

GOVERNMENT OF ANDHRA PRADESH



**STATE BOARD OF TECHNICAL EDUCATION AND TRAINING**  
**Andhra Pradesh :: Amaravathi**



Globally Competitive  
**CURRICULUM (C-16)**  
For Polytechnic Diploma Courses  
In Andhra Pradesh



**DIPLOMA IN**  
**CHEMICAL ENGINEERING**

Front Cover Page

## Objective of the New Curriculum (C-16)

To make the students 'Globally Competitive & Employable' by learning industry relevant subjects & undergoing Industrial training



Suggestions from Industrialists have been incorporated in the Curriculum by organising Industry Institute Interaction Meet.

## Highlights of the Curriculum (C-16)



- ❖ 6 months /1 year industrial training in all the Diploma Courses.
- ❖ 1 year industrial training in collaboration with BOAT (Board of Apprenticeship & Training (SR), Chennai).
- ❖ Virtual labs for ECE & Computer Branches & Strengthening of Skill Development Centers to provide industrial training to students.

Fundamentals of 'Internet of Things' (IoT) is included for all the Branches in the Subject "Industrial Management & Smart Technologies".



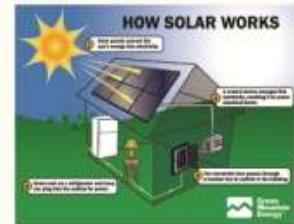
"Communication Skills" and "Life Skills" have been introduced as practical subjects for all the Branches.





“Computer Fundamentals Laboratory” is introduced for all the Branches in First year. AutoCAD specific to the Branch has been given emphasis in the Curriculum.

C Language, Programmable Logic Controllers (PLC), Microcontrollers, Solar Energy are introduced in Electrical Engineering Branch.



Mobile Communications, Consumer Electronics are introduced in Electronics and Communication Branch

CAD/ CAM, CNC Machines, Power Plant Engineering are introduced in Mechanical Engineering Branch.



OOPS through JAVA, Web Designing, Computer Hardware & Networking are introduced in Computer Engineering Branch.

Automobile Chassis and Body Engineering, Recent Trends In Automobile Engineering, Motor Transport Organization etc are introduced in Automobile Engineering Branch.



# Journal (JPAP)

The Department of  
Technical Education,  
A.P. has a bi- annual  
'Journal of Polytechnics  
of Andhra Pradesh'  
JPAP



**JOURNAL OF  
POLYTECHNICS IN ANDHRA PRADESH**  
Volume - 1, Issue - 1, Jan - Jun, 2017

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## CISCO ACADEMIES IN POLYTECHNICS

- ◆ 70 Government Polytechnics chosen to have Cisco Academies
- ◆ Course Content of CISCO has been incorporated into the ECE and Computer Diploma Courses
- ◆ CISCO to train Staff of Polytechnics in two phases to enable them to run the courses effectively
- ◆ Students to get 'Certificate from CISCO' along with Diploma Certificate.

**CURRICULUM-2016**  
**(C-16)**

**DIPLOMA IN CHEMICAL ENGINEERING**

**State Board of Technical Education & Training**  
**Andhra Pradesh**  
**HYDERABAD**

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**CURRICULUM-2016**  
**( C-16 )**  
**FOR DIPLOMA COURSES IN ANDHRA PRADESH**

**PREAMBLE**

The State Board of Technical Education and Training, Andhra Pradesh under the aegis of the Department of Technical Education, Andhra Pradesh generally reviews the Curricula once in every five years. However, recognizing the needs of the industries and enhancing the employability skills of Polytechnic students, the Government of Andhra Pradesh constituted a committee vide G.O.Rt.No:95 of Higher Education (TE) Dept dated: 29-4-2016 and G.O.Rt.No:98 of Higher Education (TE) Dept dated: 4-5-2016 for updation of polytechnic curriculum under the chairmanship of Sri. S. Balasubrahmanyam, IAS (Retd.,). The committee submitted a report on 31-5-2016 making certain recommendations and suggesting new initiatives to be incorporated in the curriculum. An Industry Institute Interaction Meet was organized with Industry experts and subject experts on 26-12-2016 and the suggestions from Industrialists have also been incorporated in the curriculum. The new Curricula for the different diploma courses have been designed with the active participation of the members of the faculty teaching in the Polytechnics of Andhra Pradesh, besides reviewed by Expert Committee constituted with eminent academicians.

The primary objective of the curricular change is to produce best technicians in the country by correlating growing needs of the industries with the academic input.

The revised New Curriculum i.e., Curriculum–2016 (C-16) is approved by BoG of SBTET for its implementation with effect from 2016-17.

**Salient Features:**

1. Duration of course is either 3 years / 3½ years duration of Regular Academic Instruction.
2. The Curriculum is prepared in Semester Pattern. However, First Year is maintained as Year-wise pattern.
3. 6 Months/ 1 year Industrial Training is introduced for all the Diploma courses.
4. Fundamentals of Internet of Things (IOT) is introduced for all the Diploma courses in the subject.
5. Modern subjects relevant to the industry are introduced in all the Diploma courses.
6. CISCO course content has been incorporated into the ECE and CME courses to get certification from CISCO along with Diploma.



7. The policy decisions taken at the State and Central level with regard to environmental science are implemented by including relevant topics in Chemistry. This is also in accordance with the Supreme Court guidelines issued in Sri Mehta's case.
8. Keeping in view the increased need of communication skills which is playing a major role in the success of Diploma Level students in the Industries, emphasis is given for learning and acquiring listening, speaking, reading and writing skills in English. Further as emphasized in the meetings, Communication Skills lab and Life Skills lab are introduced for all the branches.
9. Modern topics relevant to the needs of the industry and global scenario suitable to be taught at Diploma level are also incorporated in the curriculum.
10. AutoCAD specific to the branch has been given more emphasis in the curriculum. Preparing drawings using CAD software has been given more importance.
11. Every student is exposed to the computer lab at the 1st year itself in order to familiarize himself with skills required for keyboard/mouse operation, internet usage and e-mailing.
12. Upon reviewing the existing C-14 curriculum, it is found that the theory content is found to have more weightage than the Practical content. In the revised C-16 curriculum, more emphasis is given to the practical content of Laboratories and Workshops, thus strengthening the practical skills.
13. With increased emphasis for the student to acquire Practical skills, the course content in all the subjects is thoroughly reviewed and structured as outcome based than the conventional procedure based.
14. Curricula of Laboratory and Workshops have been thoroughly revised based on the suggestions received from the industry and faculty, for better utilization of the equipment available at the Polytechnics. The experiments /exercises that are chosen for the practical sessions are identified to conform to the field requirements of industry.
15. The Members of the working group are grateful to Sri G.S. Panda Das, I.A.S., Special Commissioner of Technical Education & Chairman of SBTET, AP. and Sri. Adityanath Das, I.A.S., Principal Secretary of Higher Education for their guidance and valuable inputs in revising, modifying and updating the curriculum.
16. The Members acknowledge with thanks the cooperation and guidance provided by Sri. A.Nirmal Kumar Priya, Secretary, SBTET, Andhra Pradesh and other officials of Directorate of Technical Education and the State Board of Technical Education, Andhra Pradesh, experts from industry, academia from the universities and higher learning institutions and all teaching fraternity from the Polytechnics who are directly or indirectly involved in preparation of the curricula.

## **RULES AND REGULATIONS**

### **1 DURATION AND PATTERN OF THE COURSES**

All the Diploma programs run at various institutions are of AICTE approved 3 years or 3½ years duration of academic instruction.

All the Diploma courses are run on year wise pattern in the first year, and the remaining two or two & half years are run in the semester pattern. In respect of few courses like Diploma in BM course, the training will be in the seventh semester. Run-through system is adopted for all the Diploma Courses, subject to eligibility conditions.

## **2 PROCEDURE FOR ADMISSION INTO THE DIPLOMA COURSES:**

Selection of candidates is governed by the Rules and regulations laid down in this regard from time to time.

- a) Candidates who wish to seek admission in any of the Diploma courses will have to appear for Common Entrance Test for admissions into Polytechnics (POLYCET) conducted by the State Board of Technical Education and Training, Andhra Pradesh, Vijayawada.

Only the candidates satisfying the following requirements will be eligible to appear for the Common Entrance Test for admissions into Polytechnics (POLYCET).

- b) The candidates seeking admission should have appeared for S.S.C examination, conducted by the Board of Secondary Education, Andhra Pradesh or equivalent examination thereto, at the time of making application to the Common Entrance Test for admissions into Polytechnics (POLYCET). In case of candidates whose results of their Qualifying Examinations is pending, their selection shall be subject to production of proof of their passing the qualifying examination in one attempt or compartmentally at the time of admission
- c) Admissions are made based on the merit obtained in the Common Entrance Test (POLYCET) and the reservation rules stipulated by the Government of Andhra Pradesh from time to time.
- d) For admission into the following Diploma Courses for which entry qualification is 10+2, candidates need not appear for POLYCET. A separate notification will be issued for admission into these courses.  
1). D.H.M.C.T. 2).D. Pharmacy

## **3 MEDIUM OF INSTRUCTION**

The medium of instruction and examination shall be English.

## **4 PERMANENT IDENTIFICATION NUMBER (PIN)**

A cumulative / academic record is to be maintained of the Marks secured in sessional work and end examination of each year for determining the eligibility for promotion etc., A Permanent Identification Number (PIN) will be allotted to each admitted candidate to maintain academic records.

## **5 NUMBER OF WORKING DAYS PER SEMESTER / YEAR:**

- a). The Academic year for all the Courses shall be in accordance with the Academic Calendar.
- b). The Working days in a week shall be from Monday to Saturday
- c). There shall be 7 periods of 50 minutes duration on all working days.
- d). The minimum number of working days for each semester / year shall be 90 / 180 days excluding examination days. If this prescribed minimum is not achieved due to any reason, special arrangements shall be made to conduct classes to cover the syllabus.

## **6 ELIGIBILITY OF ATTENDANCE TO APPEAR FOR THE END EXAMINATION**

- a). A candidate shall be permitted to appear for the end examination in all subjects, if he or she has attended a minimum of 75% of working days during the year/Semester.
- b). Condonation of shortage of attendance in aggregate upto 10% (65% and above and below 75%) in each semester or 1<sup>st</sup> year may be granted on medical grounds.
- c). A stipulated fee shall be payable towards condonation for shortage of attendance.
- d). Candidates having less than 65% attendance shall be detained.
- e). Students whose shortage of attendance is not condoned in any semester / 1st year and not paid the condonation fee in time are not eligible to take their end examination of that class and their admissions shall stand cancelled. They may seek re-admission for that semester / 1<sup>st</sup> year when offered next.

## 7 READMISSION

Readmission shall be granted to eligible candidates by the respective Principal/ Regional Joint Director.

1. a) Within 15 days after commencement of class work in any semester (Except Industrial Training).
- b) For Industrial Training: before commencement of the Industrial training.
2. Within 30 days after commencement of class works in any year (including D. Pharmacy course or first year course in Engineering and Non Engineering Diploma streams).

Otherwise such cases shall not be considered for readmission for that semester / year and are advised to seek readmission in the next subsequent eligible academic year.

The percentage of attendance of the readmitted candidates shall be calculated from the first day of beginning of the regular class work for that year / Semester, as officially announced by CTE/SBTET but not from the day on which he/she has actually reported to the class work, after readmission is granted.

## 8 SCHEME OF EXAMINATION

### a) First Year

**THEORY EXAMINATION:** Each Subject carries 80% marks with examination of 3 hours duration, along with 20% marks for internal evaluation. (Sessional marks). However, there are no minimum marks prescribed for sessionals.

**PRACTICAL EXAMINATION:** There shall be 40% Marks for regular practical work done, i.e. sessional marks for each practical subject with an end examination of 3 hours duration carrying 60% marks. However, there are no minimum marks prescribed for sessionals.

### b) III, IV, V, VI and VII Semesters:

**THEORY EXAMINATION:** Each subject carries usually 80 marks and 30 marks in respect of specified subjects of 3hours duration, along with 20 marks for internal evaluation (sessional marks) respectively.

**PRACTICAL EXAMINATION:** Each subject carry 60/30 marks of 3hours duration 40/20 sessional marks.

**9 INTERNAL ASSESSMENT SCHEME**

- a) Theory Subjects: Theory Subjects carry 20% sessional marks, Internal examinations will be conducted for awarding sessional marks on the dates specified. **Three unit tests will be conducted for I year students and two Unit Tests for semesters.** Average of marks obtained in all the prescribed tests will be considered for awarding the sessional marks.
- b) Practical Subjects: Student’s performance in Laboratories / Workshop shall be assessed during the year/ semester of study for 40% marks in each practical subject. Allotment of marks should be discrete taking into consideration of the students’ skills, accuracy, recording and performance of the task assigned to him / her. Each student has to write a record / log book for assessment purpose. In the subject of Drawing, which is also considered as a practical paper, the same rules hold good. Drawing exercises are to be filed in seriatum.
- c) Internal assessment in Labs / workshops / Survey field work etc., during the course of study shall be done and sessional marks shall be awarded by the concerned Lecturer / Senior Lecturer / Workshop superintendent as the case may be.
- d) For practical examinations, except in drawing, there shall be two examiners. External examiner shall be appointed by the Principal in consultation with respective Head of Section preferably choosing a qualified person from any local Industry/ nearby Government Polytechnic/ Local Government Organization. Internal examiner shall be the person concerned with internal assessment as in (c) above. The end examination shall be held along with all theory papers in respect of drawing.
- e) Question Paper for Practicals: Question paper should cover all the experiments / exercise prescribed.
- f) Records pertaining to internal assessment marks of both theory and practical subjects are to be maintained for official inspection.
- g) **In case of Diploma courses *having Industrial Training***, the training assessment shall be done and the marks are to be awarded in the following manner.

|                                   |   |                                 |
|-----------------------------------|---|---------------------------------|
| Industrial assessment marks each) | : | 200 marks (in two spells of 100 |
| Maintenance of log book           | : | 30 marks                        |
| Record Work                       | : | 30 marks                        |
| Seminar / viva-voce               | : | 40 marks                        |
|                                   |   | -----                           |
| TOTAL                             | : | 300 marks                       |
|                                   |   | -----                           |

The assessment at the institution level (Seminar/Viva-voce) shall be done by three members, viz., Internal Faculty member, External Examiner and Head of Section and be averaged.

**10 MINIMUM PASS MARKS  
THEORY EXAMINATION:**

For passing a theory subject, a candidate has to secure a minimum of 35% in end examination and a combined minimum of 35% of both Sessional and end examination marks put together.

**PRACTICAL EXAMINATION:**

For passing a practical subject, a candidate has to secure a minimum of 50% in end examination and a combined minimum of 50% of both sessional and practical end examination marks put together. In case of D.C.C.P., the pass mark for typewriting and short hand is 45% in the end examination. There are no sessional marks for typewriting and Shorthand subjects of D.C.C.P course.

**11. PROVISION FOR IMPROVEMENT**

1. Improvement is allowed only after he / she has completed all the subjects from First Year to Final semester of the Diploma.
2. Improvement is allowed in any 4 (Four) subjects of the Diploma.
3. The student can avail of this improvement chance **ONLY ONCE**, that too within the succeeding two examinations after the completion of Diploma. However, the duration including Improvement examination shall not exceed **FIVE** years from the year of first admission.
4. No improvement is allowed in Practical / Lab subjects or Project work or Industrial Training assessment. However, improvement in drawing subject(s) is allowed.
5. If improvement is not achieved, the marks obtained in previous Examinations hold good.
6. Improvement is not allowed in respect of the candidates who are punished under Mal-practice in any Examination.
7. Examination fee for improvement shall be paid as per the notification issued by State Board of Technical Education and Training from time to time.
8. All the candidates who wish to appear for improvement of performance shall deposit the original Marks Memos of all the years / Semesters and also original Diploma Certificate to the Board. If there is improvement in performance of the current examination, the revised Memorandum of marks and Original Diploma Certificate will be issued, else the submitted originals will be returned.

**12. RULES OF PROMOTION FROM 1<sup>ST</sup> YEAR TO 3<sup>rd</sup>, 4<sup>th</sup>, 5<sup>th</sup>, 6<sup>th</sup> and 7<sup>th</sup> SEMESTERS:**

**a) For Diploma Courses of 3 Years duration**

- i. A candidate shall be permitted to appear for first year examination provided he / she puts in 75% attendance (which can be condoned on Medical grounds upto 10%) i.e. attendance after condonation on Medical grounds should not be less than 65% and pay the examination fee.
- ii. A candidate shall be promoted to 3<sup>rd</sup> semester if he/she puts the required percentage of attendance in the first year and pays the examination fee. A candidate who could not pay the first year examination fee has to pay the promotion fee as prescribed by State Board of Technical Education and Training from time to time before commencement of 3<sup>rd</sup> semester.
- iii. A candidate shall be promoted to 4<sup>th</sup> semester provided he/she puts the required percentage of attendance in the 3<sup>rd</sup> semester and pay the examination fee. A candidate who could not pay the 3<sup>rd</sup> semester exam fee, has to pay the promotion fee as prescribed by State Board of Technical

Education and Training from time to time before commencement of 4<sup>th</sup> semester.

A candidate is eligible to appear for the 4<sup>th</sup> semester examination if he/she

- i) Puts the required percentage of attendance in the 4<sup>th</sup> semester
- ii) Should not have failed in more than Four backlog subjects of 1<sup>st</sup> year

**For IVC & ITI Lateral Entry Students:**

A candidate is eligible to appear for the 4<sup>th</sup> semester examination if he/she puts the required percentage of attendance in the 4<sup>th</sup> semester

- iv) A candidate shall be promoted to 5<sup>th</sup> semester provided he / she puts the required percentage of attendance in the 4<sup>th</sup> semester and pays the examination fee. A candidate, who could not pay the 4<sup>th</sup> semester examination fee, has to pay the promotion fee as prescribed by State Board of Technical Education and Training from time to time before commencement of 5<sup>th</sup> semester.

A candidate is eligible to appear for the 5<sup>th</sup> semester examination if he/she

- i) Puts the required percentage of attendance in the 5<sup>th</sup> semester
- ii) Should get eligibility to appear for 4<sup>th</sup> Semester examination.

**For IVC& ITI Lateral Entry students:**

- i) Puts the required percentage of attendance in the 5<sup>th</sup> semester
- ii) Should not have failed in more than Four backlog subjects of 3<sup>rd</sup> Semester

- v) A candidate shall be promoted to 6<sup>th</sup> semester provided he/she puts in the required percentage of attendance in the 5<sup>th</sup> semester and pay the examination fee. A candidate who could not pay the 5<sup>th</sup> semester examination fee, has to pay the promotion fee as prescribed by State Board of Technical Education and Training from time to time before commencement of 6<sup>th</sup> semester.

A candidate is eligible to appear for 6<sup>th</sup> semester Industrial Training assessment (Seminar/Viva-voce)

- i) Puts the required percentage of attendance, ie., 90% in 6th semester Industrial Training
- ii) Should get eligibility to appear for 4<sup>th</sup> Semester Examination.

**For IVC & ITI Lateral Entry students:**

- i) Puts the required percentage of attendance, ie., 90% in 6<sup>th</sup> semester Industrial Training.
- ii) should get eligibility to appear for 5<sup>th</sup> Semester Examination.

**Important Note:**

**Seminar/Viva-voce should not be conducted for Not-Eligible Candidates, till the candidate gets eligibility. The record of internal assessment for Industrial Training for 260 marks shall be maintained at Institution Level for all candidates and the data is to be uploaded only for eligible candidates. For not eligible candidates the data is to be uploaded as and when the candidate gets eligibility.**

- b) For Diploma Courses of 3 ½ Years duration (MET/ CH/ CHPP/ CHPC/ CHOT/ TT):

1. A candidate shall be permitted to appear for 1<sup>st</sup> year examination provided he / she puts in 75% attendance (which can be condoned on Medical grounds upto 10%) i.e. attendance after condonation on Medical grounds should not be less than 65% and pay the examination fee.
2. A candidate shall be promoted to 3<sup>rd</sup> semester if he/she puts the required percentage of attendance in the 1<sup>st</sup> year and pays the examination fee. A candidate who could not pay the 1<sup>st</sup> year examination fee has to pay the promotion fee as prescribed by State Board of Technical Education and Training from time to time before commencement of 3<sup>rd</sup> semester.
3. A candidate shall be promoted to 4<sup>th</sup> semester provided he/she puts the required percentage of attendance in the 3<sup>rd</sup> semester and pay the examination fee. A candidate, who could not pay the 3<sup>rd</sup> semester exam fee, has to pay the promotion fee as prescribed by State Board of Technical Education and Training from time to time before commencement of 4<sup>th</sup> semester.  
A candidate is eligible to appear for the 4<sup>th</sup> semester exam if he/she
  - i) Puts the required percentage of attendance in the 4<sup>th</sup> semester
  - ii) Should not have failed in more than Four backlog subjects of 1<sup>st</sup> year.

**For IVC & ITI Lateral Entry students:**

- (i) Puts the required percentage of attendance in the 4<sup>th</sup> semester
4. A candidate shall be promoted to 5th semester industrial training provided he / she puts the required percentage of attendance in the 4th semester and pays the examination fee. A candidate, who could not pay the 4th semester examination fee, has to pay the promotion fee as prescribed by State Board of Technical Education and Training from time to time before commencement of 5th semester.
5. Promotion from 5th to 6th semester is automatic (i.e., from 1st spell of Industrial Training to 2nd spell) provided he/she puts the required percentage of attendance, which in this case i.e., 90 % of attendance and attends for the VIVA-VOCE examination at the end of training.
6. A candidate shall be promoted to 7th semester provided he / she puts the required percentage of attendance in the 6th semester and pays the examination fee. A candidate, who could not pay the 6th semester examination fee, has to pay the promotion fee as prescribed by State Board of Technical Education and Training from time to time before commencement of 7th semester.
7. A candidate shall be promoted to 7th semester of the course provided he/she has successfully completed both the spells of Industrial Training.

A candidate is eligible to appear for 7th semester examination if he/she

- i) Puts the required percentage of attendance in the 7th semester
- ii) Should get eligibility to appear for 4<sup>th</sup> semester Examination.

**For IVC & ITI Lateral Entry students:**

- i) Puts the required percentage of attendance in the 7th semester

- ii) Should not have failed more than four backlog subjects of 3<sup>rd</sup> Semester

**OTHER DETAILS**

- a) In case a candidate does not successfully complete the Industrial training, he / she will have to repeat the training at his / her own cost.
- b) The I spell of Industrial training shall commence 10 days after the completion of the last theory examination of 4<sup>th</sup> Semester.
- c) The Second spell of Industrial training shall commence within 10 days after the completion of I spell of Industrial training.

**c) For Diploma Courses of 3 ½ Years duration (BM):**

The same rules which are applicable for conventional courses also apply for this course. The industrial training in respect of this course is restricted to one semester (6 months) after the 6<sup>th</sup> semester (3 years) of the course.

1. A candidate shall be permitted to appear for first year examination provided he / she puts in 75% attendance (which can be condoned on Medical grounds upto 10%) i.e. attendance after condonation on Medical grounds should not be less than 65% and pay the examination fee.
2. A candidate shall be promoted to 3<sup>rd</sup> semester if he/she puts the required percentage of attendance in the first year and pays the examination fee. A candidate who could not pay the first year examination fee has to pay the promotion fee as prescribed by State Board of Technical Education and Training from time to time before commencement of 3<sup>rd</sup> semester.
3. A candidate shall be promoted to 4<sup>th</sup> semester provided he/she puts the required percentage of attendance in the 3<sup>rd</sup> semester and pay the examination fee. A candidate who could not pay the 3<sup>rd</sup> semester examination fee, has to pay the promotion fee as prescribed by State Board of Technical Education and Training from time to time before commencement of 4<sup>th</sup> semester.

A candidate is eligible to appear for the 4<sup>th</sup> semester examination if he/she

- i) Puts the required percentage of attendance in the 4<sup>th</sup> semester
- ii) Should not have failed in more than Four backlog subjects of 1<sup>st</sup> year

**For IVC & ITI Lateral Entry Students:**

A candidate is eligible to appear for the 4<sup>th</sup> semester examination if he/she puts the required percentage of attendance in the 4<sup>th</sup> semester

4. A candidate shall be promoted to 5<sup>th</sup> semester provided he / she puts the required percentage of attendance in the 4<sup>th</sup> semester and pays the examination fee. A candidate, who could not pay the 4<sup>th</sup> semester examination fee, has to pay the promotion fee as prescribed by State Board of Technical Education and Training from time to time before commencement of 5<sup>th</sup> semester.

A candidate is eligible to appear for the 5<sup>th</sup> semester exam if he/she

- i) Puts the required percentage of attendance in the 5<sup>th</sup> semester
- ii) Should get eligibility to appear for 4<sup>th</sup> Semester examination.

**For IVC & ITI Lateral Entry students:**

- iii) Puts the required percentage of attendance in the 5<sup>th</sup> semester
- iv) Should not have failed in more than Four backlog subjects of 3<sup>rd</sup> Semester



5. A candidate shall be promoted to 6<sup>th</sup> semester provided he/she puts in the required percentage of attendance in the 5<sup>th</sup> semester and pays the examination fee.

A candidate who could not pay the 5<sup>th</sup> semester examination fee, has to pay the promotion fee as prescribed by State Board of Technical Education and Training from time to time before commencement of 6<sup>th</sup> semester.

A candidate is eligible to appear for 6<sup>th</sup> semester examination

- i) Puts the required percentage of attendance in 6<sup>th</sup> semester and
- ii) should get eligibility to appear for 4<sup>th</sup> Semester Examination.

**For IVC & ITI Lateral Entry students:**

- i) Puts the required percentage of attendance in 6<sup>th</sup> semester.
  - ii) should get eligibility to appear for 5<sup>th</sup> Semester Examination.
6. A candidate shall be promoted to 7<sup>th</sup> semester provided he/she puts the required percentage of attendance in 6<sup>th</sup> semester and pay the examination fee. A candidate, who could not pay the 6<sup>th</sup> semester examination fee, has to pay the promotion fee prescribed by SBTET from time to time before commencement of the 7<sup>th</sup> semester (Industrial Training).

A candidate is eligible to appear for 7<sup>th</sup> semester Industrial Training assessment

(Seminar/Viva-voce) if he/she

- i) Puts the required percentage of attendance, ie., 90% in 7th semester Industrial Training
- ii) Should get eligibility to appear for 4<sup>th</sup> Semester Examination.

**For IVC & ITI Lateral Entry students:**

- i) Puts the required percentage of attendance, ie., 90% in 7<sup>th</sup> semester Industrial Training.
- ii) Should get eligibility to appear for 5<sup>th</sup> Semester Examination.

**Important Note:**

**Seminar/Viva-voce should not be conducted for Not-Eligible Candidates, till the candidate gets eligibility. However, the record of internal Assessment for Industrial Training for 260 marks shall be maintained at Institution Level for all candidates and the data is to be uploaded only for eligible candidates. For not eligible candidates the data is to be uploaded as and when the candidate gets eligibility.**

**OTHER DETAILS**

- a) In case a candidate does not successfully complete the Industrial training, he / she will have to repeat the training at his / her own cost.
- b) The Industrial training shall commence 10 days after the completion of the last theory examination of 6th Semester.

**13. STUDENTS PERFORMANCE EVALUATION**

Successful candidates shall be awarded the Diploma under the following divisions of pass.

1. First Class with Distinction shall be awarded to the candidates who secure an overall aggregate of 75% marks and above.
2. First Class shall be awarded to candidates who secure overall aggregate of 60% marks and above and below 75% marks.

3. Second Class shall be awarded to candidates who secure a pass with an overall aggregate of below 60%.  
The Weightage of marks for various year/Semesters which are taken for computing overall aggregate shall be 25% of I year marks + 100% of 3<sup>rd</sup> and subsequent Semesters.  
In respect IVC & ITI Lateral Entry candidates who are admitted directly into diploma course at the 3<sup>rd</sup> semester (i.e., second year) level the aggregate of (100%) marks secured at the 3<sup>rd</sup> and subsequent semesters of study shall be taken into consideration for determining the overall percentage of marks secured by the candidates for award of class/division.
4. Second Class shall be awarded to all students, who fail to complete the Diploma in the regular 3 years/ 3 ½ years and four subsequent examinations, from the year of first admission.

**14. EXAMINATION FEE SCHEDULE:**

The examination fee should be as per the notification issued by State Board of Technical Education and Training from time to time.

**15. STRUCTURE OF END EXAMINATION QUESTION PAPER:**

The question paper for theory examination is patterned in such a manner that the Weightage of periods/marks allotted for each of the topics for a particular subject be considered Examination paper is of 3/6/9 hours duration.

- a) Each theory paper consists of Section 'A' and Section 'B'. Section 'A' contains 10 short answer questions. All questions are to be answered and each carries 3 marks Max. Marks: 10 x 3 = 30.

Section B contains 8 essay type questions including Numerical questions, out of which 5 questions each carrying 10 marks are to be answered.

Max.Marks: 5 x 10 = 50.

Total Maximum Marks: 80.

- b) For Engineering Drawing Subject (107) consist of section 'A' and section 'B'. Section 'A' contains four (4) questions. All questions in section 'A' are to be answered and each carries 5 marks. Max. Marks: 4 x 5=20. Section 'B' contains six (6) questions. Out of which four (4) questions to be answered and each question carries 10 Marks. Max. Marks 4 x 10 = 40.

- c) Practical Examinations

For Workshop practice and Laboratory Examinations, Each student has to pick up a question paper distributed by Lottery System.

Max. Marks for an experiment / exercise : 50%

Max. Marks for VIVA-VOCE : 10%

Total : 60% (of total marks for the subject)

In case of practical examinations with 50 marks, the marks will be worked out basing on the above ratio.

In case of any change in the pattern of question paper, the same shall be informed sufficiently in advance to the candidates.

**16. ISSUE OF MEMORANDUM OF MARKS**

All candidates who appear for the end examination will be issued memorandum of marks without any payment of fee. However candidates who lose the original memorandum of marks have to pay the prescribed fee to the

Secretary, State Board of Technical Education and Training, A.P. for each duplicate memo.

**17. MAXIMUM PERIOD FOR COMPLETION OF DIPLOMA COURSES:**

Maximum period for completion of the diploma courses is twice the duration of the course from the date of First admission (includes the period of detention and discontinuation of studies by student etc) failing which they will have to forfeit the claim for qualifying for the award of Diploma (They will not be permitted to appear for examinations after that date). This rule applies for all Diploma courses of 3 years and 3 ½ years of engineering and non-engineering courses.

**18. ELIGIBILITY FOR AWARD OF DIPLOMA**

A candidate is eligible for award of Diploma Certificate if he / she fulfils the following academic regulations.

- i. He / She pursued a course of study for not less than 3 / 3 ½ academic years & not more than 6 / 7 academic years.
- ii. He / she has completed all the subjects.  
Students who fail to fulfill all the academic requirements for the award of the Diploma within 6 / 7 academic years from the year of admission shall forfeit their seat in the course & their seat shall stand cancelled.

**For IVC & ITI Lateral Entry students:**

- i. He / She pursued a course of study for not less than 2 / 2 ½ academic years & not more than 4 / 5 academic years.
- ii. He / she has completed all the subjects.  
Students who fail to fulfill all the academic requirements for the award of the Diploma within 4 / 5 academic years from the year of admission shall forfeit their seat in the course & their seat shall stand cancelled.

**19. ISSUE OF PHOTO COPY OF VALUED ANSWER SCRIPT, RECOUNTING& REVERIFICATION:**

**A) FOR ISSUE OF PHOTO COPIES OF VALUED ANSWER SCRIPTS**

1. A candidate desirous of applying for Photo copy of valued answer script/  
scripts should apply within prescribed date from the date of the declaration  
of the result.
2. Photo copies of valued answer scripts will be issued to all theory subjects and  
Drawing subject(s).
3. The Photo copy of valued answer script will be dispatched to the concerned  
candidate's address as mentioned in the application form by post.
4. No application can be entertained from third parties.

**B) FOR RE-COUNTING(RC) and RE-VERIFICATION(RV) OF THE VALUED ANSWER SCRIPT**

1. A candidate desirous of applying for Re-verification of valued answer script should

apply within prescribed date from the date of the declaration of the result.

2. Re-verification of valued answer script shall be done for all theory subjects and

Drawing subject(s).

3. The Re-verification committee constituted by the Secretary, SBTETAP with subject

experts shall re-verify the answer scripts.

### **I) RE-COUNTING**

The Officer of SBTET will verify the marks posted and recount them in the already valued answer script. The variations if any will be recorded separately, without making any changes on the already valued answer script. The marks awarded in the original answer script are maintained (hidden).

### **2) RE-VERIFICATION**

- (i) The Committee has to verify the intactness and genuineness of the answer script(s) placed for Re-verification.
- (ii) Initially single member shall carry out the re-verification.
- (iii) On re-verification by single member, if the variation is less than 12% of maximum marks, and if there is no change in the STATUS in the result of the candidate, such cases will not be referred to the next level i.e., for 2-Tier evaluation.
- (iv) On re-verification by a single member, if the variation is more than 12% of maximum marks, it will be referred to 2-Tier evaluation.
- (v) If the 2-Tier evaluation confirms variation in marks as more than 12% of maximum marks, the variation is considered as follows:
  - a) If the candidate has already passed and obtains more than 12% of the maximum marks on Re-verification, then the variation is considered.
  - b) If the candidate is failed and obtains more than 12% of the maximum marks on Re-verification and secured pass marks on re-verification, then the status of the candidate changes to PASS.
  - c) If a candidate is failed and obtains more than 12% of the maximum marks on Re-verification and if the marks secured on re-verification are still less than the minimum pass marks, the status of the candidate remain FAIL only.
- (vi) After Re-verification of valued answer script the same or change if any therein on Re-verification, will be communicated to the candidate.
- (vii) On Re-verification of Valued Answer Script if the candidate's marks are revised, the fee paid by the candidate will be refunded or else the candidate has to forfeit the fee amount.

4. No request for Photo copies/ Recounting /Re-verification of valued answer script would

be entertained from a candidate who is reported to have resorted to Malpractice in that examination.

**20. MAL PRACTICE CASES:**

If any candidate resorts to Mal Practice during examinations, he / she shall be booked and the Punishment shall be awarded as per SBTETAP rules and regulations in vogue.

**21. DISCREPANCIES/ PLEAS:**

Any Discrepancy /Pleas regarding results etc., shall be represented to the SBTETAP within one month from the date of issue of results. Thereafter, no such cases shall be entertained in any manner.

**22. ISSUE OF DUPLICATE DIPLOMA**

If a candidate loses his/her original Diploma Certificate and desires a duplicate to be issued he/she should produce written evidence to this effect. He / she may obtain a duplicate from the Secretary, State Board of Technical Education and Training, A.P., on payment of prescribed fee and on production of an affidavit signed before a First Class Magistrate (Judicial) and *non-traceable certificate* from the Department of Police. In case of damage of original Diploma Certificate, he / she may obtain a duplicate certificate by surrendering the original damaged certificate on payment of prescribed fee to the State Board of Technical Education and Training, A.P.

In case the candidate cannot collect the original Diploma within 1 year from the date of issue of the certificate, the candidate has to pay the penalty prescribed by the SBTET from time to time.

**23. ISSUE OF MIGRATION CERTIFICATE AND TRANSCRIPTS:**

The Board on payment of prescribed fee will issue these certificates for the candidates who intend to prosecute Higher Studies in India or Abroad.

**24. GENERAL**

- i. The Board may change or amend the academic rules and regulations or syllabi at any time and the changes or amendments made shall be applicable to all the students, for whom it is intended, with effect from the dates notified by the competent authority.
- ii. All legal matters pertaining to the State Board of Technical Education and Training are within the jurisdiction of Vijayawada.
- iii. In case of any ambiguity in the interpretation of the above rules, the decision of the Secretary, SBTET, A.P is final.

