# ACADEMIC REGULATIONS & CURRICULUM

**Applicable to the students admitted from the Academic Year 2019-2020**

# CHEMICAL ENGINEERING

**(B.Tech. Programme)**

## MAHARAJ VIJAYARAM GAJAPATHI RAJ COLLEGE OF ENGINEERING

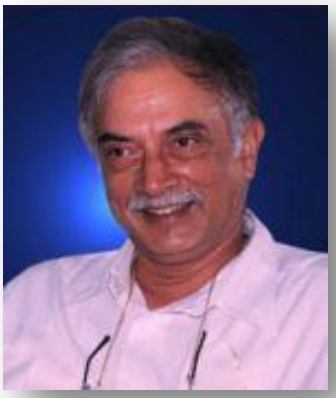
## (Autonomous)

(Approved by AICTE, New Delhi, and permanently affiliated to JNTUK, Kakinada)
Listed u/s 2(f) & 12(B) of UGC Act 1956.
Vijayaram Nagar Campus, Chintalavalasa,Vizianagaram-535005, Andhra Pradesh

# The visionaries

**Late Dr. P V G Raju**
Raja Saheb of Vizianagaram
Founder Chairman-MANSAS
Ex-Minister for Education and Health, Govt. of AP
Ex Member of Parliament

**Late Dr. P. Anand Gajapathi Raju**
**Ex-Chairman-MANSAS**
Ex-Minister for Education and Health
Govt. of AP
Ex Member of Parliament



**P. Ashok Gajapathi Raju**
**Chairman-MANSAS**
Ex-Union Minister for Civil Aviation,
Govt. of India
Ex-Minister for Finance, Govt. of AP

# Vision

Maharaj Vijayaram Gajapathi Raj College of Engineering strives to become a centre par excellence for technical education where aspiring students can be transformed into skilled and well-rounded professionals with strong understanding of fundamentals, a flair for responsible innovation in engineering practical solutions applying the fundamentals, and confidence and poise to meet the challenges in their chosen professional spheres.

## Mission

The management believes imparting quality education in an atmosphere that motivates learning as a social obligation which we owe to the students, their parents/guardians and society at large and hence the effort is to leave no stone unturned in providing the same with all sincerity. Towards that end, the management believes special focus has to be on the following areas:

M1: Have on-board staff with high quality experience and continuously updating themselves with latest research developments and sharing that knowledge with students.

M2: Having a well stream-lined teaching learning process that is continuously assessed for effectiveness and fine-tuned for improvement.

M3: Having state-of-the-art lab and general infrastructure that gives students the necessary tools and means to enhance their knowledge and understanding.

M4: Having a centralized department focused on improving placement opportunities for our students directly on campus and coordinating the training programs for students to complement the curriculum and enhance their career opportunities.

M5: Having advanced research facilities and more importantly atmosphere to encourage students to pursue self-learning on advanced topics and conduct research.

**ABOUT THE INSTITUTION:**

Maharajah Alak Narayan Society of Arts and Science (MANSAS) is an Educational Trust founded by Dr. (late) P.V.G Raju, Raja Saheb of Vizianagaram in the hallowed memory of his father Maharajah Alak Narayan Gajapati with a view to confound socio-economic inequalities in the Vizianagaram principality executing a trust deed on 12-11-1958 duly established Maharajah's College and other educational institutions in and around Vizianagaram. The Trust is a charitable one published under Section 6 a (1) of A.P Charitable and Hindu Religious Institutions and Endowment Act 30 of 1987.

The object of the Trust is to manage the properties of educational institutions under it and to promote and advance the cause of education in general, besides awarding scholarships to deserving students enabling them to undergo special training in science and industries in and out of India. The Trust has made an uncompromising contribution to the nation by presenting the stalwarts.

Trust offers KG to PhD level education in Arts, Sciences, Law, Pharmacy, Humanities Education, Engineering and Management and presently houses 13 Educational Institutions. MVGR College of Engineering is one of the 13 Institutes.

## Other Institutions under MANSAS

1. M.R. HIGH SCHOOL 1857
2. M.R COLLEGE **(NAAC ACCREDITED)** 1879
3. M.R. COLLEGE OF EDUCATION 1950
4. M.R. WOMENS COLLEGE **(NAAC ACCREDITED)** 1962
5. M.R. GIRLS HIGH SCHOOL 1974
6. M.R. MODEL HIGH SCHOOL 1974
7. M.R. ENGLISH MEDIUM SCHOOL 1979
8. M.R.V.R.G.R LAW COLLEGE 1987
9. M.R. P.G. COLLEGE **(NAAC ACCREDITED)** 1987
10. M.R.SCHOOL OF MANAGEMENT STUDIES 1994
11. M.R.V.R.G.R – II MEMORIAL JR. COLLEGE 1994
12. M.R. COLLEGE OF PHARMACY 2004

Maharaj Vijayaram Gajapathi Raj (MVGR) College of Engineering was established in the year 1997 by Maharaj Alak Narayan Society for Arts and Sciences (MANSAS) to impart quality technical education. The Institution is located in lush green, serene and pollution free environment spread over 60 acres of land in Chintalavalasa village situated in the outskirts of Vizianagaram, a fort city in the north coastal region of Andhra Pradesh.

Institution at a glance:

- MVGR is a 23 years old institution, established in 1997
- All eligible UG Programs (CHEMICAL, CIV, CSE, ECE, EEE, IT & MECHANICAL) were reaccredited by NBA.
- MBA program was also re-accredited by NBA.
- Had been re-accredited with Grade 'A' by NAAC of UGC
- Has Permanent affiliation with JN Technological University-Kakinada
- Listed under sections 2(f) & 12(b) of UGC act 1956.
- Approved by AICTE-New Delhi
- EIGHT departments are recognized as RESEARCH CENTERS by JNTU-K
- Granted Autonomy by UGC in 2015
- Campus of 60 acre
- Offering 7 UG and 5 M.Tech., and 1 MBA program
- About 250 faculty of which 84 Ph.D. Degree holders
- 83 Laboratories with an investment of about 13 Crores
- Total built up area of about 7 Lakh Sft
- About 42,000 volumes and Access to 8 international online journal packages like IEEE, SPRINGER, etc.
- 1420 Systems & 395 Mbps band width internet facility
- About Rs. 4 Crore worth of on-going R&D projects
- Actively involved in civil engineering consultancy work as Third Party Quality Auditor for Vizianagaram Municipality
- WIPRO Recognized technology learning center and MISSION 10X partner institution
- Recognized National Instruments Academy for Training in LabView
- SIRO Recognition by DSIR
- Recognized PTC Centre of Excellence for Creo Training
- Identified by MSME as Business Incubation Centre
- APSSDC-Siemens Technical Skill Development Institute
- Recognized CMs SKILL EXCELLENCY CENTER (SEC)
- Microsoft Ed-vantage Platinum Partner
- Institutional member of IUCEE
- Institutional Member of CII
- Member, Chamber of Commerce, Vizianagaram
- Green Campus award by Govt. of AP

MVGR College of Engineering is rated as one among the best engineering colleges in the state of Andhra Pradesh as it set up highest standards in all areas of curricular, co-curricular and extra-curricular activities and in students' placements. Based on industry and expert's feedback, the college is updating the curriculum from time to time. The college offers many value added add-on courses students and conducts training programs to meet the industries' requirements.

# Academic Regulations for B.Tech., Program

Applicable to the students admitted from the Academic year 2019-2020 onwards.

## 1. PROGRAM STRUCTURE:

### B.Tech.:

| Sl. No | Category | Credits |
|---|---|---|
| 1 | Humanities and Social Sciences including Management courses | 12 |
| 2 | Basic Science courses | 25 |
| 3 | Engineering Science courses including workshop, drawing, basics of electrical/mechanical/computer etc. | 26 |
| 4 | Professional core courses | 54 |
| 5 | Professional Elective courses relevant to chosen specialization/branch | 18 |
| 6 | Open subjects – Electives from other technical and /or emerging subjects | 12 |
| 7 | Project work, seminar and internship in industry or elsewhere | 13 |
| 8 | Mandatory Courses [Environmental Sciences, Induction training, Indian Constitution, Essence of Indian Traditional Knowledge] | 0 |
| | **Total** | 160 |

- Open electives offered by the parent department are listed in the course structure and are offered to students of other programs. The students of parent departments may also opt the course, provided it shall not be listed in the curriculum.
- For audit course a student is deemed to satisfy the minimum contact hours, as prescribed by the department and shall also comply with the requirements for submission of assignments/projects. A student shall also opt for MOOCs and submit the certificate.

| 1. HSS Courses | | |
|---|---|---|
| Sl. No. | Subject | Credits |
| 1 | English -1 | 3 |
| 2 | English -2 (Technical English) | 3 |
| 3 | Elective-1 (Management Related course (MEFA or MS or Operations Research) | 3 |
| 4 | Elective-2 (Professional Ethics and Human Values) | 3 |
| | Total | **12** |

| 2. Basic Science Courses | | |
|---|---|---|
| Sl. No. | Subject | Credits |
| 1 | Mathematics-I | 3 |
| 2 | Mathematics-II | 3 |
| 3 | Mathematics-III | 3 |
| 4 | Mathematics-IV | 3 |
| 5 | Applied / Engineering Physics (Theory + Lab) | 5 |
| 6 | Engineering Chemistry (Theory + Lab) | 5 |
| 7 | Biology for Engineers | 3 |
| | Total | **25** |

| 3. Engineering Science Courses | | |
|---|---|---|
| Sl. No. | Subject | Credits |
| 1 | Programming for Problem Solving (Theory + Lab) | 5 |
| 2 | Internet of Things (IOT) | 3 |
| 3 | Computer aided Engineering Graphics | 3 |
| 4 | Basic Electrical Engineering (Theory + Lab) | 5 |
| 5 | Department wise Engineering Science Course-I (AI Tools , Techniques & Applications) | 5 |
| 6 | Department wise Engineering Science Course-II (Design thinking and Product Innovation) | 3 |
| 7 | Workshop (Department Specific) | **2** |
| | Total | **26** |

| | Subjects | Credits |
|---|---|---|
| 1 | Professional Core Courses | 54 |
| 2 | Professional Elective Courses Relevant to Chosen Specialization/Branch | 18 |
| 3 | Open Subjects – Electives from other Technical and / or Emerging Subjects | 12 |
| | | **84** |

| 7. Project | | |
|---|---|---|
| Sl. No. | Subject | Credits |
| 1 | Socially Relevant Project | 1 |
| 2 | Mini Project | 2 |
| 3 | Project Phase - I | 2 |
| 4 | Project Phase - II | 8 |
| | Total | **13** |

| 8. Audit Courses (Non Credit Course) | | |
|---|---|---|
| Sl. No. | Subject | |
| 1 | Induction Program | |
| 2 | Constitution of India | |
| 3 | Indian Traditional Knowledge | |
| 4 | Environmental Science | |

BOS Chairman shall notify the list of MOOCs offered (Open Elective & Professional Elective) in the beginning of the semester.

## 2. PROGRAM PATTERN:

**B.Tech.:** The program is for 4 academic years / 8 semesters.

**B.Tech. (Lateral Entry):** The program is for 3 academic years / 6 semesters.

## 3. AWARD OF DEGREE:

**B.TECH:**

A student will be declared eligible for the award of degree if he/she fulfills the following academic regulations.

a) A student shall be declared eligible for the award of degree, if he/she pursues a course of study for not less than four academic years and not more than eight academic years from the date of admission.

b) The student shall register for **160** credits and secure all **160** credits.

c) The medium of instruction for the entire under graduate program in Engineering & Technology will be in **English** only.

d) A student shall also register and successfully complete audit programs (Non-credit) as recommended by Academic Council.

e) A student on completing 1$^{st}$ year class work may opt for a break of 1 year which shall be deemed as GAP year, as recommended by APSCHE, for undertaking successful entrepreneurial ventures.

f) Students who fail to complete Four Years Course of study within 8 years shall forfeit their seat and their admission shall stand cancelled.

**B.TECH (Lateral Entry):**

A student will be declared eligible for the award of degree on fulfilling the following academic requirements.

a) A student shall be declared eligible for the award of the degree, if he/she pursues a course of study for not less than three academic years and not more than six academic years.

b) The student shall register for **126** credits and secure all **126** credits.

c) A student shall also register and successfully complete audit programs (Non-credit) as recommended by Academic Council.

d) Students who fail to complete their three Years Course of study within 6 years shall forfeit their seat and their admission shall stand cancelled.

e) Student shall register for bridge programs, if any, as administered by the respective departments at the beginning of 2nd year and successfully complete as per the guidelines of the Institution.

## 4. CERTIFICATION PROGRAMS:

| Sl. No. | Dept. | Name of the Program |
|---|---|---|
| 1 | MECH | Windchill 10.2 PDM by Adroitec Engineering Solutions Pvt. Ltd., Hyderabad |
| 2 | MECH | Creo 2.0 by PTC |
| 3 | MECH | Edgecam by Verosoft, UK |
| 4 | MECH | ANSYS Training and Certification by Mechanical Department |
| 5 | MECH | AUTOCAD Training and Certification by Mechanical Department |
| 6 | MECH | Catia by APSSDC-Dassault Systems, CM's Center of Excellence |
| 7 | MECH | Delmia by APSSDC-Dassault Systems, CM's Center of Excellence |
| 8 | MECH | Simulia by APSSDC-Dassault Systems, CM's Center of Excellence |
| 9 | MECH | 2-Wheeler Automobile Certification by APSSDC-SIEMENS |
| 10 | MECH | 4-Wheeler Automobile Certification by APSSDC-SIEMENS |
| 11 | MECH | Welding Certification by APSSDC-SIEMENS |
| 12 | MECH | CNC Certification by APSSDC-SIEMENS |
| 13 | MECH | Commercial Electrical Certification by APSSDC-SIEMENS |
| 14 | MECH | Solid Edge Certification by APSSDC-SIEMENS |
| 15 | CHEM | Chemical Process Design and Simulation by Simtech Simulations, Hyderabad |
| 16 | ECE | Embedded Systems by Think LABS, Mumbai |
| 17 | ECE | Labview by National Instruments Systems India Pvt. Ltd. |
| 18 | ECE | Unified Technology Learning Program (UTLP) by Wipro Mission 10X |
| 19 | CSE, IT | PEGA by Virtusa Corporation |
| 20 | CSE, IT | Microsoft technologies by Microsoft Corp. |
| 21 | CSE, IT | Ethical Hacking by EC-Council Academia |
| 22 | CSE, IT | Java and C by Talent Sprint |
| 23 | CSE, IT | Network Analyst (CCNA) by Cisco Systems Inc |
| 24 | CSE, IT | Java Programming (OCJP) and DBMS by Oracle |
| 25 | EEE | PLC, Drives and Automation by Siemens |
| 26 | EEE | PLC by New Dawn Automation |
| 27 | EEE | Home Electrical Certification by APSSDC-SIEMENS |
| 28 | Civil | Remote Sensing and GIS by Indian Institute of Remote Sensing |

a) The Institution shall offer the certification programs by itself or in collaboration with industry/such other Institutions deemed to have specialized expertise in the proposed area of training.
b) Only students of the Institution shall be eligible to register on payment of prescribed fee.
c) However, subject to availability of resources and the demand the Institution may offer the program to external candidates meeting the pre-qualification requirements and in the order of the merit.
d) The duration of the course and design of the content shall be done by the respective departments of the Institution by themselves or in collaboration with industry/such other institutions deemed to have specialized expertise in the proposed area of training.
e) If the duration of the course is less than or equal to 40 hours, it can be completed in one semester, otherwise, it can suitably distributed over a number of semesters.
f) Mere enrolment/registration for the program shall not entitle any claim for award of certificate.
g) A candidate shall be deemed eligible for the award of the certificate if he/she
   - Attends at least 75% of scheduled training sessions
   - Complies to all the requirements of submission of the assignments, presentations, seminars, projects, etc., and also appears for periodic tests.
   - Shall attain minimum levels of performance in tests as prescribed.
   - Shall remit such fee as deemed fit for the certification
   - A candidate registered and failed to meet the requirements shall be permitted to repeat the said training one another time after remitting 25% of the fee fixed for the program as re-registration fee.

If the student is absent for the periodic tests, the test shall be re-conducted on payment of 10% of fee.

## 5. COURSES OFFERED:

| Name of the Program | Degree |
|---|---|
| UG Programs (Engineering & Technology) | B.Tech. (Civil)<br>B.Tech. (EEE)<br>B.Tech. (Mech.)<br>B.Tech. (ECE)<br>B.Tech. (CSE)<br>B.Tech. (CHEM)<br>B.Tech. (IT) |
| PG Programs (Engineering & Technology) | M.Tech. (Structural Engineering)<br>M.Tech. (Power Systems)<br>M.Tech. (PDM)<br>M.Tech. (VLSI)<br>M.Tech. (CN&IS) |
| Other PG Programs | MBA |
| Research Programs | Ph.D. in Civil, EEE, MECH, ECE, CSE, CHEM, MBA and MATHS |

## 6. DISTRIBUTION AND WEIGHTAGE OF MARKS:

**B.Tech.:**

a). All Theory courses will have 5 units and assessed for 100 marks, of which, 40 marks for internal assessment and 60 marks for semester end external examination.

**Internal Assessment:**

Subjective tests - 20 Marks
Objective tests - 10 Marks
Assignments - 10 Marks

- Two subjective tests shall be conducted.
- Each subjective test shall be conducted for 90 Minutes and have 3 questions each for 7 marks (No choice) and the same shall be scaled down to 20 Marks.
- Average of two subjective tests shall be considered.
- Two objective tests (online) shall be conducted each for 20 marks.
- Each objective test shall be conducted for 20 minutes and have 20 Multiple Choice Questions each for 1 mark and the same shall be scaled down to 10 Marks.
- Average of two objective tests shall be considered.
- Assignments shall be assessed for 10 marks.

**External Assessment:**

- External examination is for 60 marks (180 min). Question paper contains 10 questions (2 questions from each unit) and each question carries 12 marks. Student shall answer 5 questions (1 question from each unit).

**i) Design Thinking and Product Innovation - Evaluation pattern**

**Internal Assessment: 40 Marks**

Project based learning - 20 Marks
Assignments - 20 Marks

**Project based learning:** The student has to identify a problem and provide a solution by applying design thinking methodologies and submit a report, which is assessed for 20 Marks.

**Assignments:** The student has to submit 4 assignments (1 for each unit) and assessed for 20 marks. Each assignment shall consist of 4 questions (4X10 = 40 marks) and the same shall be scaled down to 20 marks. Average of 4 assignments shall be considered as final assignment marks.

**External Assessment: 60 Marks**

External examination is for 60 marks (180 min). Question paper contains 8 questions from first IV units (2 questions from each unit) and each question carries 10 marks. Student shall answer 4 questions from first IV units (1 question from each unit) and case study (20 Marks) from V unit.

**ii) Internet of Things (IoT) , Surveying and Geomatics, MAT Lab Programming, Programming with Lab View, Embedded Processor - Evaluation pattern**

**Internal Assessment: 40 Marks**

Subjective Test - 20 Marks

Project based learning - 20 Marks

- Two subjective tests shall be conducted.
- Each subjective test shall be conducted for 90 Minutes and have 3 questions each for 7 marks (No choice) and the same shall be scaled down to 20 Marks.
- Average of two subjective tests shall be considered.
- Project based learning shall be assessed for 20 Marks.
- In Project based learning, a student has to identify a problem such that at least 3 or 4 modular learning of experiments shall be integrated and submit comprehensive report with solution at the end of the semester.

**External Assessment: 60 Marks**

External examination is for 60 marks (180 min). Question paper contains 10 questions (2 questions from each unit) and each question carries 12 marks. Student shall answer 5 questions (1 question from each unit).

b). **Laboratory/Practice:**

All Laboratory/Practice courses are assessed for 100 marks, of which, 40 marks for internal assessment and 60 marks for semester end external examination.

**Internal Assessment : (40 Marks)**

Continuous assessment : 15 Marks
Project based learning : 15 Marks
Internal test : 10 Marks

- Continuous assessment for 15 marks for each experimental session finally averaged to 15 marks.
- Project based learning shall be assessed for 15 Marks.
- In Project based learning, a student has to identify a problem such that at least 3 or 4 modular learning of experiments shall be integrated and submit comprehensive report with solution at the end of the semester.
- An internal assessment test conducted at the end of the semester shall be assessed for 10 marks.

**Semester End Assessment:**

- Semester end examination is for 60 marks (180 min) conducted and assessed by both external and internal examiners.

- Both internal and external examination shall include assessment of the student on
    a) Knowledge of principles/concepts involved
    b) Experimental design
    c) Result interpretation and analysis
    d) Experimental report

c). **Drawing/Design/Estimation:**

**i) Computer Aided Engineering Graphics:**

**Evaluation Procedure:**

The course will have 5 units and assessed for 100 marks, of which, 40 marks for internal assessment and 60 marks for semester end external examination.

**Internal Assessment : (40 Marks)**

| | |
|---|---|
| Continuous assessment | : 15 Marks |
| Project based learning | : 15 Marks |
| Internal test | : 10 Marks |

**Semester End Assessment:**

- Semester end examination is for 60 marks (180 min) conducted and assessed by both external and internal examiners.
- Question paper contains 3 questions (with internal choice). **E**ach question carries 20 marks (5 marks for free hand drawing and list of commands & 15 marks for final drawing prepared in AUTOCAD). A Student shall answer all questions.

**ii) Computer Aided Geometric Design and Assembly:**

**Evaluation Procedure:**

The course will have 5 units and assessed for 100 marks, of which, 40 marks for internal assessment and 60 marks for semester end external examination.

**Internal Assessment : (40 Marks)**

| | |
|---|---|
| Continuous assessment | : 15 Marks |
| Project based learning | : 15 Marks |
| Internal test | : 10 Marks |

**Semester End Assessment:**

- Semester end examination is for 60 marks (180 min) conducted and assessed by both external and internal examiners.
- Semester End Examination shall include assessment of the student on Final drawings like modeling, assembly and drafting.
- Student is expected to execute one exercise.

- Final drawings like modeling, assembly and drafting hard copies shall be evaluated by both internal and external examiners

### iii) Design and Drawing Courses

**Evaluation Procedure:**

The course will have 5 units and assessed for 100 marks, of which, 40 marks for internal assessment and 60 marks for semester end external examination.

| **Internal Assessment:** | **40 Marks** |
|---|---|
| Subjective Test | - 20 Marks |
| Assignments | - 10 Marks |
| Design and Drawing reports | - 10 Marks |

- Two subjective tests shall be conducted.
- Each subjective test shall be conducted for 90 Minutes and have 3 questions each for 7 marks (No choice) and the same shall be scaled down to 20 Marks.
- Average of two subjective tests shall be considered.
- Assignments shall be assessed for 10 marks.
- Design and drawing reports shall be assessed for 10 marks.

**External Assessment:**

The end examination question paper consists of Part A and Part B.
Part A consists of two questions regarding Design and Drawing (from two clusters clearly mentioned in the syllabus). Each question carries 20 marks. The student shall answer any 1 question.
Part B consists of four questions (from the remaining four clusters) with internal choice and all four are to be answered. Each question carries 10 marks.

### iv) Estimation and Costing Courses

The course will have 5 units and assessed for 100 marks, of which, 40 marks for internal assessment and 60 marks for semester end external examination.

| **Internal Assessment:** | **40 Marks** |
|---|---|
| Subjective Test | - 20 Marks |
| Assignments | - 10 Marks |
| Bar bending schedules, | - 10 Marks |
| Estimation and cost analysis reports | |

Two subjective tests shall be conducted.

- Each subjective test shall be conducted for 90 Minutes and have 3 questions each for 7 marks (No choice) and the same shall be scaled down to 20 Marks.
- Average of two subjective tests shall be considered.
- Assignments shall be assessed for 10 marks.
- Bar bending schedules, Estimation and cost analysis reports shall be assessed for 10 marks.

**External Assessment:**

External examination is for 60 Marks. The question paper consists of 2 questions. Each question carries 60 Marks. The student shall answer 1 question.
In each question, the section, plan and reinforcement drawings of various members of a building will be given and the following items are to be calculated.

- Quantities of all the items (20 Marks).
- Reinforcement tonnage and Bar bending schedule (10 Marks).
- Specifications (10 Marks).
- Rates of all the items as per Standard Schedule of Rates (20 Marks).

**Integrated Course (Theory + Lab):**

**Theory and Lab shall be assessed for 200 Marks (Each 100 marks)**

- For Integrated course, the theory shall be assessed for 100 marks, of which 40 marks for internal assessment and 60 marks for semester end external examination.
- The Lab shall be assessed for 100 marks , of which, 40 marks for internal assessment and 60 marks for semester end external examination

**Socially Relevant Project:**

- A student shall identify and provide a solution to the problem relevant to society/Profession/Industry.
- A student shall engage at least 15 hours on socially relevant project. Socially relevant project shall be evaluated internally for 50 marks by Project Review Committee (PRC). PRC comprising of HoD, department Academic Coordinator, R&D member of the department, one senior faculty and guide shall review the progress.

**Mini Project:**

- A student shall undergo internship for a period of 4 weeks/provide solution to the problem relevant to Industry/ Modern tool during the vacation after VI semester and submit comprehensive report.
  - Mini project shall be evaluated internally for 50 marks by Project Review Committee (PRC).
  - PRC shall prepare rubrics for assessment.

**Project Evaluation**:

Project is divided into 2 phases – Phase I & Phase II

- Evaluation shall comprise of internal and external assessment.

Internal: 110 (Phase I 50 marks, Phase II 60 Marks)

External: 90

- A project Review committee (PRC) comprising of HoD, department Academic Coordinator, R&D member of the department, one senior faculty and guide shall review the progress once in four weeks.

**Project Phase I:**

- Project Phase I shall be evaluated internally by PRC for 50 Marks.
- A student shall undertake project phase I during the VII semester.
- A student shall report to the guide/external supervisor and work under his supervision at least 2 hours per week.
- Assessment shall be on
  - Literature review
  - Identification and statement of the Problem

**Project Phase II:**

- A student shall undertake project phase II during the VIII semester.
- A student shall report to the guide/external supervisor and work under his supervision at least 8 hours per week.
- Internal evaluation shall be done by HoD, department Academic Coordinator, R&D member of the department, one senior faculty and guide for 60 marks.
- External evaluation shall be done by HoD, Guide/Internal Examiner and External Examiner for 90 marks.
- Assessment shall be on
  a) Review on fundamental knowledge involved
  b) Inter disciplinary aspect
  c) Experimental/methodology design
  d) Result analysis and interpretations
  e) Report writing
  f) Team work
  g) Presentation
  h) Viva-voce

**B.Tech. (Lateral Entry):**

The rules and regulations for candidates admitted under lateral entry category for $2^{nd}$, $3^{rd}$ and $4^{th}$ years of study shall be same as applicable to regular B.Tech students.

## 7. ATTENDANCE REGULATIONS:

**B.Tech.:**

I. A student shall be eligible to appear for end semester examinations, if he or she acquires a minimum of 75% of attendance in aggregate of all the subjects (Theory & Lab.) for the semester.

II. Condonation of shortage of attendance in aggregate up to 10% (65% and above and below 75%) in each semester may be granted by the college academic committee.

III. Shortage of attendance below 65% in aggregate of all the subjects (Theory & Lab) for the semester shall not be Condoned.

IV. Detained student shall seek re- admission for that semester when offered within 4 weeks from the date of commencement of class work.

**PROMOTION RULE (Based on attendance):**

- A Student shall be promoted to the next semester on fulfillment of minimum attendance requirement (75%) of current semester.

**PROMOTION RULE (Based on credits):**

- A student shall be promoted from IV semester to V semester if he fulfills the minimum attendance requirement (75%) and academic requirement of 40% of credits up to IV semester from the following examinations irrespective of whether the candidate takes the examination or not.
    - Two regular and Two supplementary examinations of I semester
    - Two regular and One supplementary examinations of II semester
    - One regular examination and One supplementary examination of III semester
    - One regular examination of IV semester.
- A student shall be promoted from VI semester to VII semester if he fulfills the minimum attendance requirement (75%) and academic requirement of 40% of credits up to VI semester from the following examinations irrespective of whether the candidate takes the examination or not.
    - Three regular and Three supplementary examinations of I semester
    - Three regular and Two supplementary examinations of II semester
    - Two regular and Two supplementary examinations of III semester
    - Two regular and One supplementary examinations of IV semester
    - One regular and One supplementary examination of V semester
    - One regular examination of VI semester.

**B.TECH (Lateral Entry):**

**PROMOTION RULE (Based on attendance):**

A Student shall be promoted to the next semester on fulfillment of minimum attendance requirement of current semester.

**PROMOTION RULE (Based on credits):**

A student shall be promoted from VI semester to VII semester if he fulfills the minimum attendance requirement (75%) and academic requirement of 40% of credits up to VI semester from the following examinations irrespective of whether the candidate takes the examination or not.

- Two regular and Two supplementary examinations of III semester
- Two regular and one supplementary examinations of IV semester
- One regular and One supplementary examinations of V semester
- One regular examination of VI semester.

**B.Tech. (Lateral Entry):**

The rules and regulations for candidates admitted under lateral entry category for 2nd, 3rd and 4th years of study shall be same as applicable to regular B.Tech students.

## 8. MINIMUM ACADEMIC REQUIREMENTS:

**B.Tech.: (Theory/Lab)**

i. A student is deemed to have satisfied the minimum academic requirements for a course on securing at least 24 marks out of 60 marks at semester end examination and overall minimum of 40 marks out of 100 marks including internal assessment.

ii. **Integrated Course (Theory + Lab):**

- The student shall secure minimum 24 marks out of 60 marks at semester end examination and overall 40 marks out of 100 marks for Theory and Laboratory courses independently. In case of failure in either theory or Laboratory course, the student should re-appear for both theory and laboratory.
- The assessment shall be done independently for both theory and laboratory courses and final marks shall be calculated on weighted average method for converting marks into grade points.

**Sample calculation:**

Integrated course-5 credits. Theory is for 3 credits and laboratory is for 2 credits.

Total Marks obtained in theory: 70 out of 100 (3 Credits)

Total Marks obtained in Lab : 90 out of 100 (2 Credits)

Final marks of the integrated course is

(70X3 + 90X2) / 5 = 78 Marks

**B.Tech. (Lateral Entry):**

The rules and regulations for candidates admitted under lateral entry category for 2nd, 3rd and 4th years of study shall be same as applicable to regular B.Tech students.

## 9. GRADING SYSTEM:

**B.Tech. / B.Tech. (Lateral Entry)**

Semester Grade Point Average (SGPA) for the current semester which is calculated on the basis of grade points obtained in all courses, except audit courses and courses in which satisfactory or course continuation has been awarded,

SGPA= Σ (course credits earned x Grade points) /
Σ (Total course credits in the semester.

**CGPA= Σ (course credits earned x Grade points) up to successfully completed semesters ) / Σ (Total course credits up to successfully completed)**

The UGC recommends a 10-point grading system with the following letter grades as given below:

| | | |
|---|---|---|
| O | (Outstanding) | 10 |
| A+ | (Excellent) | 9 |
| A | (Very Good) | 8 |
| B+ | (Good) | 7 |
| B | (Above Average) | 6 |
| C | (Average) | 5 |
| P | (Pass) | 4 |
| F | (Fail) | 0 |
| Ab | (Absent) | 0 |

- iii. A student obtaining Grade F shall be considered failed and will be required to reappear in the examination.

**Illustration of Computation of SGPA and CGPA and Format for Transcripts**

Computation of SGPA and CGPA

**Illustration for SGPA**

| Course | Credit | Grade Letter | Grade point | Credit Point (Credit x Grade) |
|---|---|---|---|---|
| Course 1 | 3 | A | 8 | 3 X 8 = 24 |
| Course 2 | 4 | B+ | 7 | 4 X 7 = 28 |
| Course 3 | 3 | B | 6 | 3 X 6 = 18 |
| Course 4 | 3 | O | 10 | 3 X10 = 30 |
| Course 5 | 3 | C | 5 | 3 X 5 = 15 |
| Course 6 | 4 | B | 6 | 4 X 6 = 24 |
| | **20** | | | **139** |

Thus, **SGPA** =139/20 = 6.95

**Illustration for CGPA**

| **Semester 1** | **Semester 2** | **Semester 3** | **Semester 4** | **Semester 5** | **Semester 6** |
|---|---|---|---|---|---|
| Credits: 16 | Credits: 18 | Credits: 25 | Credits: 21 | Credits: 23 | Credits: 22 |
| SGPA: 7.9 | SGPA: 7.8 | SGPA: 7.6 | SGPA: 8.0 | SGPA: 8.3 | SGPA: 8.6 |

| **Semester 7** | **Semester 8** |
|---|---|
| Credits: 21 | Credits:14 |
| SGPA: 8.2 | SGPA: 8.5 |

Thus,

**CGPA**= $\frac{16x7.9 + 18x7.8 + 25x7.6 + 21x8.0 + 23x8.3 + 22x8.6 + 21x8.2 + 14x8.5}{160}$ = **8.1**

## 10. ELIGIBILITY FOR AWARD OF DEGREE:

**B.Tech:**

A student shall be eligible for award of the degree if he/she fulfills the following conditions:

1) Successfully completes all the courses prescribed for the Program.
2) CGPA greater than or equal to 4.5(Minimum requirement for Pass),

## 11. AWARD OF CLASS:

**B.Tech:**

Eligible Candidates for the award of B.Tech., Degree shall be placed in one of the following Classes based on CGPA.

| Class | CGPA |
|---|---|
| Distinction | $\geq 7.5$ |
| First Class | $\geq 6.5$ |
| Second Class | $\geq 5.5$ |
| Pass class | $\geq 4.5$ |

## 12. INSTRUCTION DAYS:

A semester shall have a minimum of 90 clear instruction days (including internal examinations).

