H | H | H | H | | | | H | | H | M |

**H/M/L indicates strength of correlation H – High, M – Medium, L – Low**

| Category | Basic Sciences | Engg Sciences | Humanities & Social Sciences | Program core | Program Electives | Open Electives | Practical / Project | Internships / Technical Skills | Soft Skills |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | √ | | |

| BES18L02 | INTEGRATED PHYSICAL SCIENCE LAB | 0 | 0/0 | 2/0 | 1 |
|---|---|---|---|---|---|

## LIST OF EXPERIMENTS

1. Determination of Coefficient of Viscosity of a given liquid by Poiseuille`s method.
2. Particle Size determination using Laser Source.
3. Determination of Numerical Aperture of an Optical Fiber.
4. Spectrometer- Refractive Index/Dispersive power/i-d curve.
5. Potentiometer - Resistance of a wire.
6. Transistor Characteristics - Input Resistance, Output Resistance and Gain .
7. Studies on acid-base conductometric titration.
8. Determination of redox potentials using potentiometry.
9. Determination of $R_f$ values of various components using thin layer chromatography.
10. Viscosity studies using Digital capillary viscometer.
11. Compute the structures of the given polymers, drugs, biomolecules usingChem Draw.
12. Studies on potential energy surface of the given molecules.
13. Estimate NMR spectra from a Chem Draw structure.

| Subject Code : BES18ET3 | Subject Name : C Programming and Lab | L | T / SLr | P/ R | C |
|---|---|---|---|---|---|
| | Prerequisite : None | 1 | 0/0 | 2/0 | 2 |

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory / Lab / Embedded Theory and Lab

**OBJECTIVES :**

- Outline the basics of C Language.
- Apply fundamentals in C programming.
- Produce and present activities associated with the course**.**

**COURSE OUTCOMES (Cos) : (3 – 5)**
Students completing the course were able to

| | |
|---|---|
| **CO1** | Acquire knowledge how to write and execute c programs |
| **CO2** | Understand the fundamental expression and statements of C Language. |
| **CO3** | Work with arrays, functions, pointers, structures, Strings and Files in C. |
| **CO4** | Identify and provide solutions for engineering problems in C programming |

**Mapping of Course Outcomes with Program Outcomes (POs)**

| COs/POs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | H | H | | | M | M | | H | M | | | H |
| CO2 | H | M | | | H | M | | M | H | | | M |
| CO3 | H | | | H | | M | | M | H | | | M |
| CO4 | H | | | M | | M | | H | M | | | M |

**H/M/L indicates strength of correlation H – High, M – Medium, L – Low**

| Category | Basic Sciences | Engg Sciences | Humanities & Social Sciences | Program core | Program Electives | Open Electives | Practical / Project | Internships / Technical Skills | Soft Skills |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | √ | | |

| BES18ET3 | C PROGRAMMING AND LAB | 1 0/0 2/0 2 |
|---|---|---|

**UNIT I INTRODUCTION 6HRS**

Fundamentals, C Character set, Identifiers and Keywords, Data Types, Variables and Constants, Structure of a C Program, Executing a C Program.

**UNIT II EXPRESSION AND STATEMENT 6HRS**

Operators, Types-Complex and Imaginary, Looping Statement-For, While, Do, Break, continue, Decision Statement-If, If else, Nested if, Switching Statement, Conditional Operator.

**UNIT III ARRAYS AND FUNCTIONS 6HRS**

Defining an Array, Using Array elements as counters, Generate Fibonacci number, Generate Prime Numbers, Initializing Arrays, Multidimensional Arrays, Defining a Function, Function call -types of Function calls -Function pass by value -Function pass by reference, Write a Program in Recursive Function.

**UNIT IV STRUCTURES AND POINTERS 6HRS**

Working with Structures -Introduction -Syntax of structures -Declaration and initialization -Declaration of structure variable -Accessing structure variables, Understanding Pointers -Introduction -Syntax of Pointer.

**UNIT V STRINGS AND FILE HANDLING 6HRS**

Strings -Syntax for declaring a string -Syntax for initializing a string -To read a string from keyboard, Files in C -File handling functions -Opening a File closing a file --example: fopen, fclose -Reading data from a File- Problem solving in C

**Total No of Periods: 30HRS**

1. **www.spoken-tutorials.org**
2. **http://www.learn-c.org/**

**REFERENCE :**

1. Stephen G. Kochen“ Programming in C- A complete introduction to the C Programming Language. Third Edition, Sams Publishing -2004
2. Ajay Mital, “ Programming in C: A Practical Approach”, Pearson Publication-2010

**LIST OF PROGRAMS**

1. Write a program to check 'a' is greater than 'b' or less than 'b' Hint: use if statement.
2. Write another program to check which value is greater 'a', 'b' or 'c'. Hint: use else-if statement. (Take values of a, b, c as user inputs)
3. Write a Program to find the sum of the series : $x + X^3/3! + X^5/5! + \ldots\ldots\ldots\ldots\ldots X^n/n!$
4. Write a C Program to solve a Quadratic Equation by taking input from Keyboard
5. Write a C Program to arrange 20 numbers in ascending and descending Order. Input the Numbers from Keyboard
6. Write a C Program to Multiply a 3 x 3 Matrix with input of members from Keyboard
7. Write a program that takes marks of three students as input. Compare the marks to see which student has scored the highest. Check also if two or more students have scored equal marks.
8. Write a program to display records of an employee. Like name, address, designation, salary.
9. Write a C program, declare a variable and a pointer. Store the address of the variable in the pointer. Print the value of the pointer.
10. Write a C program to concatenate String 'best' and String 'bus'. Hint: strcat(char str1, char str2);
11. Explore the other functions in string library.
12. Write a program to create a file TEST. Write your name and address in the file TEST. Then display it on the console using C program.

**SEMESTER - III (THEORY)**

| **Subject Code: BMA18009** | **Subject Name: Mathematics III for Chemical Engineers** | **Ty / Lb/ ETL** | **L** | **T / SLr** | **P/ R** | **C** |
|---|---|---|---|---|---|---|
| | **Prerequisite: Maths 1 and Maths 2** | **Ty** | **3** | **1/0** | **0/0** | **4** |

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

**OBJECTIVE:**

- The aim of this course is to introduce the basic concepts of Probability, Design of Experiments and, Linear programming relevant to chemical Engineering.

**COURSE OUTCOMES (COs) : ( 3- 5)**

| | |
|---|---|
| **CO1** | To understand the basic concepts in P.D.E & its application. |
| **CO2** | To understand the basic concepts in analytic for complex integral. |

**Mapping of Course Outcomes with Program Outcomes (POs)**

| **COs/POs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | **H** | **-** | **-** | **-** | **-** | **-** | **-** | **-** | **-** | **-** | **-** | **L** |
| **CO2** | **H** | **-** | **-** | **-** | **-** | **-** | **-** | **-** | **-** | **-** | **-** | **M** |

| **COs / PSOs** | **PSO1** | **PSO2** | **PSO3** | **PSO4** |
|---|---|---|---|---|
| **CO1** | **M** | **H** | **-** | **-** |
| **CO2** | **M** | **H** | **-** | **-** |

**H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low**

| Category | Basic Sciences | Engineering Sciences | Humanities and Social Sciences | Program Core | Program Electives | Open Electives | Practical / Project | Internships / Technical Skill | Soft Skills | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | √ | | | | | | | | | | | |

| BMA18009 | MATHEMATICS III FOR CHEMICAL ENGINEERS | 3 | 1/0 | 0/0 | 4 |
|---|---|---|---|---|---|

**UNIT I PARTIAL DIFFERENTIAL EQUATIONS 12Hrs**

Formation – Solutions of standard types of first order equations – Lagrange's equation – Linear partial differential equations of second order and higher order with constant Coefficients.

**UNIT II FOURIER SERIES 12Hrs**

Dirichlet's conditions – General Fourier series – Half range Sine & Cosine series – Complex form of Fourier series – Parseval's identity – Harmonic Analysis.

**UNIT III APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATIONS 12Hrs**

Classification of second order linear partial differential equations – Solutions of one-dimensional wave equation, one-dimensional heat equation – Steady state solution of two- dimensional heat equation (Cartesian coordinates only) – Fourier series solutions.

**UNIT IV ANALYTIC FUNCTIONS 12Hrs**

Analytic functions – Cauchy Riemann equations in Cartesian and Polar form – Properties of analytic functions – Construction of analytic functions – Simple Transformations – Standard transformations : $w = z^2$, $w = e^z$, $w = \sin z$, $w = \cosh z$ – Bilinear transformations.

**UNIT V COMPLEX INTEGRATION 12Hrs**

Cauchy's integral theorem (without proof) – Cauchy's integral formulae (without proof) – Taylor's and Laurent's series (without proof) – Singularities: Types – Residues – Cauchy's residue theorem (without proof) – Evaluation of real integrals by Contour Integration (excluding poles on real axis).

**Total No. of Hours: 60Hrs**

**TEXT BOOKS :**

1) *Veerarajan T., Engineering Mathematics (for first year), Tata McGraw Hill Publishing Co., (2008).*
2) *Veerarajan T., Engineering Mathematics (for semester III), Tata McGraw Hill Publishing Co., (2005).*
3) *Singaravelu, Transforms and Partial Differential Equations, Meenakshi Agency, (2017).*

**REFERENCES:**

1) *Kreyszig E., Advanced Engineering Mathematics ($10^{th}$ ed.), John Wiley & Sons, (2011).*
2) *Grewal B.S., Higher Engineering Mathematics, Khanna Publishers, (2012).*

| Subject Code: BCT18007 | Subject Name : Mechanical Operations | Ty/Lb/ETL | L | T / S.Lr | P/ R | C |
|---|---|---|---|---|---|---|
| | Prerequisite: Unit operations and processes | Ty | 3 | 1/0 | 0/0 | 4 |

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

**OBJECTIVE :**

- To provide knowledge of particle size analysis, size reduction, storage of solids, particle mechanics, sedimentation and floatation, flow through packed beds, fluidization, filtration, fluid-solid conveying.

**COURSE OUTCOMES (COs) : ( 3- 5)**

| | |
|---|---|
| **CO1** | Ability to know about properties of solids. |
| **CO2** | To understand the process and equipment. |
| **CO3** | To select suitable size reduction equipment. |

**Mapping of Course Outcomes with Program Outcomes (POs)**

| COs/POs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | H | M | L | - | - | L | - | - | - | - | M | L |
| CO2 | M | L | H | - | - | - | M | - | L | - | L | H |
| CO3 | L | M | H | - | H | - | - | - | - | - | M | H |

| COs / PSOs | PSO1 | PSO2 | PSO3 | PSO4 |
|---|---|---|---|---|
| CO1 | H | M | L | - |
| CO2 | M | L | H | - |
| CO3 | L | M | H | - |

**H/M/L indicates Strength of Correlation H- High, M- Medium, L-Lo**

| Category | Basic Sciences | Engineering Sciences | Humanities and Social Sciences | Program Core | Program Electives | Open Electives | Practical / Project | Internships / Technical Skill | Soft Skill | | | |
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|---|---|---|---|---|---|
| **BCT18007** | **MECHANICAL OPERATIONS** | **3** | **1/0** | **0/0** | **4** |

**UNIT I PARTICLE CHARACTERISTICS AND SIZE ANALYSIS 12Hrs**

General characteristics of solids, their behavior under different external forces, agglomeration, techniques for size analysis.

**UNIT II SIZE REDUCTION 12Hrs**

Laws of size reduction classification of equipment, methods of size reduction, disintegration, preparation of colloids.

**UNIT III MECHANICAL SEPARATIONS 12Hrs**

Screening and Screening equipment, effectiveness of screens, gravity settling, sedimentation, thickening, centrifugal separation, impingement methods, industrial dust removing equipment with special reference to electrostatic and magnetic separators, heavy media separations, floatation.

**UNIT IV FILTRATION, MIXING AND AGITATION 12Hrs**

Theory of filtration, Batch and continuous filters, centrifuges, membrane and ultra filtration. Equipment for blending and kneading, dispersion, power for agitation, correlations.

**UNIT V STORAGE AND CONVEYING OF SOLIDS 12Hrs**

Conveyors, elevators, pneumatic conveying, Different methods for storage of solids.

**Total No.of Hours: 60Hrs**

**TEXT BOOK:**

1. *McCabe,W.L, Smith J.C and Harriot, P., " UNIT Operations in Chemical Engineering ", McGraw-Hill, Fourth Edition, 1984.*

**REFERENCES:**

1. *Coulson, J.M., Richardson, J.F., "Chemical Engineering ", Volume 2, Third Edition, Pergamon Press, 1977.*

| Subject Code: BCT18005 | Subject Name : Chemical Technology | Ty / Lb/ ETL | L | T / S.Lr | P/ R | C |
|---|---|---|---|---|---|---|
| | **Prerequisite: Basic science** | **Ty** | **3** | **0/0** | **0/0** | **3** |

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

**OBJECTIVE:**

- To introduce history, importance and components of chemical engineering, concepts of unit operations and unit processes. Currents scenario of chemical & allied process industries.

**COURSE OUTCOMES (COs) : ( 3- 5)**

| | |
|---|---|
| **CO1** | Student will be able to explain the basic history, current issues, and trends in process industries. This shall give them first hand information about the environment in industries and prepare them well for industries |
| **CO2** | The students are informed about some basic industries with the help of process diagrams, material of construction used, chemical and physical processes involved including the equipments used, their safety precautions in design and operation. |
| **CO3** | This shall give them first hand information about the environment in industries and prepare them well for industries. |

**Mapping of Course Outcomes with Program Outcomes (POs)**

| COs/POs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | M | L | - | M | - | - | - | - | M | - | L | - |
| CO2 | H | M | - | - | - | - | - | - | H | - | - | - |
| CO3 | L | H | - | - | - | L | - | - | H | - | - | M |

| COs / PSOs | PSO1 | PSO2 | PSO3 | PSO4 | | | |
|---|---|---|---|---|---|---|---|
| CO1 | H | L | L | M | | | |
| CO2 | M | L | H | H | | | |
| CO3 | L | H | M | L | | | |

**H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low**

| Category | Basic Sciences | Engineering Sciences | Humanities and Social Sciences | Program Core | Program Electives | Open Electives | Practical / Project | Internships / Technical Skill | Soft Skills | | | |
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|---|---|---|---|---|---|
| **BCT18005** | **CHEMICAL TECHNOLOGY** | **3** | **0/0** | **0/0** | **3** |

**UNIT I INTRODUCTION 9Hrs**

Chemical processing, the role of chemical engineers in process industries, importance of block diagrams and flow charts, UNIT operations, UNIT processes, process utilities sand economics, industrial safety and pollution, outline plant and equipment design, process control and instrumentation.

**UNIT II FERTILIZER CHEMICALS 9Hrs**

Growth elements, Function, Nitrogenous fertilizers, Ammonium sulfate, Ammonium Nitrate and Urea, Phosphatic fertilizers, single and triple superphosphate, Ammonium phosphate, Nitro phosphate, Potassium Fertilizers, Potassium Chloride, Potassium Nitrate and phosphate, Compound fertilizers and bio-fertilizers. PHOSPHORUS INDUSTRIES: Phosphate rock, benefaction, phosphoric acid-phosphate. NITROGEN INDUSTRIES: Synthesis ammonia and nitric acid. AGRICHEMICAL INDUSTRIES: Insecticides, pesticides, herbicides, plant nutrients and regulators

**UNIT III INDUSTRIAL CHEMICALS - I 9Hrs**

EXPLOSIVES AND PROPELLANTS INDUSTRIES: Explosives, types and characteristics, industrial and military explosives, propellants for rockets. SURFACE COATING INDUSTRIES: Paints, pigments, varnishes, lacquers, industria, and marine coatings. PHOTOGRAPHIC CHEMICALS: Photographic chemicals, manufacture of films, plates and papers, recovery. INDUSTRIAL GASES: Synthetic gas, natural gas, carbon dioxide sulphur-di-oxide, acetylene, helium and argon, hydrogen, oxygen, nitrogen.

**UNIT IV INDUSTRIAL CHEMICALS - II 9Hrs**

CHOLORO - ALKALI INDUSTRIES: Soda ash and sodium bicarbonate, Chlorine and caustic soda; bleaching powder and related bleaching agents, hydrochloric acid.SULPHUR AND SULPHURIC ACID INDUSTRIES: Mining and manufacturing of Sulphur, recovery of sulphur from polluting gases, sulphur trioxide and sulphuric acid.ELECTROLYTIC AND ELECTROTHERMAL INDUSTRIES: Abrasives, Carborondum, Calcium Carbide, Aluminium and Magnesium.

**UNIT V INDUSTRIAL CHEMICALS - III 9Hrs**

WATER IN INDUSTRY: Role of water treatment methods for industrial and domestic use, recovery of waste water, water conditioning.MARINE CHEMICALS: Sodium chloride, By-products of common salt industry, value added product.NUCLEAR INDUSTRIES: Production of uranium, thorium and zirconium from ores and minerals, separation of isotopes, waste disposal.

**Total No of Hours: 45Hrs**

**TEXT BOOKS**

1. *Austin, G.T. Shreve, " Chemical Process Industries ", Fifth Edition,McGraw Hill International Book Co., Singapore, 1984.*
2. *Dryden, C.E., " Outlines of Chemicals Technology ", Edited andRevised by Gopala Rao, M. and Sitting, M., Second Edition,Affiliated East-West Press, 1993.*

| Subject Code: BCT18003 | Subject Name : Chemical Engineering Thermodynamics | Ty/Lb/ ETL | L | T / S.Lr | P/ R | C |
|---|---|---|---|---|---|---|
| | Prerequisite: Engineering mathematics, physics, stoichiometric concepts, chemistry | Ty | 3 | 0/0 | 0/0 | 3 |

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

**OBJECTIVE:**

- To understand the theory and applications of classical thermodynamics, thermodynamic properties, equations of state, methods used to describe and predict phase equilibria.
- To provide knowledge of thermodynamic properties of real fluids and mixtures to design chemical process plants.

**COURSE OUTCOMES (COs) : ( 3- 5)**

| | |
|---|---|
| **CO1** | Basic concept for thermodynamics and first law can be understood. |
| **CO2** | PVT behavior of fluids and ideal gas processes can be analysed. |

**Mapping of Course Outcomes with Program Outcomes (POs)**

| COs/POs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | H | - | - | M | - | - | H | - | - | - | - | L |
| CO2 | M | - | - | - | - | - | L | - | - | M | - | - |

| COs / PSOs | PSO1 | PSO2 | PSO3 | PSO4 |
|---|---|---|---|---|
| CO1 | H | H | - | - |
| CO2 | M | H | - | - |

**H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low**

| Category | Basic Sciences | Engineering Sciences | Humanities and Social Sciences | Program Core | Program Electives | Open Electives | Practical / Project | Internships / Technical Skill | Soft Skills | | | |
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|---|---|---|---|---|---|
| **BCT18003** | **CHEMICAL ENGINEERING THERMODYNAMICS** | **3** | **0/0** | **0/0** | **3** |

**UNIT I INTRODUCTION 7Hrs**

Systems – surroundings – heat, work ,energy; first ,second and third law of thermodynamics, applications-heat engines, refrigeration, liquefaction .

**UNIT II PURE FLUIDS 9Hrs**

Fluids-state equations-ideal gas-actual gas-fugacity coefficient-activity-residual properties-exact differentials-fundamental energy property relation-maxwell's equation-heat capacity relation-entropy relationship-gibbs-helmholtz equations.

**UNIT III SOLUTION THERMODYNAMICS 11Hrs**

Partial molar properties-properties of solutions-determination of pmp-chemical potential- fugacity/ fugacity coefficient of solutions-lewis-randasl rule-ideal/real solutions- raoult's and henry's law- activity/activity coefficient of solutions-gibbsduhem equation-property change of mixing-excess properties.

**UNIT IV PHASE EQUILIBRIA 11Hrs**

Criteria for phase equilibrium-stability criteria-phase equilibria in single component system, multicomponent system-phase rule for non reacting systems-v.l.e at high pressure-non ideal solution v.l.e margules/vandar equations-consistency tests for v.l.e data.

**UNIT V CHEMICAL REACTION EQUILIBRIA 7Hrs**

Definition-stoichiometric number-extent of reaction-criteria for reaction equilibria-equilibrium constant-relations-effects of temp and pressure-other factors influencing reaction equilibria-phase rule for reacting system.

**Total No.of Hours: 45Hrs**

**TEXT BOOKS:**

1. *Smith, J.M., and Van Ness, H.C., "Introduction to Chemical Engineering Thermodynamics", Kogakushai 1976.*
2. *Narayanan K.V" A text book of chemical engineering thermodynamics" Prentice Hall of India pvt. Ltd 2001.*
3. *Kyle, B.G., "Chemical and Process Thermodynamics 2nd edn. "Prentice Hall of India Pvt.Ltd., 1990.*

**REFERENCES:**

1. *Hougen, O.A., Watson, K.M., and Ragatz, R.A., " Chemical Process Principles Part II, Thermodynamics ", John Wiley 1970.*
2. *Dodge, B.F., "Chemical Engineering Thermodynamics ", McGraw-Hill, 1960.*
3. *Sandler, S.I.,"Chemical and Engineering Thermodynamics 2nd edn.", Wiley, 1989.*
4. *Kyle, B.G., "Chemical and Process Thermodynamics 2nd edn.", Prentice Hall of India Pvt.Ltd., 1990.*

| Subject Code: BCE18I04 | Subject Name : Environmental Engineering (Inter Disciplinary I) | Ty/Lb/ETL | L | T / S.Lr | P/ R | C |
|---|---|---|---|---|---|---|
| | Prerequisite: None | Ty | 3 | 0/0 | 0/0 | 3 |

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

**OBJECTIVE :**

- To impart knowledge in fundamental theory and design of conventional water treatment facilities.
- To impart knowledge in fundamental theory and design of conventional wastewater treatment facilities.
- To impart knowledge on the principles used to design advanced wastewater treatments.

**COURSE OUTCOMES (COs) : ( 3- 5)**

| | |
|---|---|
| **CO1** | An insight into the structure of drinking water supply and waste water systems, including water transport, treatment and distribution. |
| **CO2** | An understanding of water quality and waste water criteria and standards, and their relation to public health. |
| **CO3** | The ability to design and evaluate water supply and waste water project alternatives on basis of chosen. |

**Mapping of Course Outcomes with Program Outcomes (POs)**

| COs/POs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | H | M | M | - | - | L | - | - | - | M | - | L |
| CO2 | H | M | - | - | - | - | - | - | - | M | - | - |
| CO3 | H | M | L | - | - | M | - | - | - | M | - | H |

| COs / PSOs | PSO1 | PSO2 | PSO3 | PO4 | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| CO1 | H | H | H | - | | | | | |
| CO2 | H | H | H | - | | | | | |
| CO3 | H | H | H | - | | | | | |

**H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low**

| Category | Basic Sciences | Engineering Sciences | Humanities and Social Sciences | Program Core | Program Electives | Open Electives | Practical / Project | Internships / Technical Skill | Soft Skills | | | |
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|---|---|---|---|---|---|
| **BCE18I04** | **ENVIRONMENTAL ENGINEERING** | **3** | **0/0** | **0/0** | **3** |

**UNIT I PLANNING FOR WATER SUPPLY SYSTEMS 9Hrs**

Scope of environmental engineering – role of environmental engineer – Public water supply systems – objectives – design period – population forecasting – water demand – sources of water – sources selection – water quality – characterization – sources of wastewater –estimation of storm runoff.

**UNIT II WATER TREATMENT 9Hrs**

Screening - types of screening - plain sedimentation – sedimentation with coagulation – settling & flotation - filtration – disinfection.

**UNIT II SEWAGE TREATMENT – PRIMARY TREATMENT 9Hrs**

Objectives – unit operations & processes – principles, functions and design of screen, grit chambers and primary sedimentation tanks.

**UNIT IV SEWAGE TREATMENT – SECONDARY TREATMENT 9Hrs**

Secondary treatment – activated sludge process and trickling filter; other treatment methods – stabilization ponds and septic tanks – advances in sewage treatment.

**UNIT V SEWAGE DISPOSAL AND SLUDGE MANAGEMENT 9Hrs**

Methods – dilution – self purification of surface water bodies – oxygen sag curve – land disposal – sewage farming – deep well injection – soil dispersion system. Thickening – sludge digestion – biogas recovery - drying beds – conditioning and dewatering – sludge disposal.

**Total No of Hours: 45Hrs**

**TEXT BOOKS:**

1. *Garg, S.K., Environmental Engineering, Vols. I &II, Khanna Publishers, New Delhi, 1994*
2. *C.S.Shah, Water Supply And Sanitation, Galgotia Publishing Company, New Delhi, 1994*

**REFERENCES:**

1. *Manual on Water Supply And Treatment, Ministry Of Urban Development, Government Of India, New Delhi, 1999.*
2. *Manual on sewerage and sewage treatment, CPHEEO, Ministry Of Urban Development, Government Of India, New Delhi, 1993*
3. *H.S.Peavy, D.R.Rowe and George Tchobanoglous, Environmental Engineering, Mcgraw-Hill Book Company, New Delhi, 1995.*

**SEMESTER III (PRACTICAL)**

| **Subject Code:** | **Subject Name : Technical Analysis Lab I** | **Ty/Lb/ETL** | **L** | **T / S.Lr** | **P/ R** | **C** |
|---|---|---|---|---|---|---|
| **BCT18L01** | **Prerequisite: Chemistry Lab** | **Lb** | **0** | **0/0** | **3/0** | **1** |

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

**OBJECTIVE:**

- To provide a broad foundation in technical aspects that stresses scientific reasoning and analytical problem solving with molecular perspective.

**COURSE OUTCOMES (COs) : ( 3- 5)**

| | |
|---|---|
| **CO1** | At the end of this practical course, the student would have a thorough understanding on the estimation and analysis of chemical compounds. |
| **CO2** | To do all the calculation. |

**Mapping of Course Outcomes with Program Outcomes (POs)**

| **COs/POs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | **M** | **H** | **-** | **-** | **-** | **-** | **M** | **-** | **-** | **L** | **-** | **-** |
| **CO2** | **M** | **H** | **-** | **-** | **H** | **-** | **-** | **-** | **-** | **-** | **-** | **M** |

| **COs / PSOs** | **PSO1** | **PSO2** | **PSO3** | **PSO4** |
|---|---|---|---|---|
| **CO1** | **M** | **M** | **-** | **-** |
| **CO2** | **H** | **L** | **-** | **-** |

**H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low**

| Category | Basic Sciences | Engineering Sciences | Humanities and Social Sciences | Program Core | Program Electives | Open Electives | Practical / Project | Internships / Technical Skill | Soft Skills | | | |
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|---|---|---|---|---|---|
| **BCT18L01** | **TECHNICAL ANALYSIS LAB I** | **0** | **0/0** | **3/0** | **1** |

1. Ore/alloy analysis
2. Pigment Analysis
3. Industrial Waste Water Analysis
4. Estimation of Phenol
5. Analysis of fertilizers
6. Sugar Analysis
7. Analysis

| Subject Code: | Subject Name : Mechanical Operation Lab | Ty/Lb/ETL | L | T / S.Lr | P/ R | C |
|---|---|---|---|---|---|---|
| BCT18L03 | Prerequisite: Mechanical operation theory | Lb | 0 | 0/0 | 3/0 | 1 |

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

**OBJECTIVE:**

- In this course, the students will learn characterization of solids, size reduction, techniques of solid – fluid separation and mixing.