**DIPLOMA IN CHEMICAL ENGINEERING (DCHE)  
SCHEME OF INSTRUCTIONS AND EXAMINATIONS  
C-16/FIRST YEAR**

| Subject Code      | Name of the Subject              | Instruction periods / week |                     | Total Period / year | Scheme of Examination |                 |                |             |
|-------------------|----------------------------------|----------------------------|---------------------|---------------------|-----------------------|-----------------|----------------|-------------|
|                   |                                  | Theory                     | Practical /Tutorial |                     | Duration (hours)      | Sessional Marks | End Exam Marks | Total Marks |
| <b>THEORY:</b>    |                                  |                            |                     |                     |                       |                 |                |             |
| CH-101            | English                          | 03                         | -                   | 90                  | 3                     | 20              | 80             | 100         |
| CH-102            | Engineering Mathematics - I      | 05                         | -                   | 150                 | 3                     | 20              | 80             | 100         |
| CH-103            | Engineering Physics              | 04                         | -                   | 120                 | 3                     | 20              | 80             | 100         |
| CH-104            | Inorganic Chemistry              | 04                         | -                   | 120                 | 3                     | 20              | 80             | 100         |
| CH-105            | General Mechanical Engineering   | 05                         | -                   | 150                 | 3                     | 20              | 80             | 100         |
| CH-106            | Materials Technology             | 03                         | -                   | 90                  | 3                     | 20              | 80             | 100         |
| <b>PRACTICAL:</b> |                                  |                            |                     |                     |                       |                 |                |             |
| CH-107            | Engineering Drawing              |                            | 06                  | 180                 | 3                     | 40              | 60             | 100         |
| CH-108            | Work Shop practice               |                            | 03                  | 90                  | 3                     | 40              | 60             | 100         |
| CH-109            | Physics Laboratory               | -                          | 03                  | 90                  | 3                     | 20              | 30             | 50          |
| CH-110            | Chemistry Laboratory             | -                          | 03                  | 90                  | 3                     | 20              | 30             | 50          |
| CH-111            | Computer Fundamentals Laboratory | -                          | 03                  | 90                  | 3                     | 40              | 60             | 100         |
| <b>TOTAL</b>      |                                  | 24                         | 18                  |                     |                       |                 |                | 1000        |

CH-101, 102, 103, 107: Common to all  
 CH-104, 105: Common with DPCT  
 CH-106: Common with DCHE (PC/PP/OT), DPCT

**Note:** 30 students will go to Physics lab and the remaining 30 will go to Chemistry lab

**DIPLOMA IN CHEMICAL ENGINEERING**  
**SCHEME OF INSTRUCTIONS AND EXAMINATIONS**  
**C-16, III Semester**

| Subject Code      | Name of the Subject                                      | Instruction period / week |                     | Total Period / year | Scheme of Examination |                 |                |             |
|-------------------|--|---------------------------|---------------------|---------------------|-----------------------|-----------------|----------------|-------------|
|                   |  | Theory                    | Practical /Tutorial |                     | Duration (hours)      | Sessional Marks | End Exam Marks | Total Marks |
| <b>THEORY:</b>    |  |                           |                     |                     |                       |                 |                |             |
| CH- 301           | Engineering Mathematics – II                             | 05                        | --                  | 75                  | 3                     | 20              | 80             | 100         |
| CH-302            | Electrical Technology                                    | 04                        | --                  | 60                  | 3                     | 20              | 80             | 100         |
| CH-303            | Fluid Mechanics  | 05                        | --                  | 75                  | 3                     | 20              | 80             | 100         |
| CH-304            | Organic and Physical Chemistry                           | 05                        | --                  | 75                  | 3                     | 20              | 80             | 100         |
| CH-305            | Mass and Energy Balance                                  | 05                        | --                  | 75                  | 3                     | 20              | 80             | 100         |
| <b>PRACTICAL:</b> |  |                           |                     |                     |                       |                 |                |             |
| CH-306            | Chemical Engineering Drawing Lab using CAD               | --                        | 06                  | 90                  | 3                     | 40              | 60             | 100         |
| CH-307            | Electrical Technology and Organic Physical Chemistry Lab | --                        | 06                  | 90                  | 3                     | 40              | 60             | 100         |
| CH-308            | Communication skills                                     | --                        | 03                  | 45                  | 3                     | 40              | 60             | 100         |
| CH-309            | Fluid Mechanics Lab                                      | --                        | 03                  | 45                  | 3                     | 40              | 60             | 100         |
| <b>TOTAL</b>      |  | 24                        | 18                  | 630                 |                       | 260             | 640            | 900         |

CH-301 Common to all branches.

CH-302 Common to CHPC/PP/OT-302

CH-305 Common to CHPC/PP/OT-305

**DIPLOMA IN CHEMICAL ENGINEERING**  
**SCHEME OF INSTRUCTIONS AND EXAMINATIONS**  
**C-16,IV Semester**

| Subject Code      | Name of the Subject                              | Instruction period / week |                     | Total Period / year | Scheme of Examination |                 |                |             |
|-------------------|--|---------------------------|---------------------|---------------------|-----------------------|-----------------|----------------|-------------|
|                   |  | Theory                    | Practical /Tutorial |                     | Duration (hours)      | Sessional Marks | End Exam Marks | Total Marks |
| <b>THEORY:</b>    |  |                           |                     |                     |                       |                 |                |             |
| CH- 401           | Mechanical Unit Operations                       | 4                         | --                  | 60                  | 3                     | 20              | 80             | 100         |
| CH-402            | Inorganic Chemical Technology                    | 5                         | --                  | 75                  | 3                     | 20              | 80             | 100         |
| CH-403            | Organic Chemical Technology                      | 5                         | --                  | 75                  | 3                     | 20              | 80             | 100         |
| CH-404            | Heat Transfer                                    | 5                         | --                  | 75                  | 3                     | 20              | 80             | 100         |
| CH-405            | Mass Transfer                                    | 5                         | --                  | 75                  | 3                     | 20              | 80             | 100         |
| <b>PRACTICAL:</b> |  |                           |                     |                     |                       |                 |                |             |
| CH-406            | Chemical Technology Lab                          | --                        | 6                   | 90                  | 3                     | 40              | 60             | 100         |
| CH-407            | Mechanical Unit Operations and Mass transfer Lab | --                        | 6                   | 90                  | 3                     | 40              | 60             | 100         |
| CH-408            | Life skills                                      | --                        | 3                   | 45                  | 3                     | 40              | 60             | 100         |
| CH-409            | Heat transfer Lab                                | --                        | 3                   | 45                  | 3                     | 40              | 60             | 100         |
| <b>TOTAL</b>      |  | 24                        | 18                  | 630                 |                       | 260             | 640            | 900         |



**DIPLOMA IN CHEMICAL ENGINEERING**  
**SCHEME OF INSTRUCTIONS AND EXAMINATIONS**  
**C-16, V Semester (Industrial Training) CH -501**

| S.No.        | Subject   | Scheme of Examination |           |   |            |
|--------------|---|-----------------------|-----------|---|------------|
|              |   | Duration (hours)      | Nature    | Item Each spell of 6 months                           | Max. marks |
| 1.           | Practical Training in a Chemical or Allied Industry | 6 months              | Viva voce | 1.First assessment                                    | 100        |
|              |   |                       |           | 2.Second Assessment (written & viva-voce)             | 100        |
|              |   |                       |           | 3.At the institution after completion of the training |            |
|              |   |                       |           | (a) Log Book  | 30         |
|              |   |                       |           | (b) Training Report                                   | 30         |
|              |   |                       |           | (c) Seminar   | 40         |
|              |   |                       |           |   |            |
|              |   |                       |           |   |            |
|              |   |                       |           |   |            |
|              |   |                       |           |   |            |
| <b>TOTAL</b> |   |                       |           |   | <b>300</b> |

**DIPLOMA IN CHEMICAL ENGINEERING**  
**SCHEME OF INSTRUCTIONS AND EXAMINATIONS**  
**C-16, VI Semester (Industrial Training) CH - 601**

| S.No.        | Subject   | Scheme of Examination |           |   |            |
|--------------|---|-----------------------|-----------|---|------------|
|              |   | Duration (hours)      | Nature    | Item Each spell of 6 months                           | Max. marks |
| 1.           | Practical Training in a Chemical or Allied Industry | 6 months              | Viva voce | 1.First assessment                                    | 100        |
|              |   |                       |           | 2.Second Assessment (written & viva-voce)             | 100        |
|              |   |                       |           | 3.At the institution after completion of the training |            |
|              |   |                       |           | (a) Log Book  | 30         |
|              |   |                       |           | (b) Training Report                                   | 30         |
|              |   |                       |           | (c) Seminar   | 40         |
|              |   |                       |           |   |            |
|              |   |                       |           |   |            |
|              |   |                       |           |   |            |
|              |   |                       |           |   |            |
|              |   |                       |           |   |            |
| <b>TOTAL</b> |   |                       |           |   | <b>300</b> |

**DIPLOMA IN CHEMICAL ENGINEERING**  
**SCHEME OF INSTRUCTIONS AND EXAMINATIONS**  
**C-16, VII Semester**

| Subject Code      | Name of the Subject                                   | Instruction period / week |                     | Total Period / year | Scheme of Examination |                 |                |             |
|-------------------|---|---------------------------|---------------------|---------------------|-----------------------|-----------------|----------------|-------------|
|                   |   | Theory                    | Practical /Tutorial |                     | Duration (hours)      | Sessional Marks | End Exam Marks | Total Marks |
| <b>THEORY:</b>    |   |                           |                     |                     |                       |                 |                |             |
| CH-701            | Industrial Management and smart Technologies          | 5                         | --                  | 75                  | 3                     | 20              | 80             | 100         |
| CH-702            | Thermodynamics and Reaction Engineering               | 5                         | --                  | 75                  | 3                     | 20              | 80             | 100         |
| CH-703            | Instrumentation and Process Control                   | 5                         | --                  | 75                  | 3                     | 20              | 80             | 100         |
| CH-704            | Environmental studies & Pollution Control Engineering | 4                         | --                  | 60                  | 3                     | 20              | 80             | 100         |
| CH-705            | Energy Technology                                     | 5                         | --                  | 75                  | 3                     | 20              | 80             | 100         |
| <b>PRACTICAL:</b> |   |                           |                     |                     |                       |                 |                |             |
| CH-706            | Chemical plant equipment drawing                      | --                        | 6                   | 90                  | 3                     | 40              | 60             | 100         |
| CH-707            | Instrumentation and Process Control Lab               | --                        | 3                   | 45                  | 3                     | 40              | 60             | 100         |
| CH-708            | Energy Technology and Reaction Engineering Lab        | --                        | 6                   | 90                  | 3                     | 40              | 60             | 100         |
| CH-709            | Project work  | --                        | 3                   | 45                  | 3                     | 40              | 60             | 100         |
| <b>TOTAL</b>      |   | 24                        | 18                  | 630                 |                       | 260             | 640            | 900         |

CH-701 Common to all branches

CH-702 Common to CHPC/PP/OT-702

CH-703 Common to CHPC/PP/OT-703

**I Year**

**DIPLOMA IN CHEMICAL ENGINEERING (DCHE)  
SCHEME OF INSTRUCTIONS AND EXAMINATIONS  
C-16/FIRST YEAR**

| Subject Code      | Name of the Subject            | Instruction periods / week |                     | Total Period / year | Scheme of Examination |                 |                |             |
|-------------------|--------------------------------|----------------------------|---------------------|---------------------|-----------------------|-----------------|----------------|-------------|
|                   |                                | Theory                     | Practical /Tutorial |                     | Duration (hours)      | Sessional Marks | End Exam Marks | Total Marks |
| <b>THEORY:</b>    |                                |                            |                     |                     |                       |                 |                |             |
| CH-101            | English                        | 03                         | -                   | 90                  | 3                     | 20              | 80             | 100         |
| CH-102            | Engineering Mathematics - I    | 05                         | -                   | 150                 | 3                     | 20              | 80             | 100         |
| CH-103            | Engineering Physics            | 04                         | -                   | 120                 | 3                     | 20              | 80             | 100         |
| CH-104            | Inorganic Chemistry            | 04                         | -                   | 120                 | 3                     | 20              | 80             | 100         |
| CH-105            | General Mechanical Engineering | 05                         | -                   | 150                 | 3                     | 20              | 80             | 100         |
| CH-106            | Materials Technology           | 03                         | -                   | 90                  | 3                     | 20              | 80             | 100         |
| <b>PRACTICAL:</b> |                                |                            |                     |                     |                       |                 |                |             |
| CH-107            | Engineering Drawing            |                            | 06                  | 180                 | 3                     | 40              | 60             | 100         |
| CH-108            | Work Shop practice             |                            | 03                  | 90                  | 3                     | 40              | 60             | 100         |
| CH-109            | Physics Lab                    | -                          | 03                  | 90                  | 3                     | 20              | 30             | 50          |
| CH-110            | Chemistry Lab                  | -                          | 03                  | 90                  | 3                     | 20              | 30             | 50          |
| CH-111            | Computer Fundamentals Lab      | -                          | 03                  | 90                  | 3                     | 40              | 60             | 100         |
| <b>TOTAL</b>      |                                | 24                         | 18                  |                     |                       |                 |                | 1000        |

CH-101, 102, 103, 107: Common to all

CH-104, 105: Common with DPCT

CH-106: Common with DCHE (PC/PP/OT), DPCT

**Note:** 30 students will go to Physics lab and the remaining 30 will go to Chemistry lab

**C-16-COMMON-101- ENGLISH**

(Common to all Branches)

**Subject Title : ENGLISH**

**Subject Code : CH – 101 COMMON-101**

**Periods per Week : 3**

**Periods per Year : 90**

**Time Schedule & Weightage**

| <b>Sl No</b> | <b>Major Topics</b>                      | <b>Titles of the Lessons</b>                              | <b>No. of Periods</b> | <b>Weightage of Marks</b> | <b>No of Short Answers</b> | <b>No of Long Answers</b> |
|--------------|--|---|-----------------------|---------------------------|----------------------------|---------------------------|
| <b>1</b>     | <b>Vocabulary &amp; Need for English</b> | <b>Lessons 1,2 &amp; Regular and essential vocabulary</b> | <b>5</b>              | <b>13</b>                 | <b>1</b>                   | <b>1</b>                  |
| <b>2</b>     | <b>Grammar</b>                           | <b>Lessons 11,12 &amp; 19 to 26</b>                       | <b>30</b>             | <b>31</b>                 | <b>7</b>                   | <b>1</b>                  |
| <b>3</b>     | <b>Reading</b>                           | <b>Lessons 13 To 18</b>                                   | <b>10</b>             | <b>10</b>                 | <b>-</b>                   | <b>1</b>                  |
| <b>4</b>     | <b>Writing</b>                           | <b>Lessons 27 To 40</b>                                   | <b>30</b>             | <b>40</b>                 | <b>-</b>                   | <b>4</b>                  |
| <b>5</b>     | <b>English in Action</b>                 | <b>Lessons 3 To 10</b>                                    | <b>15</b>             | <b>16</b>                 | <b>2</b>                   | <b>1</b>                  |
|              |  | <b>Total</b>  | <b>90</b>             | <b>110</b>                | <b>10</b>                  | <b>08</b>                 |

**Rationale and Scope**

**Globalization has ushered in an era of opportunities for those who have the necessary competencies. Effective communication is one among them. This shift demands strengthening of English in polytechnics. In C-16 Curriculum the focus is on the special needs of English for technicians.**

**. This course aims at integration of the four fold language abilities viz., listening, speaking, reading and writing. The use of English for learning technical subjects and for performing technical functions like, writing reports, giving instructions and interpreting graphics/data is of great importance. Therefore the curriculum C-16 focuses on improving communicative abilities equipping the students to become industry- ready and employable.**

**On completion of this course the student will be able to:**

- 1.0 Build vocabulary in the direction of future needs**
- 2.0 Learn various grammatical structures**
- 3.0 Read and comprehend English and understand the details and draw inferences**
- 4.0 Learn to be competent in various forms of written communication (writing composition and data interpretation)**
- 5.0 Practice spoken communication suited to various situations.**

**1.0 Extend their vocabulary in the direction of their future needs**

**1.1 Locate words, learn spellings, understand meanings**

**1.2 Pronounce words intelligibly**

**1.3 Find synonyms and antonyms**

**1.4 Use affixation**

**1.5 Comprehend meanings of words by understanding meanings of roots**

**2.0 Learn various grammatical structures**

**2.1 Identify and use nouns**

**2.2 Identify and use pronouns**

- 2.3 Use the present tense**
- 2.4 Use the past tense**
- 2.5 Use the future tense**
- 2.6 Identify and use adjectives**
- 2.7 Identify and use adverbs**
- 2.8 Use prepositions**
- 2.9 Use linkers**
- 2.10 State basic sentence structures**
- 2.11 Construct different types of sentences**
- 2.12 Frame questions to elicit information**
- 2.13 Frame questions for confirmation**
- 2.14 Use active voice**
- 2.15 Use passive voice**
- 2.16 Use direct speech**
- 2.17 Use indirect speech**
- 2.18 Identify and correct errors**

### **3.0 Read and comprehend English**

- 3.1 Identify the main ideas**
- 3.2 Identify the specific details**
- 3.3 Draw inferences**
- 3.4 Give contextual meanings of the words**
- 3.5 Perceive tone in a text**

### **4.0 Learn to excel in various forms of written communication (writing composition and data interpretation)**

- 4.1 Identify components of a good paragraph**



- 4.2 Write types of paragraphs**
- 4.3 Distinguish between formal and informal letters**
- 4.4 Write personal letters**
- 4.5 Write leave letters**
- 4.6 Write official letters**
- 4.7 Write letters of complaints**
- 4.8 Prepare a resume**
- 4.9 Write a cover letter**
- 4.10 Write short messages**
- 4.11 Report incidents**
- 4.12 Report experiments**
- 4.13 Report Industrial visits**
- 4.14 Write work done statements**
- 4.15 Write maintenance reports**
- 4.16 Make notes using Cue method and Mapping method**
- 4.17 Summarize Paragraphs**
- 4.18 Present and Interpret Data from flow charts, tree diagrams, bar graphs, tables, pie charts**

**Practice spoken communication suited to various situations.**

- 4.19 Use appropriate expressions to greet and take leave**
- 4.20 Use proper expressions to make requests**
- 4.21 Use apt expressions for asking and giving directions**
- 4.22 Use suitable expressions to seek and offer suggestions**
- 4.23 Use suitable expressions to state intentions**
- 4.24 Use suitable expressions to state feelings**

- 4.25 Use appropriate expressions to state agreement and disagreement**
- 4.26 Use proper expressions to make complaints**
- 4.27 Use suitable expressions to express obligations**

### **Course Material**

**The textbook prepared by the faculty of English of Polytechnics in AP.**

### **Reference Books**

- 1. Essential English Grammar (Intermediate Level) Raymond Murphy**
- 2. Learn English ( A Fun Book of Functional Language, Grammar and Vocabulary)  
SantanuSinhaChaudhuri**
- 3. Grammar Builder ( Entire Series) Oxford University Press**
- 4. High School English Grammar ( Revised Edition) Wren and Martin**
- 5. Sentence skills with Readings ( fourth Edition, Tata McGraw Hill)  
John Langan, Paul Langan**
- 6. Word Power Made Easy Norman Lewis**
- 7. Spoken English Shashi Kumar and Dhamija**

## Engineering Mathematics - I

(Common to all Branches)

Subject Title : Engineering Mathematics - I

Subject Code : CH- 102 COMMON-102

Periods per Week : 5

Periods per Year : 150

### Time Schedule

| S. No | Major Topic                           | No of Periods |          | Weightage of Marks | Short Type |   |     | Essay Type |     |     |
|-------|---------------------------------------|---------------|----------|--------------------|------------|---|-----|------------|-----|-----|
|       |                                       | Theory        | Practice |                    | R          | U | App | R          | U   | App |
|       | <b>Unit - I : Algebra</b>             |               |          |                    |            |   |     |            |     |     |
| 1     | Logarithms                            | 3             | 0        | 0                  | 0          | 0 | 0   | 0          | 0   | 0   |
| 2     | Partial Fractions                     | 5             | 0        | 3                  | 0          | 1 | 0   | 0          | 0   | 0   |
| 3     | Matrices and Determinants             | 10            | 10       | 16                 | 2          | 0 | 0   | 0          | 0   | 1   |
|       | <b>Unit - II : Trigonometry</b>       |               |          |                    |            |   |     |            |     |     |
| 4     | Trigonometric Ratios                  | 2             | 0        | 0                  | 0          | 0 | 0   | 0          | 0   | 0   |
| 5     | Compound Angles                       | 3             | 2        | 3                  | 1          | 0 | 0   | 0          | 0   | 0   |
| 6     | Multiple and Submultiple angles       | 4             | 4        | 3                  | 0          | 1 | 0   | 0          | 0   | 0   |
| 7     | Transformations                       | 4             | 4        | 5                  | 0          | 0 | 0   | 1/2        | 0   | 0   |
| 8     | Inverse Trigonometric Functions       | 3             | 2        | 5                  | 0          | 0 | 0   | 0          | 1/2 | 0   |
| 9     | Trigonometric Equations               | 3             | 2        | 5                  | 0          | 0 | 0   | 1/2        | 0   | 0   |
| 10    | Properties and solutions of triangles | 4             | 4        | 5                  | 0          | 0 | 0   | 0          | 0   | 1/2 |

|              |  |               |           |                    |            |           |          |            |              |              |
|--------------|--|---------------|-----------|--------------------|------------|-----------|----------|------------|--------------|--------------|
| 11           | Hyperbolic Functions                       | 2             | 0         | 0                  | 0          | 0         | 0        | 0          | 0            | 0            |
| 12           | Complex Numbers                            | 4             | 2         | 3                  | 1          | 0         | 0        | 0          | 0            | 0            |
|              |  |               |           |                    |            |           |          |            |              |              |
|              | <b>Unit III : Co-ordinate Geometry</b>     |               |           |                    |            |           |          |            |              |              |
| 13           | Straight Lines                             | 5             | 3         | 6                  | 1          | 1         | 0        | 0          | 0            | 0            |
| 14           | Circle                                     | 4             | 2         | 5                  | 0          | 0         | 0        | 0          | 1/2          | 0            |
| 15           | Conic Sections                             | 4             | 3         | 5                  | 0          | 0         | 0        | 0          | 1/2          | 0            |
|              | <b>Unit – IV : Differential Calculus</b>   |               |           |                    |            |           |          |            |              |              |
| 16           | Limits and Continuity                      | 4             | 2         | 3                  | 0          | 1         | 0        | 0          | 0            | 0            |
| 17           | Differentiation                            | 18            | 10        | 23                 | 1          | 0         | 0        | 1          | 1            | 0            |
| S. No        | Major Topic                                | No of Periods |           | Weightage of Marks | Short Type |           |          | Essay Type |              |              |
|              | Unit - V : Applications of Differentiation | Theory        | Practice  |                    | R          | U         | App      | R          | U            | App          |
| 18           | Geometrical Applications                   | 3             | 2         | 5                  | 0          | 0         | 0        | 0          | 0            | 1/2          |
| 19           | Physical Applications                      | 2             | 2         | 5                  | 0          | 0         | 0        | 0          | 0            | 1/2          |
| 20           | Maxima and Minima                          | 3             | 4         | 5                  | 0          | 0         | 0        | 0          | 0            | 1/2          |
| 21           | Errors and Approximations                  | 2             | 0         | 5                  | 0          | 0         | 0        | 0          | 0            | 1/2          |
| <b>Total</b> |  | <b>92</b>     | <b>58</b> | <b>110</b>         | <b>6</b>   | <b>4</b>  | <b>0</b> | <b>2</b>   | <b>2 1/2</b> | <b>3 1/2</b> |
|              |  |               |           | <b>Marks</b>       | <b>18</b>  | <b>12</b> | <b>0</b> | <b>20</b>  | <b>25</b>    | <b>35</b>    |

|             |                           |                 |
|-------------|---------------------------|-----------------|
| <b>R:</b>   | <b>Remembering type</b>   | <b>38 marks</b> |
| <b>U:</b>   | <b>Understanding type</b> | <b>37 marks</b> |
| <b>App:</b> | <b>Application type</b>   | <b>35 marks</b> |

# ENGINEERING MATHEMATICS – I

## COMMON TO ALL BRANCHES – 102

### Objectives

Upon completion of the course the student shall be able to:

### UNIT – I

#### Algebra

- 1.0 Use Logarithms in engineering calculations
- 1.1 Define logarithm and list its properties.
- 1.2 Distinguish natural logarithms and common logarithms.
- 1.3 Explain the meaning of e and exponential function.
- 1.4 State logarithm as a function and its graphical representation.
- 1.5 Use the logarithms in engineering calculations.
- 2.0 Resolve Rational Fraction into sum of Partial Fractions in engineering problems
- 2.1 Define the following fractions of polynomials:
  1. Rational,
  2. Proper and
  3. Improper
- 2.2 Explain the procedure of resolving rational fractions of the type mentioned below into partial fractions
  - i)  $\frac{f(x)}{(x+a)(x+b)(x+c)}$
  - ii)  $\frac{f(x)}{(x+a)^2(x+b)(x+c)}$
  - iii)  $\frac{f(x)}{(x^2+a)(x+b)}$
  - iv)  $\frac{f(x)}{(x+a)(x^2+b)^2}$
- 3.0 Use Matrices for solving engineering problems
- 3.1 Define a matrix and order of a matrix.
- 3.2 State various types of matrices with examples (upto 3<sup>rd</sup> order square matrices).

- 3.3 Compute sum, scalar multiplication and product of matrices.
- 3.4 Illustrate the properties of these operations such as associative, distributive, commutative properties with examples and counter examples.
- 3.5 Define the transpose of a matrix and write its properties.
- 3.6 Define symmetric and skew-symmetric matrices.
- 3.7 Resolve a square matrix into a sum of symmetric and skew- symmetric matrices with examples in all cases.
- 3.8 Define minor, co-factor of an element of  $2 \times 2$  and  $3 \times 3$  square matrices with examples.
- 3.9 Expand the determinant of a  $3 \times 3$  matrix using Laplace expansion formula.
- 3.10 Distinguish singular and non-singular matrices.
- 3.11 State properties of determinants with simple examples.
- 3.12 Define multiplicative inverse of a matrix and list properties of adjoint and inverse.
- 3.13 Compute adjoint and multiplicative inverse of a square matrix.
- 3.14 Representation of system of linear equations (2 variables in 2 equations and 3 variables in 3 equations) in matrix form.
- 3.15 Solve system of linear equations using Cramer's rule.
- 3.16 Solve system of linear equations by matrix inversion method
- 3.17 State elementary row operations.
- 3.18 Solve a system of linear equations by Gauss- Jordan method

## UNIT – II

### Trigonometry :

- 4.0 Understand Trigonometric Ratios
- 4.1 Define trigonometric ratios of any angle.
- 4.2 List the values of trigonometric ratios at specified values.
- 4.3 Draw graphs of trigonometric functions

- 4.4 Explain periodicity of trigonometric functions.**
- 5.0 Solve simple problems on Compound Angles**
- 5.1 Define compound angles and state the formulae of  $\sin(A\pm B)$ ,  $\cos(A\pm B)$ ,  $\tan(A\pm B)$  and  $\cot(A\pm B)$**
- 5.2 Give simple examples on compound angles to derive the values of  $\sin 15^\circ$ ,  $\cos 15^\circ$ ,  $\sin 75^\circ$ ,  $\cos 75^\circ$ ,  $\tan 15^\circ$ ,  $\tan 75^\circ$  etc.**
- 5.3 Derive identities like  $\sin(A+B)\sin(A-B) = \sin^2 A - \sin^2 B$  etc.,**
- 5.4 Solve simple problems on compound angles.**
- 6.0 Solve problems using the formulae for Multiple and Sub- multiple Angles**
- 6.1 Derive the formulae of multiple angles  $2A$ ,  $3A$  etc and sub multiple angles  $A/2$  in terms of angle  $A$  of trigonometric functions.**
- 6.2 Derive useful allied formulas like  $\sin A = (1 - \cos 2A)/2$  etc.,**
- 6.3 Solve simple problems using the above formulae**
- 7.0 Apply Transformations for solving the problems in Trigonometry**
- 7.1 Derive the formulae on transforming sum or difference of two trigonometric ratios in to a product and vice versa- examples on these formulae.**
- 8.0 Use Inverse Trigonometric Functions for solving engineering problems**
- 8.1 Explain the concept of the inverse of a trigonometric function by selecting an appropriate domain and range.**
- 8.2 Define inverses of six trigonometric functions along with their domains and ranges.**
- 8.3 Derive relations between inverse trigonometric functions so that given  $A = \sin^{-1}x$ , express angle  $A$  in terms of other inverse trigonometric functions - with examples.**
- 8.4 State various properties of inverse trigonometric functions and identities like**
- $$\sin^{-1}x + \cos^{-1}x = \frac{\pi}{2} \text{ etc.}$$
- 8.5 Derive formulae like**
- $$\tan^{-1}x + \tan^{-1}y = \tan^{-1}\left(\frac{x+y}{1-xy}\right), \text{ where } x \geq 0, y \geq 0, xy < 1$$
- and solve simple problems. etc.,**
- 9.0 Solve Trigonometric Equations in engineering applications**



- 9.1** Explain what is meant by solutions of trigonometric equations and find the general solutions of  $\sin x=k$ ,  $\cos x =k$  and  $\tan x=k$  with appropriate examples.
- 9.2** Solve models of the type  $a \sin^2 x + b \sin x + c=0$ ,  $a \cos x + b \sin x=c$  etc., and problems using simple transformations.
- 10.0** Appreciate Properties of triangles and their solutions
- 10.1** State sine rule, cosine rule, tangent rule and projection rule.
- 10.2** Explain the formulae for  $\sin A/2$ ,  $\cos A/2$ ,  $\tan A/2$  and  $\cot A/2$  in terms of semi-perimeter and sides  $a, b, c$ .
- 10.3** List various formulae for the area of a triangle.
- 10.4** Solve problems using the above formulae.
- 10.5** Solve a triangle when (i) three sides, (ii) two sides and an included angle, (iii) two sides and an opposite angle-case of two solutions and (iv) one side and two angles are given.
- 11.0** Represent the Hyperbolic Functions in terms of logarithm functions
- 11.1** Define  $\sinh x$ ,  $\cosh x$  and  $\tanh x$  and list the hyperbolic identities.
- 11.2** Represent inverse hyperbolic functions in terms of logarithms.
- 12.0** Represent Complex numbers in various forms
- 12.1** Define complex number, its modulus, conjugate and list their properties.
- 12.2** Define the operations on complex numbers with examples.
- 12.3** Define amplitude of a complex number
- 12.4** Represent the complex number in various forms like modulus-amplitude (polar) form, Exponential (Euler) form – illustrate with examples.
- 12.5** State DeMoivre's theorem and its applications to complex numbers e.g., finding the roots, powers, simplifications of a complex number with illustrative examples

### **UNIT - III**

#### **Coordinate Geometry**

- 13.0** Solve the problems on Straight lines

**13.1 Write the different forms of a straight line – point slope form, two point form, intercept form, normal form and general form**

**13.2 Solve simple problems on the above forms**

**13.3 Find distance of a point from a line, acute angle between two lines, intersection of two non-parallel lines and distance between two parallel lines.**

**14.0 Solve the problems on Circles**

**14.1 Define locus of a point – circle and its equation.**

**14.2 Find the equation of a circle given**

(i) Center and radius

(ii) Two ends of a diameter

(iii) Centre and a point on the circumference

(iv) Three non collinear points

**14.3 Write the general equation of a circle and find the centre and radius.**

**15.0 Appreciate the properties of Conics in engineering applications**

**15.1 Define a conic section.**

**15.2 Explain the terms focus, directrix, eccentricity, axes and latus rectum of a conic with illustrations.**

**15.3 Find the equation of a conic when focus, directrix and eccentricity are given**

**15.4 Describe the properties of Parabola, Ellipse and Hyperbola in standard form.**

## **UNIT - IV**

### **Differential Calculus**

**16.0 Use the concepts of Limit and Continuity for solving the problems**

**16.1 Explain the concept of limit and meaning of  $\lim_{x \rightarrow a} f(x) = l$  and state the properties of limits.**

**16.2** Mention the Standard limits  $\lim_{x \rightarrow a} \frac{x^n - a^n}{x - a}$ ,  $\lim_{x \rightarrow 0} \frac{\sin x}{x}$ ,  $\lim_{x \rightarrow 0} \frac{\tan x}{x}$ ,  $\lim_{x \rightarrow 0} \frac{a^x - 1}{x}$ ,

$\lim_{x \rightarrow 0} \frac{e^x - 1}{x}$ ,  $\lim_{x \rightarrow 0} (1 + x)^{\frac{1}{x}}$ ,  $\lim_{x \rightarrow \infty} \left(1 + \frac{1}{x}\right)^x$  (All without proof).

**16.3** Solve the problems using the above standard limits

**16.4** Evaluate the limits of the type  $\lim_{x \rightarrow l} \frac{ax^2 + bx + c}{\alpha x^2 + \beta x + \gamma}$  and  $\lim_{x \rightarrow \infty} \frac{f(x)}{g(x)}$

**16.5** Explain the concept of continuity of a function at a point and on an interval with some examples whether a given function is continuous or not.

**17.0** Appreciate Differentiation and its meaning in engineering situations

**17.1** State the concept of derivative of a function  $y = f(x)$  – definition, first principle as

$\lim_{h \rightarrow 0} \frac{f(x+h) - f(x)}{h}$  and also provide standard notations to denote the derivative of a function.

**17.2** State the significance of derivative in scientific and engineering applications.

**17.3** Find the derivatives of elementary functions like  $x^n$ ,  $a^x$ ,  $e^x$ ,  $\log x$ ,  $\sin x$ ,  $\cos x$ ,  $\tan x$ ,  $\sec x$ ,  $\csc x$  and  $\cot x$  using the first principles.

**17.4** Find the derivatives of simple functions from the first principle .

**17.5** State the rules of differentiation of sum, difference, scalar multiplication, product and quotient of functions with illustrative and simple examples.

**17.6** Explain the method of differentiation of a function of a function (Chain rule) with illustrative examples such as

$$(i) \sqrt{t^2 + \frac{2}{t}} \quad (ii) x^2 \sin 2x \quad (iii) \frac{x}{\sqrt{x^2 + 1}} \quad (iv) \log(\sin(\cos x)) .$$

**17.7** Find the derivatives of Inverse Trigonometric functions and examples using the Trigonometric transformations.

**17.8** Explain the method of differentiation of a function with respect to another function and also differentiation of parametric functions with examples.