**13. Transfers from other Institutions shall not be permitted**.

## 14. SUPPLEMENTARY EXAMINATIONS:

Supplementary examinations shall be conducted within 4 weeks from the date of announcement of results of regular examinations.

**15. WITHHOLDING OF RESULTS:** The result of a student shall be withheld

- If the student has not paid the dues, if any, to the institution
- If any case of pending disciplinary action ,
- Involvement in any sort of malpractices etc.
- Involvement in ragging.

## 16. TRANSITORY REGULATIONS:

a) Detained candidates are eligible for re-admission as and when next offered.

b) The re-admitted candidate will be governed by the rules and regulations under which the candidate has been admitted.

c) In case of transferred students from other Universities, credits shall be transferred to JNTUK as per the academic regulations and course structure of JNTUK.

d) The students seeking transfer to colleges affiliated to JNTUK from various other Universities/ Institutions have to obtain the credits of any equivalent subjects as prescribed by JNTUK. The transferred candidates have to write the backlogs/failed subjects, if any, in the same Institution where he/she was admitted.

## 17. AMENDMENTS TO REGULATIONS:

The Academic Council of MVGR College of Engineering (Autonomous) reserves the right to revise, amend, change or nullify the Regulations, Schemes of Examinations, and/ or Syllabi or any other such matter relating to the requirements of the program which are compatible to the contemporary/emerging trends effectively meeting the needs of society/industry/stake holding groups.

## 18. Regulations for MALPRACTICES during the conduct of examinations

| | Nature of Malpractices/Improper conduct | Punishment |
|---|---|---|
| 1 (a) | If the candidate possesses or keeps accessible in examination hall, any paper, note book, programmable calculators, Cell phones, pager, palm computers or any other form of material concerned with or related to the subject of the examination (theory or practical) in which he is appearing but has not made use of (material shall include any marks on the body of the candidate which can be used as an aid in the subject of the examination) | Expulsion from the examination hall and cancellation of the performance in that subject only. * |
| (b) | If the candidate gives assistance or guidance or receives it from any other candidate orally or by any other body language methods or communicates through cell phones with any candidate or persons in or outside the exam hall in respect of any matter. | Expulsion from the examination hall and cancellation of the performance in that subject only of all the candidates involved. In case of an outsider, he will be handed over to the police and a case is registered against him. * |

| | | |
|---|---|---|
| 2 | If the candidate has copied in the examination hall from any paper, book, programmable calculators, palm computers or any other form of material relevant to the subject of the examination (theory or practical) in which the candidate is appearing. | Expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted to appear for the remaining examinations of the subjects of that Semester/year.<br>The Hall Ticket of the candidate is to be cancelled.<br>* |
| 3 | If the candidate impersonates any other candidate in connection with the examination. | The candidate who has impersonated shall be expelled from examination hall. The candidate is also debarred and forfeits the seat. The performance of the original candidate, who has been impersonated, shall be cancelled in all the subjects of the examination (including practicals and project work) already appeared and shall not be allowed to appear for examinations of the remaining subjects of that semester/year. The candidate is also debarred for two consecutive semesters from class work and all University examinations. The continuation of the course by the candidate is subject to the academic regulations in connection with forfeiture of seat. If the imposter is an outsider/candidate not on rolls, he will be handed over to the police and a case is registered against him.<br>* |
| 4 | If the candidate mishandles the Answer book or additional sheet or takes out or arranges to send out the question paper during the examination or answer book or additional sheet, during or after the examination.<br>Also if the answer script is mutilated / damaged disturbing the shape, of the script, answers, the bar code intentionally. | Expulsion from the examination hall and cancellation of performance in that subject and all the other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester. He shall be debarred from class work and all examinations and be allowed to reregistered for the next subsequent odd or even semester only. The continuation of the course by the candidate is subject to the academic regulations in connection with forfeiture of seat.* |

| | | |
|---|---|---|
| 5. | Uses objectionable, abusive or offensive language in the answer paper or in letters to the examiners or writes to the examiner requesting him to award pass marks. | The same should be brought to the notice of CE who in turn in consultation with malpractice committee makes decision for cancellation of the performance in that subject.<br>* |
| 6. | Refuses to obey the orders of the Chief Superintendent/Assistant – Superintendent / any officer on duty or misbehaves or creates disturbance of any kind in and around the examination hall or organizes a walk out or instigates others to walk out, or threatens the officer-in charge or any person on duty in or outside the examination hall of any injury to his person or to any of his relations whether by words, either spoken or written or by signs or by visible representation, assaults the officer-in-charge, or any person on duty in or outside the examination hall or any of his relations, or indulges in any other act of misconduct or mischief which result in damage to or destruction of property in the examination hall or any part of the College campus or engages in any other act which in the opinion of the officer on duty amounts to use of unfair means or misconduct or has the tendency to disrupt the orderly conduct of the examination. | In case of students of the college, they shall be expelled from examination halls and cancellation of their performance in that subject and all other subjects the candidate(s) has (have) already appeared and shall not be permitted to appear for the remaining examinations of the subjects of that semester. The candidates also are debarred and forfeit their seats. In case of outsiders, they will be handed over to the police and a police case is registered against them.<br>* |
| 7. | Leaves the exam hall taking away answer script or intentionally tears of the script or any part thereof inside or outside the examination hall. | Expulsion from the examination hall and cancellation of performance in that subject and all the other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year. The candidate is also debarred for two consecutive semesters from class work and all University examinations. The continuation of the course by the candidate is subject to the academic regulations in connection with forfeiture of seat. * |
| 8. | Possess any lethal weapon or firearm in the examination hall. | Expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year. The candidate is also debarred and forfeits the seat. * |

| | | |
|---|---|---|
| 9. | If student of the college, who is not a candidate for the particular examination or any person not connected with the college indulges in any malpractice or improper conduct mentioned in clause 6 to 8. | Student of the colleges expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester. The candidate is also debarred and forfeits the seat.<br>Person(s) who do not belong to the College will be handed over to police and, a police case will be registered against them. * |
| 10 | Comes in a drunken condition to the examination hall. | Expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester. * |
| 11 | Copying detected on the basis of internal evidence, such as, during valuation or during special scrutiny. | Cancellation of the performance in that subject and all other subjects the candidate has appeared including practical examinations and project work of that semester/year examinations.* |

*

**19. General :**

- Wherever the words “he”, “him”, “his”, occur in the regulations, they include “she”, “her”, “hers”.
- The academic regulation should be read as a whole for the purpose of any interpretation.
- In the case of any doubt or ambiguity in the interpretation of the above rules, the decision of the Vice-Chancellor is final.
- The University may change or amend the academic regulations or syllabi at any time and the changes or amendments made shall be applicable to all the students with effect from the dates notified by the University.

* * *

# Ragging

## Prohibition of ragging in educational institutions Act 26 of 1997

### Salient Features

- **Ragging within or outside any educational institution is prohibited.**
- **Ragging means doing an act which causes or is likely to cause Insult or Annoyance of Fear or Apprehension or Threat or Intimidation or outrage of modesty or Injury to a student**

| | Imprisonment upto | | Fine Upto |
|---|---|---|---|
| Teasing, Embarrassing and Humiliation | 6 Months | + | Rs. 1,000/- |
| Assaulting or Using Criminal force or Criminal intimidation |  1 Year | + | Rs. 2,000/- |
| Wrongfully restraining or confining or causing hurt |  2 Years | + | Rs. 5,000/- |
| Causing grievous hurt, kidnapping or Abducts or rape or committing unnatural offence |  5 Years | + | Rs. 10,000/- |
| Causing death or abetting suicide |  10 Months | + | Rs. 50,000/- |

**In Case of Emergency CALL TOLL FREE NO. : 1800 - 425 - 1288**

**LET US MAKE MVGR A RAGGING FREE CAMPUS**

# Ragging

ABSOLUTELY NO TO RAGGING

**1. Ragging is prohibited as per Act 26 of A.P. Legislative Assembly, 1997.**

**2. Ragging entails heavy fines and/or imprisonment.**

**3. Ragging invokes suspension and dismissal from the College.**

**4. Outsiders are prohibited from entering the College and Hostel without permission.**

**5. Girl students must be in their hostel rooms by 7.00 p.m.**

**6. All the students must carry their Identity Cards and show them when demanded**

**7. The Principal and the Wardens may visit the Hostels and inspect the rooms any time.**

**PROGRAM STRUCTURE**

**B. TECH – CHEMICAL ENGINEERING**

**(A2 Regulation)**

| **SEMESTER-I** | | | | | | |
|---|---|---|---|---|---|---|
| **Sl. No** | **Course Code** | **Course Title** | **L** | **T** | **P** | **Credits** |
| 1 | A2MAT101 | Mathematics-I | 3 | - | - | 3 |
| 2 | A2PYI101 | Engineering Physics (Integrated Course) | 3 | - | 3 | 5 |
| 3 | A2CII201 | Programming for Problem Solving (Integrated Course) | 3 | - | 3 | 5 |
| 4 | A2MED201 | Computer Aided Engineering Graphics | 1 | - | 4 | 3 |
| 5 | A2EHA701 | Constitution of India | 2 | - | - | 0 |
| **Total number of Credits:** | | | | | | **16** |

| **SEMESTER-II** | | | | | | |
|---|---|---|---|---|---|---|
| **Sl. No** | **Course Code** | **Course Title** | **L** | **T** | **P** | **Credits** |
| 1 | A2MAT102 | Mathematics-II | 3 | - | - | 3 |
| 2 | A2CYI101 | Engineering Chemistry (Integrated Course) | 3 | - | 3 | 5 |
| 3 | A2EEI201 | Basic Electrical Engineering (Integrated Course) | 3 | - | 3 | 5 |
| 4 | A2EHL001 | Essential Communication in English | 1 | - | 3 | 3 |
| 5 | A2CHW201 | Workshop | - | - | 3 | 2 |
| **Total number of Credits:** | | | | | | **18** |

| **SEMESTER-III** | | | | | | |
|---|---|---|---|---|---|---|
| **Sl. No** | **Course Code** | **Course Title** | **L** | **T** | **P** | **Credits** |
| 1 | A2CHT101 | Biology for Engineers | 3 | - | - | 3 |
| 2 | A2MAT105 | Mathematics-III | 3 | - | - | 3 |
| 3 | A2CHT202 | Design Thinking and Product Innovation | 3 | - | - | 3 |
| 4 | A2CHT301 | Chemical Technology | 3 | - | - | 3 |
| 5 | A2CHT302 | Fluid Mechanics for Chemical Engineers | 3 | - | - | 3 |
| 6 | A2CHI201 | AI Tools, Techniques and Applications (Integrated Course) | 3 | - | 3 | 5 |
| 7 | A2CHL301 | Fluid Mechanics Lab | - | - | 3 | 1.5 |
| 8 | A2CHL302 | CHEM CAD Lab | - | - | 3 | 1.5 |
| 9 | A2EHA702 | Essence of Indian Traditional Knowledge | 2 | - | - | 0 |
| **Total number of Credits:** | | | | | | **23** |

| SEMESTER-IV | | | | | | |
|---|---|---|---|---|---|---|
| **Sl. No** | **Course Code** | **Course Title** | **L** | **T** | **P** | **Credits** |
| 1 | A2EHT001 | Effective Technical Communication | 2 | - | 2 | 3 |
| 2 | A2MAT110 | Mathematics-IV | 3 | - | - | 3 |
| 3 | A2CHT201 | Internet of Things | 2 | - | 2 | 3 |
| 4 | A2CHT303 | Chemical Process Calculations | 3 | - | - | 3 |
| 5 | A2CHT304 | Mechanical Unit Operations | 3 | - | - | 3 |
| 6 | A2CHT305 | Process Heat Transfer | 3 | - | - | 3 |
| 7 | A2CHL303 | Mechanical Unit Operations Lab | - | - | 3 | 1.5 |
| 8 | A2CHL304 | Process Heat Transfer Lab | - | - | 3 | 1.5 |
| 9 | A2CHP602 | Mini Project | - | - | 4 | 2 |
| 10 | A2CHA701 | Environmental Science | 2 | - | - | 0 |
| **Total number of Credits:** | | | | | | **23** |

| SEMESTER-V | | | | | | |
|---|---|---|---|---|---|---|
| **Sl. No** | **Course Code** | **Course Title** | **L** | **T** | **P** | **Credits** |
| 1 | A2CHT306 | Chemical Engineering Thermodynamics | 3 | - | - | 3 |
| 2 | A2CHT307 | Chemical Reaction Engineering - I | 3 | - | - | 3 |
| 3 | A2CHT308 | Mass Transfer - I | 3 | - | - | 3 |
| 4 (PE-1) | A2CHT401 | New Material Technology | 3 | - | - | 3 |
| | A2CHT402 | Fertilizer Technology | | | | |
| | A2CHT403 | Polymer Technology | | | | |
| 5 (OE-1) | A2MST002 | OE-I: Human Resources Development and Organizational Behavior | 3 | - | - | 3 |
| 6 (OE-2) | A2XXT5XX | Open Elective - 2 | 3 | - | - | 3 |
| 7 | A2CHL305 | Chemical Reaction Engineering Lab | - | - | 3 | 1.5 |
| 8 | A2CHL306 | Mass Transfer Lab | - | - | 3 | 1.5 |
| **Total number of Credits:** | | | | | | **21** |

| SEMESTER-VI | | | | | | |
|---|---|---|---|---|---|---|
| **Sl. No** | **Course Code** | **Course Title** | **L** | **T** | **P** | **Credits** |
| 1 | A2MST001 | Managerial Economics and Financial Analysis | 3 | - | - | 3 |
| 2 | A2CHT309 | Chemical Reaction Engineering - II | 3 | - | - | 3 |
| 3 | A2CHT310 | Mass Transfer - II | 3 | - | - | 3 |
| 4 | A2CHT311 | Process Instrumentation and Control | 3 | - | - | 3 |
| 5 | A2CHT312 | Process Modeling & Simulation | 3 | - | - | 3 |
| 6 (PE-2) | A2CHT404 | Petroleum Refining | 3 | - | - | 3 |
| | A2CHT405 | Petro Chemical Technology | | | | |
| | A2CHT406 | Fuel Cell Technology | | | | |
| 7 (PE-3) | A2CHT407 | Phase & Reaction Equilibria | 3 | - | - | 3 |
| | A2CHT408 | Corrosion & Control | | | | |
| | A2CHT409 | Process Intensification | | | | |
| 8 | A2CHL307 | Process Instrumentation and Control Lab | - | - | 3 | 1.5 |
| 9 | A2CHL308 | Process Modeling & Simulation Lab | - | - | 3 | 1.5 |
| **Total number of Credits:** | | | | | | **24** |

| SEMESTER-VII | | | | | | |
|---|---|---|---|---|---|---|
| **Sl. No** | **Course Code** | **Course Title** | **L** | **T** | **P** | **Credits** |
| 1 | A2EHT002 | Professional Ethics and Human Values | 3 | - | - | 3 |
| 2 | A2CHT313 | Plant Design and Economics | 3 | - | - | 3 |
| 3 | A2CHT314 | Transport Phenomena | 3 | - | - | 3 |
| 4 (PE-4) | A2CHT410 | Food Processing Technology | 3 | - | - | 3 |
| | A2CHT411 | Nano Technology | | | | |
| | A2CHT412 | Pharmaceutical Technology | | | | |
| 5 (PE-5) | A2CHT413 | Bio Chemical Engineering | 3 | - | - | 3 |
| | A2CHT414 | Enzyme Engineering | | | | |
| | A2CHT415 | Nuclear Reactor Engineering | | | | |
| 6 (PE-6) | A2CHT416 | Industrial Bio Technology | 3 | - | - | 3 |
| | A2CHT417 | Industrial Safety & Hazard Management | | | | |
| | A2CHT418 | Optimization of Chemical Processes | | | | |
| 7 | A2CHP601 | Socially Relevant Project | - | - | 2 | 1 |
| 8 | A2CHP603 | Project (Phase-I) | - | - | 4 | 2 |
| **Total number of Credits:** | | | | | | **21** |

| SEMESTER-VIII | | | | | | |
|---|---|---|---|---|---|---|
| **Sl. No** | **Course Code** | **Course Title** | **L** | **T** | **P** | **Credits** |
| 1 (OE-3) | A2CHT507 | Energy Engineering | 3 | - | - | 3 |
| | A2CHT508 | Bio Energy | | | | |
| | A2CHT509 | Energy Conservation and Management | | | | |
| 2 (OE-4) | A2CHT510 | Environmental Impact Assessment | 3 | - | - | 3 |
| | A2CHT511 | Solid Waste Management | | | | |
| | A2CHT512 | Industrial Pollution Control & Engineering | | | | |
| 3 | A2CHP604 | Project (Phase-II) | - | - | 16 | 8 |
| **Total number of Credits:** | | | | | | **14** |

**Note:** Each department is offering 4 open elective courses. One elective course is from Humanities (Human Resources Development and Organizational Behavior) which is common to all Engineering departments. 2nd Open elective course should be opted from the other departments (List of Open elective courses offered by various departments are given below). 3rd and 4th Open elective courses (Emerging subjects) should be discipline centric.

## OPEN ELECTIVES

| OPEN ELECTIVE COURSES OFFERED BY THE DEPARTMENT OF CIVIL ENGINEERING | | | | | | |
|---|---|---|---|---|---|---|
| **Sl. No** | **Course Code** | **Course Title** | **L** | **T** | **P** | **Credits** |
| 1 | A2CET501 | Remote Sensing and GIS | 3 | - | - | 3 |
| 2 | A2CET502 | Project Planning and Management | 3 | - | - | 3 |
| 3 | A2CET503 | Road Safety Engineering | 3 | - | - | 3 |
| 4 | A2CET504 | Geomatics | 3 | - | - | 3 |
| 5 | A2CET505 | Building Services | 3 | - | - | 3 |
| 6 | A2CET506 | Water Power Engineering | 3 | - | - | 3 |
| **OPEN ELECTIVE COURSES OFFERED BY THE DEPARTMENT OF EEE** | | | | | | |
| **Sl. No** | **Course Code** | **Course Title** | **L** | **T** | **P** | **Credits** |
| 1 | A2EET501 | Basic Control Systems | | | | |
| 2 | A2EET502 | Applied Electrical Engineering | | | | |
| 3 | A2EET503 | Electrical Safety | | | | |
| 4 | A2EET504 | Concepts of Electrical Wiring | | | | |
| 5 | A2EET505 | Basic Automation Course | | | | |
| 6 | A2EET506 | Illumination Engineering | | | | |
| **OPEN ELECTIVE COURSES OFFERED BY THE DEPARTMENT OF MECHANICAL ENGINEERING** | | | | | | |
| **Sl. No** | **Course Code** | **Course Title** | **L** | **T** | **P** | **Credits** |
| 1 | A2MET501 | Introduction to Robotics | 3 | - | - | 3 |
| 2 | A2MET502 | Solar and Wind Energy | 3 | - | - | 3 |
| 3 | A2MET503 | Production and Operations Management | 3 | - | - | 3 |
| 4 | A2MET504 | Micro Electromechanical Systems | 3 | - | - | 3 |
| 5 | A2MET505 | Product Lifecycle Management | 3 | - | - | 3 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 6 | A2MET506 | Foundation of Computational Fluid Dynamics | 3 | - | - | 3 |
| **OPEN ELECTIVE COURSES OFFERED BY THE DEPARTMENT OF ECE** | | | | | | |
| **Sl. No** | **Course Code** | **Course Title** | **L** | **T** | **P** | **Credits** |
| 1 | A2ECT501 | Principles of Communication Engineering | 3 | - | - | 3 |
| 2 | A2ECT502 | Electronic Instrumentation | 3 | - | - | 3 |
| 3 | A2ECT503 | Biomedical Engineering | 3 | - | - | 3 |
| 4 | A2ECT504 | Modern Communication Systems | 3 | - | - | 3 |
| 5 | A2ECT505 | Transducers and Sensors | 3 | - | - | 3 |
| 6 | A2ECT506 | Principles of Mobile Communications | 3 | - | - | 3 |
| **OPEN ELECTIVE COURSES OFFERED BY THE DEPARTMENT OF CSE & IT** | | | | | | |
| **Sl. No** | **Course Code** | **Course Title** | **L** | **T** | **P** | **Credits** |
| 1 | A2CIT501 | Fundamentals of Data Structures | 3 | - | - | 3 |
| 2 | A2CIT502 | Object Oriented Programming with JAVA | 3 | - | - | 3 |
| 3 | A2CIT503 | Web Design and Development | 3 | - | - | 3 |
| 4 | A2CIT504 | Python Programming | 3 | - | - | 3 |
| 5 | A2CIT505 | NoSQL Databases | 3 | - | - | 3 |
| 6 | A2CIT506 | Data Analytics | 3 | - | - | 3 |
| **OPEN ELECTIVE COURSES OFFERED BY THE DEPARTMENT OF CHEMICAL ENGINEERING** | | | | | | |
| **Sl. No** | **Course Code** | **Course Title** | **L** | **T** | **P** | **Credits** |
| 1 | A2CHT501 | Computational Fluid Dynamics | 3 | - | - | 3 |
| 2 | A2CHT502 | Non-Conventional Sources of Energy | 3 | - | - | 3 |
| 3 | A2CHT503 | Design & Analysis of Experiments | 3 | - | - | 3 |
| 4 | A2CHT504 | Industrial Waste Water Engineering | 3 | - | - | 3 |
| 5 | A2CHT505 | Green Chemistry & Technology | 3 | - | - | 3 |
| 6 | A2CHT506 | Air Pollution Control and Design of Equipment | 3 | - | - | 3 |

| A2MAT101 | SEMESTER - I | L | T | P | C |
|---|---|---|---|---|---|
| | MATHEMATICS-I (common to ALL branches) | 3 | 0 | - | 3 |
| | Total Contact Hours – 48 | | | | |

## SYLLABUS

**UNIT-I: LINEAR ALGEBRA-1**

Rank of a matrix: Elementary row and column transformations, equivalent matrices, Echelon form of a matrix, calculation of rank by reducing the matrix to Echelon form. System of equations: Linear system of equations, homogeneous and non-homogeneous system of equations, consistency criteria, trivial and non-trivial solutions, solving system of equations by Rank method; Eigenvalues and Eigenvectors: Finding Eigenvalues and Eigenvectors, properties of Eigenvalues and Eigenvectors (statements) including spectral mapping theorem.

**UNIT- II: LINEAR ALGEBRA-2**

Cayley-Hamilton Theorem: Statement of the theorem and its verification. Applications: Finding higher powers of a matrix, finding matrix polynomials, finding inverse of matrix. Diagonal form of a matrix: Reduction to diagonal form, spectral and modal matrices, finding higher powers of a matrix using diagonalisation, Quadratic forms: Matrix form of quadratic forms, orthogonal transformation, canonical form, reduction of quadratic form to canonical form by orthogonal transformation method, rank, index, signature and nature (definiteness) of a quadratic form.

**UNIT-III: FIRST ORDER DIFFERENTIAL EQUATIONS & APPLICATIONS**

Outlines: Differential Equations(DEs), Order and degree of a DE, Formation of DEs, general solutions of a DE; Solving first order and first degree DEs: linear DEs, Bernoulli's DEs (reducible to linear), exact DEs, integrating factors, non-exact DEs (reducible to exact).

Applications to real world problems: Newton's law of cooling, laws of growth and decay, family of curves, orthogonality of families curves, orthogonal trajectories (Cartesian and polar curves).

**UNIT-IV: HIGHER ORDER DIFFERENTIAL EQUATIONS**

Differential equations of higher order: Linear differential equations of higher order, its operator form. Solution concepts: General (complete) solution, particular solution. Solution of linear differential equations of higher order: Auxiliary equations, rules for finding complementary functions, rules for finding particular integrals (general and special methods).

**UNIT-V: LAPLACE TRANSFORMS**

Laplace transformation: Laplace transformation of elementary functions, Properties: Linearity, change of scale, first shifting properties, finding Laplace transformations using properties, Advanced properties: Laplace transformations of derivatives and integrals, multiplication by $t^n$, division by t (statements), finding Laplace transformations using advanced properties; Inverse Laplace transformations: Finding inverse Laplace transformations using partial fractions, statement of Convolution theorem, finding inverse Laplace transformations by Convolution theorem; Applications: Solving Initial Value Problems by using Laplace transformations.

//Topics prefixed with ‘outlines / overview’ are not for assessment//

**TEXT BOOKS:**

1. B.S. Grewal, Higher Engineering Mathematics, 44/e, Khanna Publishers, 2017
2. T.K.V. Iyengar et al, Engineering Mathematics, S. Chand Publishers, Revised edition

**REFERENCE BOOKS:**

1. Erwin Kreyszig, Advanced Engineering Mathematics, 10/e, John Wiley & Sons, 2011
2. B.V. Ramana, Higher Engineering Mathematics, Tata McGraw Hill New Delhi, 11th Reprint, 2010
3. T. Veerarajan, Higher Engineering Mathematics, Tata McGraw-Hill, 2008

**COURSE OUTCOMES:** Learners at the end of this course will be able to

| | | |
|---|---|---|
| CO 1 | KO#1 | Recall the concepts of Linear algebra |
| CO 2 | KO#2 | Recall the solution methods and applicability of first order differential equations |
| CO 3 | KO#3 | Recall the solution methods of higher order differential equations and the concepts of Laplace transforms |
| CO 4 | UO#1 | Use and interpret the concepts of linear algebra |
| CO 5 | UO#2 | Use and interpret solution methods and applicability of first order differential equations |
| CO 6 | UO#3 | Use and interpret solution methods of higher order differential equations and the concepts of Laplace transforms |
| CO 7 | AO#1 | Apply the concepts of linear algebra, differential equations and Laplace transformation to model and solve real world problems |

CO/PO Mapping

| Course Title: | Mathematics-I (Common to ALL Branches) | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Course Code: | A2MAT101 | | | | | | | | | | | | | |
| Course Designed by | Dept. of Mathematics | | | | | | | | | | | | | |
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
| CO1 | 3 | 3 | | 2 | | | | | | | 2 | | | |
| CO2 | 3 | 3 | | 2 | | | | | | | 2 | | | |
| CO3 | 3 | 3 | | 2 | | | | | | | 2 | | | |
| CO4 | 3 | 3 | | 2 | | | | | | | 2 | | | |
| CO5 | 3 | 3 | | 2 | | | | | | | 2 | | | |
| CO6 | 3 | 3 | | 2 | | | | | | | 2 | | | |
| CO7 | 3 | 3 | | 2 | | | | | | | 2 | | | |

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|---|---|
| Course designed by | DEPARTMENT OF MATHEMATICS |
| Approval | Approved by: Meeting of Board of Studies held on 06.07.2019 |
| | Ratified by: 5th Meeting of Academic Council, 13-07-2019. |

| A2PYI101 | SEMESTER – I | L | T | P | C |
|---|---|---|---|---|---|
| | ENGINEERING PHYSICS (Common to CIV,ME & CHEM) | 3 | - | - | 3 |
| | Total Contact Hours – 48 | | | | |

## SYLLABUS

**Unit – I: CRYSTALLOGRAPHY [8 hrs]**

Introduction- Crystal systems- Bravais lattices- Packing fractions of simple, body centered, face centered cubic structures - Directions and Planes in crystals- Miller indices- Inter planar spacing- Bragg's Law of X-Ray diffraction- Powder X-Ray diffraction method.

**Unit –II: LASER & FIBER OPTICS [10hrs]**

**LASER:** Introduction- Absorption, Spontaneous and stimulated emission of radiation- Einstein coefficients- Population inversion- Basic components of laser- Nd YAG Laser – $CO_2$ Laser- Applications of LASER.

**FIBER OPTICS:** Introduction- Principle of optical fiber- Numerical Aperture- Acceptance angle- Classification of optic fibers- Applications of fibers.

**Unit-III: ULTRASONICS & ACOUSTICS [10hrs]**

**Ultrasonics**-Introduction- Properties of ultrasonic sounds- Generation of Ultrasonic sounds- Magnetostriction- Piezoelectric effect- Detection- Kunts tube- Converse piezoelectric method- Ultrasonic Nondestructive testing technique (pulse-echo technique under reflection mode)- Applications.

**ACOUSTICS-** Introduction– Reverberation- Reverberation time- Sabines formula for reverberation time- Absorption coefficient and its measurement- Factors effecting acoustic design of hall.

**Unit – IV: THERMODYNAMICS [10hrs]**

Introduction- First Law- Isothermal process- Adiabatic process- Work done- Second Law- Carnot's heat engine- Efficiency- Entropy- Physical significance- Entropy and second law- Temperature entropy diagram- Third Law of Thermodynamics- Applications of thermodynamics.

**Unit – V: PRINCIPLES OF MECHANICS [10hrs]**

Introduction- System of forces- Resultant of coplanar forces- Method of resolution- Parallel forces- Moment of force- Varignon theorem- Force system in space- Friction- Limiting friction & Impending motion- Coulomb's laws of dry friction- Coefficient of friction- Cone of friction- Types of friction (qualitative).

**TEXTBOOKS**

1. Engineering Physics by R.K. Gaur and S.L. Gupta, Dhanpat Rai Publications.

**REFERENCES**

1. RESNICK, HALLIDAY and WALKER, Principles of Physics, Wiley Publishers
2. A.NELSON, Engineering Mechanics: Statics & Dynamics by, Tata Mc Graw Hill Publishers.
3. P.K. NAG, Engineering Thermodynamics, Mc. Graw Hill Publishers

**COURSE OUTCOMES:**

CO1. The student will be able to recognize the underlying principles of crystalline solids, LASER production and Optical fibers

CO2. The student will be able to gain knowledge on the fundamentals of acoustics and production & detection of ultrasonics

CO3. The student will be able to describe the essentials of thermodynamics, force systems and friction.

CO4. The student will be able to understand crystal structures and X-ray diffraction as a tool for crystal structure analysis.

CO5. The student will be able to understand the importance of industrially relevant LASERS, applications of optical fibers and the prominence of ultrasonics in nondestructive testing.

CO6. The student will be able to understand basic processes involved in thermo-dynamical systems and force systems

CO7. The student will have the ability to apply the conceptual knowledge of forces and its related physical quantities in solving engineering problems.

**CO/PO MAPPING**:

| Course Title: | Engineering Physics | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Course Code: | A2PYI101 | | | | | | | | | | | | | |
| Course Designed by | Dept. of Physics | | | | | | | | | | | | | |
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
| CO1 | 3 | 3 | | | | | | 1 | | | | 1 | | |
| CO2 | 3 | 3 | | | | | | 1 | | | | 1 | | |
| CO3 | 3 | 3 | | | | | | 1 | | | | 1 | | |
| CO4 | 3 | 3 | | | | | | 1 | | | | 1 | | |
| CO5 | 3 | 3 | | | | | | 1 | | | | 1 | | |
| CO6 | 3 | 3 | | | | | | 1 | | | | 1 | | |
| CO7 | 3 | 3 | | | | | | 1 | | | | 1 | | |

| | |
|---|---|
| Course designed by | DEPARTMENT OF PHYSICS |
| Approval | Approved by: Meeting of Board of Studies held on 29.06.2019 |
| | Ratified by: 5th Meeting of Academic Council, 13-07-2019. |

| A2PYI101 | SEMESTER – I | L | T | P | C |
|---|---|---|---|---|---|
| | ENGINEERING PHYSICS LAB | - | - | 3 | 2 |
| | Total Contact Hours – 42 | | | | |

## LIST OF EXPERIMENTS

| | |
|---|---|
| 1. | Determination of size of the micro dimensional system by Laser diffraction. |
| 2. | Determination of numerical aperture and acceptance angle of the optic fiber. |
| 3. | Determination of lattice constants of the crystal systems. |
| 4. | Verification of laws of transverse vibrations in stretched strings by using Sonometer. |
| 5. | Determination of velocity of ultrasonic sounds in liquids by acoustic grating method |
| 6. | Determination of thermal conductivity coefficient of the disc shaped material. |
| 7. | Determination of specific heat of the given liquid by Newton's law of cooling principle. |
| 8. | Determination of temperature coefficient resistance for the thermistor. |
| 9. | Determination of the static friction coefficient. |
| 10. | Determination of rigidity modulus of the wire shaped material by using Torsional pendulum. |

**TEXTBOOKS:**

1. BALASUBRAMANIAN.S, SRINIVASAN.M..N, A Text book of Practical Physics, S Chand Publishers, 2017

**REFERENCES:**

1. https://vlab.amrita.edu.