**COURSE OUTCOMES (COs) : ( 3- 5)**

| | |
|---|---|
| **CO1** | The students would understand about solids, their characterization, handling and the various processes involving solids. |
| **CO2** | And do all calculation |

**Mapping of Course Outcomes with Program Outcomes (POs)**

| COs/POs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | M | - | - | - | H | - | - | - | H | - | - | L |
| CO2 | M | - | M | - | H | - | - | - | H | - | - | M |

| COs / PSOs | PSO1 | PSO2 | PSO3 | PSO4 |
|---|---|---|---|---|
| CO1 | M | M | - | - |
| CO2 | H | L | - | - |

**H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low**

| Category | Basic Sciences | Engineering Sciences | Humanities and Social Sciences | Program Core | Program Electives | Open Electives | Practical / Project | Internships / Technical Skill | Soft Skills | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | √ | | | | | |

| | | | | | |
|---|---|---|---|---|---|
| **BCT18L03** | **MECHANICAL OPERATION LAB** | **0** | **0/0** | **3/0** | **1** |

1. Jaw crusher
2. Crushing rolls
3. Ball mill
4. Size analysis by sieving
5. Size analysis by sub-sieving
6. Filter press
7. Leaf filter
8. Cyclone separator
9. Sedimentation
10. Elutriator
11. Rotary Drum filter
12. Effectiveness of screens

*** Minimum 10 experiments shall be offered**

| Subject Code: BCE18IL1 | Subject Name: Environmental Engineering Lab | Ty/Lb/ETL | L | T / S.Lr | P/ R | C |
|---|---|---|---|---|---|---|
| | Prerequisite: Environmental Engineering | Lb | 0 | 0/0 | 3/0 | 1 |

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

**OBJECTIVE:**

- To provide technical expertise in Environmental Engineering. This will enable them to have a career and professional accomplishment in the public or private sector.

**COURSE OUTCOMES (COs) : ( 3- 5)**

| | |
|---|---|
| **CO1** | The students would understand the importance of environmental, concepts behind the methodologies to control pollution. |
| **CO2** | To do all calculation |

**Mapping of Course Outcomes with Program Outcomes (POs)**

| COs/POs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | M | H | - | - | - | M | - | - | - | L | - | L |
| CO2 | M | H | - | M | - | - | - | M | - | - | - | H |

| COs / PSOs | PSO1 | PSO2 | PSO3 | PSO4 |
|---|---|---|---|---|
| CO1 | M | M | - | - |
| CO2 | H | L | - | - |

**H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low**

| Category | Basic Sciences | Engineering Sciences | Humanities and Social Sciences | Program Core | Program Electives | Open Electives | Practical / Project | Internships / Technical Skill | Soft Skills | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | √ | | | | | |

| BCE18IL1 | ENVIRONMENTAL ENGINEERING LAB | 0 | 0/0 | 3/0 | 1 |
|---|---|---|---|---|---|

1. a) Determine of $P^H$

b) Determination of Turbidity.

2. Determination of Hardness.

3. Determination of Alkalinity.

4. Determination of Residual Chlorine.

5. Estimation of Chlorides.

6. Estimation of Ammonia Nitrogen.

7. Estimation of Sulphate.

8. Determination of optimum coagulant dose.

9. Determination of specific conductivity.

10. Estimation of available chlorine in Bleaching Powder.

11. Determination of dissolved Oxygen.

12. Determination of suspended settle able, volatile and fixed solids.

13. B.O.D. Test.

14. C.O.D. Test.

**Total No of Hours: 30Hrs**

*** Minimum 10 experiments shall be offered**

**SEMESTER IV (THEORY)**

| **Subject Code:** **BCT18004** | **Subject Name : Process Control And Dynamics** | **Ty/Lb/ ETL** | **L** | **T / S.Lr** | **P/ R** | **C** |
|---|---|---|---|---|---|---|
| | **Prerequisite: Engineering Chemistry I & II, Engineering Mathematics III & IV** | **Ty** | **3** | **1/0** | **0/0** | **4** |

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

**OBJECTIVE:**

- To gain the knowledge of process instruments & understand dynamic modeling of a physical process using first principles.
- To design various control schemes and to apply the control system in various processes.

**COURSE OUTCOMES (COs) : ( 3- 5)**

| | |
|---|---|
| **CO1** | Develop fundamental and empirical models for dynamic processes & Implement dynamic models with or without controllers. |
| **CO2** | Analyse PID controllers and more advanced controllers to achieve desired performance & Understand various controller designs, and methods of controller tuning. |

**Mapping of Course Outcomes with Program Outcomes (POs)**

| **COs/POs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | **H** | **M** | **-** | **H** | **-** | **-** | **H** | **-** | **M** | **L** | **-** | **L** |
| **CO2** | **M** | **-** | **-** | **H** | **-** | **H** | **-** | **-** | **H** | **L** | **-** | **M** |

| **COs / PSOs** | **PSO1** | **PSO2** | **PSO3** | **PSO4** | | | | |
|---|---|---|---|---|---|---|---|---|
| **CO1** | **H** | **M** | **L** | **L** | | | | |
| **CO2** | **M** | **L** | **H** | **H** | | | | |

**H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low**

| Category | Basic Sciences | Engineering Sciences | Humanities and Social Sciences | Program Core | Program Electives | Open Electives | Practical / Project | Internships / Technical Skill | Soft Skills | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | √ | | | | | | | | |

| | | | | | |
|---|---|---|---|---|---|
| **BCT18004** | **PROCESS CONTROL AND DYNAMICS** | **3** | **1/0** | **0/0** | **4** |

**UNIT I RESPONSE OF FIRST ORDER SYSTEM 12Hrs**

Laplace transformation, transform of standard functions, derivatives and integrals, inversion, theorems in Laplace transformation, application. Open-loop systems, first order systems and their transient response for standard input functions, first order systems in series, linearization and its application in process control, second order systems and their dynamics, transfer function for chemical reactors and dynamics.

**UNIT II THE CONTROL SYSTEM 12Hrs**

Closed loop control systems, development of block diagram for feed-back control systems, servo and regulator problems, Transfer function for controllers and final control element, principles of pneumatic and electronic controllers, transportation lag, transient response of closed-loop control systems and their stability.

**UNIT III CLOSED LOOP TRANFER FUNCTIONS 12Hrs**

Introduction to frequency response of closed-loop systems, control system design by frequency, Bode diagram, stability criterion, Nyquist diagram; Tuning of controller settings.

**UNIT IV CONTROLSYSTEM DESIGN BY FREQUENCY RESPON 12Hrs**

Controller mechanism, introduction to advanced control systems, cascade control, feed forward control, control of distillation towers and heat exchangers, introduction to microprocessors and computer control of chemical processe

**UNIT V ADVANCED CONTRO SYSTEM 12Hrs**

Principles of measurements and classification of process control instruments, measurements of temperature, pressure, fluid flow, liquid weight and weight flow rate, viscosity and consistency, $p^H$, concentration, electrical and thermal conductivity, humidity of gases, composition by physical and chemical properties and spectroscopy.

**Total No of Hours: 60Hrs**

**TEXT BOOKS:**

1. *Patranabis .D, Principles of Process control, II edition, Tata McGraw Hill Publishing Co Ltd., 1981.*
2. *PeterHarriott, Processcontrol, Tata McGraw Hill Publishing Co., Reprint 2004.*

**REFERENCES:**

1. *Thomas, E.Marlin, Process Control, 2nd Edn, McGraw Hills International Edn 2000.George Stephanopoulos, Chemical Process Control, Prentice Hall of India 2003.*
2. *Norman H.CEAGLSKE, Automatic process control for chemical engineers, John Wiley & Sons, Japan*

| Subject Code: | Subject Name : Chemical Process Calculations | Ty / Lb/ETL | L | T / S.Lr | P/ R | C |
|---|---|---|---|---|---|---|
| BCT18008 | Prerequisite: General Chemistry & basic chemical reactions | Ty | 3 | 1/0 | 0/0 | 4 |

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

**OBJECTIVE:**

- This course brings together the concepts of engineering and economics for chemical plant design and optimization and also composition of mixtures.

**COURSE OUTCOMES (COs) : ( 3- 5)**

| | |
|---|---|
| CO1 | Units and dimensions. |
| CO2 | Material balance and Energy balance calculation for all chemical processes. |
| CO3 | Calculation for batch and continuous processes applied to solution of problems in chemical process industries. |

**Mapping of Course Outcomes with Program Outcomes (POs)**

| COs/POs | PO1 | PO2 | PO3 | PO 4 | PO5 | PO 6 | PO7 | PO8 | PO9 | PO10 | PO1 1 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | H | M | L | - | - | - | L | - | - | - | - | L |
| CO2 | M | H | L | - | - | - | M | - | - | - | - | - |
| CO3 | M | H | L | - | - | - | L | - | - | - | - | M |

| COs / PSOs | PSO1 | PSO2 | PSO3 | PSO4 | | | | |
|---|---|---|---|---|---|---|---|---|
| CO1 | H | H | H | M | | | | |
| CO2 | M | H | L | M | | | | |
| CO3 | H | L | M | M | | | | |

**H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low**

| Category | Basic Sciences | Engineering Sciences | Humanities and Social Sciences | Program Core | Program Electives | Open Electives | Practical / Project | Internships / Technical Skill | Soft Skills | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | √ | | | | | | | | |

| BCT18008 | CHEMICAL PROCESS CALCULATIONS | 3 | 1/0 | 0/0 | 4 |
|---|---|---|---|---|---|

**UNIT I UNITS, DIMENSIONS AND GAS CALCULATIONS 12Hrs**

Basic and derived UNITs, use of model UNITs in calcualtions, Methods of expression, compositions of mixture and solutions. Ideal and real gas laws - Gas constant - calculations of pressure, volume and temperature using ideal gas law. Use of partial pressure and pure component volume in gas calculations, applications of real gas relationship in gas calculation.

**UNIT II MATERIAL BALANCE 12Hrs**

Stoichiometric principles, Application of material balance to UNIT operations like distillation, evaporation, crystallisation, drying etc., - Material balance with chemical reaction - Limiting and excess reactants - recycle - bypass and purging - Unsteady state material balances.

**UNIT III HUMIDITY AND SATURATION 12Hrs**

Calculation of absolute humidity, molal humidity, relative humidity and percentage humidity - Use of humidity in condensation and drying - Humidity chart, dew point.

**UNIT IV FUELS AND COMBUSTION 12Hrs**

Determination of Composition by orsat analysis of products of combustion of solid, liquid and gas fuels - Calculation of excess air from orsat technique, problems on sulphur and sulphur bearing compounds.

**UNIT V THERMO PHYSICS AND THERMOCHEMISTRY 12Hrs**

Heat capacity of solids, liquids, gases and solutions, use of mean heat capacity in heat calculations, problems involving sensible heat and latent heats, evaluation of enthalpy. Standard heat of reaction, heats of formation, combustion, solution, mixing etc., calculation of standard heat of reaction - Effect of pressure and temperature on heat of reaction - Energy balance for systems with and without chemical reaction. - unsteady state energy balances.

**Total No of Hours: 60Hrs**

**TEXT BOOKS:**

1. *Bhatt, B.L., Vora, S.M., " Stoichiometry ", Tata McGraw-Hill, 1976.*
2. *Himmelblau, D.M., " Basic Principles and Calculations in Chemical Engineering ",EEE Sixth Edition, Prentice Hall Inc., 2003 (with CD containing programmes and problems).*

**REFERENCES*:***

1. *Process Calculation for Chemical Engineering, Second Revised Edition, Chemical Engineering Education Developement Centre, I.I.T., Madras, 1981*
2. *Process Calculations, Venkataramani, V and Anantharaman, N, Prentice Hall of India Pvt. Ltd. 2007*

| Subject Code: | Subject Name : Fluid Mechanics | Ty/Lb/ETL | L | T / S.Lr | P/ R | C |
|---|---|---|---|---|---|---|
| BCT18006 | Prerequisite: maths & science | Ty | 3 | 0/0 | 0/0 | 3 |

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

**OBJECTIVE:**

- To understand basic concept of fluid flow and its application to chemical process industries including pipe flow, fluid machinery and agitation & mixing.

**COURSE OUTCOMES (COs) : ( 3- 5)**

| | |
|---|---|
| **CO1** | Ability to understand the fluid particle system and fluid properties. |
| **CO2** | Study analytical solutions to variety of simplified problems. |
| **CO3** | Apply concept of mass, momentum and energy conservation to flows. |

**Mapping of Course Outcomes with Program Outcomes (POs)**

| COs/POs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | H | M | - | - | - | - | M | - | - | - | L | L |
| CO2 | M | L | - | H | - | L | - | - | - | - | H | M |
| CO3 | H | M | - | - | - | - | H | - | - | - | H | M |

| COs / PSOs | PSO1 | PSO2 | PSO3 | PSO4 | | | |
|---|---|---|---|---|---|---|---|
| CO1 | H | M | L | H | | | |
| CO2 | M | L | M | L | | | |
| CO3 | M | L | L | H | | | |

**H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low**

| Category | Basic Sciences | Engineering Sciences | Humanities and Social Sciences | Program Core | Program Electives | Open Electives | Practical / Project | Internships / Technical Skill | Soft Skills | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
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| | | | | | |
|---|---|---|---|---|---|
| **BCT18006** | **FLUID MECHANICS** | **3** | **0/0** | **0/0** | **3** |

**UNIT I INTRODUCTION 9Hrs**

Concept of fluid - the fluid as a continuum - properties of a fluid –density -viscosity –surface tension – heat capacity – vapour pressure.

**UNIT II FLUID STATICS 9Hrs**

Application to manometry – Floatation – gravity settling – centrifugal separation – acceleration.

**UNIT III FLOW OF FLUIDS 9Hrs**

Bernoullis theorem and application – laminar flow – turbulent flow – pressure drop – Newtonian and non-newtonian flow.

**UNIT IV COMPRESSIBLE FLUID FLOW 9Hrs**

Mach no – nozzle flow – flow of fluid through packed bed – fluidization.

**UNIT V INDUSTRIAL PIPING 9Hrs**

Valves – fluid moving machinery – pumps – characteristics of centrifugal pump – other types of pumps – compressors – work – blowers of pumps

**Total No of periods: 45Hrs**

**TEXT BOOKS:**

1. *Noel de Nevers, " Fluid Mechanics for Chemical Engineers ", Second Edition, McGraw-Hill, 1991.*
2. *McCabe,W.L, Smith J.C and Harriot .P.," UNIT Operations in Chemical Engineering ", McGraw-Hill, Sixth Edition 2000.*

**REFERENCES:**

1. *Chemical engineering hand book by Perry.*
2. *White, F.M., " Fluid Mechanics ", 4th Edition, McGraw-Hill Inc., 1999.*

| Subject Code: BCS18I03 | Subject Name : Computer Applications in Chemical Engineering (Inter Disciplinary II) | Ty/Lb/ETL | L | T / S.Lr | P/ R | C |
|---|---|---|---|---|---|---|
| | Prerequisite: Computer Fundamentals | Ty | 3 | 0/0 | 0/0 | 3 |

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

**OBJECTIVE:**

- To gain knowledge based on various programming languages applied for chemical technology.

**COURSE OUTCOMES (COs) : ( 3- 5)**

| | |
|---|---|
| **CO1** | Select appropriate computer applications to store and retrieve data. |
| **CO2** | Disseminate given information in basic and advanced PC applications.. |
| **CO3** | Identify and apply digital/computer fundamentals. |

**Mapping of Course Outcomes with Program Outcomes (POs)**

| COs/POs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | H | M | - | - | L | - | - | - | - | L | L | - |
| CO2 | M | M | - | - | - | - | M | - | - | L | H | - |
| CO3 | L | L | - | - | H | - | - | - | - | M | L | - |

| COs / PSOs | PSO1 | PSO2 | PSO3 | PSO4 |
|---|---|---|---|---|
| CO1 | M | L | M | L |
| CO2 | M | L | M | L |
| CO3 | L | M | L | M |

**H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low**

| Category | Basic Sciences | Engineering Sciences | Humanities and Social Sciences | Program Core | Program Electives | Open Electives | Practical / Project | Internships / Technical Skill | Soft Skills | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | √ | | | | | | | | |

| | | | | | |
|---|---|---|---|---|---|
| **BCS18I03** | **COMPUTER APPLICATIONS IN CHEMICAL ENGINEERING** | **3** | **0/0** | **0/0** | **3** |

**UNIT I INTRODUCTION TO PROGRAMMING LANGUAGES 9Hrs**

Evaluation of Programming Languages - C,C++ and Java, Review on Windows operating system. Application Program : introduction to Word, Power point

**UNIT II INTRODUCTION TO C PROGRAMMING 9Hrs**

Introduction to C Programming - data types - constants - Variables - Expressions – Operators – input and output functions – Control Statements – Looping statements. Functions -Definition –Types of Function, Arrays - types of Array- Files handling.

**UNIT III SPREAD SHEETS 9Hrs**

Creating – opening and saving files – working with worksheets – entering data – editing – formatting – printing – formulae –Charts - Application in Density, molecular weight, mole and percentage compositions, Empirical and Molecular formula calculations, Heat of mixing, Gas laws, Vapour pressure, Chemical Kinetics calculations.

**UNIT IV SPREAD SHEETS (DATA ANALYSIS) 9Hrs**

Application in data processing, Statistical analysis of data, Regression. Analysis of variance, Interpolation, Graphical representations of various Chemical Engineering

**UNIT V FORTRAN 9Hrs**

Syntax – Mathematical and logical operation – Looping – Conditional statements – function – sub function – Simple application Programs.

**Total No.of Hours: 45Hrs**

**TEXT BOOK**

*1. Ashok N.Kamthane ,Programming with ANSI and Turbo C , Pearson Education, 2006*
*2. E. Joseph Billo, "Excel® for Chemists- A Comprehensive Guide", John Wiley & Sons, 3rd Edition*

**REFERENCE BOOKS**:

*1. B.W. Kernighan and D.M.Ritchie, The C Programming Language, 2nd Edition, PHI, 1988*

*2. Kanetkar Y., Let us C, BPB Pub., New Delhi, 1999.*
*3. Jerry, O., Breneman, G.L. Spreadsheet Chemistry, Prentice Hall, Englewood Cliffs, 1991.*

| Subject Code: BHS18NC1 | Subject Name : The Indian Constitution | Ty/Lb/ETL | L | T / S.Lr | P/ R | C |
|---|---|---|---|---|---|---|
| | Prerequisite: NIL | Ty | 2 | 0/0 | 0/0 | NC |

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

**OBJECTIVES:**

- To provide an overview of the history of the making of Indian Constitution
- To understand the preamble and the basic structures of the Constitution.
- To Know the fundamental rights, duties and the directive principles of state policy
- To understand the functionality of the legislature , the executive and the judiciary

**COURSE OUTCOMES (COs) : After studying this course the student would be able to**

| | |
|---|---|
| **CO1** | To provide an overview of the history of the making of Indian Constitution |
| **CO2** | To understand the preamble and the basic structures of the Constitution. |
| **CO3** | To Know the fundamental rights, duties and the directive principles of state policy |

**Mapping of Course Outcomes with Program Outcomes (POs)**

| COs/POs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | | | | | | H | L | L | L | L | | |
| CO2 | | | | | | H | L | L | L | L | | |
| CO2 | | | | | | H | L | L | M | L | | |

| COs / PSOs | PSO1 | PSO2 | PSO3 |
|---|---|---|---|
| CO1 | L | L | M |
| CO2 | L | L | M |
| CO3 | L | L | M |

**H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low**

| Category | Basic Sciences | Engg Sciences | Humanities & Social Sciences | Program Core | Program Electives | Open Electives | Practical / Project | Internships / Technical Skill | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | ✓ | | | | | | | | |

| | | | | | |
|---|---|---|---|---|---|
| **BHS18NC1** | **THE INDIAN CONSTITUTION** | **2** | **0/0** | **0/0** | **NC** |

**UNIT 1** **3Hrs**

The History of the Making of Indian Constitution, Preamble and the Basic Structures

**UNIT 2** **3Hrs**

Fundamental Rights and Duties, Directive Principles of State Policy

**UNIT 3** **3Hrs**

Legislature, Executive and Judiciary

**UNIT 4** **3Hrs**

Emergency Powers

**UNIT 5** **3Hrs**

Special Provisions for Jammu and Kashmir, Nagaland and Other Regions, Amendments

**Total no Hrs: 15 Hrs**

**TEXT BOOKS:**

1. D D Basu, Introduction to the Constitution of India, 20th Edn.,LexisnexisButterworths, 2012.

**REFERENCE BOOKS:**

1. *Rajeev Bhargava (ed), Ethics and Politics of the Indian Constitution, Oxford University Press, New Delhi, 2008.*
2. *Granville Austin, The Indian Constitution: Cornerstone of a Nation, Oxford University Press, Oxford, 1966.*
3. *Zoya Hassan, E. Sridharan and R. Sudarshan (eds), India's Living Constitution: Ideas, Practices, Controversies, Permanent Black, New Delhi, 2002.*
4. *Subhash C. Kashyap, Our Constitution, National Book Trust, New Delhi, 2011.*

| Subject Code: BHS18NC2 | Subject Name : The Indian Traditional Knowledge | T / L/ ETL | C | L | T/SLr | P/R |
|---|---|---|---|---|---|---|
| | Prerequisite: NIL | Ty | NC | 2 | 0/0 | 0/0 |

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

**OBJECTIVE :**

- To understand the Pre- colonial and Colonial Period, Indian Traditional Knowledge System
- To understand the Traditional Medicine, Traditional Production and Construction Technology
- To Know the History of Physics and Chemistry, Traditional Art and Architecture and Vastu Shashtra, Astronomy and Astrology
- To understand the Origin of Mathematics, Aviation Technology in Ancient India, Crafts and Trade in Ancient India

**COURSE OUTCOMES (COs) : ( 3- 5)**

The Students will be able to

| | |
|---|---|
| **CO1** | To understand the Pre- colonial and Colonial Period, Indian Traditional Knowledge System |
| **CO2** | To understand the Traditional Medicine, Traditional Production and Construction Technology |
| **CO3** | To understand the Origin of Mathematics, Aviation Technology in Ancient India, Crafts and Trade in Ancient India |

**Mapping of Course Outcomes with Program Outcomes (POs)**

| COs/POs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | | H | H | L | | M | | | | M | | L |
| CO2 | | H | H | L | | M | | | | M | | L |
| CO3 | | H | H | L | | M | | | | M | | L |

| COs / PSOs | PSO1 | PSO2 | PSO3 |
|---|---|---|---|
| CO1 | L | L | M |
| CO2 | L | L | M |
| CO3 | L | L | M |

**H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low**

| Category | Basic Sciences | Engg Sciences | Humanities & Social Sciences | Program Core | Program Electives | Open Electives | Practical / Project | Internships / Technical Skill | Soft Skills | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | ✓ | | | | | | | | | |

| BHS18NC2 | THE INDIAN TRADITIONAL KNOWLEDGE | NC | 2 | 0/0 | 0/0 |
|---|---|---|---|---|---|

**UNIT I** **3Hrs**

Historical Background: TKS During the Pre- colonial and Colonial Period, Indian Traditional Knowledge System

**UNIT II** **3Hrs**

Traditional Medicine, Traditional Production and Construction Technology

**UNIT III** **3Hrs**

History of Physics and Chemistry, Traditional Art and Architecture and Vastu Shashtra, Astronomy and Astrology

**UNIT IV** **3Hrs**

Origin of Mathematics, Aviation Technology in Ancient India, Crafts and Trade in Ancient India

**UNIT V** **3Hrs**

TKS and the Contemporary World, TKS and the Indian Union, TKS and IT Revolution.

**Total no Hrs: 15 Hrs**

**TEXT BOOKS:**

1. *Amit Jha (2009) , Traditional knowledge system in india, 1st Edition, Delhi University (North Campus)*
2. *Dr.A.K.Ghosh (2011), Traditional Knowledge of Household Products*

## SEMESTER IV (PRACTICAL)

| Subject Code: | Subject Name : Fertilizer Technology | Ty/Lb/ETL | L | T / S.Lr | P/ R | C |
|---|---|---|---|---|---|---|
| BCT18ET1 | Prerequisite: Basic science | ETL | 1 | 0/1 | 3/0 | 3 |

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

**OBJECTIVE:**

- To enable the students to learn the fertilizer manufacturing including new or modified fertilizer products and new techniques.

**COURSE OUTCOMES (COs) : ( 3- 5)**

| | |
|---|---|
| **CO1** | At the end of this course, the students would know about the manufacturing techniques of fertilizers and design the equipments in fertilizer industry. |
| **CO2** | To do all calculations. |

**Mapping of Course Outcomes with Program Outcomes (POs)**

| COs/POs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | M | H | - | - | - | L | - | - | - | - | H | - |
| CO2 | M | H | - | - | - | M | - | - | - | - | H | L |

| COs / PSOs | PSO1 | PSO2 | PSO3 | PSO4 | | | | |
|---|---|---|---|---|---|---|---|---|
| CO1 | M | M | - | - | | | | |
| CO2 | H | L | - | - | | | | |

**H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low**

| Category | Basic Sciences | Engineering Sciences | Humanities and Social Sciences | Program Core | Program Electives | Open Electives | Practical / Project | Internships / Technical Skill | Soft Skills | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | √ | | | | | |

| BCT18ET1 | FERTILIZER TECHNOLOGY | 1 | 0/1 | 3/0 | 3 |
|---|---|---|---|---|---|

**UNIT I NITROGENOUS FERTILISERS 9Hrs**

Methods of production of nitrogenous fertilizer-ammonium sulphate, nitrate,urea and calciumammonium nitrate; ammonium chloride and their methods ofproduction, characteristics and specifications, storage and handling.

**UNIT II PHOSPHATIC FERTILISERS 9Hrs**

Raw materials; phosphate rock, sulphur; pyrites etc., processes for the production of sulphuric and phosphoric acids; phosphates fertilizers – groundrock phosphate; bone meal-single superphosphate, triple superphosphate, triplesuperphosphate, thermal phosphates and their methods of production, characteristics and specifications.

**UNIT III POTASSIC FERTILISERS 9Hrs**

Methods of production of potassium chloride, potassium sulphatetheircharacteristics and specifications.

**UNIT IV COMPLEX AND NPK FERTILISERS 9Hrs**

Methods of production of ammonium phosphate, sulphated ammoniumphosphate, nitrophosphates, urea, ammonium phosphate, mono-ammonium phosphate and various grades of NPK fertilizers produced in the country.

**UNIT V MISCELLANEOUS FERTILISERS 9Hrs**

Mixed fertilizers and granulated mixtures; biofertilisers, nutrients, secondary nutrients and micro nutrients; fluid fertilizers, controlled release fertilizers,controlled release fertilizers.

**Total No of Hours: 45Hrs**

**TEXT BOOKS:**

1. *"Handbook of fertilizer technology", Association of India, New Delhi, 1977.*
2. *Menno, M.G.; "Fertilizer Industry - An Introductory Survey", HigginbothamsPvt. Ltd., 1973.*

**REFERENCES:**

1. *Sauchelli, V.; "The Chemistry and Technology of Fertilizers", ACSMONOGRAPH No. 148, Reinhold Publishing Cor. New York, 1980.*
2. *Fertiliser Manual, "UNITed Nations Industrial Development Organisation",UNITed Nations, New York, 1967.*
3. *Slack, A.V.; Chemistry and Technology of Fertilisers, Interscience, New York, 1966.*

| Subject Code: | Subject Name : Technical Analysis Lab II | Ty/Lb/ETL | L | T / S.Lr | P/ R | C |
|---|---|---|---|---|---|---|
| BCT18L02 | Prerequisite: Programming languages | Lb | 0 | 0/0 | 3/0 | 1 |

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C:
Credits T/L/ETL : Theory/Lab/Embedded Theory and Lab

**OBJECTIVE:**

- To gain knowledge based on various programming languages applied for chemical technology.