**17.9** Find the derivatives of hyperbolic functions.

**17.10 Explain the procedures for finding the derivatives of implicit function with examples.**

**17.11 Explain the need of taking logarithms for differentiating some functions with examples like  $[f(x)]^{g(x)}$ .**

**17.12 Explain the concept of finding the higher order derivatives of second and third order with examples.**

**17.13 Explain the concept of functions of several variables, partial derivatives and difference between the ordinary and partial derivatives with simple examples.**

**17.14 Explain the definition of Homogenous function of degree n**

**17.15 Explain Euler's theorem for homogeneous functions with applications to simple problems.**

## **UNIT - V**

### **Applications of the Differentiation**

**18.0 Understand the Geometrical Applications of Derivatives**

**18.1 State the geometrical meaning of the derivative as the slope of the tangent to the curve  $y=f(x)$  at any point on the curve.**

**18.2 Explain the concept of derivative to find the slope of tangent and to find the equation of tangent and normal to the curve  $y=f(x)$  at any point on it.**

**18.3 Find the lengths of tangent, normal, sub-tangent and sub normal at any point on the curve  $y=f(x)$ .**

**18.4 Explain the concept of angle between two curves and procedure for finding the angle between two given curves with illustrative examples.**

**19.0 Understand the Physical Applications of Derivatives**

**19.1 Explain the derivative as a rate of change in distance-time relations to find the velocity and acceleration of a moving particle with examples.**

**19.2 Explain the derivative as a rate measurer in the problems where the quantities like volumes, areas vary with respect to time- illustrative examples.**

**20.0 Use Derivatives to find extreme values of functions**

**20.1 Define the concept of increasing and decreasing functions.**

**20.2 Explain the conditions to find points where the given function is increasing or decreasing with illustrative examples.**

**20.3 Explain the procedure to find the extreme values (maxima or minima) of a function of single variable - simple problems yielding maxima and minima.**

**20.4 Solve problems on maxima and minima in applications like finding areas, volumes, etc.**

**21.0 Use Derivatives to find Errors and Approximations**

**21.1 Find the absolute error, approximate error, relative error and percentage error in functions of single variable.**

## **COURSE CONTENT**

### **Unit-I**

#### **Algebra**

##### **1. Logarithms :**

**Definition of logarithm and its properties, natural and common logarithms; the meaning of  $e$  and exponential function, logarithm as a function and its graphical representation.**

##### **2. Partial Fractions :**

**Rational, proper and improper fractions of polynomials. Resolving rational fractions in to their partial fractions covering the types mentioned below:**

$$i) \frac{f(x)}{(x+a)(x+b)(x+c)} \quad ii) \frac{f(x)}{(x+a)^2(x+b)(x+c)}$$

$$iii) \frac{f(x)}{(x^2+a)(x+b)} \quad iv) \frac{f(x)}{(x+a)(x^2+b)^2}$$

### Matrices:

**3. Definition of matrix, types of matrices-examples, algebra of matrices-equality of two matrices, sum, scalar multiplication and product of matrices. Transpose of a matrix-Symmetric, skew symmetric matrices-Minor, cofactor of an element-Determinant of a square matrix-Laplace's expansion, properties of determinants. Singular and non singular matrices-Adjoint and multiplicative inverse of a square matrix- examples-System of linear equations in 2 or 3 variables-Solutions by Cramer's rule, Matrix inversion method-examples-Elementary row operations on matrices -Gauss-Jordan method to solve a system of equations.**

### Unit-II

#### Trigonometry :

**4. Trigonometric ratios: definition of trigonometric ratios of any angle, values of trigonometric ratios at specified values, draw graphs of trigonometric functions, periodicity of trigonometric functions.**

**5. Compound angles: Formulas of  $\sin(A \pm B)$ ,  $\cos(A \pm B)$ ,  $\tan(A \pm B)$ ,  $\cot(A \pm B)$ , and related identities with problems.**

**6. Multiple and sub multiple angles: trigonometric ratios of multiple angles  $2A, 3A$  and submultiple angle  $A/2$  with problems.**

**7. Transformations of products into sums or differences and vice versa simple problems**

**8. Inverse trigonometric functions : definition, domains and ranges-basic properties-problems.**

**9. Trigonometric equations: concept of a solution, principal value and general solution of trigonometric equations :**

$$\sin x = k, \cos x = k, \tan x = k.$$

**Solutions of simple quadratic equations, equations involving usage of transformations-problems.**

**10. Properties and solutions of triangles: relation between sides and angles of a triangle-sine rule, cosine rule, tangent rule and projection rule-area of a triangle- solving a triangle- problems.**

**11. Hyperbolic functions: Definitions of hyperbolic functions, identities of hyperbolic functions, inverse hyperbolic functions and expression of inverse hyperbolic functions in terms of logarithms.**

**12. Complex Numbers: Definition of a complex number, Modulus and conjugate of a complex number, Arithmetic operations on complex numbers, Modulus- Amplitude (polar) form, Exponential form (Euler) form of a complex number- Problems. DeMoivre's Theorem and its applications in complex numbers- Simple problems.**

### **UNIT-III**

#### **Coordinate geometry**

**13. Straight lines: various forms of straight lines, angle between lines, perpendicular distance from a point, distance between parallel lines-examples.**

**14. Circle: locus of a point, Circle definition-Circle equation given (i) center and radius, (ii) two ends of a diameter (iii) centre and a point on the circumference (iv) three non collinear points - general equation of a circle - finding center, radius.**

**15. Definition of a conic section, equation of a conic when focus directrix and eccentricity are given. Properties of parabola, ellipse and hyperbola, standard forms.**

### **UNIT-IV**

#### **Differential Calculus**

**16. Concept of Limit- Definition- Properties of Limits and Standard Limits -Simple Problems-Continuity of a function at a point- Simple Examples only.**

**17. Concept of derivative- definition (first principle) - different notations-derivatives of elementary functions - problems. Derivatives of sum, product, quotient, scalar multiplication of functions - problems. Chain rule, derivatives of inverse trigonometric functions, derivative of a function with respect to another function, derivative of parametric functions, derivative of hyperbolic, implicit functions, logarithmic differentiation – problems in each case. Higher order derivatives - examples – functions of several variables – partial differentiation, Euler's theorem-simple problems.**

## **UNIT-V**

### **Applications of Derivatives:**

**18. Geometrical meaning of the derivative, equations of Tangent and normal to a curve at any point. Lengths of tangent, normal, sub tangent and subnormal to the curve at any point. Angle between the curves - problems.**

**19. Physical applications of the derivative – velocity, acceleration, derivative as a rate Measure – Problems.**

**20. Applications of the derivative to find the extreme values – Increasing and decreasing functions, finding the maxima and minima of simple functions - problems leading to applications of maxima and minima.**

**21. Applications of derivative in finding errors and approximations of functions and simple problems.**

### **Reference Books :**

- 1. A text book of matrices by Shanti Narayan,**
- 2. Plane Trigonometry, by S.L Loney**
- 3. Co-ordinate Geometry, by S.L Loney**
- 4. Thomas Calculus, Pearson Addison-Wesley publishers**
- 5. Calculus – I, by Shanti Narayan and Manicavachgam Pillai, S.V Publications**



## ENGINEERING PHYSICS

|                               |          |                            |
|-------------------------------|----------|----------------------------|
| <b>Subject Title</b>          | <b>:</b> | <b>Engineering Physics</b> |
| <b>Subject Code</b>           | <b>:</b> | <b>CH -103 COMMON-103</b>  |
| <b>Periods per week</b>       | <b>:</b> | <b>04</b>                  |
| <b>Total periods per year</b> | <b>:</b> | <b>120</b>                 |

### TIME SCHEDULE

| S.No | Major Topics            | No. of     | Weightage of Marks | Short     | Essay Type |
|------|-------------------------|------------|--------------------|-----------|------------|
| 1.   | Units and Dimensions    | 08         | 03                 | 1         | -          |
| 2.   | Elements of Vectors     | 12         | 13                 | 1         | 1          |
| 3.   | Kinematics              | 14         | 13                 | 1         | 1          |
| 4.   | Friction                | 08         | 10                 | -         | 1          |
| 5.   | Work, Power and Energy  | 12         | 10                 | -         | 1          |
| 6.   | Simple Harmonic Motion  | 12         | 13                 | 1         | 1          |
| 7.   | Heat & Thermodynamics   | 12         | 13                 | 1         | 1          |
| 8.   | Sound                   | 12         | 13                 | 1         | 1          |
| 9.   | Properties of matter    | 10         | 06                 | 2         | -          |
| 10.  | Electricity & magnetism | 12         | 13                 | 1         | 1          |
| 11.  | Modern Physics          | 08         | 03                 | 1         | -          |
|      | <b>Total:</b>           | <b>120</b> | <b>110</b>         | <b>10</b> | <b>8</b>   |

### OBJECTIVES

Upon completion of the course the student shall be able to

- 1.0 Understand the concept of Units and dimensions
  - 1.1 Explain the concept of Units
  - 1.2 Define the terms
    - a) Physical quantity, b) Fundamental physical quantities and
    - c) Derived physical quantities
- 1.3 Define unit
- 1.4 Define fundamental units and derived units
- 1.5 State SI units with symbols

- 1.6 State Multiples and submultiples in SI system**
- 1.7 State Rules of writing S.I. units**
- 1.8 State advantages of SI units**
- 1.9 Define Dimensions**
- 1.10 Write Dimensional formulae**
- 1.11 Derive dimensional formulae of physical quantities**
- 1.12 List dimensional constants and dimensionless quantities**
- 1.13 State the principle of Homogeneity of Dimensions**
- 1.14 State the applications of Dimensional analysis**
- 1.15 State the limitations of dimensional analysis**
- 1.16 Solve problems**
- 2.0 Understand the concept of Elements of Vectors**
  - 2.1 Explain the concept of Vectors**
  - 2.2 Define Scalar and Vector quantities**
  - 2.3 Give examples for scalar and vector quantities**
  - 2.4 Represent vectors graphically**
  - 2.5 Classify the Vectors**
  - 2.6 Resolve the vectors**
  - 2.7 Determine the Resultant of a vector by component method**
  - 2.8 Represent a vector in space using unit vectors (  $\hat{i}$ ,  $\hat{j}$ ,  $\hat{k}$  )**
  - 2.9 State triangle law of addition of vectors**
  - 2.10 State parallelogram law of addition of vectors**
  - 2.11 Illustrate parallelogram law of vectors in case of flying bird and sling.**
  - 2.12 Derive expression for magnitude and direction of resultant of two vectors**
  - 2.13 State polygon law of addition of vectors**
  - 2.14 Explain subtraction of vectors**
  - 2.15 Define Dot product of two vectors with examples (Work done, Power)**

- 2.16** Mention the properties of Dot product
  - 2.17** Define Cross products of two vectors with examples (Torque, Linear velocity)
  - 2.18** Mention the properties of Cross product.
  - 2.19** Solve the related numerical problems
- 3.0** Understand the concept of Kinematics
- 3.1** Write the equations of motion in a straight line
  - 3.2** Explain the acceleration due to gravity
- 3.3** Derive expressions for vertical motion
- a) Maximum Height, b) time of ascent, c) time of descent, and d) time of flight
- 3.4** Derive height of a tower when a body projected vertically upwards from the top of a tower.
- 3.5** Explain projectile motion with examples
  - 3.6** Explain Horizontal projection
  - 3.7** Derive an expression for the path of a projectile in horizontal projection
  - 3.8** Explain oblique projection
  - 3.9** Derive an expression for the path of projectile in oblique projection
  - 3.10** Derive formulae for projectile in oblique projection
- a) Maximum Height, b) time of ascent, c) time of descent, and d) time of flight
- e) Horizontal Range, f) Maximum range
- 3.11** Solve the related numerical problems
- 4.0** Understand the concept of Friction
- 4.1** Define friction
  - 4.2** Classify the types of friction and define
  - 4.3** Explain the concept of Normal reaction

- 4.4 State the laws of friction
- 4.5 Define coefficients of friction
- 4.6 Explain the Angle of friction
- 4.7 Derive an expression for acceleration of a body on a rough horizontal surface
- 4.8 Derive an expression for the displacement and time taken to come to rest over a rough horizontal surface
- 4.9 Define Angle of repose
- 4.10 Derive expressions for acceleration of a body on a smooth inclined plane (up and down)
- 4.11 Derive expressions for acceleration of a body on a rough inclined plane (up and down)
- 4.12 List the Advantages and Disadvantages of friction
- 4.13 Mention the methods of minimizing friction
- 4.14 Solve the related numerical problems
- 5.0 Understand the concepts of Work, Power, and Energy
  - 5.1 Define the terms 1.Work, 2. Power and Energy
  - 5.2 State SI units and dimensional formulae for 1.Work, 2. Power, and Energy
  - 5.3 Define potential energy and state examples
  - 5.4 Derive the expression for Potential energy
  - 5.5 Define kinetic energy and state examples
  - 5.6 Derive the expression for kinetic energy
  - 5.7 State and derive Work- Energy theorem
  - 5.8 Derive the relation between Kinetic energy and momentum
  - 5.9 State the law of conservation of energy and mention examples

**5.10** Verify the law of conservation of energy in the cases of a freely falling body and vertically projected body in the upward direction

**5.11** Solve the related numerical problems

**6.0** Understand the concept of Simple harmonic motion

**6.1** Define Simple harmonic motion

**6.2** Give examples for Simple harmonic motion

**6.3** State the conditions of Simple harmonic motion

**6.4** Explanation of SHM in terms of projection of circular motion on any one of the diameters of the circular path

**6.5** Derive expression for displacement

**6.6** Derive expression for velocity

**6.7** Derive expression for acceleration

**6.8** Derive expression for Time period and frequency of S H M

**6.9** Define phase of S H M and explain from the expression of displacement

**6.10** Define Ideal simple pendulum and derive expression for Time period of simple pendulum

**6.11** State the laws of motion of simple pendulum and mention formulae

**6.12** Solve the related numerical problems

**7.0** Understand the concept of Heat and thermodynamics

**7.1** Explain the concept of expansion of gases

**7.2** State and explain Boyle's law and also express it in terms of density

**7.3** Define absolute zero temperature

**7.4** Explain absolute scale of temperature

**7.5** State Charles laws in terms of absolute temperature and explain

**7.6** Define ideal gas and distinguish from real gas

**7.7** Derive Ideal gas equation

- 7.8 Define Specific gas constant and Universal gas constant
- 7.9 Explain why universal gas constant is same for all gases
- 7.10 State SI unit and dimensional formula of universal gas constant
- 7.11 Calculate the value of universal gas constant
- 7.12 State the gas equation in different forms ( as a function of density and mass )
- 7.13 Distinguish between  $r$  and  $R$
- 7.14 State and Explain Isothermal process
- 7.15 State and Explain adiabatic process
- 7.16 Distinguish between isothermal and adiabatic processes
- 7.17 State first and second laws of thermodynamics and state applications
- 7.18 Define specific heats & molar specific heats of a gas and differentiate them
- 7.19 Derive the relation  $C_p - C_v = R$  ( Mayer's Equation)
- 7.20 Solve the relevant numerical problems

## 8.0 Understand the concept of Sound

- 8.1 Define the term sound
- 8.2 Explain longitudinal and transverse wave motion and state differences
- 8.3 Distinguish between musical sound and noise
- 8.4 Explain noise pollution and state SI unit for intensity level of sound
- 8.5 Explain causes of noise pollution
- 8.6 Explain effects of noise pollution
- 8.7 Explain methods of minimizing noise pollution
- 8.8 Explain the phenomenon of beats
- 8.9 State the applications of beats
- 8.10 Define Doppler effect

- 8.11 List the Applications of Doppler effect**
- 8.12 Define reverberation and reverberation time**
- 8.13 Write Sabine's formula and name the parameters contained**
- 8.14 Define and Explain echoes and also state its applications**
- 8.15 State conditions of good auditorium**
- 8.16 Solve the related numerical problems**

**9.0 Understand the properties of matter**

- 9.1 Define the term Elasticity**
- 9.2 Define the terms stress and strain and also define different types of stress and strain**
- 9.3 State the units and dimensional formulae for stress and strain**
- 9.4 State and explain Hooke's law**
- 9.5 Define surface tension and state examples**
- 9.6 Explain Surface tension with reference to molecular theory**
- 9.7 Define angle of contact**
- 9.8 Define capillarity**
- 9.9 Write the formula for surface tension based on capillarity and name the parameters**
- 9.10 Explain the concept of Viscosity**
- 9.11 Mention examples of Viscosity**
- 9.12 State Newton's formula for viscous force and explain**
- 9.13 Define co-efficient of viscosity and write its units and dimensional formula**
- 9.14 Explain the effect of temperature on viscosity of liquids and gases**
- 9.15 State Poiseulle's equation for Co-efficient of viscosity and name the physical quantities involved**
- 9.16 Solve the related numerical problems**

**10.0 Understand the concept of Electricity and Magnetism**

**10.1 Explain the concept of Electricity**

**10.2 State Ohm's law and write the formula**

**10.3 Explain Ohm's law**

**10.4 Define specific resistance, conductance and state their units**

**10.5 State Kichoff's laws**

**10.6 Explain Kichoff's laws**

**10.7 Describe Wheatstone's bridge with legible sketch**

**10.8 Derive an expression for balancing condition of Wheatstone's bridge**

**10.9 Describe Meter Bridge experiment for the determination of resistivity with a neat circuit diagram**

**10.10 Write the formula in Meter Bridge to determine specific resistance**

**10.11 Explain the concept of magnetism**

**10.12 State the Coulomb's inverse square law of magnetism**

**10.13 Define magnetic field and magnetic lines of force and write the properties of magnetic lines of force**

**10.14 State the Magnetic induction field strength and mention its units and dimensional formula**

**10.15 Derive an expression for the moment of couple on a bar magnet placed in a uniform magnetic field**

**10.16 Derive Magnetic induction field strength at a point on the axial line**

**10.17 Derive Magnetic induction field strength at a point on the equatorial line**

**10.18 Solve the related numerical problems**

**11.0 Understand the concept of Modern physics**

**11.1 State and Explain Photo-electric effect**

**11.2 Write Einstein's photoelectric equation and explain**



- 11.3 State laws of photoelectric effect**
- 11.4 Explain the Working of photoelectric cell**
- 11.5 List the Applications of photoelectric effect**
- 11.6 Recapitulate refraction of light and its laws**
- 11.7 Define critical angle**
- 11.8 Explain the Total Internal Reflection**
- 11.9 Explain the principle and working of Optical Fiber**
- 11.10 Mention types of optical fibers**
- 11.11 List the applications of Optical Fiber**
- 11.12 Define super conductor and superconductivity and mention examples for superconductors**
- 11.13 State the properties of superconducting materials**
- 11.14 List the applications of superconductors**

## **COURSE CONTENT**

### **1. Units and Dimensions:**

**Introduction – Physical quantity – Fundamental and Derived quantities – Fundamental and Derived units- SI units –Multiples and Sub multiples – Rules for writing S.I. units- Advantages of SI units – Dimensions and Dimensional formulae- Dimensional constants and Dimensionless quantities- Principle of Homogeneity- Advantages and limitations of Dimensional analysis- - Problems.**

### **2. Elements of Vectors:**

**Scalars and Vectors –Types of vectors(Proper Vector, Null Vector, Unit Vector, Equal , Negative Vector, Like Vectors, Co-Initial Vectors, Co-planar Vectors and Position Vector).Addition of vectors- Representation of vectors- Resolution of vectors - Parallelogram, Triangle and Polygon laws of vectors–Subtraction of vectors- Dot and Cross products of vectors-Problems**

### **3. Kinematics**

**Introduction- Concept of acceleration due to gravity- Equations of motion for a freely falling body and for a body thrown up vertically- Projectiles- Horizontal and Oblique projections- Expressions for maximum height, time of flight, range - problems**

### **4. Friction:**

**Introduction to friction- Causes- Types of friction- Laws of friction- Angle of repose- Angle of friction— Motion of a body over a horizontal surface- smooth inclined plane- rough inclined plane- Advantages and disadvantages of friction- Methods of reducing friction – Problems**

### **5. Work, Power and Energy:**

**Work, Power and Energy- Definitions and explanation- potential energy- kinetic energy-Derivations of Potential and Kinetic energies-K.E and Momentum relation - Work-Energy theorem- Law of Conservation of energy- Problems**

### **6. Simple Harmonic Motion:**

**Introduction- Conditions of SHM- Definition- Examples- Expressions for displacement, velocity, acceleration, Time period, frequency and phase in SHM- Time period of a simple pendulum- Laws of simple pendulum-seconds pendulum- Problems**

### **7. Heat and Thermodynamics:**

**Expansion of Gases- Boyle's law- Absolute scale of temperature- Charles laws- Ideal gas equation- Universal gas constant- Differences between  $r$  and  $R$ - Isothermal and adiabatic processes- Laws of thermodynamics- Specific heats - molar specific heats of a gas –Derivation of Mayer's Equation- Problems**

### **8. Sound:**

**Sound- Nature of sound- Types of wave motion -musical sound and noise- Noise pollution – Causes & effects- Methods of reducing noise pollution- Beats- Doppler effect- Echo- Reverberation-Reverberation time-Sabine 's formula-Conditions of good auditorium- Problems**

## **9. Properties of matter**

**Definition of Elasticity –Definition of stress and strain -the units and dimensional formulae for stress and strain-The Hooke’s law- Definition of surface tension- Explanation of Surface tension with reference to molecular theory - Definition of angle of contact - Definition of capillarity -The formula for surface tension based on capillarity - Explanation of concept of Viscosity - Examples for surface tension and Viscosity - Newton’s formula for viscous force- Definition of co-efficient of viscosity- The effect of temperature on viscosity of liquids and gases - Poiseuille’s equation for Co-efficient of viscosity- The related numerical problems**

## **10. Electricity & Magnetism:**

**Ohm’s law and explanation- Specific resistance- Kirchoff ’s laws- Wheatstone’s bridge - Meter bridge- Coulomb’s inverse square law magnetic field- magnetic lines of force- Magnetic induction field strength- magnetic induction field strength at a point on the axial line - magnetic induction field strength at a point on the equatorial line –problems.**

## **11. Modern Physics;**

**Photoelectric effect –Einstein’s photoelectric equation-laws of photoelectric effect - photoelectric cell –Applications of photo electric effect- Total internal reflection- fiber optics- -principle and working of an optical fiber-types of optical fibers - Applications of optical fibers- superconductivity - applications**

## **REFERENCE BOOKS**

- |   |                              |
|---|------------------------------|
| <b>1. Intermediate physics Volume-I &amp; 2<br/>English version )</b> | <b>Telugu Academy (</b>      |
| <b>2. Unified physics Volume 1,2,3 and 4<br/>Sanjeev Guptha</b>       | <b>Dr.S.L Guptha and</b>     |
| <b>3. Text book of physics Volume I</b>                               | <b>Resnick &amp; Holiday</b> |
| <b>4. Text book of applied physics</b>                                | <b>Dhanpath Roy</b>          |
| <b>5. Fibre optics</b>  | <b>D.A Hill</b>              |
| <b>6. NCERT Text Books ----- XI &amp; XII Standard</b>                |                              |

**Blue Print for setting question paper at different levels**

| S.No | Major Topics            | No. of Periods | Weightage of Marks | Short answer |          |          | Essay type |          |          |
|------|-------------------------|----------------|--------------------|--------------|----------|----------|------------|----------|----------|
|      |                         |                |                    | K            | U        | A        | K          | U        | A        |
| 1.   | Units and Dimensions    | 08             | 03                 | 1            | 0        | 0        | 0          | 0        | 0        |
| 2.   | Elements of Vectors     | 12             | 13                 | 0            | 0        | 1        | 0          | 1        | 0        |
| 3.   | Kinematics              | 14             | 13                 | 0            | 1        | 0        | 1          | 0        | 0        |
| 4.   | Friction                | 08             | 10                 | 0            | 0        | 0        | 0          | 1        | 0        |
| 5.   | Work, Power and Energy  | 12             | 10                 | 0            | 0        | 0        | 0          | 1        | 0        |
| 6.   | Simple Harmonic Motion  | 12             | 13                 | 0            | 0        | 1        | 0          | 1        | 0        |
| 7.   | Heat & Thermodynamics   | 12             | 13                 | 0            | 1        | 0        | 1          | 0        | 0        |
| 8.   | Sound                   | 12             | 13                 | 0            | 1        | 0        | 0          | 0        | 1        |
| 9.   | Properties of Matter    | 10             | 06                 | 1            | 1        | 0        | 0          | 0        | 0        |
| 10.  | Electricity & magnetism | 12             | 13                 | 0            | 1        | 0        | 0          | 1        | 0        |
| 11.  | Modern Physics          | 08             | 03                 | 1            | 0        | 0        | 0          | 0        | 0        |
|      | <b>Total:</b>           | <b>120</b>     | <b>110</b>         | <b>3</b>     | <b>5</b> | <b>2</b> | <b>2</b>   | <b>2</b> | <b>5</b> |

## INORGANIC CHEMISTRY

**Subject** : Inorganic Chemistry  
**Subject Code** : CH – 104  
**Periods / Week** : 04  
**Periods / Year** : 120

### TIME SCHEDULE

| Sl. No. | MAJOR TOPICS               | No. of Periods | Weightage Of Marks | Short answer type | Essay type |
|---------|----------------------------|----------------|--------------------|-------------------|------------|
| 1.      | Classification of Elements | 10             | 08                 | 1                 | ½          |
| 2.      | “s” Block Elements         | 16             | 13                 | 1                 | 1          |
| 3.      | “p” Block Elements         | 32             | 26                 | 2                 | 2          |
| 4.      | “d” Block Elements         | 08             | 08                 | 1                 | ½          |
| 5.      | Solutions                  | 12             | 13                 | 1                 | 1          |
| 6.      | Acids – bases              | 12             | 13                 | 1                 | 1          |
| 7.      | Oxidation – Reduction      | 10             | 08                 | 1                 | ½          |
| 8.      | Water Technology           | 12             | 13                 | 1                 | 1          |
| 9.      | Principles of Metallurgy   | 08             | 08                 | 1                 | ½          |
| Total   |                            | 120            | 110                | 10                | 08         |

### OBJECTIVES:

After the completion of the subject, the student will be able to know.

#### 1 CLASSIFICATION OF ELEMENTS

- 1.1 Need for classification of Elements
- 1.2 State the modern periodic law
- 1.3 Periodicity and periodic properties
- 1.4 Main features of modern periodic table
- 1.5 Classification of Elements into s,p,d,f blocks

#### 2 “S” BLOCK ELEMENTS

- 2.1.1 Elements of Group IA – General Properties
  - a) Electronic configuration
  - b) Metallic – Non Metallic character
  - c) Ionization potential
  - d) Electron affinity
  - e) Electro positive nature
- 2.1.2 Physical Properties
  - a) Physical State
  - b) Metallic Character
  - c) Density
  - d) Melting Point and Boiling Point
  - e) Bonding
- 2.1.3 Chemical Properties
  - a) Oxides
  - b) Hydrides
  - c) Halides

- 2.1.4 Compounds of 1<sup>st</sup> Group elements
  - a) Preparation of NaOH (by Castner – Kelner process)
  - b) Physical properties Chemical Properties
  - c) Chemical properties and uses of Na<sub>2</sub>CO<sub>3</sub>
- 2.2 Elements of II A Group Elements – General Properties
  - a) Electronic configuration
  - b) Metallic – Non Metallic character
  - c) Ionization Potential
  - d) Electron affinity
  - e) Electropositive nature
- 2.2.1 Physical Properties
  - a) Melting Point and Boiling Point
  - b) Density
  - c) Bonding
- 2.2.3 Chemical Properties
  - a) Oxides
  - b) Hydrides
  - c) Halides
- 2.2.4 Chemical Properties and uses of
  - a) CaO b) Ca (OH)<sub>2</sub> c) CaCl<sub>2</sub>

### 3. “p” Block Elements

- 3.1.1 Elements of III A group – General properties
  - a) Electronic configurations
  - b) Ionization Energy
  - c) Electronegative nature
  - d) Metallic and Non Metallic character
  - e) Electropositive nature
- 3.1.2 Physical Properties
  - a) M.P b) B.P c) Bonding
- 3.1.3 Extraction of aluminum (Hall herald process)
- 3.1.4 Chemical Properties
  - a) Oxides
  - b) Halides
- 3.1.5 Chemical Properties and uses of
  - a) Boric Acid b) Potash Alum
- 3.2 Elements of IV A group – general properties
  - 3.2.1 Describe the properties and uses of carbon & silicon
  - 3.2.2 State the allotropy of carbon and silicon
  - 3.2.3 Describe the properties and uses of oxides of carbon
  - 3.2.4 Describe the allotropic forms of carbon and their uses
- 3.3. Elements of V group – General Properties
  - a) Electronic Configuration
  - b) Ionization potential
  - c) Electro negativity
  - d) Electropositive nature
- 3.3.1 Physical and Chemical Properties
  - a) M.P. and B.P
  - b) Bonding
  - c) Oxides and Oxy-acids

- d) Hydroxides
- e) Halides
- 3.3.2 Preparation of  $\text{NH}_3$  by Haber process
- 3.3.3 Physical properties and chemical properties of  $\text{NH}_3$ 
  - a)  $\text{NH}_3 + \text{CO}_2$
  - b)  $\text{NH}_3 + \text{Na}$
  - c) Basic Nature
  - d) Action with halogens
  - e) Actions with  $\text{CaOCl}_2$
- 3.3.4 Uses of Ammonia
- 3.3.5 Preparation of  $\text{HNO}_3$  (Berkland-Eyde Process)
- 3.3.6 Physical and Chemical Properties of  $\text{HNO}_3$ 
  - a) M.P and B.P
  - b) Oxidizing Properties
  - c) Action of Metals
  - d) Action of Organic compounds
  - e) Formation of Aquaregia
  - f) Decomposition
- 3.3.7 Allotropic forms of phosphorus
- 3.4 VI Group elements – General properties
  - a) Electronic configuration
  - b) Ionization Potential
  - c) Electro negativity
  - d) Electro positivity
- 3.4.1 Physical properties of VI group elements
  - a) M.P and B.P b) Bonding.
- 3.4.2 Chemical properties
  - a) Oxides and Oxyacids
  - b) Halides
  - c) Hydrides
- 3.4.3
  - a) Preparation of ozone (Siemen's and Halske's method)
  - b) Physical and chemical properties of ozone
  - c) Uses of ozone
- 3.4.4
  - a) Allotropic forms of "S"
  - b) Physical and chemical properties of "S"
- 3.4.5. Heavy water properties and uses.
- 3.5 VII A group elements
  - a) General properties of VII group elements
  - b) Preparation of fluorine (Whyt law – gray's method)
  - c) Preparation of chlorine (Nelson Method)
  - d) Preparation of HCl
  - e) Physical and Chemical properties and uses of HCl
  - f) Preparations, properties and uses of bleaching powder (Bachman's Plant)

#### **4. "d" BLOCK ELEMENTS (Transition Elements)**

- 4.1 General Properties of transition elements
- 4.2 General characteristics
- 4.3 Werner's theory of complex compounds
- 4.4 Effective atomic numbers

## 5 SOLUTIONS:

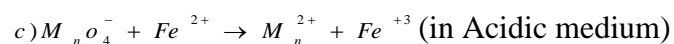
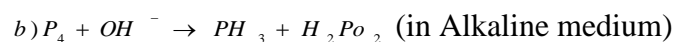
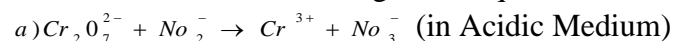
- 5.1 Definitions of solutions, solute, solvent.
- 5.2 Aqueous solutions, alcoholic solutions
- 5.3 Define Molarity, Normality and Mole fractions
- 5.4 Simple problems based on concentration method
- 5.5 Buffer solutions, different types of buffer solutions application of buffer solutions
- 5.6 Define dilute solutions and Raoult's Law
- 5.7 Define Vapour pressure and determination by Ostwald's method
- 5.8 Solubility of a solid in liquid

## 6. ACIDS – BASES

- 6.1 Arrhenius concept of acids and bases with examples
- 6.2 Lowry Bronsted concept with examples
- 6.3 Lewis concept with examples
- 6.4 Definition of pH – pH Scale
- 6.5 Simple problems based on pH
- 6.6 Theories of Indicators
- 6.7 Ostwald's theory of acid and base indicator.
- 6.8 Postulates of Ostwald's theory.
- 6.9 Action of phenolphthalein and methylorange indicators.

## 7. OXIDATION - REDUCTION

- 7.1 Oxidation – Reduction based on electronic concept
- 7.2 Definition of oxidation number
- 7.3 Rules determining oxidation numbers
- 7.4 Calculate the oxidation numbers
- 7.5 Rules determining the balancing of equations by ion electron method
- 7.6 Balance the following Ionic Equations



## 8 WATER TECHNOLOGY

- 8.1 Soft water and hard water
- 8.2 Temporary and permanent hardness
- 8.3 Units of degree of hardness
- 8.4 Interaction between units of degree of hardness
- 8.5 Calculations of total hardness – Simple problems
- 8.6 Definitions Of Osmosis and Reverse osmosis with examples, their advantages and applications

## 9 METALLURGY – GENERAL PRINCIPLES

- 9.1 Introduction
- 9.2 Occurrence of Metals
- 9.3 Characteristic of metals
- 9.4 Metallurgy – Metallurgical operations

## COURSE CONTENTS

### 1. Periodic classification of elements



Classification – periodic law – periodicity and periodic properties classification of elements into s, p, d, f blocks.

2. **S – Block elements** (Alkali metals and Alkaline earth metals)  
Elements of group IA – General properties, physical and chemical properties of compounds of I group i.e. NaOH, Na<sub>2</sub>CO<sub>3</sub> – preparations, properties and uses.
- 3 **P – Block Elements** (III, IV, V, VI, VII group elements)
  - A. III Group: General Properties – Physical properties, chemical properties – compounds of III Group – Boric acid, Potash Alum properties – uses.
  - B. IV Group: Describe the properties of carbon, sulphur – state the allotropes of carbon, silicon – properties, uses of oxides.
  - C. V Group: General properties, physical and chemical properties, preparation of NH<sub>3</sub>, HNO<sub>3</sub> - chemical, physical properties and uses – allotropic forms of “P”
  - D. VI Group: General properties – physical and chemical properties preparation of ozone and heavy water – their properties and uses – allotropic form of “S”
  - E. VII Group: General properties – preparation and properties of fluorine, chlorine, HCl – preparation of Bleaching powder (by Bachmann’s plant) – uses.
- 4 **D – BLOCK ELEMENTS (Transition Elements)**  
General properties of transition elements – some general characteristics – werner’s theory of complex compounds – effective atomic number
- 5 **Solutions** – Concentration methods, problems – buffer solutions – colligative properties - solubility
- 6 **Acids and bases** – Arrhenius acid base theory – Lowry Bronsted concept – Lewis concept – pH Problems- theory of indicators.
- 7 **Oxidation – Reduction** – definition - rules determining – calculation of oxidation numbers – balancing the equations by Ion electron method.
- 8 **WATER TECHNOLOGY**  
Soft and hard water – temporary and permanent hardness units of degree of hardness – their inter relations – calculation of degree of hardness – osmosis and reverse osmosis
- 9 **Metallurgy – General Principles**  
Introductions – occurrence of metals – characteristics of metals – metallurgy – various metallurgical operations

#### REFERENCE BOOKS

1. Intermediate 1<sup>st</sup> Year Chemistry by Telugu Akademi (2002 Editor)
2. Intermediate 2<sup>nd</sup> Year Chemistry by Telugu Akademi (2002 Editor)
3. Unified Chemistry for B.Sc. Students, JPNN, Meerut
4. Inorganic Chemistry by P.L. Soni
5. Engineering Chemistry by B.K. Sharma
6. Engineering Chemistry by O.P. Agarwal
7. Engineering Chemistry by Jain & Jain

## GENERAL MECHANICAL ENGINEERING

**Subject Name** : General Mechanical Engineering  
**Subject Code** : CH-105  
**Periods/Week** : 05  
**Periods /Year** : 150

### TIME SCHEDULE

| S.No  | Major Topics                     | No. of Periods | Weightage of Marks | Short answer type | Essay type |
|-------|----------------------------------|----------------|--------------------|-------------------|------------|
| 1.    | Measuring Instruments            | 16             | 13                 | 1                 | 1          |
| 2.    | Fitting Operations               | 16             | 13                 | 1                 | 1          |
| 3.    | Welding                          | 16             | 13                 | 1                 | 1          |
| 4.    | Friction and Lubrication         | 16             | 03                 | 1                 | 0          |
| 5.    | Transmission of Mechanical Power | 10             | 13                 | 1                 | 1          |
| 6.    | I.C. Engines                     | 21             | 16                 | 2                 | 1          |
| 7.    | Boilers                          | 25             | 18                 | 1                 | 1½         |
| 8.    | Properties Of Steam              | 10             | 08                 | 1                 | ½          |
| 9.    | Steam Nozzels & Steam Turbines   | 20             | 13                 | 1                 | 1          |
| Total |                                  | 150            | 110                | 10                | 08         |

### OBJECTIVES

On completion of the study of the subject the student will be able to

#### 1.0 Know about Measuring Instruments.

- 1.1 Know about Measurement, types of measurement
- 1.2 Familiarize with the use of checking and measuring Instruments.
- 1.3 Line diagrams of different measuring tools.
- 1.4 Specific use of each Instrument
- 1.5 Least count of different measuring tools.
- 1.6 Differentiate measuring and checking Instruments.

#### 2.0 Fitting operations

- 2.1 Familiarize with different hand tools
- 2.2 List and explain different marking tools, cutting tools, striking tools, holding devices and miscellaneous tools
- 2.3 List different fitting operations
- 2.4 Differentiate Tapping and dyeing, drilling and Reaming.
- 2.5 Explain cutting, filing, scraping
- 2.6 Identify the different types of hammers and their specifications.

#### 3.0 Welding

- 3.1 Define welding
- 3.2 State the advantages and limitations of welding
- 3.3 Give the classification of welding processes.
- 3.4 State the working principle of Arc welding
- 3.5 Identify the equipment and tools of arc welding
- 3.6 Arc welding procedure (sequential operations)
- 3.7 State the working principle of gas welding (Oxy-acetylene).