**COURSE OUTCOMES:**

CO1. Design experiments to determine the size of the micro-dimensional system and the parameters impelling communication through optic fibre.

CO2. Investigate the powder X-Ray diffraction patterns for crystal structure analysis.

CO3. Design experiments for demonstration of mechanical resonance and determine the velocity of ultrasonic sounds in liquid media.

CO4. Design experiments to determine physiognomies of materials like the thermal conductivity coefficient ($K$), specific heat (s) and temperature coefficient of resistance ($\alpha$).

CO5 Design experiments to determine the mechanical properties like the rigidity modulus ($\eta$) and the static friction coefficient ($\mu_s$).

**CO/PO MAPPING**:

| Course Title: | Engineering Physics Lab | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Course Code: | A2PYI101 | | | | | | | | | | | | | |
| Course Designed by | Dept. of Physics | | | | | | | | | | | | | |
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
| CO1 | 3 | 3 | | | | | | 1 | 2 | 1 | | 1 | | |
| CO2 | 3 | 3 | | | | | | 1 | 2 | 1 | | 1 | | |
| CO3 | 3 | 3 | | | | | | 1 | 2 | 1 | | 1 | | |
| CO4 | 3 | 3 | | | | | | 1 | 2 | 1 | | 1 | | |
| CO5 | 3 | 3 | | | | | | 1 | 2 | 1 | | 1 | | |

| Course designed by | DEPARTMENT OF PHYSICS |
|---|---|
| Approval | Approved by: Meeting of Board of Studies held on 29.06.2019 |
| | Ratified by: 5$^{th}$ Meeting of Academic Council, 13-07-2019. |

| A2CII201 | SEMESTER – I | L | T | P | C |
|---|---|---|---|---|---|
| | **PROGRAMMING FOR PROBLEM SOLVING** | **3** | **0** | **3** | **5** |
| | **Total Contact Hours : 54** | | | | |
| | **Prerequisites: Mathematics** | | | | |

| **COURSE OBJECTIVES** | |
|---|---|
| **COBJ1.** | Students will study systematic approach to problem solution specification using finite number of unambiguous steps. |
| **COBJ2.** | Students will gain understanding of procedural language features using C as the template. |
| **COBJ3.** | Students will read and analyse alternative construct choices in procedural language C. |
| **COBJ4.** | Students will get exposure to systematic approach of automated solution design, implementation and testing using a procedural language. |

## SYLLABUS

**UNIT – I: [9 HOURS]**

**INTRODUCTION:** Introduction to Programming, Computer System, Hardware and Software concepts.

**PROBLEM SOLVING:** Algorithm, Pseudo-code, flow-chart, program development steps, high-level, Assembly and machine languages.

**BASICS OF C PROGRAMMING:** Structure of C program, identifier, basic data types and sizes, constants, variables, arithmetic operators, relational operators, logical operators, increment and decrement operators, assignment operator, conditional operator, scanf and printf built-in functions, Creating and running programs.

**UNIT – II: [9 HOURS]**

**BIT-WISE OPERATORS:** logical, shift, rotation, masks.

**EXPRESSIONS:** expressions, type conversions, conditional expressions, precedence and order of evaluation.

**SELECTION:** Two-way selection: if-else, nested if, examples, multi-way selection: switch, else-if, examples.

**ITERATIVE:** loops - while, do-while and for statements, break continue, event and counter controlled loops.

**UNIT – III: [18 HOURS]**

**Part – I: [9 HOURS]**

**ARRAYS:** Arrays (1-D, 2-D), Character arrays and Strings, Searching (Linear Search and Binary Search).

**Part – II: [9 HOURS]**

**BASIC ALGORITHMS:** Basic Sorting Algorithms (Bubble, Insertion and Selection), comparing algorithms for complexity.

**FUNCTIONS:** Functions, Scope and Extent of Variables, Function Parameters, parameter passing using call-by-value, sub-routines, Storage Classes,#define,#ifdef, #ifndef pre-processor directives.

**UNIT – IV: [9 HOURS]**

**RECURSION:** Definition of Recursion, example programs using recursion like finding Factorial, Fibonacci series, Quick sort, puzzle solving using recursive functions (towers of hanoi, ackerman function).

**POINTERS:** Definition of Pointers, Pointer Type, Pointer Arithmetic, Function parameter passing using call-by-reference.

**MEMORY ALLOCATION:** Difference between static and dynamic memory allocation, dynamic memory allocation using built-in functions, dangling pointer, unreferenced memory problem.

**UNIT – V: [9 HOURS]**

**ENUMERATED, STRUCTURE AND UNION TYPES:** Derived types- structures-declaration, definition and initialization of structures, accessing structures, nested structures, arrays of structures, structures and functions, pointers to structures, self-referential structures, unions, typedef, bit-fields, concept of linked list, program applications.

**FILE-HANDLING:** Input and output- concept of a file, text files and binary files, Formatted I/O, File I/O operations, command line arguments.

Suggested Text Books

1. Programming For Problem Solving, Behrouz A.Forouzan & Richard F.Gilberg, Cengage Publishers, 3rd Edition
2. Programming In C:A Practical Approach, Ajay Mittal, Pearson Education

Suggested Reference Books


**1.** Brian W. Kernighan And Dennis M. Ritchie, The C Programming Language, Prentice Hall Of India

**2.** Introduction To C Programming, Reema Thareja, Oxford University Press

**3.** E. Balaguruswamy, Programming In Ansi C, Tata Mcgraw-Hill


## COURSE OUTCOMES

The student will

1. Have the ability to **describe** a formal algorithmic solution for the given problem, **list** the features of C including scalar & vector data types, operators, **Outline** expressions, expression evaluation, operator precedence, sequential, conditional & iterative constructs.

2. Have the ability to **describe** one and two-dimensional arrays, **outline** loops and arrays for searching and **describe** various sorting techniques.

3. Have the ability to **outline** the purpose of functions, pointers, command line arguments, dynamic memory allocation. **Define** storage classes. **Describe** command like arguments, structures, unions, and enumeration. Have knowledge of handling files.

4. Have the ability to **solve** complex expressions, **design** algorithms and **develop** programs in C language using the basic constructs, data types, operators, control & iterative statements, and arrays.

5. Have the ability to **apply** arrays to solve complex matrix related problems and strings. **Compare and contrast** various searching and sorting techniques for complexity.
6. Have the ability to **distinguish between** function call types. **Draw inferences on** command line arguments, storage classes, and pre-processor directives. **Use** pointers with functions, arrays, strings, to **solve** complex problems. **Give example** and **solve** classical recursion problems**. Compare and contrast** static and dynamic memory allocation, and **apply** them. **Use** structures and unions to implement and **solve** real-time problems. **Apply** file related functions to process files.

7. Have the ability to **Fully appreciate** the art of procedural programming in C and develop programs **optimally** using the full feature set of C language.

| Course Title: | Programming for problem solving (Common to ALL Branches) | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Course Code: | A2CIT201 | | | | | | | | | | | | | | |
| Course Designed by | Dept. of Computer Science and Engineering | | | | | | | | | | | | | | |
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSOM | PSON | PSOO |
| CO1 | 3 | 3 | | | | | | 3 | 2 | 1 | | 2 | 1 | 1 | 1 |
| CO2 | 3 | 3 | | | | | | 3 | 2 | 1 | | 2 | 1 | 1 | 1 |
| CO3 | 3 | 3 | | | | | | 3 | 2 | 1 | | 2 | 1 | 1 | 1 |
| CO4 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 1 | 1 | 2 | 3 | 3 | 3 |
| CO5 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 1 | 1 | 2 | 3 | 3 | 3 |
| CO6 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 1 | 1 | 2 | 3 | 3 | 3 |
| CO7 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 1 | 1 | 3 | 3 | 3 | 3 |

**Levels of Correlation: High-3, Medium-2, Low-1**

## PROGRAMMING FOR PROBLEM SOLVING PRACTICE

| COURSE OBJECTIVES | |
|---|---|
| 1. | To use basic data types, operators, expressions and expression evaluation mechanisms using C Programming Language. |
| 2. | To implement control flows construct in C Programming Language and understand the syntax, semantics and usability contexts of these different construct. |
| 3. | To develop composite data types in C and constructs available to develop their data-types, utilize them to model things and dealing with data from and to external files. |
| 4. | To design programs with different variations of the constructs available for practicing modular programming and understand the pros and cons of using different variants and apply optimization. |

### UNIT – I

**WEEK 1:**

**Objective:** Getting familiar with the programming environment on the computer and writing the first program.

**Suggested Experiments/Activities:**

**Tutorial 1:** Problem-solving using computers

**Lab1:** Familiarization with programming environment

i) Exposure to Turbo C, gcc, Code Blocks IDE
ii) Writing simple programs using printf(), scanf()

**WEEK 2:**

**Objective:** Getting familiar with how to formally describe a solution to a problem in a series of finite steps both using textual notation and graphic notation.

**Suggested Experiments/Activities:**

**Tutorial 2:** Problem-solving using Algorithms and Flow charts

**Lab1:** Converting algorithms/flowcharts into C Source code

Developing the algorithms/flowcharts for the following sample programs

i. Sum and average of 3 numbers
ii. Conversion of Fahrenheit to Celsius and vice versa
iii. Simple interest calculation

**WEEK 3:**

**Objective:** Learn how to define variables with the desired data-type, initialize them with appropriate values and how arithmetic operators can be used with variables and constants.

**Suggested Experiments/Activities:**

**Tutorial 3:** Variable types and type conversions:

**Lab 3:** Simple computational problems using arithmetic expressions

i) Finding the square root of a given number
ii) Finding compound interest
iii) Area of a triangle using heron's formulae
iv) Distance travelled by an object

## UNIT – II

**WEEK 4:**

**Objective:** Explore the full scope of expressions, type-compatibility of variables & constants and operators used in the expression and how operator precedence works.

**Suggested Experiments/Activities:**

**Tutorial 4:** Operators and their precedence and associativity:

**Lab 4:** Simple computational problems using the operator's precedence and associativity

i) Evaluate the following expressions
   a. A+B*C+(D*E)+F*G
   b. A/B*C-B+A*D/3

ii) a. A+++B---A
   b. J=(i++)+(++i)

iii) Find the maximum of three numbers using conditional operator

iv) Take marks of 5 subjects in integers, and find the total, average in float

**WEEK 5:**

**Objective:** Explore the full scope of different variants of "if construct" namely if-else, null-else, if-else if*-else, switch and nested-if including in what scenario each one of them can be used and how to use them. Explore all relational and logical operators while writing conditionals for "if construct".

**Suggested Experiments/Activities:**

**Tutorial 5:** Branching and logical expressions:

**Lab 5**: Problems involving if-then-else structures

i) Write a C program to find the max and min of four numbers using if-else

ii) Write a C program to generate electricity bill

iii) Find the roots of the quadratic equation

iv) Write a C program to simulate a calculator using switch case

v) Write a C program to find the given year is a leap year or not

**WEEK 6:**

**Objective:** Explore the full scope of iterative constructs namely while loop, do-while loop and for loop in addition to structured jump constructs like break and continue including when each of these statements is more appropriate to use.

**Suggested Experiments/Activities:**

**Tutorial 6:** Loops, while and for loops:

**Lab 6:** Iterative problems e.g., the sum of series

i) Find the factorial of given number using any loop

ii) Find the given number is a prime or not

iii) Compute sine and cos series

iv) Checking a number palindrome

v) Construct a pyramid of numbers

## UNIT – III

**WEEK 7:**

**Objective:** Explore the full scope of Arrays construct namely defining and initializing 1-D and 2-D and more generically n-D arrays and referencing individual array elements from the defined array. Using integer 1-D arrays, explore search solution linear search.

**Suggested Experiments/Activities:**

**Tutorial 7:** 1D Arrays: searching

**Lab 7:** 1D Array manipulation, linear search

i) Find the min and max of a 1-D integer array
ii) Perform linear search on1D array
iii) The reverse of a 1D integer array
iv) Find 2's complement of the given binary number
v) Eliminate duplicate elements in an array

**WEEK 8:**

**Objective:** Explore the difference between other arrays and character arrays that can be used as Strings by using null character and get comfortable with string by doing experiments that will reverse a string and concatenate two strings. Explore sorting solution bubble sort using integer arrays.

**Suggested Experiments/Activities:**

**Tutorial 8:** 2D arrays, Sorting and Strings

**Lab 8:** Matrix problems, String operations, Bubble sort

i) Addition of two matrices
ii) Multiplication two matrices
iii) Sort array elements using bubble sort
iv) Concatenate two strings without built-in functions
v) Reverse a string using built-in and without built-in string functions

## UNIT-IV

**WEEK 9:**

**Objective:** Explore the Functions, sub-routines, scope and extent of variables, doing some experiments by parameter passing using call by value. Basic methods of numerical integration

**Suggested Experiments/Activities:**

**Tutorial 9:** Functions, call by value, scope and extent,

**Lab 9:** Simple functions using call by value, Solving differential equations using Eulers theorem

i) Write a C function to calculate NCR value
ii) Write a C function to find the length of a string
iii) Write a C function to transpose of a matrix
iv) Write a C function to demonstrate numerical integration of differential equations using Euler's method

**WEEK 10:**

**Objective:** Explore how recursive solutions can be programmed by writing recursive functions that can be invoked from the main by programming at-least five distinct problems

that have naturally recursive solutions.

**Suggested Experiments/Activities:**

**Tutorial 10:** Recursion, the structure of recursive calls
**Lab 10:** Recursive functions

i) Write a recursive function to generate Fibonacci series
ii) Write a recursive function to find the lcm of two numbers
iii) Write a recursive function to find the factorial of a number
iv) Write a C Program to implement Ackermann function using recursion
v) Write a recursive function to find the sum of series.

**WEEK 11:**
**Objective:** Explore the basic difference between normal and pointer variables, Arithmetic operations using pointers and passing variables to functions using pointers
**Suggested Experiments/Activities:**
**Tutorial 11:** Call by reference, dangling pointers
**Lab 11:** Simple functions using Call by reference, Dangling pointers

i) Write a C program to swap two numbers using call by reference
ii) Demonstrate Dangling pointer problem using a C program
iii) Write a C program to copy one string into another using pointer
iv) Write a C program to find no of lowercase, uppercase, digits and other characters using pointers.

**UNIT – V**

**WEEK 12:**
**Objective:** Explore pointers to manage a dynamic array of integers, including memory allocation & value initialization, resizing changing and reordering the contents of an array and memory de-allocation using malloc(), calloc(), realloc() and free() functions. Gain experience processing command-line arguments received by C

**Suggested Experiments/Activities:**
**Tutorial 12:** Pointers, structures and dynamic memory allocation
**Lab 12:** Pointers and structures, memory dereference

i) Write a C program to find the sum of a 1D array using malloc()
ii) Write a C program to find the total, average of n students using structures
iii) Enter n students data using calloc() and display failed students list
iv) Read student name and marks from the command line and display the student details along with the total.
v) Write a C program to implement realloc()

**WEEK 13:**
**Objective:** Experiment with C Structures, Unions, bit fields and self-referential structures (Singly-linked lists) and nested structures
**Suggested Experiments/Activities:**
**Tutorial 12:** Bitfields**,** Self-Referential Structures, Linked lists
**Lab 12:** Bitfields, linked lists

i) Read and print a date using dd/mm/yyyy format using bit-fields and differentiate the same without using bit-fields
ii) Create and display a singly linked list using self-referential structure
iii) Demonstrate the differences between structures and unions using a C program
iv) Write a C program to shift/rotate using bitfields
v) Write a C program to copy one structure variable to another structure of the same type.

**WEEK 14:**
**Objective:** To understand data files and file handling with various file I/O functions. Explore the differences between text and binary files.
**Suggested Experiments/Activities:**
**Tutorial 14:** File handling:
**Lab 14:** File operations

i) Write a C program to write and read text into a file
ii) Write a C program to write and read text into a binary file using fread() and fwrite()
iii) Copy the contents of one file to another file
iv) Write a C program to merge two files into the third file using command-line arguments
v) Find no. of lines, words and characters in a file
vi) Write a C program to print last n characters of a given file.

**TEXTBOOKS:**

1. Ajay Mittal, Programming in C: A practical approach, Pearson.
2. Byron Gottfried, Schaum's Outline of Programming with C, McGraw-Hill

**REFERENCES:**

1. Brian W. Kernighan and Dennis M. Ritchie, The C Programming Language, Prentice-Hall of India
2. C Programming, A Problem Solving Approach, Forouzan, Gilberg, Prasad, CENGAGE

**COURSE OUTCOMES**

| | |
|---|---|
| CO1. | **Demonstrate** the ability to write a formal algorithmic solution for the given problem, **name & explain** the features of C like types including scalar & vector types, operators, expressions, expression evaluation, operator precedence, sequential, conditional & iterative constructs. |
| CO2. | **Implement** one and two-dimensional arrays to solve simple mathematical and matrix related problems. **Make use of** loops and arrays for searching and **Compare** various sorting techniques. |
| CO3. | **Identify** the purpose of functions, pointers, command line arguments, dynamic memory allocation. **Define** storage classes. **Understand** command like arguments, structures and unions. Have **knowledge** of handling files. |
| CO4. | **Design** algorithms and **develop** programs in C language using the basic constructs, data types, operators, control statements, and arrays. |
| CO5 | **Apply** pointers, functions, derived data types, and dynamic memory allocation, **design** solutions to challenging problems. |
| CO6 | **Illustrate** the art of procedural programming in C and **develop** programs optimally using the full feature set of C language. |

| Course Title: | Programming for problem solving lab | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Course Code: | A2CII201 | | | | | | | | | | | | | | |
| Course Designed by | Dept. of CSE & IT | | | | | | | | | | | | | | |
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1 | 3 | 3 | 1 | 2 | 3 | 1 | 1 | 1 | 2 | 2 | | | 2 | 2 | 2 |
| CO2 | 3 | 3 | 1 | 2 | 3 | 1 | 1 | 1 | 2 | 2 | | | 2 | 2 | 2 |
| CO3 | 3 | 3 | 2 | 3 | 3 | 2 | 1 | 1 | 2 | 2 | | | 3 | 3 | 3 |
| CO4 | 3 | 3 | 2 | 3 | 3 | 3 | 1 | 1 | 2 | 2 | | | 3 | 3 | 3 |
| CO5 | 3 | 3 | 3 | 3 | 3 | 3 | 1 | 1 | 2 | 2 | | | 3 | 3 | 3 |
| CO6 | 3 | 3 | 3 | 3 | 3 | 3 | 1 | 1 | 3 | 3 | 3 | | 3 | 3 | 3 |

Levels of Correlation: High-3, Medium-2, Low-1

| | |
|---|---|
| Course designed by | DEPARTMENTS OF CSE & IT |
| Approval | Approved by: Meeting of Board of Studies held on 29-06-2019 |
| | Ratified by: 5th Meeting of Academic Council, 13-07-2019 |

| A2MED201 | SEMESTER - I | L | T | P | C |
|---|---|---|---|---|---|
| | COMPUTER AIDED ENGINEERING GRAPHICS | 1 | - | 3 | 3 |
| | Total Contact Hours – 60 | | | | |

## SYLLABUS

**UNIT-I**

**Overview of Computer Graphics:**

Computer technologies that impact on graphical communication, Demonstrating knowledge of CAD software [such as: The Menu System, Toolbars (Standard, Object Properties, Draw, Modify and Dimension), Drawing Area (Background, Crosshairs, Coordinate System), Dialog boxes and windows, Shortcut menus (Button Bars), The Command Line, The Status Bar, Different methods of zoom as used in CAD, Select and erase objects.

Set up of the drawing page and the printer, Scale settings, Setting up of units and drawing limits; ISO and ANSI standards for coordinate dimensioning and tolerancing.

Applying dimensions to objects, applying annotations to drawings;

**UNIT-II**

**Layers:** Setting up and use of Layers, layers to create drawings, create, edit and use customized layers, concept of view ports.

**Introduction to Orthographic Projections**: Projections of Points; Projections of Straight Lines parallel to both planes; Projections of Straight Lines-Parallel to one and inclined to other plane.

**UNIT-III**

**Projections of Straight Lines and Planes:** Lines inclined to both planes, determination of true lengths, angle of inclinations and traces, Projections of Planes

**UNIT-IV**

**Projections and sections of solids:** Projections of simple solids- Sections of solids

**UNIT -V**

**Development of surfaces, Isometric Projection and Conversion of Isometric Views to Orthographic Views:** Principles of Isometric projection – Isometric Scale, Isometric Views, Conventions; Isometric Views of lines, Planes, Simple and compound Solids; Conversion of Isometric Views to Orthographic Views and Vice-versa

**TEXT BOOKS**

1. DM Kulkarni, AP Rastogi, AK Sarkar "Engineering graphics with Auto CAD" PHI Publishers
2. Bhatt N.D., Panchal V.M. & Ingle P.R "Engineering Drawing" Charotar Publishing House.

**REFERENCE BOOKS**

1. Shah, M.B. & Rana B.C "Engineering Drawing and Computer Graphics", Pearson Education.
2. Agrawal B. & Agrawal C. M "Engineering Graphics", TMH Publication.
3. Narayana, K.L. & P Kannaiah "Engineering Drawing", SciTech Publishers.
4. CAD Software Theory and User Manuals.

**COURSE OUTCOMES**

At the end of the course the students will be able to:

CO1: Prepare two dimensional drawings using draw and modify commands in Auto CAD software and represent dimensions to the drawings

CO2: Clearly differentiate different types of projections and get solutions to projections of points in Auto CAD by applying the layers concept

CO3: Solve problems related to projections of straight lines and planes

CO4: Prepare simple solids in CAD software and obtain solutions to projections and sections of solids

CO5: Develop the surfaces of simple solids, prepare Isometric drawings and convert isometric drawings into orthographic views

**CO/PO Mapping**

| Course Title: | Computer Aided Engineering Graphics | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Course Code: | A2MED201 | | | | | | | | | | | | | |
| Course Designed by | Dept. of Mechanical Engineering | | | | | | | | | | | | | |
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
| CO1 | 3 | 2 | 2 | | 3 | 1 | | 1 | 2 | 3 | 2 | 2 | 3 | 2 |
| CO2 | 3 | 2 | 2 | | 3 | 1 | | 1 | 2 | 3 | | | 2 | 1 |
| CO3 | 3 | 2 | 2 | | 3 | 1 | | 1 | 2 | 3 | | | 2 | 1 |
| CO4 | 3 | 2 | 3 | | 3 | 1 | | 1 | 2 | 3 | 2 | 2 | 3 | 1 |
| CO5 | 3 | 2 | 3 | | 3 | 1 | | 1 | 2 | 3 | 2 | 2 | 3 | 1 |

| Course designed by | DEPARTMENT OF MECHANICAL ENGINEERING |
|---|---|
| Approval | Approved by: Meeting of Board of Studies held on 29-06-2019 |
| | Ratified by: 5th Meeting of Academic Council, 13-07-2019. |

* * *

| A2EHA701 | SEMESTER - I | L | T | P | C |
|---|---|---|---|---|---|
| | CONSTITUTION OF INDIA | 2 | - | - | 0 |
| | Total Contact Hours – 30 | | | | |

**SYLLABUS**

**UNIT – I: HISTORY OF MAKING OF THE INDIAN CONSTITUTION**
History - Drafting Committee, (Composition & Working)

**UNIT – II: PHILOSOPHY OF THE INDIAN CONSTITUTION:** Preamble - Salient Features

**UNIT-III: CONTOURS OF CONSTITUTIONAL RIGHTS & DUTIES:** Fundamental Rights -Right to Equality -Right to Freedom -Right against Exploitation -Right to Freedom of Religion -Cultural and Educational Rights -Right to Constitutional Remedies ; Directive Principles of State Policy ; Fundamental Duties.

**UNIT-IV: ORGANS OF GOVERNANCE:** Parliament -Composition - Qualifications and Disqualifications - Powers and Functions - Executive - President - Governor - Council of Ministers; Judiciary, Appointment and Transfer of Judges, Qualifications.
**UNIT – V: LOCAL ADMINISTRATION:** District's Administration head: Role and Importance, Municipalities: Introduction, Mayor and role of Elected Representative, CEO of Municipal Corporation. Panchayati raj: Introduction, PRI: Zila Panchayat. Elected officials and their roles, CEO Zila Panchayat : Position and role. Block level: Organizational Hierarchy (Different departments), Village level: Role of Elected and Appointed officials, Importance of grass root democracy

**TEXT BOOK:**
Reference Source compilation

**REFERENCES:**
**1.** The Constitution of India, 1950 (Bare Act), Government Publication.
2. Dr. S. N. Busi, Dr. B. R. Ambedkar framing of Indian Constitution, 1st Edition, 2015.
3. M. P. Jain, Indian Constitution Law, 7th Edn., Lexis Nexis, 2014.

**COURSE OUTCOMES:**

CO1. Students will be able to discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.

CO2. Students will be able discuss the intellectual origins of the framework of argument that informed the conceptualization of social reforms leading to revolution in India.

CO3. Students will be able to discuss the circumstances surrounding the foundation of the Congress Socialist Party [CSP]under the leadership of Jawaharlal Nehru and the eventual failure of the proposal of direct elections through adult suffrage in the Indian Constitution.

CO4. Students will be able to discuss the passage of the Hindu Code Bill of 1956.

CO5. Students will be able to discuss the powers of Executive, Judiciary and Legislature.

CO/PO Mapping

| Course Title: | Constitution of India (Common to ALL Branches) | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Course Code: | A2EHA701 | | | | | | | | | | | | | |
| Course Designed by | Dept. of English & Humanities | | | | | | | | | | | | | |
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
| CO1 | | | | | | 2 | | | | | | | | |
| CO2 | | | | | | 2 | | | | | | | | |
| CO3 | | | | | | 2 | | | | | | | | |
| CO4 | | | | | | 2 | | | | | | | | |
| CO5 | | | | | | 2 | | | | | | | | |

| Course designed by | DEPARTMENT OF ENGLISH & HUMANITIES |
|---|---|
| Approval | Approved by: Meeting of Board of Studies held on 23.06.15 |
| | Ratified by: 5th Meeting of Academic Council, 13-07-2019. |

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| A2MAT102 | SEMESTER - II | L | T | P | C |
|---|---|---|---|---|---|
| | MATHEMATICS-II (CIV, EEE, MEC, ECE & CHE) | 3 | 0 | - | 3 |
| | Total Contact Hours – 48 | | | | |

## SYLLABUS

**UNIT-I: NUMERICAL METHODS-1**

Solving Algebraic and Transcendental Equations: Intermediate value theorem (statement), solution concepts, error in solution, measure of accuracy, approximate and exact solutions, Solution methods: Bisection method, Regula-Falsi method and Newton-Raphson Iterative method; Finite differences: Forward, backward and shift operators, relations among operators, Interpolation: Interpolation and extrapolation, data of equal and unequal intervals, Newton's forward and backward Interpolation formulae, Lagrange's interpolation formula, Fitting polynomials to the data by using Newton's and Lagrange's formulae, Inverse Interpolation by Lagrange's formula.

**UNIT- II: NUMERICAL METHODS-2**

Numerical Integration: Simpson's and Trapezoidal rules, Weddle's and Boole's rules of integrations; Numerical solutions of ordinary differential equations: Concepts of Initial Value Problem, Taylor's series method, Euler's method, Runge - Kutta method of fourth order; Predictor-corrector method: Milne's method to solve initial value problems.

**UNIT-III: MULTIVARIABLE CALCULUS**

Overview: Functions of two variables, limit and continuity, partial derivative and its geometrical meaning; Functions of several variables: Partial differential coefficients of higher order, total derivatives, Chain rules for partial differentiation, partial differentiation of Implicit functions; Jacobians: Jacobian and properties, chain rule, functional dependence, Jacobian of implicit functions

Maxima and Minima: Maxima and minima of a function of two variables, constrained maxima and minima, Lagrange's method of undetermined multipliers.

**UNIT-IV:** PARTIAL DIFFERENTIAL EQUATIONS -FIRST ORDER

Formation of PDEs: Elimination of arbitrary constants, Elimination of arbitrary functions; Solution concepts of PDEs: Complete solution / integral, particular integral, general integral and singular integral, PDEs solvable by direct integration; Linear PDEs of first order (Lagrange's linear equation): Method of grouping and method of multipliers; Nonlinear PDEs of first order: Solution methods of solving PDEs in standard forms I, II, III & IV (as is specified in Text Book 1).

**UNIT-V:** PARTIAL DIFFERENTIAL EQUATIONS -HIGHER ORDER

Homogeneous Linear Partial Differential Equations of second and higher order with constant coefficients: Symbolic form, Rules for finding complementary function, Rules for finding particular integral, working procedure to get complete solution; Solving nonhomogeneous linear PDEs of second and higher order with constant coefficients; Method of separation of variables: concept of boundary value problem, solving boundary value problems by separating variables.

//Topics prefixed with ‘outlines / overview’ are not for assessment//

**TEXT BOOKS:**

1. B.S. Grewal, Higher Engineering Mathematics, 44/e, Khanna Publishers, 2017
2. T.K.V. Iyengar et al, Engineering Mathematics, S. Chand Publishers, Revised edition

**REFERENCE BOOKS:**

1. Erwin Kreyszig, Advanced Engineering Mathematics, 10/e, John Wiley & Sons, 2011
2. B.V. Ramana, Higher Engineering Mathematics, Tata McGraw Hill New Delhi, 11th Reprint, 2010
3. T. Veerarajan, Higher Engineering Mathematics, Tata McGraw-Hill, 2008

**COURSE OUTCOMES: A**t the end of course, students shall be able to

CO1 Recall the concepts of numerical methods.
CO2 Recall the concepts of multivariable calculus.
CO3 Recall solution methods of PDEs.
CO4 Use the concepts of numerical methods to solve equations, do interpolation & numerical integration and also to solve ODEs numerically.
CO5 Use the concepts of multivariable calculus to find maxima & minima of a multivariable function.
CO6 Use solution methods of PDEs to solve BVPs.
CO7 Apply the concepts of numerical methods, multivariable calculus and PDEs to solve real world problems including BVPs.

CO/PO Mapping

| Course Title: | MATHEMATICS-II (CIV, EEE, MEC, ECE & CHE) | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Course Code: | A2MAT102 | | | | | | | | | | | | | |
| Course Designed by | Dept. of Mathematics | | | | | | | | | | | | | |
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
| CO1 | 3 | 3 | | 2 | | | | | | | 2 | | | |
| CO2 | 3 | 3 | | 2 | | | | | | | 2 | | | |
| CO3 | 3 | 3 | | 2 | | | | | | | 2 | | | |
| CO4 | 3 | 3 | | 2 | | | | | | | 2 | | | |
| CO5 | 3 | 3 | | 2 | | | | | | | 2 | | | |
| CO6 | 3 | 3 | | 2 | | | | | | | 2 | | | |
| CO7 | 3 | 3 | | 2 | | | | | | | 2 | | | |

| Course designed by | DEPARTMENT OF MATHEMATICS |
|---|---|
| Approval | Approved by: Meeting of Board of Studies held on 06.07.2019 |
| | Ratified by: 5th Meeting of Academic Council, 13-07-2019. |

| A2CYI101 | SEMESTER - II | L | T | P | C |
|---|---|---|---|---|---|
| | ENGINEERING CHEMISTRY (Common to all branches) | 3 | -- | 3 | 5 |
| | Total Contact Hours – 48 | | | | |

## SYLLABUS

### UNIT 1: WATER TECHNOLOGY

Introduction –Soft Water and hardness of water, Estimation of hardness by EDTA Method - Boiler troubles - Industrial water treatment – specifications for drinking water, Bureau of Indian Standards(BIS) and World health organization(WHO) standards, zeolite and ion-exchange processes - desalination of brackish water, reverse osmosis (RO) and electro dialysis.

### UNIT 2: POLYMERS

Introduction to polymers, functionality of monomers, addition and condensation polymerization, copolymerization, stereospecific polymerization with specific examples. Thermoplastics and Thermo-sets – their differences.

Elastomers – applications with specific examples- Preparation, properties and uses of PVC, Bakelite, Teflon and Nylon-6, 6, Buna-S and Thiokol rubber- Fibre reinforced plastics – carbon fibre, glass fibre and aramids.