**COURSE OUTCOMES (COs) : ( 3- 5)**

| | |
|---|---|
| **CO1** | At the end of this practical course, the student would have a thorough understanding of skills in chemical components. |
| **CO2** | And do all calculation |

**Mapping of Course Outcomes with Program Outcomes (POs)**

| COs/POs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | M | L | - | H | - | - | - | - | L | - | - | H |
| CO2 | M | - | - | H | - | L | - | - | M | - | - | L |

| COs / PSOs | PSO1 | PSO2 | PSO3 | PSO4 | | | |
|---|---|---|---|---|---|---|---|
| CO1 | M | M | - | - | | | |
| CO2 | H | L | - | - | | | |

**H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low**

| Category | Basic Sciences | Engineering Sciences | Humanities and Social Sciences | Program Core | Program Electives | Open Electives | Practical / Project | Internships / Technical Skill | Soft Skills | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | √ | | | | | |

| BCT18L02 | TECHNICAL ANALYSIS LAB II | 0 | 0/0 | 3/0 | 1 |
|---|---|---|---|---|---|

1. Oil Analysis: (3 experiments)
   a) Acid value
   b) Saponification value
   c) Iodine value
2. Soap Analysis: (2 experiments)
   a) Alkali Content
   b) Fatty acid content of Soap
3. Estimation of purity of glycerol: by Dichromatic method
4. Analysis of water:

   Determination chlorine demand in water : Estimation of residual chlorine in water by Volumetric method
5. Cement Analysis (3 experiments)
   a) Estimation of silica content
   b) Estimation of calcium oxide content
   c) Estimation of mixed oxide content
6. Fertilizer Analysis:

   Estimation of Nitrogen in Urea by Kjeldals method

| Subject Code: BCT18L04 | Subject Name : Process Simulation Software(CHEM CAD) | Ty / Lb/ETL | L | T / S.Lr | P/ R | C |
|---|---|---|---|---|---|---|
| | Prerequisite: General Chemistry & basic chemical reactions | Lb | 0 | 0/0 | 3/0 | 1 |

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

**OBJECTIVE**

- Supply of software on CD-ROM media.
- Technical support on telephone, fax and email.
- Has facility to regress physical and transport properties

**COURSE OUTCOMES (COs) : ( 3- 5)**

| | |
|---|---|
| **CO1** | To understand graphical user interface |
| **CO2** | To apply vapor phase association data for important system |
| **CO3** | To apply different k values for different unit operations/trays |

**Mapping of Course Outcomes with Program Outcomes (POs)**

| COs/POs | PO1 | PO2 | PO3 | PO4 | PO 5 | PO 6 | PO7 | PO8 | PO9 | PO10 | PO1 1 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | H | M | L | - | - | - | L | - | - | - | - | L |
| CO2 | M | H | L | - | - | - | M | - | - | - | - | - |
| CO3 | M | H | L | - | - | - | L | - | - | - | - | M |

| COs / PSOs | PSO1 | PSO2 | PSO3 | PSO4 | | | | |
|---|---|---|---|---|---|---|---|---|
| CO1 | H | H | H | M | | | | |
| CO2 | M | H | L | M | | | | |
| CO3 | H | L | M | M | | | | |

**H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low**

| Category | Basic Sciences | Engineering Sciences | Humanities and Social Sciences | Program Core | Program Electives | Open Electives | Practical / Project | Internships / Technical Skill | Soft Skills | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | √ | | | | | |

| BCT18L04 | PROCESS SIMULATION SOFTWARE | 0 | 0/0 | 3/0 | 1 |
|---|---|---|---|---|---|

| | |
|---|---|
| CC STEADY STATE | Steady state process simulation software for simulation/ Process design of continuous processes involving Distillation, Reactors, Absorbers, Pumps, Compressors, Piping, Control Value, Safety valves, liquid-liquid extraction, expanders etc. |
| CC SAFETYNET | For the design/analysis of emergency relief systems (in steady state or dynamic mode) using DIERS technology and complex piping systems. Can also be applied to any other (non-emergency) piping network or for utility distribution analysis |
| CC DYNAMICS | Dynamic Analysis of Distillation Columns and Kinetic data regression, reactor scale up and Dynamic Simulation of batch reactor and/or their associated equipment. |
| CC BATCH | Simulation for Batch Distillation Process. |
| CC THERM | Design/ Rating/ Simulation/ Fouling factor determination for Shell & tube, plate & frame, Air Cooled , and double pipe heat exchangers software |

| Subject Code: BCS18IL3 | Subject Name : Computer Programming Lab | Ty/Lb/ETL | L | T / S.Lr | P/ R | C |
|---|---|---|---|---|---|---|
| | Prerequisite: Computer application in chemical lab | Lb | 0 | 0/0 | 3/0 | 1 |

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits T/L/ETL : Theory/Lab/Embedded Theory and Lab

**OBJECTIVE:**

- To gain knowledge based on various programming languages applied for chemical technology.

**COURSE OUTCOMES (COs) : ( 3- 5)**

| | |
|---|---|
| **CO1** | At the end of this practical course, the student would have a thorough understanding of skills in computer programs. |
| **CO2** | |

**Mapping of Course Outcomes with Program Outcomes (POs)**

| COs/POs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | M | - | L | - | H | - | M | - | H | M | - | M |
| CO2 | M | - | L | - | H | - | M | - | H | - | H | L |

| COs / PSOs | PSO1 | PSO2 | PSO3 | PSO4 |
|---|---|---|---|---|
| CO1 | M | M | M | M |
| CO2 | H | L | L | M |

**H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low**

| Category | Basic Sciences | Engineering Sciences | Humanities and Social Sciences | Program Core | Program Electives | Open Electives | Practical / Project | Internships / Technical Skill | Soft Skills | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | √ | | | | | |

| | | | | | |
|---|---|---|---|---|---|
| **BCS18IL3** | **COMPUTER PROGRAMMING LAB** | **0** | **0/0** | **3/0** | **1** |

1. Operating Systems Commands ( like Copy , ren, del, type, cd, md, rd,..)

2. Formatting the Word Document (Fonts, Header, Footer, page number, Tables,..)

   i. Text Manipulations, Usage of Spell check, and Find & Replace
   ii. Usage of Numbering, Bullets, Footer and Headers.
   iii. Picture insertion and alignment.
   iv. Creation of documents, using templates.
   v. Mail Merge Concepts.

3. Power point Presentation (Slide Design, animation and effects.)

4. Working with Excel

   i. Cell Editing, Usage of Formulae and Bulit-in Functions.
   ii. using Spread sheet, Empirical and Molecular formula calculation
   iii. using Spread sheet, Chemical Kinetics calculation

5. C- Programming

   i. Write a C program to implement Single non-linear equation (Equation state such as Van der Waal, Peng Robinson, RKS, Friction factor equation, Ergun equation, Estimation of Drag coefficient etc)

   ii. Write a C program to implement set of linear equation (Material balance of distillation column, multiple extraction unit, etc)

   ii. Write a C program to find the

   a. Density  b. Molecular Weight  c. Mole  d. Percentage of Composition

| Subject Code: BCT18TS1 | Subject Name : Technical Skill I | Ty/Lb/ETL | L | T / S.Lr | P/ R | C |
|---|---|---|---|---|---|---|
| | Prerequisite: Nil | Lb | 0 | 0/0 | 3/0 | 1 |

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

**OBJECTIVE :**

- To gain knowledge based on various programming languages applied for chemical technology

**COURSE OUTCOMES (COs) : ( 3- 5)**

| | |
|---|---|
| **CO1** | At the end of this practical course, the student would have a thorough understanding of skills in chemical components. |
| **CO2** | And do all calculation |

**Mapping of Course Outcomes with Program Outcomes (POs)**

| COs/POs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | H | H | H | H | H | H | M | M | H | M | H | M |
| CO2 | H | H | M | H | H | H | M | M | H | H | H | H |

| COs / PSOs | PSO1 | PSO2 | PSO3 | PSO4 | | | |
|---|---|---|---|---|---|---|---|
| CO1 | M | M | - | - | | | |
| CO2 | H | L | - | - | | | |

**H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low**

| Cate gory | Basic Sciences | Engineering Sciences | Humanities and Social Sciences | Program Core | Program Electives | Open Electives | Practical / Project | Internships / Technical Skill | Soft Skills | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | √ | | | | |

| | | | | | |
|---|---|---|---|---|---|
| **BCT18TS1** | **TECHNICAL SKILL I** | **0** | **0/0** | **3/0** | **1** |

The students will need to show:

Skills-I

- An understanding of engineering principles and mathematics
- An aptitude for, and interest in chemistry
- Project management skills

| Subject Code: BEN18SK1 | Subject Name : Soft Skills I (Career & Confidence Building) | Ty/Lb/ETL | L | T / S.Lr | P/ R | C |
|---|---|---|---|---|---|---|
| | **Prerequisite: Technical English I & II** | **ETL** | **0** | **0/0** | **3/0** | **1** |

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

**OBJECTIVE:** 1.

- To create awareness in students, various top companies helping them improve their skill set matrix, leading to develop a positive frame of mind.
- To help students be aware of various techniques of candidate recruitment and help them prepare CV's and resume.
- To help student how to face various types of interview, preparing for HR, technical interviews.
- To help students improve their verbal reading, narration and presentation skills by performs various mock sessions.

**COURSE OUTCOMES (COs) : ( 3- 5)**
Students will be able to

| | |
|---|---|
| **CO1** | Be aware of various top companies leading to improvement in skills amongst them |
| **CO2** | Be aware of various candidate recruitment techniques like group discussion, interviews and be able to prepare CV's and resumes. |
| **CO3** | Prepare for different types of interviews and be prepared for HR and technical interviews. Improve their verbal, written and other skills by performing mock sessions. |

**Mapping of Course Outcomes with Program Outcomes (POs)**

| COs/POs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | L | L | L | L | L | M | M | H | M | H | M | H |
| CO2 | L | L | L | L | L | M | M | H | M | H | M | H |
| CO3 | L | L | L | L | L | M | M | H | M | H | M | H |

| COs / PSOs | PSO1 | PSO2 | PSO3 | PSO4 |
|---|---|---|---|---|
| CO1 | L | L | H | L |
| CO2 | L | L | H | L |
| CO3 | L | L | H | L |

**H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low**

| Category | Basic Sciences | Engineering Sciences | Humanities and Social Sciences | Program Core | Program Electives | Open Electives | Practical / Project | Internships / Technical Skill | Soft Skills | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
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| | | | | | |
|---|---|---|---|---|---|
| **BEN18SK1** | **SOFT SKILL I (CAREER & CONFIDENCE BUILDING)** | **0** | **0/0** | **3/0** | **1** |

**UNIT I AWARENESS CREATION 6Hrs**

Creation of awareness of the top companies / improving skill set matrix, - Development of positive frame of mind /Creation of self awareness.

**UNIT II GROUP DISCUSSIONS 6Hrs**

Group discussions/Do's and Don'ts - handling of Group discussions /What evaluators look for! Interpersonal relationships /Preparation of curriculum Vitae/Resume.

**UNIT III FACING INTERVIEW 6Hrs**

Interview - awareness of facing questions - Do's and Don'ts of personal interview / group interview, enabling students prepare for different procedures such as HR interviews and Technical Interviews/self introductions.

**UNIT IV PRESENTATION 6Hrs**

Verbal aptitude, Reading comprehension/narration/presentation/Mock Interviews.

**UNIT V PRACTICAL SESSION 6Hrs**

Practical session on Group Discussion and written tests on vocabulary and reading comprehension.

**Practical component P : Include case studies / application scenarios**

**Research component R : Future trends / research areas / Comparative Analysis**

**Total No. of Hours: 30Hrs**

**SEMESTER V (THEORY)**

| **Subject Code:** | **Subject Name : MASS TRANSFER-I** | **Ty/Lb/ETL** | **L** | **T / S.Lr** | **P/ R** | **C** |
|---|---|---|---|---|---|---|
| **BCT18013** | **Prerequisite: Engineering mathematics, physics, stoichiometric concepts, chemistry** | **Ty** | **3** | **1/0** | **0/0** | **4** |

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

**OBJECTIVE:**

- The purpose of this course istointroduce the undergraduate students with them Ostimportant separation equipments in the process industry.

**COURSE OUTCOMES (COs) : ( 3- 5)**

| | |
|---|---|
| **CO1** | To provide proper understanding of UNIT operations. |
| **CO2** | |

**Mapping of Course Outcomes with Program Outcomes (POs)**

| **COs/POs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | **H** | **-** | **-** | **M** | **-** | **L** | **H** | **-** | **-** | **-** | **-** | **L** |
| **CO2** | **M** | **-** | **M** | **-** | **-** | **-** | **L** | **-** | **M** | **M** | **-** | **M** |

| **COs / PSOs** | **PSO1** | **PSO2** | **PSO3** | **PSO4** | | | |
|---|---|---|---|---|---|---|---|
| **CO1** | **H** | **H** | **-** | **-** | | | |
| **CO2** | **M** | **H** | **-** | **-** | | | |

**H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low**

| Category | Basic Sciences | Engineering Sciences | Humanities and Social Sciences | Program Core | Program Electives | Open Electives | Practical / Project | Internships / Technical Skill | Soft Skills | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
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| | | | | | |
|---|---|---|---|---|---|
| **BCT18013** | **MASS TRANSFER-I** | **3** | **1/0** | **0/0** | **4** |

**UNIT I DIFFUSION 12Hrs**

Molecular and eddy diffusion in gases and liquids, steady state diffusion under stagnant and laminar flow conditions Diffusivity measurement and prediction, multicomponent diffusion, diffusion in solids and its applications.

**UNIT II MASS TRANSFER COEFFICIENTS 12Hrs**

Concept of mass transfer coefficients, mass transfer under laminar and turbulent flow past solids, boundary layers, mass transfer at fluids surfaces correlation of mass transfer coefficients, JD,HTU,and NTU concepts, theories of mass transfer and their applications, interphase mass transfer and over all mass transfer coefficients in binary and multicomponent systems, application to gas-liquid and liquid-liquid systems.

**UNIT III HUMIDIFICATION AND AIR CONDITIONING 12Hrs**

Basic concepts, psychrometric chart construction, Humidification and dehumidification operations, design calculations, cooling tower principle and operation, types of equipment, design calculation. UNIT - IV DRYING 9Hrs Theory and mechanism of drying, drying characteristics of materials, batch and continuous drying, calculation for continuous drying, drying equipment, design and performance of various drying equipments.

**UNIT IV DRYING 12Hrs**

Theory and mechanism of drying, drying characteristics of materials, batch and continuous drying, calculation for continuous drying, drying equipment, design and performance of various drying equipments

**UNIT V CRYSTALLISATION 12Hrs**

Nuclei formation and crystal growth, theory of crystallisation, growth coefficients and the factors affecting these in crystallisation, batch and continuous industrial crystallisers, principle of design of equipment.

**Total No of periods: 60Hrs**

**TEXT BOOKS**

*1. Treybal, R.E., " Mass Transfer Operations ", McGraw-Hill Kogakusha, 1980.*

*2. McCabe, W.L., Smith, J.C., and Harriot, P., "UNIT Operations in Chemical Engineering ", McGrawHill Edn, 1993.*

**REFERENCES**

*1. Roman Zarzytci, AndrzaiChacuk, " Absorption: Fundamentals and Application ", Pergamon Press, 1993.*

*2. skelland, A.H.P., " Diffusional Mass Transfer ", Krieger, Malabar FL (1985).Strigle (jr), R.F., " Packed Tower Design and Applications ", Second Edition, Gulf Publishing Company, USA., 1994.*

*3. Coulson, J.M., Richardson, J.F., "Chemical Engineering" Vol. I, Pergamon Press, 1977.*

*4. Foust, A.S.Wenzel, L.A., Clump, C.W.,Naus, L., and Anderson, L.B., "Principles of UNIT Operations",Second Edition, Wiley, 1980.*

| Subject Code: BBT18I01 | Subject Name : Bio-Chemical Principles | Ty/Lb/ETL | L | T / S.Lr | P/ R | C |
|---|---|---|---|---|---|---|
| | **Prerequisite: Engineering mathematics, physics, stoichiometric concepts, chemistry** | **Ty** | **3** | **0/0** | **0/0** | **3** |

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

**OBJECTIVE:**

- To understand the theory and applications of classical thermodynamics, thermodynamic properties, equations of state, methods used to describe and predict phase equilibria.
- To provide knowledge of thermodynamic properties of real fluids and mixtures to design chemical process plants.

**COURSE OUTCOMES (COs) : ( 3- 5)**

| | |
|---|---|
| **CO1** | Basic concept for thermodynamics and first law can be understood. |
| **CO2** | PVT behavior of fluids and ideal gas processes can be analysed. |

**Mapping of Course Outcomes with Program Outcomes (POs)**

| COs/POs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | H | - | - | M | - | - | H | - | - | - | - | L |
| CO2 | M | - | - | - | - | - | L | - | - | M | - | - |

| COs / PSOs | PSO1 | PSO2 | PSO3 | PSO4 | | | |
|---|---|---|---|---|---|---|---|
| CO1 | H | H | - | - | | | |
| CO2 | M | H | - | - | | | |

**H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low**

| Category | Basic Sciences | Engineering Sciences | Humanities and Social Sciences | Program Core | Program Electives | Open Electives | Practical / Project | Internships / Technical Skill | Soft Skills | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | √ | | | | | | | | |

| | | | | | |
|---|---|---|---|---|---|
| **BBT18I01** | **BIO-CHEMICAL PRINCIPLES** | **3** | **0/0** | **0/0** | **3** |

**UNIT I OVERVIEW OF FERMENTATION PROCESSES 9Hrs**

Overview of fermentation industry, general requirements of fermentation processes, basic configuration of fermentor and ancillaries, main parameters to be monitored and controlled in fermentation processes.

**UNIT II RAW MATERIALS AND MEDIA DESIGN FOR FERMENTATION PROCESS 9Hrs**

Criteria for good medium, medium requirements for fermentation processes, carbon, nitrogen, minerals, vitamins and other complex nutrients, oxygen requirements, medium formulation of optimal growth and product formation, examples of simple and complex media, design of various commercial media for industrial fermentations – medium optimization methods

**UNIT III STERILIZATION KINETICS 9Hrs**

Thermal death kinetics of microorganisms, batch and continuous heat sterilization of liquid media, filter sterilization of liquid media, air sterilization and design of sterilization equipment - batch and continuous.

**UNIT IV METABOLIC STOICHIOMETRY AND ENERGETICS 9Hrs**

Stoichiometry of cell growth and product formation, elemental balances, degrees of reduction of substrate and biomass, available electron balances, yield coefficients of biomass and product formation, maintenance coefficients energetic analysis of microbial growth and product formation, oxygen consumption and heat evolution in aerobic cultures, thermodynamic efficiency of growth.

**UNIT V KINETICS OF MICROBIAL GROWTH AND PRODUCT FORMATION 9Hrs**

Modes of operation - batch, fed batch and continuous cultivation. Simple unstructured kinetic models for microbial growth, Monod model, growth of filamentous organisms, product formation kinetics - leudeking- piret models, substrate and product inhibition on cell growth and product formation.

**Total No. of Hrs: 45Hrs**

**TEXT BOOKS:**

1. *Bailey and Ollis, " Biochemical Engineering Fundamentals", McGraw Hill (2nd Ed.), 1986.*
2. *Shule and Kargi, " Bioprocess Engineering ", Prentice Hall, 1992.*

**REFERENCES:**

1. *Pauline Doran, Bioprocess Engineering Calculation, Blackwell Scientific Publications.*
2. *Peter F. Stanbury, Stephen J. Hall & A. Whitaker, Principles of Fermentation Technology, Science & Technology Books.*
3. *Harvey W. Blanch, Douglas S. Clark, Biochemical Engineering, Marcel Dekker, Inc*

## SEMESTER V (PRACTICAL)

| Subject Code: BCT18ET2 | Subject Name: Polymer Technology | Ty/Lb/ETL | L | T / S.Lr | P/ R | C |
|---|---|---|---|---|---|---|
| | Prerequisite: Engineering chemistry 1 | ETL | 1 | 0/1 | 3/0 | 3 |

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

**OBJECTIVE:**

- To enable the students to compute molecular weight averages from the molecular weight distribution, Condensation polymerization and transition in polymers.

**COURSE OUTCOMES (COs) : ( 3- 5)**

| | |
|---|---|
| **CO1** | At the end of this course, the student would be able to demonstrate knowledge and understanding on the principles related to the synthesis and characterization of polymers. |
| **CO2** | To do all calculation. |

**Mapping of Course Outcomes with Program Outcomes (POs)**

| COs/POs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | H | - | M | - | L | - | - | - | - | M | - | H |
| CO2 | M | - | - | - | M | - | - | L | - | H | - | M |

| COs /PSOs | PSO1 | PSO2 | PSO3 | PSO4 |
|---|---|---|---|---|
| CO1 | H | M | - | - |
| CO2 | M | L | - | - |

**H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low**

| Category | Basic Sciences | Engineering Sciences | Humanities and Social Sciences | Program Core | Program Electives | Open Electives | Practical / Project | Internships / Technical Skill | Soft Skills | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | √ | | | | | |

| BCT18ET2 | POLYMER TECHNOLOGY | 1 | 0/1 | 3/0 | 3 |
|---|---|---|---|---|---|

**UNIT I INTRODUCTION 9Hrs**

History of Macromolecules – structure of natural products like cellulose, rubber,proteins – concepts of macro molecules – Staudinger's theory of macromolecules – difference between simple organic molecules and macromolecules.

**UNIT II ADDITION POLYMERIZATION 9Hrs**

Chemistry of Olefins and Dienes – double bonds – Chemistry of free radicals –monomers – functionality – Polymerization: Initiation – types of initiation – free radical polymerization – cationic polymerization – anionic polymerization – coordination polymerization – industrial polymerization – bulk, emulsion, suspension and solution polymerization techniques – Kinetics – Copolymerization concepts.

**UNIT III CONDENSATION POLYMERIZATION 9Hrs**

Simple condensation reactions – Extension of condensation reactions to polymer synthesis – functional group reactivity – polycondensation – kinetics of polycondensation- Carother's equation – Linear polymers by polycondensation– Interfacial polymerization – crosslinked polymers by condensation – gel point.

**UNIT IV MOLECULAR WEIGHTS OF POLYMERS 9Hrs**

Difference in molecular weights between simple molecules and polymers –number average and weight average molecular weights – Degree of polymerization and molecular weight – molecular weight distribution – Polydispersity – molecular weight determination. Different methods – Gel Permeation Chromatography – Osmometry, Light Scattering.

**UNIT V TRANSITIONS IN POLYMERS 9Hrs**

First and second order transitions – Glass transition, Tg – multiple transitions in polymers – experimental study – significance of transition temperatures –crystallinity in polymers – effect of crystallization – in polymers – factors affecting crystallization crystal nucleation and growth – relationship between Tg and Tm – Relationship between properties and crystalline structure.

**Total No. of Hours: 45Hrs**

**TEXT BOOKS:**

*1. Billmeyer.F.W.,Jr, Text Book of Polymer Science, Ed. Wiley-Interscience,1984.*
*2. Seymour.R.B., and Carraher.C.E., Jr., Polymer Chemistry, 2nd Ed., Marcel Dekker, 1988.*
*3. Gowariker.V.T., Viswanathan.N.V., and Sreedar.J., Polymer Science, Wiley Eastern Ltd., 1988.*

**REFERENCES*:***

*1. Joel,R.F Polymer Science and Technology, Eastern Economy Edition,1999.*
*2. Rodriguez, F., Cohen.C., Oberic.K and Arches, L.A., Principles of Polymer Systems, 5th edition, Taylor*

| Subject Code: BCT18L05 | Subject Name : Fluid Mechanics Lab | Ty/Lb/ETL | L | T / S.Lr | P/ R | C |
|---|---|---|---|---|---|---|
| | **Prerequisite: Fluid Mechanics** | **Lb** | **0** | **0/0** | **3/0** | **1** |

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

**OBJECTIVE:**

- To learn experimentally to calibrate flow meters, find pressure loss for fluid flows and determine pump characteristics.

**COURSE OUTCOMES (COs) : ( 3- 5)**

| | |
|---|---|
| **CO1** | Practical knowledge on the measurement of Fluid Flow and their characteristics at different operating conditions. |
| **CO2** | To do all calculation. |

**Mapping of Course Outcomes with Program Outcomes (POs)**

| COs/POs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | H | - | - | M | - | M | - | H | - | L | - | - |
| CO2 | M | - | - | L | - | - | - | - | - | H | - | L |

| COs / PSOs | PSO1 | PSO2 | PSO3 | PSO4 |
|---|---|---|---|---|
| CO1 | H | M | - | - |
| CO2 | M | L | - | - |

**H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low**

| Category | Basic Sciences | Engineering Sciences | Humanities and Social Sciences | Program Core | Program Electives | Open Electives | Practical / Project | Internships / Technical Skill | Soft Skills | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
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| | | | | | |
|---|---|---|---|---|---|
| **BCT18L05** | **FLUID MECHANICS LAB** | **0** | **0/0** | **3/0** | **1** |

1. Calibration of constant and variable Head meters
2. Calibration of Weirs
3. Drag reduction studies
4. Flow through straight pipe
5. Flow through Vertical concentric pipe
6. Pressure drop studies in packed column
7. Fluidisation
8. Open drum orifice and draining time
9. Flow through helical coil and spiral
10. Characteristic curves of centrifugal pump
11. Viscosity measurement of non Newtonian fluids
12. Flow of air thro' orifice using Air compressor

*** Minimum 10 experiments shall be offered.**

| Subject Code: BCT18L06 | Subject Name : Process Control Lab | Ty/Lb/ETL | L | T / S.Lr | P/ R | C |
|---|---|---|---|---|---|---|
| | Prerequisite: Process control and dynamics | Lb | 0 | 0/0 | 3/0 | 1 |

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

**OBJECTIVE:**

- To determine experimentally the methods of controlling the processes including measurements using process simulation techniques.

**COURSE OUTCOMES (COs) : ( 3- 5)**

| | |
|---|---|
| **CO1** | Students would have knowledge on the development and use of right type of control dynamics for process control under different operative conditions. |
| **CO2** | To do all calculations. |

**Mapping of Course Outcomes with Program Outcomes (POs)**

| COs/POs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | L | - | M | - | H | - | - | - | L | - | L | - |
| CO2 | L | - | - | - | L | - | H | - | - | - | - | M |

| COs / PSOs | PSO1 | PSO2 | PSO3 | PSO4 |
|---|---|---|---|---|
| CO1 | M | L | - | - |
| CO2 | M | M | - | - |

**H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low**

| Category | Basic Sciences | Engineering Sciences | Humanities and Social Sciences | Program Core | Program Electives | Open Electives | Practical / Project | Internships / Technical Skill | Soft Skills | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
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| | | | | | |
|---|---|---|---|---|---|
| **BCT18L06** | **PROCESS CONTROL LAB** | **0** | **0/0** | **3/0** | **1** |

1. Response of first order system
2. Response of second order system
3. Response of Non-Interacting level System
4. Response of Interacting level System
5. Open loop study on a thermal system
6. Closed loop study on a level system
7. Closed loop study on a flow system
8. Closed loop study on a thermal system
9. Tuning of a level system
10. Tuning of a pressure system
11. Tuning of a thermal system
12. Flow co-efficient of control valves
13. Characteristics of different types of control valves
14. Closed loop study on a pressure system
15. Tuning of pressure system
16. Closed loop response of cascade control system

***Minimum 10 experiments shall be offered**.

| Subject Code: BBT18IL1 | Subject Name : Biochemical Lab For Chemical Engineers | Ty/Lb/ETL | L | T / S.Lr | P/ R | C |
|---|---|---|---|---|---|---|
| | Prerequisite: Chemistry | Lb | 0 | 0/0 | 3/0 | 1 |

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

**OBJECTIVE:**

- To enable the students to acquire a specialized knowledge on biomolecular concepts.
- To understand the selected aspect related to metabolism.