- 3.8 List different Gas welding equipment and explain each.
- 3.9 Gas welding procedure (sequential operations)
- 3.10 Differentiate bare electrode and coated electrode
- 3.11 State the uses of flux in welding
- 3.12 Differentiate soldering and brazing
- 3.13 Explain various flame-cutting processes.
- 3.14 State the advantages and limitations of flame cutting.

#### **4.0 Friction and Lubrication**

- 4.1 To appreciate the existence of friction in elements of power transmission
- 4.2 Understand the concept of friction
- 4.3 Explain the necessity of lubrication
- 4.4 Give the classification of lubrication
- 4.5 Explain the properties of good lubricant
- 4.6 State different methods of lubrication
- 4.7 Give the applications of above methods.

#### **5.0 Transmission of mechanical power**

- 5.1 To know the selection criteria of various means of power transmission
- 5.2 List different methods of power transmission
- 5.3 Explain Belt drive, open and cross belt drive with line diagram and state its applications advantages and disadvantages.
- 5.4 To identify different types of drives in belts.
- 5.5 State the applications, advantages and disadvantages of belt drives.
- 5.6 Explain Gear drives, simple, compound, worm and bevel gears and its velocity ratio.
- 5.7 Know the merits and demerits of Gear drive
- 5.8 Define shaft and shaft coupling
- 5.9 Differentiate the Hollow shaft with solid shaft
- 5.10 List different types of couplings, and give its applications.

#### **6.0 I.C. Engine**

- 6.1 Define Heat engine
- 6.2 Classify Heat engines.
- 6.3 Give examples for each type.
- 6.4 Summarise the advantages of I.C.Engines and E.C.Engines.
- 6.5 Give the classification of I.C.Engines.  
Draw a neat sketch of an I.C engine and name the various parts.
- 6.6 Explain the working of 4-stroke petrol engine with a line diagram
- 6.7 Explain the working of 2 stroke petrol engine with a line diagram.
- 6.8 Explain the working of a 4-stroke and 2-stroke diesel engine with a line diagram
- 6.9 Compare two-stroke engine with 4-stroke engine
- 6.10 Explain with the help of a line sketch ignition system of an SI engine.
- 6.11 Explain with the help of a line sketch ignition system of an CI engine.
- 6.12 Explain simple carburetor with a line diagram
- 6.13 Explain air-cooling and water-cooling
- 6.14 Explain the working of Fuel Injector with the help of a line diagram
- 6.15 Explain fuel pump
- 6.16 Know about governing

- 6.17 List different methods of governing
- 6.18 Compare SI engine with CI engine

### **7.0 Boilers**

- 7.1 Define Boiler
- 7.2 Give the classification of Boiler
- 7.3 Differentiate fire tube and water tube boiler
- 7.4 Name different types of Boilers
- 7.5 Explain the construction and working of a simple Vertical Boiler with a line diagram
- 7.6 Explain Lancashire Boiler with a line diagram.
- 7.7 Explain the construction and working of a Babcock and Wilcox Boiler with a line diagram
- 7.8 List the different Boiler mountings.
- 7.9 State the specific use of each mounting.
- 7.10 Name the different Boiler accessories
- 7.11 State the functions of boiler accessories
- 7.12 List different methods of firing of coal
- 7.13 Distinguish solid fuel firing with Pulverized fuel firing.
- 7.14 Know about Boiler draught.
- 7.15 State different methods of Boiler draught.

### **8.0 Understand the properties of steam**

- 8.1 Define the various properties of steam
- 8.2 Compute the enthalpy, Internal energy and entropy of given pressure
- 8.3 Use the steam tables.
- 8.4 Interpret the data in steam tables to calculate enthalpy.
- 8.5 Compute the above values using Mollier chart

### **9.0 Understand the function of Steam Turbines**

- 9.1 State the function of steam nozzle in a turbine
- 9.2 Name different types of nozzles
- 9.3 Define steam turbine
- 9.4 Give the classification of steam turbines
- 9.5 Explain the working of Impulse turbine with a line diagram.
- 9.6 Explain the working of a Reaction turbine with a line diagram
- 9.7 Explain the governing of turbines.

## **COURSE CONTENT:**

### **1. Measuring Instruments**

Outside and inside Calipers, spring calipers-Hermaphrodite (odd leg) caliper, Transfer caliper – sizes and uses:

Dividers:- Sizes and uses combination square, bevel protractor, universal bevel protractor, sine bar, universal surface gauge. Engineers parallels, slip gauges. feeler gauge, angle gauge blocks, Radius gauge & template gauge, Screw pitch gauge, telescope gauges, plate and wire gauge, ring and plug gauges, snap gauges, specifications and uses. Vernier caliper, vernier height gauge, vernier depth gauge, micrometer outside & inside, stick micrometer – depth micrometer, vernier

micrometer, screw thread micrometer specification & uses, calculation of least count the above instruments.

Differentiating between measuring and checking instruments.

## 2. **Fitting Operations**

Cutting, Filing, Scraping, thread cutting (Trapping and dieing) drilling and reaming (hand) – marking tools, cutting tools, striking tools, holding devices and miscellaneous tools.

## 3. **Welding**

Introduction and classification of welding processes (IS:8.12)- Advantages and limitations of welding.principle of Arc welding-Equipment.Principle of gas welding (Oxy-acetylene)-Equipment. Welding procedures (Arc & Gas) –soldering–various flame cutting processes. Advantages and limitations of flame cutting.

## 4. **Friction & Lubrication**

Concept of friction with practical examples– Disadvantages of friction Necessity for lubrication – Classification of lubricants-properties of good lubrication Method of lubrication – their application.

## 5. **Transmission of Mechanical Power**

5.1 Methods of power Transmission

a) Belt drives – types and application, advantages and disadvantages.

b) Gear drives- simple, compound, worm and bevel gears- Merits and demerits.

5.2 Shaft and shaft couplings.

a) Types and uses of shafts (Hollow and solid)-comparison.

b) Types of couplings.

i) Flange ii) Muff iii) Universal.

c) Application of the above couplings.

## 6. **I.C. Engines**

6.1 Classification on the basis of

a) Cycle of operation

b) Types of fuel used

c) Methods of ignition

d) Methods of Cooling

e) Speed of engine

f) Arrangement of cylinders.

6.2 Four stroke and two strike cycles (petrol engine)

a) Principle and operation of 4-stroke and 2-stroke engine –explanation with neat sketch.

b) Fuel system in S.I engines - Fuel pump - Fuel filter - Air cleaner; Simple carburetor

6.3 Four stroke and two-stroke diesel engine.

a) Principle of operation, explanation with a neat sketch.

b) components of solid injection system (CI)-fuel feed pump – injection pump – injector – fuel filter.

c) Governing system

i) Quality Governing,

(ii) Quantity Governing

- iii) Hit and miss method.
- d) Cooling system
- e) Scavenging and Super charging importance

**7. Boilers**

- 7.1 Classification of boilers
  - a) Fire-tube b) Water tube.
- 7.2 Sketch and description of:
  - a) Simple vertical boiler b) Lancashire boiler
  - c) Babcock and Wilcox boiler.
- 7.3 Boiler Mountings, sketch and description of
  - a) Water level indicator
  - b) Pressure gauge
  - c) Safety valve
  - d) Steam stop valve
  - e) Feed check valve
  - f) Blow of cock, Fusible plug.
- 7.4 Boiler accessories sketch and description of:
  - a) Steam Trap and separator,
  - b) Economiser (Greens)
  - c) Super heater
  - d) Air-Preheater
- 7.5 Draught
  - a) Natural
  - b) Artificial – Induced, forced, and balanced.

**8. Properties of steam**

- 8.1 Formation of steam under constant pressure, dryness fraction and degree of super heat, specific volume.
- 8.2 Determination of enthalpy, Internal energy, latent heat.
- 8.3 Simple direct problems on the above using tables and charts.

**9. Steam Turbines**

- 9.1 Steam Nozzles – function
  - Types-convergent, divergent and convergent and divergent.
- 9.2 Steam turbines
  - a) Classification with examples
    - i) Impulse-Construction, working, comparison
    - ii) Reaction-advantages - disadvantages
    - iii) Impulse - Reaction
  - b) Methods of reducing speed of rotors.
    - i) Velocity compounding (CURTIS)
    - ii) Pressure compounding (Rateau)
    - iii) Pressure and Velocity compounding.
  - c) Governing of turbines
    - i) Throttle governing.
    - ii) Nozzle governing.

**REFERENCE BOOKS:**

- 1. Workshop Technology, Volume 1 by Raghu Vamsi.

2. Workshop Technology
3. Thermal Engineering
4. Heat Engines – Volume I&II
5. Thermal Engineering I & II

by HazraChowdary.  
by R.S.Kurmi.  
by R.C.Patel.  
by Prakirappa

## MATERIALS TECHNOLOGY

**Subject** : Materials Technology  
**Subject Code** : CH – 106  
**Periods / Week** : 03  
**Periods / Year** : 90

### TIME SCHEDULE

| S. No. | Major Topics   | No. of Periods | Weightage of Marks | Short answer type | Essay type |
|--------|--|----------------|--------------------|-------------------|------------|
| 1.     | Introduction   | 03             | 03                 | 1                 | -          |
| 2.     | Mechanical Properties of metals and Testing of materials | 12             | 26                 | 2                 | 2          |
| 3.     | Structure of metals and alloys                           | 08             | 5                  | -                 | ½          |
| 4.     | Thermal equilibrium diagram                              | 10             | 10                 | -                 | 1          |
| 5.     | Production of Iron and Steel                             | 13             | 13                 | 1                 | 1          |
| 6.     | Plain Carbon and Alloy Steels                            | 06             | 11                 | 2                 | ½          |
| 7.     | Non ferrous metals and alloys                            | 09             | 08                 | 1                 | ½          |
| 8.     | Miscellaneous materials                                  | 15             | 16                 | 2                 | 1          |
| 9.     | Corrosion  | 14             | 18                 | 1                 | 1½         |
| Total  |  | 90             | 110                | 10                | 08         |

### Objectives:

On completion of study of the subject the student should be able to

#### **1.0 Introduction**

- 1.1 Define Engineering Material
- 1.2 Classification of Engineering Materials
- 1.3 Need of Engineering Materials and their applications.

#### **2.0 Mechanical properties of metals and testing of materials**

- 2.1 Define the following properties
  - a. Strength of a material
  - b. Ultimate Strength
  - c. Stress
  - d. Strain
  - e. Elasticity
  - f. Tensile and compressive strength
  - g. Ductility
  - h. Hardness
  - i. Toughness
  - j. Brittleness
  - k. Impact strength
  - l. Fatigue and creep strength.
- 2.2 Know about the various destructive methods of testing and non destructive methods of testing to identify various defects of materials and their applications.
- 2.3 Know the determination of tensile strength and compressive strength by universal testing machine (UTM).



- 2.4 Know the determination of hardness by Brinell hardness testing and Rockwell hardness testing machines.
- 2.5 Know the determination of impact strength by Izod and Charpy's testing machines.
- 2.6 Identify the procedures to detect the internal defects of a metal by X – ray,  $\gamma$  – ray (Gamma ray) and ultrasonic tests.

### **3.0 Understand the structure of metals and alloys**

- 3.1 Define Unit cell and space lattice.
- 3.2 Understand the arrangement of atoms in FCC (Face Centered Cubic), BCC (Body Centered Cubic) and HCP (Hexagonal close packed) systems and give examples.
- 3.3 State the effect of grain size on mechanical properties.
- 3.4 Identify the factors promoting grain size.
- 3.5 Explain the phenomenon of crystallization.

### **4.0 Understand thermal equilibrium diagram**

- 4.1 Explain Cooling curve for pure iron
- 4.2 Know Allotropic forms of pure iron
- 4.3 Draw Iron – Carbon thermal equilibrium diagram.
- 4.4 Locate the peritectic, eutectic, eutectoid points from the iron – carbon diagram.

### **5.0 Know the methods of producing iron and steel**

- 5.1 Name the various raw materials required for the production of iron.
- 5.2 Name the various methods of manufacturing of steel and iron.
- 5.3 Explain the production of Pig iron by Blast Furnace
- 5.4 Explain the manufacturing methods of steel
- 5.5 Explain the production of Cast iron by Cupola Furnace
- 5.6 Write the classification of different types of cast iron such as white, gray & malleable cast iron.
- 5.7 Know about of properties and applications of different types of cast iron.

### **6.0 Know the plain carbon steels and alloy steels.**

- 6.1 State the classification of plain carbon steels.
- 6.2 Describe the need for alloying the steel with other elements.
- 6.3 State the composition, properties, industrial applications of alloy steels.
- 6.4 Select the proper alloy steel for the given engineering application.

### **7.0 Understand non – ferrous metals and their alloys**

- 7.1 State the importance of various non – ferrous metals and alloys – Aluminum, Copper, Nickel, Lead, Tin, Zinc, Titanium, Zirconium
- 7.2 Know the properties of aluminum, copper, zinc, tin, lead, and their applications.
- 7.3 State the effects of the alloying elements (a) Copper (b) Silica (c) Magnesium (d) Manganese with Aluminum.
- 7.4 Know the types of copper alloys (Brasses & Bronzes), their properties and applications.

7.5 Know the types of Nickel alloys (Monel, Hastalloy), their properties and applications.

**8.0 Know the common miscellaneous materials**

8.1 Know the Importance of Glass, its types and applications

8.2 Understand the importance of glass and its lining as materials of construction for the process equipments.

8.3 State the properties and applications of carbon and graphite.

8.4 Know the composition, properties and applications of stoneware.

8.5 Know the application of Asbestos, Rubber, Elastomers.

8.6 Know the application of Polymers.

8.7 Know about Refractories and their applications

8.8 Know about Glass ceramics, Ceramites and Glass wool

**9.0 Understand corrosion and its prevention**

9.1 Define corrosion and explain the causes of corrosion.

9.2 Explain electro chemical theory of corrosion

9.3 Know briefly about (a) electrode potential (b) passivity (c) electro chemical series (d) polarization.

9.4 Explain briefly about (a) uniform corrosion (b) stress corrosion (c) pitting (d) hydrogen attack (e) bimetallic corrosion (f) grain boundary corrosion (g) Fatigue corrosion

9.5 Know briefly about the methods of prevention of corrosion by (a) Proper selection of materials (b) organic coatings (c) inorganic coatings (d) Anodic and cathodic protection (e) Anodic and cathodic inhibitors.

**COURSE CONTENTS:**

- 1. Introduction** – Definition, Classification of engineering materials, need and applications.
- 2. Mechanical properties of metals & Testing of materials** – Define the terms ,ultimate strength , stress , strain ,elasticity , tensile and compressive strength, ductility, hardness, toughness, brittleness, impact strength, fatigue and creep strength- various destructive testing methods of tensile strength, compressive strength, hardness, impact strength and various non destructive testing methods – x ray,  $\gamma$  – ray and ultrasonic test.
- 3. Structure of metals and alloys** – unit cell – space lattice – FCC, BCC, HCP space lattices – formation of grains by dendritic growth, effect of rate of cooling on grain formation – effect of grain size on mechanical properties – factors promoting grain size – crystallization.
- 4. Thermal equilibrium diagram** – cooling curve for pure iron – allotropic forms of pure iron, iron – carbon thermal equilibrium diagram – peritectic, eutectic and eutectoid points in iron carbon diagram.
- 5. Production of iron and steel** – Production of iron by Blast furnace, cast iron by Cupola furnace – Steel by Bessemer converter, L.D converter, electric arc furnace- classification of cast iron – white, grey, malleable and S.G. cast irons.
- 6. Plain carbon steels and alloy steels** – classification and application of plain carbon steels, – alloying of steels – industrial applications of alloy steels, selection of alloy steels for engineering applications.

7. **Non ferrous metals and their alloys** – importance of various non ferrous metals of aluminum, copper, nickel, lead, tin, zinc, titanium, zirconium, - properties of aluminum, copper, zinc, tin, lead and their application – effect of alloying elements Cu, Si, Mg, Mn with aluminum – types of Nickel and copper alloys, their properties and applications.
8. **Miscellaneous materials** – Importance of glass, types and applications – application of polymers – composition, properties, applications of stoneware – applications of asbestos, rubber, elastomers, epoxy resin, fibre glass, reinforced plastics, refractories, Glass ceramics, Ceramites and Glass wool.
9. **Corrosion:** corrosion – causes of corrosion – electro chemical theory – electrode potential – passivity – electro chemical series – polarization – types of corrosion – uniform corrosion – stress corrosion – pitting corrosion – hydrogen attack – bimetallic corrosion – grain boundary corrosion – fatigue corrosion – methods of prevention of corrosion.

**REFERENCE BOOKS:**

1. Engineering Chemistry by Jain & Jain, Dhanapat Rai Publications, New Delhi.
2. Engineering Metallurgy by D. Swarup
3. Engineering Metallurgy by Higgins.
4. Corrosion Engineering by Fontane McGraw Hill.
5. Engineering Metallurgy by S.P.Naik.
6. Engineering Metallurgy by D. Swarup.
7. Material Science by HazraChowdhery.
8. An introduction to Science of corrosion and inhibition by S.N.Benerjee.
9. Elements of Fuels, furnaces and refractories by O.P.Gupta
10. Engineering Materials by Pakirappa

## ENGINEERING DRAWING

|                         |          |                            |
|-------------------------|----------|----------------------------|
| <b>Subject Title</b>    | <b>:</b> | <b>Engineering Drawing</b> |
| <b>Subject Code</b>     | <b>:</b> | <b>CH-107 (COMMON-107)</b> |
| <b>Periods/Week</b>     | <b>:</b> | <b>06</b>                  |
| <b>Periods Per Year</b> | <b>:</b> | <b>180</b>                 |

### Time Schedule

| <b>Sno</b> | <b>Major Topics</b>                                     | <b>No. of Periods</b> | <b>Weightage of marks</b> | <b>Short Answer Questions</b> | <b>Essay type Questions</b> |
|------------|---|-----------------------|---------------------------|-------------------------------|-----------------------------|
| <b>1</b>   | <b>Importance of Engineering Drawing</b>                | <b>01</b>             | <b>-</b>                  | <b>-</b>                      | <b>-</b>                    |
| <b>2</b>   | <b>Engineering Drawing Instruments</b>                  | <b>05</b>             | <b>-</b>                  | <b>-</b>                      | <b>-</b>                    |
| <b>3</b>   | <b>Free hand lettering &amp; Numbering</b>              | <b>06</b>             | <b>5</b>                  | <b>1</b>                      | <b>-</b>                    |
| <b>4</b>   | <b>Dimensioning Practice</b>                            | <b>09</b>             | <b>5</b>                  | <b>1</b>                      | <b>-</b>                    |
| <b>5</b>   | <b>Geometrical Constructions</b>                        | <b>21</b>             | <b>15</b>                 | <b>1</b>                      | <b>1</b>                    |
| <b>6</b>   | <b>Projection of points, Lines, Planes &amp; Solids</b> | <b>21</b>             | <b>10</b>                 | <b>-</b>                      | <b>1</b>                    |
| <b>7</b>   | <b>Auxiliary views</b>                                  | <b>06</b>             | <b>5</b>                  | <b>1</b>                      | <b>-</b>                    |
| <b>8</b>   | <b>Sectional views</b>                                  | <b>27</b>             | <b>10</b>                 | <b>-</b>                      | <b>1</b>                    |
| <b>9</b>   | <b>Orthographic Projection</b>                          | <b>33</b>             | <b>10</b>                 | <b>-</b>                      | <b>1</b>                    |
| <b>10</b>  | <b>Pictorial drawing</b>                                | <b>30</b>             | <b>10</b>                 | <b>-</b>                      | <b>1</b>                    |
| <b>11</b>  | <b>Development of surfaces</b>                          | <b>21</b>             | <b>10</b>                 | <b>-</b>                      | <b>1</b>                    |
|            | <b>Total</b>  | <b>180</b>            | <b>80</b>                 | <b>04</b>                     | <b>06</b>                   |

**The course is aimed at developing basic graphic skills so as to enable them to use these skills in preparation of engineering drawings, their reading and interpretation**

## **OBJECTIVES**

*Upon completion of the subject the student shall be able to*

### **1) Understand the basic concepts of Engineering Drawing**

- a) State the importance of drawing as an engineering communication medium**
- b) State the necessity of B.I.S. Code of practice for Engineering Drawing**
- c) Explain the linkages between Engineering drawing and other subjects of study in diploma course**

### **2) Use of Engineering Drawing Instruments**

- a) Select the correct instruments and draw lines of different orientation**
- b) Select the correct instruments and draw small and large Circles**
- c) Select the correct instruments for measuring distances on the drawing**
- d) Use correct grade of pencil for different types of lines, thickness and given function**
- e) Select and use appropriate scales for a given application**
- f) Identify different drawing sheet sizes as per I.S. and Standard Layouts**
- g) Prepare Title block as per B.I.S. Specifications**
- h) Identify the steps to be taken to keep the drawing clean and tidy**

### **3) Write Free Hand Lettering and Numbers**

- a) Write titles using slanting letters and numerals of 7mm, 10mm and 14mm height**
- b) Write titles using vertical letters and numerals of 7mm, 10mm and 14mm height**
- c) Select suitable sizes of lettering for different layouts and applications**

### **4) Understand Dimensioning Practice**

- a) Define “Dimensioning”
- b) State the need of dimensioning the drawing according to accepted standards
- c) Identify notations of Dimensioning used in dimensioned drawing
- d) Identify the system of placement of dimensions in the given dimensioned drawing
- e) Dimension a given drawing using standard notations and desired system of dimensioning
- f) Dimension standard features applying necessary rules
- g) Arrange dimensions in a desired method for a given drawing
- h) Identify the departures if any made in the given dimensioned drawing with reference to SP-46-1988, and dimension the same correctly

**5) Apply Principles of Geometric Constructions**

- a) Divide a given line into desired number of equal parts internally
- b) Draw tangent lines and arcs
- c) Use General method to construct any polygon
- d) Explain the importance of conics
- e) Construct ellipse by concentric circles method
- f) Construct parabola by rectangle method
- g) Construct rectangular hyperbola from the given data
- h) Construct involute from the given data
- i) Construct cycloid and helix from the given data
- j) State the applications of the above constructions in engineering practice

**6) Apply Principles of Projection of points, lines, planes & solids**

- a) Visualize the objects
- b) Explain the I-angle and III-angle projections
- c) Practice the I-angle projections
- d) Draw the projection of a point with respect to reference planes (HP&VP)

- e) **Draw the projections of straight lines with respect to two reference planes (cases of lines parallel to one plane and inclined to other plane only)**
- f) **Draw the projections of planes (cases of planes perpendicular to one plane and inclined to other plane only)**
- g) **Draw the projections of solids (cases of axis perpendicular to one plane and inclined to other plane only)**

**7) Understand the need of auxiliary views**

- a) **State the need of Auxiliary views for a given engineering drawing**
- b) **Draw the auxiliary views of a given engineering component**
- c) **Differentiate between auxiliary view and apparent view**

**8) Appreciate the need of Sectional Views**

- a) **Explain the need to draw sectional views**
- b) **Select the section plane for a given component to reveal maximum information**
- c) **Explain the positions of section plane with respect to reference planes**
- d) **Differentiate between true shape and apparent shape of section**
- e) **Draw sectional views and true sections of regular solids discussed in chapter-6 above**
- f) **Apply principles of hatching**

**9) Apply principles of orthographic projection**

- a) **Explain the principles of orthographic projection with simple sketches**
- b) **Draw the orthographic view of an object from its pictorial drawing**
- c) **Draw the minimum number of views needed to represent a given object fully**

**10) Prepare pictorial drawings**

- a) **State the need of pictorial drawings**
- b) **Differentiate between isometric scale and true scale**
- c) **Prepare Isometric views for the given orthographic drawings**

**11) Interpret Development of surfaces of different solids**

- a) **State the need for preparing development drawing**

- b) Prepare development of simple engineering objects (cubes, prisms, cylinders, cones, pyramids) using parallel line and radial line methods
- c) Prepare development of surface of engineering components like trays, funnels, 90° elbows & rectangular ducts

## **COURSE CONTENT**

### **NOTE**

- 1) B.I.S Specifications should invariably be followed in all the topics.
- 2) A-3 Size Drawing Sheets are to be used for all Drawing Practice Exercises.
- 3) First Angle Projection is to be followed for all Orthographic projection exercises

### **1) The importance of Engineering Drawing**

**Explanation of the scope and objectives of the subject of Engineering Drawing, Its importance as a graphic communication -Need for preparing drawing as per standards – SP-46–1988 – Mention B.I.S - Role of drawing in engineering education – Link between Engineering drawing and other subjects of study**

### **2) Engineering drawing Instruments**

**Classification: Basic tools, tools for drawing straight lines, tools for curved lines, tools for measuring distances and special tools like mini drafter & drafting machine – Mention the names under each classification and their brief description -Scales: Recommended scales reduced & enlarged scales-Lines: Types of lines, selection of line thickness - Selection of Pencils -Sheet Sizes: A0, A1, A2, A3, A4, A5, Layout of drawing sheets in respect of A0, A1, A3 sizes, Sizes of the Title block and its contents - Care and maintenance of Drawing Sheet**

**Drawing Plate 1: Consisting of two exercises on use of drawing instruments**

### **3) Free hand lettering & numbering**



**Importance of lettering – Types of lettering -Guide Lines for Lettering- Practicing letters & numbers of given sizes (7mm, 10mm and 14mm) Advantages of single stroke or simple style of lettering**

**Drawing plate 2: Consisting of five to six exercises on freehand Lettering & Numbering**

#### **4) Dimensioning practice**

**Purpose of engineering Drawing, Need of B.I.S code in dimensioning -Shape description of an Engineering object - Dimensioning size, Location features, surface finish, fully dimensioned Drawing - Notations or tools of dimensioning, dimension line, extension line, leader line, arrows, symbols, number and notes, rules to be observed in the use of above tools - Placing dimensions: Aligned system and unidirectional system ( SP-46-1988) - Arrangement of dimensions: Chain, parallel, combined, progressive, and dimensioning by co-ordinate methods - The rules for dimensioning standard features Circles (holes) arcs, angles, tapers, chamfers, and dimensioning of narrow spaces**

**Drawing Plate 3: Consisting of 8 exercises on Dimensioning methods and rules**

#### **5) Geometric Constructions**

**Division of a line: to divide a straight line into given number of equal parts internally and it's examples in engineering applications. Construction of tangent lines: to draw tangent lines touching circles internally and externally. Construction of tangent arcs i) To draw tangent arc of given radius to touch two lines inclined at given angle (acute, right and obtuse angles) ii) Tangent arc of given radius touching a circle or an arc and a given line iii) Tangent arcs of radius R, touching two given circles internally and externally Construction of polygon: Construction of any regular polygon of given side using general method. Conical Curves: Explanation of Ellipse, Parabola, Hyperbola, as sections of a double cone and loci of a moving point, Eccentricity of above curves – Their Engg. applications viz. Projectiles, reflectors, P-V Diagram of a Hyperbolic process - Construction of ellipse by concentric circles method - Construction of parabola by rectangle method - Construction of rectangular hyperbola - General Curves: Involute, Cycloid and Helix, explanations as locus of a moving point, their**

engineering applications, viz, Gear tooth profile, screw threads, springs etc. - their construction.

**Drawing Plate 4:** Consisting of eight exercises on construction of polygons

**Drawing Plate 5:** Consisting of eight exercises on construction of conics

**Drawing Plate 6:** Consisting of eight exercises on involute, cycloid and helix

#### 6) Projection of points, lines, planes & solids

Projecting a point on two planes of projection -Projecting a point on three planes of projection -Projection of straight line i) Parallel to both the planes ii) Perpendicular to one of the planes iii) Inclined to one plane and parallel to other plane - Projection of regular planes- i) Plane perpendicular to HP and parallel to VP and vice versa ii) Plane perpendicular to HP and inclined to VP and vice versa - Projection of regular solids with i) Axis perpendicular to one of the planes ii) Axis parallel to VP and inclined to HP and vice versa

**Drawing Plate 7:** Consisting of eight exercises on projection of points and Lines

**Drawing Plate 8:** Consisting of eight exercises on projection of planes

**Drawing Plate 9:** Consisting of eight exercises on projection of solids

#### 7) Auxiliary views

Need for drawing auxiliary views - Explanation of the basic principles of drawing auxiliary views, explanation of reference plane and auxiliary plane - Partial auxiliary view.

**Drawing plate 10:** Consisting of four exercises on auxiliary views

#### 8) Sectional views

**Need for drawing sectional views – what is a sectional view - Location of cutting plane – Purpose of cutting plane line – Selection of cutting plane to give maximum information (vertical and offset planes) - Hatching – Section of regular solids inclined to one plane and parallel to other plane**

**Drawing Plate 11: Consisting of six exercises on sections of solids**

### **9) Orthographic Projections**

**Meaning of orthographic projection -Using a viewing box model – Number of views obtained on the six faces of the box, - Legible sketches of only 3 views for describing object - Concept of front view, top view, and side view, sketching these views for number of engineering objects - Explanation of first angle projection. – Positioning of three views in First angle projection - Projection of points as a means of locating the corners of the surfaces of an object – Use of mitre line in drawing a third view when other two views are given - Method of representing hidden lines - Selection of minimum number of views to describe an object fully**

**Drawing Plate 12: Consisting of 12 exercises on orthographic projections of engineering objects**

### **10) Pictorial Drawings**

**Brief description of different types of pictorial drawing viz., Isometric, oblique, and perspective and their use - Isometric drawings: Iso axis, angle between them, meaning of visual distortion in dimensions - Need for an isometric scale, difference between Isometric scale, and ordinary scale- difference between Isometric view and Isometric projection - Isometric and Non-isometric lines -Isometric drawing of common features like rectangles, circular shapes, non-isometric lines - Use of box and offset methods**

**Drawing plate 13: Consisting of 12 exercises on Isometric views of engineering objects**

## **11) Development of Surfaces**

**Need for preparing development of surface with reference to sheet metal work - Concept of true length of a line with reference to its orthographic projection when the line is (i) parallel to the plane of projection (ii) inclined to one principal plane and parallel to the other -Development of simple solids like cubes, prisms, cylinders, cones, pyramids -Types of development: Parallel line and radial line development -Procedure of drawing development - drawings of trays, funnels, 90<sup>0</sup> elbow pipes and rectangular ducts.**

**Drawing plate 14: Consisting of 5 exercises on development problems**

### **REFERENCE BOOKS**

**Engineering Graphics by P I Varghese – ( McGraw-hill)**

**Engineering Drawing by Basant Agarwal & C.M Agarwal - ( McGraw-hill)**

**Engineering Drawing by N.D.Bhatt.**

**T.S.M. & S.S.M on “ Technical Drawing” prepared by T.T.T.I., Madras.**

**SP-46-1998 – Bureau of Indian Standards.**

## WORK SHOP PRACTICE

**Subject title** : Work shop practice  
**Subject Code** : CH-108  
**Periods per Week** : 03  
**Periods per Year** : 90

### TIME SCHEDULE:

| S.No.        | Major Topics             | No. of periods |
|--------------|--------------------------|----------------|
| 1.           | Carpentry                | 24             |
| 2.           | Fitting and welding      | 36             |
| 3.           | Basic machine operations | 22             |
| 4.           | Plumbing                 | 08             |
| <b>TOTAL</b> |                          | <b>90</b>      |

### OBJECTIVES

**Upon completion of the practice, the student will be able to**

- 1.0 Use of different tools in Carpentry, Fitting, Welding and Turning section of workshop.
- 2.0 Prepare various carpentry joints, panel boards and cabinet boxes.
- 3.0 Hacksaw cutting, grinding, thread cutting for metal conduit; G.I. Pipes and rods etc, in fitting section.
- 4.0 Handle welding transformer and make lap and butt joints.
- 5.0 Exercise on lathe like simple turning, step turning, taper turning and knurling.
- 6.0 Exercise on thread cutting for pipes and rods on Lathes.
- 7.0 Hand drilling machines and grinding machine.
- 8.0 Know the basics of plumbing work and applications.
  - 8.1 Know the types of pipe joints.
    - Understand the symbols.
    - Know the materials used pipes.
    - Assembling, threading, joining of pipes.
    - Able to understand cross, T, L joints etc.

## **COURSE CONTENT**

**Following list of experiments are to be made by every student in the workshop**

### **1. CARPENTRY**

1. Exercises on planning, sawing and chiseling
2. Prepare a half lap joint
3. Prepare a Dovetail joint.
4. Prepare a Mortise joint.
5. Prepare a 20 cm X 15 cm Teakwood switch board with hinges and bottom hook.
6. Fix the laminate sheet to the above box and cut suitable holes to mount tone flush type switch, socket.

### **2. FITTING AND WELDING**

1. Exercises to cut a metal conduit, G.I. Pipe and solid rod using hack saw.
2. 3 & 4 Thread cutting of G.I.pipe, metal conduit and solid rod using Die set.
5. & 6. Internal thread cutting using Tap set and cleaning the threads using reamers and make a hexagonal nut from a round rod.

### **WELDING**

1. Prepare a job and to make a lap joint and finish it using grinder.
2. Prepare a job and make a butt joint and finish it with grinder.
3. Prepare the job and make 'T' joint.

### **3. MACHINE SHOP**

Exercise on turning the given rod to get three different diameters using lathe.

Make a bolt and cut threads using lathe.

Cut the threads to G.I. Pipe using lathe.

Prepare a centre punch and knurl its head.

Make a square plate using power hack saw, remove sharp edges using grinder, make triangle and drill three holes of different diameters at the vertices.

### **4. PLUMBING**

Plumbing work and applications

1. Types of pipe joints.
2. Symbols
3. Materials used for pipes
4. Assembling, Threading, Joining of pipes.
5. Different fittings such as cross, L, T etc.,

## PHYSICS LABORATORY

|                        |   |                      |
|------------------------|---|----------------------|
| Subject Title          | : | Physics Laboratory   |
| Subject Code           | : | CH -109 (COMMON-109) |
| Periods per week       | : | 03                   |
| Total periods per year | : | 45                   |

### TIME SCHEDULE

| S.No | Name of the Experiment   | No. of    |
|------|--|-----------|
| 1.   | Hands on practice on Vernier Calipers                                  | 03        |
| 2.   | Hands on practice on Screw gauge                                       | 03        |
| 3.   | Verification of Parallelogram law of forces and Triangle law of forces | 03        |
| 4.   | Simple pendulum  | 03        |
| 5.   | Velocity of sound in air – (Resonance method)                          | 03        |
| 6.   | Focal length and Focal power of convex lens (Separate & Combination)   | 03        |
| 7.   | Refractive index of solid using traveling microscope                   | 03        |
| 8.   | Surface tension of liquid using traveling microscope                   | 03        |
| 9.   | Coefficient of viscosity by capillary method                           | 03        |
| 10.  | Boyle's law verification   | 03        |
| 11.  | Meter bridge   | 03        |
| 12.  | Mapping of magnet lines of force                                       | 03        |
|      | Revision   | 06        |
|      | Test   | 03        |
|      | <b>Total:</b>  | <b>45</b> |

### Objectives:

Upon completion of the course the student shall be able to

1.0 Practise with Vernier calipers to determine the volumes and areas of a cylinder and sphere and their comparison etc .