### UNIT 3: ELECTROCHEMISTRY AND APPLICATIONS

Electrodes – concepts, electrochemical cell, Nernst equation, cell potential calculations.
Primary cells –dry cell- Secondary cells – lead acid, nickel-cadmium and lithium ion batteries- working of the batteries including cell reactions- Fuel cells, hydrogen-oxygen, and methanol fuel cells – working of the cells.
Corrosion: Introduction to corrosion, mechanism of dry and wet corrosion, Pilling Bedworth ratios and uses, Types of corrosion – Differential aeration corrosion, galvanic corrosion, pitting corrosion, waterline corrosion and stress corrosion, Factors affecting the rate of corrosion – metal based factors and environmental based factors, protection techniques – metal coatings – galvanization and tinning, cathodic protection, inhibitors – cathodic and anodic, organic coatings – paints – constituents and their functions.

### UNIT-4: CHEMISTRY OF ADVANCED MATERIALS

**NANOMATERIALS:** introduction- synthesis of Nano material by sol gel method- CVD- engineering applications of Nano materials
**CEMENT**: Introduction to ordinary Portland cement- manufacturing of OPC- setting and hardening of cement- decay of cement.
**FUELS**: Introduction- classification- liquid fuels- cracking- knocking- octane number and cetane number; Lubricants- definition- mechanism and properties of lubricants

### UNIT 5: INSTRUMENTAL METHODS AND APPLICATIONS

Electromagnetic spectrum. Absorption of radiation: Beer-Lambert's law. Principle, instrumentation (Block diagram and working), applications of UV, IR and NMR spectroscopic methods. Chromatography- introduction- Ion exchange chromatography- applications

## COURSE OUTCOMES:

**CO1:** The student will have the ability to describe softening methods and desalination processes. He/ She will be able to explain various types of polymers; preparation, properties and engineering applications of thermoplastic, thermosetting plastics, rubbers and FRP's.

**CO2:** The student will have the ability to describe electrochemical reactions, principles of batteries, fuel cell and corrosion.

**CO3:** The student will have the ability to outline electromagnetic spectrum and explain the working principles of IR, UV, NMR and chromatographic techniques. The student describes the synthesis, properties and applications of nanomaterials, cement. HE/ She Outlines the cracking methods, knocking of fuels.

**CO4:** The student will have the ability to differentiate between hard and soft water, demineralization and deionization processes and thermosetting – thermoplastic materials.

**CO5:** The students will have the ability to give examples on primary and secondary batteries, various types of corrosion, methods of corrosion prevention.

**CO6:** The student will have the ability to draw inferences on the principles and applications of various instrumental methods and also can compare and contrast between cracking methods.

**CO7:** The student will have the ability to analyze water samples and validate the results obtained and apply their knowledge on polymers, batteries, materials and instrumentation.

*Text books:*


1. Jain and Jain, Engineering Chemistry, 16/e, Dhanpat Rai, 2013.
2. Skoog and West, Principles of Instrumental Analysis, 6/e, Thomson, 2007.


*Reference books:*


1. H.F.W. Taylor, Cement Chemistry, 2/e, Thomas Telford Publications, 1997.
2. H.Kaur, Instrumental Methods of chemical analysis, Pragathi Prakashan, 2012.
3. Chemistry for Engineers, Teh Fu Yen, Imperial college press, London


CO/PO Mapping

| Course Title: | Engineering Chemistry | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Course Code: | A2CYI101 | | | | | | | | | | | | | |
| Course Designed by | Dept. of Chemistry | | | | | | | | | | | | | |
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
| CO1 | 3 | | | | | | | | 2 | | | 1 | | |
| CO2 | 3 | | | | | | | | 2 | | | 1 | | |
| CO3 | 3 | | | | | | | | 2 | | | 1 | | |
| CO4 | 3 | | | | | | | | 2 | | | 1 | | |
| CO5 | 3 | | | | | | | | 2 | | | 1 | | |
| CO6 | 3 | | | | | | | | 2 | | | 1 | | |
| CO7 | 3 | | | | | | | | 2 | | | 1 | | |

| Course designed by | DEPARTMENT OF CHEMISTRY |
|---|---|
| Approval | Approved by: Meeting of Board of Studies held on 29.06.2019 |
| | Ratified by: 5th Meeting of Academic Council, 13-07-2019. |

**Engineering Chemistry - Laboratory**

**List of Experiments:**

1. Determination of HCl using sodium carbonate
2. Determination of Hardness of a groundwater sample.
3. pH metric titration of strong acid vs. strong base
4. Condcutometric titration of Strong acid VS Strong base
5. Condcutometric titration of Weak acid VS strong base
6. Potentiometric titration of Fe(II) with potassium dichromate
7. Determination of Strength of an acid in Pb-Acid battery
8. Preparation of a polymer
9. Determination of viscosity of polymer solution using survismeter
10. Determination of percentage of Iron in Cement sample by colorimetry
11. Estimation of Calcium oxide in port land Cement
12. Preparation of Nanomaterials (ex: Fe/ Zn/ Ferrite)
13. Adsorption of acetic acid by charcoal
14. Determination of acid value and saponification value of a given lubricant
15. Project based learning (Mandatory for all students)

**Course Outcomes:**

**CO1:** The student will be able to determine total hardness, strength of acid in a lead acid battery, calcium in Portland cement using volumetric analysis

**CO2:** The student will be able to explain condcutometric, potentiometric, pH metric titrations and colorimetric determination.

**CO3:** The student will be able to explain the synthesis of a polymer, nanomaterials

CO/PO Mapping

| Course Title: | Engineering Chemistry | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Course Code: | A2CYI101 | | | | | | | | | | | | | |
| Course Designed by | Dept. of Chemistry | | | | | | | | | | | | | |
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
| CO1 | 3 | | 1 | | | 1 | | | | 1 | 1 | 2 | | |
| CO2 | 3 | | 1 | | | 1 | | | | 1 | 1 | 1 | | |
| CO3 | 3 | | 1 | | | | | | | 1 | 1 | 1 | | |

| Course designed by | DEPARTMENT OF CHEMISTRY |
|---|---|
| Approval | Approved by: Meeting of Board of Studies held on 29.06.2019 |
| | Ratified by: 5th Meeting of Academic Council, 13-07-2019. |

| | SEMESTER – II | L | T | P | C |
|---|---|---|---|---|---|
| A2EEI201 | Basic Electrical Engineering (Common to all branches) | 3 | - | 3 | 5 |
| | Total Contact Hours – 50 | | | | |

## SYLLABUS

**UNIT 1: D.C. CIRCUITS**

Electrical circuit elements (R, L and C), voltage and current sources, Kirchhoff's current and voltage laws, Analysis of simple circuits with DC excitation, Superposition, Thevenin's and Norton's Theorems, Time-domain analysis of first-order RL and RC circuits.

**UNIT 2: A.C. CIRCUITS**

Representation of sinusoidal waveforms, Average and RMS values, phasor representation, real power, reactive power, apparent power, power factor, Analysis of single-phase AC circuits (Series & Parallel), Resonance, Three-phase balanced circuits, voltage and current relations in star and delta configurations.

**UNIT 3: DC & AC MACHINES [ELEMENTARY TREATMENT ONLY]**

Principle and operation of DC Generator - EMF equation – open circuit characteristic of DC shunt generator – principle and operation of DC Motor – Types of DC Motors – Performance Characteristics of DC Motor - Speed control of DC Motor – Principle and operation of single-phase Transformer - OC and SC tests on transformer - principle and operation of single phase & Three phase Induction Motors, construction and working of synchronous motors

**UNIT 4: BASICS OF POWER SYSTEMS:**

Layout & operation of Hydro, Thermal, Nuclear Stations - Solar & wind generating stations – Typical AC Power Supply scheme – Elements of Transmission line – Types of Distribution systems: Primary & Secondary distribution systems.

**UNIT 5: ELECTRICAL INSTALLATIONS**

Components of LT Switchgear: Switch Fuse Unit (SFU), MCB, ELCB, MCCB, Types of Wires and Cables, Earthing, Types of Batteries, Characteristics of Batteries. Elementary calculations for energy consumption, power factor improvement, battery backup.

**TEXT BOOK/ REFERENCES:**


1. D. P. Kothari and I. J. Nagrath, "Basic Electrical Engineering", Tata McGraw Hill, 2010
2. E. Hughes, "Electrical and Electronics Technology", Pearson, 2010.
3. Vincent Del Toro, "Electrical Engineering Fundamentals", Pearson, 2015.


**COURSE OUTCOMES:**

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

CO1. To recall fundamental concepts of electrical circuits such as charge, voltage, current and power.
CO2. Describe the principle of operation of D.C. & A.C. machines.
CO3. Outline the working operation of various generating stations.
CO4. Explain the procedure for solving circuits with A.C and D.C. Excitation
CO5. Summarize the performance characteristics of different machines.
CO6. Explain about different equipment used in power industry
CO7. Apply the fundamental laws, associated with Basic Electrical Engineering to solve real world problems in the field of Engineering

CO/PO Mapping

| CO / PO mapping | Program Outcomes | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | PSO1 | PSO2 |
| To recall fundamental concepts of electrical circuits such as charge, voltage, current and power. | 3 | 3 | 1 | 1 | | | 3 | | | 1 | | | 1 | 1 |
| Describe the principle of operation of D.C. & A.C. machines. | 3 | 2 | 2 | 2 | 2 | | | | | 1 | | | 1 | 1 |
| Outline the working operation of various generating stations. | 3 | 3 | 3 | 1 | 1 | | 1 | | | 1 | | | 1 | 1 |
| Explain the procedure for solving circuits with A.C and D.C. Excitation | 3 | 3 | 2 | 1 | 1 | | 2 | | | 1 | | | 1 | 1 |
| Summarize the performance characteristics of different machines. | 3 | 3 | 2 | 1 | 1 | 3 | 1 | | | 1 | | | 1 | 1 |
| Explain about different equipment used in power industry | 3 | 3 | 2 | 1 | | 2 | 2 | | | 1 | | 1 | 3 | 2 |
| Apply the fundamental laws, associated with Basic Electrical Engineering to solve real world problems in the field of Engineering | 3 | 3 | 3 | 3 | 3 | 2 | 2 | | | 2 | | 3 | 3 | 3 |

| | |
|---|---|
| Course designed by | Department of Electrical & Electronics Engineering |
| Approval | Approved by: Meeting of Board of Studies held on 29.06.19 |
| | Ratified by: 5th Meeting of Academic Council, 13-07-2019. |

## Basic Electrical Engineering Laboratory

LIST OF EXPERIMENTS

Basic safety precautions, Introduction and use of measuring instruments – voltmeter, ammeter, multi-meter, oscilloscope, resistors, capacitors and inductors.

1. Verification of Kirchhoff laws.
2. Verification of Network Theorems.
3. Magnetization characteristics of a DC Shunt Generator.
4. Speed control of DC Shunt Motor.
5. Predetermination of performance parameters of 1 – Phase Transformer.
6. I – V Characteristics of Solar PV cell
7. Brake test on DC Shunt Motor.
8. Measurement of earth resistance.
9. Measurement of reactive power in three phase balanced circuit.
10. Measurement of Choke coil parameters
11. Brake test on 3 - Phase Induction Motor.
12. Determination of AC quantities using CRO/DSO.
13. I – V characteristics of battery.

**COURSE OUTCOMES:**

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

CO 1. Identify common electrical equipment used in laboratory.(L1)

CO 2. Estimate the ratings of different equipment used to perform an experiment. (L2)

CO 3. Demonstrate the usage of various electrical measuring instruments.(L3)

CO 4. Analyze the characteristics of rotating & stationery electrical machines (L4).

CO 5. Interpret the characteristics of PV cell and Battery.(L5)

CO/PO Mapping

| CO / PO Mapping | Program Outcomes | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | PSO1 | PSO2 |
| Identify common electrical equipment used in laboratory. | 3 | | 1 | 1 | 3 | 1 | | | 3 | 2 | 2 | 2 | 2 | 1 |
| Estimate the ratings of different equipment used to perform an experiment. | 3 | 2 | 3 | 3 | 3 | 2 | 1 | | 3 | 3 | 2 | 2 | 2 | 3 |
| Demonstrate the usage of various electrical measuring instruments. | 2 | 2 | 2 | 2 | 3 | 1 | | | 3 | 3 | 1 | 2 | 2 | 1 |
| Analyze the characteristics of rotating & stationery electrical machines. | 3 | 3 | 3 | 3 | 2 | | | | 3 | 3 | | 2 | 3 | 2 |
| Interpret the characteristics of PV cell and Battery. | 3 | 3 | 3 | 3 | 3 | | 1 | | 3 | 3 | 2 | 2 | 3 | 3 |

| | |
|---|---|
| Course designed by | Department of Electrical & Electronics Engineering |
| Approval | Approved by: Meeting of Board of Studies held on 29.06.19 |
| | Ratified by: 5th Meeting of Academic Council, 13-07-2019. |

| A2EHL001 | SEMESTER - II | L | T | P | C |
|---|---|---|---|---|---|
| | Essential Communication in English | 1 | - | 3 | 3 |
| | Total Contact Hours – 60 | | | | |

## SYLLABUS

**UNIT – I: BASIC LANGUAGE SKILLS – A REFRESHER**

**Organs of Speech:** Consonant Sounds &Vowel Sounds; Phonemic Transcription; Using a Dictionary to know the Pronunciation of a word

**Presenting Oneself**: Introducing oneself -Using different expressions in Formal&Informal Contexts.

**Reading a News Article**: Identifying the key words and their usage; summarizing the information

**Word Study & Mind Mapping:** Root words–Derivatives; Homonyms, Homographs, Homophones; Synonyms & Antonyms

**UNIT – II: RUDIMENTS OF FUNDAMENTAL COMMUNICATION**

**The World:** Listening & watching Documentaries on World famous Places.

**Describing People, Places and Life experiences:** Physical Description- Describing someone's qualities – Usage of Jargon to present topography.

**Short Story Corner:** Reading a short story – Understanding the mood and essence – Sharing different perspectives.

**Sentence Patterns:** Concord – Rules – Common errors in day-day usage

**UNIT-III: COMMUNICATION AT PRACTICE**

**Oratory Skills:** Listening to World's Famous Speeches

**JAM (Just a Minute) Talk:** Format & Delivery Techniques

**Nuances of Language:** Company Description –Position Description (Formal) – processes like Chocolate Making( Informal)**.**

**Types of Sentences** – Declarative, Interrogative, Assertive etc.

**UNIT-IV: COMMUNICATION THROUGH CONCEPTUAL LEARNING**

**BBC English:** Watching interviews of Famous people.

**Dialogue Practice:** Situational Dialogues; Structuring a Role Play

**New Inventions:** Reading about latest technology pertaining to different fields (Source : Science Journals)

**Transformation of sentences:** Active Voice-Passive Voice**,** Direct & Indirect Speech**,** Degrees of Comparison**,** Simple Compound & Complex Sentences.

**UNIT – V: COMMUNICATION THROUGH LIFE SKILLS**

**Watching Movies for Language Enrichment & Writing Reviews.**

**Skits:** Enacting a Skit on a Social Issue

**Reflections:** Reading News Paper Editorial columns, Literacy Reviews, Poetry

**Presenting an autobiography:** Exploring different styles of writing autobiographies and evolving an own style**.**

**TEXT BOOK:**
Reference Source Compilation by the Department

**REFERENCES:**
1. **Fundamentals of Technical Communication** by Meenakshi Raman,OUP.
2. **Living English Structure** by W.Stannard Allen, Pearson Publications.
3. **English Made Easy** by Mary Margaret Hosler, Mc Graw Hill.
4.. **English and Communication Skills for Students of Science and Engineering**, by Dhanavel, S.P. Orient Blackswan Ltd.
5. **The Oxford Guide to Writing and Speaking** by John Seely , OUP

**COURSE OUTCOMES:**

CO1. Student will be able to come to terms with the basic language Skills required to cater to the requirement of the programme undertaken.

CO2. Student will be able to comprehend and analyze the core concepts well.

CO3. Student will be able to gain proficiency in all four skills of Language – Listening, Reading, Speaking and Writing.

CO4. Student will be able to understand the Syntactical and Grammatical Components of English Language and their correct use.

CO5: Student will be able to present his/her ideas confidently in a Professional manner.

CO/PO Mapping

| Course Title: | **Essential Communication in English** | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Course Code: | A2EHL001 | | | | | | | | | | | | | |
| Course Designed by | Dept. of English & Humanities | | | | | | | | | | | | | |
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
| CO1 | | | | | | 2 | | 2 | 3 | 3 | | 3 | | |
| CO2 | | | | | | 2 | | 2 | 3 | 3 | | 3 | | |
| CO3 | | | | | | 2 | | 2 | 3 | 3 | | 3 | | |
| CO4 | | | | | | 2 | | 2 | 3 | 3 | | 3 | | |
| CO5 | | | | | | 2 | | 2 | 3 | 3 | | 3 | | |

| Course designed by | DEPARTMENT OF ENGLISH & HUMANITIES |
|---|---|
| Approval | Approved by: Meeting of Board of Studies held on 29.06.19 |
| | Ratified by: 5th Meeting of Academic Council, 13-07-2019. |

| A2CHW201 | SEMESTER - II | L | T | P | C |
|---|---|---|---|---|---|
| | **Work Shop (Chemical Engineering)** | **0** | **0** | **3** | **2** |
| | **Total Contact Hours – 45** | | | | |

| COURSE OBJECTIVES | |
|---|---|
| 1 | To determine the flow regimes in a pipe flow. |
| 2 | To understand the significance of thermal conductivity and diffusivity |
| 3 | To understand the factors affecting the rate of reaction |
| 4 | To understand the difference between classification and clarification |
| 5 | To understand the parameters affecting ground and surface water |
| 6 | To understand the significance of diffusivity |
| 7 | To understand the factors affecting solubility |

**List of experiments**

1. Distinguish between Laminar and turbulent flows – concept of Reynolds number
2. Use of manometers (different manometric fluids) to measure pressure drop – relate the pressure drop to fluid properties – express pressure in the height of a liquid (different) column – atmospheric pressure measurement
3. Measurement of fluid flow (liquids and gases) by different instruments
4. Determination of thermal conductivity of a metal rod.
5. Dissolution of solid in a liquid –identify the variables effecting the rate of dissolution
6. Diffusion of a solid in gas – factors effecting the rate – concepts of mass transfer
7. Estimation of half-life time (fractional life) of a chemical reaction (Hydrolysis of tertiary butyl chloride)
8. Estimation of chemical and physical parameters of ground and surface water like pH, TDS, conductivity.
9. Analysis of different oils to find acid value
10. Preparation of soap

**Text book:**

1. Unit Operations in Chemical Engg by W.L. McCabe and J.C. Smith and P Harriott, Mc Graw Hill 7th ed. 2005.
2. Mass Transfer Operations by R.E.Treybal, Mc. Graw Hill, 7th ed.

**Reference books:**


1. Brown G. G., "Unit Operations", CBS publishers.
2. Coulson J. H. and Richardson J.F., "Chemical Engg, Vol. I", 5th Ed., Butterworth-Heinemann.
3. Coulson J. H. and Richardson J.F., "Chemical Engg, Vol. II", 5th Ed., Butterworth-Heinemann.


**Course Outcomes (CO)**

Students will be able to

- Distinguish between laminar flow and turbulent flow based on Reynolds number.
- Determination of flow rates by U tube manometer.
- Determine the conversion of a chemical reaction.
- Characterize the solid particles.
- Estimate the chemical and physical parameters of ground and surface water such as pH, TDS, conductivity, hardness, turbidity and fluoride.
- Understand the magnitude of thermal conductivity
- Determination of solubility of solid in a liquid.

| A2CHW201 Work Shop | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Course Outcomes | Program Outcomes | | | | | | | | | | | | |
| | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO1 2 | PS O1 | PS O2 |
| CO1 | 3 | 1 | | | | | | | 3 | 2 | | 2 | 1 | 1 |
| CO2 | 3 | 2 | | | | | | | 3 | 2 | | 2 | 1 | 1 |
| CO3 | 3 | 2 | | | | | | | 3 | 2 | | 2 | 1 | 1 |
| CO4 | 3 | 2 | | | | | | | 3 | 2 | | 2 | 1 | 1 |
| CO5 | 1 | 1 | | | | | | | 3 | 2 | | 2 | 1 | 1 |
| CO6 | 3 | 1 | | | | | | | 3 | 2 | | 2 | 1 | 1 |
| CO7 | 3 | 1 | | | | | | | 3 | 2 | | 2 | 1 | 1 |

| A2CHW201 Work Shop | |
|---|---|
| Course designed by | Department of Chemical Engineering |
| Approval | Approved by: Meeting of Board of Studies held on 29.06.2019. |
| | Ratified by: 5th Meeting of Academic Council held on 13.07.2019. |

* * *

| A2CHT101 | SEMESTER - III | L | T | P | C |
|---|---|---|---|---|---|
| | **Biology for Engineers** | **3** | **0** | **0** | **3** |
| | Total Contact Hours – 48 | | | | |

| COURSE OBJECTIVES | |
|---|---|
| 1 | To understand the biological concepts from an engineering perspective |
| 2 | To study the importance of chemicals like lipids, sugars, polysaccharides, amino acids and proteins |
| 3 | To understand about DNA and RNA |
| 4 | To understand the process of metabolism |
| 5. | To understand the various applications of industrial enzymes |
| 6. | To understand the importance of industrial microbiology in the current scenario |
| 7. | To understand the importance of microbes and its applications |

**Syllabus:**

**UNIT-I:**
**Introduction**: Biology and its applications, Biological classification, Living Organisms: Cells and Cell theory, Cell structure and function.

**UNIT-II:**
**Biochemistry and molecular analysis:** Chemical composition of living forms, analysis of Chemical composition, Carbohydrates, Amino acid and proteins, protein synthesis, Nucleic acids, lipids, nature of bonding and qualitative tests.

**Unit-IIIA**:
**Genetics:** Transfer of genetic information, Mendelian Law, Mendel's law of inheritance, Gene interaction, multiple allens, chromosome theory of inheritance., linkage, Recombination, Chromosome mapping, Genetic disorders, Nucleic acids, replication of DNA, types of RNA, Transcription, Genetic code, translation and steps in translation.

**Unit-IIIB**:
**Metabolism:** Thermodynamics as applied to biological systems. Exothermic and endothermic reactions. Concept of Keq and its relation to standard free energy, Spontaneity. ATP as an energy currency. The breakdown of glucose to$CO_2 + H_2O$ (Glycolysis and Krebs cycle) and synthesis of glucose from $CO_2$ and $H_2O$ (Photosynthesis). Energy yielding and energy consuming reactions, Concept of Energy charge.

**UNIT-IV**:
**Enzymes and industrial applications**: Mode of action of enzymes, properties of enzymes, chemical reactions, factors affecting enzyme activity, Co-factors, importance of enzymes, industrial application of enzymes.

**UNIT-V:**
**Microbiology and Industrial applications:** Microorganism, Growth kinetics, culture media, sterilization, Microscopy, application of microbiology, immunology and immunity, Cancer Biology, stem cells.

**Course Outcomes:**

Students will be able to:

1. Explain the importance of biology in engineering.
2. Identify the importance of chemicals like lipids, sugars, polysaccharides, amino acids and proteins
3. Know the importance of DNA and RNA
4. Describe the process metabolism
5. Know the various applications of industrial enzymes
6. Know the importance of industrial microbiology in the current scenario.
7. Explain importance of the microbes and its applications.

**Text books:**

1. Biology for Engineers by Wiley (ISBN: 9781121439931), 1st edition TMH, New Delhi (2019)
2. Suraish kumar G K, Biology for Engineers, Oxford University Press, New Delhi (2019)

**References:**


1. Campbell, NA and Reece JB, Biology, International edition, 7th edition or later, Benjamin Cummings, New York (2007 or later)
2. Karp, G, Cell and Molecular Biology: Concepts and Experiments, 7th edition, Wiley, New York (2013)


**Mapping of POs & COs (Program Outcomes & Course Outcomes)**

| **A2CHT101 Biology for Engineers** | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO / PO mapping | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | PSO1 | PSO2 |
| CO-1 | 2 | | | 2 | | | | 2 | 2 | | 2 | 2 | 2 | |
| CO-2 | 2 | | | | | | | | | | | | 2 | |
| CO-3 | 2 | | | | | | | | | | | | 2 | |
| CO-4 | 2 | | | | | | | | | | | | 2 | |
| CO-5 | 2 | | | | | | | | | | | | 2 | |
| CO-6 | 2 | | | 2 | | | | 2 | 2 | | 2 | 2 | 2 | |
| CO-7 | 2 | | | | | | | | | | | | 2 | |

| **A2CHT101 Biology for Engineers** | |
|---|---|
| Course designed by | Department of Chemical Engineering |
| Approval | Approved by: Meeting of Board of Studies held on 29th Jun, 2019 |
| | Ratified by: 2nd Meeting of Academic Council, 13th AUG, 2020 |

| A2MAT105 | SEMESTER - III | L | T | P | C |
|---|---|---|---|---|---|
| | MATHEMATICS-III (CHE) | 3 | 0 | - | 3 |
| | Total Contact Hours – 48 | | | | |

## Syllabus

**Unit-I: Random Variables & Probability Distributions** **09 Hours**

Random Variables: Discrete and continuous random variables, properties of mass and density functions. Mathematical Expectation: Properties (statements), Moment Generating Function; Outlines: of Binomial and Poission distributions; Normal Distribution: Probability density function, Normal approximation to Binomial Distribution, Parameters of Normal Distribution(statements), Characteristics of normal distribution, Area under normal curve, Standard normal distribution.

**Unit-II: Statistical Methods** **08 Hours**

Curve fitting by least squares method: Bi-variate data, scatter diagram, method of least squares, normal equations, fitting of straight line, second degree curve (parabola), exponential and power curves; Correlation: types of correlation, measures of correlation, Karl Pearson coefficient of correlation and its properties; Regression Analysis: Regression Coefficients and its Properties, Regression lines.

**Unit-III: Sampling Distributions & Testing of hypothesis (Large Samples) 07+07 Hours**

Sampling distributions: population, sample, population parameters, sample statistic and types of sampling, sampling distribution of means (with and without replacement), standard error, Testing of hypothesis (large samples): Statistical hypothesis, null hypothesis, alternative hypothesis, type-I and type-II errors, critical region, level of significance, one tailed and two tailed tests.
Testing of hypothesis (Large Samples): Large Sample tests: Z-test for single mean and difference of means, single proportion and difference of proportions.

**Unit-IV: Testing of Hypothesis (Small Samples)** **09 Hours**

Testing of hypothesis (small samples): Introduction to small sample tests, degrees of freedom, Student's t, F and Chi-square distributions; student's t-test: t-test for single mean, difference of means and paired t-test; Chi-square test: Goodness of fit, independence of attributes, F-test: equality of population variances.

**Unit-V: Statistical Quality Control** **08 Hours**

Concepts of quality control: Causes of variation of quality, Techniques of statistical quality control, process control and product control, control charts, methodology of constructing control charts, types of control charts; Control charts for variables: Mean chart (X- Chart), Range chart (R-chart) and standard deviation chart; Control charts for attributes: p-chart, np-chart and c-chart.

//Topics prefixed with ‘Outlines’ are not for assessment//

**Text Books**:

TB1 RE Walpole, SL Mayeres & K May, Probability and Statistics for Engineers & Scientists, 3/e, Pearson Publishers

TB2 T.K.V. Iyengar et al, Probability and Statistics, S. Chand Publications, Revised edition.

**Reference Books:**

RB1 MH Mahajan, Statistical Quality Control, Dhanpat Rai Publishers

RB2 Murugesan and Gurusamy, Probability, Statistics and Random Process, Anuradha Publicatons.

RB3 S.C. Gupta and V.K. Kapoor, Fundamentals of Mathematical Statistics, 11/e, Sultan Chand & Sons Publications, 2012.

**Course Outcomes**

At the end of the course, students shall be able to:

| | | |
|---|---|---|
| CO 1 | KO#1 | Recall the concepts of random variables, probability distributions and statistical methods. |
| CO 2 | KO#2 | Recall the concepts of Sampling distributions and testing of hypothesis (large samples). |
| CO 3 | KO#3 | Recall the concepts of testing of hypothesis (small samples), stochastic processes and queuing models. |
| CO 4 | UO#1 | Understand and interpret the concepts of random variables, probability distributions and statistical methods. |
| CO 5 | UO#2 | Understand and interpret the concepts of Sampling distributions and testing of hypothesis (large samples). |
| CO 6 | UO#3 | Understand and interpret the concepts of testing of hypothesis (small samples), Statistical Quality Control |
| CO 7 | AO#1 | Apply the tools of Probability and statistics to real world problems. |

**CO/PO Mapping**

| | |
|---|---|
| Course Title: | Mathematics-III (CHE) |
| Course Code: | A2MAT105 |
| Course Designed by | Dept. of Mathematics |

| CO | Program Outcome (PO) | | | | | | | | | | | | PSO | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 |
| 1 | 3 | 3 | | 2 | | | | | | | 2 | | | |
| 2 | 3 | 3 | | 2 | | | | | | | 2 | | | |
| 3 | 3 | 3 | | 2 | | | | | | | 2 | | | |
| 4 | 3 | 3 | | 2 | | | | | | | 2 | | | |
| 5 | 3 | 3 | | 2 | | | | | | | 2 | | | |
| 6 | 3 | 3 | | 2 | | | | | | | 2 | | | |
| 7 | 3 | 3 | | 2 | | | | | | | 2 | | | |

| | |
|---|---|
| Course Designed by | Dept. of Mathematics |
| Approval | Approved by Board of Studies (BoS) of Department of Mathematics in its 4th meeting held on 06.07.2019. |
| | Ratified by Academic Council in its 5th meeting held on 13.07.2019. |

| A2CHT202 | SEMESTER - III | L | T | P | C |
|---|---|---|---|---|---|
| | **Design Thinking and Product Innovation** | 3 | 0 | 0 | 3 |
| | **Total Contact Hours – 48** | | | | |

Course Objectives

1. Students will understand Design Thinking and various methodologies for new product development
2. Students will understand principles, tools and activities in various phases of Design Thinking
3. Students will study the thought process in designing radically new products in emerging startups
4. Students will be able to carry out an end to end case study with their knowledge on Design Thinking
5. Students will be able to understand about Ideation & Prototyping in Design Thinking
6. Students will be able to understand about the empathizing and defining phases of Design Thinking
7. Students will be able to apply Design Thinking principles, methodologies, phases and tools to design a New/Radically new Process/Service/Product

SYLLABUS:

**UNIT 1: Introduction to Design Thinking**

**Design Thinking in General :** The Concept of Design Thinking, Wicked Problems, The Principles and the mindset of Design Thinking, Generic Phases of Design Thinking process and activities involved in each of the phase, Design Thinking Frameworks.

**Design Thinking for New Product Development :** Role of Design Thinking in NPD, When to Apply Design Thinking and When Not to, StageGate Vs Lean Vs. Agile methodologies Vs Design Thinking, Design innovation.

UNIT 2: Problem Identification process in Design Thinking

**Empathize:** Empathize - Goals and methods, Usage of Tools (Design Briefs - Nine Criteria with example), Usage of Tools (Creation of Personas, Illustrative application of Personas), Student Activity on Empathize phase.

**Define:** Importance of Define Phase, activities, Usage of Tools (Experience Mapping process with example), Usage of Tools (Developing Insights using HMW Questions, question ladder), Student Activity on Define phase.