**COURSE OUTCOMES (COs) : ( 3- 5)**

| | |
|---|---|
| **CO1** | Understanding of biological basics and bioprocessing Bioprocess design and operation. |
| **CO2** | Understanding the difference between bioprocesses and chemical processes. |
| **CO3** | Bioprocess design and operation. |

**Mapping of Course Outcomes with Program Outcomes (POs)**

| COs/POs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | H | - | L | - | - | - | L | M | - | - | - | M |
| CO2 | M | - | - | H | - | - | H | - | - | M | - | L |
| CO3 | M | - | - | - | - | - | H | H | - | - | - | H |

| COs / PSOs | PSO1 | PSO2 | PSO3 | PSO4 |
|---|---|---|---|---|
| CO1 | H | M | H | - |
| CO2 | M | L | M | - |
| CO3 | H | M | H | - |

**H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low**

| Category | Basic Sciences | Engineering Sciences | Humanities and Social Sciences | Program Core | Program Electives | Open Electives | Practical / Project | Internships / Technical Skill | Soft Skills | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | √ | | | | | |

| | | | | | |
|---|---|---|---|---|---|
| **BBT18IL1** | **BIOCHEMICAL LAB FOR CHEMICAL ENGINEERS** | **0** | **0/0** | **3/0** | **1** |

1. Buffer Preparation.
2. Qualitative analysis of Carbohydrate
   a. Monosaccharide
   b. Disaccharide
   c. Polysaccharide
3. Qualitative analysis of Protein
   a. Albumin
   b. Peptone
   c. Casein
4. Estimation of Carbohydrate by Benedict's method.
5. Estimation of Protein by Lowry's method.
6. Isolation of Protein from Milk.
7. Isolation of Starch from Potato.
8. Isolation of Cholesterol from Egg Yolk.
9. Paper Chromatography.
10. Thin layer Chromatography.

| Subject Code: BCT18TS2 | Subject Name : Technical Skill II | Ty/Lb/ETL | L | T / S.Lr | P/ R | C |
|---|---|---|---|---|---|---|
| | Prerequisite: Chemistry | Lb | 0 | 0/0 | 3/0 | 1 |

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

**OBJECTIVE:**

- To enable the students to acquire a specialized knowledge on biomolecular concepts.
- To understand the selected aspect related to metabolism.

**COURSE OUTCOMES (COs) : ( 3- 5)**

| | |
|---|---|
| **CO1** | Understanding of biological basics and bioprocessing Bioprocess design and operation. |
| **CO2** | Understanding the difference between bioprocesses and chemical processes. |

**Mapping of Course Outcomes with Program Outcomes (POs)**

| COs/POs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | H | H | H | H | H | H | M | M | H | M | H | M |
| CO2 | H | H | M | H | H | H | M | M | H | H | H | H |

| COs / PSOs | PSO1 | PSO2 | PSO3 | PSO4 | | | |
|---|---|---|---|---|---|---|---|
| CO1 | H | M | - | - | | | |
| CO2 | M | L | - | - | | | |

**H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low**

| Category | Basic Sciences | Engineering Sciences | Humanities and Social Sciences | Program Core | Program Electives | Open Electives | Practical / Project | Internships / Technical Skill | Soft Skills | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
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|---|---|---|---|---|---|
| **BCT18TS2** | **TECHNICAL SKILL II** | **0** | **0/0** | **3/0** | **1** |

- The capacity to motivate and lead a team
- Strong IT skills
- A careful and methodical approach with good attention to detail
- Commercial and business awareness
- Creativity and innovation.
- The ability to work as part of a team

**SEMESTER VI (THEORY)**

| Subject Code: | Subject Name : Mass Transfer II | Ty/Lb/ETL | L | T / S.Lr | P/ R | C |
|---|---|---|---|---|---|---|
| BCT18014 | Prerequisite: Basic mathematics & energy & material balance | Ty | 3 | 1/0 | 0/0 | 4 |

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

**OBJECTIVE:**

- To teach the students different separation techniques and also to know the design of a distillation column.
- To understand the calculations involved In liquid-liquid extraction and solid liquid extraction.

**COURSE OUTCOMES (COs) : ( 3- 5)**

| | |
|---|---|
| **CO1** | To study diffusion phenomenon in various mass transfer theories. |
| **CO2** | To study Humidification operation, drying operation and adsorption. |

**Mapping of Course Outcomes with Program Outcomes (POs)**

| COs/POs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | M | - | - | H | | - | - | H | L | M | - | - |
| CO2 | H | - | - | - | - | - | - | M | L | L | - | M |

| COs / PSOs | PSO1 | PSO2 | PSO3 | PSO4 |
|---|---|---|---|---|
| CO1 | H | M | L | H |
| CO2 | H | L | H | H |

**H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low**

| Category | Basic Sciences | Engineering Sciences | Humanities and Social Sciences | Program Core | Program Electives | Open Electives | Practical / Project | Internships / Technical Skill | Soft Skills | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | √ | | | | | | | | |

| | | | | | |
|---|---|---|---|---|---|
| **BCT18014** | **MASS TRANSFER II** | **3** | **1/0** | **0/0** | **4** |

**UNIT I ABSORPTION 12Hrs**

Equilibrium and operating line concept in absorption calculations; types of contactors, design of packed and plate type absorbers; Operating characteristics of stagewise and differential contactors, concepts of NTU, HTU and overall volumetric mass transfer coefficients; multicomponent absorption; mechanism and model of absorption with chemical reaction; thermal effects in absorption process.

**UNIT II DISTILLATION 12Hrs**

Vapour-liquid equilibria, Raoult's law and deviations from ideality, methods of distillation; fractionation of binary and multicomponent system; design calculations by McCabe-Thiele and ponchon-Savarit, methods; continuous contact distillation tower (packed tower) design; extractive and azeotropic; distillation low pressure distillation; steam distillation.

**UNIT III LIQUID-LIQUID EXTRACTION 12Hrs**

Equilibrium in ternary systems; equilibrium stagewise contact calculations for batch and continuous extractors, differential contact extraction equipment - spray, packed and mechanically agitated contactors and their design calculations; pulsed extractors, centrifugal extractors.

**UNIT IV SOLID-LIQUID EXTRACTION (LEACHING) 12Hrs**

Solid-liquid equilibria; leaching equipment-batch and continuous types; calculation of number of stages.

**UNIT V ADSORPTION, ION EXCHANGEAND MISCELLANEOUS SEPARATION PROCESSES 12Hrs**

Theories of adsorption of gases and liquids; industrial adsorbents, adsorption equipment for batch and continuous operation; design calculation of ion-exchange resins; principle of ion-exchnage; industrial equipment. Membrane separation process; solid and liquid membranes; concept of osmosis; reverse osmosis; electrodialysis; their applications; foam separation process; Thermal and sweep diffusion process.

**Total No. of Hrs: 60Hrs**

**TEXT BOOKS**

*1.R.E.Treybal, " Mass Transfer Operations ", McGraw-Hill, Kogakusha, 1980.*

*2.W.L McCabe J.C.Smith, and Harriot. P., " UNIT Operations of Chemical Engineering ", sixth edition McGraw-Hill. International Edition, 2001.*

**REFERENCES**

*1, C.Judson King " Separation Processes ", Tata McGraw-Hill 1974.*

*2. A.H.P.Skelland, " Diffusional Mass Transfer ", Krieger, Malapur, FL (1985).*

*3. Roman Zarfyki and Andrzej Chacuk, " Absorption Fundamentals and Applications", Pergamon Press, 1993.*

*4. P.Wankat" Equilibrium Stage Separations ", Prentice Hall, 1993.*

*5. R.F.Strigle (jr), Packed Tower Design and Application, 2nd Edn Gulf Publishing company U.S.A. 1994.*

| Subject Code: BCT18009 | Subject Name : Heat Transfer | Ty/Lb/ETL | L | T / S.Lr | P/ R | C |
|---|---|---|---|---|---|---|
| | Prerequisite: Basic maths & material energy balance | Ty | 3 | 1/0 | 0/0 | 4 |

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

**OBJECTIVE:**

- To understand the fundamentals of heat transfer mechanisms in fluids and solids and their applications in various heat transfer equipment in process industries.

**COURSE OUTCOMES (COs) : ( 3- 5)**

| | |
|---|---|
| **CO1** | To impart knowledge on heat conduction, convection and radiation phenomena. |
| **CO2** | To impart knowledge on application of heat transfer principles in heat exchanger design. |
| **CO3** | To impart knowledge on the principles of evaporation and evaporator design. |

**Mapping of Course Outcomes with Program Outcomes (POs)**

| COs/POs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | H | L | - | - | H | - | - | - | - | - | M | M |
| CO2 | L | M | - | - | - | - | M | - | - | - | H | M |
| CO3 | M | H | - | - | L | - | - | - | - | - | H | L |

| COs / PSOs | PSO1 | PSO2 | PSO3 | PSO4 | | | |
|---|---|---|---|---|---|---|---|
| CO1 | H | M | L | H | | | |
| CO2 | L | M | H | M | | | |
| CO3 | H | M | L | H | | | |

**H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low**

| Category | Basic Sciences | Engineering Sciences | Humanities and Social Sciences | Program Core | Program Electives | Open Electives | Practical / Project | Internships / Technical Skill | Soft Skills | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
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| BCT18009 | HEAT TRANSFER | 3 | 1/0 | 0/0 | 4 |
|---|---|---|---|---|---|

**UNIT I BASIC PRINCIPLES AND CONDUCTION 12Hrs**

Importance of heat transfer in Chemical Engineering operations - Modes of heat transfer - Mean temperature difference. Concept of heat conduction - Fourier's law of heat conduction - one dimensional steady state heat conduction equation for flat plate, hollow cylinder, hollow sphere - Heat conduction through a series of resistances - Analogy between flow of heat and flow of electricity - Thermal conductivity measurement; effect of temperature on thermal conductivity; conduction through liquids.

**UNIT II FILM COEFFICIENTS AND THEIR APPLICATION 12Hrs**

Individual and overall heat transfer coefficients and the relationship between them - Conduction with heat source - Two dimensional steady state conduction - Analytical and graphical methods - Transient heat conduction.

**UNIT III CONVECTION 12Hrs**

Concept of heat transfer by convection - Natural and forced convection - Application of dimensional analysis for convection - Equations for forced convection under laminar, transition and turbulent conditions - Equations for natural convection - Heat transfer from condensing vapours, heat transfer to boiling liquids - Influence of boundary layer on heat transfer - Heat transfer to molten metals - Heat transfer in packed and fluidised beds.

**UNIT IV HEAT EXCHANGERS 12Hrs**

Parallel and counter flow heat exchangers - Log mean temperature difference - Single pass and multipass heat exchangers; plate heat exchangers; use of correction factor charts; heat exchangers effectiveness; number of transfer UNIT - Chart for different configurations - Fouling factors and wilson's plot - Design of various types of heat exchangers - Design of furnaces - Design of condensers, - Design of tubular reactors.

**UNIT V RADIATION AND EVAPORATION 12Hrs**

Concept of thermal radiations - Black body concept - Stefan Boltsman's law -concept of grey body – radiation between surfaces. Types of evaporation - single effect and multiple effect evaporation - Design calculation for single and multiple effect evaporation.

**Total No of Hours: 60Hrs**

**TEXT BOOKS:**

1. *McCabe, W.L., Smith, J.C., and Harriot, P., "UNIT Operations in Chemical Engineering ", McGraw-Hill Recent Edn.*
2. *BinayK.Dutta "Heat Transfer Principles and Applications", Prentice Hall of India, 2001.*
3. *Kern, D.Q., " Process Heat Transfer ", McGraw-Hill - Revised adition.*

**REFERENCES*:***

*Coulson, J.M., Richardson, J.F., "Chemical Engineering ", Vol.I.,Pergamon and ECBPRACTICAL*

**SEMESTER VI (PRACTICAL)**

| Subject Code: BCT18ET4 | Subject Name : Chemical Process Equipment Design & Drawing Lab | Ty/Lb/ETL | L | T / S.Lr | P/ R | C |
|---|---|---|---|---|---|---|
| | Prerequisite: Chemical Process Equipment Design | ETL | 1 | 0/1 | 3/0 | 3 |

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

**OBJECTIVE:** To study the design principles of various chemical process equipments and to draw them with appropriate dimensions.

**COURSE OUTCOMES (COs) : ( 3- 5)**

| | |
|---|---|
| **CO1** | At the end of this practical course, the student is capable of performing the design calculation of various chemical process equipments. |
| **CO2** | To do all calculations. |

**Mapping of Course Outcomes with Program Outcomes (POs)**

| COs/POs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | M | - | - | - | - | L | - | - | H | - | - | H |
| CO2 | M | - | H | - | - | - | H | - | - | L | - | H |

| COs / PSOs | PSO1 | PSO2 | PSO3 | PSO4 |
|---|---|---|---|---|
| CO1 | M | M | - | - |
| CO2 | H | L | - | - |

**H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low**

| Category | Basic Sciences | Engineering Sciences | Humanities and Social Sciences | Program Core | Program Electives | Open Electives | Practical / Project | Internships / Technical Skill | Soft Skills | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
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| BCT18ET4 | CHEMICAL PROCESS EQUIPMENT DESIGN & DRAWING LAB | 1 | 0/1 | 3/0 | 3 |
|---|---|---|---|---|---|

**UNIT – I** **9Hrs**

Design of storage vessels for non-volatile and volatile fluids – design of pressure vessels – design of vessel supports.

**UNIT – II** **9Hrs**

Design of Heat Exchangers – Double pipe – shell & tube – finned tube – plate heat exchangers – design of evaporators – single & multi effect.

**UNIT – III** **9Hrs**

Design of mass transfer operation equipment – Absorber – Distillation column – Plate and packed columns.

**UNIT – IV** **9Hrs**

Design of Dryers – Rotary – Spray dryers – cooling towers

**UNIT – V** **9Hrs**

Design of Agitated vessels – filters – cyclones

**Total No of periods: 45Hrs**

(All Tables/Chemical Engineers' Handbook/Data Books/Graph Sheets are permitted during the Examination.)

1. Fundamental principles, equations, general design and drawing considerations of cooling towers, evaporators and driers.
2. Heat exchangers, condensers and reboilers.
3. Distillation columns- sieve tray, and bubble cap tray columns and packed column.
4. Equipments for absorption and adsorption of gases.
5. Equipments for liquid-liquid extraction and solid-liquid extraction.

| Subject Code: BCT18L07 | Subject Name : Mass Transfer Lab | Ty/Lb/ETL | L | T / S.Lr | P/ R | C |
|---|---|---|---|---|---|---|
| | Prerequisite: Chemical engineering | Lb | 0 | 0/0 | 3/0 | 1 |

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

**OBJECTIVE:**

- To train the students to develop sound working knowledge on different types of mass transfer equipments.

**COURSE OUTCOMES (COs) : ( 3- 5)**

| | |
|---|---|
| **CO1** | Students would be able to determine important data for the design and operation of the process equipments like distillation, extraction, diffusivity and drying principles which are having wide applications in various industries. |
| **CO2** | To do all calculations |

**Mapping of Course Outcomes with Program Outcomes (POs)**

| COs/POs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | M | - | L | - | - | L | - | H | - | - | - | L |
| CO2 | M | - | - | H | - | - | - | - | - | H | - | H |

| COs / PSOs | PSO1 | PSO2 | PSO3 | PSO4 |
|---|---|---|---|---|
| CO1 | M | M | - | - |
| CO2 | H | L | - | - |

**H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low**

| Category | Basic Sciences | Engineering Sciences | Humanities and Social Sciences | Program Core | Program Electives | Open Electives | Practical / Project | Internships / Technical Skill | Soft Skills | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
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| | | | | | |
|---|---|---|---|---|---|
| **BCT18L07** | **MASS TRANSFER LAB** | **0** | **0/0** | **3/0** | **1** |

1. Simple distillation
2. Steam distillation
3. Packed column distillation
4. Bubble cap distillation
5. Diffusivity measurements
6. Liquid-liquid extraction
7. Vacuum Dryer
8. Tray dryer
9. RDC
10. Adsorption
11. Surface Evaporation

*** Minimum 10 experiments shall be offered.**

| Subject Code: BCT18L08 | Subject Name : Heat Transfer Lab | Ty/Lb/ETL | L | T / S.Lr | P/ R | C |
|---|---|---|---|---|---|---|
| | Prerequisite: Transfer by conduction | Lb | 0 | 0/0 | 3/0 | 1 |

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits T/L/ETL : Theory/Lab/Embedded Theory and Lab

**OBJECTIVE:**

- To enable the students to learn heat transfer by conduction, convection and radiation and heat transfer equipments like evaporator and heat exchanger.

**COURSE OUTCOMES (COs) : ( 3- 5)**

| | |
|---|---|
| **CO1** | At the end of this course, the students would have knowledge in various heat transfer methodology in process engineering and to design heat transfer equipments such as furnace, boilers, heat exchangers evaporation. |
| **CO2** | To do all calculations. |

**Mapping of Course Outcomes with Program Outcomes (POs)**

| COs/POs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | H | - | - | H | - | - | L | - | - | H | M | L |
| CO2 | M | - | H | H | - | - | H | - | H | - | - | - |

| COs / PSOs | PSO1 | PSO2 | PSO3 | PSO4 |
|---|---|---|---|---|
| CO1 | H | M | - | - |
| CO2 | M | L | - | - |

**H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low**

| Category | Basic Sciences | Engineering Sciences | Humanities and Social Sciences | Program Core | Program Electives | Open Electives | Practical / Project | Internships / Technical Skill | Soft Skills | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
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| | | | | | |
|---|---|---|---|---|---|
| **BCT18L08** | **HEAT TRANSFER LAB** | **0** | **0/0** | **3/0** | **1** |

1. Thermal Conductivity measurement
2. Emissivity mesurement
3. Stefan-Boltzmann Constant verification
4. Thermocouple calibration
5. Natural Convection
6. Forced Convection
7. Parallel Flow Double Pipe Heat Exchanger
8. Counter Flow Double Pipe Heat Exchanger

| Subject Code: BEN18SK2 | Subject Name : Soft Skill II ( Qualitative And Quantitative Skills) | Ty/Lb/ETL | L | T / S.Lr | P/ R | C |
|---|---|---|---|---|---|---|
| | **Prerequisite: Technical English** | **ETL** | **0** | **0/0** | **3/0** | **1** |

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits T/L/ETL : Theory/Lab/Embedded Theory and Lab

**OBJECTIVE:**

- To bring behavioural patterns of students and train them for corporate culture and create self awareness and build confidence and train the students for facing the interviews and develop interpersonal relationship.

**COURSE OUTCOMES (COs) : ( 3- 5)**

| | |
|---|---|
| **CO1** | Explain the use of tools and techniques in problem solving. |
| **CO2** | Recognizing and removing barriers to thinking in challenging situations. |

**Mapping of Course Outcomes with Program Outcomes (POs)**

| COs/POs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | M | H | - | - | - | L | - | - | - | - | H | L |
| CO2 | M | H | H | - | - | - | - | - | M | - | - | - |

| COs / PSOs | PSO1 | PSO2 | PSO3 | PSO4 |
|---|---|---|---|---|
| CO1 | M | M | L | L |
| CO2 | H | L | L | M |

**H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low**

| Category | Basic Sciences | Engineering Sciences | Humanities and Social Sciences | Program Core | Program Electives | Open Electives | Practical / Project | Internships / Technical Skill | Soft Skills | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
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| | | | | | |
|---|---|---|---|---|---|
| **BEN18SK2** | **SOFT SKILL II ( QUALITATIVE AND QUANTITATIVE SKILLS)** | **0** | **0/0** | **3/0** | **1** |

**UNIT I LOGICAL REASONING I** **4Hrs**

Logical Statements – Arguments – Assumptions – Courses of Action.

**UNIT II LOGICAL REASONING II** **4Hrs**

Logical conclusions – Deriving conclusions from passages – Theme detection.

**UNIT III ARITHMETICAL REASONING I** **4Hrs**

Number system – H.C.F & L.C.M – Problem on ages – Percentage – Profit & Loss – Ratio & Proportion – Partnership.

**UNIT IV ARITHMETICAL REASONING II** **4Hrs**

Time & Work – Time & Distance – Clocks – Permutations & Combinations – Heights & Distances – Odd man out and Series.

**UNIT V DATA INTERPRETATION** **4Hrs**

Tabulation – Bar graphs – Pie graphs – Line graphs.

**Total No of periods: 20Hrs**

**REFERENCE BOOK:**

*1. R.S.Agarwal, A modern approach to Logical Reasoning, S.Chand & Co., (2017).*
*2. R.S.Agarwal, A modern approach to Verbal and Non verbal Reasoning, S.Chand & Co., (2017).*
*3. R.S.Agarwal, Quantitative Aptitude for Competitive Examinations, S.Chand & Co., (2017).*
*4. A.K.Gupta, Logical and Analytical Reasoning, Ramesh Publishing House, (2014).*
*5. B.S.Sijwali, Indu sijwali, A new approach to Reasoning (Verbal and Non verbal), Arihant Publishers, (2014).*

| Subject Code: BCT18L09 | Subject Name : Mini Project/In plant Training/Industrial training | Ty/Lb/ETL | L | T / S.Lr | P/ R | C |
|---|---|---|---|---|---|---|
| | **Prerequisite: Nil** | **Lb** | **0** | **0/0** | **3/0** | **1** |

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

**OBJECTIVE:**

- The main objective of the Inplant training is to provide a short-term work experience in an Industry/Company/ Organization.

**COURSE OUTCOMES (COs) : ( 3- 5)**

| | |
|---|---|
| **CO1** | To get an insight of an industry / organization/company pertaining to the domain of study. |
| **CO2** | To acquire skills and knowledge for a smooth transition into the career. To gain field experience and get linked with the professional network. |

**Mapping of Course Outcomes with Program Outcomes (POs)**

| COs/POs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | M | L | L | L | L | H | H | H | H | H | H | H |
| CO2 | H | M | H | H | M | H | H | H | H | H | H | M |

| COs / PSOs | PSO1 | PSO2 | PSO3 | PSO4 |
|---|---|---|---|---|
| CO1 | H | H | M | H |
| CO2 | H | H | M | H |

**H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low**

| Category | Basic Sciences | Engineering Sciences | Humanities and Social Sciences | Program Core | Program Electives | Open Electives | Practical / Project | Internships / Technical Skill | Soft Skills | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
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| | | | | | |
|---|---|---|---|---|---|
| **BCT18L09** | **MINI PROJECT/IN PLANT TRAINING/INDUSTRIAL TRAINING** | **0** | **0/0** | **3/0** | **1** |

- The Inplant Training program is absolutely practical.
- Chemical Engineering students can gain hands on experience in various chemical processes, reactor desingning and safety measures.
- Trainers and expers will share their experience with the students.

| Subject Code: BCT18TS3 | Subject Name : Technical Skill III | Ty/Lb/ETL | L | T / S.Lr | P/ R | C |
|---|---|---|---|---|---|---|
| | Prerequisite: Chemical Reaction Engineering | Lb | 0 | 0/0 | 3/0 | 1 |

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

**OBJECTIVE:**

- To impart knowledge on design of reactors.

**COURSE OUTCOMES (COs) : ( 3- 5)**

| | |
|---|---|
| **CO1** | Students would get a sound working knowledge on different types of reactors |
| **CO2** | To do all calculations. |

**Mapping of Course Outcomes with Program Outcomes (POs)**

| COs/POs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | H | H | H | H | H | H | M | M | H | M | H | M |
| CO2 | H | H | M | H | H | H | M | M | H | H | H | H |

| COs / PSOs | PSO1 | PSO2 | PSO3 | PSO4 | | | |
|---|---|---|---|---|---|---|---|
| CO1 | M | M | - | - | | | |
| CO2 | H | L | - | - | | | |

**H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low**

| Category | Basic Sciences | Engineering Sciences | Humanities and Social Sciences | Program Core | Program Electives | Open Electives | Practical / Project | Internships / Technical Skill | Soft Skills | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | √ | | | | |

| | | | | | |
|---|---|---|---|---|---|
| **BCT18TS3** | **TECHNICAL SKILL III** | **0** | **0/0** | **3/0** | **1** |

1. Resource management skills
2. Oral and written communication skills
3. Analytical and problem-solving ability

**SEMESTER VII (THEORY)**

| **Subject Code:** | **Subject Name : Chemical Reaction Engineering** | **Ty/Lb/ETL** | **L** | **T / S.Lr** | **P/ R** | **C** |
|---|---|---|---|---|---|---|
| **BCT18010** | **Prerequisite: Basic maths, chemistry & material energy balance** | **Ty** | **3** | **1/0** | **0/0** | **4** |

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

**OBJECTIVE:**

- To apply knowledge from calculus differential equations, thermodynamics and material and energy balances to solve reactor design problems and simulate several types of reactor in process industries.

**COURSE OUTCOMES (COs) : ( 3- 5)**

| | |
|---|---|
| **CO1** | Develop rate loss for homogeneous reactions |
| **CO2** | Design of ideal reactors for single and complex reactions |
| **CO3** | Develop rate loss for heterogeneous reactions |

**Mapping of Course Outcomes with Program Outcomes (POs)**

| **COs/POs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | **H** | **M** | **-** | **-** | **-** | **-** | **L** | **L** | **-** | **-** | **-** | **L** |
| **CO2** | **L** | **H** | **-** | **H** | **-** | **-** | **M** | **H** | **-** | **-** | **-** | **-** |
| **CO3** | **H** | **M** | **-** | **-** | **-** | **-** | **L** | **L** | **-** | **-** | **-** | **M** |

| **COs / PSOs** | **PSO1** | **PSO2** | **PSO3** | **PSO4** |
|---|---|---|---|---|
| **CO1** | **M** | **H** | **L** | **M** |
| **CO2** | **H** | **M** | **L** | **H** |
| **CO3** | **L** | **M** | **H** | **H** |

**H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low**

| Category | Basic Sciences | Engineering Sciences | Humanities and Social Sciences | Program Core | Program Electives | Open Electives | Practical / Project | Internships / Technical Skill | Soft Skills | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | √ | | | | | | | | |

| | | | | | |
|---|---|---|---|---|---|
| **BCT18010** | **CHEMICAL REACTION ENGINEERING** | **3** | **1/0** | **0/0** | **4** |

**UNIT I REACTION KINETICS 12Hrs**

Law Of Mass Action, Rate Equation, Elementary, Non-Elementary Reactions-Their Mechanism, Theories Of Reaction Rate And Temp Dependency, Analysis Of Experimental Data-Evaluation Of Rate Equation Integral And Differential Analysis For Constant/Variable Volume Systems.

**UNIT II HOMOGENEOUS REACTIONS 12Hrs**

Batch, Stirred Tank Reactor Design, Choice Of Reactors, Optimum Yield And Conversion, Isothermal, Non Isothermal Reaction, Adiabatic Reactors, Rates Of Heat Exchange, Criteria For Stability Of Reactors, Equilibrium Constant-Evaluation, Effect Of Temperature

**UNIT III HETEROGENEOUS REACTIONS-(NON CATALYTIC). 12Hrs**

Rate Equations, Analysis Of Rate Equation, Rate Controlling Steps, Models For Explaining Kinetics, Volume And Surface Models, Controlling Resistances &Rate Controlling Steps; Time For Complete Conversion In Static And Fluidized Bed Reactors, Absorptions With Chemical Reactions, Mass Transfer Co Efficient& Kinetic Constants, Hatta Number, Enhancement Factor For First Order Reaction

**UNIT IV HETEROGENEOUS REACTIONS- CATALYTIC REACTIONS 12Hrs**

Adsorption Isotherms, Rates Of Adsorption/Desorption, Surface Reaction, Rate Controlling Steps Surface Area And Pore Volume Distribution-Diffusion Within Catalyst Particles, Mass And Heat Transfer Within Catalyst Particles, Effectiveness Factors-Internal & Overall; Thiele Modulus

**UNIT V NON IDEAL REACTORS 12Hrs**

Definition, Cause For Deviation From Identity, Concept Of Residence Time Distribution RTD E-Curve, F-Curve, Their Inter Relationship, Basic Model Tanks In Series Model, Conversion Relationships In Non-Ideal Reactors.