- 2.0 Practise with Screw gauge to determine thickness of a glass plate, cross sectional area of a wire and volumes of sphere and also their comparison etc**
- 3.0 Verify the parallelogram law and Triangle law**
- 4.0 Determine the value of acceleration due to gravity using Simple Pendulum**
- 5.0 Determine the velocity of sound in air at room temperature and its value at zero degree centigrade**
- 6.0 Calculate the Focal length and focal power of convex lenses using distant object method , U-V method , U-V graph and  $1 / U - 1 / V$  graph methods and their comparison,**
- 7.0 Determine the refractive index of a solid using travelling microscope**
- 8.0 Determine the surface tension of a liquid using travelling microscope**
- 9.0 Determine the viscosity of a liquid using capillary method**
- 10.0 Verify the Boyle’s law employing a Quill tube**
- 11.0 Determine the specific resistance of material of a wirel using Meter Bridge**
- 12.0 Drawing magnetic lines of force under N-S and N-N methods and locate null points**

**Competencies and Key competencies to be achieved by the student**

| <b>Name of the Experiment</b>                       | <b>Competencies</b>  | <b>Key competencies</b>  |
|---|--|--|
| <b>1. Hands on practice on Vernier Calipers(03)</b> | <ul style="list-style-type: none"> <li>• Find the Least count</li> <li>• Fix the specimen in posit</li> </ul>                            | <ul style="list-style-type: none"> <li>• Read the scales</li> <li>• Calculate the requisite physical quantities of given objects</li> </ul>                                  |
| <b>2. Hands on practice on Screw gauge(03)</b>      | <ul style="list-style-type: none"> <li>• Find the Least count</li> <li>• Fix the specimen in posit</li> <li>• Read the scales</li> </ul> | <ul style="list-style-type: none"> <li>• Read the scales</li> <li>• Calculate thickness of given glass plate</li> <li>• Calculate cross section of wire and other</li> </ul> |



|   |  |   |
|---|--|---|
| <b>3. Verification of Parallelogram law of forces and Triangle law of forces(03)</b>    | <ul style="list-style-type: none"> <li>• Fix suitable weights</li> <li>• Note the positions of threads on drawing sheet</li> <li>• Find the angle at equilibrium point</li> <li>• Construct parallelogram</li> </ul>                           | <ul style="list-style-type: none"> <li>• Find the angle at equilibrium point</li> <li>• Constructing parallelogram</li> <li>• Construct triangle</li> <li>• Compare the ratios of force and length</li> </ul>                   |
| <b>4. Simple pendulum(03)</b>   | <ul style="list-style-type: none"> <li>• Fix the simple pendulum to the stand</li> <li>• Adjust the length of pendulum</li> <li>• Find the time for number of oscillations</li> <li>• Find the time period</li> <li>• Calculate the</li> </ul> | <ul style="list-style-type: none"> <li>• Find the time for number of oscillations</li> <li>• Find the time period</li> <li>• Calculate the acceleration due to gravity</li> <li>• Draw l-T and l-T<sup>2</sup> graph</li> </ul> |
| <b>5. Velocity of sound in air<br/>–Resonance method (03)</b>                           | <ul style="list-style-type: none"> <li>• Arrange the resonance apparatus</li> <li>• Adjust the reservoir level for booming sound</li> <li>• Find the first and second resonating</li> </ul>  | <ul style="list-style-type: none"> <li>• Adjust the reservoir level</li> <li>• Find the first and second resonating lengths</li> <li>• Calculate velocity of</li> </ul>   |
| <b>Name of the Experiment(Periods)</b>  | <b>Competencies</b>  | <b>Key competencies</b>   |
| <b>6. Focal length and Focal power of convex lens (Separate &amp; Combination) (03)</b> | <ul style="list-style-type: none"> <li>• Fix the object distance</li> <li>• Find the Image distance</li> <li>• Calculate the focal length and power of convex lens and combination of convex lenses</li> </ul>                                 | <ul style="list-style-type: none"> <li>• Calculate the focal length and power of convex lens</li> <li>• Draw u-v and 1/u – 1/v graphs</li> </ul>  |

|  |  |   |
|--|--|---|
| <b>7. Refractive index of solid using traveling microscope(03)</b> | <ul style="list-style-type: none"> <li>• Find the least count of vernier on microscope</li> <li>• Place the graph paper below microscope</li> <li>• Read the scale</li> </ul>  | <ul style="list-style-type: none"> <li>• Read the scale</li> <li>• Calculate the refractive index of glass slab</li> </ul>  |
| <b>8. Surface tension of liquid using traveling microscope(03)</b> | <ul style="list-style-type: none"> <li>• Find the least count of vernier on microscope</li> <li>• Focus the microscope to the lower meniscus &amp; bent pin</li> <li>• Read the scale</li> <li>• Calculate height of</li> </ul>  | <ul style="list-style-type: none"> <li>• Read the scale</li> <li>• Calculate height of liquid rise</li> <li>• Calculate the surface tension of water</li> </ul>   |
| <b>9. Coefficient of viscosity by capillary method(03)</b>         | <ul style="list-style-type: none"> <li>• Find the least count of vernier</li> <li>• Fix the capillary tube to aspiratory bottle</li> <li>• Find the mass of collected water</li> <li>• Find the pressure head</li> <li>• Calculate rate of volume of liquid collected</li> </ul> | <ul style="list-style-type: none"> <li>• Find the pressure head</li> <li>• Calculate rate of volume of liquid collected</li> <li>• Find the radius of capillary tube</li> <li>• Calculate the viscosity of water</li> </ul> |

| Name of the Experiment                          | Competencies  | Key competencies   |
|---|---|--|
| <b>10. Boyle's law verification (03)</b>        | <ul style="list-style-type: none"> <li>• Note the atmospheric pressure</li> <li>• Fix the quill tube to retort stand</li> <li>• Find the length of air column</li> <li>• Find the pressure of enclosed air</li> </ul> | <ul style="list-style-type: none"> <li>• Find the length of air column</li> <li>• Find the pressure of enclosed air</li> <li>• Find the value <math>P \times l</math></li> </ul> |
| <b>11. Meter bridge(03)</b>                     | <ul style="list-style-type: none"> <li>• Make the circuit connections</li> <li>• Find the balancing length</li> <li>• Calculate unknown resistance</li> </ul>   | <ul style="list-style-type: none"> <li>• Find the balancing length</li> <li>• Calculate unknown resistance</li> <li>• Calculate the specific resistance</li> </ul>               |
| <b>12. Mapping of magnet lines of force(03)</b> | <ul style="list-style-type: none"> <li>• Draw magnetic meridian</li> <li>• Placed the bar magnet in NN and NS directions</li> <li>• Draw magnetic lines of force</li> <li>• Locate the neutral</li> </ul>             | <ul style="list-style-type: none"> <li>• Draw magnetic lines of force</li> <li>• Locate the neutral points along equatorial and</li> </ul>                                       |

## CHEMISTRY LABORATORY

**Subject Title** : Chemistry laboratory  
**Subject Code** : CH-110  
**Periods/Week** : 03  
**Periods /Year** : 45

### TIME SCHEDULE:

| S.No. | Major topics   | No. of periods |
|-------|--|----------------|
| 1     | Volumetric analysis, Use of analytical balance and Preparation of standard solution. | 06             |
| 2     | Acid base titration  | 03             |
| 3     | Redox titration  | 03             |
| 4     | Iodometry  | 03             |
| 5     | Water analysis   | 06             |
| 6     | Qualitative analysis   |                |
|       | a) Reactions of Anions   | 06             |
|       | b) Reactions of Cations  | 06             |
|       | c) Identification of cation and anion in a given salt                                | 12             |
| Total |  | 45             |

### OBJECTIVES:

**On completion of the practical, the student will be able to**

**1.0 understand Volumetric Analysis**

- 1.1 Introduction
- 1.2 Use of analytical balance
- 1.3 Preparation of standard solution

**2.0 understand Acid – base titration by the**

- a) Estimation of HCl using standard  $\text{Na}_2\text{CO}_3$  solution
- b) Estimation of NaOH using standard  $\text{H}_2\text{SO}_4$  solution

**3.0 understand Redox titration by the**

- a) Estimation of Ferrous Ammonium sulphate using standard  $\text{KmnO}_4$

**4.0 understand Iodometry by the**

Estimation of amount of potassium dichromate present in the given solution using a standard solution of sodium thiosulphate.

**5.0 conduct water analysis by the**

a) Determination of alkalinity of a given water sample

b) Determination of acidity of a given water sample

**6.0 know Qualitative analysis by the**

6.a.1 Reaction of Anions

a) Carbonates b) Sulphates c) Chlorides d) Nitrate.

6.b.1 Reactions of Cations

a) Copper b) Lead c) Manganese d) Magnesium e) Calcium

f) Ammonium g) Zinc h) Ferrous i) Ferric j) Barium

6.c.1 Identification of cation, anion in a given salt.

1. Copper sulphate ( $\text{CuSO}_4$ )

2. Copper chloride ( $\text{CuCl}_2$ )

3. Copper nitrate ( $\text{Cu}(\text{NO}_3)_2$ )

4. Calcium carbonate ( $\text{CaCO}_3$ )

5. Lead carbonate ( $\text{PbCO}_3$ )

6. Manganese sulphate ( $\text{MnSO}_4$ )

7. Manganese chloride ( $\text{MnCl}_2$ )

8. Ferric chloride ( $\text{FeCl}_3$ )

9. Ferroussulphate ( $\text{FeSO}_4$ )

**COURSE CONTENTS :**

**Volumetric analysis :**

Use of analytical balance, technical terms in volumetric analysis, definition of volumetric analysis, titrant, titrate, titration, end point or equivalence point, indicators, standard solutions, primary standard solution, secondary standard solution.

**Methods of concentration :**

Normality and normal solution.

Molarity and molar solution.

**Quantitative analysis :**

Reactions of anions, cations – systematic identification of salt.

**Anions :**

Carbonates, sulphates, chlorides, iodides and nitrates.

**Cations :**

- a) Copper ( $\text{Cu}^{+2}$ ) b) Manganese ( $\text{Mn}^{+2}$ ) c) Magnesium ( $\text{Mg}^{+2}$ )  
d) Calcium ( $\text{Ca}^{+2}$ ) e) Ammonium ( $\text{NH}_4^+$ ) f) Zinc ( $\text{Zn}^{+2}$ )  
g) Ferrous ( $\text{Fe}^{+2}$ ) h) Ferric ( $\text{Fe}^{+3}$ )

### **LIST OF EXPERIMENTS:**

1. Use of analytical balance.
2. Preparation of standard solution of  $\text{Na}_2\text{CO}_3$ .
3. Estimation of HCl using standard  $\text{Na}_2\text{CO}_3$  solution.
4. Estimation of NaOH using standard  $\text{H}_2\text{SO}_4$  solution.
5. Preparation of standard  $\text{KMnO}_4$  solution.
6. Estimation of ferrous ammonium sulphate using standard  $\text{KMnO}_4$  solution.
7. Estimation of amount of potassium dichromate present in given solution using standard solution of sodium thiosulphate.

### **Water analysis experiments:**

8. Determination of Alkalinity of given water sample.
9. Determination of acidity of given water sample.

### **Qualitative Analysis**

10. Identification of anion and cation in (the above given cations and anions) the given salts
  1. Ammonium carbonate ( $\text{NH}_4)_2\text{CO}_3$
  2. Ammonium chloride ( $\text{NH}_4\text{Cl}$ )
  3. Barium chloride ( $\text{BaCl}_2$ )
  4. Barium nitrate ( $\text{Ba}(\text{NO}_3)_2$ )

### **REFERENCE BOOKS:**

- Practical Engineering Chemistry by Sudha Rani.  
Intermediate practical chemistry, Vikram Series.  
Applied Science Lab Manual by SBTET (for water analysis).

## COMPUTER FUNDEMENTALS LABORATORY

(Common to all Branches)

**Subject Title : Computer Fundamentals laboratory**

**Subject Code : CH-111**

**Periods/Week : 03**

**Periods/Year : 90**

| S. No.       | Major Topics             | No. of sessions<br>each of 3 periods<br>duration | No. of<br>Periods |
|--------------|--------------------------|--|-------------------|
| I.           | Computer hardware Basics | 02   | 06                |
| II.          | Windows Operating System | 02   | 06                |
| III.         | MS Word                  | 08   | 24                |
| IV.          | MS Excel                 | 09   | 27                |
| V.           | MS PowerPoint            | 09   | 27                |
| <b>Total</b> |                          | <b>30</b>  | <b>90</b>         |

### List of Experiments:

**Rationale:** The knowledge of Computer usage has become a must for everyone, due to widespread computer usage and related applications in all fields. This laboratory is designed to give the students hands on practice of Windows Operating System and MS Office to enable the students to use these skills in future courses.

#### I. Computer Hardware Basics (Not for end examination)

1. a).To Familiarize with Computer system and hardware connections
- b).To start and Shut down Computer correctly
- c). To check the software details of the computer

- 2. To check the hardware present in your computer**

## **II. Windows's operating system (Not for end examination)**

- 3. To Explore Windows Desktop**
- 4. Working with Files and Folders**
- 5. Windows Accessories: Calculator – Notepad – WordPad – MS Paint**

## **III. Practice with MS-WORD**

- 6. To familiarize with Ribbon layout of MS Word**  
**Home - Insert - Page layout – References – Review - View**
- 7. To practice Word Processing Basics**
- 8. To practice Formatting techniques**
- 9. To insert a table of required number of rows and columns**
- 10. To insert Objects, Clipart and Hyperlinks**
- 11. To use Mail Merge feature of MS Word**
- 12. To use Equations and symbols features**

## **IV. Practice with MS-EXCEL**

- 13. To familiarize with MS-EXCEL layout**
- 14. To access and Enter data in the cells**
- 15. To edit a spread sheet- Copy, Cut, Paste, and selecting Cells**
- 16. To use built in functions and Formatting Data**
- 17. To create Excel Functions, Filling Cells**
- 18. To enter a Formula for automatic calculations**
- 19. To practice Excel Graphs and Charts**
- 20. To format a Worksheet in Excel, Page Setup and Print**

## **V. Practice with MS-POWERPOINT**



21. To familiarize with Ribbon layout features of PowerPoint 2007.
22. To create a simple PowerPoint Presentation
23. To set up a Master Slide in PowerPoint
24. To insert Text and Objects
25. To insert a Flow Charts
26. To insert a Table
27. To insert a Charts/Graphs
28. To insert video and audio
29. To practice Animating text and objects
30. To Review presentation

**Competencies and Key Competencies to be achieved by the students**

| <b>Exp No.</b> | <b>Name of the Experiment</b>                                       | <b>Competencies</b>  | <b>Key Competencies</b>   |
|----------------|---|--|---|
| <b>1 (a).</b>  | <b>To familiarize with Computer system and hardware connections</b> | <p><b>a. Identify the Parts of a Computer system a). CPU b) Monitor c) CD/DVD Drive d) Power Switch e) Start Button f) Reset Button</b></p> <p><b>b. Identify and connect various peripherals</b></p> <p><b>c. Identify and connect the cables used with computer system</b></p> <p><b>d. Identify various ports on CPU and connect Keyboard &amp; Mouse</b></p> | <b>Connect cables to external hardware and operate the computer</b> |
| <b>1 (b).</b>  | <b>To Start and Shut down Computer correctly</b>                    | <p><b>a. Log in using the password</b></p> <p><b>b. Start and shut down the</b></p>  | <b>a. Login and logout as per the standard procedure</b>            |

|        |  |   |  |
|--------|--|---|--|
|        |  | <p>computer</p> <p>c. Use Mouse and Key Board</p>   | <p>b. Operate mouse &amp;Key Board</p>   |
| 1 (c). | To Explore Windows Desktop                     | <p>a. Familiarize with Start Menu, Taskbar, Icons and Shortcuts</p> <p>b. Access application programs using Start menu, Task manager</p> <p>c. Use Help support</p>   | <p>a. Access application programs using Start menu</p> <p>b. Use taskbar and Task manager</p>  |
| 2.     | To check the software details of the computer  | <p>a. Find the details of Operating System being used</p> <p>b. Find the details of Service Pack installed</p>  | Access the properties of computer and find the details   |
| 3.     | To check the hardware present in your computer | <p>a. Find the CPU name and clock speed</p> <p>b. Find the details of RAM and Hard disk present</p> <p>c. Access Device manager using Control Panel and check the status of devices like mouse and key board</p> <p>d. Use My Computer to check the details of Hard drives and partitions</p> <p>e. Use the Taskbar</p> | <p>a. Access device manager and find the details</p> <p>b. Type /Navigate the correct path and Select icon related to the details required</p> |

|    |  |  |   |
|----|--|--|---|
| 4. | <b>Working with Files and Folders</b>  | <ul style="list-style-type: none"> <li>a. Create folders and organizing files in different folders</li> <li>b. Use copy / paste move commands to organize files and folders</li> <li>c. Arrange icons – name wise, size, type, Modified</li> <li>d. Search a file or folder and find its path</li> <li>e. Create shortcut to files and folders (in other folders) on Desktop</li> <li>f. Familiarize with the use of My Documents</li> <li>g. Familiarize with the use of Recycle Bin</li> </ul> | <ul style="list-style-type: none"> <li>a. Create files and folders<br/>Rename , arrange and search for the required folder/file</li> <li>b. Restore deleted files from Recycle bin</li> </ul>                         |
| 5. | <b>To use Windows Accessories:</b><br><br><b>Calculator – Notepad – WordPad – MS Paint</b> | <ul style="list-style-type: none"> <li>a. Familiarize with the use of Calculator</li> <li>b. Access Calculator using Run command</li> <li>c. Create Text Files using Notepad and WordPad and observe the difference in file size</li> <li>d. Use MS paint and create .jpeg, .bmp files using MS Paint</li> </ul>   | <ul style="list-style-type: none"> <li>a. Use windows accessories and select correct text editor based on the situation.</li> <li>b. Use MS pain to create /Edit pictures and save in the required format.</li> </ul> |

|    |   |  |  |
|----|---|--|--|
| 6. | To familiarize with Ribbon layout of MS word. – Home – Insert- page layout- References-Review- View | <ul style="list-style-type: none"> <li>a. Create/Open a document</li> <li>b. Use Save and Save as features</li> <li>c. Work on two documents simultaneously</li> <li>d. Choose correct Paper size and Printing options</li> </ul>  | <ul style="list-style-type: none"> <li>a. Create a Document and name appropriately and save</li> <li>b. Set paper size and print options</li> </ul>  |
| 7. | To practice Word Processing Basics  | <ul style="list-style-type: none"> <li>a. Typing text</li> <li>b. Keyboard usage</li> <li>c. Use mouse (Left click / Right click / Scroll)</li> <li>d. Use Keyboard shortcuts</li> <li>e. Use Find and Replace features in MS- word</li> <li>f. Use Undo and Redo Features</li> <li>g. Use spell check to correct Spellings and Grammar</li> </ul> | <ul style="list-style-type: none"> <li>a. Use key board and mouse to enter/edit text in the document.</li> <li>b. Use shortcuts</li> <li>c. Use spell check/ Grammar features for auto corrections.</li> </ul>                                       |
| 8. | To practice Formatting techniques   | <ul style="list-style-type: none"> <li>a. Formatting Text</li> <li>b. Formatting Paragraphs</li> <li>c. Setting Tabs</li> <li>d. Formatting Pages</li> <li>e. The Styles of Word</li> <li>f. Insert bullets and numbers</li> <li>g. Themes and Templates</li> </ul>  | <ul style="list-style-type: none"> <li>a. Format Text and paragraphs and use various text styles.</li> <li>b. Use bullets and numbers to create lists</li> <li>c. Use Templates /Themes</li> <li>d. Insert page numbers date, headers and</li> </ul> |

|                   |  |   |  |
|-------------------|--|---|--|
|                   |  | <p><b>h. Insert page numbers, header and footer</b></p>   | <p><b>footers</b></p>  |
| <p><b>9.</b></p>  | <p><b>To insert a table of required number of rows and columns</b></p> | <p><b>a. Edit the table by adding the fields – Deleting rows and columns – inserting sub table – marking borders. Merging and splitting of cells in a Table</b></p> <p><b>b. Changing the background colour of the table</b></p> <p><b>c. Use table design tools</b></p> <p><b>d. Use auto fit – fixed row/ column height/length – Even distribution of rows / columns features</b></p> <p><b>e. Convert Text to table and Table to Text</b></p> <p><b>f. Use Sort feature of the Table to arrange data in ascending/descending order</b></p> | <p><b>a. Insert table in the word document and edit</b></p> <p><b>b. Use sort option for arranging data.</b></p> |
| <p><b>10.</b></p> | <p><b>To Insert objects, clipart and Hyperlinks</b></p>                | <p><b>a. Create a 2-page document. &amp;Insert hyperlinks and t Bookmarks.</b></p> <p><b>b. Create an organization chart</b></p> <p><b>c. Practice examples like preparing an Examination schedule notice with a hyperlink to Exam schedule table.</b></p>  | <p><b>a. Insert hyperlinks &amp;Bookmarks</b></p> <p><b>b. Create organization charts/flow charts</b></p>        |

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|-----|---|---|---|
| 11. | <b>To Use Mail merge feature of MS Word</b>   | <ul style="list-style-type: none"> <li>a. Use mail merge to prepare individually addressed letters</li> <li>b. Use mail merge to print envelopes.</li> </ul>  | Use Mail merge feature  |
| 12. | <b>To use Equations and symbols features.</b> | <ul style="list-style-type: none"> <li>a. Explore various symbols available in MS Word</li> <li>b. Insert a symbol in the text</li> <li>c. Insert mathematical equations in the document</li> </ul>   | <b>Enter Mathematical symbols and Equations in the word document</b>  |
| 13. | <b>To Practice with MS-EXCEL</b>              | <ul style="list-style-type: none"> <li>a. Open /create an MS Excel spreadsheet and familiarize with MS Excel 2007 layout like MS office Button-</li> <li>b. Use Quick Access Toolbar- Title Bar- Ribbon-Worksheets- Formula Bar-Status Bar</li> </ul> | <ul style="list-style-type: none"> <li>a. Familiarize with excel layout and use</li> <li>b. Use various features available in toolbar</li> </ul>        |
| 14. | <b>To access and Enter data in the cells</b>  | <ul style="list-style-type: none"> <li>a. Move Around a Worksheets-Quick access -Select Cells</li> <li>b. Enter Data-Edit a Cell- Wrap Text-Delete a Cell Entry-Save a File-Close Excel</li> </ul>  | <ul style="list-style-type: none"> <li>a. Access and select the required cells by various addressing methods</li> <li>b. Enter data and edit</li> </ul> |

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|-----|--|---|--|
| 15. | To edit spread sheet<br>Copy, Cut, Paste, and<br>selecting cells | <ul style="list-style-type: none"> <li>a. Insert and Delete<br/>Columns and Rows-<br/>Create Borders-Merge<br/>and Center</li> <li>b. Add Background Color-<br/>Change the Font, Font<br/>Size, and Font Color</li> <li>c. Format text with Bold,<br/>Italicize, and Underline-<br/>Work with Long Text-<br/>Change a Column's<br/>Width</li> </ul> | Format the excel sheet   |
| 16. | To use built in functions<br>and Formatting Data                 | <ul style="list-style-type: none"> <li>a. Sort and filter data<br/>in a worksheet</li> <li>b. Perform<br/>Mathematical<br/>Calculations verify -<br/>AutoSum</li> <li>c. Perform Automatic<br/>Calculations-Align<br/>Cell Entries</li> </ul>   | Use built in functions in<br>Excel                                       |
| 17. | To enter a Formula for<br>automatic calculations                 | <ul style="list-style-type: none"> <li>a. Enter formula</li> <li>b. Use Cell References<br/>in Formulae</li> <li>c. Use Automatic<br/>updating function of<br/>Excel Formulae</li> <li>d. Use Mathematical<br/>Operators in<br/>Formulae</li> <li>e. Use Excel Error<br/>Message and Help</li> </ul>  | Enter formula for<br>automatic calculations                              |
| 18. | To Create Excel<br>Functions, Filling Cells                      | <ul style="list-style-type: none"> <li>a. Use Reference<br/>Operators</li> <li>b. Work with sum,<br/>Sum if , Count and</li> </ul>  | a. Create Excel<br>sheets involving<br>cross references<br>and equations |

|     |   |   |  |
|-----|---|---|--|
|     |   | <p style="text-align: center;"><b>Count If Functions</b></p> <p style="text-align: center;"><b>c. Fill Cells Automatically</b></p>  | <p><b>b. Use the advanced functions for conditional calculations</b></p>   |
| 19. | <b>To Practice Excel Graphs and Charts</b>                                  | <p><b>a. Produce an Excel Pie Chart</b></p> <p><b>b. Produce</b></p> <p><b>c. Excel Column Chart</b></p>  | <p><b>a. Use data in Excel sheet to Create technical charts and graphs Produce Excel Line Graph</b></p> <p><b>b. Produce a Pictograph in Excel</b></p> |
| 20. | <b>To format a Worksheet in Excel, page setup and print</b>                 | <p><b>a. Shade alternate rows of data</b></p> <p><b>b. Add currency and percent symbols</b></p> <p><b>c. Change height of a row and width of a column</b></p> <p><b>d. Change data alignment</b></p> <p><b>e. Insert Headers and Footers</b></p> <p><b>f. Set Print Options and Print</b></p> | <p><b>a. Format Excel sheet</b></p> <p><b>b. Insert headers &amp; footers and print</b></p>  |
| 21. | <b>To familiarize with Ribbon layout &amp; features of PowerPoint 2007.</b> | <b>Use various options in Home, insert, design, animation, slideshow, Review &amp; View in the PowerPoint</b>   | <b>Access required options in the tool bar</b>   |
| 22. | <b>To create a simple PowerPoint Presentation</b>                           | <p><b>a. Insert a New Slide into PowerPoint</b></p> <p><b>b. Change the Title of a PowerPoint Slide</b></p> <p><b>c. PowerPoint Bullets</b></p>   | <p><b>a. Create simple PowerPoint presentation with photographs/Clip Art and text boxes</b></p>  |



|     |  |   |   |
|-----|--|---|---|
|     |  | <ul style="list-style-type: none"> <li>d. Add an Image to a PowerPoint Slide</li> <li>e. Add a Textbox to a PowerPoint slide</li> </ul>   | <ul style="list-style-type: none"> <li>b. Use bullets option</li> </ul>                                 |
| 23. | To Set up a Master Slide in PowerPoint and add notes | <ul style="list-style-type: none"> <li>a. Create a PowerPoint Design Template</li> <li>b. Modify themes</li> <li>c. Switch between Slide master view and Normal view</li> <li>d. Format a Design Template Master Slide</li> <li>e. Add a Title Slide to a Design Template</li> <li>f. The Slide Show Footer in PowerPoint</li> <li>f. Add Notes to a PowerPoint Presentation</li> </ul> | <ul style="list-style-type: none"> <li>a. Setup Masterslide and format</li> <li>b. Add notes</li> </ul> |
| 24. | To Insert Text and Objects                           | <ul style="list-style-type: none"> <li>a. Insert Text and objects</li> <li>b. Set Indents and line spacing</li> <li>c. Insert pictures/ clipart</li> <li>d. Format pictures</li> <li>e. Insert shapes and word art</li> <li>f. Use 3d features</li> <li>g. Arrange objects</li> </ul>   | <p>Inset Text and Objects</p> <p>Use 3d features</p>  |
| 25. | To insert a Flow Chart / Organizational Charts       | <ul style="list-style-type: none"> <li>a. Create a Flow Chart in PowerPoint</li> <li>b. Group and Ungroup Shapes</li> </ul>   | <p>Create organizational charts and flow charts using smart art</p>                                     |

|     |  |   |   |
|-----|--|---|---|
|     |  | <ul style="list-style-type: none"> <li>c. Use smart art</li> </ul>  |   |
| 26. | <p><b>To insert a Table</b></p>  | <ul style="list-style-type: none"> <li>a. PowerPoint Tables</li> <li>b. Format the Table Data</li> <li>c. Change Table Background</li> <li>d. Format Series Legend</li> </ul>   | <p><b>Insert tables and format</b></p>  |
| 27. | <p><b>To insert a Charts/Graphs</b></p>  | <ul style="list-style-type: none"> <li>a. Create 3D Bar Graphs in PowerPoint</li> <li>b. Work with the PowerPoint Datasheet</li> <li>c. Format a PowerPoint Chart Axis</li> <li>d. Format the Bars of a Chart</li> <li>e. Create PowerPoint Pie Charts</li> <li>f. Use Pie Chart Segments</li> <li>g. Create 2D Bar Charts in PowerPoint</li> <li>h. Format the 2D Chart</li> <li>e. Format a Chart Background</li> </ul> | <p><b>Create charts and Bar graphs, Pie Charts and format.</b></p>  |
| 28. | <p><b>To Insert audio &amp; video, Hyper links in a slide</b></p> <p><b>Add narration to the slide</b></p> | <ul style="list-style-type: none"> <li>a. Insert sounds in the slide and hide the audio symbol</li> <li>b. Adjust the volume in the settings</li> <li>c. Insert video file in the format supported by PowerPoint in a</li> </ul>  | <ul style="list-style-type: none"> <li>a. Insert Sounds and Video in appropriate format.</li> <li>b. Add narration to the slide</li> <li>c. Use hyperlinks to switch to different slides</li> </ul> |

|     |                               |  |  |
|-----|-------------------------------|--|--|
|     |                               | <p>slide</p> <p>d. Use automatic and on click options</p> <p>e. Add narration to the slide</p> <p>f. Insert Hyperlinks</p>   | and files  |
| 29. | To Practice Animation effects | <p>a. Apply transitions to slides</p> <p>b. To explore and practice special animation effects like <i>Entrance, Emphasis, Motion Paths &amp; Exit</i></p>  | Add animation effects  |
| 30. | Reviewing presentation        | <p>a. Checking spelling and grammar</p> <p>b. Previewing presentation</p> <p>c. Set up slide show</p> <p>d. Set up resolution</p> <p>e. Exercise with Rehearse Timings feature in PowerPoint</p> <p>f. Use PowerPoint Pen Tool during slide show</p> <p>g. Saving</p> <p>h. Printing presentation</p> <p>(a) Slides</p> <p>(b) Handout</p> | <p>a. Use Spell check and Grammar feature</p> <p>b. Setup slide show</p> <p>c. Add timing to the slides</p> <p>d. Setup automatic slide show</p> |

# **III semester**

**DIPLOMA IN CHEMICAL ENGINEERING**  
**SCHEME OF INSTRUCTIONS AND EXAMINATIONS**  
**C-16, III Semester**

| Subject Code      | Name of the Subject                                      | Instruction period / week |                     | Total Period / year | Scheme of Examination |                 |                |             |
|-------------------|--|---------------------------|---------------------|---------------------|-----------------------|-----------------|----------------|-------------|
|                   |  | Theory                    | Practical /Tutorial |                     | Duration (hours)      | Sessional Marks | End Exam Marks | Total Marks |
| <b>THEORY:</b>    |  |                           |                     |                     |                       |                 |                |             |
| CH- 301           | Engineering Mathematics – II                             | 05                        | --                  | 75                  | 3                     | 20              | 80             | 100         |
| CH-302            | Electrical Technology                                    | 04                        | --                  | 60                  | 3                     | 20              | 80             | 100         |
| CH-303            | Fluid Mechanics  | 05                        | --                  | 75                  | 3                     | 20              | 80             | 100         |
| CH-304            | Organic and Physical Chemistry                           | 05                        | --                  | 75                  | 3                     | 20              | 80             | 100         |
| CH-305            | Mass and Energy Balance                                  | 05                        | --                  | 75                  | 3                     | 20              | 80             | 100         |
| <b>PRACTICAL:</b> |  |                           |                     |                     |                       |                 |                |             |
| CH-306            | Chemical Engineering Drawing Lab using CAD               | --                        | 06                  | 90                  | 3                     | 40              | 60             | 100         |
| CH-307            | Electrical Technology and Organic Physical Chemistry Lab | --                        | 06                  | 90                  | 3                     | 40              | 60             | 100         |
| CH-308            | Communication skills                                     | --                        | 03                  | 45                  | 3                     | 40              | 60             | 100         |
| CH-309            | Fluid Mechanics Lab                                      | --                        | 03                  | 45                  | 3                     | 40              | 60             | 100         |
| <b>TOTAL</b>      |  | 24                        | 18                  | 630                 |                       | 260             | 640            | 900         |

CH-301 Common to all branches.

CH-302 Common to CHPC/PP/OT-302

CH-305 Common to CHPC/PP/OT-305

**ENGINEERING MATHEMATICS – II**  
(Common to all Branches)

Subject Title : Engineering Mathematics-II  
 Subject Code : CH-301  
 Periods per week : 05  
 Periods per Semester : 75

**Blue print**

Upon completion of the subject the student shall be able to

| S. No | Major Topic                                      | No of Periods | Weightage of Marks | Short Type |   |     | Essay Type     |                |                |
|-------|--|---------------|--------------------|------------|---|-----|----------------|----------------|----------------|
|       |  |               |                    | R          | U | App | R              | U              | App            |
|       | <b>Unit - I</b>                                  |               |                    |            |   |     |                |                |                |
| 1     | <b>Indefinite Integration</b>                    | 15            | 21                 | 1          | 1 | 0   | $\frac{1}{2}$  | $\frac{1}{2}$  | $\frac{1}{2}$  |
|       | <b>Unit - II</b>                                 |               |                    |            |   |     |                |                |                |
| 2     | <b>Definite Integration and its applications</b> | 35            | 60                 | 1          | 1 | 3   | 1              | 1              | $2\frac{1}{2}$ |
|       | <b>Unit - III</b>                                |               |                    |            |   |     |                |                |                |
| 3     | <b>Differential Equations</b>                    | 25            | 29                 | 2          | 1 | 0   | 1              | 1              | 0              |
|       | <b>Total</b>                                     | 75            | 110                | 4          | 3 | 3   | $2\frac{1}{2}$ | $2\frac{1}{2}$ | 30             |
|       |  |               | Marks:             | 12         | 9 | 9   | 25             | 25             | 30             |

**R: Remembering type** 37 marks  
**Understanding**

**U: type** 34 marks

**App: Application type** 39 marks

**OBJECTIVES**

**Unit-I**

**1.0 Indefinite Integration**

- 1.1 Explain the concept of Indefinite integral as an anti-derivative.
- 1.2 State the indefinite integral of standard functions and properties of Integrals  $\int (u + v) dx$  and  $\int ku dx$  where  $k$  is constant and  $u, v$  are functions of  $x$ .
- 1.3 Solve integration problems involving standard functions using the above rules.

- 1.4 Evaluate integrals involving simple functions of the following type by the method of substitution.
- $\int f(ax + b) dx$  where  $f(x)$  is in standard form.
  - $\int [f(x)]^n f'(x) dx$
  - $\int f'(x)/[f(x)] dx$
  - $\int f\{g(x)\} g'(x) dx$
- 1.5 Find the Integrals of  $\tan x$ ,  $\cot x$ ,  $\sec x$  and  $\operatorname{cosec} x$  using the above.
- 1.6 Evaluate the integrals of the form  $\int \sin^m \theta \cos^n \theta. d\theta$  where m and n are positive integers.
- 1.7 Evaluate integrals of powers of  $\tan x$  and  $\sec x$ .
- 1.8 Evaluate the Standard Integrals of the functions of the type

$$i) \frac{1}{a^2 + x^2}, \frac{1}{a^2 - x^2}, \frac{1}{x^2 - a^2}$$

$$ii) \frac{1}{\sqrt{a^2 + x^2}}, \frac{1}{\sqrt{a^2 - x^2}}, \frac{1}{\sqrt{x^2 - a^2}}$$

$$iii) \sqrt{x^2 - a^2}, \sqrt{x^2 + a^2}, \sqrt{a^2 - x^2}$$

- 1.9 Evaluate the integrals of the type

$$\int \frac{1}{a \pm b \sin \theta} d\theta, \int \frac{1}{a \pm b \cos \theta} d\theta \text{ and } \int \frac{1}{a \cos \theta \pm b \sin \theta \pm c} d\theta .$$

- 1.10 Evaluate integrals using decomposition method.
- 1.11 Evaluate integrals using integration by parts with examples.
- 1.12 State the Bernoulli's rule for evaluating the integrals of the form  $\int u.v dx$  .
- 1.13 Evaluate the integrals of the form  $\int e^x [f(x) + f'(x)] dx$ .

## Unit-II

### (a) Understand definite integral and its properties

- State the fundamental theorem of integral calculus
- Explain the concept of definite integral.
- Calculate the definite integral over an interval.
- State various properties of definite integrals.
- Evaluate simple problems on definite integrals using the above properties.

### (b) Real life applications of definite integrals

- Explain definite integral as a limit of sum by considering an area.
- Find the areas under plane curves and area enclosed between two curves using integration.
- Obtain the volumes of solids of revolution.
- Obtain the mean value and root mean square value of the functions in any given interval.
- Explain the Trapezoidal rule, Simpson's 1/3 rules for approximation of integrals and provide some examples.

### (c) Certain special integrals: Laplace Transforms

- Write the definition of Laplace Transform and explain sufficient conditions for its existence.
- Provide formulae for Laplace transforms of standard functions.