UNIT 3: Problem Solving Process in Design Thinking, Case Study discussion & implementation

**Ideate:** Importance of Ideate Phase, 77 Design Heurisitics, Diverge Ideas, Converge Ideas Student Activity on Ideate phase

**Prototype & Test*:*** "A Design Thinking Product Development Framework", What Is a Story? What Is a Prototype?, "Putting It Together—Combining Stories and Prototypes", Employing Stories and Prototypes in Your Process

**Case Study Implementation:** Case Study Discussion mapping the End to End Design Thinking Process to the topics discussed till cluster 3**,** Case Study - 1 (Problem Identification Processes in Design Thinking)

Case Study - 1 (Problem Solving Processes in Design Thinking)
Case Study - 2 (Problem Identification Processes in Design Thinking) Case Study - 3 (Problem Solving Processes in Design Thinking) **Student implementing phases of DT towards Problem Solving:** Problem Area Identification
Application of Empathize Phase Application of Empathize Phase Case Study Evaluation Phase - 1

UNIT 4: Product Innovation
**The Role of Design in Early-Stage Ventures:** Introduction: An Emerging Start-up Culture, The Process: Winding from idea to product, Discussion on Case Study, Troubleshooting Common Mistakes
**Optimal Design for Radically New Products:** Introduction- six ideas and their implementation
Communicate the Challenge Goal toward Radically New Products, Shift Time Frames to Future and Past, Promote an Emerging Technology Focus across the Consumption Chain, Use of Analogical Thinking, Look for Novel Ways to Solve Simple Problems, Leverage More Ideators via Crowdsourcing

UNIT 5: Case Study implementation
**Student implementing phases of DT towards Problem Identification & Solving**
Application of Define Phase Application of Define Phase Case Study Evaluation Phase - 2
Application of Ideate Phase
Student implementing phases of DT towards Problem Identification & Solving
Application of Ideate Phase Build Prototype
Test the solution
Case Study Evaluation Phase – 3

Text books & Reference books:

1. Design think new product development essentials from the PDMA – Wiley edition
2. Product Design and Development Karl Ulrich (Author), Steven Eppinger –Fifth edition
3. Design Thinking Getting Started Sidneyeve Matrix, https://innovationbydesign.pressbooks.com/
4. https://en.wikipedia.org/wiki/Wicked_problem
5. https://web.mit.edu/jrankin/www/engin_as_lib_art/Design_thinking.pdf
6. https://www.interaction-design.org/literature/article/5-stages-in-the-design-thinking-process
7. https://www.interaction-design.org/literature/article/design-thinking-a-quick-overview
8. https://www.designorate.com/measuring-the-impact-of-design-thinking/
9. https://www.mindtheproduct.com/understanding-design-thinking-lean-agile-work-together/
10. https://www.sopheon.com/spiral-development-lean-vs-stage-gate/#:~:text=In%20practice%2C%20lean%20product%20development,is%20completed%20within%20each%20stage.
11. https://medium.com/codomo/what-is-design-innovation-why-you-need-to-know-it-b8d850503b3a
12. https://dschool-old.stanford.edu/groups/k12/wiki/3d994/empathy_map.html

13. https://www.designkit.org/methods/how-might-we
14. https://careerfoundry.com/en/blog/ux-design/what-is-ideation-in-design-thinking/
15. https://www.interaction-design.org/literature/article/stage-3-in-the-design-thinking-process-ideate

**Course Outcomes:**

Students will be able to:

1. Describe various phases of Design Thinking and various tools for Empathizing in Design Thinking
2. Describe various tools for Ideation, Prototyping in Design Thinking
3. Outline the Design process for new Product development in startups and techniques to design Radically New Products
4. Give examples for empathizing and defining phases in Design Thinking
5. Give examples for Ideation, Prototyping in Design Thinking
6. Draw inferences on designing radically new products in emerging startups.
7. Apply Design Thinking principles, methodologies, phases and tools to design a New/Radically new Process/Service/Product

**CO/PO Mapping:**

| **A2CHT202: Design Thinking and Product Innovation** | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Course designed by | Department of Mechanical Engineering | | | | | | | | | | | | | |
| CO / PO mapping | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | PSO1 | PS02 |
| i. | 3 | 1 | 1 | 1 | 1 | 1 | | 1 | 1 | | 1 | 1 | 2 | 2 |
| ii. | 3 | 1 | 1 | 1 | 1 | 1 | | 1 | 1 | | 1 | 1 | 2 | 2 |
| iii. | 3 | 1 | 1 | 1 | 1 | 1 | | 1 | 1 | | 1 | 1 | 2 | 2 |
| iv. | 3 | 3 | 3 | 2 | 2 | 1 | | 1 | 2 | 1 | 1 | 2 | 2 | 2 |
| v. | 3 | 3 | 3 | 2 | 2 | 1 | | 1 | 2 | 1 | 1 | 2 | 2 | 2 |
| vi. | 3 | 3 | 3 | 2 | 2 | 1 | | 1 | 2 | 1 | 1 | 2 | 2 | 2 |
| vii. | 3 | 3 | 3 | 3 | 3 | 2 | 1 | 1 | 2 | 1 | 2 | 2 | 3 | 3 |

| **A2CHT202: Design Thinking and Product Innovation** | |
|---|---|
| Course designed by | Department of Chemical Engineering |
| Approval | Approved by: Meeting of Board of Studies held on |
| | Ratified by: 2nd Meeting of Academic Council |

| A2CHT301 | SEMESTER - III | L | T | P | C |
|---|---|---|---|---|---|
| | CHEMICAL TECHNOLOGY | 3 | 0 | 0 | 3 |
| | **Total Contact Hours – 48** | | | | |

| **COURSE OBJECTIVES** | |
|---|---|
| 1 | To understand the basic principles of unit processes and unit operations involved in chemical processes. |
| 2 | The process technology, development and production associated with Soda ash, caustic soda , chlorine gas , and glass manufacturing industries |
| 3 | The process technology, development and production associated with production of industrially important gases like carbon dioxide, hydrogen, oxygen and production of valuable chemicals from nitrogen industries. |
| 4 | The process technology involved in manufacturing of sulfur, sulfuric acid, hydrochloric acid, aluminium sulphate, alum, barium salts, cements, and some miscellaneous chemicals from calcium and magnesium |
| 5 | The process technologies in manufacturing of organic chemicals like phenols, formaldehydes, vinyl chloride and vinyl acetate, phenol formaldehyde resin, PVC monomer, and SB rubber |
| 6 | The industrial process technology involved in extraction , refining of vegetable oils, manufacturing of soaps, detergents and pulp and paper |
| 7 | Major Engineering problems and Economics in both Inorganic and Organic chemical Technology. |

**SYLLABUS**

**UNIT-I**

Basic principles of Unit process and Unit operations in Chemical Industries,

Chlor- Alkali Industries: Manufacturing of Soda ash by Solvay & Dual process, caustic soda and chlorine by Electrolytic process.

Glass Industries: manufacture of Glass by Fourcault & continuous sheet process, Properties & applications of special glasses

**UNIT II**

Fuel &Industrial gases: producer gas, water gas & Coke oven gas; Carbon dioxide

Cryogenics in Chemical Industries: Hydrogen, oxygen and Nitrogen Production

Nitrogen & Fertilizer industries: synthetic ammonia, urea, nitric acid, ammonium nitrate, ammonium phosphate and complex fertilizers.

**UNIT-III**

**Part-A:**

Sulphur Industries: Extraction of sulphur by Frasch process, manufacture of sulphuric acid by contact process.

Industrial Chemicals: Hydrochloric acid and Aluminum sulphate and miscellaneous salts

**Part-B:**

Cement Industries: Portland Cement manufacture, special cements, miscellaneous calcium compounds, magnesium compounds

**UNIT-IV**

Petrochemical & Polymer Industries: Manufacture of phenols, formaldehyde, vinyl chloride and, manufacture of phenol- formaldehyde resin and polyvinyl chloride polymer, SBR.

**UNIT-V**

Natural Product Industries: Oils- Definition, constitution, extraction and expression of vegetable oils, refining and hydrogenation

Soaps and Detergents: Definitions, continuous process for the production of fatty acids, glycerin and soap, production of detergents.

Pulp and paper industry: Methods of pulping, production of sulphate and sulphite Pulp, production of paper –wet process

**TEXT BOOK:**

1. Shreeve's Chemical Process Industries edited by Austin, McGraw-Hill.5th ed.1985.
2. Dryden's Outlines of Chemical Technology, edited by M.Gopal Rao and M.Sittig, 2nd ed. 1973.

**REFERENCES:**

1. Industrial Chemistry by B.K.Sharma
2. Hand book of Industrial Chemistry Vol 1&II K.H.Davis& F.S. Berner Edited by S.C. Bhatia, CBS publishers
3. Austin, G. T., Shreve's Chemical Process Industries, Tata – McGraw Hill Publishers, 2012.

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

1. To learn the concepts of unit operations and unit processes involved in chemical processes
2. To Have technological knowledge of various process equipment and their respective functionalities in Process flow sheet.
3. To relate the physical and chemical properties of various chemical compounds towards the working principles of various established technology in industrial flow sheets
4. To Learn the complexity of various process equipment such as heat and mass transfer units, etc.
5. To Have conceptual knowledge towards the application of principles of energy efficient, pollution abatement and raw material recovery and reuse in process flow sheets
6. To have an overall idea towards various alternate processes for the manufacture of important inorganic and organic products.
7. To Have a working knowledge towards various safety issues, engineering problems & economics etc., associated to both inorganic and organic chemical technology

| A2CHT301 CHEMICAL TECHNOLOGY | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO / PO mapping | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | PSO1 | PSO2 |
| CO1 | 3 | 1 | 2 | | | | 1 | | | | | | | 2 |
| CO2 | 3 | 2 | 2 | 2 | 1 | | | | | | 1 | 1 | | 3 |
| CO3 | 3 | 1 | 2 | 2 | 1 | | | | | | 1 | 1 | | 3 |
| CO4 | 3 | 2 | 3 | 2 | 1 | | 1 | | | | 1 | | | 2 |
| CO5 | 2 | 2 | 2 | 1 | 1 | | 1 | | | | 1 | | | 3 |
| CO6 | 2 | 2 | 2 | 1 | 1 | | 1 | | | | 1 | | 1 | |
| CO7 | 2 | 2 | 2 | 3 | 1 | | 1 | | | | | | 1 | 2 |

| A2CHT301 CHEMICAL TECHNOLOGY | |
|---|---|
| Course designed by | Department of Chemical Engineering |
| Approval | Approved by: Meeting of Board of Studies held on 29th Jun, 2019 |
| | Ratified by: 2nd Meeting of Academic Council, 13th AUG, 2020 |

| A2CHT302 | SEMESTER - III | L | T | P | C |
|---|---|---|---|---|---|
| | **FLUID MECHANICS FOR CHEMICAL ENGINEERS** | 3 | 0 | 0 | 3 |
| | **Total Contact Hours – 48** | | | | |

| **COURSE OBJECTIVES** | |
|---|---|
| 1 | derstand the basic fluid flow properties and rheological properties of fluid flow. |
| 2 | arn and apply Bernoulli's equation for various simple and complex cases of fluid flow |
| 3 | Estimate the energy losses (major and minor) that occurs during fluid flow through pipes for various fluids to determine the size of the pumps and blowers required for a particular operation |
| 4 | derstand the basic differences between compressible and incompressible fluid flow and suitably adapt, modify and apply suitable correlations for compressible fluid flow. |
| 5 | timate the pressure drop that occurs during fluid flow through packed bed and fluidized bed |
| 6 | ve knowledge on various types of pumps, compressor, and blowers |
| 7 | derstand the knowledge related to various fluid flow measuring devises |

## SYLLABUS

**UNIT-I:**

Basics on dimensional Analysis, Nature of fluids, hydrostatic equilibrium, applications of fluid statics: U-Tube and Inclined Manometers.

Fluid flow phenomena- Rheological properties of fluids, Boundary layers.

**UNIT-II**

Basic equation of fluid flow –Mass balance in a flowing fluid; continuity,

Differential momentum balance; Equation of motion.

**UNIT-III**

***Part -A***

Incompressible Newtonian /Non Newtonian Flow in pipes and channels- shear stress and skin friction in pipes, laminar flow & turbulent flow in pipes and channels.

***Part- B***

Flow of compressible fluids- Definitions and basic equations, Processes of compressible flow Isentropic flow through nozzles, adiabatic frictional flow & isothermal frictional flow.

**UNIT-IV:**

Flow past immersed bodies, Drag and Drag coefficient, flow through beds of solids, Motion of particles through fluids.

Fluidization: Types of fluidization, Minimum fluidization velocity & applications of fluidization.

**UNIT-V:**

Transportation and Metering of fluids- Pipes, fittings and valves.

Pumps: positive displacement pumps, and centrifugal pumps, Fans, blowers, and compressors.

**TEXT BOOK:**

1. Unit Operations of Chemical Engineering by W.L.McCabe, J.C.Smith& Peter Harriot, McGraw-Hill, 6th Ed, 2001

**REFERENCE BOOKS:**

1. Transport processes and unit operations by Christie J. Geankoplis, PHI.
2. Introduction to Fluid mechanics by R.W. Fox, A.T.McDonald, P.J.Pritchard, JohnWiley and sons-6th edition

**COURSE OUTCOMES:**

Student will be able to

I. Analyze fluid flow in circular and non-circular conduits.
II. Do calculations involving Bernoulli's equation for transport of fluids in pipelines.
III. Calculate pressure drops and energy requirements associated to fluid flow in pipes.
IV. Calculate the pressure drops and energy requirements associated to compressible fluid flow in circular and rectangular ducts.
V. Estimate pressure drop in packed bed and fluidized bed
VI. Carry out various calculations associated to fluid flow in various types of pumps.
VII. Calculate and calibrate various flow measuring devices.

| **A2CHT302 FLUID MECHANICS FOR CHEMICAL ENGINEERS** | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Course designed by | Department of Chemical Engineering | | | | | | | | | | | | |
| CO / PO mapping | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | PSO1 | PSO2 |
| | | | | | | | | | | | | | | |
| CO1 | 3 | 3 | | 2 | 2 | | | | | | | 2 | 2 | 2 |
| CO2 | 3 | 3 | | 2 | 2 | | | | | | | 2 | 2 | 2 |
| CO3 | 3 | 2 | | 2 | 2 | | | | | | | 2 | 2 | 3 |
| CO4 | 3 | 2 | | 2 | 2 | | | | | | | 2 | 2 | 3 |
| CO5 | 3 | 3 | | 2 | 2 | | | | | | | 2 | 2 | 3 |
| CO6 | 3 | 2 | | 2 | 2 | | | | | | | 2 | 2 | 3 |
| CO7 | 3 | 1 | | 2 | 2 | | | | | | | 2 | 2 | 3 |

| **A2CHT302** | **FLUID MECHANICS FOR CHEMICAL ENGINEERS** |
|---|---|
| Course designed by | Department of Chemical Engineering |
| Approval | Approved by: Meeting of Board of Studies held on 29th Jun, 2019 |
| | Ratified by: 2nd Meeting of Academic Council, 13th AUG, 2020 |

| | SEMESTER - III | L | T | P | C |
|---|---|---|---|---|---|
| **A2CHI201** | **AI Tools, Techniques and Applications** (Integrated Course) | **3** | **0** | **3** | **5** |
| | **Total Contact Hours : 96** | | | | |
| | **Prerequisites: PPS Course** | | | | |

**Course Objectives:**

1 Students will understand the basic programming constructs and object oriented programming concepts in Python
2 Students will understand the fundamentals of AI & ML concepts and DL concepts.
3 Students will understand the about Image Processing & Computer Vision concepts
4 Students will understand the fundamental concepts and OOP of Python.
5 Students will understand the features of AI & ML and DL
6 Students will understand about the Image Processing techniques & Computer Vision concepts.
7 Students will understand the concepts of Python and solve AI problems through programming with Python.

## Syllabus

**UNIT-I: Introduction to Python**

The basic elements of python, Control Structures, Loops, Functions and scoping, Recursion, Global variables, Modules, Strings, Files.

**UNIT-II: OOP in Python**

Structured Types, Mutability and Higher-Order Functions, Tuples, Lists and Dictionaries, OOP in Python: Classes, Objects, Constructors, Inheritance, Encapsulation.

**UNIT-III: Introduction to AI**

Basics of AI. Applications of AI. Advanced search, Constraint satisfaction problems, Knowledge representation & reasoning, Non-standard logics, Uncertain and probabilistic reasoning

Conceptual introduction to **Machine Learning:** Introduction to Neural Networks, Supervised, Unsupervised, and Semi-Supervised Learning, introduction to Reinforcement learning, Deep Learning: layers, activation functions, optimizers.

**UNIT-IV: Image Processing**

Conceptual introduction to **Image Processing & Computer Vision:** Introduction to Image processing, Setting up OpenCV, Filtering Images, Tracking Faces with Haar Cascades, Detecting Edges and Applying Image Filters, Detecting and Tracking Different Body Parts, Extracting Features from an Image.

**Applications: *GEN*:** Automation, Agriculture [Crop and Soil Monitoring, Grading farm produce, Predictive Analytics]. ***CHEM:*** Industrial Reactors.

**Unit V: Computer Vision:**

Image - Definition and Tagging. Classification of images. Image formation, Deep Learning algorithms for Object detection & Recognition. Object Tracking, Stereo Vision and 3D Reconstruction, Augmented Reality

**Applications: *GEN*:** Robotics; ***CHEM***: Industrial systems.

**Text Books:**

- Programming and Problem solving with PYTHON, McGraw Hill Education, Ashok Namdev Kamthane, Amit Ashok Kamthane, 2018 (UNIT-I & II)
- Joseph Howse, Prateek Joshi, Michael Beyeler - OpenCV Computer Vision Projects with Python-Packt Publishing (2016) – (UNIT-IV & V)
- Stuart J. Russell and Peter Norvig, Artificial Intelligence A Modern Approach (UNIT-III)

**References:**

- Tom Mickiewicz & Josh Zheng, Getting started with Artificial Intelligence, Published by O'Reilly Media, 2017.
- Aurelian Geron, Hands on Machine Learning with Scikit-Learn and TensorFlow [Concepts, Tools, and Techniques to Build Intelligent Systems], Published by O'Reilly Media, 2017.
- Navin Kumar Manaswi, Deep Learning with Applications Using Python, Apress.

## Laboratory Experiments

**Week 1)** Working of operators, expression evaluation, ways of accepting input and displaying output. Recall the basics of elements of Python and their usage in different advanced packages.

**Week 2 & 3)** Explore on control and iterative statements.

**Week 4 & 5)** Working on Functions, Strings, Files, and Global variables along with modules.

**Week 6 &7)** Explore on python data Structures like lists, tuples and dictionaries.

**Week 8)** Integrating Machine Learning with Computer Vision.

**Week 9)** Image preprocessing operations using openCV

**Week 10)** Feature extraction of an image

**Week 11)** Perform object detection.

**Week 12)** Image classification

**Week 13)** Lab based Project

**Week 14)** Lab based Project

**References:**


1. Programming and Problem solving with PYTHON, McGraw Hill Education, Ashok Namdev Kamthane, Amit Ashok Kamthane, 2018.
2. AI Tool and Techniques Laboratory manual.
3. Computer Vision with Python 3, Packt Publishing Ltd, Saurabh Kapur, 2017.

**Course Outcomes:**
After completing this course, the students will:

| | |
|---|---|
| 1 | Have the ability to describe basic programming constructs and object oriented programming concepts in Python |
| 2 | Have the ability to describe the fundamentals of AI & ML concepts and DL concepts. |
| 3 | Have the ability to describe about Image Processing & Computer Vision concepts |
| 4 | Have the ability to explain the fundamental concepts and OOP of Python. |
| 5 | Have the ability to explain and outline the features of AI & ML and DL |
| 6 | Have the ability to demonstrate the Image Processing techniques & Computer Vision concepts and apply in various domains. |
| 7 | Have the ability to apply the concepts of Python and solve AI problems through programming with Python. |

| **A2CHI201 & AI Tools, Techniques and Applications** | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Course designed by | | | Department of Electronics and Communication Engineering | | | | | | | | | | | |
| CO / PO mapping | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
| CO1 | 3 | 3 | | | 3 | | | | | | 2 | 3 | | |
| CO2 | 3 | 2 | 2 | 1 | | | | | | | | | 3 | |
| CO3 | 3 | 2 | 2 | 1 | | | | | | | | | 1 | |
| CO4 | 2 | 1 | | | 3 | | | | | | | 1 | | |
| CO5 | 3 | 2 | 2 | 1 | | | | | | | | | 2 | |
| CO6 | 3 | 2 | 2 | 1 | | | | | | | | | 2 | |
| CO7 | 3 | 2 | 2 | 1 | | | | | | | 1 | 2 | 3 | |

1. Low 2. Medium 3. High

**A2CHI201 & AI Tools, Techniques and Applications**

| | |
|---|---|
| Course designed by | Department of Chemical Engineering |
| Approval | Approved by: Meeting of Board of Studies held on |
| | Ratified by: Meeting of Academic Council |

| A2CHL301 | SEMESTER - III | L | T | P | C |
|---|---|---|---|---|---|
| | FLUID MECHANICS LAB | 0 | 0 | 3 | 1.5 |
| | **Total Contact Hours – 45** | | | | |

| COURSE OBJECTIVES | |
|---|---|
| | e students will be able |
| 1 | provide practical knowledge in verification of principles of fluid flow |
| 2 | derstand the basic measurement techniques of fluid mechanics |
| 3 | understand Major and Minor Losses |
| 4 | gain knowledge in performance of pumps |
| 5 | calculate pressure drop in packed, fluidized beds and helical coils |
| 6 | calibrate V notch and Rotameter |
| 7 | write clear lab reports |

**LIST OF EXPERIMENTS:**

1. Verification of Bernoulli's Equation
2. Determination of discharge coefficient for orifice meter and its variation with Reynolds number
3. Determination of discharge coefficient for Venturi meter and its variation with Reynolds number
4. Determination of weir meter constant K for V-Notch
5. Determination of friction factor for flow through straight pipes of different diameters and study of variation of friction factor with Reynolds number
6. Determination friction losses in pipe fittings
7. Determination of characteristic curves for centrifugal pump.
8. Determination of characteristic curves for Reciprocating pump.
9. Determination of pressure drop of fluid flowing through helical coils
10. Determination of friction factor for packed beds.
11. Determination of variation of pressure drop with velocity in fluidized bed and hence find minimum fluidization velocity
12. Determination of variation of pressure drop with velocity of fluid flowing through helical coils
13. Calibration of Rota meter
14. Determination of critical velocity by Reynolds experiments
15. Determine the viscosity of glycerin using Stoke's Law and the concept of terminal velocity.

**COURSE OUTCOMES:**

After completion of the course, students will be able to do the following:

1. Measure pressure, discharge and velocity of fluid flow.
2. Collect, analyze data data and interpret the results and compare with values available in literature.
3. Calculate various types of energy losses in pipes and pipe fittings.
4. Determine viscosity of liquids using Stokes law
5. Measure Pressure drops with varying velocity through fluidized bed, Fixed bed and compare with values from theoretical equations.
6. To understand the performance of the pumps through characteristics pumps.
7. Work in teams and develop writing skill for report writing

| **A2CHL302 FLUID MECHANICS LAB** | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Course designed by Department of Chemical Engineering | | | | | | | | | | | | | |
| CO / PO mapping | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | PSO1 | PSO2 |
| CO1 | 3 | 2 | | | | | | | | | | | 2 | |
| CO2 | 3 | 3 | | | | | | | | | | | 2 | |
| CO3 | 3 | | | 3 | | | | | | | | | 2 | 3 |
| CO4 | 3 | | | 3 | | | | | | | | | 2 | 3 |
| CO5 | 3 | | | 3 | | | | | | | | | 2 | 3 |
| CO6 | | | | | | | | | 3 | | | | | |
| CO7 | | | | | | | | | | 3 | | | | |

| **A2CHL302 FLUID MECHANICS LAB** | |
|---|---|
| Course designed by | Department of Chemical Engineering |
| Approval | Approved by: Meeting of Board of Studies held on 29th Jun, 2019 |
| | Ratified by: 2nd Meeting of Academic Council, 13th AUG, 2020 |

| A2CHL302 | SEMESTER - III | L | T | P | C |
|---|---|---|---|---|---|
| | **AutoCAD LAB** | 0 | 0 | 3 | 1.5 |
| | **Total Contact Hours – 48** | | | | |

| **COURSE OBJECTIVES** | |
|---|---|
| 1 | Understanding and drawing of standard symbols used to represent various pipes, valves and fittings and their use in development of P&ID(Piping &Instrument Diagram) using AutoCAD. |
| 2 | Understanding of and drawing of standard symbol used to represent various instruments, sensing elements, impulse lines, local& digital(DCS) instruments, pneumatic/electronic signals, controllers, control valves, etc. using AutoCAD. |
| 3 | Understanding and drawing of standard symbols used to represent process equipment using AutoCAD. |
| 4 | Understanding and preparation of Piping&Instrumentation Diagrams using AutoCAD. |
| 5 | Understanding and preparation of Important Heat and Mass Transfer Equipments drawings using AutoCAD. |
| 6 | Understanding and Preparation of drawings of Storage Equipment using AutoCAD |
| 7 | Understanding and Preparation of Process flow sheet drawing of manufacturing process of any industrial chemical using AutoCAD |

LIST OF EXPERIMENTS

1. Drawing of Flow Sheet Symbols – Equipments
2. Drawing of Flow Sheet Symbols – Valves
3. Drawing of Flow Sheet Symbols – Piping Lines
4. Drawing of Instrumentation Symbols
5. Drawing of Instrumentation Diagram
6. Drawing of Double Pipe Heat Exchanger
7. Drawing of Shell and Tube Heat Exchanger
8. Drawing of Evaporator
9. Drawing of Distillation Column
10. Drawing of Batch Reactor
11. Developing a new P&ID as per the given problem statement
12. Drawing of Spherical storage tank
13. Drawing of Any Manufacturing Process Flow sheet of an Industrial Chemical such as Caustic Soda, Soda Ash, Sulfuric Acid, Nitric Acid, Urea, Ammonia, Cement, Phenol, Paper Etc. (Project Based Learning Experiment)

**TEXT/REFERENCE BOOKS**

Joshi's Process Equipment Design by V.V.Mahajani, S.B.Umarji, 4th Edition, Macmillan Publishers, 2009.

Dryden's Outlines of Chemical Technology, edited by Gopal Rao, M and Marshall Sitting, , 3rd edition, East West Press, 2010.

**COURSE OUTCOMES:**
Student will be able to

1. Draw standard symbols used to represent various pipes, valves and fittings and their use in development of P&ID(Piping &Instrument Diagram) using AutoCAD.
2. Draw standard symbol used to represent various instruments, sensing elements, impulse lines, local& digital(DCS) instruments, pneumatic/electronic signals, controllers, control valves, etc. using AutoCAD.
3. Draw standard symbols used to represent process equipment using AutoCAD.
4. Draw Piping&Instrumentation Diagrams using AutoCAD
5. Draw Important Heat and Mass Transfer Equipments drawings using AutoCAD.
6. Prepare drawings of Storage Equipment using AutoCAD
7. Prepare Process flow sheet drawing of manufacturing process of any industrial chemical using AutoCAD

| | | PO | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | PSO1 | PSO2 |
| CO | CO1 | | | 3 | | 3 | | 1 | | | | | | 3 | 2 |
| | CO2 | | | 3 | | 3 | | 1 | | | | | | 3 | 2 |
| | CO3 | | | 3 | | 3 | | 1 | | | | | | 3 | 2 |
| | CO4 | | | 3 | | 3 | | 1 | | | | | | 3 | 2 |
| | CO5 | | | 3 | | 3 | | 1 | | | | | | 3 | 2 |
| | CO6 | | | 3 | | 3 | | 1 | | | | | | 3 | 2 |
| | CO7 | | | 3 | | 3 | | 1 | | | | | | 3 | 2 |

| **A2CHL302** | **AutoCAD Lab** |
|---|---|
| Course designed by | Department of Chemical Engineering |
| Approval | Approved by: Meeting of Board of Studies held on 29th Jun, 2019 |
| | Ratified by: 2nd Meeting of Academic Council, 13th AUG, 2020 |

| | | | | | |
|---|---|---|---|---|---|
| **A2EHA702** | **SEMESTER – III** | **L** | **T** | **P** | **C** |
| | **ESSENCE OF INDIAN TRADITIONAL KNOWLEDGE** | **2** | **-** | **-** | **0** |
| | **Total Contact Hours – 30** | | | | |

**BROAD OBJECTIVE**

Make students understand the thought process, reasoning and holistic life style of Yogic system.

**Course Objectives:**

- To impart basic principles of thought process, reasoning and inference. Sustainability is at the core of Indian Traditional Knowledge Systems connecting society and nature.

- To impart holistic lifestyle of Yogic-science and wisdom capsules in Sanskrit literature which is very important in modern society experiencing rapid technological advancements and societal disruptions.

- To focus on introduction to Indian Knowledge System, Indian perspective of modern scientific world-view and basic principles of Yoga and holistic health care system.

**Course Content**

- Basic Structure of Indian Knowledge System

  i) Ashtadasa vidya
  ii) Veda
  iii) Upavedha
  iv) Ayurvedha
  v) Dhanurvedha
  vi) Ghaandravedha
  vii) Vedang
    a. Shiksha,Kalp
    b. Nirutha
    c. Vyakaran
    d. Jyotishya)
  viii) Shastra
    a. Meemamsha
    b. Purana
    c. Tarka Shasthra

- Modern Science and Indian Knowledge System
- Yoga and Holistic Health care
- Case Studies.

**Suggested Text/Reference Books**


1. V. Sivaramakrishna (Ed.), Cultural Heritage of India-Course Material, Bharatiya Vidya Bhavan, Mumbai, 5th Edition, 2014
2. Swami Jitatmanand, Modern Physics and Vedant, Bharatiya Vidya Bhavan
3. Fritzof Capra, Tao of Physics
4. Fritzof Capra, The wave of Life
5. V N Jha ( Eng. Trans,), Tarkasangraha of Annam Bhatta, Inernational Chinmay Foundation, Velliarnad, Amaku,am
6. Yoga Sutra of Patanjali, Ramakrishna Mission, Kolkatta
7. GN Jha ( Eng. Trans.) Ed. R N Jha, Yoga-darshanam with Vyasa Bhashya, Vidyanidhi Prakasham, Delhi, 2016
8. RN Jha, Science of Consciousness Psychotherapy and Yoga Practices, Vidyanidhi Prakasham, Delhi, 2016
9. P R Sharma ( English translation), Shodashang Hridayam


**COURSE OUTCOMES**

CO -1: The students will be able to comprehend the concepts of Indian Traditional Knowledge.

CO-2: The Students will be able to connect themselves with Knowledge from the modern scientific perspective.

CO-3: The students will be able to connect the past with the present advancements in Technology.

CO-4: The students will be to come to terms with the holistic health care system.

C0-5: The students will be able to develop critical thinking skills.

C0-6: The students will be able to comprehend the principles enshrined in ancient Sanskrit Literature

**CO/PO Mapping**

| **Course Title:** | | | | **ESSENCE OF INDIAN TRADITIONAL KNOWLEDGE** | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** | **PSO1** | **PSO2** |
| **CO1** | | | | | | **2** | | | | | | | | |
| **CO2** | | | | | | **2** | | | | | | | | |
| **CO3** | | | | | | **2** | | | | | | | | |
| **CO4** | | | | | | **2** | | | | | | | | |
| **CO5** | | | | | | **2** | | | | | | | | |
| **C06** | | | | | | **2** | | | | | | | | |

| | |
|---|---|
| Course designed by | DEPARTMENT OF ENGLISH & HUMANITIES |
| Approval | Approved by: Meeting of Board of Studies held on 23.06.2019 |
| | Ratified by: 5th Meeting of Academic Council, 13-07-2019. |

| A2EHT001 | SEMESTER - IV | L | T | P | C |
|---|---|---|---|---|---|
| | **EFFECTIVE TECHNICAL COMMUNICATION** (Skill Oriented Course) | **2** | **-** | **2** | **3** |
| | **Total Contact Hours – 48** | | | | |

## SYLLABUS

**UNIT – I: PROFICIENCY SKILLS IN COMMUNICATION**

**Listening Comprehension (Basic Level)**:

- Working memory – attention –Vocabulary – Inference- comprehension monitoring.

**Elocution**:

- Composition of words in phrases and clauses – Collocation of words – patterns of sentences – proper use of conjunctions.

**Reading Comprehension Practice – I:**

- Reading Passages for Enrichment of Vocabulary and Sentence Improvement.

**Sentence Completion:**

- Concepts &Rules

**UNIT – II: COMMUNICATION FOR COMPETITIVE WORLD**

**Listening Comprehension- (Advanced)**:

- TOEFL – GRE - IELTS Orientation, Mock Tests.

**Group Discussion**:

- Purpose – Planning –Participation. Etiquette – reaching consensus in group work

**Reading Comprehension Practice – II:**

- Skimming & Scanning Techniques

**Idiomatic expressions & Foreign Expressions and their usage**

**UNIT-III: COMMUNICATION FOR PROFESSIONAL OUTREACH**

**Interview Skills:**

- Watching Mock Interviews**,** Interview Training Sessions,

**Mock Interviews:**

- Facing Interviews, Prerequisites and practice

**Cloze Passages:**

- Reading &Understanding the sequence of sentences in passages

**Syllogisms**:

- Major Premise – Minor premise – Conclusion

**Analogies**:

- Types of Analogies

**UNIT-IV: CAREER PLANNING & GUIDANCE**

**Video Profile:**

- Preparation – Planning - Execution

**Presentation Skills:**

- Making an oral Presentation -Structuring ideas – Power Point Presentation etiquette –Practice

**Reading Comprehension – III (Practice)**

- (Passages culled from model papers of competitive and qualifying examinations)

**Resume Writing & Cover Letter writing**

**UNIT – V: ENGLISH & PROFESSIONAL ETIQUETTE**

**Learning through Visuals:**

- Body Language Gestures & Postures.