**Total No of Hours: 60Hrs**

**TEXT BOOKS**

*1. Levenspiel.O, " Chemical Reaction Engineering ", John Wiley, Second Edition, 1972.*
*2. Fogler. H.S., "Elements Of Chemical Reaction Engineering" 3rd Edition, Prentice Hall Of India Pvt. Ltd., 1999 (Indians Reprint 2003)*

**REFERENCES**

*1. Smith.J.M., " Chemical Engineering Kinetics ", Mcgraw-Hill Third Edition, 1981.*
*2. Levenspiel , O; " Chemical Reaction Engineering ", 2nd Edition, John Wiley, 1972.*

| Subject Code: BCT18011 | Subject Name : Transport Phenomena | Ty/Lb/ETL | L | T / S.Lr | P/ R | C |
|---|---|---|---|---|---|---|
| | Prerequisite: Mass transfer, Heat transfer | Ty | 3 | 0/0 | 0/0 | 3 |

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

**OBJECTIVE :**

- This course will provide the fundamentals to solve real life problems involving transports of Momentum, energy and mass in biological, mechanical and chemical systems using a unified approach.

**COURSE OUTCOMES (COs) : ( 3- 5)**

| | |
|---|---|
| **CO1** | Understanding of transport processes. |
| **CO2** | Ability to develop steady and time dependent solutions along with their limitations. |
| **CO3** | Ability to analyze industrial problems along with appropriate boundary conditions. |

**Mapping of Course Outcomes with Program Outcomes (POs)**

| COs/POs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | L | - | H | - | - | - | - | L | - | M | - | H |
| CO2 | L | - | L | - | - | H | - | - | - | M | - | L |
| CO3 | L | - | H | - | - | - | - | - | - | M | - | M |

| COs / PSOs | PSO1 | PSO2 | PSO3 | PSO4 | | | | |
|---|---|---|---|---|---|---|---|---|
| CO1 | M | L | M | M | | | | |
| CO2 | M | M | H | M | | | | |
| CO3 | H | H | H | L | | | | |

**H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low**

| Category | Basic Sciences | Engineering Sciences | Humanities and Social Sciences | Program Core | Program Electives | Open Electives | Practical / Project | Internships / Technical Skill | Soft Skills | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
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|---|---|---|---|---|---|
| **BCT18011** | **TRANSPORT PHENOMENA** | **3** | **0/0** | **0/0** | **3** |

**UNIT I PHILOSOPHY AND FUNDAMENTALS OF TRANSPORT PHENOMENA 9Hrs**

Importance of transport phenomena; analogous nature of transfer process; basic concepts, conservation laws; continuous concept, field, reference frames, substantial derivative and boundary conditions; methods of analysis; differential, integral and experimental methods.

**UNIT II TRANSPORT BY MOLECULAR MOTION 9Hrs**

Phenomenological laws of transport properties,Newtonian and non Newtonian fluids; rheological models; theories of transport properties of gases and liquids; effect of pressure and temperature.

**UNIT III ONE DIMENSIONAL TRANSPORT IN LAMINAR FLOW 9Hrs**

General method of shell balance approach to transfer problems; Choosing the shape of the shell; most common boundary conditions; momentum flux and velocity distribution for flow of Newtonian and non-newtonian fluids in pipes for flow of Newtonian fluids in planes, slits and annulus heat flux and temperature distribution for heat sources such as electrical, nuclear viscous and chemical; forced and free convection; mass flux and concentration profile for diffusion in stagnant gas, systems involving reaction and forced convection.

**UNIT IV EQUATIONS OF CHANGE AND THEIR APPLICATIONS 9Hrs**

Conservation laws and equations of change; Development of equations of continuity motion and energy in single multi components systems in rectangular co-ordinates and the forms in curvilinear co-ordinates; simplified forms of equations for special cases, solutions of momentum mass and heat transfer problems discussed under shell balance by applications of equation of change, scale factors; applications in scale-up

**UNIT V TRANSPORT IN TURBULENT AND BOUNDARY LAYER FLOW ANALOGIES BETWEEN TRANSPORT PROCESSES 9Hrs**

Turbulents phenomena; phenomenological relations for transfer fluxes; time smoothed equations of change and their applications for turbulent flow in pipes; boundary layer theory; laminar and turbulent hydrodynamics thermal and concentration boundary layer and their thicknesses; analysis of flow overflat surface. ANALOGIES BETWEEN TRANSPORT PROCESSES: Importance of analogy; development and applications of analogies between momentum and mass transfer; Reynolds, Prandtl, Von Karman and Colbum analogies

**Total No of Hours: 45Hrs**.

**TEXT BOOKS:**

1. *R.B. Bird, W.E. Stewart and E.W.Lighfoot, "Transport Phenomena", John Wiley, 1978*
2. *Robert, S Brodkey, Harry C. Hershey, "Transport Phenomena", McGraw-Hill International Edn 1988.*

**REFERENCE*:***

1. *L.S.Sissom, and D.R.Pitts, "Elements of Transport Phenomena", McGraw-Hill, New York, 1972.*
2. *R.W.Fahien, "Elementary Transport Phenomena", McGraw-Hill, New York, 1983.*
3. *J.R. Welty, R.W. Wilson, and C.W.Wicks, "Fundamentals of Momentum Heat and Mass Transfer", 2nd Edn. John Wiley, New York, 1973.*

| Subject Code: BMG18001 | Subject Name: Total Quality Management for Chemical Engineers | T y/ Lb/ETL | L | T / SLr | P/ R | C |
|---|---|---|---|---|---|---|
| | Prerequisite: Quality control and quality engineering | Ty | 3 | 0/0 | 0/0 | 3 |

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

**OBJECTIVE:**

- To introduce the main principles of business and social excellence.
- To generate knowledge and skills of students to use models and quality management methodology for the implementation of total quality management in any sphere of business and public sector.

**COURSE OUTCOMES (COs) :**

| | |
|---|---|
| **CO1** | Help to apply appropriate techniques in identifying customer needs. |
| **CO2** | Measure the cost of poor quality and process effectiveness and efficiency. |

**Mapping of Course Outcomes with Program Outcomes (POs)**

| COs/POs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | H | M | H | M | M | L | L | H | H | H | M | H |
| CO2 | M | M | M | - | M | L | - | H | - | - | H | M |

| COs / PSOs | PSO1 | PSO2 | PSO3 | PSO4 |
|---|---|---|---|---|
| CO1 | H | M | L | H |
| CO2 | M | L | H | H |

**H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low**

| Category | Basic Sciences | Engineering Sciences | Humanities and Social Sciences | Program Core | Program Electives | Open Electives | Practical / Project | Internships / Technical Skill | Soft Skills | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
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|---|---|---|---|---|---|
| **BMG18001** | **TOTAL QUALITY MANAGEMENT FOR CHEMICAL ENGINEERS** | **3** | **0/0** | **0/0** | **3** |

**UNIT I INTRODUCTION 9Hrs**

Definition of Quality, Dimensions of Quality, Quality Planning, Quality costs - Analysis Techniques for Quality Costs, Basic concepts of Total Quality Management, Historical Review, Principles of TQM, Leadership – Concepts, Role of Senior Management, Quality Council, Quality Statements, Strategic Planning, Deming Philosophy, Barriers to TQM Implementation.

**UNIT II TQM PRINCIPLES 9Hrs**

Customer satisfaction – Customer Perception of Quality, Customer Complaints, Service Quality, Customer Retention, Employee Involvement – Motivation, Empowerment, Teams, Recognition and Reward, Performance Appraisal, Benefits, Continuous Process Improvement – Juran Trilogy, PDSA Cycle, 5S, Kaizen, Supplier Partnership – Partnering, sourcing, Supplier Selection, Supplier Rating, Relationship Development, Performance Measures – Basic Concepts, Strategy, Performance Measure.

**UNIT III STATISTICAL PROCESS CONTROL (SPC) 9Hrs**

The seven tools of quality, Statistical Fundamentals – Measures of central Tendency and Dispersion, Population and Sample, Normal Curve, Control Charts for variables and attributes, Process capability, Concept of six sigma, New seven Management tools.

**UNIT IV TQM Tools 9Hrs**

Benchmarking – Reasons to Benchmark, Benchmarking Process, Quality Function Deployment (QFD) – House of Quality, QFD Process, Benefits, Taguchi Quality Loss Function, Total Productive Maintenance (TPM) – Concept, Improvement Needs, FMEA – Stages of FMEA.

**UNIT V QUALITY SYSTEMS 9Hrs**

Need for ISO 9000 and Other Quality Systems, ISO 9000:2000 Quality System – Elements, Implementation of Quality System, Documentation, Quality Auditing, QS 9000, ISO 14000 – Concept, Requirements and Benefits.

**Total No. of Hours: 45Hrs**

**TEXT BOOK:**

1. *Dale H.Besterfiled, et at., Total Quality Management, Pearson Education Asia, 1999 (Indian reprint 2002).*

**REFERENCES**

1. *JaesR.Evans& William M.Lidsay, The Management and Control of Quality, (5th Edition), South-Western (Thomson Learning), 2002 (ISBN 0-324-06680-5).*
2. *Feigenbaum.A.V. "Total Quality Management, McGraw Hill, 1991.*
3. *Oakland.J.S. "Total Quality Management Butterworth – Hcinemann Ltd., Oxford. 1989.*
4. *Narayana V. and Sreenivasan, N.S. Quality Management – Concepts and Tasks, New Age International 1996.*
5. *Zeiri. "Total Quality Management for Engineers Wood Head Publishers, 1991*

**SEMESTER VII (PRACTICAL)**

| Subject Code: | Subject Name : Petroleum Technology | Ty/Lb/ETL | L | T / S.Lr | P/ R | C |
|---|---|---|---|---|---|---|
| BCT18ET3 | Prerequisite: Petroleum Engineering | ETL | 1 | 0/1 | 3/0 | 3 |

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

**OBJECTIVE:**

- To make the students understand petroleum engineering principles, their application to petroleum and natural gas manufacturing problems.

**COURSE OUTCOMES (COs) : ( 3- 5)**

| | |
|---|---|
| **CO1** | At the end of this practical course, the student would have a thorough understanding of skills in Petroleums. |
| **CO2** | And do all calculations. |

**Mapping of Course Outcomes with Program Outcomes (POs)**

| COs/POs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | H | - | L | - | - | H | - | - | L | - | - | M |
| CO2 | M | - | H | - | M | - | - | - | M | - | - | M |

| COs / PSOs | PSO1 | PSO2 | PSO3 | PSO4 |
|---|---|---|---|---|
| CO1 | H | M | - | - |
| CO2 | M | L | - | - |

**H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low**

| Category | Basic Sciences | Engineering Sciences | Humanities and Social Sciences | Program Core | Program Electives | Open Electives | Practical / Project | Internships / Technical Skill | Soft Skills | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | √ | | | | | |

| | | | | | |
|---|---|---|---|---|---|
| **BCT18ET3** | **PETROLEUM TECHNOLOGY** | **1** | **0/1** | **3/0** | **3** |

**UNIT I INTRODUCTION** **9Hrs**

Refinery products – Refinery Feeds – Crude distillation – Coking and thermal process.

**UNIT II CATALYTIC CRACKING** **9Hrs**

Catalytic Cracking - Catalytical hydro cracking – Hydro processing and Reused processing hydro treating.

**UNIT III CATALYTICAL** **9Hrs**

Reforming and isomerization alkylation and polymerization – Product blending –Supporting processes.

**UNIT IV LUBRICIATING** **9Hrs**

Lubriciating oil blending stocks petrochemical feed stocks.

**UNIT V COST EVALUATION** **9Hrs**

Cost Evaluation – Economic evaluation of petroleum reused and refineries.

**Total No. of Hours: 45Hrs**

**TEXT BOOKS:**

*1. Petroleum Refining: Technology and economics CRC Press V Edition 2007J.CH Garry, Hardward G.E and M.J.Kaiser.*

**REFERENCES*:***

*1. Modern Petroleum Technology Upstream Vol I A.G. Lucas Hurley Edition, 2002*

PRACTICAL EXERCISE

Classification of fuels: G/L/S
Automotive Fuels Bharat Standards II III & IV

SUGGESTED STUDENT ACTIVITIES

Solid Fuels: Characterization
- Coal
- Biomass
- Residue from Refinery
- Plastic waste
- Municipal domestic waste

Combustion of Fuels :
- Basic equation, air requirement norms for excess air.
- Heating value : GHV/LHV Calculations for mixture of components.
- Wobbe number for Gaseous Fuels definition and significance.
- Burners : Gas/Liquid/Hydrogen.
- Flue gas composition, Dew point calculations.
- Treatment of flue gas to meet local standards, Carbon Credit.

| Subject Code: BCT18L10 | Subject Name : Instrument Methods of Analysis Lab | Ty/Lb/ETL | L | T / S.Lr | P/ R | C |
|---|---|---|---|---|---|---|
| | **Prerequisite: Instrument Methods of Analysis** | **Lb** | **0** | **0/0** | **3/0** | **1** |

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

**OBJECTIVE:** To provide and understanding of skills in **i**nstrument methods of analysis.

**COURSE OUTCOMES (COs) : ( 3- 5)**

| | |
|---|---|
| **CO1** | At the end of this practical course, the student would have a thorough understanding of skills in **i**nstrument methods of analysis. |
| **CO2** | To do all the calculation. |

**Mapping of Course Outcomes with Program Outcomes (POs)**

| COs/POs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | M | H | - | H | - | - | - | - | - | - | M | - |
| CO2 | M | H | - | - | - | M | - | - | L | - | - | H |

| COs / PSOs | PSO1 | PSO2 | PSO3 | PSO4 |
|---|---|---|---|---|
| CO1 | M | M | - | - |
| CO2 | H | L | - | - |

**H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low**

| Category | Basic Sciences | Engineering Sciences | Humanities and Social Sciences | Program Core | Program Electives | Open Electives | Practical / Project | Internships / Technical Skill | Soft Skills | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | √ | | | | | |

| BCT18L10 | INSTRUMENT METHODS OF ANALYSIS LAB | 0 | 0/0 | 3/0 | 1 |
|---|---|---|---|---|---|

**Set (I): Spectroscopy**

1. Spectrophotometric Determination of Ferrous Ion Concentration
2. Spectrophotometric Determination of Tin (IV) with Catechol-Violet and Cetyltrimethylammonium bromide.
3. Polarimetry / Optical Activity, Refractometry
4. Atomic Absorption Spectroscopy (AAS) and atomic Emission Spectroscopy (AES)
5. Flame Photometric analysis

**Set (II): Chromatography**

6. Analysis of weight % of benzene GC/TCD
7. Analysis of alcohol's mixture using GC/FID
8. Column efficiency / HPLC
9. Adsorption chromatography
10. Ion exchange chromatography

| Subject Code: BCT18L11 | Subject Name : Chemical Reaction Engineering Lab | Ty/Lb/ETL | L | T / S.Lr | P/ R | C |
|---|---|---|---|---|---|---|
| | **Prerequisite: Chemical Reaction Engineering** | **Lb** | **0** | **0/0** | **3/0** | **1** |

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

**OBJECTIVE:**

- To impart knowledge on design of reactors.

**COURSE OUTCOMES (COs) : ( 3- 5)**

| | |
|---|---|
| **CO1** | Students would get a sound working knowledge on different types of reactors. |
| **CO2** | To do all calculations. |

**Mapping of Course Outcomes with Program Outcomes (POs)**

| COs/POs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | M | H | H | - | L | - | - | - | M | - | - | H |
| CO2 | M | H | - | H | - | - | H | - | H | - | M | - |

| COs / PSOs | PSO1 | PSO2 | PSO3 | PSO4 |
|---|---|---|---|---|
| CO1 | M | M | - | - |
| CO2 | H | L | - | - |

**H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low**

| Category | Basic Sciences | Engineering Sciences | Humanities and Social Sciences | Program Core | Program Electives | Open Electives | Practical / Project | Internships / Technical Skill | Soft Skills | | | |
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|---|---|---|---|---|---|
| **BCT18L11** | **CHEMICAL REACTION ENGINEERING LAB** | **0** | **0/0** | **3/0** | **1** |

1. Kinetic studies in a batch reactor
2. Kinetics in a plug flow reactor
3. Kinetics in a PFR followed by a CSTR
4. RTD in a PFR
5. RTD in a packed bed
6. RTD in CSTRs in series
7. Combined Reactor
8. Packed Bed Reactor
9. Adiabatic Reactor
10. Catalytic Reactor
11. Kinetics in Semi-batch Reactor

***Minimum 10 experiments shall be offered.**

| Subject Code: BCT18L12 | Subject Name : Project Phase -1 | Ty/Lb/ETL | L | T / S.Lr | P/ R | C |
|---|---|---|---|---|---|---|
| | Prerequisite: Practical Knowledge of Basic Chemical Engineering Concepts | Lb | 0 | 0/0 | 3/0 | 2 |

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

**OBJECTIVE**:

- The objective of the Main Project is to culminate the academic study and provide an opportunity to explore a problem or issue, address through focused and applied research under the direction of a faculty mentor.
- The project demonstrates the student's ability to synthesize and apply the knowledge and skills acquired to real-world issues and problems.
- This project affirms the students to think critically and creatively, find an optimal solution, make ethical decisions and to present effectively.

**COURSE OUTCOMES (COs) : ( 3- 5)**

| | |
|---|---|
| **CO1** | Apply the knowledge and skills acquired in the course of study addressing a specific problem or issue. |
| **CO2** | To encourage students to think critically and creatively about societal issues and develop user friendly and reachable solutions. |
| **CO3** | To refine research skills and demonstrate their proficiency in communication skills |
| **CO4** | To take on the challenges of teamwork, prepare a presentation and demonstrate the innate talents. |

**Mapping of Course Outcomes with Program Outcomes (POs)**

| COs/POs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | H | H | H | H | M | H | H | L | M | M | H | H |
| CO2 | H | H | H | H | H | H | H | M | M | M | H | H |

| COs / PSOs | PSO1 | PSO2 | PSO3 | PSO4 |
|---|---|---|---|---|
| CO1 | H | H | M | H |
| CO2 | H | H | H | M |

**H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low**

| Category | Basic Sciences | Engineering Sciences | Humanities and Social Sciences | Program Core | Program Electives | Open Electives | Practical / Project | Internships / Technical Skill | Soft Skills | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
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| | | | | | |
|---|---|---|---|---|---|
| **BCT18L12** | **PROJECT PHASE -1** | **0** | **0/0** | **3/0** | **2** |

**During the first term the students are required to:**

1. Define the research problem.
2. Write a research proposal, which should contain –

a. Project title
b. Introduction
c. Origin of the problem
d. Literature review of research and development at national & international level
e. Significance of the problem
f. Objective
g. Methodology
h. Details of collaboration (if any)

3. Carry out *preliminary* experimental investigations or product design or process design etc.
4. Summarize the results (if any).

**Criteria for Project Design:**

1. Projects suggested by the staff on the basis of collected industrial problem.
2. Projects to cater to development of infrastructure of the department.
3. Projects to cater to preparation for application for funding agents.
4. Projects to cater to obtaining relevant data for doctoral programme.
5. Projects to recalibrate and standardize existing equipment.
6. Projects to establish relevant instrumentation and analytical procedures.
7. Projects to give students an opportunity if they suggest an innovative / alternate approach to the existing solution.

| Subject Code: BHS18FLX | Subject Name : Foreign Language | Ty / Lb/ ETL | L | T / S.Lr | P/ R | C |
|---|---|---|---|---|---|---|
| | Prerequisite: Nil | Lb | 0 | 0/0 | 3/0 | 1 |

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

**OBJECTIVE:**

- To recognize the cultural values, practices, and heritage of the foreign country, communicate effectively in a foreign language and interact in a culturally appropriate manner with native speakers of that language.

**COURSE OUTCOMES (COs) : ( 3- 5)**

| | |
|---|---|
| **CO1** | Achieve functional proficiency in listening, speaking, reading, and writing. |
| **CO2** | Develop an insight into the nature of language itself, the process of language and culture acquisition. Decode, analyze, and interpret authentic texts of different genres. |

**Mapping of Course Outcomes with Program Outcomes (POs)**

| COs/POs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | L | L | L | L | L | H | L | H | M | H | H | L |
| CO2 | M | L | L | L | L | H | L | H | H | H | H | L |

| COs / PSOs | PSO1 | PSO2 | PSO3 | PSO4 | | | | |
|---|---|---|---|---|---|---|---|---|
| CO1 | M | L | M | M | | | | |
| CO2 | M | M | H | M | | | | |

**H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low**

| Category | Basic Sciences | Engineering Sciences | Humanities and Social Sciences | Program Core | Program Electives | Open Electives | Practical / Project | Internships / Technical Skill | Soft Skills | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
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| | | | | | |
|---|---|---|---|---|---|
| **BHS18FLX** | **FOREIGN LANGUAGE** | **0** | **0/0** | **3/0** | **1** |

For students to be successful language and culture learners, they must have access to language and culture study that is integrated into the entire college experience.

- Benefit from the development and maintenance of proficiency in more than one language.
- Learn in a variety of ways and settings.
- Acquire proficiency at varied rates. Language and culture education is part of the core curriculum, and
- It is tied to program models that incorporate effective strategies, assessment procedures, and technologies.
- Reflects evolving standards at the national, state, and local levels.
- Develops and enhances basic communication skills and higher order thinking skills.

## SEMESTER VIII (THEORY)

| Subject Code: BCT18012 | Subject Name : Safety In Chemical Process Industries | Ty/Lb/ETL | L | T / S.Lr | P/ R | C |
|---|---|---|---|---|---|---|
| | Prerequisite: Chemical Reaction Engineering | Ty | 3 | 1/0 | 0/0 | 4 |

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

**OBJECTIVE:**

- To impart knowledge on design of reactors.

**COURSE OUTCOMES (COs) : ( 3- 5)**

| | |
|---|---|
| **CO1** | To impart the principles of safety in chemical process operations. |
| **CO2** | To educate the students the importance of safety procedures and safety regulations in chemical industries. |

**Mapping of Course Outcomes with Program Outcomes (POs)**

| COs/POs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | M | H | H | - | L | - | - | - | M | - | - | H |
| CO2 | M | H | - | H | - | - | H | - | H | - | M | - |

| COs / PSOs | PSO1 | PSO2 | PSO3 | PSO4 |
|---|---|---|---|---|
| CO1 | M | M | - | - |
| CO2 | H | L | - | - |

**H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low**

| Category | Basic Sciences | Engineering Sciences | Humanities and Social Sciences | Program Core | Program Electives | Open Electives | Practical / Project | Internships / Technical Skill | Soft Skills | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | √ | | | | | |

| BCT18012 | SAFETY IN CHEMICAL PROCESS INDUSTRIES | 3 | 1/0 | 0/0 | 4 |
|---|---|---|---|---|---|

**UNIT I INTRODUCTION 12Hrs**

Safety in industries – need for development – importance of safety consciousness in Indian Chemical Industry – social environmental setup – Tolerance limit of the society – Psychological attitude towards safety programmes.

**UNIT II SAFETY PROGRAMMES 12Hrs**

Elements of safety programmes – Effective realization – Economic and social benefits – Effective communication training at various levels of production and operation.

**UNIT III SAFETY PERFORMANCE 12Hrs**

Appraisal – Effective steps to implement safety procedures – Periodic inspection and study of plant layout and constant maintenance – Periodic advice and checking to follow safety procedures – proper selection and replacement of handling equipments – personal protective equipment.

**UNIT IV ACCIDENTS 12Hrs**

Industrial accidents – accident costs – identification of accident spots – remedial measure – identification and analysis of causes of injury to men and machines – accident prevention – accident proneness – vocational guidance, fault free analysis – Fire prevention and fire protection.

**UNIT V HEALTH HAZARDS AND LEGAL ASPECTS 12Hrs**

Health hazards – occupational – Industrial health hazards – health Standards and rules – safe working environments – parliamentary legislation – Factories act – Labor Welfare Act – ESI Act – Workmen Compensation Act.

**Total No of Hrs: 60Hrs**

**TEXT BOOK**

1. *William Handley, Industrial Safety Hand Book, Mc Graw-Hill Book Company, 2nd edition, 1969.*
2. *Fawatt, H.H and Wood, W.S., Safety and Accident Prevention in Chemical operation, Interscience, 1965.*

**REFERENCE**

*1. Heinrich, H.W, Dan Perterson, P.E and Nester Rood, Industrial Accident Prevention, McGraw- Hill, 1980. 2. Blake, R.P., Industrial Safety, PHI, III ed, 1963.*

## SEMESTER VII (PRACTICAL)

| Subject Code: BCT18L13 | Subject Name : Project Phase II | Ty/Lb/ETL | L | T / S.Lr | P/ R | C |
|---|---|---|---|---|---|---|
| | Prerequisite: Project Phase – 1 | Lb | 0 | 0/0 | 12/12 | 8 |

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

**OBJECTIVE:**

- The objective of the project is to make use of the knowledge gained by the student at various stages of the degree course.

**COURSE OUTCOMES (COs) : ( 3- 5)**

| | |
|---|---|
| **CO1** | . Projects to establish relevant instrumentation and analytical procedures. |
| **CO2** | Projects to give students an opportunity if they suggest an innovative / alternate approach to the existing solution. |

**Mapping of Course Outcomes with Program Outcomes (POs)**

| COs/POs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | H | - | - | H | - | M | - | - | H | - | - | L |
| CO2 | M | M | - | H | - | H | - | - | H | - | - | L |

| COs / PSOs | PSO1 | PSO2 | PSO3 | PSO4 |
|---|---|---|---|---|
| CO1 | H | H | M | H |
| CO2 | H | H | H | M |

**H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low**

| Category | Basic Sciences | Engineering Sciences | Humanities and Social Sciences | Program Core | Program Electives | Open Electives | Practical / Project | Internships / Technical Skill | Soft Skills | | | |
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|---|---|---|---|---|---|
| **BCT18L13** | **PROJECT PHASE II** | **0** | **0/0** | **12/12** | **8** |

Each student is required to submit a report on the project assigned to him by the department. The report should be based on the informationn available in the literature or data obtained in the laboratory/industry. Students, in addition to the home problem will be permitted to undertake industrial/ consultancy project work, outside the department, in industries/Research labs for which proportional weightage will be given in the final assessment.

The above phase I project may be continued or a separate project can be assigned depending upon the students interest.

**Criteria for Project Design:**

1. Projects suggested by the staff on the basis of collected industrial problem.
2. Projects to cater to development of infrastructure of the department.
3. Projects to cater to preparation for application for funding agents.
4. Projects to cater to obtaining relevant data for doctoral programme.
5. Projects to recalibrate and standardize existing equipment.
6. Projects to establish relevant instrumentation and analytical procedures.
7. Projects to give students an opportunity if they suggest an innovative / alternate approach to the existing solution

**SEMESTER V (ELECTIVE)**

| **Subject Code:** | **Subject Name: Food Technology** | **Ty / Lb/ ETL** | **L** | **T / SLr** | **P/ R** | **C** |
|---|---|---|---|---|---|---|
| **BCT18E01** | **Prerequisite: Chemistry and Microbiology** | **Ty** | **3** | **0/0** | **0/0** | **3** |

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

**OBJECTIVE:**

- To impart knowledge to the students about food processing and various unit operations involved in it, packaging, storing and preservation, food poisoning, food related hazards and safety, and transportation.