- 2.13 State Linear property, First shifting property, Change of Scale property for Laplace transforms. Solve simple problems using these properties.
- 2.14 Write formulae for Laplace transform of  $t^n f(t)$ ,  $\frac{f(t)}{t}$ ,  $f^{(n)}(t)$ ,  $\int_0^t f(u) du$  in terms of Laplace transform of  $f(t)$ . Provide simple examples on these functions.
- 2.15 Define unit step function and write the Laplace Transform of unit step function.  
State second shifting property.
- 2.16 Define inverse Laplace Transform and write inverse Laplace Transform of standard functions. Solve simple problems.
- 2.17 Write first shifting property of inverse Laplace Transform with examples
- 2.18 Define convolution of two functions and state convolution theorem with few examples for understanding only.
- (d) Understand the Fourier series expansion of functions**
- 2.19 Define Fourier series of a function on the interval  $(c, c + 2l)$  and state sufficient conditions for its existence. Write the Euler's formulae for determining the Fourier coefficients.
- 2.20 Find Fourier series of simple functions in the range  $(0, 2l)$ ,  $(0, 2\pi)$ ,  $(-l, l)$  and  $(-\pi, \pi)$ .
- 2.21 Find Fourier coefficients for even and odd functions in the interval  $(-l, l)$  and  $(-\pi, \pi)$  in simple examples.
- 2.22 Define half range Fourier sine and cosine series of a function over the interval  $(0, l)$  with examples.

### 3.0 Introduction to Differential Equations

- 3.1 Define a Differential equation, its order, degree
- 3.2 Form a differential equation by eliminating arbitrary constants.
- 3.3 Solve the first order first degree differential equations by the following methods:
- i. Variables Separable.
  - ii. Homogeneous Equations.
  - iii. Exact Differential Equations
  - iv. Linear differential equation of the form  $dy/dx + Py = Q$ , where P and Q are functions of x or constants.
  - iv. Bernoulli's Equation (Reducible to linear form.)
- 3.4 Solve Differential equations of the type  $(aD^2 + bD + c)y = 0$  when the roots of the auxiliary equation are real and different, real and repeated, Complex conjugates.
- 3.5 Solve the higher order homogeneous differential equations with constant coefficients.
- 3.6 Explain the concept of complementary function, particular Integral and general solution of a differential equation.



- 3.7 Solve  $n^{\text{th}}$  order differential equation of the type  $f(D) y = X$  where  $f(D)$  is a polynomial of  $n^{\text{th}}$  order and  $X$  is a function of the form  $k, e^{ax}, \text{Sin}ax, \text{Cos}ax, x^n$ .
- 3.8 Solve simple problems leading to engineering applications

## COURSE CONTENT

### Unit-I

#### Indefinite Integration:

1. Integration regarded as anti-derivative – Indefinite integral of standard functions. Properties of indefinite integral. Integration by substitution or change of variable. Integrals of the form

$\sin^m \theta, \cos^n \theta$ . where  $m$  and  $n$  are positive integers. Integrals of  $\tan x, \cot x, \sec x, \text{cosec } x$  and powers of  $\tan x, \sec x$  by substitution.

Evaluation of integrals which are reducible to the following forms :

$$i) \frac{1}{a^2 + x^2}, \frac{1}{a^2 - x^2}, \frac{1}{x^2 - a^2}$$

$$ii) \frac{1}{\sqrt{a^2 + x^2}}, \frac{1}{\sqrt{a^2 - x^2}}, \frac{1}{\sqrt{x^2 - a^2}}$$

$$iii) \sqrt{x^2 - a^2}, \sqrt{x^2 + a^2}, \sqrt{a^2 - x^2}$$

Integration by decomposition of the integrand into simple rational, algebraic functions. Integration by parts, Bernoulli's rule.

### Unit-II

#### Definite Integral and its applications:

2. Definite integral-fundamental theorem of integral calculus, properties of definite integrals, evaluation of simple definite integrals. Definite integral as the limit of a sum. Area under plane curves – Area enclosed between two curves. Volumes of solids of revolution. Mean and RMS values of a function on a given interval. Trapezoidal rule, Simpson's 1/3 rule to evaluate an approximate value of a definite integral.

Definition, sufficient conditions for existence of Laplace Transform (LT), LT of elementary functions, linearity property, scale change property, first shifting property, multiplication by  $t^n$ , division by  $t$ , LT of derivatives and integrals, unit step function, LT of unit step function, second shifting theorem, inverse Laplace transforms- shifting theorems and change of scale property, multiplication by  $s^n$  and division by  $s$  – examples of inverse LT using partial fractions – convolution theorem (no proof).

Representation of a function in Fourier series over the interval  $(c, c + 2l)$ , Give sufficient conditions for existence of Fourier series. Euler's formulae for Fourier coefficients, Finding Fourier coefficients for simple functions, elementary even and odd functions. Define half range Fourier series.

### Unit -III

**Differential Equations:**

Definition of a differential equation-order and degree of a differential equation-formation of differential equations-solution of differential equation of first order, first degree: variable-separable, homogeneous, exact, linear differential equation, Bernoulli's equation.

Homogenous linear differential equations with constant coefficients of order two and higher with emphasis on second order.

Non-homogenous linear differential equations with constant coefficients of the form

$f(D)y = X$ , where  $X$  is in the form  $k$ ,  $e^{ax}$ ,  $\sin ax$ ,  $\cos ax$ ,  $x^n$ , ( $n= 1,2$ ) – complimentary function, particular integral and general solution.

**Reference Books:**

1. Integral Calculus Vol.I, by M.Pillai and Shanti Narayan
2. Thomas' Calculus, Pearson Addison –Wesley Publishers
3. A Text book of Engg. Mathematics by B.S.Grawel
4. A Text book of Engg. Mathematics by B.V.Ramana- T.Mc Graw Hill Publishers

## ELECTRICAL TECHNOLOGY

**Subject Title** : Electrical Technology  
**Subject – Code** : CH-302  
**Periods / Week** : 04  
**Periods / Semester** : 60

### TIME SCHEDULE

| S. No.               | Major Topics  | No. of Periods | Weightage of Marks | Short answer type | Essay type |
|----------------------|---|----------------|--------------------|-------------------|------------|
| 1                    | D.C & A.C Circuits  | 15             | 24                 | 3                 | 1½         |
| 2                    | Electromagnetism and Electromagnetic Induction                            | 10             | 18                 | 1                 | 1½         |
| 3                    | D.C & A.C Machines  | 20             | 39                 | 3                 | 3          |
| 4                    | Electrical Measuring Instrument   | 05             | 13                 | 1                 | 1          |
| 5                    | Understand the different equipments & safety procedures used in industry. | 05             | 08                 | 1                 | ½          |
| 6                    | Electronic Devices  | 05             | 08                 | 1                 | ½          |
| <b>Total Periods</b> |   | <b>60</b>      | <b>110</b>         | <b>10</b>         | <b>08</b>  |

### **OBJECTIVES:**

Upon the study, at the end of the Semester, the Student will be able to

#### **Unit-1: Understand D.C & A.C Circuits:**

- 1.1 Understand the concepts of Current, Electric potential, potential difference, Resistance, Conductance, Specific resistance and conductivity.
- 1.2 Laws of resistance & Statement of Ohms Law.
- 1.3 Calculation of current, Voltage and Resistance in a given dc circuit.
- 1.4 Calculation of equivalent resistance in a – Series Circuit, parallel Circuit.
- 1.5 Simple problems on Series, Parallel Circuits.
- 1.6 State and explain Kirchhoff's of Laws.
- 1.7 Define the following terms related to alternating quantities.  
i) Alternating quantity, ii) wave form iii) Cycle iv) Time period v) frequency vi) instantaneous value vii) RMS value viii) average value ix) form factor x) peak factor.
- 1.8 Express instantaneous value , RMS value and average value in terms of maximum value.
- 1.9 Explain phase and phase difference between two alternating quantities.
- 1.10 State leading and lagging vector quantities.
- 1.11 State phase relationships between voltage and current in (a) R (b) L (c) C (d) R – L – C in series.
- 1.12 Define Power factor .
- 1.13 State equation for i) Active power ii) reactive power iii) apparent power in single phase AC circuits.
- 1.14 Explain Star and Delta connections in 3 -  $\Phi$  circuits.
- 1.15 State phase and line voltages and currents and their relationship in Star and Delta connections.
- 1.16 State expression for i) Active power ii) reactive power iii) apparent power in 3- phase AC circuits.
- 1.17 Simple problems on the above.

### **Understand the Principles of Electromagnetism and Electromagnetic Induction.**

- 2.1 Explain the terms – permeability, magnetic field strength, flux and Flux density – Relation between permeability, flux density and magnetic field strength.
- 2.2 Express the field strength due to i) straight current carrying conductor ii) on the axis of a solenoid.
- 2.3 State the following terms related to electromagnetic induction
  - i. Faraday's laws of electromagnetic induction
  - ii. Fleming's Left Hand Rule
  - iii. Statically Induced emf
  - iv. Dynamically Induced emf
  - v. Self induced emf
  - vi. Mutually Induced emf
  - vii. Lenz's Law.
- 2.4 Give the expression for self inductance, Mutual Inductance and Coefficient of coupling. (No derivation).
- 2.5 Simple problems on above.

### **DC & AC machines :**

- 3.1 List the parts and function of each part of the D.C. Machine.
- 3.2 Classify the D.C. Machines as D.C. Generators and D.C. Motors – State their working principle.
- 3.3 State generated emf equation. (No derivation).
- 3.4 State and explain Back emf. (No derivation).
- 3.5 State torque equation. (No derivation).
- 3.6 Solve simple problems on above.
- 3.7 Explain the necessity of starter and explain 3 point starter with neat diagram.
- 3.8 Explain speed control of D.C. Shunt motor by armature control and (b) Field control methods.
- 3.9 State the applications of D.C. Generators and D.C. Motors
- 3.10 Explain the principle of working of a transformer.
- 3.11 Classify the types of transformers basing on construction of the transformers. (Core type and shell type).
- 3.12 State emf equation of a transformer. Solve simple problems. (No derivation).
- 3.13 State step – up and step – down transformers.
- 3.14 Explain Auto transformers.
- 3.15 Classify the three phase induction motors and single phase Induction motors – state the application of each motor.
- 3.16 Explain the construction and working principles of 3 – phase Induction Motors
- 3.17 Explain the construction and working principles of 1 – phase Induction Motors
- 3.18 Explain the necessity of starter in 3-phase induction motor
- 3.19 Explain i) DOL starter ii) Star Delta Starter with neat diagrams.
- 3.20 State the applications of 1 phase and 3-phase induction motors.
- 4.0 Understand the working of electrical measuring instrument**
- 4.1 Explain the construction and working of moving iron and moving coil instruments.
- 4.2 State uses of (a) Megger (b) Multi meter and (c) Energy Meter in electrical circuits.
- 4.3 Explain Thermocouple instruments for measuring temperatures.
- 5.0 Understand the different equipments & safety procedures used in industry.**

- 5.1 Explain the basic principles of electric Heating.
- 5.2 State applications of electric Heating.
- 5.3 Explain the basic principles of electric welding.
- 5.4 Classify the methods of electric welding, state applications of each method.
- 5.5 Describe the working of DC welding generator with neat diagram.
- 5.6 Describe the working of welding transformer with neat diagram.
- 5.7 State the function of the following i) Switch ii) Fuse iii) Circuit breaker iv) Relay v) Capacitor banks.
- 5.8 State safety precautions to be adopted for prevention of electric shock to persons working on electric equipments or live wires.
- 5.9 State procedures for first aid to a person came into contact with live wires.
- 6.0 Understand the working of Electronic Devices**
- 6.1 Classify the materials like conductors, insulators and semi conductors based on i) Valence electrons ii) Conductivity iii) Energy band diagrams.
- 6.2 Explain the P- type semiconductor and N – type semiconductor.
- 6.3 Explain P – N Junction diode.
- 6.4 State the applications of a P – N Junction diode (as a rectifier).
- 6.5 Explain the P– N – P and N – P – N transistors and their applications.

## Course Contents:

1. Concepts of Current, Electric potential, potential difference, Resistance, Conductance, Specific resistance and conductivity.  
Ohm's Law – simple problems on D.C.circuits – Equivalent and resistance- Parallel circuits – Kirchoff's Laws – Problems- Single Phase circuits – Definitions related to alternative quantities - Phase and phase difference – leading and lagging quantities – Phase relationships between voltage and current in R, L, C, R-L in series , R-C in series and R-L-C in series – define power factor – Solve simple A.C.circuits – expression– active power and reactive power- apparent power in single phase circuits- star and delta connections in 3-phase circuits - expression– active power and reactive power- apparent power – simple problems on above.
2. Concepts of different terms related to Electromagnetism – electromagnetic induction – expressions for field strength due to straight current carrying conductor and on the axis of solenoid - Dynamically induced emf – statically induced emf – self and mutually induced emf – self inductance and mutual inductance – Simple Problems.
3. D.C & A.C. Machines – working – construction – types of D.C.generators – types of D.C motors – Generated emf – Back emf – torque – equations – 3 – point starter – speed control – Applications of D.C Generators D.C. Motors- Single – phase– Auto transformers – Construction and working principles of 3-phase and single phase induction motors –DOL starter and Star delta starter Applications - Single – phase and Three – Phase induction motors.
4. Electrical Measuring Instruments – Construction and working of moving iron and moving coil instruments – Megger, Multimeter – Single – Phase energy meter – Thermocouple Instruments.
5. Understand the different equipments & safety procedures used in industry basic principles of electric heating and welding methods – classification of methods of electric heating and welding with their applications- D.C.welding generator- welding transformer – functions of switch, fuse, circuit breaker, Relay , Capacitor banks and Motor control centres- safety precautions to prevent shock – safety procedures for first aid against electric shock.
6. Electronic Devices – Semiconductors – P type and N type semiconductor – P – N Junction diode –PNP transistor and NPN transistors with their applications.

## REFERENCES BOOKS:

1. Electrical Technology – By B.L. Theraja (Vol – I and Vol – II)
2. Fundamentals of Electrical Engineering and Electronics – By B.L. Theraja.
3. The Art and Science of utilization of electrical energy - By H. Partab.
4. Electrical Technology – By Huges
5. Electrical Technology – By V.K. Mehta

## FLUID MECHANICS

**Subject Title : Fluid Mechanics**  
**Subject Code : CH – 303**  
**Periods per week : 05**  
**Total periods/ semester : 75**

### TIME SCHEDULE:

| S.No.        | Major topics                           | No. of periods | Weightage of Marks | Short answer type | Essay type |
|--------------|--|----------------|--------------------|-------------------|------------|
| 1.           | Introduction to Fluid flow phenomena   | 15             | 26                 | 2                 | 2          |
| 2.           | Basic equations of Fluid flow          | 13             | 16                 | 2                 | 1          |
| 3.           | Flow of incompressible fluids in pipes | 14             | 19                 | 3                 | 1          |
| 4.           | Flow past immersed bodies              | 10             | 13                 | 1                 | 1          |
| 5.           | Transportation and Metering of fluids. | 23             | 36                 | 2                 | 3          |
| <b>Total</b> |  | <b>75</b>      | <b>110</b>         | <b>10</b>         | <b>08</b>  |

### OBJECTIVES:

**After completion of the course, the student will be able to**

#### **1.0 Understand the Fluid flow phenomena**

- 1.1 Define fluid and fluid mechanics.
- 1.2 State and discuss types of fluids.
- 1.3 State the important physical properties of fluid and give their units.
- 1.4 Explain compressible and incompressible fluids and give examples.
- 1.5 Explain fluid statics and static pressure.
- 1.6 Explain the concept of pressure and its measurement.
- 1.7 Explain the working of 'U' tube manometer and inverted 'U' tube manometer,
- 1.8 Know about inclined manometer.
- 1.9 State Newton's law of viscosity.
- 1.10 Explain Newtonian and non Newtonian fluids and give examples.
- 1.11 Distinguish Laminar flow and turbulent flow.
- 1.12 Describe Reynold's experiment.
- 1.13 Explain the importance of Reynold's number.
- 1.14 Explain the flow in boundary layers.
- 1.15 Explain the Boundary layer separation and its effects on flow.

1.16 Solve simple problems on calculation of Reynolds number and pressure drop while using manometers.

## **2.0 Know about basic equations of fluid flow**

2.1 Know about mass balance.

2.2 Derive continuity equation.

2.3 Simple problems on Continuity equation

2.4 Know about momentum balance.

2.5 State Bernoulli's theorem and write Bernoulli's equation without friction

2.6 Derive Bernoulli's theorem without friction

2.7 State the modified Bernoulli's equation for friction flow

2.8 Know about Kinetic energy correction.

2.9 Know the pump work in Bernoulli's equation.

2.10 Solve simple problems on calculation of various heads using Bernoulli's equation

2.11 Simple problems on pump work calculation

## **3.0 Know about flow of incompressible fluids in conduits**

3.1 Explain flow of incompressible fluids in pipes.

3.2 Explain velocity and shear stress distribution in pipes

3.3 Define friction factor and know the equations connecting friction factor.

3.4 Explain laminar flow in pipes.

3.5 Know average velocity and kinetic energy correction factor.

3.6 State Hagen Poiseuille equation.

3.7 Simple problems on Hagen Poiseuille equation for pressure drop calculation.

3.8 Know about friction factor in laminar and turbulent flow

3.9 Know about the relation between pressure drop and friction factor.

3.10 Know the effect of roughness.

3.11 Explain the friction factor chart.

3.12 Understand the energy loss due to (a)flow (b) pipe fittings (c) sudden expansion and (d)sudden contraction.

3.13 Know about equivalent length in pipes

3.14 Solve simple problems on friction factor in Laminar & turbulent flow and energy losses in fluid flow through pipes.

## **4.0 Understand about flow past immersed bodies**

4.1 Define Drag.

4.2 Know about different types of drag.



- 4.3 Define drag coefficient.
- 4.4 Explain the relation between Drag Coefficient and Reynolds number.
- 4.5 Explain about stoke's law.
- 4.6 Solve simple problems on Stoke's Law.
- 4.7 Know about Free & Hindered settling.
- 4.8 Explain about Packed bed.
- 4.9 Know the equations to calculate pressure drop in packed beds.
- 4.10 Explain the process of fluidization.
- 4.11 Applications of fluidization.

**5.0 Know about Flow measurement & Transportation of fluids:**

- 5.1 Know the classification of pipes and tubes.
- 5.2 Know about Schedule number and gauge for pipes and tubes.
- 5.3 Know the various types of pipe fittings.
- 5.4 Explain the classification and working of valves
  - (a) gate valve (b) globe valve (c) plug valve (d) check valves and (e) diaphragm valve.
- 5.5 Explain the classification of Flow meters (a) Head Meters (b) Area meters
- 5.6 Explain the principle and working of venturi meter with line diagram
- 5.7 Derive the equation for volumetric flow rate in venturimeter
- 5.8 Explain the principle and working of orifice meter with line diagram
- 5.9 Explain the principle and working of pitot tube with line diagram
- 5.10 Explain the principle and working of rotameter with line diagram
- 5.11 Indicate the functions of pump in fluid handling.
- 5.12 Describe the methods of classification of pumps.
- 5.13 Differentiate positive displacement and centrifugal pumps.
- 5.14 Know about the following pumps.
  - (i) Reciprocating Pumps (ii) Piston pump (iii) Plunger Pump (iv) Diaphragm Pump
- 5.15 Know about the following Rotary pumps
  - (i) Gear pump (ii) Screw pump
- 5.16 Describe with neat sketch the construction and operation of the Centrifugal pump.
- 5.17 Describe with neat sketch the construction and operation of the reciprocating piston pump.
- 5.18 Explain the following
  - (a) Suction head (b) Discharge head (c) Total head (d) NPSH (e) Cavitation (f) Priming (g) Mechanical efficiency (h) Power required.
- 5.19 Know about characteristic curves of centrifugal pumps.

- 5.20 Differentiate fan and blower.
- 5.21 Know about the working of (i) Fan (ii) Blower (iii) Vacuum pump (iv) Ejectors.
- 5.22 Solve problems based on calculation of velocities, volumetric flow rates using venturi and orifice meters.
- 5.23 Solve problems on calculation of local velocity in pitot tube.
- 5.24 Simple problems on calculation of NPSH.
- 5.25 Simple problems on power required by a centrifugal pump.

## **COURSE CONTENT:**

**1. Introduction & fluid flow phenomena:** Definition of fluid– Compressible and incompressible fluids– Newtonian and Non-Newtonian fluids– Physical properties of fluids– Density, Viscosity, velocity head, pressure head and static head– Pressure concept– Manometers: U – Tube Manometer, inverted U tube manometer, Inclined manometer– Laminar flow – Turbulent flow– Reynold's experiment- Importance of Reynold's number- Flow in boundary layer- Solve problems on Reynolds number and Pressure drop in manometers, Boundary layer separation and its effects on flow.

**2. Basic equations for fluid flow:** Mass balance- Momentum balance, Continuity equation- Bernoulli's equation– Modified Bernoulli's equation for frictional flow and pump work- kinetic energy correction- Solve problems on various heads using Bernoulli's equation and pump work in Bernoulli's equation

**3. Flow of incompressible fluids in pipes:** Flow of incompressible fluids-Shear stress distribution in pipes- Equation for friction factor- Laminar flow in pipes- Average velocity- Kinetic energy factor- Hagen Poiseuille equation- average velocity- Roughness- Friction factor chart- Energy loss for fluids during flow – Expansion and contraction losses in fitting- equivalent length- Solve simple problems on friction factor in Laminar & turbulent flow , Hagen Poiseuille equation and energy losses in fluid flow through pipes.

**4. Flow past immersed bodies:** Drag- Types of Drag-Drag coefficient– Stokes law- Drag coefficient Vs Reynolds number curve- Friction in flow through beds of solids– Packed bed- void fraction- Pressure drop equations- Free settling-hindered settling-equations for terminal velocities for different particle Reynolds number ranges– Fluidization – Fluidization velocities and pressure drops-Applications of fluidization-simple problems on Stoke's law..

**5. Metering and transportation of fluids:** Flow meters- Head meters, Area meters- Orifice meter, Venturi meter, Pitot tube ,Rotameter- Schedule number, gauge for pipes-Pipes and tubes – Pipe fitting and joints – Valves – Gate valve, Globe valve, Plug valve, Check valve, Diaphragm valve– Pumps-functions of a pump- Classification- Positive displacement pumps –Reciprocating pumps : Piston, Plunger pumps, Diaphragm pumps, - Rotary pumps-Gear pump, screw pump– Centrifugal pumps – Suction head – Discharge head – Total developed head- NPSH– Priming – Cavitation– Characteristic curve – Equipment for gas flow- fans, blowers, Vacuum producing equipment– Ejectors– Solve simple problems on calculation of velocities, volumetric flow rates using Venturi, orifice meters and pitot tube, power required by a centrifugal pump.

## **REFERENCE BOOKS:**

- (1) Unit operations of chemical Engg. by warren L.Mc Cabe, Julian C.Smith and Peter Harriott, Fifth edition, Mc Graw Hill Publication.
- (2) Introduction to Chemical Engg. by Walter L.Badger & Julius T.Banchero. Mc GRAW Hill Publication.
- (3) Chemical engineering Series, Coulson & Richardson, Vol-1,5th edition, Butterworth & Heinmann Publications.
- (4) Unit operations –1, K.A.Ghavane, Nirali Prakashan Publications.

## ORGANIC & PHYSICAL CHEMISTRY

**Subject Title** : Organic & Physical Chemistry  
**Subject Code** : CH – 304  
**Periods per week** : 05  
**Total periods per Semester** : 75

### TIME SCHEDULE:

| S.No.        | Major topics                        | No. of periods | Weightage of Marks | Short answer type | Essay type |
|--------------|-------------------------------------|----------------|--------------------|-------------------|------------|
| 1.           | Chemistry of Aliphatic compounds-I  | 12             | 18                 | 1                 | 1½         |
| 2.           | Chemistry of Aliphatic compounds-II | 20             | 31                 | 2                 | 2½         |
| 3.           | Chemistry of Aromatic compounds     | 09             | 13                 | 1                 | 1          |
| 4.           | Electro Chemistry                   | 13             | 19                 | 3                 | 1          |
| 5.           | Chemical Equilibrium                | 12             | 16                 | 2                 | 1          |
| 6.           | Thermo Chemistry                    | 09             | 13                 | 1                 | 1          |
| <b>Total</b> |                                     | <b>75</b>      | <b>110</b>         | <b>10</b>         | <b>08</b>  |

### OBJECTIVES:

On completion of study of this subject the student will be able to

#### 1. Chemistry of Aliphatic Compounds-I.

- 1.1 Introduction.
- 1.2 Unique characteristics of carbon.
- 1.3 Hybridization of carbon in organic compounds i.e.,  $sp^3$ ,  $sp^2$  and  $sp$ .
- 1.4 Classification of organic compounds.
- 1.5 IUPAC nomenclature of organic compounds.
- 1.6 Homologous series and characteristics.
- 1.7 Isomerism: Structural isomerism and Stereo isomerism (Geometrical and optical) with examples.
- 1.8 Alkanes: Preparation of Methane and Ethane (i) by De-carboxylation (ii) Wurtz reaction (Ethane only) (iii) by reduction of Alkyl Halides.
- 1.9 Properties of Alkanes: (i) Halogenation (ii) Nitration (iii) Combustion of methane and ethane.
- 1.10 Uses of Alkanes.

1.11 Alkenes Preparation of Ethylene: (i) Dehydration of ethyl alcohol (ii) Dehydrohalogenation of ethyl bromide (iii) Dehalogenation of 1, 2 – dibromo ethane.

1.12 Properties of Ethylene: Reaction with (i)  $H_2$ , (ii)  $Br_2/CCl_4$  (iii) Ozone (iv) Oxidation by  $KMnO_4$ .

1.13 Uses of Ethylene.

1.14 ALKYNES: Preparation of Acetylene from (i) Calcium carbide (ii) Dehydrohalogenation of 1,2 di-bromo ethane (iii) Dehalogenation of 1, 1, 2, 2 –tetra bromo ethane.

1.15 Properties of Acetylene: Reaction with (i)  $H_2 / Ni$  (ii)  $Br_2 / CCl_4$  (iii)  $H_2O$  in presence of 30%  $H_2SO_4$  and 1%  $HgSO_4$ .

1.16 Uses of Acetylene.

## 2. Chemistry of Aliphatic Compounds-II.

2.1 Ethyl chloride preparation from (i) Grove's process (ii)  $PCl_3$  (iii) Ethylene  
Properties of Ethyl Chloride - Reaction with (i)  $KOH$  (ii)  $KCN$  (iii)  $AgCN$  (iv) Wurtz Reaction  
Uses of Ethyl chloride

2.2 Chloroform preparation from (i) Ethyl alcohol (ii) Methane (iii)  $CCl_4$   
Properties of Chloroform (i) Reimer-Tiemann reaction (ii) Carbylamine or isocyanide test (iii) oxidation (iv)  $HNO_3$

2.3 Alcohols:

Classification into primary, secondary and tertiary alcohols.

Distinction of primary, secondary and tertiary alcohols using Lucas reagent.

Preparation of Ethyl alcohol from

- i) Ester hydrolysis
- ii) Grignard reagent
- iii) Fermentation of molasses

Properties of Ethyl alcohol: Reaction with

- i) Acetic acid
- ii) Conc.  $H_2SO_4$
- iii) Bleaching powder
- iv)  $PCl_3$

Uses of Ethyl alcohol:

2.4 Aldehydes:

Preparation of acetaldehyde from

- i) Oxidation of ethyl alcohol
- ii) Distillation of calcium acetate and calcium formate.

iii) Acetylene.

Properties of Acetaldehyde

- i) Addition of Grignard reagent
- ii) Reaction with hydrazine
- iii) Aldol condensation
- iv) Silver mirror test
- iv) Fehling's test

Uses of acetaldehyde.

## 2.5 Ketones:

Preparation of acetone from

- i) Oxidation of Isopropyl alcohol
- ii) Distillation of calcium acetate
- iii) Propyne.

Properties of acetone

- i) Addition of Grignard reagent
- ii) Reaction with hydrazine
- iii) Iodoform reaction

Uses of acetone

## 2.6 Carboxylic Acids:

Preparation of Acetic acid from

- i) Ester hydrolysis
- ii) Oxidation of ethyl alcohol
- iii) Hydrolysis of methyl cyanide.

Properties of Acetic acid

- i) Reaction with sodium
- ii) Reaction with ethyl alcohol
- iii) Reaction with  $\text{Cl}_2 / \text{P}$  (Hell – Volhard – Zelinsky reaction)

Uses of Acetic acid.

## 2.7 Ethers:

Preparation of diethyl ether

- i) Williamson's synthesis
- ii) Dehydrating of ethyl alcohol

Properties of ether

- i) Halogenation
- ii) Hydrolysis by dil.  $\text{H}_2\text{SO}_4$
- iii) Action HI.

Uses of ether.

## 2.8 Polymerization: a) Definition and types of polymerization b) Addition polymerization

ex : Polyethene c) Condensation polymerization ex : Bakelite.

### 3. Chemistry of Aromatic compounds.

- 3.1 Aromaticity, Huckel's rule.
- 3.2 Nomenclature of aromatic compounds.
- 3.3 Benzene: preparation, properties and uses.
- 3.4 Nitrobenzene: preparation, properties and use
- 3.5 Aniline: preparation, properties and uses
- 3.6 Phenol: preparation, properties and uses

### 4. Electro Chemistry.

- 4.1 Introduction.
- 4.2 Electrolytes and non electrolytes – examples.
- 4.3 Electrolytic conduction and metallic conduction – definition and differences.
- 4.4 Strong electrolytes and weak electrolytes – examples.
- 4.5 Faraday's laws of electrolysis.
- 4.6 Simple problems based on Faraday's laws.
- 4.7 Industrial applications of electrolysis.

### 5. Chemical equilibrium

- 5.1 Chemical Equilibrium: Reversible and irreversible reactions – examples. Homogeneous and heterogeneous Equilibria – examples.
- 5.2 Chemical equilibrium and its characteristics.
- 5.3 Law of Mass Action – Application to a general reaction i.e.  
$$mA + nB \leftrightarrow pC + qD$$
- 5.4 Effect of (i) concentration (ii) pressure (iii) temperature and (iv) catalyst on chemical equilibrium.
- 5.5 Lechatelier's principle – Application to (i) manufacture of  $\text{NH}_3$  by Haber's process (ii) Formation of  $\text{SO}_3$  in contact process.

### 6. Thermo chemistry.

- 6.1 Introduction.
- 6.2 State 1<sup>st</sup> law of thermo dynamics and know the equations for "T", "Q", "W" and "H".
- 6.3 Internal energy and Enthalpy.
- 6.4 Exothermic and Endothermic reactions with examples.
- 6.5 Types of heats of reactions.
  - i) Heat of formation ii) Heat of combustion
  - iii) Heat of neutralization iv) Heat of solution.

## **COURSE CONTENT:**

1. Introduction – Classification and nomenclature of organic compounds – Isomerism – Preparation, properties and uses of Alkanes, Alkenes and Alkynes
2. Ethyl Chloride, Chloroform, Alcohols, Aldehydes, Ketones, Carboxylic acids, Ethers. Polymerization- Addition and Condensation polymerization
3. Preparation, properties and uses of – Benzene, Nitro benzene, Aniline.
4. Electrolytes, non electrolytes, Arrhenius theory- Faraday's laws of electrolysis – Problems.
5. Chemical equilibrium – Law of mass action – Effect of concentration, pressure, temperature and catalyst on chemical equilibrium – Lechatelier's principle – Applications.
6. Internal energy and Enthalpy-First law of Thermodynamics– Exothermic and Endothermic reactions – Different heats of reactions.

## **REFERENCE BOOKS:**

1. Intermediate Chemistry – Vol, 1 & 2 published by Telugu Academy (or) Vikram Series.
2. Text book of Applied Science – R.V. Subba Rao published by: Book Traders, Hyderabad.
3. Text Book of Organic Chemistry – Arun Bahl & B.S. Bahl, published by S. Chand & Co, New Delhi.
4. Essentials of Physical Chemistry – Bahl & Tuli, published by S. Chand & Co, New Delhi.