**Debating Skills:**

- Making an opening statement – rebuttals – Closing statement**,** Debate etiquette

**Logic based English Language Tests – Practice**

**Report Writing:**

- Types of Reports – Writing a Technical Report

**TEXT BOOK:**

Open Source Compilation

**REFERENCES:**


1. Basic Communication Skills for Technology by Andrea J.Rutherfoord, Pearson Publications.
2. Business Communication Today Courtland L. Bovee,John V.Thill Abha Chatterjee, Pearson Publications.
3. How to Do Well in GDs and Interviews by Pearson Publications.

**COURSE OUTCOMES:**

CO1. Student will be able to develop proficiency in Communication in English.

CO2. Student understands the structure and pattern of various competitive and qualifying examinations for higher studies and employment.

CO3. Student will be able to express professionally his/her views to the context.

CO4. Student will be able to understand the need and concept of professional etiquette as a prerequisite for written and spoken communication.

CO5. Student shall be able to hone his/her analytical thinking skills.

CO6. Student will be able to acquire the employability skills needed.

CO/PO Mapping

| Course Title: | **Effective Technical Communication** | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Course Code: | **A2EHT001** | | | | | | | | | | | | | |
| Course Designed by | Dept. of English & Humanities | | | | | | | | | | | | | |
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
| CO1 | | | | | | 2 | | 2 | 3 | 3 | | 3 | | |
| CO2 | | | | | | 2 | | 2 | 3 | 3 | | 3 | | |
| CO3 | | | | | | 2 | | 2 | 3 | 3 | | 3 | | |
| CO4 | | | | | | 2 | | 2 | 3 | 3 | | 3 | | |
| CO5 | | | | | | 2 | | 2 | 3 | 3 | | 3 | | |
| C06 | | | | | | 2 | | 2 | 3 | 3 | | 3 | | |

| Course designed by | DEPARTMENT OF EHGLISH & HUMANITIES |
|---|---|
| Approval | Approved by: Meeting of Board of Studies held on 29.06.19 |
| | Ratified by: 5th Meeting of Academic Council, 13-07-2019. |

| A2MAT110 | SEMESTER - IV | L | T | P | C |
|---|---|---|---|---|---|
| | MATHEMATICS-IV (common to MEC, CHE & CIV) | 3 | 0 | - | 3 |
| | Total Contact Hours – 48 | | | | |

## Syllabus

**Unit-I: Fourier Series** **09 Hours**

Outlines: Periodic function, even and odd functions, generalized rule of integration by parts, special wave forms like square wave, half wave rectifier, full wave rectifier, saw-toothed wave, triangular wave; Fourier Series expansions: Euler's formulae for Fourier series, Dirichlet's conditions, Fourier series expansions for functions of period $2\pi$, functions having points of discontinuity, Change of interval, Fourier series expansions for functions of period 2L, Fourier series of odd and even functions; Half range Fourier Series: Half range sine and cosine series.

**Unit-II: Fourier Transformations** **08 Hours**

Fourier Integral: Fourier integral theorem and its complex, sine and cosine forms (statements only); Fourier Transformations (FTs): Concepts of integral transforms and its Kernels, Complex Fourier transformation, Fourier sine transformation & Fourier cosine transformations and their inverse transforms, Properties of Fourier transforms, Computation of Fourier, Fourier sine and Fourier cosine transformations using properties, evaluation of integrals, deductions of identities, Applications of FTs to solve integral equations.

**Unit-III: Applications of PDEs** **07 + 07 Hours**

Transverse vibrations of a stretched string (One dimensional wave equation): Solution by separation of variables method, boundary conditions, formation of physical problems of stretched string in to a boundary value problem (BVP), Solving BVPs for their particular solutions;

One dimensional heat flow equation: Solution by separation of variables method, modeling one dimensional heat flow phenomena as a BVP, solving BVPs for their particular solutions; Two dimensional heat flow equation (Laplace equation): Solution by separation of variables method, modeling two dimensional heat flow phenomena as a BVP, solving BVPs for their particular solutions.

**Unit-IV: Complex Variables (Differentiation)** **09 Hours**

Functions of complex variables: Neighborhood of a point in complex plane, Regions, limit and continuity of a complex function, derivative of a complex function, Cauchy-Riemann equations, analytic function, Entire function, Conjugate function, C-R equations in polar coordinates, Laplace equation, harmonic functions, harmonic conjugates; Construction of analytic functions: Milne-Thomson method; Applications to Electrical field and fluid flow problems: Complex potential, velocity potential, stream function in electrical field and fluid flow problems.

**Unit-V: Complex Variables (Integration)** **08 Hours**

Line integral of a complex function: Concept of complex integration, simple closed curve and multiple curves, simply and multiply connected domains, line integral and its properties, evaluation of line integral, Cauchy's integral formula, Cauchy's integral theorem, Cauchy's integral formula for derivatives; Outlines: of Taylor's & Laurent's series; Cauchy's residue theorem: Concepts of zeros, singularities and poles of an analytic function, residues, calculation of residues, Cauchy's residue theorem.

//Topics prefixed with 'Outlines' are not for assessment//

**Text Books**:

TB1 B. S. Grewal, Higher Engineering Mathematics, 44/e, Khanna Publishers, 2017

TB2 T.K.V. Iyengar et al, Mathematical Methods, S.Chand Publishers

**Reference Books:**

RB1 Erwin Kreyszig, Advanced Engineering Mathematics, 10/e, John Wiley & Sons, 2011

RB2 B.V. Ramana, Higher Engineering Mathematics, Tata McGraw Hill New Delhi, 11th Reprint, 2010.

RB3 T. Veerarajan, Higher Engineering Mathematics, Tata McGraw-Hill, 2008

**Course Outcomes (COs):** At the end of course, students shall be able to:

| | | |
|---|---|---|
| CO 1 | KO#1 | Recall the concepts of Fourier Series and Fourier Transformations |
| CO 2 | KO#2 | Recall the Applications of PDEs |
| CO 3 | KO#3 | Recall the concepts of Complex variables |
| CO 4 | UO#1 | Use and Interpret the concepts of Fourier Series and Fourier Transformations |
| CO 5 | UO#2 | Use and interpret the Applications of PDEs |
| CO 6 | UO#3 | Use and interpret the concepts of Complex variables |
| CO 7 | AO#1 | Apply the concepts of Fourier Series, Fourier Transformations, PDEs and complex variables to model and solve real world problems. |

**CO/PO Mapping**

| Course Title: | Mathematics-IV (Common to MECH, CHEM & CIVIL) | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Course Code: | A2MAT110 | | | | | | | | | | | | | |
| Course Designed by | Dept. of Mathematics | | | | | | | | | | | | | |
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
| CO1 | 3 | 3 | | 2 | | | | | | | 2 | | | |
| CO2 | 3 | 3 | | 2 | | | | | | | 2 | | | |
| CO3 | 3 | 3 | | 2 | | | | | | | 2 | | | |
| CO4 | 3 | 3 | | 2 | | | | | | | 2 | | | |
| CO5 | 3 | 3 | | 2 | | | | | | | 2 | | | |
| CO6 | 3 | 3 | | 2 | | | | | | | 2 | | | |
| CO7 | 3 | 3 | | 2 | | | | | | | 2 | | | |

| | |
|---|---|
| Course designed by | DEPARTMENT OF MATHEMATICS |
| Approval | Approved by: Meeting of Board of Studies held on 06.07.2019 |
| | Ratified by: 5th Meeting of Academic Council, 13-07-2019. |

| A2CHT201 | SEMESTER - IV | L | T | P | C |
|---|---|---|---|---|---|
| | Subject : INTERNET OF THINGS | 3 | 0 | 0 | 3 |
| | Total Contact Hours – 48 | | | | |
| | Prerequisite: Basics of Programming, Basics of Electronics | | | | |

**COURSE OBJECTIVES:**

1. Students will define IOT, list the applications of IOT and the design principles of IOT
2. Students will choose the platform for design and sensors required to interface to get the desired results
3. Students will do programing using python
4. Students will understand different protocols and enabling technologies for IOT
5. Students will compare and contrast the different Prototyping Embedded Devices and sensors
6. Students will understand the cloud storage models for IOT
7. Students will understand the concepts learned to design the Real time applications

**SYLLABUS**

**UNIT I : Introduction to IoT**

Definition and characterization of IoT, Physical and Logic Design of IoT, IoT Enabling Technologies, IoT Levels, Domain Specific IOTs: Home Automation, Cities, Environment, Energy, Retail, Logistics, Agriculture, Industry, Health & Life Style.

**UNIT II : Design Principles of IoT**

Internet Principles – Internet communication, IP Addresses, MAC Address, TCP and UDP ports, Application Layer Protocols.

**IoT and M2M -** M2M, Differences between IoT and M2M, SDN and NFV for IoT, Need for IOT Systems Management, Simple Network Management Protocol, Limitations of SNMP.

**UNIT III : Prototyping Embedded Devices**

IoT Design Methodology, Electronics, Arduino, Raspberry Pi, Beagle Bone Black, Other Notable Platforms.

**Importance of Sensors in IoT**- Example Sensors, Interfacing with Arduino, Programming.

**UNIT IV : Internet of Things Systems - Logical Design using Python**

Introduction, Motivation for using Python, Installing Python, Python Data Types & Data Structures, Control Flow, Functions, Modules, Packages, File Handling, Date/ Time Operations, Classes, Python Packages of Interest for IoT.

**UNIT V : IoT Physical Servers and cloud offerings**

Introduction to Cloud storage models and communication API, ThingSpeak, Thingworks, Microsoft Azure, Amazon AWS.

**Text Books:**

1. Vijay Madisetti and Arshdeep Bahga, "Internet of Things (A Hands-on-Approach)", 1st Edition, VPT, 2014.
2. Adrian McEwen, Hakim Cassimally, "Designing the Internet of Things" 1st Editionm John Wiley, 2014

**References:**

1. Francis daCosta, "Rethinking the Internet of Things: A Scalable Approach to Connecting Everything", 1st Edition, Apress Publications, 2013
2. Olivier Hersent, The Internet of Things: Key Applications and Protocols, 2nd Edition, Wiley publisher 2012.

**COURSE OUTCOMES :** Learners at the end of course will be able to

1. fine what is IOT, List the applications of IOT and what are design principles of IOT
2. Choose the platform for design and sensors required to interface to get the desired results
3. To program using python
4. Outline different protocols and enabling technologies for IOT
5. Compare and Contrast different Prototyping Embedded Devices and sensors
6. plain the cloud storage models for IOT
7. Apply the concepts learned to design the Realtime applications

| **Course Title** | | | | **INTERNET OF THINGS** | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Course Code** | | | | **A2CHT201** | | | | | | | | | | |
| **Course Designed by** | | | | **Department of Electronics and Communication Engineering** | | | | | | | | | | |
| CO/PO Mapping | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO10 | PO11 | PO12 | PSO 1 | PSO 2 |
| CO1 | 3 | | | | | | | | | | | | | |
| CO2 | 3 | | | | | | | | | | | | | |
| CO3 | 3 | 2 | 2 | | 2 | | | | | | | | | |
| CO4 | 3 | | | | | | | | | | | | | |
| CO5 | 3 | | | | | | | | | | | | | |
| CO6 | 3 | | | | 2 | | | | | | | | | |
| CO7 | 3 | 3 | 3 | | 3 | | | | | | 2 | 2 | 3 | 3 |

**Subject Code & Subject Name : A2CHT201 & Internet of Things**

| Course designed by | Department of Chemical Engineering |
|---|---|
| Approval | Approved by: Meeting of Board of Studies held on |
| | Ratified by: Meeting of Academic Council held on |

| A2CHT303 | SEMESTER - IV | L | T | P | C |
|---|---|---|---|---|---|
| | CHEMICAL PROCESS CALCULATIONS | 3 | 0 | 0 | 3 |
| | Total Contact Hours – 48 | | | | |

| COURSE OBJECTIVES | |
|---|---|
| 1 | To solve basic stoichiometric calculations |
| 2 | To evaluate the composition of gases at various temperatures and pressures |
| 3 | To understand about humidity and saturation |
| 4 | To acquaint with the material balance calculations performed in chemical operations |
| 5 | To acquaint with the energy balance calculations performed in chemical operations |
| 6 | To calculate the actual and theoretical flame temperature |
| 7 | To perform combustion calculations for solid, liquid and gaseous fuels |

**SYLLABUS**

**UNIT-I**

Stoichiometric relations, basis of calculations, methods of expressing composition of mixtures and solutions, Density and specific gravity, Baume and API gravity.
Behavior of ideal gases, kinetic theory of gases, applications of gas laws.

**UNIT-II**

Vapor pressure, liquefaction, vaporization, boiling point, effect of temperature on vapor pressure, Antoine equation, vapor pressure plots, estimation of critical properties, vapor pressure of miscible liquids and ideal solutions, Raoult's law.

**UNIT-III**

**Part-A:**

Humidity and saturation, relative and percentage saturation or dew point, Wet and dry bulb temperature, use of humidity charts for engineering calculations.

**Part B:**

Material balances, tie substance, yield, processes involving chemical reactions, material balance calculations involving drying, dissolution and crystallization, recycle, bypass and purge calculations.

**UNIT-IV**

Thermo physics: Energy, energy balances, heat capacity of gases, liquid and mixture solutions, Kopp's rule, Heat of fusion and heat of vaporization, Truton's rule, Kistyawkowsky equation for non-polar liquids, enthalpy and its evaluation.
Thermo chemistry: Calculation and applications of heat of reaction, combustion, formation and neutralization, Kirchoff's equation, Enthalpy concentration change, calculation of theoretical and actual flame temperature.

**UNIT-V**

Combustion calculations: Introduction, fuels, calorific value, coal, liquid fuels, gaseous fuels, air requirement and flue gases, combustion calculations, incomplete combustion, material and energy balances, thermal efficiency calculations.

**TEXT BOOK:**

1. Chemical Process principles, Part-1, Material and Energy balances by Hougen O.A, Watson K.M and Ragatz, R.A. 2nd edition.

**REFERENCES:**

1. Stoichiometry and process calculations K.V.Narayanan and Lakshmikutty, 1st edition.
2. Stoichiometry by Bhat and Vora, 4th edition.
3. Basic principles and calculations in Chemical Engineering by Himmelblau, 7th edition

**COURSE OUTCOMES:**

Student will be able to:

1. Solve basic stoichiometric calculations
2. Evaluate the composition of gases at various temperatures and pressures
3. Understand about humidity and saturation
4. Acquaint with the material balance calculations performed in chemical operations
5. Acquaint with the energy balance calculations performed in chemical operations
6. Calculate the actual and theoretical flame temperature
7. Perform combustion calculations for solid, liquid and gaseous fuels

| **A2CHT303** | PO | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | PSO1 | PSO2 |
| CO1 | 3 | 2 | 2 | | | | | | | | | 1 | 3 | 2 |
| CO2 | 3 | 2 | 2 | | | | | | | | | 1 | 3 | 2 |
| CO3 | 3 | 2 | 2 | | | | | | | | | 1 | 3 | 2 |
| CO4 | 3 | 2 | 2 | | | | | | | | | 1 | 3 | 2 |
| CO5 | 3 | 2 | 2 | | | | | | | | | 1 | 3 | 2 |
| CO6 | 3 | 2 | 2 | | | | | | | | | 1 | 3 | 2 |
| CO7 | 3 | 2 | 2 | | | | | | | | | 1 | 3 | 2 |

| **A2CHT303** | **CHEMICAL PROCESS CALCULATIONS** |
|---|---|
| Course designed by | Department of Chemical Engineering |
| Approval | Approved by: Meeting of Board of Studies held on 29th Jun, 2019 |
| | Ratified by: 2nd Meeting of Academic Council, 13th AUG, 2020 |

| A2CHT304 | SEMESTER - IV | L | T | P | C |
|---|---|---|---|---|---|
| | **MECHANICAL UNIT OPERATIONS** | 3 | 0 | 0 | 3 |
| | **Total Contact Hours – 48** | | | | |

| **COURSE OBJECTIVES** | |
|---|---|
| 1 | To enable the student to gain basic knowledge in particle characterization namely particle size, shape and specific surface. |
| 2 | To find out the power consumption in various size reduction equipment |
| 3 | To enable the student to learn the principles of size reduction and screening and concepts of filtration. |
| 4 | To understand the concept of classification and clarifications |
| 5 | To understand the concept of membrane separation techniques |
| 6 | To enable the student to understand the functioning of various prominent solid fluid operations related equipment. |
| 7 | To understand about electrostatic precipitators and floatation technoques |

**SYLLABUS**

**UNIT-I**

**Characterization of solid Particles,** properties of particulate masses, storage of solids, conveyors

**Size reduction:** Principles, criteria for comminution, characteristics of comminution, size reduction equipment-crushers, grinders, ultra fine grinders, cutting machines, Equipment operation, open circuit and closed circuit operations.

**UNIT II**

**Conventional Mechanical separations:** Screening, Industrial screening equipments, general factors in selecting and screening equipment, comparison of ideal and actual screens, material balance over a screen and screening efficiency and trammel

**Non-conventional mechanical separations**: Magnetic separations, electrostatic separation.Froth flotation. General description, flotation reagents, applications, flotation machines

**UNIT-III**

**Part-A**

**Filtration:** Cake filters, centrifugal filters, filter aids, clarifying filters, liquid clarification, and gas cleaning. Principles of cake filtration, Principles of clarification.

**Part-B**

**Types of membranes-**Ultra filtration, microfiltration, permeate flux for ultrafiltration, concentration polarization, partial rejection of solutes, Membrane fouling.

**UNIT-IV**

**Separations based on motion of particles through fluids:** Gravity sedimentation process: gravity classifiers, sorting classifiers, clarifiers and thickeners, Equipment for sedimentation, clarifier and thickener design.

**Centrifugal settling process:** Separations of solids from gases: Cyclones, Separations of solids from liquids: Hydro clones, principles of centrifugal sedimentation, centrifugal classifiers.

**UNIT-V**

**Agitation and mixing of liquids:** Agitation of liquids, circulation velocities, power consumption in agitated vessels, purpose of Agitation, types of impellers.

**Mixing of solids**: measures for mixer performance, Mixers for Non-cohesive solids, Mixers for cohesive solids, mixing index and mixing effectiveness

**TEXT BOOK:**

1. Unit Operations Of Chemical Engineering-Mc. Cabe Smith &Harriot (TMH)

**REFERENCES:**

1. Unit Operations-Brown (CBS Publishers & Distribution)
2. Mechanical Operations for Chemical Engineers-C.M. Narayanan, B.C. Bhattacharyya (Khanna Publishers)
3. Coulson & Richardson's Chemical Engineering Volume.2

**COURSE OUTCOMES:**

Student will be able to

1. Have knowledge on particle characterization and solids handling and mixing
2. Calculate the power consumption in various size reduction equipment
3. Learn size reduction of solids, screening and filtration.
4. Distinguish between classification and clarifications
5. Understand the concept of membrane separation techniques.
6. Understand about equipment's associated to solid fluid mechanical operations.
7. Learn about electrostatic precipitators and floatation techniques.

| | | PO | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | PSO1 | PSO2 |
| CO | CO1 | 3 | 1 | 2 | | | | 2 | | | | | 2 | | 2 |
| | CO2 | 3 | 1 | 2 | | | | 2 | | | | | 2 | | 2 |
| | CO3 | 3 | 1 | 2 | | | | 2 | | | | | 2 | | 2 |
| | CO4 | 3 | 1 | 2 | | | | 2 | | | | | 2 | | 2 |
| | CO5 | 3 | 1 | 2 | | | | 2 | | | | | 2 | | 2 |
| | CO6 | 3 | 1 | 2 | | | | 2 | | | | | 2 | | 2 |
| | CO7 | 3 | 1 | 2 | | | | 2 | | | | | 2 | | 2 |

| **A2CHT304 MECHANICAL UNIT OPERATIONS** | |
|---|---|
| Course designed by | Department of Chemical Engineering |
| Approval | Approved by: Meeting of Board of Studies held on 29th Jun, 2019 |
| | Ratified by: 2nd Meeting of Academic Council, 13th AUG, 2020 |

| A2CHT305 | SEMESTER - IV | L | T | P | C |
|---|---|---|---|---|---|
| | PROCESS HEAT TRANSFER | 3 | 0 | 0 | 3 |
| | **Total Contact Hours – 48** | | | | |

| COURSE OBJECTIVES | |
|---|---|
| 1 | Understand the nature of heat flow and phenomena of heat transfer processes. |
| 2 | Learn the principles of one dimensional steady and unsteady heat transfer by conduction and solve problems for a variety of geometries. |
| 3 | Learn the principles of heat transfer estimate heat transfer coefficients in laminar and turbulent flow conditions without phase change |
| 4 | Illustrate the heat transfer processes involved in boiling and condensation |
| 5 | Understand the process of radiation heat transfer between ideal, actual surfaces and enclosures |
| 6 | To inculcate the ability to design or predict the performance of heat exchangers |
| 7 | Outline the principles of evaporation and analyze the performance of evaporators |

**SYLLABUS**

**UNIT-I: Heat transfer by Conduction**

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

Heat transfer by conduction in solids: Fourier's law, thermal conductivity, steady state conduction in plane wall & composite wall, compound resistances in series, heat flow through a cylinder, spheres, variable thermal conductivity. Electrical analogy, critical radius of insulation. Equation for one-dimensional unsteady state heat conduction, Lumped heat capacity systems.

**UNIT II: Heat Transfer to Fluids without Phase change**

Regimes of heat transfer in fluids, thermal boundary layer, heat transfer by forced convection in laminar flow, heat transfer by forced convection in turbulent flow, analogy between transfer of momentum and heat, Reynolds and Colburn analogies. Natural convection from vertical shapes and horizontal planes. Dimensionless numbers in heat transfer and their significance.

**UNIT-III**

**Part-A: Heat transfer to fluids with phase change**

Heat transfer from condensing vapors; drop wise and film wise condensation, derivation and practical use of Nusselt equation, condensation of super-heated vapors. Heat transfer to boiling liquids; pool boiling of saturated liquid, maximum flux and critical temperature drop.

**Part B: Radiation Heat transfer**

Nature of thermal radiation, black body radiation, Laws of black body radiation, absorption of radiation by opaque solids, radiation between surfaces, radiation shields.

**UNIT-IV: Design of double pipe heat exchangers**

Double pipe heat exchanger, counter current and parallel current flows, overall heat transfer coefficient, fouling factors, logarithmic mean temperature difference (LMTD method), heat exchanger effectiveness (NTU method).

**UNIT-V: Heat-Exchange Equipment:** Shell & tube heat exchangers and types, LMTD correction factor in multi pass heat exchangers, choice of tube-side fluid, condensers, Reboilers, extended surface equipment.

**Evaporation:** Types of Evaporators, performance of tubular evaporators, area calculations for single effect evaporators. Multiple effect evaporators, methods of feeding.

**TEXT BOOK:**

1. W.L. McCabe, J. C. Smith & P. Harriot, Unit Operations of Chemical Engineering, 7th ed., McGraw-Hill, 2005
2. J. P.Holman, Heat Transfer, 10th ed., McGraw Hill, 2009
3. Y.V.C.Rao, Heat Transfer, University Press, 1st ed., 2002

**REFERENCES:**

1. B. K. Dutta, Heat Transfer Principles and Applications, 2nd ed., PHI, 2009
2. D.Q. Kern, Process Heat Transfer, 1st ed., McGraw-Hill Publications, 1950
3. N. Ozisik, Basic approach to Heat Transfer, 1st ed., McGraw-Hill, 1985
4. P. L. E. Sissom, Schaum's Outlines of Heat Transfer 2nd ed., McGraw-Hill publications, 2005

**Course Outcomes:**

**On completion of the course the students should be able to,**

1. Explain the basic modes and laws of heat transfer and solve steady state heat conduction problems in simple geometries
2. Evaluate heat transfer coefficients in forced and natural convective heat transfer
3. Illustrate the heat transfer processes involved in condensation and boiling
4. Apply the Nusselt theory to solve single-component laminar film condensation problems
5. Understand the laws of black body radiation and able to predict radiative heat transfer between black as well non-black surfaces
6. Design double pipe heat exchangers using LMTD and NTU methods
7. Illustrate the construction details for various types of heat exchangers and able to analyze the performance of evaporators

| **A2CHT305** | **PROCESS HEAT TRANSFER** | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Course designed by | Department of Chemical Engineering | | | | | | | | | | | | | |
| CO / PO mapping | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | PSO1 | PSO2 |
| CO1 | 2 | 2 | 1 | | | | | | | | | 1 | 1 | |
| CO2 | 2 | 2 | 2 | | | | | | | | | 1 | 1 | |
| CO3 | 2 | 2 | 1 | | | | | | | | | 1 | 1 | 1 |
| CO4 | 2 | 2 | 2 | | | | | | | | | 2 | 1 | |
| CO5 | 2 | 2 | 1 | | | | | | | | | 1 | 1 | |
| CO6 | 1 | 2 | 3 | 1 | | | | | | | | 3 | 2 | 2 |
| CO7 | 2 | 2 | 2 | 1 | | | | | | | | 3 | 1 | 2 |

| **A2CHT305** | **PROCESS HEAT TRANSFER** |
|---|---|
| Course designed by | Department of Chemical Engineering |
| Approval | Approved by: Meeting of Board of Studies held on 29th Jun, 2019 |
| | Ratified by: 2nd Meeting of Academic Council, 13th AUG, 2020 |

| A2CHL303 | SEMESTER - IV | L | T | P | C |
|---|---|---|---|---|---|
| | MECHANICAL UNIT OPERATIONS LAB | 0 | 0 | 3 | 1.5 |
| | Total Contact Hours – 45 | | | | |

| COURSE OBJECTIVES | |
|---|---|
| 1 | Understand sieve analysis of a given sample |
| 2 | Understand the mechanism of size reduction and energy consumption |
| 3 | Understand the capacity and efficiencies of various screens |
| 4 | Understand separation of solids from gases. |
| 5 | Understand the operation of filtration techniques |
| 6 | Understand the operation of froth floatation techniques |
| 7 | Understand the operation of sedimentation techniques |

## LIST OF EXPERIMENTS

1. Sieve analysis of a given sample using Rotap sieve shaker
2. To calculate the effectiveness of a given screen for different capacities.
3. To calculate the effectiveness of a different screen for same capacity.
4. To crush the coal in a Primary Jaw Crusher (Blake Jaw Crusher) and determination of average product size and energy consumption for crushing.
5. To determine power consumption required for crushing of a given quantity of material using Roll crusher and compare with the values obtained from crushing laws.
6. To compare open circuit and closed circuit grinding by using Ball mill also to compare energy requirements for crushing in both the cases.
7. Determine particle size from batch sedimentation tests
8. To determine the specific cake resistance and filter medium resistance of slurry in a plate and frame filter press.
9. To study the effect of inlet gas velocity and particle size on collecting efficiency of a cyclone separator.
10. To calculate the percentage recovery of coal from coal-sand mixture using froth floatation cell
11. Separation of coal mixture using sink and float method
12. To grind the coal in a attrition mill and determine the average product size and energy consumption for grinding.
13. To grind the coal in a hammer mill and determine the average product size and energy consumption for grinding.

**COURSE OUTCOMES:**

| After successful completion of this lab, the students will be able | |
|---|---|
| I | Calculate avg. particle size of a given sample. (Arithmetic mean diameter, Mass mean diameter, Volume mean diameter, Volume surface mean diameter, Surface area), Calculate effectiveness of a screen |
| II | Operate various size reduction mills and calculate energy requirements in these mills for a given size reduction ratio |
| III | To estimate the capacity and effectiveness of various screens |
| IV | To evaluate the collection efficiency of cyclone separator |
| V | Operate filter press calculate the resistances of medium and cake |
| VI | To determine percentage recovery of given feed using froth floatation |
| VII | To sorting out the various ores using sedimentation techniques |

**Mapping CO vs PO**

| | | PO | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | PSO1 | PSO2 |
| CO | CO1 | 3 | 2 | 2 | | | | 2 | | 3 | 2 | 1 | 2 | | 2 |
| | CO2 | 3 | 2 | 2 | | | | 2 | | 3 | 2 | 1 | 2 | | 2 |
| | CO3 | 3 | 2 | 2 | | | | 2 | | 3 | 2 | 1 | 2 | | 2 |
| | CO4 | 3 | 2 | 2 | | | | 2 | | 3 | 2 | 1 | 2 | | 2 |
| | CO5 | 3 | 2 | 2 | | | | 2 | | 3 | 2 | 1 | 2 | | 2 |
| | CO6 | 3 | 2 | 2 | | | | 2 | | 3 | 2 | 1 | 2 | | 2 |
| | CO7 | 3 | 2 | 2 | | | | 2 | | 3 | 2 | 1 | 2 | | 2 |

| **A2CHL303** | **MECHANICAL UNIT OPERATIONS LAB** |
|---|---|
| Course designed by | Department of Chemical Engineering |
| Approval | Approved by: Meeting of Board of Studies held on 29th Jun, 2019 |
| | Ratified by: 2nd Meeting of Academic Council, 13th AUG, 2020 |

| A2CHL304 | SEMESTER - IV | L | T | P | C |
|---|---|---|---|---|---|
| | PROCESS HEAT TRANSFER LAB | 0 | 0 | 3 | 1.5 |
| | **Total Contact Hours – 45** | | | | |

| **COURSE OBJECTIVES** | |
|---|---|
| 1 | To demonstrate the fundamentals of heat transfer by conduction, convection and radiation |
| 2 | To understand principles involving the estimation of overall heat transfer coefficients in natural and forced convection |
| 3 | To understand principles involving the estimation of efficiency of extended surfaces |
| 4 | To apply the concepts of heat transfer, fluid dynamics and thermodynamics to the design and operation of heat transfer experiments |
| 5 | To develop practical understanding of common heat transfer equipment |
| 6 | To develop skills in experimental design and troubleshooting |
| 7 | To develop skills in data collection, analysis and interpretation |

**List of Experiments**

1. Determination of total thermal resistance and thermal conductivity of composite wall
2. Determination of overall heat transfer coefficient of lagged pipe
3. Determination of thermal conductivity of insulating powder
4. Determination of Thermal Conductivity of given metal rod
5. Determination of heat transfer coefficient in unsteady state heat transfer
6. Determination of efficiency and effectiveness of pin-fin
7. Determination of critical radius of insulation of a lagged pipe
8. Determination of heat transfer coefficient in natural convection
9. Determination of forced convective heat transfer coefficient for air flowing through a pipe
10. Determination of critical heat flux point for pool boiling of water
11. Determination of Stefan–Boltzmann constant for a given test body with black body
12. Determination of emissivity of a given plate at various temperatures
13. Determination of effectiveness and overall heat transfer coefficient in double pipe heat exchanger
14. Heat transfer through helical coil
15. Heat transfer coefficient in drop wise & film type condensation (Demonstration).