**COURSE OUTCOMES (COs) : ( 3- 5)**

| | |
|---|---|
| CO1 | Understanding the various causes of food deterioration and food poisoning. |
| CO2 | Identification of appropriate processing, preservation, and packaging method. |
| CO3 | Analyze product quality and effect of processing technique on it. |

**Mapping of Course Outcomes with Program Outcomes (POs)**

| COs/POs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | H | - | L | - | - | - | M | - | H | - | L | - |
| CO2 | M | - | L | - | L | - | H | - | - | - | L | M |
| CO3 | H | - | L | - | - | - | M | - | - | - | L | - |

| COs / PSOs | PSO1 | PSO2 | PSO3 | PSO4 | | | | |
|---|---|---|---|---|---|---|---|---|
| CO1 | H | M | L | H | | | | |
| CO2 | M | L | H | H | | | | |
| CO3 | M | H | H | L | | | | |

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

| Category | Basic Sciences | Engineering Sciences | Humanities and Social Sciences | Program Core | Program Electives | Open Electives | Practical / Project | Internships / Technical Skill | Soft Skills | | | |
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|---|---|---|---|---|---|
| **BCT18E01** | **FOOD TECHNOLOGTY** | **3** | **0/0** | **0/0** | **3** |

**UNIT I AN OVERVIEW 9Hrs**

General aspects of food industry world food needs and Indian situation.

**UNIT II FOOD CONSTITUENTS, QUALITY AND DERIVATIVE FACTORS 9Hrs**

Constituents of food quality and nutritive aspects food additives standards deteriorative factors and their control.

**UNIT III GENERAL ENGINEERING ASPECTS AND PROCESSING METHODS 9Hrs**

Preliminary processing methods conversion and preservation operations.

**UNIT IV FOOD PRESERVATION METHODS 9Hrs**

Preservation by heat and cold dehydration concentration drying irradiation microwave heating sterilization and pasteurization fermentation and pickling packing methods.

**UNIT V P RODUCTION AND UTILISATION OF FOOD PRODUCTS 9Hrs**

Cereal grains pulses vegetables; fruits; spices fats and oils bakery confectionery and chocolate productssoft and alcoholic beverages dairy products meat poultry and fish products.

**Total No. of Hours: 45Hrs**

**TEXT BOOKS:**

*1. Heid J.L. Joslyn M.A., Fundamentals of Food Processing Operation, The AVI publishing Co., West port 1967.*
*2. Potter N.N., Food Science, The AVI publishing Co., Westport, 1963.*

**REFERENCES:**

*1. Heldman D.R., Food Process Engineering, The AVI publishing co., 1975.*
*2. Charm S.E., The Fundamentals of Foods Engineering, The AVI Publishing Co., Westport, 1966*

| Subject Code: BCT18E02 | Subject Name: Industry Pollution Prevention And Control | Ty / Lb/ ETL | L | T / SLr | P/ R | C |
|---|---|---|---|---|---|---|
| | Prerequisite: Chemistry and Microbiology | Ty | 3 | 0/0 | 0/0 | 3 |

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

**OBJECTIVE:**

- To impart knowledge to the students about food processing and various unit operations involved in it, packaging, storing and preservation, food poisoning, food related hazards and safety, and transportation.

**COURSE OUTCOMES (COs) : ( 3- 5)**

| | |
|---|---|
| **CO1** | Understanding the various causes of food deterioration and food poisoning. |
| **CO2** | Identification of appropriate processing, preservation, and packaging method. |
| **CO3** | Analyze product quality and effect of processing technique on it. |

**Mapping of Course Outcomes with Program Outcomes (POs)**

| COs/POs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | H | - | L | - | - | - | M | - | H | - | L | - |
| CO2 | M | - | L | - | L | - | H | - | - | - | L | M |
| CO3 | H | - | L | - | - | - | M | - | - | - | L | - |

| COs / PSOs | PSO1 | PSO2 | PSO3 | PSO4 | | | | |
|---|---|---|---|---|---|---|---|---|
| CO1 | H | M | L | H | | | | |
| CO2 | M | L | H | H | | | | |
| CO3 | M | H | H | L | | | | |

**H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low**

| Category | Basic Sciences | Engineering Sciences | Humanities and Social Sciences | Program Core | Program Electives | Open Electives | Practical / Project | Internships / Technical Skill | Soft Skills | | | |
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|---|---|---|---|---|---|
| **BCT18E02** | **INDUSTRY POLLUTION PREVENTION AND CONTROL** | **3** | **0/0** | **0/0** | **3** |

**UNIT I INTRODUCTION 9Hrs**

Industrial activity and environment, industrialization and sustainable development indicators of sustainability-sustainability strategies-Barriers to sustainability- Pollution prevention in achieving sustainability

**UNIT II POLICIES AND REGULATIONS 9Hrs**

Prevention vs control of industrial pollution-Environment policies and Regulations to encourage pollution prevention 143 CHEM-Engg&Tech-SRM-2013

**UNIT III ENVIRONMENTAL CONTAMINANTS 9Hrs**

Environment friendly chemical processes-Properties of environmental contaminants - Regulations for clean environment and implications for industries

**UNIT IV LIFE CYCLE ASSESSMENT 9Hrs**

Life cycle assessment and pollution prevention economics-Design for the environment-International environmental standards-Environmental technology assessment.

**UNIT V INDUSTRIAL APPLICATIONS OF POLLUTION PREVENTION 9Hrs**

Water,energy and reagent conservation-residuals management-Economic recovery and recycling of wastes. Industrial applications of pollution prevention, Life cycle assessment, waste audits and technology assessments

**Total No. of Hours: 45Hrs**

**TEXT BOOK**

*1. Bishop .P, "Pollution Prevention: Fundamentals and Practice", McGraw Hill International Edn., McGraw Hill Book Co., Singapore, 2000.*

*2. Roy T.K. (Editor), "Chemical Technology for better Environment", Allied Publishers Ltd., Chennai, 1998.*

**REFERENCES**

1. Freeman. H.M , "Industrial Pollution Prevention Hand Book", McGraw Hill, 1995. 2. James G. Mann and Y.A.Liu, "Industrial Water Reuse and Waste Water Minimization", McGraw Hill, 1999

| Subject Code: BCT18E03 | Subject Name: Chemistry Of Polymer And Composite Materials | Ty / Lb/ ETL | L | T / SLr | P/ R | C |
|---|---|---|---|---|---|---|
| | Prerequisite: Chemistry | Ty | 3 | 0/0 | 0/0 | 3 |

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

**OBJECTIVE:**

- To enable the students to understand the mechanism of polymerization, various techniques of polymerization, characterization of polymers by molecular weight, reactions and degradation of polymers.

**COURSE OUTCOMES (COs) : ( 3- 5)**

| | |
|---|---|
| CO1 | Will develop knowledge in polymerization techniques |
| CO2 | Will be aware about chemical reaction of polymers |
| CO3 | Will be able to determine the molecular weight of the polymer |

**Mapping of Course Outcomes with Program Outcomes (POs)**

| COs/POs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | H | - | L | - | M | - | M | - | H | - | L | M |
| CO2 | M | L | L | - | L | L | H | - | M | - | L | M |
| CO3 | H | - | L | - | - | - | M | - | M | - | L | M |

| COs / PSOs | PSO1 | PSO2 | PSO3 | PSO4 | | | | |
|---|---|---|---|---|---|---|---|---|
| CO1 | H | M | L | H | | | | |
| CO2 | M | L | H | H | | | | |
| CO3 | M | H | H | L | | | | |

**H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low**

| Category | Basic Sciences | Engineering Sciences | Humanities and Social Sciences | Program Core | Program Electives | Open Electives | Practical / Project | Internships / Technical Skill | Soft Skill | | | |
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|---|---|---|---|---|---|
| **BCT18E03** | **CHEMISTRY OF POLYMER AND COMPOSITE MATERIALS** | **3** | **0/0** | **0/0** | **3** |

**UNIT I FUNDAMENTAL CONCEPTS OF POLYMER 9Hrs**

Introduction, classification of polymer, nomenclature, trade and common name of polymer, monomers and functionality concept of monomers (with example), concept of cross linking and isomerism, general applications of polymer.

**UNIT II SOLVENTS, FILLERS AND ADDITIVES 9Hrs**

**Solvents**: Introduction, Classification, types of solvents, types of solutions, method of finding chain length, demixing, flexible chains, particle size & shape, compatibility, phase transition, ternary systems.**Fillers**: Introduction, types of fillers, particle geometry, organic fillers, cellulosic, fibers, and inorganic fillers, applications.**Additives**: Introduction, plasticizers, classification, effect on chemical properties & stability, flexibilizers, release agents, antioxidants, applications.

**UNIT III POLYMERIZATION PATHWAY 9Hrs**

Step polymerization, chain polymerization, anionic polymerization, cationic polymerization, free radical polymerization (with kinetics), and ring opening polymerization.

**UNIT IV POLYMER SYNTHESIS 9Hrs**

Synthesis and applications of polystyrene, polyvinyl acetate, nylon-6, nylon-66, polyvinyl chloride, unsaturated polyvinyl chloride, chlorinated polyvinyl chloride, teflon, poly (3- hydroxybutyrate-co- 3-hydroxyvalerate)(PHBV), polyethylene terephthalate, poly glyptal, polymethyl methacrylate, poly urethane, neoprene, phenol formaldehyde, urea formaldehyde, melamine formaldehyde, epoxy resins, poly propylene, High-density polyethylene, low- density polyethylene.

**UNIT V COMPOSITE MATERIALS 9Hrs**

Introduction and industrial applications of composites, **Fiber Reinforced Composites (FRC):** introduction, importance and properties, manufacture of fiber fabric, manufacture of fiber preforms, Forming processes, Bladder moulding, Compression moulding, Autoclave and vacuum bag, Mandrel wrapping, Wet layup, Chopper gun, Filament winding, Pultrusion, Resin transfer moulding, Carbon fibre, Aramid fibre material, Kevlar.Introduction, example and application of Particle Reinforced Composites (PRC).

**Total No. of Hours: 45Hrs**

**REFERENCE BOOKS:**

1. *A Textbook of Polymers – Vol I & II, M. S. Bhatnagar, S. Chand Publication*
2. *Plastic Materials – John Brydson, Elsevier Publication*
3. *Polymer Science & Technology – Joel Fried, PHI*
4. *Introductory Polymer Chemistry, G. S. Misra, New Age International*
5. *Polymer Science, G. Govariker, New Age International*

**SEMESTER VI (ELECTIVE)**

| **Subject Code:** | **Subject Name: Green Chemistry and Engineering** | **Ty/Lb/ETL** | **L** | **T / S.Lr** | **P/ R** | **C** |
|---|---|---|---|---|---|---|
| **BCT18E04** | **Prerequisite: Nil** | **Ty** | **3** | **0/0** | **0/0** | **3** |

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

**OBJECTIVE:**

- To make the students aware of global environmental issues, concepts behind pollution prevention, environmental risks, green chemistry, methods to evaluate environmental costs and life cycle assessments.

**COURSE OUTCOMES (COs) :**

| | |
|---|---|
| **CO1** | Explain how Green chemistry and sustainability relates to problems of societal concern. |
| **CO2** | Analyze a process and identify how it may be made more environmentally friendly/sustainable/green. |
| **CO3** | Integrate, synthesize, and apply knowledge of the relationship between science and technology and societal issues in both focused and broad interdisciplinary contexts. |

**Mapping of Course Outcomes with Program Outcomes (POs)**

| **COs/POs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | **M** | **M** | **L** | **H** | **-** | **-** | **-** | **-** | **-** | **M** | **-** | **-** |
| **CO2** | **H** | **M** | **L** | **H** | **-** | **-** | **H** | **-** | **-** | **-** | **-** | **L** |
| **CO3** | **M** | **H** | **H** | **H** | **L** | **-** | **-** | **-** | **H** | **-** | **-** | **-** |

| **COs / PSOs** | **PSO1** | **PSO2** | **PSO3** | **PSO4** |
|---|---|---|---|---|
| **CO1** | **M** | **L** | **H** | **H** |
| **CO2** | **H** | **H** | **M** | **L** |
| **CO3** | **H** | **M** | **L** | **L** |

**H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low**

| Category | Basic Sciences | Engineering Sciences | Humanities and Social Sciences | Program Core | Program Electives | Open Electives | Practical / Project | Internships / Technical Skill | Soft Skill | | | |
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|---|---|---|---|---|---|
| **BCT18E04** | **GREEN CHEMISTRY AND ENGINEERING** | **3** | **0/0** | **0/0** | **3** |

**UNIT I ENVIROMENTAL ISSUES 9Hrs**

Overview of Major Environmental Issues, Global Environmental Issues. Air Quality Issues. Water Quality Issues, Ecology, Natural Resources, Description of Risk. Value of Risk Assessment in the Engineering Profession. Risk-Based Environmental Law. Risk Assessment Concepts. Hazard Assessment. Dose- Response. Risk Characterization.

**UNIT II POLLUTION PRAVENTION 9Hrs**

Pollution Prevention- Pollution Prevention Concepts and Terminology. Chemical Process Safety. Responsibilities for Environmental Protection. Environmental Persistence. Classifying Environmental Risks Based on Chemical Structure.Exposure Assessment for Chemicals in the Ambient Environment.

**UNIT III GREEN CHEMISTRY 9Hrs**

Green Chemistry. Green Chemistry Methodologies. Quantitative/Optimization-Based Frameworks for the Design of Green Chemical Synthesis Pathways.Green Chemistry Pollution Prevention in Material Selection for Unit Operations.Pollution Prevention for Chemical Reactors. Pollution Prevention for Separation Devices. Pollution Prevention Applications for Separative Reactors. Pollution
Prevention in Storage Tanks and Fugitive Sources.

**UNIT IV ESTIMATION OF ENVIROMENTAL EFFECTS 9Hrs**

Process Energy Integration. Process Mass Integration. Case Study of a Process Flow sheet- Estimation of Environmental Fates of Emissions and Wastes.

**UNIT V ENVIROMENTAL EVALUATIONS 9Hrs**

Magnitudes of Environmental Costs. A Framework for Evaluating Environmental Costs. Hidden Environmental Costs. Liability Costs. Internal Intangible Costs.External Intangible Costs. Introduction to Product Life Cycle Concepts. Life-Cycle Assessment. Life-Cycle Impact Assessments. Streamlined Life-Cycle Assessments. Uses of Life-Cycle Studies.

**Total No. of Hours: 45Hrs**

**TEXT BOOKS:**

*1. Allen, D.T., Shonnard, D.R, Green Engineering: Environmentally Conscious Design of Chemical Processes. Prentice Hall PTR 2002.*
*2. MukeshDoble and Anil Kumar Kruthiventi, Green Chemistry and Engineering, Elsevier, Burlington, USA, 2007.*

| Subject Code: BCT18E05 | Subject Name: Modern Separation Processes | T y/ Lb/ ETL | L | T / SLr | P/ R | C |
|---|---|---|---|---|---|---|
| | Prerequisite: Advanced separation | Ty | 3 | 0/0 | 0/0 | 3 |

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

**OBJECTIVE:**

- To enable the students to learn the principle and technical concept of advanced separation processes.

**COURSE OUTCOMES (COs) : ( 3- 5)**

| | |
|---|---|
| **CO1** | The students would fully understand key concepts of separation processes including equilibrium stages, reflux, countercurrent contacting, limiting cases, efficiency and mass transport effects. |
| **CO2** | To do all calculation. |

**Mapping of Course Outcomes with Program Outcomes (POs)**

| COs/POs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | H | - | - | H | - | - | M | - | - | - | - | L |
| CO2 | M | - | - | - | - | - | H | - | - | - | M | - |

| COs / PSOs | PSO1 | PSO2 | PSO3 | PSO4 |
|---|---|---|---|---|
| CO1 | H | M | - | - |
| CO2 | M | L | - | - |

**H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low**

| Category | Basic Sciences | Engineering Sciences | Humanities and Social Sciences | Program Core | Program Electives | Open Electives | Practical / Project | Internships / Technical Skill | Soft Skills | | | |
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|---|---|---|---|---|---|
| **BCT18E05** | **MODERN SEPARATION PROCESSES** | **3** | **0/0** | **0/0** | **3** |

**UNIT I BASICS OF SEPARATION PROCESS 9Hrs**

Review of Conventional Processes, Recent advances in Separation Techniques based on size, surface properties, ionic properties and other special characteristics of substances, Process concept, Theory and Equipment used in cross flow Filtration, cross flow Electro Filtration, Surface based solid – liquid
separations involving a second liquid.

**UNIT II MEMBRANE SEPARATIONS 9Hrs**

Types and choice of Membranes, Plate and Frame, tubular, spiral wound and hollow fiber Membrane Reactors and their relative merits, commercial, Pilot Plant and Laboratory Membrane permeators involving Dialysis, Reverse Osmosis, Nanofiltration, Ultra filtration and Micro filtration, Ceramic- Hybrid process and Biological Membranes.

**UNIT III SEPARATION BY ADSORPTION 9Hrs**

Types and choice of Adsorbents, Adsorption Techniques, Dehumidification Techniques, Affinity Chromatography and Immuno Chromatography, Recent Trends in Adsorption.

**UNIT IV INORGANIC SEPARATIONS 9Hrs**

Controlling factors, Applications, Types of Equipment employed for Electrophoresis, Dielectrophoresis, Ion Exchange Chromatography and Eletrodialysis, EDR, Bipolar Membranes.

**UNIT V OTHER TECHNIQUES 9Hrs**

Separation involving Lyophilisation, Pervaporation and Permeation Techniques for solids, liquids and gases, zone melting, Adductive Crystallization, other Separation Processes, Supercritical fluid Extraction, Oil spill Management,Industrial Effluent Treatment by Modern Techniques.

**Total No. of Hours: 45Hrs**

**REFERENCES*:***

*1. King, C. J., "Separation Processes", Tata McGraw Hill, 1982.83*
*2. Roussel, R. W., "Handbook of Separation Process Technology", John Wiley,New York, 1987.*
*3. Nakagawal, O. V., "Membrane Science and Technology"' Marcel Dekkar,1992.*

| Subject Code: | Subject Name: Renewable Energy Engineering | Ty / Lb/ ETL | L | T / SLr | P/ R | C |
|---|---|---|---|---|---|---|
| BCT18E06 | Prerequisite: conversion technologies | Ty | 3 | 0/0 | 0/0 | 3 |

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

**OBJECTIVE:**

- This course helps the students to understand the importance, availability, conversion technologies of renewable energy resources and its applications.

**COURSE OUTCOMES (COs) : ( 3- 5)**

| | |
|---|---|
| **CO1** | Various aspects of solar energy and utilization. |
| **CO2** | Familiarize other renewable energy sources. |

**Mapping of Course Outcomes with Program Outcomes (POs)**

| COs/POs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | H | M | - | - | H | - | - | - | M | - | - | H |
| CO2 | M | H | - | L | - | - | - | - | H | - | L | - |

| COs / PSOs | PSO1 | PSO2 | PSO3 | PSO4 |
|---|---|---|---|---|
| CO1 | H | M | - | - |
| CO2 | M | L | - | - |

**H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low**

| Category | Basic Sciences | Engineering Sciences | Humanities and Social Sciences | Program Core | Program Electives | Open Electives | Practical / Project | Internships / Technical Skill | Soft Skills | | | |
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|---|---|---|---|---|---|
| **BCT18E06** | **RENEWABLE ENERGY ENGINEERING** | **3** | **0/0** | **0/0** | **3** |

**UNIT I INTRODUCTION 9Hrs**

World energy status, Current energy scenario in India, Environmental aspects of energy utilization, Environment - Economy - Energy and Sustainable development,energy planning.classification of Energy resources, Advantages and disadvantages of Non-Conventional source of energy, Renewable energy
resources - potentials -achievements – applications.

**UNIT II SOLAR ENERGY 9Hrs**

Basic concepts, Solar thermal systems – Flat plate and concentrating collectors, Solar passive space - Solar heating and cooling techniques – Solar desalination –Solar Pond - Solar cooker - Solar dryers-Solar furnaces - Solar pumping, Solar 139 CHEM-Engg&Tech-SRM-2013 green house- Solar thermal power plant – Solar photo voltaic conversion – Solar cells – PV applications

**UNIT III WINDENERGY 9Hrs**

Introduction-Background-Availability- wind power plants , Power from the wind,Wind energy conversion systems, site characteristics, Wind turbines types –Horizontal and vertical axis-design principles of wind turbine, Magnus effect-Performance.Wind energy Applications – New developments - Safety and environmental aspects.

**UNIT IV BIOMASS ENERGY 9Hrs**

Biomass – usable forms- composition- fuel properties – applications, Biomass resources, Biomass conversion technologies - direction combustion - pyrolysis –gasification -anaerobic digestion, Bioethanol and Biodiesel Production – Recent developments.Energy farming, Biogas technology - Family biogas plants,Community and institutional biogas plants – design consideration – applications**.**

**UNIT V OTHER RENEWABLE ENERGY SOURCES 9Hrs**

Tidal energy – Wave energy – Open and closed OTEC Cycles – Small hydro –Geothermal energy Fuel cell technology - types, principle of operation –applications.Hydrogen energy production - Storage system.

**Total No. of Hours: 45Hrs**

**TEXT BOOK:**

*1. Rai. G.D. "Non Conventional Energy Sources", Khanna Publishers, New Delhi, 1999.*
*2. Sukhatme.. S.P. "Solar Energ", Tata McGraw Hill Publishing Company Ltd., New Delhi, 1997.*
*3. "Renewable energy sources of conversion technology": Bansal..N.K Manfred Kleen Man and Michael Meliss, TMH Publicatio*

***REFERENCES:***

*1. Kothari. P, K C, Singal and Rakesh Ranjan, " Renewable EnergySources and Emerging Technologies ", PHI Pvt. Ltd.,New Delhi, 2008*
*2. Godfrey Boyle, Renewable Energy, Power for a Sustainable Future, OxfordUniversityPress, U.K, 1996.*
*3. Twidell. J.W. & Weir, A., Renewable Energy Sources, EFN Spon Ltd., UK,1986.*
*4.* Freris, Wind Energy Conversion systems, Prentice Hall, UK, 1990.

**SEMESTER VII (ELECTIVE)**

| **Subject Code: BCT18E07** | **Subject Name: Computational Fluid Dynamics** | **T y/ Lb/ ETL** | **L** | **T / S.Lr** | **P/ R** | **C** |
|---|---|---|---|---|---|---|
| | **Prerequisite: Basic Mathematics and fluid mechanics** | **Ty** | **3** | **0/0** | **0/0** | **3** |

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

**OBJECTIVE:**

- To make the students to demonstrate competence in setting up computational fluid dynamics models for some industrially important applications. This technical competence in building and conducting CFD simulations is a skill.

**COURSE OUTCOMES (COs) : ( 3- 5)**

| | |
|---|---|
| **CO1** | Upon completing the course, the student should have a Hands-on experience with a commercial CFD program. |
| **CO2** | |

**Mapping of Course Outcomes with Program Outcomes (POs)**

| **COs/POs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | **M** | **H** | **-** | **-** | **L** | **-** | **-** | **-** | **H** | **-** | **-** | **H** |
| **CO2** | **M** | **H** | **-** | **-** | **-** | **-** | **-** | **-** | **H** | **H** | **-** | **-** |

| **COs / PSOs** | **PSO1** | **PSO2** | **PSO3** | **PSO4** | | | | |
|---|---|---|---|---|---|---|---|---|
| **CO1** | **M** | **M** | **-** | **-** | | | | |
| **CO2** | **H** | **L** | **-** | **-** | | | | |

**H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low**

| Category | Basic Sciences | Engineering Sciences | Humanities and Social Sciences | Program Core | Program Electives | Open Electives | Practical / Project | Internships / Technical Skill | Soft Skil | | | |
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|---|---|---|---|---|---|
| **BCT18E07** | **COMPUTATIONAL FLUID DYNAMICS** | **3** | **0/0** | **0/0** | **3** |

**UNIT I CONSERVATION LAWS AND TURBULENCE MODELS 9Hrs**

Governing equations of fluid flow and heat transfer –mass conservation, momentum and energy equation, differential and integral forms, conservation and non-conservation form. Characteristics of turbulent flows, time averaged Navier Strokes equations, turbulence models-one and two equation, Reynolds Stress, LES and DNS.

**UNIT II FINITE DIFFERNCE APPROXIMATION 9Hrs**

Mathematical behaviour of PDE, finite difference operators, basic aspects of discretization by FDM, explicit and implicit methods, error and stability analysis.

**UNIT III FINITE VOLUME METHOD 9Hrs**

Diffusion problems – explicit and implicit time integration Convection-diffusion problems – properties of discretisation schemes, central, upwind, hybrid, QUICK schemes Solution of discretised equations.

**UNIT IV FLOW FIELD COMPUTATION 9Hrs**

Pressure velocity coupling, staggered grid, SIMPLE algorithm, PISO algorithm for steady and unsteady flows.

**UNIT V GRID GENERATION 9Hrs**

Physical aspects, simple and multiple connected regions, grid generation by PDE solution, grid generation by algebraic mapping.

**Total No. of Hours: 45Hrs**

**TEXT BOOKS:**

*1. Anderson, J. D., "Computational Fluid Dynamics: The Basics with Applications", McGraw-Hill, 1995.*
*2. Fletcher, C. A. J., "Computational Techniques for Fluid Dynamics", Springer Verlag, 1997.*
*3. Versteeg, H.K. and Malalasekera, W., "An Introduction to Computational Fluid Dynamics: The Finite Volume Method", Pearson Education Ltd., 2007.*

**REFERENCES:**

*1. Chung T.J Computational Fluid Dynamics Cambridge University Press,2003.*
*2. Muralidhar, K., and Sundararajan, T., "Computational Fluid Flow and Heat Transfer", arosa Publishing House, New Delhi, 2001.*
*3. Ghoshdastidar, P.S., "Computer Simulation of flow and heat transfer" Tata McGraw – Hill Publishing Company Ltd. 1998.*
*4. Subas, V. Patankar "Numerical heat transfer fluid flow", Hemisphere Publishing Corporation, 1980.*
*5. Taylor, C and Hughes, J.B. "Finite Element Programming of the Navier Stock Equation", Pineridge Press Limited, U.K., 1981.*

| Subject Code: BCT18E08 | Subject Name : Frontiers of Chemical Engineering | T y/ Lb/ETL | L | T /S.Lr | P/ R | C |
|---|---|---|---|---|---|---|
| | Prerequisite: Chemical product design | Ty | 3 | 0/0 | 0/0 | 3 |

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

**OBJECTIVE:**

- To enable the students to understand the chemical product design and available renewable energy resources.

**COURSE OUTCOMES (COs) : ( 3- 5)**

| | |
|---|---|
| **CO1** | Upon completing the course, the student should have a Hands-on experience with a commercial CFD program. |
| **CO2** | To do all calculation. |

**Mapping of Course Outcomes with Program Outcomes (POs)**

| COs/POs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | M | - | M | - | - | - | L | - | - | - | - | H |
| CO2 | M | - | - | - | - | H | - | - | - | M | - | H |

| COs / PSOs | PSO1 | PSO2 | PSO3 | PSO4 |
|---|---|---|---|---|
| CO1 | M | M | - | - |
| CO2 | H | L | - | - |

**H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low**

| Category | Basic Sciences | Engineering Sciences | Humanities and Social Sciences | Program Core | Program Electives | Open Electives | Practical / Project | Internships / Technical Skill | Soft Skills | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
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|---|---|---|---|---|---|
| **BCT18E08** | **FRONTIERS OF CHEMICAL ENGINEERING** | **3** | **0/0** | **0/0** | **3** |

**UNIT I PROCESS INTENSIFICATION 9Hrs**

Novel reactor configurations combination of reaction and separation use of different energy fields, lab on a chip.