## MASS AND ENERGY BALANCE

**Subject Title** : Mass and Energy Balance  
**Subject Code** : CH-305  
**Periods / Week** : 05  
**Periods / Semester** : 75

### TIME SCHEDULE

| S. No.       | Major Topics                                | No. of periods | Weightage of Marks | Short Answer type | Essay Answer type |
|--------------|---|----------------|--------------------|-------------------|-------------------|
| 1            | Units and Dimensions                        | 10             | 15                 | 2                 | 0                 |
| 2            | Basic Calculations                          | 20             | 30                 | 2                 | 2                 |
| 3            | Material balance without Chemical Reactions | 15             | 20                 | 1                 | 2                 |
| 4            | Material balance with Chemical Reactions    | 10             | 15                 | 2                 | 1                 |
| 5            | Energy balance                              | 12             | 18                 | 2                 | 2                 |
| 6            | Combustion                                  | 08             | 12                 | 1                 | 1                 |
| <b>Total</b> |   | <b>75</b>      | <b>110</b>         | <b>10</b>         | <b>08</b>         |

### OBJECTIVES:

#### 1.0 Units and Dimensions:

- 1.1 Know about Physical Quantities
- 1.2 Know Fundamental and Derived quantities
- 1.3 Know about Unit and System of units
- 1.4 Know the Formula, Units in SI system and Dimensional formula of different derived quantities.
- 1.5 Know the conversion factors for various fundamental quantities (Mass, Length, Time and Temperature) from one system of unit to another system of units.
- 1.6 Know the conversion factors for the following derived quantities  
a) Force b) Newton's Law conversion factor c) Pressure from one system of unit to another system of units.
- 1.7 Know the conversion factors for the following derived quantities  
a) Work done b) Heat c) Power from one system of unit to another system of units.
- 1.8 Know the conversion factors for the following derived quantities

- a) Viscosity b) Heat capacity c) Latent heat d) Specific heat  
from one system of unit to another system of units.
- 1.9 Know the conversion factors for the following derived quantities  
a) Kinematic Viscosity b) Surface Tension c) Density d) Specific Volume  
from one system of unit to another system of units.
- 1.10 Know different dimensionless groups
- 1.11 Know the conversion of a equation from one system of units into another  
system of units.
- 1.12 Numerical problems on all the above topics
- 2.0 Basic Calculations:**
- (a) Stoichiometric and composition relationships**
- 2.1 Define Atom, Molecule, Mole, Gram-atom, Gram-molecule, Gram molar  
volume
- 2.2 Define Molarity, Normality, Molality, PPM, Weight percent, Volume  
percent, Mole percent, Analysis on dry basis and wet basis
- 2.3 Define Density and Specific gravity, different gravity scales , and  
relation between gravity scale and Specific gravity ,
- 2.4 know the Variation of density and specific gravity with temperature
- 2.5 Numerous problems on all the above topics
- (b) Behavior of ideal gases**
- 2.5 Kinetic theory of gases
- 2.6 Know about Gas laws: Boyle's law, Charles law, Gay-Lussac's law,  
Avogadro's law, Derivation of Ideal gas equation
- 2.7 Know about Vander Waal's equation of state, Critical properties of substances
- 2.8 Ideal gas constant-Derive the value of ideal gas constant in different  
system of units
- 2.9 state and explain Dalton's law of partial pressures, Amagat's law of  
partial volumes for gaseous mixtures
- 2.10 Explain the characteristics of an Ideal gas, Differences between Ideal  
gas and Real gas
- 2.11 (i) Derive the equation  $\text{volume \%} = \text{mole \%} = \text{pressure \%}$  for an ideal gas  
mixture
- (ii) Know about average molecular weight of a gas mixture and the evaluation  
procedure
- 2.12 Know the evaluation procedure for the density of a gaseous mixture
- 2.13 Numerous problems on all the above topics
- (c) Vapour Pressures:**
- 2.14 Define vapour pressure, understand the relation between vapor  
pressure and boiling point
- 2.15 Know the effect of temperature on vapor pressure
- 2.16 Know the methods of evaluation of vapor pressure
- (a) Antoine equation

- (b) Clausius – Clapeyron equation.
- (b) Vapor pressure reference substance plots - Cox chart, Duhring's lines
- 2.17 Ideal solutions and Non-Ideal solutions. Differences between Ideal and Non-Ideal solutions
- 2.18 Define (a) Raoult's Law (b) Henry's Law for solutions
- 2.19 Numerous problems on all the above topics
- (d) Humidity and Saturation:**
- 2.20 Define and explain the following.
  - (a) Un-saturation, Saturation
  - (b) Humidity, Absolute humidity, Relative Humidity, Molal absolute humidity, % Saturation
  - (c) Dew Point
- 2.21 Know about Dry and wet bulb temperature
- 2.22 Numerous problems on all the above topics

### **3.0 Material balance without chemical reactions:**

- 3.1 Know Unit operation and Unit Process. Give Examples
- 3.2 Know about representation of unit operations/unit processes by a process flow chart or a block diagram
- 3.3 Know the basis for material balances
- 3.4 Understand the terms in the general material balance equation
- 3.5 Define and explain tie substance, key component and inert substance
- 3.6 Establish the steps to solve material balance problems
- 3.7 Know about Degrees of Freedom
- 3.8 Know about steady and un-steady state mass balance
- 3.9 Solve material balance problems related to Evaporation
- 3.10 Solve material balance problems related to Drying
- 3.11 Solve material balance problems related to Mixing
- 3.12 Solve material balance problems related to Distillation
- 3.13 Solve material balance problems related to Extraction
- 3.14 Solve material balance problems related to Crystallization
- 3.15 Know about Bypass in continuous chemical processes with examples
- 3.16 Know about Recycle in continuous chemical processes with examples
- 3.17 Know about Purge streams in continuous chemical processes with examples
- 3.18 Know about Blow-down streams in continuous chemical processes with examples
- 3.19 Numerous problems on all the above topics

### **4.0 Material balance with chemical reactions:**

- 4.1 Know about Stoichiometry, application of stoichiometry, stoichiometric equations, stoichiometric coefficients, and stoichiometric proportions .Give suitable examples
- 4.2 Define and explain (a) limiting component and (b) excess reactant

- 4.3 Understand % conversion in a chemical reaction
- 4.4 Understand % yield in a chemical reaction
- 4.5 Understand Degree of completion in a chemical reaction
- 4.6 Know about theoretical quantity of reactant
  
- 4.7 Know about selectivity of a chemical process
- 4.8 Solve problems related to oxidation of sulphur compounds
- 4.9 Solve problems related to recovery of metals and non-metals from ores
- 4.10 Solve problems related to all the above concepts
- 5.0 Energy balance:**
- 5.1 Explain the terms internal energy and enthalpy
- 5.2 Define Heat and Work
- 5.3 State and explain 1<sup>st</sup> law of thermodynamics – problems related to 1<sup>st</sup> law
- 5.4 Derive the general energy balance equation for a steady flow process
- 5.5 Know the terms sensible heat, latent heat of fusion, latent heat of vaporization
- 5.6 Define Heat capacity and Specific heat
- 5.7 Explain the importance of mean heat capacity
- 5.8 Do the problems on heat requirement calculations, using  $Q = mc_p \Delta T$  and  $Q = nc_p \Delta T$
- 5.9 Know about exothermic, endothermic, adiabatic and isothermal reaction systems
- 5.10 Define and explain Heat of Formation , Heat of combustion and Heat of Reaction,
- 5.11 Know about Heat of Solution, Heat of Neutralization, Heat of mixing and Heat of crystallization
- 6.0 Combustion process:**
- 6.1 Distinguish between Partial and Complete Combustion
- 6.2 Define and explain Calorific values (Gross and Net Calorific values)
- 6.3 Calculate the calorific value of a fuel using Dulong's Formulae
- 6.4 Know about net hydrogen
- 6.5 Solve combustion problems related to refuse analysis
- 6.6 Explain the proximate and ultimate analysis of coal
- 6.7 Know about the composition of flue gas obtained after combustion of a fuel
- 6.8 Calculate the air requirement for combustion of a specific fuel
- 6.9 Know the compositions of fuel and flue gases, and calculate the flue gas analysis using fuel analysis
- 6.10 Calculate the fuel analysis using flue gas analysis for complete combustion and incomplete combustion
- 6.11 Solve problems related to combustion

## **COURSE CONTENTS:**

### **1.0 Units and Dimensions:**

Physical Quantities-Fundamental and Derived quantities-Unit and System of units-Formula, Units in SI system and Dimensional formula of different derived quantities-Area, Volume, Velocity, Acceleration, Density, Specific volume, Work done-Energy-Enthalpy-Power-Heat Capacity-Humidity-Mass flow rate-Momentum-Acceleration due to gravity-Volumetric flow rate-Viscosity-Specific heat-Latent heat-Surface Tension-Kinematic viscosity- Conversion factors for various fundamental quantities-Mass, Length, Time and Temperature from one system of unit to another system of unit-Conversion factors for various derived quantities-Force, Newton's Law conversion factor, Pressure, Work done, Heat, Power, Viscosity, Heat capacity, Latent heat, Specific heat, Kinematic Viscosity, Surface Tension, Density, Specific volume from one system of unit to another system of unit-Dimensionless groups-Reynolds number, Prandtl number, Nusselt number, Grashof number, Peclet number, Mach number, Schmidt number, Graetz number, Lewis number, Sherwood number, Stanton number-Conversion of one system of equation into another system.

### **2.0 Basic Calculations:**

#### **(a) Stoichiometric and composition relationships:**

Define Atom, Molecule, Mole, Gram-atom, Gram-molecule, Gram molar volume-Different methods of expressing concentration-Define Molarity, Normality, Molality, PPM, Weight percent, Volume percent, Mole percent, Analyze on dry basis and wet basis-Define Density and Specific gravity, specific gravity scales, Variation of density and specific gravity with temperature-Numerous problems on all the above topics.

#### **(b) Behavior of ideal gases:**

Kinetic theory of gases-Gas laws: Boyle's law, Charles law, Gay-Lussac's law, Avogadro's law, Derivation of Ideal gas equation-Vander Waal's equation of state, Critical properties of substances-Ideal gas constant-Derive the value of ideal gas constant in different system of units-Define and explain Dalton's law of partial pressures, Amagat's law of partial volumes for gaseous mixtures-Characteristics of an Ideal gas, Differences between Ideal gas and Real gas-Derive the equation  $\text{volume \%} = \text{mole \%} = \text{pressure \%}$  for an ideal gas mixture-Average molecular weight of a gas mixture-Density of a gaseous mixture-Numerous problems on all the above topics.

#### **(c) Vapor Pressures:**

Vapor pressure, Relation between vapor pressure and boiling point-Effect of temperature on vapor pressure-Methods of vapor pressure determination-Antoine equations, Clausius-Clapeyron equation-Vapor pressure reference substance plots-Cox chart, Duhring's lines-Ideal solutions and Non-Ideal solutions-Differences between Ideal and Non-Ideal solutions-Define (a) Raoult's Law (b) Henry's Law for solutions-Numerous problems on all the above topics.

#### **(d) Humidity and Saturation:**

Un-saturation, Saturation-Humidity-Absolute humidity-Relative Humidity-Molal absolute humidity-% Saturation-Dew Point-Dry and wet bulb temperature-Numerous problems on all the above topics.

### **3.0 Material balance without chemical reactions:**

Unit operation and Unit Process-Give examples for unit operation and unit processes-Representation of unit operations/unit processes by a process flow chart or a block diagram-Basis for material balances-Terms in the general material balance equation-Tie substance, key component and inert substance-Steps to solve material balance problems-Degrees of Freedom-Steady and un-steady state mass balance-Material balance problems related to Evaporation-Material balance problems related to Drying-Material balance problems related to Mixing-Material balance problems related to Distillation-Material balance problems related to Extraction-Material balance problems related to Crystallization-Bypass in continuous chemical processes with examples-Recycle in continuous chemical processes with examples-Purge streams in continuous chemical processes with examples-Blowdown streams in continuous chemical processes with examples-Numerous problems on all the above topics.

### **4.0 Material balance with Chemical Reactions:**

Stoichiometry, application of stoichiometry, stoichiometric equations, stoichiometric coefficients, and stoichiometric proportions-Limiting component-Excess reactant- % conversion in a chemical reaction system-% yield in a chemical reaction system-Degree of completion in a chemical reaction system-Theoretical quantity of reactant-Selectivity of a chemical process-Oxidation of sulphur compounds-Recovery of metals and non-metals from ores-Problems related to all the above concepts.

### **5.0 Energy Balance:**

Internal energy and enthalpy-Heat and Work-1<sup>st</sup> law of thermodynamics-Problems related to 1<sup>st</sup> law-General energy balance equation for a steady flow process-Sensible heat, Latent heat of Fusion, Latent heat of vaporization-Heat capacity and Specific heat-Importance of mean heat capacity-Problems on heat requirement calculations using  $Q = mc_p \Delta T$  and  $Q = nc_p \Delta T$ -Exothermic, Endothermic, Adiabatic and Isothermal reaction systems-Heat of Reaction, Heat of Formation and Heat of combustion-Heat of Solution, Heat of Neutralization, Heat of mixing and Heat of crystallization.

### **6.0 Combustion process:**

Distinguish between Partial and Complete Combustion-Calorific values (Gross and Net Calorific values)-Calorific value of a fuel using Dulong's Formulae-Net hydrogen-Combustion problems related to refuse analysis-Proximate and ultimate analysis of coal-Composition of flue gas obtained after combustion of a fuel-Air requirement for combustion of a specific fuel-Compositions of fuel and flue gases, and calculate the flue gas analysis

using fuel analysis-Fuel analysis using flue gas analysis for complete combustion and incomplete combustion-Problems related to combustion.

**REFERENCE BOOKS:**

| S.No. | Book Title  | Author   | Publications   |
|-------|---|--|--|
| 1     | Chemical Process Principles                               | 1. Olaf A. Hougen<br>2. Kenneth M.Watson<br>3. Ronald A.Ragatz | Asia Publishing House                                  |
| 2     | Stoichiometry (SI Units)                                  | 1. B.I.Bhatt<br>2. S.M.Vora                                    | Tata McGraw-Hill Publishing company Limited, New Delhi |
| 3     | Basic Principles and calculations in Chemical Engineering | 1. David M.Himmel Bleau  |  |
| 4     | Introduction to Stoichiometry (SI units)                  | 1. K.A.Gavhane   | Nirali Prakashan                                       |
| 4     | Stoichiometry and Process Calculations                    | 1. K.V.Narayanan<br>2. B.Lakshmikutty                          | Prentice Hall of India Pvt Limited, New Delhi          |
| 6.    | Process Calculations                                      | 1. V.Venkataramani<br>2. N.Anantharaman                        | Prentice Hall of India Pvt Limited, New Delhi          |
| 7.    | Process calculations for Chemical Engineers               | 1. Ch.Durga Prasada Rao<br>2. D.V.S.Murthy                     | MACMillan India Limited                                |

## CHEMICAL ENGINEERING DRAWING LAB USING CAD

**Subject Title** : Chemical Engineering Drawing Lab using CAD  
**Subject Code** : CH-306  
**Periods/week** : 06  
**Periods/ Semester** : 90

1. Introduction to AUTOCAD and its applications
  - a. Features of AUTOCAD
  - b. Starting and exiting
  - c. Drawing screen creation , saving and opening a drawing
  - d. Using pull down menu
  - e. Key board input
  - f. Setting of units and limits of a drawing
2. Drawing commands
  - a. Understanding the coordinate systems- Absolute coordinates, relative coordinates, polar coordinates
  - b. Creation of lines, arcs, rectangle, polygon, ellipse, donut, polylines and text.
  - c. Selecting objects, erasing, undo, redo, oops
3. Modifying commands
  - a. Copy, mirror, offset, array, move, rotate, scale, stretch, lengthen, trim, extend, break, chamfer, fillet, explode, editing text, hatching
4. Dimensioning
  - a. Dimensioning commands, setting dimensioning style, linear dimensions, aligned, ordinate, radius, diameter, angular, editing a dimension, align text
5. Three dimensional modeling
  - a. Viewing in three dimensions
  - b. Types of three dimensional modelling i.e,wire frame models, surface models and solid models
  - c. Editing of solids i.e, joining and subtracting of solids.
6. Plotting of an AUTOCAD drawing using printer
7. Drawing of symbols for pumps and compressors.
8. Drawing of symbols for vertical and horizontal boiler
9. Drawing of symbols for pipe lines.
10. Flow sheet symbols
  - a. Reducer, venturi meter, orifice meter, rotameter, sight flow indicator, pitot tube, burner , air trap bucket trap, vacuum trap, flat trap, separator, ejector



11. Draw the 2D drawings; Knuckle joint, screw jack.
12. Draw the following chemical equipments using CAD
  - a) Double pipe heat exchanger
  - b) Mixer
13. Drawing of symbols for agitator, absorbers, fractionating column
14. Basic instrument symbols
  - a. Basic symbols for instrument with single service and function
  - b. For combination to instrument or device with two services or functions for transmitters and for diaphragm valves
15. Draw the plant layout using AUTOCAD
  - a. Sugar Industry
  - b. Cement Industry

## ELECTRICAL TECHNOLOGY AND ORGANIC PHYSICAL CHEMISTRY LAB

**Subject Title** : ELECTRICAL TECHNOLOGY AND ORGANIC  
PHYSICAL CHEMISTRY LAB  
**Subject Code** : CH-307  
**Periods per week** : 06  
**Periods per Semester** : 90

### List of experiments in Electrical Technology Lab.

1. Verification of ohms Law and Determination of the resistance of the given resistor.
2. Measurement of power in D.C. Circuit consisting of resistance in a) Series b) parallel c) Series and parallel combination.
3. Calibrate the given 1-phase energy meter (know how to connect the energy meter in a given circuit)
4. Study of starters a) 3-point starters b) D.O.L starters and c) star/Delta starters.
5. Obtain the speed control of D C Shunt Motor by Field control method.
6. Obtain the speed control of D C Shunt Motor by Armature control Method.
7. Measure the line voltage and phase voltage, line current and phase current in a given a) star connected load and b) Delta connected load.
8. Conduct the Load test on Single phase Capacitor type Induction Motor.
9. Measure the primary and secondary voltages of step-up Transformers and step down transformer
10. Single –phase circuit wiring (single-lamp controlled by a single-way switch)  
Single lamp controlled by two-way switch.

### List of experiments in Organic and Physical Chemistry Lab.

#### TIME SCHEDULE

| S. No.       | Major Topics  | No. of periods |
|--------------|---|----------------|
| 1.           | Determination of Melting point of Solid Organic compounds.<br>Determination of Boiling points of liquid organic compounds | 05             |
| 2.           | Detection of Elements   | 10             |
| 3.           | Reactions of Functional groups  | 20             |
| 4.           | Systematic identification of functional groups in an Organic Compound   | 20             |
| 5.           | Preparation of Organic Compounds.   | 20             |
| <b>Total</b> |   | <b>45</b>      |

### OBJECTIVES:

After completion of the practicals, the student will be able to:

### **1.0 Conduct**

- 1.1 Determination of Melting Point of solid Organic Compounds.
- 1.2 Determination of Boiling Point of liquid organic Compounds.

### **2.0 know detection of following elements present in organic compounds.**

- 2.1 Carbon
- 2.2 Hydrogen
- 2.3 Oxygen
- 2.4 Nitrogen
- 2.5 Sulphur
- 2.6 Halogens.

### **3.0 know Reactions of functional groups present in organic compounds.**

- 3.1 Alcohols
- 3.2 Acids
- 3.3 Aldehydes
- 3.4 Ketones
- 3.5 Amines
- 3.6 Amides
- 3.7 Esters.

### **4.0 Understand Systematic identification of the functional groups in Organic compounds.**

### **5.0 Understand Preparation of following Organic Compounds**

- 5.1 Preparation of Acetanilide.
- 5.2 Preparation of Bromoacetanilide.
- 5.3 Preparation of Nitro Benzene.
- 5.4 Preparation of Azodye.
- 5.5 Preparation of Aspirin.

### **COURSE CONTENT:**

1. Determination of Melting Points and Boiling Point of Organic Compounds.
2. Detection of elements Carbon – Hydrogen – Oxygen – Nitrogen – Sulphur – Halogens.
3. Reactions of functional groups – OH, -COOH, -CHO, -CO-R, -NH<sub>2</sub>, -CONH<sub>2</sub>, -COOR.
4. Identification of functional groups in an Organic Compound.
5. Preparation of organic Compounds – Acetanilide – Bromoacetanilide – Nitro Benzene – Azodye – Aspirin.



**Communication Skills Lab Practice  
(Common to all Branches)**

Subject title : Communication skills  
 Subject code : CH-308  
 Periods per week : 3  
 Periods per semester : 45

**Introduction :**

In the context of globalization , competence in speaking skills is the need of the hour  
 The gap between the needs of the industry and the curriculum can be bridged by enabling the students to hone their speaking and listening skills. This course aims at providing opportunities for practicing speaking.

**Time Schedule**

| Sno. | Topic                               | Periods | Weightage of marks (End Exam ) | Sessional marks | Total |
|------|-------------------------------------|---------|--------------------------------|-----------------|-------|
| 1    | Listening I                         | 3       | 10                             | 10              | 20    |
| 2    | Listening II                        | 3       |                                |                 |       |
| 3    | Introducing oneself                 | 3       | 50                             | 30              | 80    |
| 4    | Describing objects                  | 3       |                                |                 |       |
| 5    | Describing events                   | 3       |                                |                 |       |
| 6    | Reporting past incidents            | 3       |                                |                 |       |
| 7    | Speaking from observation / reading | 3       |                                |                 |       |
| 8    | JAM                                 | 6       |                                |                 |       |
| 9    | Group discussion                    | 6       |                                |                 |       |
| 10   | Mock interviews                     | 6       |                                |                 |       |
| 11   | Making presentations                | 6       | 60                             | 40              | 100   |
|      |                                     | 45      |                                |                 |       |

**Objectives :**

On completion of the course the students will be able to

- Strengthen their listening skills
- Strengthen their speaking skills

**Competencies and key competencies to be achieved by the student**

| Topic                       | Teacher's input/ methodology   | Students competence   |
|-----------------------------|--|---|
| Listening I<br>Listening II | Pre- Listening –eliciting, pictures<br>While - Listening<br>Post –Listening –project , writing                     | Identifying the main idea,<br>Identifying specific details,<br>Identifying parallel and contradictory ideas<br>Drawing inferences,<br>Reasoning |
| Introducing oneself         | Kinds of introduction --official/ personal, dynamic vocabulary, Body language, Model introduction, Use of line ups | Use of simple present tense,<br>Sequencing,<br>Appropriate vocabulary   |

|                                   |   |  |
|-----------------------------------|---|--|
| Reporting incidents               | Group work /pair work, Elicit, Use of past tense, Student presentations   | Use of past tense, Relevant vocabulary   |
| Describing objects                | Vocabulary , Use of adjectives, Games—I spy, Group presentations          | Use of adjectives, Dimensions, shapes Compare and contrast, Sequence           |
| Describing events                 | Group work/pair work Use of appropriate tense                             | Use of appropriate tense, Sequencing   |
| Reporting past incidents          | Use of past tense, Vocabulary Student presentations                       | Use of past tense , sequencing   |
| Speaking from observation/reading | Group work/pair work, Reading techniques ,                                | Use of past tense, Summarising , evaluating, comprehension                     |
| JAM                               | Effective techniques , Good beginning , conclusion, tips, Use of line ups | Vocabulary, Sequencing, Fluency, Thinking spontaneously                        |
| Group discussion                  | Expressing opinion, body language,  | Expressing opinion, agree/ disagree, fluency, Persuasive and leadership skills |
| Mock interview                    | FAQs , body language  | Role play, body language,  |
| Making presentations              | Student presentations   | Using charts , pictures, interpreting data, sequencing, PPTs                   |

Communicative methodology (CLT) should be used to create an interactive class. Apart from the suggestions given teachers are free to innovate to use any activity to improve the language competence of students . Attention can also be given to improve the accent and intonation of students.

Note:

\* This subject is a theory subject.

\*\* The workload should be calculated as theory workload.

\*\*\*Examinations in the subject will be treated as a practical one.

## **FLUID MECHANICS LAB**

**Subject Title** : Fluid Mechanics Lab  
**Subject Code** : CH-309  
**Periods per week** : 03  
**Periods / Semester** : 45

### **List of Experiments:**

1. Calibration of given Rotameter and to draw calibration curve(Rotameter reading Vs Actual discharge)
2. Identification of laminar & turbulent flow using Reynold's apparatus.
3. Conduct an experiment on Bernoulli's apparatus to verify Bernoulli's theorem.
4. Conduct an experiment on Orifice meter and determine the coefficient of discharge.
5. Conduct an experiment on Venturimeter and determine the coefficient of discharge.
6. Determination of friction factor in various pipes.
7. Determination of frictional losses in various pipe fittings.
8. Determination of Pressure drop in a packed bed for different fluid velocities.
9. Determination of characteristics of a Centrifugal Pump to draw the curves.
10. Determination of characteristics of a Reciprocating pump to draw the curves.

## **IV Semester**



**DIPLOMA IN CHEMICAL ENGINEERING**  
**SCHEME OF INSTRUCTIONS AND EXAMINATIONS**  
**C-16,IV Semester**

| Subject Code      | Name of the Subject                              | Instruction period / week |                     | Total Period / year | Scheme of Examination |                 |                |             |
|-------------------|--|---------------------------|---------------------|---------------------|-----------------------|-----------------|----------------|-------------|
|                   |  | Theory                    | Practical /Tutorial |                     | Duration (hours)      | Sessional Marks | End Exam Marks | Total Marks |
| <b>THEORY:</b>    |  |                           |                     |                     |                       |                 |                |             |
| CH- 401           | Mechanical Unit Operations                       | 4                         | --                  | 60                  | 3                     | 20              | 80             | 100         |
| CH-402            | Inorganic Chemical Technology                    | 5                         | --                  | 75                  | 3                     | 20              | 80             | 100         |
| CH-403            | Organic Chemical Technology                      | 5                         | --                  | 75                  | 3                     | 20              | 80             | 100         |
| CH-404            | Heat Transfer                                    | 5                         | --                  | 75                  | 3                     | 20              | 80             | 100         |
| CH-405            | Mass Transfer                                    | 5                         | --                  | 75                  | 3                     | 20              | 80             | 100         |
| <b>PRACTICAL:</b> |  |                           |                     |                     |                       |                 |                |             |
| CH-406            | Chemical Technology Lab                          | --                        | 6                   | 90                  | 3                     | 40              | 60             | 100         |
| CH-407            | Mechanical Unit Operations and Mass transfer Lab | --                        | 6                   | 90                  | 3                     | 40              | 60             | 100         |
| CH-408            | Life skills                                      | --                        | 3                   | 45                  | 3                     | 40              | 60             | 100         |
| CH-409            | Heat transfer Lab                                | --                        | 3                   | 45                  | 3                     | 40              | 60             | 100         |
| <b>TOTAL</b>      |  | 24                        | 18                  | 630                 |                       | 260             | 640            | 900         |

## MECHANICAL UNIT OPERATIONS

|                                |   |                                   |
|--------------------------------|---|-----------------------------------|
| <b>Subject Title</b>           | : | <b>Mechanical unit operations</b> |
| <b>Subject Code</b>            | : | <b>CH – 401</b>                   |
| <b>Periods per week</b>        | : | <b>04</b>                         |
| <b>Total periods/ semester</b> | : | <b>60</b>                         |

### TIME SCHEDULE:

| S. No.       | Major topics               | No.of periods | Weightage Of Marks | Short answer type | Essay type |
|--------------|----------------------------|---------------|--------------------|-------------------|------------|
| 1.           | Introduction and screening | 09            | 16                 | 2                 | 1          |
| 2.           | Storage and conveying      | 07            | 13                 | 1                 | 1          |
| 3.           | Mixing                     | 08            | 13                 | 1                 | 1          |
| 4.           | Size Reduction             | 14            | 26                 | 2                 | 2          |
| 5.           | Mechanical Separations     | 12            | 26                 | 2                 | 2          |
| 6.           | Filtration                 | 10            | 16                 | 2                 | 1          |
| <b>Total</b> |                            | <b>60</b>     | <b>110</b>         | <b>10</b>         | <b>08</b>  |

**OBJECTIVES:** After completion of the course, the student will be able to

#### **1.0 Introduction and screening**

- 1.1 Importance of mechanical operations in chemical industries.
- 1.2 State the importance of size, shape, density and sphericity of particle.
- 1.3 Know about the mixed particle sizes and size analysis.
- 1.4 Know about the specific surface, average particle size and particle population.
- 1.5 Specify various standard screening sieves viz. Taylor standard series & Indian standard series.
- 1.6 Know about differential screen analysis to evaluate specific surface, average particle size and particle population.
- 1.7 Know about cumulative screen analysis to evaluate specific surface, average particle size and particle population.
- 1.8 Distinguish between differential and cumulative screen analysis
- 1.9 Know about actual & ideal screens
- 1.10 Know about screen effectiveness and screen capacity.
- 1.11 Solve problems on screen analysis and screen effectiveness.

#### **2.0 Understand the storage and conveying of solids**

- 2.1 Know about storage of solids.
- 2.2 Understand the bulk storage of solids.
- 2.3 Know about bin storage- Flat bottomed bins, sloped bottomed bins, silos and hoppers.
- 2.4 List out various conveyors.

2.5 Explain the working of following conveyors with diagrams

- (1) Belt conveyor
- (2) Chain conveyor
- (3) Screw conveyors and
- (4) Pneumatic conveyors

### **3.0 Understand the objective of mixing.**

3.1 Know the importance of mixing.

3.2 Explain the mixing of various systems like (a) liquid-liquid (b) solid-liquid (c) gas-liquid and (d) solid-solids.

3.3 Explain the working principle of mixing equipments with diagrams used for liquid-liquid mixing-

- (a) propellers (b) paddles and (c) turbines.

3.4 Describe the working principle of mixing equipments with diagrams used for solid-solid mixing –

- (a) Ribbon blenders (b) tumbling mixers.

3.5 Describe the working principle of mixing equipments with diagrams used for viscous masses-

- (a) Banbury mixer (b) kneading machine (c) pug mill.

3.6 Know the difference between mixing, agitation and blending.

3.7 Explain about vortex formation and its significance.

### **4.0 Understand the size reduction operations.**

4.1 Explain the principle involved in Size Reduction.

4.3 Know about mechanical efficiency and crushing efficiency.

4.4 State and explain (a) Rittinger's Law (b) Kick's Law (c) Bond's crushing law and work index.

4.5 Evaluate the power requirement for crushing and grinding.

4.6 Classify the size reduction equipment.

4.7 Distinguish between crushing and grinding

4.8 Explain the working principles of following crushing equipment: Jaw crusher, Gyratory crusher, Roll crusher,

4.9 Explain the working principles of following grinding equipment: Rod mill, Ball mill and ultrafine grinder.

4.9 Draw the line sketches of Jaw crusher, Roll mill and Ball mill.

4.9 Evaluate angle of nip in crushing rolls.

4.10 Evaluate the critical speed of Ball mill.

4.11 Mention the applications of various crushers and grinders.

4.12 Distinguish between closed circuit grinding and open circuit grinding.

4.13 Solve simple problems based on Rittinger's Law, Kick's Law and Bond's crushing law.

4.14 Solve problems on evaluating critical speed and angle of nip.

### **5.0 Understand mechanical separations.**

5.1 List out the industrial screens and mention their applications.

5.2 Know about Grizzlies, Trommels, Shaking and vibrating screens.

5.3 Understand the various classifiers.

5.4 Know about hydraulic classifiers-Mineral jig, Wilfley table

5.5 Explain froth flotation.

5.6 Know about magnetic separation and electrostatic separation.

- 5.7 Know about air separation methods – Air separator, Cyclone separator, Bag filter
- 5.8 Know about the working principles of Electrostatic precipitator and Scrubber.
- 5.9 Draw a neat sketch of cyclone separator.
- 5.10 Discuss the process of batch sedimentation and identify various zones.
- 5.11 Explain the Stoke's law and Newton's law.
- 5.12 Know about free settling and hindered settling
- 5.13 Define terminal velocity.
- 5.14 Explain the principle of working of industrial thickener with diagram.
- 5.15 Solve simple problems on terminal velocity.

## **6.0 Know about filtration.**

- 6.1 Know about sand filters and use of coagulant
- 6.2 State the principles of cake filtration.
- 6.3 State the principles of constant rate filtration and constant pressure filtration.
- 6.4 Know about working principle of Plate and frame filter press and leaf filter
- 6.5 Draw a neat sketch of rotary drum filter.
- 6.6 Know about working principle of continuous rotary drum vacuum filter.
- 6.7 Know the various types of filter medium used and its requirements.
- 6.8 Know the function of filter aid and mention various filter aids.
- 6.9 State the principles of centrifugal filtration.
- 6.10 Know the application and selection of various filters
- 6.11 Draw the neat sketches of centrifugal filters.
- 6.12 Explain the working principle of Batch and Continuous centrifugal filters

## **COURSE CONTENTS:**

- 1. Introduction and screening:** Particle size, shape, density and sphericity- mixed particle sizes and size analysis- specific surface, average particle size and particle population-Standard screening sieves viz Taylor standard series & Indian standard series- differential & cumulative screen analysis- actual & Ideal screens- Screen effectiveness.
- 2. Storage and conveying of solids:** Various types of storage of solids-Bin storage- flat bottomed bin, sloped bottomed bin, silos, hoppers and bulk storage- Conveying-types of conveyers –Working principles – Belt conveyor, Chain conveyor, screw conveyor and pneumatic conveyor.
- 3. Mixing:** Objectives of mixing, Liquid-liquid mixers- paddles, turbines, propellers, agitators- Solid-liquid mixers, mixer for viscous masses- Banbury mixer, ribbon blenders, tumbling mixers.
- 4. Size Reduction:** Principles of comminution- Size Reduction laws- Efficiencies in size reduction- Size reduction equipments- Description and working of jaw crusher, gyratory crusher, roller crusher, hammer mill, ball mill, ultrafine grinder- Evaluation of angle of nip- critical speed of ball mill - Closed circuit grinding and open circuit grinding- simple problems on size reduction laws.
- 5. Mechanical Separations:** Industrial screens -Their applications- Grizzlies, Trommels, Shaking, vibrating screens, classifiers- hydraulic classifiers, jigging,

tabling, froth flotation- Magnetic separation and electrostatic separation- Air separation- cyclone separator, bag filters, electrostatic separators.

**6. Filtration:** Sand filters- Coagulants-Application of filters- Classification of filters- Selection of filters- Plate and frame filter press, leaf filters, continuous rotary filters- Filter aids- Constant pressure and constant rate filtration- Centrifugal filtration- Batch, semi continuous, continuous centrifuges.

**REFERENCE BOOKS:**

1. Unit operations of chemical Engg. by Warren L.Mc Cabe, Julian C.Smith and Peter Harriott, Fifth edition, Mc Graw Hill Publication.
2. Introduction to Chemical Engg. by Walter L.Badger & Julius T.Banchero. Mc GRAW Hill Publication.
3. Chemical engineering Series, Coulson & Richardson, Vol-1,5th edition, Butterworth & Heinmann Publications.
4. Unit operations –1, K.A.Ghavane, Nirali Prakashan Publications.

## INORGANIC CHEMICAL TECHNOLOGY

**Subject Title** : **Inorganic Chemical Technology**  
**Subject Code** : **CH – 402**  
**Periods/week** : **05**  
**Periods/year** : **75**

### TIME SCHEDULE

| S. No.       | Major topics                                    | No. of periods | Weightage of Marks | Short answer type | Essay type |
|--------------|---|----------------|--------------------|-------------------|------------|
| 1.           | Water   | 06             | 08                 | 1                 | ½          |
| 2.           | Basic chemical industries                       | 09             | 13                 | 1                 | 1          |
| 3.           | Industrial acids                                | 07             | 13                 | 1                 | 1          |
| 4.           | Nitrogenous fertilizers<br>Phosphate industries | 15             | 23                 | 1                 | 2          |
| 5.           | Industrial gases                                | 10             | 16                 | 2                 | 1          |
| 6.           | Miscellaneous inorganic chemicals               | 10             | 16                 | 2                 | 1          |
| 7.           | Silicate products                               | 09             | 10                 | -                 | 1          |
| 8.           | Paints, pigments and varnishes                  | 09             | 11                 | 2                 | ½          |
| <b>Total</b> |   | <b>75</b>      | <b>110</b>         | <b>10</b>         | <b>08</b>  |

### OBJECTIVES:

#### 1.0 Know the methods of water treatment.

- 1.1 Understand the sources of water as rainwater, surface water and spring water.
- 1.2 Analyze the impurities in water such as gases, dissolved solids and dissolved minerals and undissolved solids.
- 1.3 Describe the process of water treatment by municipal water treatment.
- 1.4 Describe the process of water treatment by ion exchange process.
- 1.5 Describe the process of water treatment by lime soda process.
- 1.6 Explain the process of osmosis and reverse osmosis.

#### 2.0 Know the manufacture of basic industrial chemicals.

- 2.1 Understand the various sources of common salt.
- 2.2 Understand the preparation of common salt from seawater by solar evaporation and vacuum pan evaporation system.
- 2.3 Describe the production of soda ash by modified solvay processes.
- 2.4 Describe the manufacture of caustic soda and chlorine by electrolytic cell methods (diaphragm and mercury cells) from brines.
- 2.5 Describe the constructional details of mercury cell
- 2.6 Describe the constructional details of diaphragm cell
- 2.7 Prepare bleaching powder by the action of chlorine with calcium hydroxide.

#### 3.0 Know the manufacture of industrial acids.

- 3.1 Describe the production of hydrochloric acid by synthesis process.
- 3.2 Explain the ammonia oxidation process for nitric acid manufacture.
- 3.3 Explain the extractions method for sulphur from mines.

- 3.4 Describe the method of manufacture of sulfuric acid by contact & double contact double absorption process.

#### **4.0 Know the manufacture of nitrogenous fertilizers and comprehend the phosphate industries**

- 4.1 Discuss various feed stocks for ammonia production.
- 4.2 Explain the method of manufacture of ammonia by steam reforming process of hydrocarbon feed.
- 4.3 Describe the manufacture of urea by partial recycle process.
- 4.4 Describe the manufacture of urea by total recycle process
- 4.5 Explain the production of ammonium sulphate by neutralization method.
- 4.6 Explain the production of ammonium sulphate from gypsum.
- 4.7 Understand the manufacture of ammonium chloride by direct neutralization method.
- 4.8 Understand the manufacture of ammonium chloride by dual salt process.
- 4.9 Origin of Phosphate rock and dressing.
- 4.10 Describe the method of manufacture of phosphoric acid by wet process.
- 4.11 Explain how single super phosphate is produced.
- 4.12 Explain how triple super phosphate is produced.

#### **5.0 Describe the manufacture of industrial gases (O<sub>2</sub>, N<sub>2</sub>, H<sub>2</sub>, CO<sub>2</sub> and acetylene).**

- 5.1 Discuss the hydrogen production by steam reforming of hydrocarbon process.
- 5.2 Separation of oxygen and nitrogen a by liquefaction process of Linde cycle.
- 5.3 Separation of oxygen and nitrogen a by liquefaction process of modified Linde Frankle cycle.
- 5.4 Production of carbon dioxide by molasses fermentation .
- 5.5 Recovery of CO<sub>2</sub> from various sources.
- 5.6 The production of acetylene from Calcium carbide.

#### **6.0 Discuss the important miscellaneous inorganic chemicals.**

- 6.1 Describe the manufacture of potassium fertilizers i.e., potassium chloride.
- 6.2 Describe the manufacture of potassium fertilizers i.e., NPK fertilizers.
- 6.3 Production of Graphite by electric furnace.
- 6.4 Production of Alum from bauxite by reacting with H<sub>2</sub>SO<sub>4</sub>.
- 6.5 Production of Silicon carbide from coke, sand and sand dust using electric arc furnace.
- 6.6 Description of quick lime process for Calcium carbide production.