**TEXT BOOK:**

1. W.L. McCabe, J. C. Smith & P. Harriot, Unit Operations of Chemical Engineering, 7th ed., McGraw-Hill, 2005
2. B. K. Dutta, Heat Transfer Principles and Applications, 2nd ed., PHI, 2009
3. J. P. Holman, Heat Transfer, 10th ed., McGraw Hill, 2009

**REFERENCES:**

1. Y.V.C. Rao, Heat Transfer, University Press, 1st ed., 2002
2. D.Q. Kern, Process Heat Transfer, 1st ed., McGraw-Hill Publications, 1950
3. Dr. D.S. Kumar, Heat & Mass transfer, S.K. Kataria & Sons, 2013

**Course Outcomes**

On completion of the lab the student should be able to,

1. Apply Fourier's law of heat conduction in finding out the thermal conductivity of a given material
2. Calculate critical insulation thickness for cylindrical surfaces
3. Compare the heat transfer coefficients and rate of heat transfer between natural and forced convection mechanism
4. Evaluate the efficiency of the pin fin in both natural and forced heat transfer operations
5. Apply Stefan–Boltzmann's law to find out Stefan - Boltzmann constant & unknown body emissivity
6. Identify different boiling regimes and evaluate the critical heat flux through pool boiling of water
7. Evaluate effectiveness of co-current and counter current heat exchanger

| **A2CHL304** | **PROCESS HEAT TRANSFER LAB** | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Course designed by | Department of Chemical Engineering | | | | | | | | | | | | | |
| CO / PO mapping | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | PSO1 | PSO2 |
| CO1 | 2 | 2 | | 1 | | | | | 1 | 2 | | | 1 | |
| CO2 | 2 | 2 | | 1 | | | | | 1 | 2 | | | 1 | |
| CO3 | 2 | 2 | | 1 | | | | | 1 | 2 | | | | |
| CO4 | 2 | 2 | | 1 | | | | | 1 | 2 | | 1 | 1 | |
| CO5 | 2 | 2 | | 1 | | | | | 1 | 2 | | | 1 | |
| CO6 | 1 | 2 | | 1 | | | | | 1 | 2 | | 1 | 1 | |
| CO7 | 2 | 2 | | 1 | | | | | 1 | 2 | | 2 | 1 | 2 |

| **A2CHL304** | **PROCESS HEAT TRANSFER LAB** |
|---|---|
| Course designed by | Department of Chemical Engineering |
| Approval | Approved by: Meeting of Board of Studies held on 29th Jun, 2019 |
| | Ratified by: 2nd Meeting of Academic Council, 13th AUG, 2020 |

| A2CHA701 | SEMESTER - IV | L | T | P | C |
|---|---|---|---|---|---|
| | ENVIRONMENTAL SCIENCE | 2 | 0 | 0 | 0 |
| | Total Contact Hours – 30 | | | | |

| COURSE OBJECTIVES | |
|---|---|
| 1. | To study about the scope and importance of multidisciplinary nature of environmental science. |
| 2. | To study about the natural resources and their importance for the sustenance of life and the need to conserve natural resources. |
| 3. | To study about the ecosystem and its function in the environment. |
| 4. | To study about the importance of biodiversity, the threats to biodiversity and conservation practices to protect the biodiversity. |
| 5. | To study about the various types of pollution, its impact and measures to control pollution. |
| 6. | To study about solid waste management techniques |
| 7. | To study about the sustainability nature of environment |

## ENVIRONMENTAL SCIENCE

**SYLLABUS:**

**UNIT – I:**

**Multidisciplinary nature of Environmental Studies:** Definition, Scope and Importance of Multidisciplinary nature of Environmental Studies, Climate change: Global warming, Acid rains, Ozone layer depletion

**UNIT – II:**

**Natural resources:**

Forest resources, deforestation, case studies –Water resources – Use and over utilization of surface and ground water –Floods, drought, conflicts over water, dams – benefits and problems, Mineral resources: Use and exploitation, environmental effects of mining, case studies. Food resources- World food problems, effects of modern agriculture, Land resources-land degradation, soil erosion and desertification, Energy resources: Growing energy needs, renewable and non-renewable energy sources.

**UNIT – III:**

**Part A:**

**Ecosystem:** Concept of an ecosystem**,** Classification, Structure of an Ecosystem: Producers, consumers and decomposers, different functions of an ecosystem.

**Part B:**

**Biodiversity**

Definition and types: genetic, species and ecosystem diversity, Values of biodiversity, Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity.

**UNIT – IV:**

**Environnemental Pollution :**

Definition, Cause, effects and control measures of Air pollution, Water pollution, Soil pollution, Marine pollution, Noise pollution, Nuclear hazards. Role of an individual in prevention of pollution.

**UNIT – V: Social issues and the environment:**

Sustainability, urban and energy related problems

Solid waste Management: Causes, effects and control measures of urban and industrial wastes,

**Text Books:**

1. Environmental Studies by Anubha Kaushik, 4th Edition
2. A Textbook of Environmental Studies by Shaashi Chawla, TMH, New Delhi
3. Environmental Studies by P.N. Palanisamy, P. Manikandan, A. Geetha, and K. Manjula Rani; Pearson Education, Chennai

**References:**

1. Text Book of Environmental Studies by Deeshita Dave & P. Udaya Bhaskar, Cengage Learning.
2. Environmental Studies by K.V.S.G. Murali Krishna, VGS Publishers, Vijayawada
3. Environmental Studies by Benny Joseph, Tata McGraw Hill Co, New Delhi

**Course Outcomes:**

Students will be able to:

1. Understand the scope and importance of multidisciplinary nature of environmental science.
2. Understand the natural resources and their importance for the sustenance of life and the need to conserve natural resources.
3. Understand ecosystem and its function in the environment,
4. Understand the importance of biodiversity, the threats to biodiversity and conservation practices to protect the biodiversity.
5. Understand the various types of pollution, its impact and measures to control pollution.
6. Understand solid waste management technologies.
7. Understand the sustainability nature of environment.

| **ENVIRONMENTAL SCIENCE** | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO / PO mapping | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | PSO1 | PSO2 |
| CO-1 | 2 | | | | | 1 | | | | | | | | |
| CO-2 | 1 | | | | | 2 | 2 | | | | | | | |
| CO-3 | 2 | | | | | 2 | 1 | | | | | | 1 | |
| CO-4 | 1 | | | | | 1 | | | | | | | | |
| CO-5 | 1 | 1 | | | | | 1 | | | | | | 1 | |
| CO-6 | 1 | | | | | 2 | 1 | | | | | | 1 | |
| CO-7 | 1 | 1 | | | | | | | | | | | 1 | |

| **A2CHA701** | **ENVIRONMENTAL SCIENCE** |
|---|---|
| Course designed by | Department of Chemical Engineering |
| Approval | Approved by: Meeting of Board of Studies held on 29th Jun, 2019 |
| | Ratified by: 2nd Meeting of Academic Council, 13th AUG, 2020 |

| A2CHT306 | V Semester | L | T | P | C |
|---|---|---|---|---|---|
| | **Chemical Engineering Thermodynamics** | **3** | **0** | **0** | **3** |
| | **Total Contact Hours – 48** | | | | |

| **COURSE OBJECTIVES** | |
|---|---|
| **The Students will be able to** | |
| 1 | Understand various thermodynamic properties and processes. |
| 2 | Know the difference between ideal and non-ideal gas |
| 3 | Differentiate the heat engine cycle and refrigeration cycles |
| 4 | Analyze Thermodynamic problems involving first and second laws |
| 5 | Bring out thermodynamic relationships among thermodynamic properties and be able to calculate changes in U, H, and S for ideal gases, and also for non-ideal gases through the use of residual properties. |
| 6 | alyze the performance of typical thermodynamic devices and units (turbine, pump, nozzles, compressor, heat engines, Heat pump, Refrigerator, etc) using thermodynamic principles. |
| 7 | Know PVT behavior of fluids |

**Syllabus**

**UNIT : I**

Scope of thermodynamics, Definition of system and surroundings,, control volume, state and path function, equilibrium, reversibility, energy, work and heat. Equilibrium, Phase rule and its applications.

Joule's experiment, internal energy, enthalpy, first law, energy balance for closed systems, mass and energy balance for open systems.

**UNIT : II**

PVT behaviour of fluids; Mathematical representation of PVT behaviour; Equations for adiabatic, isothermal, isobaric and isochoric process, Application of virial equations, Cubic equation of state, Theorem of corresponding states, generalized correlation for gases and liquids.

**UNIT: III**

**Part-A:** Statements of the second law of thermodynamics, heat engine and refrigerator, Carnot cycle and Carnot theorems, thermodynamic temperature scale, entropy and its calculation, second law of thermodynamics for a control volume, Entropy changes for an ideal gas. Third law of thermodynamics.

**Part-B:** Property relations for homogeneous phases, Maxwell relations, Enthalpy and entropy as a function of T&P, internal energy as a function of P, Internal energy as a function of T and V, Residual properties.

**UNIT: IV**

Duct flow of compressible fluids, Compression and expansion processes, steam power plant.

**UNIT: V**

Carnot Refrigeration, Vapor compression cycle, choice of Refrigerant, Absorption Refrigeration, heat pump, Liquefaction processes,

TEXT BOOKS:


1. Smith, J.M., Van Ness, H.C and Abbot M.M "Introduction to Chemical Engineering Thermodynamics ", McGraw Hill Publishers, VI edition, 2003
2. Narayanan, K.V. A Textbook of Chemical Engineering Thermodynamics Prentice Hall India, 2004

Reference :

1. Koretsky, M.D., Engineering and Chemical Thermodynamics, 2nd edition, John Wiley & Sons, 2004.
2. Richard Elliott,J. and Carl T.Lira, Introductory Chemical Engineering Thermodynamics, 2nd Edition, Prentice Hall, 2012.
3. Stanley Sandler, Chemical, Biochemical and Engineering Thermodynamics, 4th Edition, Wiley India Pvt Ltd, 2006.
4. Vidal,J., Thermodynamics: Applications in Chemical Engineering and the Petroleum Industry, Edition Technip, 2003.
5. Kyle, B.G., Chemical and Process Thermodynamics, 3rd Edition, PHI Learning, 2008.
6. Thomas E. Dauber, Chemical Engineering Thermodynamics, McGraw Hill, 1985.
7. Rao, Y.V.C., "Chemical Engineering Thermodynamics" Universities Press, 2005

Course Outcomes :

1. Use of 1st law for a flow and non-flow process.
2. Determination of property changes associated with a process
3. Determine the PVT behaviour of pure fluid
4. Able to calculate the efficiency of Carnot Engine and Coefficient of performance.
5. Able to explain the difference between Linde and Claude process of liquefaction.
6. Understand the significance of Virial equations of state.
7. Able to apply 2nd law to the physical and chemical process.

| **A2CHT306** | Chemical Engineering Thermodynamics | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Course designed by | Department of Chemical Engineering | | | | | | | | | | | | | |
| | PO | | | | | | | | | | | | | |
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | PSO1 | PSO2 |
| CO1 | 3 | 3 | | | | | | | | | | 2 | | 3 |
| CO2 | 3 | 3 | | | | | | | | | | 2 | | 3 |
| CO3 | 3 | 3 | | | | | | | | | | 2 | | 3 |
| CO4 | 3 | 3 | | | | | | | | | | 2 | | 3 |
| CO5 | 3 | 3 | | | | | | | | | | 2 | | 3 |
| CO6 | 3 | 3 | | | | | | | | | | 2 | | 3 |
| CO7 | 3 | 3 | | | | | | | | | | 2 | | 3 |

| **A2CHT306** | Chemical Engineering Thermodynamics |
|---|---|
| Course designed by | Department of Chemical Engineering |
| Approval | Approved by: Meeting of Board of Studies held on 30th Jul,2021 |

| A2CHT307 | V Semester | L | T | P | C |
|---|---|---|---|---|---|
| | CHEMICAL REACTION ENGINEERING-I | 3 | 0 | 0 | 3 |
| | Total Contact Hours – 48 | | | | |

| COURSE OBJECTIVES | |
|---|---|
| 1 | Provide knowledge of different types of reactions, reaction rate and its dependency on various parameters |
| 2 | Collect and analyse reaction rate data to derive rate expressions |
| 3 | Provide knowledge on different kinetic models to analyse the batch reactor data |
| 4 | Know characteristics of different types of ideal reactors and derive their design equations from mole balance |
| 5 | Compare various reactors and choose right kind of reactor for a single reaction |
| 6 | Provide knowledge of qualitative and quantitative product distribution in multiple Reactions |
| 7 | Derive performance equations of non-isothermal ideal reactors |

**SYLLABUS**

**UNIT- I: Kinetics of Homogeneous Reactions**

Classification of reactions, Rate equations of elementary and non-elementary reactions, variables affecting the rate of reaction, reaction rate constant, reaction order and molecularity, Elementary and non-elementary reactions; Concentration dependent term of rate equation, Temperature dependent term of rate equation, Comparison of theories with Arrhenius law.

**Unit-II: Interpretation of Batch reactor kinetic data**

Constant and variable volume reaction systems, integral and differential methods of kinetic analysis, half-lives, fractional life method – general procedure, irreversible unimolecular type first order, bimolecular type second order, and trimolecular type third order reactions, empirical reactions of nth order, zero-order reactions, overall order of irreversible reactions, Irreversible reactions in series and parallel, Analysis of total pressure data obtained in a constant-volume system, First and second order reversible reactions, reactions of shifting order,

**Unit-III: Ideal reactors and design for single reactions**

**Part-A:** Introduction to ideal reactors – Characteristics and performance equations of ideal batch reactor, Steady-state mixed flow reactor, Steady-state plug flow reactors.

**Part-B:** Design for single reactions - Size comparison of single reactors, multiple reactor systems, Recycle reactor, Autocatalytic reactions.

**Unit-IV: Design for multiple reactions**

Introduction to multiple reactions - Selectivity and Yield, qualitative discussion and quantitative treatment of product distribution and of reactor size for parallel reactions. Irreversible first order reactions in series, qualitative discussion and quantitative treatment of product distribution, quantitative treatment - plug flow or batch reactor, mixed flow reactor

.

**Unit-V: Temperature and pressure effects**

Non-isothermal operation of reactors: Optimum temperature progression; Adiabatic and non-adiabatic batch, mixed flow and plug flow reactors; exothermic reactions in mixed flow reactors;

**Text Books:**

1. O. Levenspiel, Chemical Reaction Engineering, 3rd ed. John Wiley & Sons, 2007.

**Reference Books:**

1. H. S. Fogler, Elements of Chemical Reaction Engineering, 4th ed., PHI, 2005.
2. K.G. Denbigh, J.C.R Turner, Chemical Reactor Theory: An introduction, Cambridge University Press, 3rd Ed.,1984
3. K. A.Gavhane, Chemical Reaction Engineering – I, Nirali Prakashan, 2004

**Course Outcomes:**
After the completion of the course will be able to

1. Classify various reaction types and understand fundamentals of kinetics including definitions of rate and forms of rate expressions
2. Analyze the experimental data obtained from batch reactors and determine the kinetics of homogeneous reactions of various types for both at constant volume and variable volume conditions.
3. Understand the characteristics of various ideal reactors
4. Design isothermal ideal reactors for homogeneous single reactions.
5. Compare the performance of various types of reactors including multiple reactor systems and recycle reactors and develop skills to choose right kind of reactor
6. Design suitable ideal reactors for carrying out multiple reactions both parallel and series
7. Analyze the effects of temperature and pressure on equilibrium constants and equilibrium conversions and predict the performance of non-isothermal reactors.

| **A2CHT307 CHEMICAL REACTION ENGINEERING-I** | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO / PO mapping | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PSO 1 | PSO 2 |
| CO-1 | 2 | 2 | 2 | | | 2 | 2 | | | | | 2 | | |
| CO-2 | 2 | 2 | 2 | 3 | | 2 | 2 | | | | | 2 | 2 | |
| CO-3 | 2 | 2 | 2 | | | 2 | 2 | | | | | 2 | | |
| CO-4 | 2 | 2 | 2 | | | 2 | 2 | | | | | 2 | 2 | 3 |
| CO-5 | 2 | 2 | 2 | 2 | | 2 | 2 | | | | | 2 | 2 | 2 |
| CO-6 | 2 | 2 | 3 | | | 2 | 2 | | | | | 3 | 2 | 2 |
| CO-7 | 2 | 2 | 2 | | | 2 | 2 | | | | | 3 | 2 | 3 |

| **A2CHT307 CHEMICAL REACTION ENGINEERING-I** | |
|---|---|
| Course designed by | Department of Chemical Engineering |
| Approval | Approved by: Meeting of Board of Studies held on 30th JUL,2021 |

| A2CHT308 | V Semester | L | T | P | C |
|---|---|---|---|---|---|
| | MASS TRANSFER - 1 | 3 | 0 | 0 | 3 |
| | Total Contact Hours – 48 | | | | |

| COURSE OBJECTIVES | |
|---|---|
| 1 | Give a basic understanding of engineering mathematics to solve mass transfer operation problems. |
| 2 | Evaluate the application of concepts of physical and chemical separation methodologies in mass transfer operations. |
| 3 | Determine the threshold limits of separation processes. |
| 4 | Understand the concept of molecular diffusion. |
| 5. | Distinguish the different theories of Mass Transfer. |
| 6. | Know the Interphase Mass Transfer. |
| 7. | Study the equipment's used for gas-liquid operations. |

**SYLLABUS**

**Unit-I: Molecular diffusion**

Introduction: Classification of Mass Transfer Operations, Methods of conducting the Mass Transfer Operations, Design Principles. Molecular diffusion: Fick's law, Molecular diffusion in gases, Molecular diffusion in liquids, Diffusion in solids, Fick's law for solids, Unsteady state diffusion, Types of solid diffusion.

**Unit-II: Mass Transfer Coefficients**

Mass transfer coefficients, Theories of Mass Transfer: Film Theory, Penetration Theory, Surface Renewal Theory, Combination of film-surface renewal theory, Surface stretch theory. Flow past solids: Boundary layers, Dimensionless groups in mass transfer, Mass and heat transfer analogies.

**Unit-III**

**Part-A : Interphase Mass Transfer**

Equilibrium, Diffusion between phases, Raoult's law, Henry's law, Mass transfer between two phases, Overall mass transfer coefficient, Material balances: Steady state concurrent processes, Steady state countercurrent processes, Stages, Cascades: Cross flow cascades, Countercurrent cascades.

**Part-B : Equipment for Gas-Liquid Operations**

Gas dispersed: Bubble columns, Mechanically Agitated vessels, Tray towers. Liquid dispersed: Venturi scrubbers, Wetted wall towers, Spray towers, Packed towers.

**Unit-IV: Gas absorption**

Equilibrium solubility of gases in liquids, Ideal liquid solutions, Selection of solvent, Co-current flow, Counter-current flow, Determination of the number of stages in a tray tower, Height equivalent to theoretical plate (HETP), Tray efficiency.

**Unit-V: Distillation**

Vapor-liquid equilibria, Relative volatility, Flash distillation, Simple distillation, Continuous rectification of binary mixtures, Condenser, Re-boiler, Enriching section, Exhausting section, McCabe-Thiele method, Ponchon Savarit method, Azeotropic distillation, Extractive distillation.

**TEXT BOOKS:**

1. Principles of Mass Transfer and Separation Processes by Binay K. Dutta, Prentice-Hall of India, 2006.

2. Mass Transfer Operations, R.E. Treybal, 3rd Edition., Mc Graw Hill, 1980

**REFERENCE BOOKS:**


1. Unit Operations of Chemical Engineering, W.L.Mc Cabe, J.C.Smith & Peter Harriott, McGraw- Hill, 6th Edition, 2001.
2. Transport Processes and Unit Operations **by Geankoplis**, C. J., 3rd Edition, Prentice-Hall International,1993.
3. Coulson and Richardson's Chemical engineering, Vol 1,Backhurst, J.R., Harker, Richardson, J.F., and Coulson, J.M., Butterworth-Heinemann, 1999
4. Coulson and Richardson's Chemical engineering, Vol 2, Richardson, J.F. & Harker, J.H. with Backhurst, J.R., Butterworth-Heinemann, 2002.


**COURSE OUTCOMES:**

Student will be able to

1. Apply knowledge of mathematics, physical and chemical sciences in solving mass transfer operations problems.
2. Understand an engineering system, component or process (absorption and distillation).
3. Determine the threshold limits of separation processes.
4. Know the concept of molecular diffusion.
5. Distinguish the different theories of Mass Transfer.
6. Learn the Interphase Mass Transfer.
7. Study the equipment's used for gas-liquid operations.

**CO/PO Mapping:**

| CO / PO mapping | | PO | | | | | | | | | | | | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | | |
| CO | 1 | 3 | 2 | 2 | | | | | | | | | 2 | 2 | 2 |
| | 2 | 3 | 2 | 2 | | | | | | | | | 2 | 2 | 2 |
| | 3 | 3 | 2 | 2 | | | | | | | | | 2 | 2 | 2 |
| | 4 | 3 | 2 | 2 | | | | | | | | | 2 | 2 | 2 |
| | 5 | 3 | 2 | 2 | | | | | | | | | 2 | 2 | 2 |
| | 6 | 3 | 2 | 2 | | | | | | | | | 2 | 2 | 2 |
| | 7 | 3 | 2 | 2 | | | | | | | | | 2 | 2 | 2 |

| **A2CHT308 MASS TRANSFER – 1** | |
|---|---|
| Course designed by | Department of Chemical Engineering |
| Approval | Approved by: Meeting of Board of Studies held on 30th JUL,2021 |

| A2CHT401 | V Semester Professional Elective-I | L | T | P | C |
|---|---|---|---|---|---|
| | NEW MATERIAL TECHNOLOGY | 3 | 0 | 0 | 3 |
| | Total Contact Hours – 48 | | | | |

| COURSE OBJECTIVES | |
|---|---|
| The student will be able to learn | |
| 1 | Understand the importance and classification of materials |
| 2 | Introduce various new materials |
| 3 | Know different properties of metals and polymers |
| 4 | Comprehend the theory of alloys and types of phase diagrams |
| 5 | Analyze the importance of heat treatment process in new material technology |
| 6 | Learn various modern metallic materials |
| 7 | Gain knowledge of various modern non- metallic materials |

**SYLLABUS**

**UNIT I INTRODUCTION TO MATERIALS**

**Classification of materials: Metallic materials, polymeric materials, ceramics introduction to new materilas: composites and Nano materials: General properties, applications with examples.**

**UNIT II PROPERTIES OF METALS AND POLYMERS**

Elasticity in metals and polymers, mechanism of plastic deformation, role of dislocations, yield stress, shear strength of perfect and real crystals, strengthening mechanism, work hardening, solid solution, grain boundary strengthening. Poly phase mixture, precipitation, particle, fiber and dispersion strengthening, effect of temperature, strength and strain rate of plastic behavior, super plasticity, deformation of non crystalline material

.

**UNIT III**

**Part-A: THEORY OF ALLOYS & ALLOYS DIAGRAMS**

Significance of alloying, Definition, Classification and properties of different types of alloys, Solidification of pure metal, Different types of phase diagrams (Isomorphous, Eutectic, Peritectic, Eutectoid, Peritectoid) and their analysis, Importance of Iron as engineering material, Allotropic forms of Iron, Influence of carbon in Iron- Carbon alloying Iron-Iron carbide diagram, Hastelloy and its applications.

**Part-B: HEAT TREATMENT PROCESS**

Technology of heat treatment, Classification of heat treatment process, Annealing- Principle process, properties and applications of full annealing, Diffusion annealing, process annealing and Cyclic annealing, Normalizing, Hardening heat treatment, Tempering, Subzero treatment,Surface hardening: Hardening and surface Hardening methods. Carburizing, Nitriding, Cyaniding, Carbonitriding, induction hardening and flame hardening processes.

**UNIT IV MODERN METALLIC MATERIALS**

Composites: Basic concepts of composites, Processing of composites, advantages over metallic materials, various types of composites and their applications Modern Metallic Materials: Dual Steels, Micro alloyed, High Strength Low alloy (HSLA) Steel, Transformation induced plasticity

(TRIP) Steel, Maraging Steel, Inter metallics, Ni and Ti Aluminides, Smart Materials, Shape Memory alloys, Metallic Glass Quasi Crystal and Nano Crystalline Materials.

**UNIT V MODERN NON-METALLIC MATERIALS**

Non-metallic Materials: Polymeric materials and their molecular structures, Production Techniques for Fibers, Foams, Adhesives and Coatings, structure, Properties and Applications of Engineering Polymers, Advanced Structural Ceramics WC, TiC, TaC, A12 O3, SiC, Si3 N4, CBN and Diamond – properties, Processing and applications.

**TEXTBOOKS**

1. Mechanical Behavior of Materials/Thomas H. Courtney/ McGraw Hill/2 nd Edition/2000
2. Mechanical Metallurgy/George E. Dicter/McGraw Hill, 1998.
3. Material Science and Engineering/Willsiam D Callister/John Wiley and Sons

**REFERENCES**

1. Selection and use of Engineering Materials 3e/Charles J.A/Butterworth Heiremann.
2. Engineering Materials Technology/James A Jacob Thomas F Kilduff/Pearson

**COURSE OUTCOMES:**

After the completion of the course will be able to

1. To identify importance of materials based on their classification
2. To identify various new materials
3. To characterize the materials based on their properties
4. To select heat treatment method for material technology
5. To explain theory of alloys and phase diagrams
6. To select various modern metallic materials
7. To select various modern non-metallic materials

| **A2CHT401** | **NEW MATERIAL TECHNOLOGY** | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO / PO mapping | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PSO 1 | PSO 2 |
| CO-1 | 3 | 2 | | | | | | | | | | | 2 | |
| CO-2 | 3 | 2 | | | | 2 | | | | | | | 2 | |
| CO-3 | 3 | 2 | 2 | | | 2 | | | | | | | 2 | |
| CO-4 | 3 | 2 | 3 | | 2 | 2 | | | | | | | 2 | 2 |
| CO-5 | 3 | 2 | | | | 2 | | | | | | | 2 | |
| CO-6 | 3 | 2 | 2 | 3 | 2 | 2 | | | | | | 2 | 2 | |
| CO-7 | 3 | 2 | 2 | 3 | 2 | 2 | | | | | | 2 | 2 | |

| A2CHT401 NEW MATERIAL TECHNOLOGY | | | | | | |
|---|---|---|---|---|---|---|
| Course designed by | Department of Chemical Engineering | | | | | |
| Approval | Approved by: Meeting of Board of Studies held on 30th JUL,2021 | | | | | |
| A2CHT402 | V Semester Professional Elective-I | | L | T | P | C |
| | FERTILIZER TECHNOLOGY | | 3 | 0 | 0 | 3 |
| | Total Contact Hours – 48 | | | | | |

**COURSE OBJECTIVES**

The student will be able to learn

| | |
|---|---|
| 1 | Understand the importance and sources of fertilizer production. |
| 2 | Know different methods available for Production of nitrogenous fertilizers |
| 3 | Study different methods available for Production of phosphatic fertilizers |
| 4 | Comprehend different methods available for Production of potassic fertilizers |
| 5 | Interpret different methods available for production of complex and NPK fertilizers |
| 6 | Analyze the process available for production of miscellaneous fertilizers. |
| 7 | Understand the environmental issues of fertilizer industries. |

**SYLLABUS**

**UNIT I OVERVIEW OF FERTILIZERS**

Synthetic fertilizers, Classification of fertilizers, Role of essential Elements in plant Growth, Macro elements and Micro elements, Application of fertilizers, Development of fertilizer industry; Fertilizer production and consumption in India; Nutrient contents of fertilizers; Secondary nutrients.

**UNIT II NITROGENOUS FERTILIZERS**

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

**UNIT III**

**Part-A: PHOSPHATIC FERTILIZERS**

Raw materials; phosphate rock, sulphur; pyrites etc., processes for the production of sulphuric and phosphoric acids; phosphates fertilizers - ground rock phosphate; bone meal**,** Single superphosphate, triple uperphosphate, triple superphosphate, thermal phosphates and their methods of production, characteristics and specifications.

**Part-B: POTASSIC FERTILIZERS**

Methods of production of potassium chloride, potassium schoenite, their characteristics and specifications.

**UNIT IV COMPLEX AND NPK FERTILIZERS**

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

**UNIT V MISCELLANEOUS FERTILIZERS**

Mixed fertilizers and granulated mixtures; biofertilisers, nutrients, secondary nutrients and micro nutrients; fluid fertilizers, controlled release fertilizers, Environmental issues on fertilizer industries with a case study.

**TEXTBOOKS**

1. “Handbook of fertilizer technology”, Association of India, New Delhi, 1977.
2. Menno, M.G.; “Fertilizer Industry - An Introductory Survey”, Higginbothams Pvt. Ltd., 1973.72

3. “Production of Fertilizers(Booklets 1 to 8)”, European Fertilizer Manufacturers’ Association.

**REFERENCES**

1. Sauchelli, V.; “The Chemistry and Technology of Fertilizers”, ACS MONOGRAPH 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.
4. Pollution Prevention and Abatement Handbook”, The world Bank Group

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

1. Use reactions and unit operations steps in manufacturing of various fertilizers
2. Characterize fertilizers on the basis of different properties.
3. Identify selective method for manufacturing process
4. Identify engineering problems in fertilizer manufacturing.
5. Identify suitable fertilizers for selective applications.
6. Select appropriate mixed fertilizer.
7. Identify other forms of fertilizers and method of production

| **A2CHT402** | **FERTILIZER TECHNOLOGY** | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO / PO mapping | PO 1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO 11 | PO 12 | PS O1 | PS O2 |
| CO-1 | 3 | 3 | 2 | | | | | | | | | | 2 | 2 |
| CO-2 | 2 | 2 | 2 | | | | | | | | | | | 2 |
| CO-3 | 3 | 2 | 2 | | | | | | | | | | 2 | 2 |
| CO-4 | 3 | 3 | 3 | 3 | 3 | | | | | | 2 | | 2 | 2 |
| CO-5 | 2 | 2 | | | | 2 | 2 | | | | 2 | | | 2 |
| CO-6 | 2 | 2 | | 2 | 3 | 2 | 2 | | | | 2 | | 2 | 2 |
| CO-7 | 2 | 2 | | 2 | 2 | 2 | 2 | | | | 2 | 2 | 2 | 2 |

| **CHT402 FERTILIZER TECHNOLOGY** | |
|---|---|
| Course designed by | Department of Chemical Engineering |
| Approval | Approved by: Meeting of Board of Studies held on 30th JUL,2021 |

| A1CHT403 | V Semester Professional Elective-I | L | T | P | C |
|---|---|---|---|---|---|
| | **POLYMER TECHNOLOGY** | 3 | 0 | 0 | 3 |
| | **Total Contact Hours – 48** | | | | |

| **COURSE OBJECTIVES** | |
|---|---|
| 1 | Learn Basic fundamentals of polymer technology and classification of polymers |
| 2 | Explain different methods of polymerization and comparison between them |
| 3 | Understand kinetics of addition polymerization |
| 4 | Understand different properties of polymers |
| 5 | Find the effect of additives in polymers. |
| 6 | Explain manufacture of few typical polymers |
| 7 | Identify appropriate polymer processing methods |

**SYLLABUS**

**Unit I:**
Introduction; definitions: polymer& macro molecule, monomer, functionality, average functionality, co-polymer, polymer blend., plastic and resin. Classification of polymers: based on
source, structure, applications, thermal behavior, mode of polymerization. Concept of average molecular weight of polymers, molecular weight distribution, poly disparity index.

**Unit II:**
Natural polymers: brief study of i) Natural rubber ii) shellac iii) rosin iv) cellulose v) proteins.
Mechanism and kinetics of: Addition or chain polymerization
a) Free radical addition polymerization b) Ionic addition polymerizations c) Coordination polymerization d) Coordination or step growth or condensation polymerization.

**Unit III:**
**Part-A:** Methods of polymerization: mass or bulk polymerization process, solution polymerization process, suspension polymerization process and emulsion polymerization method comparison of merits and demerits of these methods.
**Part-B:** Properties of polymers: crystalline and amorphous status, melting and glass transition temperatures and their determination, effect of polymer structure on mechanical, physical, chemical and thermal properties.

**Unit IV:**
Role of the following additives in the polymers: i) Fillers and reinforcing fillers ii) Plasticizers iii) Lubricants iv) Antioxidants and UV stabilizers v) Blowing agents vi) Coupling agents vii) Flame retardants viii) Inhibitors

**Unit V:**
Brief description of manufacture, properties and uses of: i) Polyethylene (HDPE&LDPE) ii) Polypropylene iii) Polyvinylchloride iv) Polystyrene v) Polyesters (Polyethylene terephthalate)
Brief description of: i) Compression and transfer moulding ii) Injection moulding iii) Extrusion iv) Blow moulding v) Calendaring vi) Laminating and pultrusion

**TEXT BOOKS:**
1. Plastic materials, J.A. Brydson, Newnes-Butterwarths (London) 1989.
2. Text book of polymer science, Bill meyer, F.W.Jr. (3rd ed.) John Wiely&sons 1984

**REFERENCES:**
1. Introduction to plastics, J.H. Brison and C.C. Gosselin, Newnes, London 1968.

2. Polymeric Materials, C.C.Winding and G.D.Hiatt Mc Graw Hill Book Co. 1961 3. Polymer Science by Gowarikar

**COURSE OUTCOMES:**

After the completion of the course students will be able to

1. Summarize the polymer classification and mechanism
2. Know the different methods of polymerization
3. Find kinetics of addition polymerization
4. Find glass transition temperature, phase diagrams and crystallinity of polymers.
5. Explain the role of additives like antioxidants, plasticizers, lubricants, stabilizers, inhibitors in polymers
6. Describe the manufacture of few typical polymers like Polyethylene, Polypropylene and Polyvinylchloride
7. Understand different polymer processing methods like Moulding, extrusion, calendaring

| **A1CHT403** | **POLYMER TECHNOLOGY** | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Course designed by | Department of Chemical Engineering | | | | | | | | | | | | | |
| CO / PO mapping | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | PSO1 | PSO2 |
| CO1 | 2 | | | | | 2 | 2 | | | | | | 2 | |
| CO2 | 2 | | | | | 2 | 2 | | | | | | 2 | |
| CO3 | 2 | | | | | 2 | 2 | | | | | | 2 | |
| CO4 | 2 | | | | | 2 | 2 | | | | | | 2 | |
| CO5 | 2 | | | | | 2 | 2 | | | | | 2 | 2 | |
| CO6 | 2 | | | | | 2 | 2 | | | | | 2 | 2 | |
| CO7 | 2 | | | | | 2 | 2 | | | | | 2 | 2 | |

| **A1CHT403 POLYMER TECHNOLOGY** | |
|---|---|
| Course designed by | Department of Chemical Engineering |
| Approval | Approved by: Meeting of Board of Studies held on 30th JUL,2021 |

| A2CHT501 | V Semester Open Elective-II | L | T | P | C |
|---|---|---|---|---|---|
| | **COMPUTATIONAL FLUID DYNAMICS** | 3 | 0 | 0 | 3 |
| | **Total Contact Hours – 48** | | | | |

| **COURSE OBJECTIVES** | |
|---|---|
| 1 | Introduce finite element and finite volume methods and governing equations for fluid flow and heat transfer. |
| 2 | Show unsteady state heat conduction problems in Cartesian, cylindrical and spherical coordinate systems along with necessary boundary conditions and their solution using implicit and explicit methods |
| 3 | Impart discretizing the equations using Finite difference and volume formulation and their solution using different techniques |
| 4 | Explain pressure velocity coupling algorithms |
| 5 | Analyze fluid flow problems using Navier-Stokes equation |
| 6 | Solution methods of elliptical, parabolic and hyperbolic partial differential equations in fluid mechanics |
| 7 | Treatment of compressible 2D and 3D fluid flow problems |

**Syllabus**

**UNIT I**

Introduction – Finite difference methods- finite element method – finite volume method- Treatment of boundary conditions- Governing differential equations. Finite difference methods – Taylor's series – Errors associated with FDE- FDE formulation for steady state heat transfer problems.