**UNIT II CHEMICAL PRODUCT DESIGN 9Hrs**

Scope and importance identification of needs and specifications sources of ideas and screening ideas selection of product idea process development for product manufacture specialty chemical manufacture economic aspects.

**UNIT III RENEWABLE ENERGY 9Hrs**

Hydrogen production, Hydrogen economy, Fuel Cell Technology, biofuel cells and bio-hydrogen, solar energy.

**UNIT IV MATERIALS ENGINEERING 9Hrs**

Polymers and composites, ceramics and glasses, colloidal dispersions and nanoparticles, thin films and electronic materials.

**UNIT V BIOENGINEERING 9Hrs**

Biomechanics, biotransport and biomaterials, biomolecular and cellular engineering, drug discovery and development.

**Total No. of Hours: 45Hrs**

**TEXT BOOKS:**

*1. Keil, F. J., Modeling of Process Intensification Wiley-VCH Verlag GmbH & Co. KGaA2007*
*2. Cussler, E.l. and Moggridge, G.D., "Chemical product design" Cambridge University Press, Cambridge, 2001*
*3. Hoffmann,P, Tomorrow's energy: hydrogen, fuel cells, and the prospects for a cleaner planet, MIT Press, Sabon, 2002.*

**REFERENCES:**

*1. Mitchell, B.S., An introduction to materials engineering and science for chemical and materials engineers, John Wiley and Sons Inc., New Jersey,2004*

| Subject Code: BCT18E09 | Subject Name: Industrial Management | T y/ L/b ETL | L | T / SLr | P/ R | C |
|---|---|---|---|---|---|---|
| | Prerequisite: Basic Management | Ty | 3 | 0/0 | 0/0 | 3 |

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

**OBJECTIVE:**

- To provide an opportunity to learn basic management concepts essential for business.

**COURSE OUTCOMES (COs) : ( 3- 5)**

| | |
|---|---|
| **CO1** | At the end of this course, the students would have knowledge on the basic management principles to become management(s) professional. |
| **CO2** | To do all calculation. |

**Mapping of Course Outcomes with Program Outcomes (POs)**

| COs/POs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | H | - | - | - | - | M | - | M | - | - | - | L |
| CO2 | M | - | - | - | - | H | - | - | - | H | - | - |

| COs / PSOs | PSO1 | PSO2 | PSO3 | PSO4 |
|---|---|---|---|---|
| CO1 | H | M | - | - |
| CO2 | M | L | - | - |

**H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low**

| Category | Basic Sciences | Engineering Sciences | Humanities and Social Sciences | Program Core | Program Electives | Open Electives | Practical / Project | Internships / Technical Skill | Soft Skills | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
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| BCT18E09 | INDUSTRIAL MANAGEMENT | 3 | 0/0 | 0/0 | 3 |
|---|---|---|---|---|---|

**UNIT I INTRODUCTION 9Hrs**

Management - Definition – Functions – Evolution of Modern Management –Scientific Management Development of Management Thought. Approaches to the study of Management, Forms of Organization – Individual Ownership – Partnership – Joint Stock Companies – Co-operative Enterprises – Public Sector Undertakings, Corporate Frame Work – Share Holders – Board of Directors – Committees – Chief Executive –Trade Union.

**UNIT II FUNCTIONS OF MANAGEMENT 9Hrs**

Planning – Nature and Purpose – Objectives – Strategies – Policies and Planning Premises – Decision Making – Organizing – Nature and Process – Premises – Departmentalization – Line and staff – Decentralization – Organizational culture, Staffing - selection and training – Placement –Performance appraisal – Career Strategy – Organizational Development. Leading – Managing human factor – Leadership – Communication, Controlling - Process of Controlling – Controlling techniques, productivity and operations management – Preventive control, Industrial Safety.

**UNIT III ORGANIZATIONAL BEHAVIOUR 9Hrs**

Definition – Organization – Managerial Role and functions – Organizational approaches, Individual behaviour – causes – Environmental Effect – Behavior and Performance, Perception – Organizational Implications. Personality – Contributing factors - Dimension – Need Theories – Process Theories – Job Satisfaction, Learning and Behavior – Learning Curves, Work Design and approaches.

**UNIT IV GROUP DYNAMICS 9Hrs**

Group Behavior – Groups – Contributing factors – Group Norms, Communication – Process – Barriers to communication – Effective communication, leadership – formal and informal characteristics – Managerial Grid – Leadership styles – Group Decision Making – Leadership Role in Group. Decision, Group Conflicts – Types – Causes – Conflict Resolution – Inter group relations and conflict, Organization centralization and decentralization – Formal and informal – Organizational Structures – Organizational Change and Development – Change Process – Resistance to Change – Culture andEthics.

**UNIT V MODERN CONCEPTS 9Hrs**

Management by Objectives (MBO), Management by Exception (MBE), Strategic. Management - Planningfor Future direction – SWOT Analysis – Information technology in management – Decisions support system – Business Process. Re-engineering (BPR) – Enterprises Resource Planning (ERP) – Supply Chain Management (SCM) – Activity Based Management (ABM).

**Total No. of Hours: 45Hrs**

**TEXT BOOKS:**

*1. Herald Knottz and Heinz Weihrich, 'Essentials of Management', TataMcGraw Hill Education Pvt. Ltd., 2010.85*

*2. Stephen P. Robbins, 'Organization Behaviour', Pearson Education Inc., 13 edition, 2010.*

**REFERENCES*:***

*1. Ties, AF, Stoner and R.Edward Freeman, 'Management' Prentice Hall of India Pvt. Ltd. New Delhi 110 011, 1992*

*2. Joseph J, Massie, 'Essentials of Management' Prentice Hall of India Pvt. Ltd. 1985.*

*3. P.C. Tripathi & P.N. Reddy, 'Principles of Management', TataMcGraw Hill,2006.*

| Subject Code: BCT18E10 | Subject Name: Drugs And Pharmaceutical Technology | T y/ L/b ETL | L | T / SLr | P/ R | C |
|---|---|---|---|---|---|---|
| | Prerequisite: Engineering Chemistry | Ty | 3 | 0/0 | 0/0 | 3 |

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

**OBJECTIVE:**

- To give the students an understanding of the poly technical nature of engineering and drug discovery in the Pharmaceutical industry involving Chemical Engineering.

**COURSE OUTCOMES (COs) : ( 3- 5)**

| | |
|---|---|
| **CO1** | At the end of this course, the students would have knowledge on the basic management principles to become management(s) professional. |
| **CO2** | To do all calculation. |

**Mapping of Course Outcomes with Program Outcomes (POs)**

| COs/POs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | H | - | - | - | - | M | - | M | - | - | - | L |
| CO2 | M | - | - | - | - | H | - | - | - | H | - | - |

| COs / PSOs | PSO1 | PSO2 | PSO3 | PSO4 |
|---|---|---|---|---|
| CO1 | H | M | - | - |
| CO2 | M | L | - | - |

**H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low**

| Category | Basic Sciences | Engineering Sciences | Humanities and Social Sciences | Program Core | Program Electives | Open Electives | Practical / Project | Internships / Technical Skill | Soft Skills | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
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| BCT18E10 | DRUGS AND PHARMACEUTICAL TECHNOLOGY | 3 | 0/0 | 0/0 | 3 |
|---|---|---|---|---|---|

**UNIT I INTRODUCTION 9Hrs**

Development of drugs and pharamaceutical industry; organic the rapeuticagents uses and economics.

**UNIT II DRUG METABOLISM AND PHARMACO KINETICS &MICROBIOLOGICAL AND ANIMAL PRODUCTS 9Hrs**

Drug metabolism; physico chemical principles; pharma kinetics-action of drugson human bodies. Antibioticsgram positive, gram negative and broad spectrumantibiotics; hormones

**UNIT III IMPORTANT UNIT PROCESSES AND THEIR APPLICATION 9Hrs**

Chemical conversion processes; alkylation; carboxylation; condensation andcyclisation; dehydration, esterification, halogenation, oxidation, sulfonation;complex chemical conversions fermentation.

**UNIT IV MANUFACTURING PRINCIPLES & PACKING AND QUALITYCONTROL 9Hrs**

Compressed tablets; wet granulation; dry granulation or slugging; advancementin granulation; direct compression, tablet presses formulation; coating pills;capsules sustained action dosage forms; parential solutions, oral liquids;injections; ointments; standard of hygiene and manufacturing practice. Packing; packing techniques; quality control.

**UNIT V PHARMACEUTICAL PRODUCTS & PHARMACEUTICALANALYSIS 9Hrs**

Vitamins; cold remedies; laxatives; analgesics; nonsteroidal contraceptives;external antiseptics; antacids and others. Analytical methods and tests forvarious drugs and pharmaceuticals – spectroscopy, chromatography, fluorimetry, polarimetry, refractometry, pHmetry.

**Total No. of Hrs: 45Hrs**

**TEXT BOOK:**

*1. Rawlines, E.A.; " Bentleys Text book of Pharmaceutics ", III Edition, BailliereTindall, London, 1977.*

**REFERENCES:**

*1. Yalkonsky, S.H.; Swarbick. J.; " Drug and Pharamaceutical Sciences ", Vol.I, II, III, IV, V, VI and VII, Marcel Dekkar Inc., New York, 1975.*

2. *"Remingtons Pharmaceutical Sciences ", Mack Publishing Co., 1975.*

**SEMESTER VIII (ELECTIVE)**

| Subject Code: | Subject Name: Professional Ethics in Engineering | Ty / Lb/ ETL | L | T / SLr | P/ R | C |
|---|---|---|---|---|---|---|
| BCT18E11 | Prerequisite: Moral science and general English | Ty | 3 | 0/0 | 0/0 | 3 |

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

**OBJECTIVE:**

- To enable the students to create an awareness on Engineering Ethics andHuman Values, to instill Moral and Social Values and Loyalty and to appreciate the rights of others.

**COURSE OUTCOMES (COs) : ( 3- 5)**

| | |
|---|---|
| **CO1** | Identify and analyze an ethical issue in the subject matter under investigation or in a relevant field. |
| **CO2** | Identify ethical concerns in research and intellectual contexts, including academic integrity, use and citation of sources, the objective presentation of data, and the treatment of human subjects. |

**Mapping of Course Outcomes with Program Outcomes (POs)**

| COs/POs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | H | - | - | L | - | - | - | L | - | H | - | - |
| CO2 | M | - | - | L | - | - | M | - | - | - | - | L |

| COs / PSOs | PSO1 | PSO2 | PSO3 | PSO4 |
|---|---|---|---|---|
| CO1 | H | M | - | - |
| CO2 | M | L | - | - |

**H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low**

| Category | Basic Sciences | Engineering Sciences | Humanities and Social Sciences | Program Core | Program Electives | Open Electives | Practical / Project | Internships / Technical Skill | Soft Skills | | | |
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| **BCT18E11** | **PROFESSIONAL ETHICS IN ENGINEERING** | **3** | **0/0** | **0/0** | **3** |

**UNIT I HUMAN VALUES 9Hrs**

Morals, values and Ethics – Integrity – Work ethic – Service learning – Civicvirtue – Respect for others – Living peacefully – Caring – Sharing – Honesty –Courage – Valuing time – Cooperation – Commitment – Empathy – Self confidence – Character – Spirituality – Introduction to Yoga and meditation for professional excellence and stress management.

**UNIT II ENGINEERING ETHICS 9Hrs**

Senses of 'Engineering Ethics' – Variety of moral issues – Types of inquiry –Moral dilemmas – Moral Autonomy – Kohlberg's theory – Gilligan's theory –Consensus and Controversy – Models of professional roles Theories about right action – Self interest – Customs and Religion – Uses of Ethical Theories

**UNIT III ENGINEERING AS SOCIAL EXPERIMENTATION 9Hrs**

Engineering as Experimentation – Engineers as responsible Experimenters –Codes of Ethics – A Balanced Outlook on Law.

**UNIT IV SAFETY, RESPONSIBILITIES AND RIGHTS 9Hrs**

Safety and Risk – Assessment of Safety and Risk – Risk Benefit Analysis andReducing Risk Respect for Authority – Collective Bargaining – Confidentiality– Conflicts of Interest – Occupational Crime – Professional Rights – Employee Rights – Intellectual Property Rights (IPR) – Discrimination.

**UNIT V GLOBAL ISSUES 9Hrs**

Multinational Corporations – Environmental Ethics – Computer Ethics –Weapons Development – Engineers as Managers – Consulting Engineers –Engineers as Expert Witnesses and Advisors – Moral Leadership –Code of Conduct – Corporate Social Responsibility

**Total No. of Hours: 45Hrs**

**TEXT BOOKS:**

*1. Mike W. Martin and Roland Schinzinger, "Ethics in Engineering", Tata McGraw Hill, New Delhi, 2003.*
*2. Govindarajan M, Natarajan S, Senthil Kumar V. S, "Engineering Ethics", Prentice Hall of India, New Delhi, 2004.*

**REFERENCES*:***

*1. Charles B. Fleddermann, "Engineering Ethics", Pearson Prentice Hall, NewJersey, 2004.*
*2. Charles E. Harris, Michael S. Pritchard and Michael J. Rabins, "Engineering Ethics – Concepts and Cases", Cengage Learning, 2009*
*3. John R Boatright, "Ethics and the Conduct of Business", Pearson Education,New Delhi, 2003*
*4. Edmund G Seebauer and Robert L Barry, "Fundametals of Ethics for Scientists and Engineers", Oxford University Press, Oxford, 2001*

| Subject Code: | Subject Name: Industrial Instrumentation | Ty / Lb/ ETL | L | T / SLr | P/ R | C |
|---|---|---|---|---|---|---|
| BCT18E12 | Prerequisite: Moral science and general English | Ty | 3 | 0/0 | 0/0 | 3 |

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

**OBJECTIVE:**

- To enable the students to create an awareness on Engineering Ethics and Human Values, to instill Moral and Social Values and Loyalty and to appreciate the rights of others.

**COURSE OUTCOMES (COs) : ( 3- 5)**

| | |
|---|---|
| **CO1** | Identify and analyze an ethical issue in the subject matter under investigation or in a relevant field. |
| **CO2** | Identify ethical concerns in research and intellectual contexts, including academic integrity, use and citation of sources, the objective presentation of data, and the treatment of human subjects. |

**Mapping of Course Outcomes with Program Outcomes (POs)**

| COs/POs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | H | - | - | L | - | - | - | L | - | H | - | - |
| CO2 | M | - | - | L | - | - | M | - | - | - | - | L |

| COs / PSOs | PSO1 | PSO2 | PSO3 | PSO4 |
|---|---|---|---|---|
| CO1 | H | M | - | - |
| CO2 | M | L | - | - |

**H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low**

| Category | Basic Sciences | Engineering Sciences | Humanities and Social Sciences | Program Core | Program Electives | Open Electives | Practical / Project | Internships / Technical Skill | Soft Skills | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
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| BCT18E12 | INDUSTRIAL INSTUMENTATION | 3 | 0/0 | 0/0 | 3 |
|---|---|---|---|---|---|

**UNIT I** **5Hrs**

Introduction – Variables, UNITs & standards of measurement, Measurementterms – characteristic. Data Analysis.

**UNIT II** **12Hrs**

Process Variables Measurement–Temperature systems– Thermocouples,Thermo resistive system, Filled-system thermometers, Radiation thermometry,Location of temperature measuring devices in equipments, Pressure system –Mechanical pressure elements Pressure Transducers and Transmitters,Vacuum measurement, Resonant wire pressure Transducer, Flow system –Differential producers, Variable area flow meters, Velocity, vortex, mass,ultrasonic & other flow meters, positive displacement flow meters, Open –channel flow measurements, Force systems, Strain gauges Humidity Moisturesystem, Humidity Measurement, Moisture measurement system, Rheological system, Viscosity measurement, Radiation system, Nuclear radiationinstrumentation.

**UNIT III** **10Hrs**

Analytical instrumentation – Analysis instruments, Sample conditioning forprocess analyzers, X-ray Analytical methods, Quadrupole mass spectrometry,Ultra violet Absorption Analysis, Infra red process analyzers, Photometricreaction product analysers Oxygen analyzers, Oxidation – reduction potential lmeasurements, pH measuring systems, Electrical conductivity and Resistivitymeasurements, Thermal conductivity, gas analysis, Combustible, Total hydrocarbon, and CO analyzer, Chromatography.

**UNIT IV** **9Hrs**

Fundamentals of Automatic process control – Control algorithms-Automaticcontrollers – Electronic controllers - Electric controllers (Traditional) – Hydrauliccontrollers – Fluidics - Programmable controllers.

**UNIT V** **9Hrs**

Sensors, Transmitters and control valves - Pressure, Flow, Level, Temperatureand Composition sensors, Transmitters, Pneumatic and electronic controlvalves, Types, Actuator, accessories, Instrumentation symbols and Labels.

**TOTAL No. of Hrs: 45Hrs**

**TEXTBOOKS:**

*1. Fribance, "Industrial Instrumentation Fundamentals" ,Mc Graw Hill Co. Inc.New York 1985*
*2. Eckman D.P. "Industrial Instrumentation", Wiley Eastern Ltd., 1989.*
*3. Considine D M and Considine G D "Process Instruments Controls"Handbook 3rd Edition, McGraw – Hill Book Co., NY, 1990.*
*4. Scborg D E,.Edgar T.F and Mellichamp D.A, "Process Dynamics andControl" John Wiley 1989.*

**REFERENCES:**

*1. Ernest Doebelin, Measurement systems, McGraw – Hill Book, Co., NY,1975.*
*2. Astrom K.J., Bjonwittenmark, Computer controlled systems, Prentice- Hallof India, New Delhi 1994.*
*3. Cartis Johnson, Process Control Instrumentation Technology, Prentice-Hallof India, New Delhi 1993.*

| Subject Code: BCT18E13 | Subject Name : Process Optimization | T y/ Lb/ ETL | L | T / S.Lr | P/ R | C |
|---|---|---|---|---|---|---|
| | Prerequisite: PCE | Ty | 3 | 0/0 | 0/0 | 3 |

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

**OBJECTIVE:**

- To expose the students with various mathematical methods for numerical analysis and use of software tools

**COURSE OUTCOMES (COs) : ( 3- 5)**

| | |
|---|---|
| **CO1** | Through this course, the students would have learnt about the systems of equations, probability statistics, error analysis and programming concepts using various software tools. |
| **CO2** | |

**Mapping of Course Outcomes with Program Outcomes (POs)**

| COs/POs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | M | H | H | - | L | - | - | - | - | - | H | - |
| CO2 | M | H | H | - | - | - | H | - | - | - | H | H |

| COs / PSOs | PSO1 | PSO2 | PSO3 | PSO4 |
|---|---|---|---|---|
| CO1 | M | M | M | - |
| CO2 | H | L | H | - |

| Category | Basic Sciences | Engineering Sciences | Humanities and Social Sciences | Program Core | Program Electives | Open Electives | Practical / Project | Internships / Technical Skill | Soft Skills | | | |
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|---|---|---|---|---|---|
| **BC T18E13** | **PROCESS OPTIMIZATION** | **3** | **0/0** | **0/0** | **3** |

**UNIT I OPTIMISATION 15Hrs**

Introduction; formulation of objective functions; fitting models to data classification of functions; necessary and sufficient conditions for optimum unimodal, multimodal functions; analytical methods lagrange multiplier methods.

**UNIT II NUMERICAL METHODS 15Hrs**

Unimodel functions; newton's quasi newton, secant methods; region elimination methods, polynomial approximation; quadratic and cubic interpolation techniques for optimum. Multimodal functions; direct methods; random, grid. Hooke's nelder and mead methods; Powell's technique; indirect methods gradient and conjugate gradient methods; secant methods.

**UNIT III LINEAR AND NON-LINEAR PROGRAMMING APPLICATIONS 15Hrs**

Review on basic concepts of LP formulations; Simplex methods; Integer,quadratic, geometric and dynamic programming. Heat transfer and energy conservation; separation processes; fluid flow systems; reactor design and operation; large scale systems.

**Total No. of Hours: 45Hrs**

**TEXT BOOKS:**

*1. Edgar, T.F., Himmelblau, D.M., "Optimisation of Chemical Processes", McGraw-Hill II Edition 2001.*
*2. Reklaitis, G.V., Ravindran, A., Ragsdell, K.M. "Engineering Optimisation", John Wiley, II Edition 2006*

**REFERENCES:**

*1. Biles, W.E., Swain, J.J.; "Optimisation and Industrial Experimentation", Inter Science, New York, 1980.*
*2. Seinfeld, J.H.; Lapidus, L; "Process Modelling, Estimation and Identification"Prentice Hall, Englewood Cliffs, New Jersey, 1974.*
*3. Beveridge, C.S.; Schechter, R.S.; "Optimisation: Theory and Practice", McGraw-Hill Book Co., New York, 1970.*

**OPEN ELETIVE**

| **Subject Code: BCT18OE1** | **Subject Name : Fundamentals of Nanoscience** | **T y/ Lb/ ETL** | **L** | **T / S.Lr** | **P/ R** | **C** |
|---|---|---|---|---|---|---|
| | **Prerequisite: Nanomaterial** | **Ty** | **3** | **0/0** | **0/0** | **3** |

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits T/L/ETL : Theory/Lab/Embedded Theory and Lab

**OBJECTIVE**:

- To enable the students to learn about basis of nanomaterial science, preparation method, types and application.

COURSE OUTCOMES (COs) : ( 3- 5)

| | |
|---|---|
| **CO1** | Will familiarize about the science of nanomaterials |
| **CO2** | Will develop knowledge in characteristic nanomaterial |
| **CO3** | Will demonstrate the preparation of nanomaterials |

Mapping of Course Outcomes with Program Outcomes (POs)

| **COs/POs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | **M** | **H** | **-** | **-** | **-** | **-** | **M** | **-** | **-** | **-** | **-** | **-** |
| **CO2** | **M** | **H** | **H** | **-** | **-** | **-** | **-** | **-** | **-** | **L** | **-** | **H** |
| **CO3** | **H** | **H** | **H** | **-** | **L** | **-** | **-** | **-** | **-** | **-** | **-** | **-** |

| **COs / PSOs** | **PSO1** | **PSO2** | **PSO3** | **PSO4** |
|---|---|---|---|---|
| **CO1** | **M** | **M** | **M** | **-** |
| **CO2** | **H** | **L** | **H** | **-** |
| **CO3** | **H** | **L** | **H** | **-** |

| Cat | Basic Sciences | Engineering Sciences | Humanities and Social Sciences | Program Core | Program Electives | Open Electives | Practical / Project | Internships / Technical Skill | S of | | | |
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|---|---|---|---|---|---|
| **BCT18OE1** | **FUNDAMENTALS OF NANOSCIENCE** | **3** | **0/0** | **0/0** | **3** |

**UNIT I INTRODUCTION 9Hrs**

Nanoscale Science and Technology- Implications for Physics, Chemistry,Biology and Engineering- Classifications of nanostructured materials- nanoparticles- quantum dots, nanowires-ultra-thinfilms- multilayered materials.Length Scales involved and effect on properties: Mechanical, Electronic, Optical, Magnetic and Thermal properties. Introduction to properties and motivation for study (qualitative only).

**UNIT II GENERAL METHODS OF PREPARATION 9Hrs**

Bottom-up Synthesis-Top-down Approach: Co-Precipitation, Ultrasonication,Mechanical Milling, Colloidal routes, Self-assembly, Vapour phase deposition,MOCVD, Sputtering, Evaporation, Molecular Beam Epitaxy, Atomic Layer Epitaxy, MOMBE.

**UNIT III NANOMATERIALS 9Hrs**

Nanoforms of Carbon - Buckminster fullerene- graphene and carbon nanotube,Single wall carbon Nanotubes (SWCNT) and Multi wall carbon nanotubes (MWCNT)- methods of synthesis(arc-growth, laser ablation, CVD routes,Plasma CVD), structure-property Relationships applications- Nanometal oxides-ZnO, TiO2,MgO, ZrO2, NiO, nanoalumina, CaO, AgTiO2, Ferrites, Nanoclays functionalization and applications-Quantum wires, Quantum dots- preparation,properties and applications.

**UNIT IV CHARACTERIZATION TECHNIQUES 9Hrs**

X- ray diffraction technique, Scanning Electron Microscopy – environmental techniques, Transmission Electron Microscopy including high-resolution imaging, Surface Analysis techniques- AFM, SPM, STM, SNOM, ESCA, SIMSNanoindentation.

**UNIT V APPLICATIONS 9Hrs**

NanoInfoTech: Information storage- nanocomputer, molecular switch, super chip, nanocrystal, Nanobiotechlogy: nanoprobes in medical diagnostics and biotechnology, Nano medicines, Targetted drug delivery, Bioimaging – Microelectro Mechanical Systems (MEMS), Nano Electro Mechanical Systems (NEMS)- Nanosensors, nano crystalline silver for bacterial inhibition,Nanoparticles for sunbarrier products - In Photostat, printing, solar cell, battery.

**Total No. of Hours: 45Hrs**

**TEXT BOOKS:**

1. A.S. Edelstein and R.C. Cammearata, eds., “Nanomaterials: Synthesis, Properties and Applications”, Institute of Physics Publishing, Bristol and Philadelphia, 1996.
2. N John Dinardo, “Nanoscale charecterisation of surfaces & Interfaces”, 2nd edition, Weinheim Cambridge, Wiley-VCH, 2000

***REFERENCES:***

*1. G Timp (Editor), “Nanotechnology”, AIP press/Springer, 1999.*
*2. Akhlesh Lakhtakia (Editor),“The Hand Book of NanoTechnology,Nanometer Structure, Theory, Modeling and Simulations”.Prentice-Hall of India (P) Ltd, New Delhi, 2007.*

| Subject Code: BCT18OE2 | Subject Name: Electrochemical Engineering | Ty / Lb/ ETL | L | T / SLr | P/ R | C |
|---|---|---|---|---|---|---|
| | Prerequisite: Moral science and general English | Ty | 3 | 0/0 | 0/0 | 3 |

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

**OBJECTIVE:**

- To solve problems related to the production, storage, distribution and utilization of electrochemical energy and the associated environmental issues

**COURSE OUTCOMES (COs) : ( 3- 5)**

| | |
|---|---|
| **CO1** | Student would be able to integrate professional, ethical, social and environmental factors in electrochemical engineering design and problem solving and understand the impact of these factors on global energy issues. |
| **CO2** | |

**Mapping of Course Outcomes with Program Outcomes (POs)**

| COs/POs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | H | - | - | L | - | M | - | - | - | - | - | L |
| CO2 | M | - | - | M | - | - | - | - | - | H | - | - |

| COs / PSOs | PSO1 | PSO2 | PSO3 | PSO4 |
|---|---|---|---|---|
| CO1 | H | M | - | - |
| CO2 | M | L | - | - |

**H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low**

| Category | Basic Sciences | Engineering Sciences | Humanities and Social Sciences | Program Core | Program Electives | Open Electives | Practical / Project | Internships / Technical Skill | Soft Skills | | | |
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|---|---|---|---|---|---|
| **BCT18OE2** | **ELECTROCHEMICAL ENGINEERING** | **3** | **0/0** | **0/0** | **3** |

**UNIT I** **9Hrs**

Review basics of electrochemistry: Faraday's law -Nernst potential –Galvanic cells – Polarography, The electrical double layer: It's role in electrochemical processes –Electro capillary curve –Helmoltz layer –Guoy –Steven's layer –fields at the interface.

**UNIT II** **9Hrs**

Mass transfer in electrochemical systems: diffusion controlled electrochemical reaction –the importance of convention and the concept of limiting current. Over potential, primary-secondary current distribution –rotating disc electrode.

**UNIT III** **9Hrs**

Introduction to corrosion, series, corrosion theories derivation of potentialcurrent relations of activities controlled and diffusion controlled corrosion process. Potential-pH diagram, Forms of corrosion- definition, factors and control methods of various forms of corrosion-corrosion control measures industrial boiler water corrosion control – protective coatings –Vapor phase inhibitors –cathodic protection, sacrificial anodes
–Paint removers.

**UNIT IV** **9Hrs**

Electro deposition –electro refining –electroforming –electro polishing –anodizing –Selective solar coatings, Primary and secondary batteries –types of batteries, Fuel cells.

**UNIT V** **9Hrs**

Electrodes used in different electrochemical industries: Metals-Graphite –Lead dioxide –Titanium substrate insoluble electrodes –Iron oxide –semi conducting type etc. Metal finishing-cell design. types of electrochemical reactors, batch cell, fluidized bed electrochemical reactor, filter press cell, Swiss roll cell, plug flow cell, design equation, figures of merits of different type of electrochemical
reactors.

**Total No. of Hours:45Hrs**

**TEXTBOOKS:**

*1. Eckenfelder, W. W, Jr. "Industrial Water Pollution Control" McGraw-Hill: New York, 1966.*
*2. P. L. Ballaney, "Thermal Engineering", Khanna Publisher New Delhi, 1986.*
*3. Perry R. H. Green D. W. "Perry's chemical Engineer's Handbook", McGraw Hill, New York, 2007.*

**REFERENCES:**

*1. P. N. Ananthanarayan, "Basic Refrigeration & Air conditioning", Tata McGraw Hill, New Delhi, 2007.*

| Subject Code: BCT18OE3 | Subject Name: Alternative Fuels And Energy Systems | Ty / Lb/ ETL | L | T / SLr | P/ R | C |
|---|---|---|---|---|---|---|
| | **Prerequisite: Moral science and general English** | **Ty** | **3** | **0/0** | **0/0** | **3** |

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

**OBJECTIVE:**

- To know about the types of alternative fuels and energy sources for IC engines.

**COURSE OUTCOMES (COs) : ( 3- 5)**

| | |
|---|---|
| **CO1** | On completion of the course, the student will understand the various alternative fuels available, its properties, performance characteristics, combustion characteristics, emission characteristics, engine modifications required etc., |
| **CO2** | |

**Mapping of Course Outcomes with Program Outcomes (POs)**

| COs/POs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | H | - | - | L | - | M | - | - | - | - | - | L |
| CO2 | M | - | - | M | - | - | - | - | - | H | - | - |

| COs / PSOs | PSO1 | PSO2 | PSO3 | PSO4 |
|---|---|---|---|---|
| CO1 | H | M | - | - |
| CO2 | M | L | - | - |

**H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low**

| Category | Basic Sciences | Engineering Sciences | Humanities and Social Sciences | Program Core | Program Electives | Open Electives | Practical / Project | Internships / Technical Skill | Soft Skills | | | |
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|---|---|---|---|---|---|
| **BCT18OE3** | **ALTERNATIVE FUELS AND ENERGY SYSTEMS** | **3** | **0/0** | **0/0** | **3** |

**UNIT I : ALCOHOLS AS FUELS** **9Hrs**

Introduction to alternative fuels. – Need for alternative fuels – Availability of different alternative fuels for SI and CI engines. Alcohols as fuels. Production methods of alcohols. Properties of alcohols as fuels. Methods of using alcohols in CI and SI engines. Blending, dual fuel operation, surface ignition and oxygenated additives. Performance emission and combustion characteristics in CI and SI engines.

**UNIT II : VEGETABLE OILS AS FUELS** **9Hrs**

Various vegetable oils and their important properties. Different methods of using vegetable oils engines – Blending, preheating Transesterification and emulsification of Vegetable oils – Performance in engines – Performance, Emission and Combustion Characteristics in diesel engines.

**UNIT III : HYDROGEN AS ENGINE FUEL** **9Hrs**

Production methods of hydrogen. Combustive properties of hydrogen. Problems associated with hydrogen as fuel and solutions. Different methods of using hydrogen in SI and CI engines. Performance, emission and combustion analysis in engines. Hydrogen storage – safety aspects of hydrogen.

**UNIT IV : BIOGAS, NATURAL GAS AND LPG AS FUELS** **9Hrs**

Production methods of Biogas, Natural gas and LPG. Properties studies. CO2 and H2S scrubbing in Biogas., Modification required to use in SI and CI Engines- Performance and emission characteristics of Biogas, NG and LPG in SI and CI engines.

**UNIT V : ELECTRIC, HYBRID AND FUEL CELL VEHICLES** **9Hrs**

Layout of Electric vehicle and Hybrid vehicles – Advantages and drawbacks of electric and hybrid vehicles. System components, Electronic control system – Different configurations of Hybrid vehicles. Power split device. High energy and power density batteries – Basics of Fuel cell vehicles.

**Total No. of Hours:45Hrs**

**TEXT BOOK:**

1. *Ayhan Demirbas, 'Biodiesel A Realistic Fuel Alternative for Diesel Engines', Springer- Verlag London Limited 2008.*

**REFERENCES:**

1. *Gerhard Knothe, Jon Van Gerpen, Jargon Krahl, The Biodiesel Handbook, AOCS Press Champaign, Illinois 2005.*
2. *Richard L Bechtold P.E., Alternative Fuels Guide book, Society of Automotive Engineers, 1997 ISBN 0-76-80-0052-1.*
3. *Transactions of SAE on Biofuels (Alcohols, vegetable oils, CNG, LPG, Hydrogen, Biogas etc.).*
4. *Science direct Journals (Biomass & Bio energy, Fuels, Energy, Energy conversion Management, Hydrogen Energy, etc.) on biofuels.*
5. *Devaradjane. Dr. G., Kumaresan. Dr. M., "Automobile Engineering", AMK Publishers, 2013.*

| Subject Code: | Subject Name: Petrochemical Unit Processes | Ty / Lb/ ETL | L | T / SLr | P/ R | C |
|---|---|---|---|---|---|---|
| BCT18OE4 | Prerequisite: Moral science and general English | Ty | 3 | 0/0 | 0/0 | 3 |

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

**OBJECTIVE:**

- To design and conduct experiments and analyze and interpret data related to petrochemical Unit processes.

**COURSE OUTCOMES (COs) : ( 3- 5)**

| | |
|---|---|
| **CO1** | Students would be able to understand the principles of various unit processes in the petrochemical industry. |
| **CO2** | |

**Mapping of Course Outcomes with Program Outcomes (POs)**

| COs/POs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | H | - | - | L | - | M | - | - | - | - | - | L |
| CO2 | M | - | - | M | - | - | - | - | - | H | - | - |

| COs / PSOs | PSO1 | PSO2 | PSO3 | PSO4 |
|---|---|---|---|---|
| CO1 | H | M | - | - |
| CO2 | M | L | - | - |

**H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low**

| Category | Basic Sciences | Engineering Sciences | Humanities and Social Sciences | Program Core | Program Electives | Open Electives | Practical / Project | Internships / Technical Skill | Soft Skills | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
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|---|---|---|---|---|---|
| **BCT18OE4** | **PETROCHEMICAL UNIT PROCESSES** | **3** | **0/0** | **0/0** | **3** |

**UNIT I FEED STOCK AND SOURCE OF PETROCHEMICALS 9Hrs**

Overview of Petrochemical Industry – The key growth area of India, Economics – Feed stock selections for Petrochemicals – Steam cracking of Gas and Naphtha to produce Olefins, Diolefins and Production of Acetylene – Cracker product separation and BTX separation.

**UNIT II SYNTHESIS GAS PRODUCTION 9Hrs**

Steam reforming of Natural gas – Naphtha and Heavy distillate to produce Hydrogen and Synthesis gas – Production of Methanol – Oxo process.

**UNIT III UNIT PROCESSES I 9Hrs**

Fundamental and Technological principled involved in Alkylation – Oxidation – Nitration and Hydrolysis.

**UNIT IV UNIT PROCESSES II 9Hrs**

Fundamental and Technological principled involved in Sulphonation, Sulfation and Isomerisation.

**UNIT V UNIT PROCESSES III 9Hrs**

Fundamental and Technological principles involved in Halogenation and Esterification

**Total No. of Hours:45Hrs**

**TEXT BOOKS:**

*1. Bhaskara Rao, B.K., "A Text on Petrochemicals", Khanna Publishers, 2000.*
*2. Sukumar Maiti, "Indroduction to Petrochemicals", 2nd Edition, Oxford and IBH Publishers,2002.*

**REFERENCES:**

*1. Margaret Wells, "Handbook of Petrochemicals and Processes", 2nd Edition, Ash GatePublishing Limited, 2002.*
*2. Sami Matar, and Lewis F. Hatch., "Chemistry of Petrochemical Processes", 2nd Edition,Gulf Publishing Company, 2000.*
*3. Dryden, C.E., "Outlines of Chemical Technology", 2nd Edition, Affiliated East-West Press,1993*

| Subject Code: BCT18OE5 | Subject Name: Principles of Desalination Technologies | Ty / Lb/ ETL | L | T / SLr | P/ R | C |
|---|---|---|---|---|---|---|
| | Prerequisite: Moral science and general English | Ty | 3 | 0/0 | 0/0 | 3 |

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

**OBJECTIVE:** Understand the techniques and technologies of desalination, Correlate the core curriculum to practical applications, Learn to select the right type of desalination system for a given location and purpose.

**COURSE OUTCOMES (COs) : ( 3- 5)**

| | |
|---|---|
| CO1 | Understand the relevance and need for desalination |
| CO2 | Learn the science behind desalination |

**Mapping of Course Outcomes with Program Outcomes (POs)**

| COs/POs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | H | - | - | L | - | M | - | - | - | - | - | L |
| CO2 | M | - | - | M | - | - | - | - | - | H | - | - |

| COs / PSOs | PSO1 | PSO2 | PSO3 | PSO4 |
|---|---|---|---|---|
| CO1 | H | M | - | - |
| CO2 | M | L | - | - |

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

| Category | Basic Sciences | Engineering Sciences | Humanities and Social Sciences | Program Core | Program Electives | Open Electives | Practical / Project | Internships / Technical Skill | Soft Skills | | | |
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|---|---|---|---|---|---|
| **BCT18OE5** | **PRINCIPLES OF DESALINATION TECHNOLOGIES** | **3** | **0/0** | **0/0** | **3** |

**UNIT I: INTRODUCTION** **9Hrs**

Water Scenario around the world and India – need and relevance of desalination - water sources for desalination – typical seawater composition – brackish water compositional changes- contaminants: anthropogenic and geogenic-drinking water standards – WHO and Indian Standards – Mineral Water standards (indian). Desalination –meaning and description – relation to natural components of desalination - general descriptionminimum energy requirement – review of fundamentals of physical chemistry aspects relevant to desalination, solution properties – estimating the minimum energy requirement - based concept of de-mixing – exergy - estimation from colligative properties – Performance assessment parameters for desalination for thermal and membrane. Different types of Desalination techniques basic resources required for desalination – energy options – relative characteristics of different types of energy options.

**UNIT II: MEMBRANE DESALINATION** **9Hrs**

General features of Pressure Driven Membrane Processes – classification –Micro-filtration(MF) Ultrafiltration (UF), Nano-Filtration (NF) – pore-size – performance relationship. Pretreatment System – Need and relevance – different unit operations including membrane pretreatment (UF) – scaling calculations – dosing systems – treated water quality monitoring – SDI concept. Reverse Osmosis – basic principle – characteristics of membranes used – Nano-filtration – basic principle – comparative features of NF and RO – concentration polarization - transport mechanism and equations (no derivation required)- energy recovery. Performance characteristics of Reverse Osmosis and Nano-filtration – solute rejection - recovery- water flux – relationship amongst them –effect of temperature – performance of lab experiments – interpretation of lab data.- application of RO and NF for desalination.

**UNIT III: THERMAL DESALINATION** **9Hrs**

Basic Components of thermal Desalination – Heat Source – Sensible heat vs latent heat for use in desalination – features of isothermal and adiabatic processes. Thermodynamic properties – pressure vs temperature for steam, change of latent, Cp and BPE with temperature. – corrosion of materials and normal material of construction.Description of Flashing and Boiling: single effect evaporation and flashing – Need for multiple effects / stages – accessories for thermal desalination – ejectors – demisters - vacuum systems – pretreatment systems – Pumps. Principles of MSF/ MED : MED with TVC and MVC : Basic design considerations for thermal systems – operational features.

**UNIT IV:NON CONVENTIONAL DESALINATION SYSTEMS** **9Hrs**

Membrane based Systems :Electrodialysis, Membrane. Distillation, Forward Osmosis.- Basic Principles – performance characteristics – Energy requirements – Challenges. Low temperature thermal desalination including ocean thermal energy and waste heat – Solar desalination including solar stills, solar thermal and solar photovoltaic– limitations and advantages. Hybrid Desalination systems, combined power and water dual purpose plants – examples of working desalination plants.

**UNIT V: SOCIETAL, COMMERCIAL, ECONOMICS AND ENVIRONMENTAL ASPECTS** **9Hrs**

Selection of Desalination System – considerations based on capacity – local resources (including power, water etc.)– ultimate use– scale up – brackish water systems – considerations for societal cause / industrial water recycle. Economic Aspects of esalination – water cost calculation– capital cost/operating costs – feasibility analysis- Environmental issues –challenges – spent membrane, disposal- discharge concentrated stream – use of concentrate stream – recovery of values.

**Total No. of Hours:45Hrs**

**REFERENCE BOOKS:**

*1 Fundamentals of Salt Water Desalination: Hisham T. El-Dessouky and Hisham M. Ettouney, ISBN:978-0-444-50810-2 Elsevier (2009)*

*2 A Desalination Primer: Introductory Book for Students and Newcomers to Desalination :K.S.Spiegler and Y.M. El-Sayed, ISBN 086689 034 3, Desalination Publications Elsevier (1994)*

*3 Kirk &Othmer :Encyclopaedia of Chemical Technology*

| Subject Code: BCT18OE6 | Subject Name : Piping Design Engineering | T y/ Lb/ ETL | L | T / S.Lr | P/ R | C |
|---|---|---|---|---|---|---|
| | Prerequisite: Nil | Ty | 3 | 0/0 | 0/0 | 3 |

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C:
Credits T/L/ETL : Theory/Lab/Embedded Theory and Lab

**OBJECTIVE:**

- To secure position of the Chief Piping Engineer in a reputed engineering firm where the sound technical experience and prowess in installation of piping can help in executing projects at a faster pace through reduced costs.

**COURSE OUTCOMES (COs) : ( 3- 5)**

| | |
|---|---|
| **CO1** | Supervising team of designers and engineers to execute piping work as well as checking various details related to piping materials and its thickness . |
| **CO2** | Develop skill in Work analysis and material management that could help in efficient management of an enterprise. |

**Mapping of Course Outcomes with Program Outcomes (POs)**

| COs/POs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | - | - | M | L | - | - | H | - | M | H | - | M |
| CO2 | M | - | - | M | - | - | M | - | - | H | M | L |

| COs / PSOs | PSO1 | PSO2 | PSO3 | PSO4 |
|---|---|---|---|---|
| CO1 | M | M | M | - |
| CO2 | H | L | H | - |

| Cat | Basic Sciences | Engineering Sciences | Humanities and | Program Core | Program Electives | Open Electives | Practical / Project | Internships / Technical Skill | Soc | | | |
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| BCT18OE6 | PIPING DESIGN ENGINEERING | 3 | 0/0 | 0/0 | 3 |
|---|---|---|---|---|---|

**UNIT I INTRODUCTION TO PIPING ENGINEERING 9Hrs**

Fluid flow, types of fluids and examples, different pipe fittings. Friction factor, pressure drop for flow Newtonian and non-Newtonian fluids, pipe sizing, economic velocity. Pipe line networks and their analysis for flow in branches, restriction orifice sizing. Pressure drop calculations for non-Newtonian fluids. two phase flow, types of two phase flow, two phase flow as encountered in piping for steam, distillation column, pressure drop, vibrations in two phase flow.

**UNIT II MATERIALS FOR PIPING 9Hrs**

Selection of material for piping, desirable properties of piping materials, materials for various temperature and pressure conditions, materials for corrosion resistance. Common ASTM and IS specifications for: Seamless / ERW pipes, pipe fittings, flanges, and fasteners, materials for valves. Gaskets: Functions and properties, types of gaskets and their selection.

**UNIT III CONTROL & SAFETY IN PIPING 9Hrs**

Types of valves, control valves, safety valves, constructional features, criteria for selection. Piping components, pressure relieving devices, constructional features, selection criteria and application, safety features. Calculations for line sizing, steam traps, P.R.V. & condensive systems.

**UNIT IV PIPING SYSTEM DESIGN 9Hrs**

Design principles, calculation of pipe diameter, thickness, important system characteristics and design principles related to steam flow at high and low pressures. Design principles and line sizing for vacuum pipelines, slurry pipelines, surge drums and flare stacks, vacuum devices including ejector system. Considerations governing pump selection, analysis of system and pump characteristics in connection with series, parallel flow, and minimum flow and equalizing lines, NPSH, allowable nozzle loads in various codes. Design principles and line sizing of pneumatic conveying of solids, components of conveying systems, dust and fume extraction systems principles.

**UNIT V INSULATION AND COSTING OF PIPING 9Hrs**

Purposes of thermal insulation, principles of conductive and convective heat transfer to the extent of application to heat loss / gain through bare pipe surfaces. Critical thickness of insulation, estimating thickness of insulation, optimum thickness of insulation. Insulation for hot and cold materials and their important properties, insulation material selection criteria, typical insulation specification – hot and cold materials. Introduction to P & I Diagrams, Process flow diagrams, standard symbols and notations. Introduction to various facilities required guidelines for Plot Plan / Plant Layout. Introduction to equipment layout, piping layout, piping isometrics and bill of material. Typical piping system layout considerations for following systems: (i) Distillation columns and heat exchangers, (ii) Reactors, (iii) Pipe racks, (iv) Storage tanks, (v) Pumps

**Total No. of Hours: 45Hrs**

**REFERENCE BOOKS:**

1. *Piping Design Handbook by John J. Mcketta, by Marcel Dekker, Inc, New York.*
2. *Process plant layout and piping design by Ed Bausbacher & Roger Hunt (PTK Prentice Hall Publication)*
3. *Piping Handbook, Edited by Mohinder Nayyar, McGraw-Hill Education*
4. *Pipe Drafting and Design by Roy A Parisher & Robert A. Rhea. ASME Codes 31*

| Subject Code: BCT18OE7 | Subject Name : E-Waste Management | T y/ Lb/ ETL | L | T / S.Lr | P/ R | C |
|---|---|---|---|---|---|---|
| | Prerequisite: Nil | Ty | 3 | 0/0 | 0/0 | 3 |

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R :
Research C: Credits T/L/ETL : Theory/Lab/Embedded Theory and Lab

**OBJECTIVE:**

- To secure position of the Chief Piping Engineer in a reputed engineering firm where the sound technical experience and prowess in installation of piping can help in executing projects at a faster pace through reduced costs.

**COURSE OUTCOMES (COs) : ( 3- 5)**

| | |
|---|---|
| **CO1** | Supervising team of designers and engineers to execute piping work as well as checking various details related to piping materials and its thickness . |
| **CO2** | Develop skill in Work analysis and material management that could help in efficient management of an enterprise. |

**Mapping of Course Outcomes with Program Outcomes (POs)**

| COs/POs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | M | H | - | L | - | - | H | - | - | H | - | M |
| CO2 | M | H | - | M | - | - | M | - | - | H | H | L |

| COs / PSOs | PSO1 | PSO2 | PSO3 | PSO4 |
|---|---|---|---|---|
| CO1 | M | M | M | - |
| CO2 | H | L | H | - |

| Category | Basic Sciences | Engineering Sciences | Humanities and Social Sciences | Program Core | Program Electives | Open Electives | Practical / Project | Internships / Technical Skill | Soft Skills | | | |
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| **BCT18OE7** | **E-WASTE MANAGEMENT** | **3** | **0/0** | **0/0** | **3** |

**UNITI INTRODUCTION 6Hrs**

Composition – e-waste generation in global context – growth of electrical and electronic industry-Environmental concerns.- Effects on Environment and Human Health.

**UNIT II THE BASEL CONVENTION 12Hrs**

Compliance and implementation- Scheme to control the movement of hazardous waste - Technical assistance offered by the Convention -Other important highlights of the Basel Convention - Waste Electrical and Electronic Equipment (WEEE)- Obligations of the producer under the WEEE.

**UNIT III MANAGEMENT E-WASTE 9Hrs**

Hazardous waste isolation- Guidelines for environmentally sound management- compliance and implementation – inventory management- reduction- process modification- volume reduction- recovery and reuse- Concerns/ Challenges for e-waste management

**UNIT IV RECYCLING E-WASTE 12Hrs**

Global trade in hazardous waste - Rising illegal e-waste exports - Main factors in global waste trade economy Waste trading as a quintessential part of electronic recycling - Free trade agreements as a means of waste trading Import of hazardous e-waste - Porous ports and lack of checking facilities - Illegal waste imports seized in ports

**UNIT V RECOMMENDED OPTIONS 6Hrs**

Creating awareness-Training for the management and minimization of hazardous wastes –sustainable product design –role of government – Responsibility of Industries and public.

**Total No. of Hours: 45Hrs**

**REFERENCES:**

1. *K. Satyamurty, 'Managing e-waste without harming environment', The Hindu, 03 April, 2006.*
2. *Marwaan Macan- Markar, 'Free Trade Cannot Include Toxic Waste', Toxic Trade News, Basel Action Network*
*(BAN), February, 2007.*
3. *Freeman M. H. 1989. Standard Handbook of Hazardous Waste Treatment and Disposal, McGraw-Hill Company.*

## OPEN LAB

| Subject Code: BCT18OL1 | Subject Name : Chemical Separation Lab | Ty/Lb/ETL | L | T / S.Lr | P/ R | C |
|---|---|---|---|---|---|---|
| | **Prerequisite: Nil** | **Lb** | **0** | **0/0** | **3/0** | **1** |

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

**OBJECTIVE:**

**COURSE OUTCOMES (COs) : ( 3- 5)**

| | |
|---|---|
| **CO1** | Knowledge of various chemical engineering separation processes |
| **CO2** | Ability to select appropriate separation technique and to analyse the separation for multi-component systems |

**Mapping of Course Outcomes with Program Outcomes (POs)**

| COs/POs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | M | - | - | - | L | - | L | - | H | - | - | L |
| CO2 | M | H | M | - | H | - | - | - | H | - | M | M |

| COs / PSOs | PSO1 | PSO2 | PSO3 | PSO4 |
|---|---|---|---|---|
| CO1 | M | M | - | - |
| CO2 | H | L | - | - |

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

| Category | Basic Sciences | Engineering Sciences | Humanities and Social Sciences | Program Core | Program Electives | Open Electives | Practical / Project | Internships / Technical Skill | Soft Skills | | | |
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| **BCT18OL1** | **CHEMICAL SEPARTATION LAB** | **0** | **0/0** | **3/0** | **1** |

LIST OF EXPERIMENTS

1. Crystallization
2. Filtration
3. Decantation
4. Sublimation
5. Evaporation
6. Simple distillation
7. Fractional distillation
8. Chromatography
9. Centrifugation
10. Separating funnel
11. Magnetic separation
12. Precipitation
13. Solvent extraction
14. Electro deposition
15. Oxidation and reduction processes

| Subject Code: BCT18OL2 | Subject Name : Chemical Composition Analysis Lab | Ty/Lb/ETL | L | T / S.Lr | P/ R | C |
|---|---|---|---|---|---|---|
| | **Prerequisite: Nil** | **Lb** | **0** | **0/0** | **3/0** | **1** |

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

**OBJECTIVE:**

**COURSE OUTCOMES (COs) : ( 3- 5)**

| | |
|---|---|
| **CO1** | To analyse various chemical components present in the sample |
| **CO2** | To adopt suitable characterization techniques |

**Mapping of Course Outcomes with Program Outcomes (POs)**

| COs/POs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | M | - | H | - | H | - | L | - | H | - | - | L |
| CO2 | - | M | M | L | H | - | - | - | H | H | - | M |

| COs / PSOs | PSO1 | PSO2 | PSO3 | PSO4 |
|---|---|---|---|---|
| CO1 | M | M | - | - |
| CO2 | H | L | - | - |

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| **BCT18OL2** | **CHEMICAL COMPOSITION ANALYSIS LAB** | **0** | **0/0** | **3/0** | **1** |

LIST OF EXPERIMENT

1. Elemental Analysis
2. Chemical composition analysis
3. Chemical trace analysis
4. Inorganic substance analysis
5. Contamination detection analysis
6. Material testing analysis
7. Petrochemical testing
8. Polymer and Plastic testing
9. Cosmetics testing
10. Pharmaceutical testing

| Subject Code: BCT18OL3 | Subject Name : Alternate Fuel Lab | Ty/Lb/ETL | L | T / S.Lr | P/ R | C |
|---|---|---|---|---|---|---|
| | Prerequisite: Nil | Lb | 0 | 0/0 | 3/0 | 1 |

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

**OBJECTIVE:**

**COURSE OUTCOMES (COs) : ( 3- 5)**

| | |
|---|---|
| **CO1** | Broad comprehension of alternate fuel and their production techniques |
| **CO2** | Environmental assessment and economic consideration of alternate fuels |

**Mapping of Course Outcomes with Program Outcomes (POs)**

| COs/POs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | M | - | - | - | H | - | - | - | H | L | - | L |
| CO2 | M | - | M | - | H | - | H | - | H | - | - | M |

| COs / PSOs | PSO1 | PSO2 | PSO3 | PSO4 |
|---|---|---|---|---|
| CO1 | M | M | - | - |
| CO2 | H | L | - | - |

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

| Category | Basic Sciences | Engineering Sciences | Humanities and Social Sciences | Program Core | Program Electives | Open Electives | Practical / Project | Internships / Technical Skill | Soft Skills | | | |
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| **BCT18OL3** | **ALTERNATE FUEL LAB** | **0** | **0/0** | **3/0** | **1** |

LIST OF EXPERIMENT

Determination of

1. MFI
2. Fire pint
3. Flash point
4. Cloud point
5. Pour point
6. Smoke point
7. Viscosity
8. Rheology
9. Stability
10. Density
11. Specific gravity
12. Weathering

| Subject Code: BCT18OL4 | Subject Name : Food Testing Laboratory | Ty/Lb/ETL | L | T / S.Lr | P/ R | C |
|---|---|---|---|---|---|---|
| | Prerequisite: Nil | Lb | 0 | 0/0 | 3/0 | 1 |

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

**OBJECTIVE:**

**COURSE OUTCOMES (COs) : ( 3- 5)**

| | |
|---|---|
| **CO1** | Understand new ford product from consumers view point |
| **CO2** | Understand factors that affect viability and potential of new food product |

**Mapping of Course Outcomes with Program Outcomes (POs)**

| COs/POs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | - | - | M | - | H | - | - | - | H | - | - | M |
| CO2 | M | - | M | - | H | - | - | H | H | - | - | M |

| COs / PSOs | PSO1 | PSO2 | PSO3 | PSO4 | | | |
|---|---|---|---|---|---|---|---|
| CO1 | M | M | - | - | | | |
| CO2 | H | L | - | - | | | |

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

| Category | Basic Sciences | Engineering Sciences | Humanities and Social Sciences | Program Core | Program Electives | Open Electives | Practical / Project | Internships / Technical Skill | Soft Skills | | | |
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| **BCT18OL4** | **FOOD TESTING LABORATORY** | **0** | **0/0** | **3/0** | **1** |

1. Benedict's test for reducing sugars
2. Iodine test for starch
3. Sudan III test for lipids
4. Biuret test for proteins
5. Heavy Metals Analysis
6. Nutritional Analysis
7. Organic Toxins Analysis
8. Pesticide and Residue Analysis
9. Plate Test Method
10. Microbial and Antimicrobial Analysis