**UNIT II**

Cartesian, cylindrical and spherical coordinate systems- boundary conditions- Un steady state heat conduction Explicit Method – Stability criteria – Implicit Method – Crank Nickolson method – 2-D FDE formulation ADI- ADE. Finite volume method – Generalized differential equation, Basic rules for control volume approach, Source term linearization, boundary conditions. Un-steady state one, two, three dimensional heat conduction.

**UNIT III**

**Part-A:** Convection and diffusion, different methods i.e., upwind scheme, Exponential scheme, Hybrid scheme, power law scheme, calculation of flow field, staggered grid method, pressure and velocity corrections, SIMPLE Algorithms & SIMPLER (revised algorithm).

**Part-B:** Solution methods of elliptical, parabolic and hyperbolic partial differential equations in fluid mechanics – Burgers equation.

**UNIT IV**

Formulations for incompressible viscous flows – vortex methods –pressure correction methods.

**UNIT V**

Treatment of compressible flows- potential equation, Navier – Stokes equation – flow field dependent variation methods, boundary conditions. Linear fluid flow problems, 2D and 3D fluid flow problems.

**TEXT BOOKS:**

1. Numerical heat transfer and fluid flow (Hemisphere Series on Computational Methods in Mechanics and Thermal Science), Suhas Patankar, 1st ed., CRC Press, 1980.
2. Computational Fluid Dynamics, T.J. Chung, Cambridge University Press, 2nd ed., 2010.

**REFERENCES:**

1. Text Book of Fluid Dynamics, Frank Chorlton, CBS Publishers, 2004.

2. Tannehill, J.E., Anderson, D.A., and Pletcher, R.H., Computational Fluid Mechanics and Heat Transfer, 2nd ed., Taylor & Francis, 1997.
3. Hoffmann, K.A. and Chiang, S.T., Computational Fluid Dynamics for Engineers, Engineering Education Systems, 2000.
4. Andeson J.D., Computational Fluid Dynamics – The basics with applications, Mc Graw-Hill, 1995.
5. Versteeg, H.K. and Malalasekera, W., An Introduction to Computational Fluid Dynamics – The finite volume method, Longman Scientific & Technical, 1995.
6. Patankar, S.V., Numerical Heat Transfer & Fluid Flow, Hemisphere, 1980

**COURSE OUTCOMES:**

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

1 Discretize the equations using Finite difference and volume formulation
2 Derive governing equations of fluid flow and heat transfer.
3 Solve the discretized equations using different techniques and Explain grid generation techniques
4 Apply pressure velocity coupling algorithms
5 Simplify Navier-Stokes equation to a given flow problem along with boundary conditions.
6 Solve partial differential equations in incompressible fluid problems
7 Understand the behaviour of compressible 2D and 3D fluid flow problems

| **A2CHT501 COMPUTATIONAL FLUID DYNAMICS** | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO / PO mapping | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PSO 1 | PSO 2 |
| CO-1 | 3 | 3 | 3 | | | | | | | | | | 2 | |
| CO-2 | 3 | 3 | 3 | | | | | | | | | | 2 | |
| CO-3 | 3 | 3 | 3 | | | | | | | | | | 2 | |
| CO-4 | 3 | 3 | 3 | | | | | | | | | | 2 | |
| CO-5 | 3 | 3 | 3 | | | | | | | | | | 2 | |
| CO-6 | 3 | 3 | 3 | | | | | | | | | | 2 | |
| CO-7 | 3 | 3 | 3 | | | | | | | | | | 2 | |

| **A2CHT501 COMPUTATIONAL FLUID DYNAMICS** | |
|---|---|
| Course designed by | Department of Chemical Engineering |
| Approval | Approved by: Meeting of Board of Studies held on 30th JUL,2021 |

| A2CHT502 | V Semester OPEN ELECTIVE-II | L | T | P | C |
|---|---|---|---|---|---|
| | **NON-CONVENTIONAL SOURCES OF ENERGY** | **3** | **0** | **0** | **3** |
| | Total Contact Hours – 48 | | | | |

| **COURSE OBJECTIVES** | |
|---|---|
| 1 | Review the sources, principles of renewable energy and its implications |
| 2 | Understand photovoltaic conversion of solar energy and its applications. |
| 3 | Demonstrate the factors influencing wind energy conversion devices. |
| 4 | Impart knowledge on the biomass conversion and conversion of biomass to energy. |
| 5 | Discuss the thermodynamics, production, storage and transportation of hydrogen. |
| 6 | Learn fuel cell construction and applications. |
| 7 | Gain knowledge of other energy conversion systems like Geothermal energy, tidal energy, ocean energy, wave energy and hydro energy. |

**SYLLABUS:**

**UNIT I**

Principles of renewable energy: Energy & Sustainable development, fundamentals, scientific principles of renewable energy, technical implication, social implication, various renewable energy resources.

**UNIT II**

**SOLAR ENERGY**

Solar radiation its measurements and prediction - solar thermal flat plate collectors concentrating collectors – applications - heating, cooling, desalination, power generation, drying, cooking etc - principle of photovoltaic conversion of solar energy, types of solar cells and fabrication. Photovoltaic applications: domestic lighting, street lighting, water pumping, power generation schemes.

**UNIT III**

**Part- A: WIND ENERGY**

Wind Energy: Atmospheric circulations – classification - factors influencing wind and wind energy systems- wind energy conversion devices - classification, characteristics, applications.

**UNIT III**

**Part- B: BIO-ENERGY**

Biomass resources and their classification - chemical constituents and physicochemical characteristics of biomass - Biomass conversion processes - Thermo chemical conversion: direct combustion, gasification, pyrolysis and liquefaction - biochemical conversion: anaerobic digestion, alcohol production from biomass - chemical conversion process: hydrolysis and hydrogenation. Biogas - generation - types of biogas Plants- applications. Waste to energy conversion: waste synthetic fuel production and waste Remediation.

**UNIT IV**

**HYDROGEN AND FUEL CELLS:** Basic design, types, and applications - production methods - Biophotolysis: Hydrogen generation from algae biological pathways - Storage gaseous, cryogenic and metal hydride and transportation. Fuel cell – principle of working- types - construction and applications.

**UNIT V**

**OTHER TYPES OF ENERGY :** Ocean energy resources - principles of ocean thermal energy conversion systems - ocean thermal power plants - principles of ocean wave energy conversion and tidal energy conversion – hydropower – site selection, construction, environmental issues - geothermal energy - types of geothermal energy sites, site selection.

**COURSE OUTCOMES:**

1. Understand the role of non-conversional Energy in sustainable development
2. Demonstrate photovoltaic conversion of solar energy and applications.
3. Discuss the classification, characteristics and applications of wind energy conversion devices
4. Explain the biochemical conversion and biomass chemical conversion processes.
5. Appraise hydrogen generation by Bio photolysis and its storage and transportation.
6. Analyze the construction, working and applications of fuel cells.
7. Explain the principles of ocean thermal energy, ocean wave energy conversion system, tidal energy conversion and geothermal power plants.

**TEXT BOOKS:**


1. Twidell, J.W. and Weir, A., Renewable Energy Sources, 3rd Ed. T&F Ltd., 2015
2. Sukhatme, S.P., Solar Energy, Tata McGraw Hill, 1984.


**REFERENCES:**


1. Kreith, F and Kreider, J. F., Principles of Solar Engineering, McGraw-Hill, 1978.
2. Godfrey Boyle, Renewable Energy, Power for a Sustainable Future, 3rd ed., Oxford University Press, U.K, 2012.
3. Veziroglu, T.N., Alternative Energy Sources, Vol 5 and 6, McGraw-Hill, 1990
4. Anthony San Pietro, Biochemical and Photosynthetic aspects of Energy Production, Academic Press, 1980.
5. Bridgurater, A.V., Thermochemical processing of Biomass, Academic Press, 1981.
6. Hart, A.B., and Womack, G. J., Fuel Cells: Theory & Applications, Prentice Hall, 1997.


| **A2CHT502 NON-CONVENTIONAL SOURCES OF ENERGY** | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO / PO mapping | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PSO 1 | PSO 2 |
| CO-1 | 3 | 2 | 2 | 3 | 2 | 2 | 2 | | | | 2 | 2 | 2 | |
| CO-2 | 3 | 2 | 2 | 2 | 2 | | | | | | 2 | | | 2 |
| CO-3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | | | | 2 | 2 | | 3 |
| CO-4 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | | | | 2 | | | 2 |
| CO-5 | 2 | 2 | 2 | | 2 | 2 | 2 | | | | 2 | | | 2 |
| CO-6 | 2 | 2 | 2 | 2 | | | 2 | | | | 2 | | | 2 |
| CO-7 | 2 | 2 | 2 | | 2 | | 2 | | | | 2 | | | 3 |

| **A2CHT502 NON-CONVENTIONAL SOURCES OF ENERGY** | |
|---|---|
| Course designed by | Department of Chemical Engineering |
| Approval | Approved by: Meeting of Board of Studies held on 30th JUL,2021 |

| A2CHT503 | V Semester OPEN ELECTIVE-II | L | T | P | C |
|---|---|---|---|---|---|
| | **Design and Analysis of Experiments** | 3 | 0 | 0 | 3 |
| | **Total Contact Hours – 48** | | | | |

| **COURSE OBJECTIVES** | |
|---|---|
| 1 | To explain different probability distributions along with parameters. |
| 2 | To teach the application of analysis of variance technique with a given confidence interval. |
| 3 | To prepare matrix versions of normal equations. |
| 4 | To convey empirical and mechanistic model building processes |
| 5 | To emphasize model testing with diagnostic parameters and its importance in model building process. |
| 6 | To introduce the factors affecting a given experiment and identifying the most significant factor for an experiment. |
| 7 | To explain calculation of the factor levels that optimize the outcome of an experiment. |

**Syllabus**

**UNIT- I**

Introduction to probability, probability laws, Baye's theorem, .Probability distributions, parameters and statistics. Normal and t-distributions, central limit theorem, random sampling and declaration of independence significance tests

**UNIT- II**

Randomization and blocking with paired comparisons significance tests and confidence interval for means, variances, proportions and frequencies.

**UNIT-III**

**Part –A:** Analysis of variance, experiments to compare k-treatment means,

**Part- B:** Two-way factorial designs, blocking, Yate's algorithm

**UNIT- IV**

Fractional factorial designs at two levels, concept of design resolution, Simple modeling with least squares (regression analysis), Matrix versions of normal equations

**UNIT- V**

Mechanistic model building, Empirical and mechanistic models, model building process, model testing with diagnostic parameters.

**Text Book:**

1. Statistics for experimenters by G.E.P. Box, William G. Hunter and J.S. Hunter, John Wiley & Sons, 2nd ed., Wiley-Interscience, 2005.

**Reference**: 1. "Design and analysis of experiments" by D.C. Montgomery, 2nd edition John Wiley and sons, NewYork (1984).

**Course outcomes:**

1. Identify different probability distributions along with parameters.
2. Predict how many numbers of experiments are to be carried out, given the number of important factors.

3. Determination of mean, variance , proportions and frequencies
4. Formulate matrix versions of normal equations.
5. Compare and contrast empirical and mechanistic model building processes.
6. Illustrate model testing with diagnostic parameters and its importance in model building process.
7. Application of factorial design techniques

| **A2CHT503 Design and Analysis of Experiments** | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO / PO mapping | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PSO 1 | PSO 2 |
| CO-1 | 2 | 2 | 2 | | | 2 | | | | | | 1 | 2 | |
| CO-2 | 2 | 2 | 2 | | | 2 | | | | | | 2 | 2 | |
| CO-3 | 2 | 2 | 2 | | | 2 | | | | | | 1 | 2 | |
| CO-4 | 2 | 2 | 2 | | | 2 | | | | | | 1 | 2 | |
| CO-5 | 2 | 2 | 2 | | | 2 | | | | | | 2 | 2 | |
| CO-6 | 2 | 2 | 2 | | | 2 | | | | | | 1 | 2 | |
| CO-7 | 2 | 2 | 2 | | | 2 | | | | | | 2 | 2 | |

| **A2CHT503 Design and Analysis of Experiments** | |
|---|---|
| Course designed by | Department of Chemical Engineering |
| Approval | Approved by: Meeting of Board of Studies held on 30$^{th}$ JUL,2021 |

| A2CHT504 | V Semester Open Elective-II<br>INDUSTRIAL WASTE WATER ENGINEERING | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |
| | **Total Contact Hours – 48 HRS** | | | | |

| COURSE OBJECTIVES | |
|---|---|
| 1 | Enables the student to distinguish between the quality of domestic and industrial water requirements and wastewater quantity generation. |
| 2 | Impart knowledge on selection of treatment methods for industrial wastes water. |
| 3 | Know the common methods of treatment in different industries. |
| 4 | Acquire knowledge on operational problems of common effluent treatment plant |
| 5 | Know the Use of Municipal wastewater in Industries |
| 6 | Impart wastewater disposal management |
| 7 | Know wastewater sampling and preservation of samples for analysis |

**SYLLABUS**

**UNIT – I : Industrial water Quantity and Quality requirements:** Boiler and cooling waters– Process water for Textiles, Food processing, Brewery Industries, power plants, fertilizers, sugar mills.

**UNIT – II : Miscellaneous Treatment:** Use of Municipal wastewater in Industries – Advanced water treatment – Adsorption, Reverse Osmosis, Ion Exchange, Ultra filtration, Freezing, elutriation, Removal of Iron and Manganese, Removal of Colour and Odour.

**UNIT – III :**

**Part-A: Basic theories of Industrial Wastewater Management:** Industrial waste survey – Measurement of industrial wastewater Flow-generation rates – Industrial wastewater sampling and preservation of samples for analysis –

**Part- B:** Wastewater characterization-Toxicity of industrial effluents-Treatment of wastewater-unit operations and processes-Volume and Strength reduction – Neutralization – Equalization and proportioning- recycling, reuse and resources recovery.

**UNIT – IV : Industrial wastewater disposal management:** discharges into Streams, Lakes and oceans and associated problems, Land treatment – Common Effluent Treatment Plants: advantages and suitability, Limitations and challenges- Recirculation of Industrial Wastes- Effluent Disposal Method.

**UNIT – V: Process and Treatment of specific Industries-1:** Manufacturing Process and origin, characteristics, effects and treatment methods of liquid waste from Steel plants, Fertilizers, Textiles, Paper and Pulp industries, Oil Refineries, Coal and Gas based Power Plants.

**Text book**


1. Wastewater Treatment by M.N. Rao and A.K. Dutta, Oxford & IBH, New Delhi.
2. Industrial Wastewater Treatment by KVSG Murali Krishna.
3. Industrial Wastewater treatment by A.D. Patwardhan, PHI Learning, Delhi.

4. Wastewater Treatment for Pollution Control and Reuse, by Soli. J Arceivala, Shyam R Asolekar, Mc-Graw Hill, New Delhi; 3rd Edition.

**References**


1. Industrial Water Pollution Control by W. Wesley Eckenfelder, Mc- GrawHill, Third Edition
2. Wastewater Engineering by Metcalf and Eddy Inc., Tata McGrawhill Co., New Delhi
3. Wastewater Treatment- Concepts and Design Approach by G.L. Karia & R.A. Christian, Prentice Hall of India.
4. Unit Operations and Processes in Environmental Engineering by Reynolds. Richard, Cengage Learning.


**Course outcomes: Course Outcome: By the end of the course, Students will be able to**

1. Identify the water requirements and wastewater quantity generation
2. classify the selection of treatment methods for industrial wasteswater
3. apply the various common methods of treatment in different industries
4. Demonstrate the operational problems of common effluent treatment
5. Apply the Use of Municipal wastewater in Industries
6. Identify to apply the wastewater disposal management
7. Describe the wastewater sampling and preservation of samples for analysis

| **A2CHT507** | **INDUSTRIAL WASTE WATER ENGINEERING** | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO / PO mapping | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PSO 1 | PSO 2 |
| CO-1 | 2 | | | | | | 1 | 1 | | 1 | | 1 | 2 | |
| CO-2 | 2 | | | | | | 1 | 1 | | 2 | | 1 | 2 | |
| CO-3 | 2 | | | | | | 2 | 1 | | 1 | | 1 | 2 | |
| CO-4 | 2 | | | | | | 1 | 1 | | 1 | | 2 | 2 | |
| CO-5 | 2 | | | | | | 1 | 1 | | 2 | | 1 | 2 | |
| CO-6 | 2 | | | | | | 2 | 1 | | 1 | | 1 | 2 | |
| CO-7 | 2 | | | | | | 1 | 1 | | 1 | | 1 | 2 | |

| **A2CHT504** | **INDUSTRIAL WASTE WATER ENGINEERING** |
|---|---|
| Course designed by | Department of Chemical Engineering |
| Approval | Approved by: Meeting of Board of Studies held on 30th JUL,2021 |

| | | | | | |
|---|---|---|---|---|---|
| **A2CHT505** | **V Semester Open ELECTIVE-II** | **L** | **T** | **P** | **C** |
| | **GREEN CHEMISTRY & TECHNOLOGY** | 3 | 0 | 0 | 3 |
| | **Total Contact Hours – 48** | | | | |

| **S.NO** | **COURSE OBJECTIVES.. student will able to know the concepts of** |
|---|---|
| 1. | Global Environmental Issues, |
| 2. | Concepts Behind Pollution Prevention, |
| 3. | Environmental Risks, |
| 4. | Green Chemistry, |
| 5. | Methods To Evaluate Environmental Costs |
| 6. | Life Cycle Assessments. |
| 7. | Process Energy Integration |

**SYLLABUS**

**UNIT I**

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 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**

**Part-A:** 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.

**Part-B:** 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**

Process Energy Integration. Process Mass Integration. Case Study using a Process Flow sheet-Estimation of Environmental Fates of Emissions and Wastes.

**UNIT V**

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.

**TEXTBOOKS:**

1. Allen, D.T., Shonnard, D.R, Green Engineering: Environmentally Conscious Design of Chemical Processes. Prentice Hall PTR 2002.
2. Mukesh Doble and Anil Kumar Kruthiventi, Green Chemistry and Engineering, Elsevier, Burlington, USA, 2007.

**REFERENCE BOOKS:**

1. **Long Zhang**, **Changsheng Gong**, **Dai Bin**, Green Chemistry and Technologies, De Gruyter publishers , 1st edition, 2018

**Course Outcomes:**

1. Identify global environmental issues
2. classify the concepts behind pollution prevention
3. apply the various environmental risks
4. Demonstrate the green chemistry
5. Apply the methods to evaluate environmental costs
6. Identify to apply the life cycle assessments
7. Describe Process energy integration

| A1CHT505 GREEN CHEMISTRY & TECHNOLOGY | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO / PO mapping | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
| CO-1 | 3 | | | 1 | | 1 | 2 | 1 | | | | 2 | 3 | |
| CO-2 | 3 | | | 2 | | 1 | 2 | | | 1 | | 2 | 3 | |
| CO-3 | 3 | | | 1 | | 1 | 1 | 1 | | 1 | | 2 | 3 | |
| CO-4 | 3 | | | 2 | | 2 | 1 | 1 | | | | 2 | 3 | |
| CO-5 | 3 | | | 1 | | 1 | 1 | 1 | | 1 | | 2 | 3 | |
| CO-6 | 3 | | | 1 | | 1 | 1 | | | 1 | | 2 | 3 | |
| CO-7 | 3 | | | 1 | | 1 | 1 | | | 1 | | 2 | 3 | |

| A1CHT505 GREEN CHEMISTRY & TECHNOLOGY | |
|---|---|
| Course designed by | Department of Chemical Engineering |
| Approval | Approved by: Meeting of Board of Studies held on 30th JUL,2021 |

| A2CHT506 | V Semester OPEN ELECTIVE-II | L | T | P | C |
|---|---|---|---|---|---|
| | **AIR POLLUTION CONTROL AND DESIGN OF EQUIPMENT** | 3 | 0 | 0 | 3 |
| | **Total Contact Hours – 48** | | | | |

| | **COURSE OBJECTIVES** |
|---|---|
| 1 | Aware the fundamentals of air pollution with a background on historical perspective and To elucidate on types of air pollutants; their sources and effects (environmental, economic and health), ambient air and stack sampling of air pollutants and their analysis |
| 2 | Identify the meteorological aspects of air pollution and the dispersion of air pollution in the atmosphere using Gaussian plume model |
| 3 | Study ambient air and stack sampling of air pollutants and their analysis |
| 4 | Predict the use of air pollution control equipment and their design aspects to guide the selection of equipment for particulate pollutants like dust, smog etc. |
| 5 | Identify the use of air pollution control equipment and their design aspects to guide the selection of equipment for major gaseous pollutants |
| 6 | Aware the knowledge of air pollution legislation and role of citizens in air pollution control |
| 7 | Analyze environmental impacts of air pollution through case studies. |

**SYLLABUS**

**UNIT-I**

Sources, nature and type of pollutants, emission factors, meteorological factors in pollution, plume behavior and characteristics, chill index, equivalent ambient temperature, chimney design considerations, plume rise, effective stack height, element of air pollution modeling, acid rain problem

**UNIT II**

Health effects of pollution, effect of plants, animals and materials, problems of air pollution in India, global problems, air pollution measurements, Ringleman's chart.

**UNIT-III**

**Part- A:** Air pollution technology-I: Sampling and analysis of particulate matter, atmospheric sampling and stack sampling methods,

**UNIT-III**

**Part- B:** Types of particulate pollution control methods- principles and design of settling chambers, solid traps, cyclone separators, fabric filters and fiber filters, scrubbers and electro-static precipitators

**UNIT-IV**

Air pollution technology-II: Sampling and analysis of gaseous pollutants, General methods of control and removal of sulfur-dioxide, oxides of nitrogen and organic vapors from gaseous effluents,

**UNIT-V**

Air pollution legislation, role of citizens in air pollution control; Case Studies :Madhura refinery and its impact on Taj Mahal, Bhopal gas tragedy, Chernobyl disaster and HPCL Visakha refinery.

**TEXT BOOK:**

1. Environmental pollution control Engineering, C.S. Rao, Wiley Eastern Limited, India, 1993

**REFERENCES:**

1. 'Design of Pollution Control Equipment' by Gregory Sincero and Adam Sincero, Prentice Hall, 1995.
2. 'Air Pollution' by H.V.N. Rao, Mc Graw Hill Publications, 1st ed., 2017.

**Course Outcomes:**

1. Identify the nature, origin and impact of air pollution
2. identify influence of meteorological parameters and their impact on air pollutants
3. Demonstrate the ambient/stack sampling for analysis of particulate matter and gaseous pollutants
4. Judge the plume behaviour using Gaussian plume model.
5. Design air pollution equipment such as settling chambers, solid traps, cyclone separators, fabric filters, scrubbers and electro-static precipitators.
6. Apply air pollution control techniques to remove $SO_X$,$NO_X$ and organic vapors from gaseous effluents.
7. Apply air pollution control strategies to few case studies in order to avoid such incidents in future

| **A2CHT506** | **AIR POLLUTION CONTROL AND DESIGN OF EQUIPMENT** | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO / PO mapping | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PSO 1 | PSO 2 |
| CO-1 | 2 | | | | | 2 | 2 | 2 | | | | | | |
| CO-2 | 2 | 3 | | | | 2 | 2 | 2 | | | | | | |
| CO-3 | 2 | 3 | 2 | | | 2 | 2 | 2 | | | | | | |
| CO-4 | 2 | 3 | 2 | 2 | 2 | 2 | 2 | 2 | | | | | | |
| CO-5 | 2 | 2 | 3 | 2 | 2 | 2 | 2 | 2 | | | 2 | | 2 | 2 |
| CO-6 | 2 | 3 | | | | 2 | 2 | 2 | | | 2 | 2 | 2 | 3 |
| CO-7 | 2 | 2 | | | | 2 | 2 | 2 | | | | 2 | | |

| **A2CHT506** | **AIR POLLUTION CONTROL AND DESIGN OF EQUIPMENT** |
|---|---|
| Course designed by | Department of Chemical Engineering |
| Approval | Approved by: Meeting of Board of Studies held on 30th JUL,2021 |

| A1CHL305 | V Semester | L | T | P | C |
|---|---|---|---|---|---|
| | **CHEMICAL REACTION ENGINEERING LABORATORY** | 0 | 0 | 3 | 1.5 |
| | **Total Contact Hours – 45** | | | | |

| **COURSE OBJECTIVES** | |
|---|---|
| 1 | ovide knowledge of different types of reactions, reaction rate and its dependency on various parameters |
| 2 | llect and analyse reaction rate data to derive rate expressions |
| 3 | Know characteristics of different types of ideal reactors |
| 4 | Provide a core foundation for the analysis and design of chemical reactor equipment practically and understand the effects of non-deal flow |
| 5 | Compare various reactors and choose right kind of reactor for a single reaction |
| 6 | Study mass transfer phenomena with chemical reaction |
| 7 | Develop skills in experimental design and troubleshooting |

**LIST OF EXPERIMENTS**

1. Determination of the order of a reaction using a batch reactor and analyzing the data by (a) differential method (b) integral method.
2. To determine the specific reaction rate constant of a reaction of a known order using a CSTR.
3. To determine the order of the reaction and the rate constant using a tubular reactor.
4. To study the effect of temperature on the reaction rate constant and to determine the activation energy of a reaction using
   (a) Batch reactor
   (b) CSTR
   (c) Plug flow reactor
5. To study the effect of residence time on conversion in a CSTR for a given reaction
6. To study the effect of residence time on conversion in a tubular reactor for a given reaction
7. To study the performance characteristics of combined flow reactors connected in series (PFR-MFR) and to determine the best reactor setup for a given reaction.
8. Determination of RTD and dispersion number for a packed-bed using tracer
9. Determination of RTD and dispersion number in a tubular reactor using a tracer.
10. Mass transfer with chemical reaction (solid-liquid system) – determination of mass transfer coefficient.
11. Mass transfer with chemical reaction (liquid-liquid system) – determination of mass transfer coefficient

**Text Books:**

1. O. Levenspiel, Chemical Reaction Engineering, 3rd ed. John Wiley & Sons, 2007.

**Reference Books:**

1. H. S. Fogler, Elements of Chemical Reaction Engineering, 4th ed., PHI, 2005.
2. K.G. Denbigh, J.C.R Turner, Chemical Reactor Theory: An introduction, Cambridge University Press, 3rd Ed.,1984

**COURSE OUTCOMES:**

On completion of the course, the students will be able to:

1. Estimate reaction rate constant by applying Arrhenius theorem
2. Analyse the concentration versus time data and determine the specific rate constant and the order of the reaction.
3. Design and sizing of industrial scale reactor on the basis of kinetic data obtained at lab scale
4. Determine RTD and model parameters in a PFR, Packed bed reactors.
5. Compare theoretical and experimental conversions in a CSTR and PFR and choose right kind of reactor for a single reaction
6. Compute mass transfer coefficients in mass transfer with chemical Reactions
7. Operate lab equipment like CSTR, Batch, PFR reactors.

**Mapping of PO's & CO's (PROGRAM OUTCOMES & COURSE OUTCOMES)**

| **A1CHL305** | **CHEMICAL REACTION ENGINEERING LAB** | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Course designed by | Department of Chemical Engineering | | | | | | | | | | | | | |
| CO / PO mapping | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | PSO1 | PSO2 |
| CO1 | 2 | 1 | | 1 | | | | | 2 | 2 | | | 2 | |
| CO2 | 2 | 1 | | 2 | | | | | 2 | 2 | | 2 | 2 | |
| CO3 | 3 | 3 | 2 | 1 | | | | | 2 | 2 | | 2 | | 3 |
| CO4 | 2 | 2 | | 1 | | | | | 2 | 2 | | 3 | 2 | |
| CO5 | 2 | 2 | 1 | 2 | | | | | 2 | 2 | | 1 | 2 | 3 |
| CO6 | 1 | 2 | | 1 | | | | | 2 | 2 | | | 2 | |
| CO7 | 2 | 2 | | | | | | | 2 | 2 | | 3 | 2 | 1 |

| **A1CHL305 CHEMICAL REACTION ENGINEERING LAB** | |
|---|---|
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| Approval | Approved by: Meeting of Board of Studies held on 30$^{th}$ JUL,2021 |

| A2CHL306 | V Semester | L | T | P | C |
|---|---|---|---|---|---|
| | **MASS TRANSFER LAB** | 0 | 0 | 3 | 1.5 |
| | **Total Contact Hours – 45** | | | | |

| **COURSE OBJECTIVES** | |
|---|---|
| 1 | Understand various mass transfer operations (leaching, liquid-liquid extraction, humidification, drying, distillation and adsorption) and their principles. |
| 2 | Understand the concept of equilibrium in various mass transfer operations. |
| 3 | Understand the influence of various parameters like temperature, concentration, flow rate, time, etc. on different mass transfer operations. |
| 4 | Evaluate Mass transfer coefficient for gas-liquid systems. |
| 5 | Understand the Hydrodynamics in a Packed Bed Column. |
| 6 | Understand the Solubility characteristics of a Ternary liquid system. |
| 7 | Become familiar with separation equipment in lab scale, useful in design of industrial mass transfer equipment. |

**List of Experiments**

1. Estimation of Diffusion coefficient of vapors of organic liquid in air
2. Evaluation of Mass Transfer Coefficient using Surface Evaporation
3. Studies on Solid Dissolution
4. Studies on Simple/Differential Distillation
5. Studies on Batch Adsorption
6. Studies on Hydrodynamics in a Packed Bed Column
7. Studies of Drying characteristics of Wet solids
8. Studies on Solubility characteristics of a Ternary liquid system
9. Studies on Batch Extraction
10. Studies on Batch Leaching
11. Studies on Vapor Liquid Equilibrium
12. Evaluation of Mass transfer coefficient using Wetted wall column

**TEXT BOOKS:**


1. Principles of Mass Transfer and separation processes by Binay K. Dutta
2. Mass transfer Operations, R.E. Treybal, 3rd Edition., Mc Graw Hill, 1980


**REFERENCE BOOKS:**


1. Unit Operations of Chemical Engineering, W.L.Mc Cabe, J.C.Smith & Peter Harriott, McGraw- Hill, 6th Edition, 2001.


COURSE OUTCOMES

Students will be able to:

1. Design and conduct experiments related to mass transfer in distillation, leaching, liquid-liquid extraction, humidification, drying and adsorption.
2. Analyze and interpret data related to above mass transfer operations.
3. Evaluate Mass transfer coefficient for gas-liquid systems.
4. Understand the Hydrodynamics in a Packed Bed Column.
5. Understand the Solubility characteristics of a Ternary liquid system.

6. Understand various industrial applications of above mass transfer operations.
7. Select an appropriate mass transfer operation for a given application.

| **A2CHL306** | **MASS TRANSFER LAB** | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
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| CO / PO mapping | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | PSO1 | PSO2 |
| CO1 | 2 | 2 | 2 | 2 | | | | | 2 | | | | | 2 |
| CO2 | 2 | 2 | 2 | 2 | | | | | 2 | 2 | | | | 2 |
| CO3 | 2 | 2 | 2 | 2 | | | | | | | | | | 2 |
| CO4 | 2 | 2 | 2 | 2 | | | | | | | | | | 2 |
| CO5 | 2 | 2 | 2 | 2 | | | | | | | | | | 2 |
| CO6 | 2 | 2 | 2 | 2 | | | | | | | | | | 2 |
| CO7 | 2 | 2 | 2 | 2 | | | | | | | | | | 2 |

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