#### **7.0 Comprehend silicate products.**

- 7.1 Discuss different types of Portland cements.
- 7.2 Describe the production of Cement by wet process.
- 7.3 Describe the production of Cement by dry process.
- 7.4 Discuss various types of glasses .
- 7.5 Describe the manufacture of Glass with various operations.
- 7.6 Discuss various silicate products.
- 7.7 Know about electronic grade silica

## **8.0 Preparation of paints pigments and varnishes.**

- 8.1 Discuss various constituents of a paint.
- 8.2 Explain the manufacture of paint by mixing method.
- 8.3 Describe the production of pigments like lithophone, iron oxide and titanium dioxide.
- 8.4 Explain the preparation of varnishes by oxidation and polymerization of drying oils.
- 8.5 Discuss rubber and plastic paints.

## **COURSE CONTENTS:**

### **1. Water:**

Sources of water – causes of scale formation – removal – water softening methods – Municipal water treatment – Lime soda process – Zeolite process – osmosis – reverse osmosis.

### **2. Basic chemical Industries.**

Common salt :Solar evaporation or vacuum pan evaporation system –Soda ash: solvey process – modified solvey process of soda ash, – Caustic soda and chlorine by electrolytic cell method – diaphragm – mercury and membrane cells – bleaching powder.

### **3. Industrial acids**

Hydrochloric acid and synthesis process - Nitric acid by ammonia oxidation process –Extraction of sulphur - Sulphuric acid by Contact process & DCDA process.

### **4.Nitrogenous fertilizers & Phosphate Industries**

Ammonia by steam reforming of hydrocarbons – Urea by partial and total recycle process –Ammonium chloride – direct neutralization – Dual salt process.

Phosphorous – Phosphoric acid –Thermal and wet process, Super phosphate – single super phosphate – triple super phosphate

### **5. Industrial gases**

Hydrogen Electrolytic method – steam hydrocarbon reforming process, Oxygen and Nitrogen – liquefaction method – Linde Frankle cycle method – modified Linde Frankle cycle method-Carbon dioxide-manufacture by different methods, acetylene from Calcium Carbide.

### **6. Miscellaneous Inorganic Chemicals**

Potassium permanganate -Potassium chloride, NPK fertilizers – Alum form Bauxite – silicon carbide by electric are furnace – calcium carbide by quick lime process.



## **7. Silicate products**

Cement by dry and wet process -types of cement and its applications –Glass- types of glasses and its applications – glass manufacture. silicate products and Electronic Grade Silica

## **8. Paints, pigments and varnishes**

Paints –Constituents-manufacture by mixing method-pigments-Different coloured pigments-manufacture of Litho phone,  $\text{TiO}_2$  and chromium oxide varnishes by oxidation and polymerization of drying oils. Rubber and plastic paints.

## **REFERENCE BOOKS:**

1. CHEMTECH VOL-II Published by CH.E.E.D.C., I I T Madras
2. A textbook of Chemical Technology – Shukhla and Pandey
3. Engineering Chemistry – Jain & Jain.
- 4.. Chemical Process Industries – Shreve & Brink., McGraw –Hill Publications
5. Outline of Chemical Technology by Dryden.

## ORGANIC CHEMICAL TECHNOLOGY

**Subject Title** : Organic Chemical Technology  
**Subject Code** : CH – 403  
**Periods/week** : 05  
**Periods/ Semester** : 75

### TIME SCHEDULE

| S. No.       | Major topics                        | No. of periods | Weightage of marks | Short answer type | Essay type |
|--------------|-------------------------------------|----------------|--------------------|-------------------|------------|
| 1.           | Introduction and Coal chemicals     | 15             | 16                 | 3                 | 1          |
| 2.           | Petroleum refining & Petrochemicals | 19             | 21                 | 1                 | 2          |
| 3.           | Oils, fats and soaps                | 05             | 08                 | 1                 | ½          |
| 4.           | Plastic industries                  | 07             | 13                 | 1                 | 1          |
| 5.           | Pulp and paper industries           | 07             | 13                 | 1                 | 1          |
| 6.           | Sugar and Fermentation Industries   | 11             | 18                 | 1                 | 1          |
| 7.           | Synthetic fibres                    | 06             | 13                 | 1                 | 1          |
| 8.           | Rubber industries                   | 05             | 08                 | 1                 | ½          |
| <b>Total</b> |                                     | <b>75</b>      | <b>110</b>         | <b>10</b>         | <b>08</b>  |

### OBJECTIVES:

#### 1.0 Introduction to Coal Chemicals

- 1.1 Know about the general requirement of a process plant.
- 1.2 Know about water demineralization
- 1.3 Know about compressed and instrument air
- 1.4 Explain the steam generation in boiler.
- 1.5 Explain the working principles of a cooling tower and its uses in a process plant.
- 1.6 Understand the steps in the process development.
- 1.7 Understand the principles of formation of coal.
- 1.8 Distinguish between low and high temperature carbonization process.
- 1.9 Draw the flow diagram containing coking of coal and how the coal chemicals recovered.
- 1.10 Describe the HTC and explain the recovery of coal chemicals.
- 1.11 Describe the LTC with a neat sketch.
- 1.12 Describe the coal tar distillation process with a flow diagram.
- 1.13 Know about the uses of coal.

#### 2.0 Petroleum Refining and Know about the usual raw materials used in petrochemicals manufacturing.

- 2.1 Know the origin of crude petroleum.
- 2.2 Know about the classification of crude petroleum, product boiling ranges

- 2.3 Write the uses and properties of products of refining.
- 2.4 Describe the atmospheric distillation and vacuum distillation of crude petroleum.
- 2.5 Explain the Cracking process.
- 2.6 Differentiate between thermal and fluid catalytic cracking
- 2.7 Describe the thermal cracking process with a neat sketch.
- 2.8 Describe the fluid catalytic cracking process with a neat sketch
- 2.9 Know about the catalytic reforming of crude.
- 2.10 Know about the refining processes.  
Comprehend other unit processes used in petroleum refining.
  - a) Polymerization
  - b) Isomerization
  - c) Alkylation
  - d) Hydro dealkylation
- 2.11 Know about the purification steps used in petroleum refining.
- 2.12 Describe the following unit operations used in petroleum refining.
  - a) Distillation b) Absorption c) Extraction
- 2.13 Describe the following
  - a) Adsorption b) Crystallization c) Humidification and dehumidification
- 2.14 Describe the processing methods of the following petrochemicals.
  - a) Formaldehyde
  - b) Methanol
  - c) Chloromethane
- 2.15 Describe the processing methods of the following petrochemicals.
  - a) 1, 2 – dichloro ethane
  - b) Vinyl chloride
  - c) Ethylene oxide

### **3.0 Know the physical and chemical properties of oil.**

- 3.1 List the important vegetable and animal oils and fats.
- 3.2 Describe the mechanical expeller process and solvent extraction process.
- 3.3 Know about the hydrogenation of oils and explain the steps in the vanaspati process.
- 3.4 Describe the continuous soap manufacturing process.
- 3.5 List the detergent builders.
- 3.6 Explain the glycerin recovery process.

3.7 Explain manufacture of linear alkyl Benzene & detergents

#### **4.0 Distinguish between a resin and plastic with examples.**

- 4.1 Get familiar with esterification and oxidation as unit processes.
- 4.2 Know about addition polymerization & condensation polymerization, suspension & co polymerization
- 4.3 Differentiate between thermosetting and thermoplastic resins with examples.
- 4.4 Describe the phenol- formaldehyde-molding powder.
- 4.5 Know about HDPE and LDPE.
- 4.6 Explain the production of HDPE.
- 4.7 Describe the manufacture of PVC.
- 4.8 Manufacturing process of phenol.
- 4.9 Manufacturing process of formaldehyde.

#### **5.0 List the raw materials for pulp and paper industry.**

- 5.1 Know the chemistry of wood.
- 5.2 Know the classification of mechanical, chemical and semi chemical pulps.
- 5.3 Explain the process details of mechanical pulp.
- 5.4 Describe the Kraft process for the manufacture of sulfate pulp.
- 5.5 Define paper and know about the paper processing.
- 5.6 Know about the additives used in paper making.
- 5.7 Know the bleaching techniques of pulp in the paper industry.
- 5.8 Explain the chemical recovery process from the black liquor.

#### **6.0 Know the properties and uses of sugar & ethyl alcohol.**

- 6.1 Understand the sugar (raw) manufacturing process.
- 6.2 Know about the by-products obtained from sugar industries.
- 6.3 Explain the steps involved in cane sugar refining.
- 6.4 Know about the grading of sugar crystals.
- 6.5 Draw the neat sketches of various centrifuges used in sugar industries.
- 6.6 Know about "Inversion of sugar" and methods to eliminate it.
- 6.7 Differentiate between aerobic and anaerobic fermentation processes.
- 6.8 Know the industrial alcohol manufacturing process from molasses.
- 6.9 Understand the term denaturing.
- 6.10 Know about potable spirits.
- 6.11 Explain the anhydrous alcohol manufacturing process.

#### **7.0 Know the importance of synthetic fibres.**

- 7.1 Describe the manufacture of Nylon 6, 6.
- 7.2 Describe the manufacturing process of Nylon – 6 from caprolactum.
- 7.3 Describe the manufacture of Dacron polyester.
- 7.4 Know the end uses of nylon 6, 6 and nylon – 6.
- 7.5 Know the importance of blended polyesters.

**8.0 Know about rubber industries.**

- 8.1 List the specific uses of various rubbers.
- 8.2 Explain the butadiene manufacturing process.
- 8.3 Explain the styrene manufacturing process.
- 8.4 Describe the SBR manufacturing processes.
- 8.5 Know the additional processing used in rubber industry.

## **COURSE CONTENTS:**

### **1.0 Introduction to chemical technology & Coal chemicals.**

General requirements of a process plant.—water demineralization, compressed and instrument air, steam generation in boiler, working principles of cooling tower. Principles of formation of coal.--List of chemicals obtained from coal.— Distinguishment between low and high temperature carbonizations of coal---General composition of coal tar.- --Coal tar distillation.---Uses of coal.—

### **2.0 Petroleum refining and Petro-chemicals.**

Origin of crude petroleum.--Petroleum products – uses – properties. Atmospheric distillation and vacuum distillation of crude.---Cracking – thermal and catalytic cracking. ---Reforming process --Other unit processes: Polymerization, isomerization, alkylation and hydro alkylation.---Purification of crude and petroleum end products. **Various raw materials for petrochemicals**-Petrochemicals from methane – formaldehyde – methanol – chloromethane --Petrochemicals from ethylene –1,2 dichloro ethane – vinyl chloride –ethylene oxide –unit operations in petroleum refining..

### **3.0 Oils, fats and soaps: Physical and chemical properties of oils.**

Important vegetable oils and fats and animal fats.--Mechanical expeller process – solvent extraction process – overall processing of crude vegetable oil – hydrogenation of oils. Soap and glycerin manufacture – uses of soap and glycerin.

Manufacture linear alkyl Benzene & detergents

### **4.0 Plastic Industries.**

Esterification – Oxidation - Plastic Industries: Resins and plastics – classification – thermo setting and thermo plastics with example - Phenol – formaldehyde molding powder preparation - Production of polyethylene (HDPE) – PVC – Manufacturing process – uses of LDPE and HDPE and PVC - Production of phenol and formaldehyde.

### **5.0 Pulp and Paper Industries :**

Raw materials – wood chemistry – mechanical, chemicals and semi-chemical pulps – processing of sulphate pulp and ground wood pulp - manufacture of paper –additives in paper making- bleaching techniques of pulp – chemicals recovery from black liquor.

### **6.0 Sugar and Fermentation industries:**

Properties and uses of sugar – raw sugar manufacturing process – cane sugar refining – inversion of sugar, byproducts from sugar industries, grading of sugar crystals and uses- neat sketches of centrifuges in sugar industries. Fermentation industries: Properties and uses of ethyl alcohol – fermentation – aerobic and anaerobic fermentation – ethyl alcohol (industrial) manufacturing process – denaturing – potable spirits – anhydrous alcohol manufacturing process.

### **7.0 Synthetic fibres:**

Advantages of synthetic fibres – manufacture of nylon – 6, 6 and nylon – 6 – manufacture of Dacron polyester – importance of blended polyesters – uses of nylon – 6, 6 and nylon 6.

## **8.0 Rubber industries:**

Classification of rubbers – butadiene manufacturing process – styrene manufacturing process – specific uses of various rubbers – SBR manufacturing process – additional processing of rubber.

### **REFERNCE BOOKS:**

1. A textbook of Chemical Technology Volume II by Shukla and Pandey.
2. Chemtech – II (Second volume of Manual of Chemical Technology, I.I.T, Madras.)
3. Chemical Process Industries by Shreve
4. Outline of Chemical Technology by Dryden.

## HEAT TRANSFER

|                         |   |               |
|-------------------------|---|---------------|
| Subject Title           | : | Heat Transfer |
| Subject Code            | : | CH – 404      |
| Periods per week        | : | 05            |
| Total periods/ semester | : | 75            |

### TIME SCHEDULE :

| S. No. | Major topics  | No. of periods | Weightage of marks | Short answer type | Essay type |
|--------|---|----------------|--------------------|-------------------|------------|
| 1.     | Heat transfer by conduction.                        | 11             | 16                 | 2                 | 1          |
| 2.     | Principles of heat flow in fluids.                  | 18             | 26                 | 2                 | 2          |
| 3.     | Heat transfer to fluids without & with Phase change | 09             | 13                 | 1                 | 1          |
| 4.     | Radiation.  | 07             | 11                 | 2                 | ½          |
| 5.     | Heat Exchange equipment                             | 12             | 18                 | 1                 | 1½         |
| 6.     | Evaporation   | 18             | 26                 | 2                 | 2          |
|        | <b>Total</b>  | <b>75</b>      | <b>110</b>         | <b>10</b>         | <b>08</b>  |

**OBJECTIVES:** After completion of the course, the student will be able to

#### 1.0 Know the heat flow through conduction

- 1.1 Understand the nature of heat flow
- 1.2 Understand various mechanisms of heat flow such as conduction, convection and Radiation.
- 1.3 Define conduction, convection and Radiation.
- 1.4 Define steady state and unsteady state heat flow
- 1.5 Explain the Fourier's law of heat flow by conduction
- 1.6 Define and explain thermal conductivity of a substance and state its units.
- 1.7 Derive an equation for conduction through a single wall, composite wall.
- 1.8 Derive equation for conduction through cylindrical wall.
- 1.9 Explain compound resistances in series.
- 1.10 Explain the significance of lagging and economic lagging thickness.
- 1.11 Know different heat insulating materials and heating fluids.
- 1.12 Solve simple problems on calculation of rate of heat flow in case of flat wall, cylindrical wall and composite walls. Also on finding intermediate temperatures.

#### 2.0 Define convection, natural convection and forced convection.

- 2.1 Define convection, natural convection and forced convection
- 2.2 Know the working of heat exchanger..
- 2.3 Define counter current and parallel current flows in an heat exchanger.



- 2.4 Understand temperature variations along the length of the exchange in both cases above.
- 2.5 Explain enthalpy balances in heat exchangers and in total condensers.
- 2.6 Explain heat flux, Average temperature of fluid stream.
- 2.7 Explain logarithmic mean temperature difference (LMTD)
- 2.8 Know the film concept in heat transfer by convection.
- 2.9 Define and explain the film coefficient (Individual heat transfer coefficient) and compare it with thermal conductivity.
- 2.10 Define Nusselt number and Prandtl number
- 2.11 Derive an equation for calculation of overall coefficients from individual coefficients.
- 2.12 Explain the Resistance form of overall coefficient.
- 2.13 Know about fouling factors and their role.
- 2.14 Solve simple problems on calculation of LMTD and overall coefficients.
- 3.0 Understand the heat transfer to fluids without and with phase charge.**
- 3.1 Understand regimes of heat transfer in fluids.
- 3.2 Explain about thermal boundary layer
- 3.3 Explain the heat transfer by forced convection in laminar flow.
- 3.4 Define Graetz and Peclet numbers
- 3.5 Understand the heat transfer by forced convection in turbulent flow.
- 3.6 Know the various empirical equations used to calculate  $h_i$  such as  
1. Dittus – Boelter Equation 2. Sieder – Tate Equation.  
Colburn equation.
- 3.7 know the mechanism of heat transfer from condensing vapors.
- 3.8 Define and explain dropwise and film type condensation.
- 3.9 Know the heat transfer mechanism to boiling liquids.
- 3.10 Explain a pool boiling, nucleate boiling and film boiling.
- 3.11 Solve simple problems to calculate various numbers and heat transfer coefficient using various equations.
- 4.0 Radiation.**
- 4.1 Define absorptivity, Reflectivity and Transmittivity.
- 4.2 Explain emission of Radiation, Wavelength and emissive power.
- 4.3 Define black body emissivity.
- 4.4 State and Explain Stefan Boltzmann Law, Planck's law and Wiens displacement law.
- 4.5 Explain Reflectivity and Absorptivity of opaque solids.
- 4.6 State and Explain Kirchoff's law.
- 4.7 Know the process of radiation between surfaces.

- 4.8 Know angle of vision and view factor.
- 4.9 Understand the combined heat transfer by conduction, convection and Radiation and explain an equation for it.
- 4.10. Solve simple problem on Stefan's law.
- 4.11 Solve simple problems on view factor.
- 5.0 Know the different types of heat exchangers used in Industry.**
- 5.1 Classification of heat exchangers.
- 5.2 Know the working principle of Double pipe heat exchanger.
- 5.3 Describe the working principle of a shell and tube heat exchanger in detail with a neat diagram
- 5.4 Explain the working principle of a floating head heat exchanger with a neat sketch
- 5.5 Explain the working principle of a multipass heat exchange.
- 5.6 Explain temperature patterns in multipass exchanges with sketches.
- 5.7 Know about the extended surface heat exchangers i.e., i). Fin Type and ii) Plate type with a neat diagram
- 5.8 Know the function of a condenser.
- 5.9 Know about a) Kettle type boilers b) Calandrias with a neat sketch
- 6.0 Evaporation.**
- 6.1 Understand the term evaporation
- 6.2 Know the different liquid properties considered in evaporation.
- 6.3 Know the different types of evaporators
- 6.4 Describe with neat sketches the construction and working of following type of evaporators.
  - a) Standard vertical tube evaporator.
  - b) Falling film and climbing film evaporators.
  - c) Forced circulation evaporators.
- 6.5 Know about evaporator accessories
  - a) Steam traps            b) Condensers            c) Entrainment separators.
  - d) Barometric leg        e) Ejectors                f) Salt removal systems.
- 6.6 Know the performance of an evaporator
- 6.7 Define and understand the terms economy and capacity of an evaporator.
- 6.8 State and Explain boiling point elevation, and the effect of hydrostatics head.
- 6.9 State and Explain Duhring's rule.
- 6.10 Write enthalpy balances for single effect evaporator and understand the equations.
- 6.11 Know about enthalpy concentration diagram.
- 6.12 Solve problems on calculation of the heat transfer area and steam requirement and economy in case of a single effect evaporator.

- 6.13 Explain the working principle of the multiple effect evaporator system with a sketch.
- 6.14 State and explain the methods of feeding the Multiple effect evaporator system with relative advantages and disadvantages
- 6.15 Explain the capacity and Economy of Multiple effect evaporators.

### **COURSE CONTENT:**

- 1. Heat transfer and its applications-Heat transfer by conduction**-Mechanisms of heat flow-Fourier's law-Thermal conductivity-Steady state conduction- Compound resistances in series- Heat flow through a Cylinder- Problems.
- 2. Principles of heat flow in fluids:** Typical heat exchange equipment – Counter current and parallel-current flows – Energy balances — Average temperature of fluid stream– LMTD – Individual heat transfer coefficients – Calculation of Overall heat transfer coefficients from Individual coefficients – Fouling factors – Classification of Individual heat transfer coefficients and its magnitude – Simple problems.
- 3. Heat transfer to Fluids without and with phase change:** Regimes of heat transfer in fluids – Thermal boundary layer – Heat transfer by forced convection in laminar flow – Graetz and Peclet numbers – Heat transfer by forced convection in Turbulent flow – Empirical equations – Heat transfer from condensing vapors – Drop wise and film wise condensation – Heat transfer to boiling liquids-pool boiling, nucleate boiling and film boiling.
- 4. Radiation Heat transfer:** - Fundamentals - Emission of Radiation wave length of radiation Emissive power – Black body radiation – Emissivities of solids – laws of Black body radiation – Absorption of radiation by opaque solids – Reflectivity and absorptivity – Kirchoff's law – Radiation between surfaces – Angle of vision – view factor – combined Heat transfer by conduction – convection and radiation.
- 5. Heat Exchange equipment:** Types of heat exchangers principles and operation of Double pipe heat exchangers – shell and tube – single, multipass, floating head – Temperature patterns in multipass exchangers – extended surface heat exchangers – Fin type and plate type condensers – dehumidifying type – contact condensers – Heat insulating materials and heating fluids
- 6. Evaporation.** Liquid characteristics – some important properties – Types of evaporators – standard vertical tube, long tube, falling film – forced circulation evaporators – evaporator accessories – steam traps – condensers – Entrainment separators – Barometric leg – Ejectors – salt removal from evaporators. Performance of tubular evaporators – Evaporator capacity – boiling point elevation and Duhrings rule – Evaporator Economy – Enthalpy balances for single effect evaporator – Simple problems – Multiple effect evaporators .

### **REFERENCE BOOKS**

1. Unit operations of chemical Engg by Wareen L.Mc Cabe, Julian C.Smith and Peter Harriott, Fifth edition, Mc Graw Hill Publication.
2. Introduction to Chemical Engg by Walter L.Badger & Julius T.Banchero. Mc GRAW Hill Publication.
3. Process Heat Transfer by Donald Q. Kern, Mc GRAW Hill Publication.
4. Heat Transfer by D.P. Tiwari, Umesh publications, New Delhi.

## MASS TRANSFER

|                           |   |                      |
|---------------------------|---|----------------------|
| <b>Subject Title</b>      | : | <b>Mass Transfer</b> |
| <b>Subject Code</b>       | : | <b>CH – 405</b>      |
| <b>Periods / Week</b>     | : | <b>05</b>            |
| <b>Periods / Semester</b> | : | <b>75</b>            |

### TIME SCHEDULE

| S.No. | Major Topics                           | No. of periods | Weightage of Marks | Short answer type | Essay type |
|-------|--|----------------|--------------------|-------------------|------------|
| 1     | Introduction & Diffusion               | 10             | 13                 | 1                 | 1          |
| 2     | Distillation                           | 15             | 21                 | 2                 | 1½         |
| 3     | Absorption & Adsorption                | 13             | 21                 | 2                 | 1½         |
| 4     | Leaching and Extraction                | 10             | 13                 | 1                 | 1          |
| 5     | Humidification and Membrane separation | 15             | 21                 | 2                 | 1½         |
| 6     | Drying and Crystallization             | 12             | 21                 | 2                 | 1½         |
| Total |  | 75             | 110                | 10                | 08         |

### **OBJECTIVES:**

After the completion of the subject, the student will be able to

#### **1.0 Know about mass transfer operations and diffusion:**

- 1.1 Define the mass transfer operation
- 1.2 Know about the unit process, unit operation
- 1.3 Know the classification of Mass Transfer operations
- 1.4 Identify the different terms and symbols involved in different operations.
- 1.5 Distinguish various mass transfer operations.
- 1.6 Understand the meaning of equilibrium between phases.
- 1.7 Understand the process of diffusion
- 1.8 Explain the process of molecular diffusion with example
- 1.9 Define Fick's First Law of diffusion.
- 1.10 Explain eddy diffusion.
- 1.11 Distinguish molecular diffusion and eddy diffusion
- 1.12 Identify the unit operations that depend on diffusion.

- 1.13 Know the various fluxes and their units.
- 1.14 Understand diffusion in single phase.
- 1.15 Diffusion in gases and liquids for the cases (i) equimolar counter diffusion and (ii) diffusion of a through non diffusion (Derivations not required).
- 1.16 Simple problems on molecular gas phase diffusion.
- 1.17 Understand Interphase mass transfer
- 1.18 Know the two resistance theory.
- 1.19 Define mass transfer coefficients.
- 1.20 Write the relation between individual and overall Mass Transfer coefficient (Derivations not required).
- 1.21 Know the phase rule
- 1.22 Know the concept of ideal stages multistage contact and continuous contact.

## **2.0 Understand distillation**

- 2.1 Define distillation
- 2.2 Apply phase rule to distillation.
- 2.3 Define Raoult's law, Henry's law and ideal solution.
- 2.4 Define relative volatility and its significance.
- 2.5 Know about equilibrium and boiling point diagrams.
- 2.6 Define and explain equilibrium distillation.
- 2.7 Distinguish between batch distillation and continuous distillation.
- 2.8 State Rayleigh's equation.
- 2.9 Understand steam distillation.
- 2.10 Explain the process of continuous distillation with rectification and stripping.
- 2.11 Discuss Bubble cap and sieve tray columns.
- 2.12 Analyze the effect of feed conditions and feed plate location.
- 2.13 Define reflux ratio and explain min and optimum reflux ration.
- 2.14 State Mc. Cabe Thiele assumptions.
- 2.15 Determine the no. of stages for a binary mixture using Mc. Cabe – Thiele method.
- 2.16 Solve problems in distillation and calculation of no. of ideal stages using Mc. Cabe – Thiele method.
- 2.17 Define and explain stage efficiency and overall plate efficiency and factors influencing them.
- 2.18 Know about constant boiling mixture, high boiling and low boiling azeotropic mixture.
- 2.19 Explain the azeotropic distillation and its applications.
- 2.20 Know about membrane separations
- 2.21 Understand Reverse osmosis and Electrodialysis

## **3.0 Understand Absorption and Adsorption:**

- 3.1 Explain absorption and stripping operation.
- 3.2 Describe absorption towers and tower packings.
- 3.3 Apply material balances for absorption tower.
- 3.4 Understand minimum liquid to gas flow rate ratio.
- 3.5 Know the concept of number of transfer units and HTU.
- 3.6 Problems based on principles of absorption.
- 3.7 Understand the gas and liquid velocities in absorption towers and their limitations such as loading, flooding velocities and channeling.
- 3.8 Define adsorption with examples

3.9 Understand equilibrium in adsorption.

#### **4.0 Know extraction and leaching**

- 4.1 Application of phase rule to extraction and leaching operations
- 4.2 Equilibrium relation (Binodal curve) for complete immiscible system.
- 4.3 Distinguish the process of extraction and leaching.
- 4.4 Know different examples of leaching.
- 4.5 Describe single stage and multistage equipment used for extraction and leaching.
- 4.6 Explain mixer – settler.
- 4.7 Know the number of stages required for extraction.

#### **5.0 Understand humidification operations**

- 5.1 Define various terms involved in humidification operations
- 5.2 discuss adiabatic saturation temperature.
- 5.3 Explain the wet bulb and dry bulb temperatures.
- 5.4 Determine the humidity of a gas system.
- 5.5 Understand the reading of the psychometric chart.
- 5.6 Describe the humidification equipment – cooling towers.
- 5.7 Describe air conditioning.
- 5.8 Simple problems without using psychometric chart.

#### **6.0 Understand Drying and Crystallization**

- 6.1 Know the equilibrium relationship in drying operation and apply phase rule to drying operation.
- 6.2 Define various terms involved in drying operation.
- 6.3 Explain batch-drying process under constant drying condition.
- 6.4 Explain the rate of drying curves and factors influencing.
- 6.5 Calculate rate of drying and time of drying for batch drying process.
- 6.6 Classification of driers.
- 6.7 Know about tray driers, vacuum driers, rotary dryers, drum driers, spray driers, fluidized bed driers and flash driers.
- 6.8 Problems on calculation of time drying.
- 6.9 Define Crystal geometry, nucleation and crystal growth
- 6.10 Explain the various methods for attaining the super saturation.
- 6.11 Describe the classification of crystallizers.
- 6.12 Describe the crystallization equipment.
- 6.13 Explain caking of crystals, prevention and critical humidity.

#### **COURSE CONTENTS:**

1. Mass transfer operation – unit process – unit operation – classification of Mass Transfer Operations – terms and symbols involved – distinguish various Mass Transfer Operations – understand equilibrium between phases. Principles of diffusion – molecular diffusion – Fick's first law – eddy diffusion – Distinguish between molecular and eddy diffusions – operations that depend on diffusion – various fluxes – diffusion in single phase – diffusion in gases and liquids – Equimolal diffusion – diffusion of "A" through non – diffusing "B" – problems. Interphase mass transfer – various mass transfer coefficients – relation between individual and overall Mass Transfer Coefficient – two resistance theory – ideal stage – multistage and continuous contacts – Phase rule.

2. Application of phase rule to distillation – Raoult's law – Henry's law – ideal solution – relative volatility – its significance – equilibrium and boiling point diagrams – equilibrium distillation – Batch distillation – continuous distillation – Rayleigh's equation – steam distillation – continuous distillation with rectification and stripping – feed conditions reflux ratio – minimum reflux and optimum reflux ratio – McCabe and Thiele assumptions – Mc. Cabe & Thiele method – stage efficiency – overall efficiency – factors influencing stage efficiency – bubble cap and sieve tray columns – constant boiling mixtures – high boiling and low boiling azeotropic mixture – azeotropic distillation – problems on principles and Mc. Cabe Thiele method.-- Membrane separations -- Reverse osmosis and Electrodialysis
3. Phase equilibrium in absorption – stripping operation – absorption tower – tower packings – gas and liquid velocities – limitations – loading and unloading velocities – channeling – material balance – minimum liquid to gas rate ratio – number of transfer units – HTU – Problems-.Adsorption—definition – examples – equilibrium – Adsorbants.
4. Phase rule applicable to extraction and leaching – Binodal curve – Process of extraction and leaching examples – single stage and multistage equipments mixer settlers – Number of stages for extraction.
5. Humidification – various terms involved – adiabatic saturation temperature – wet bulb temperature – dry bulb temperature – humidity – psychrometric chart – humidification equipment – cooling towers – air conditioning.
6. Drying – equilibrium diagrams – various terms – batch drying – constant drying conditions – rate of drying curve – factors influencing the rate – time of drying classification of driers – know different driers – problems.Crystallization – crystal – Crystal growth – methods for super saturation – classification of crystallizers – equipment – caking of crystals – prevention – critical humidity – problems.

#### REFERENCE BOOKS:

1. Mass transfer operations by Robert E. Treybal, McGraw-Hill publication.
2. 'Unit operations of Chemical Engineering' by Warren L. McCabe, Julian C. Smith, Peter Harriot. Mc. Graw Hill Publication, Fifth Edition
3. Introduction to chemical engineering by Walter L. Badger & Julius T. Banchero, McGraw-Hill publication

## CHEMICAL TECHNOLOGY LAB

**Subject Title** : **Chemical Technology Lab**  
**Subject Code** : **CH-406**  
**Periods/week** : **06**  
**Periods/ Semester** : **90**

### TIME SCHEDULE

| S. No. | Major Topics   | No. of Periods |
|--------|--|----------------|
| 1.     | Water analysis   | 18             |
| 2.     | Analysis of Common Salt  | 18             |
| 3.     | Analysis of Bleaching powder   | 06             |
| 4.     | Analysis of Portland cement  | 12             |
| 5.     | Analysis of Vegetable Oil<br>a) Acid value<br>b) Saponification Value<br>c) Iodine Value | 12             |
| 6.     | Preparation of chemical products   | 06             |
| 7.     | Instrumental analysis  | 18             |
|        | Total  | <b>90</b>      |

**OBJECTIVES** : On completion of the study of the subject the student should be able to

#### **1.0 Know the analysis of water.**

- 1.1 Determination of total solids in ppm in tap water/Sea water.
- 1.2 Estimation of dissolved solids in p.p.m in tap water/sea water
- 1.3 Determination of the total hardness & permanent hardness in water by EDTA method
- 1.4 Determination of the total hardness and permanent hardness in water by soap solution method

#### **2.0 Know the analysis of common salt**

- 2.1 Estimation of chloride content present in common salt.
- 2.2 Determination of sulphate content in a given sample.

#### **3.0 Know the analysis of Bleaching powder**

- 3.1 Determine the available chlorine in the given sample of Bleaching powder.

#### **4.0 Analysis of Portland cement**

- 4.1 Estimate the percentage loss on ignition in sample of Portland cement
- 4.2 Determination of SiO<sub>2</sub> and CaO contents in a sample of Portland cement

#### **5.0 Know the analysis of vegetable oils.**

- 5.1 Determination of acid value of coconut oil / vegetable oil.
- 5.2 Estimation of Saponification value of the given sample.
- 5.3 Determination of iodine value of given vegetable oil.

#### **6.0 Preparation of Chemical products**

- 6.1 Preparation of Phenol formaldehyde resin (Bakelite)
- 6.2 Preparation of soap by cold process



**7.0 Know the functions and applications of the following instruments to analyze the various parameters**

- 7.1 Determination of pH of the given sample of solution by using pH meter.
- 7.2 Estimation of sugar content in a given sample by using Polari meter.
- 7.3 Determination of conductivity of the give sample of solution by Conductivity meter.
- 7.4 Determination of absorbency/ transmittency of a given sample by Spectrophoto meter/Spectrometer.
- 7.5 Determination of the colour of given sample by Colouri meter.

**COURSE CONTENTS:**

Analysis of different types of water for various parameters and characters.

Analysis of common salt.

Analysis of bleaching powder.

Estimation of percentage loss on ignition and  $\text{SiO}_2$ ,  $\text{CaO}$  in a sample of Portland cement

Analysis of vegetable oil.

Preparation of chemical products

Know the functioning and application of the following instruments:

pH meter

Polari meter

Conductivity meter

Spectrophotometer

Colouri meter

## MECHANICAL UNIT OPERATIONS AND MASS TRANSFER LAB

**Subject Title** : **Mechanical unit operations and Mass Transfer Lab**  
**Subject Code** : **CH-407**  
**Periods per week** : **06**  
**Periods / Semester** : **90**

### **List of Experiments :** **Mechanical unit operations**

1. Verification of the various laws of crushing by using Jaw crusher.
2. Verification of various crushing laws using roll crusher.
3. Determination of angle of nip in roll crusher.
4. Determination of critical speed & energy consumed in size reduction using ball mill / rod mill.
5. Perform screen analysis for determination of average size, Specific surface area, Particle population for the given sample.
6. Determination of effectiveness of screening in separating the given material by use of vibrating screens.
7. Perform froth flotation experiment to separate a mixture of coal into two fractions.
8. Verification of Stoke's law by settling a particle in a liquid column
9. Perform batch Sedimentation experiment to calculate the thickener area required using Kynch formula.
10. Determination of the resistance offered by filter cake & filter medium under constant pressure & constant rate of filtration in filtration operation by plate & frame type of filter press.

### **Mass Transfer :**

11. To draw a graph of specific gravity Vs mole fraction of a given binary system.
12. To draw a graph of refractive index Vs mole fraction of a given binary system
13. Verification of Rayleigh's equation by conducting a simple distillation experiment.
14. Verification of Steam distillation law by conducting steam distillation experiment.
15. Estimation of vapor liquid equilibrium data of a given binary system.
16. To determine the no. of trays required using Mc.Cabe Thiele method
17. Calculation of time of drying of a given material and to draw the rate of drying curve.
18. To draw the Binodal curve for the given ternary liquid system.
19. To estimate the diffusivity for a given system.
20. Determination of amount of sodium carbonate/ sodium chloride in a mixture with sand using water by leaching process.
21. To determine the surface area of adsorption of a given sample by using Adsorption experiment.

## LIFE SKILLS

|                  |   |             |
|------------------|---|-------------|
| Subject Title    | : | Life Skills |
| Subject Code     | : | CH-408      |
| Scheme           | : | C-16        |
| Periods/ Week    | : | 03          |
| Periods/Semester | : | 45          |

### TIME SCHEDULE

| SI No. | UNITS             | No. of periods Allotted |            |       |
|--------|-------------------|-------------------------|------------|-------|
|        |                   | Explanation             | Activities | Total |
| 1.     | ATTITUDE          | 1                       | 3          | 4     |
| 2.     | ADAPTABILITY      | 1                       | 3          | 4     |
| 3.     | GOAL SETTING      | 1                       | 3          | 4     |
| 4.     | MOTIVATION        | 1                       | 3          | 4     |
| 5.     | TIME MANAGEMENT   | 1                       | 3          | 4     |
| 6.     | CRITICAL THINKING | 2                       | 3          | 5     |
| 7.     | CREATIVITY        | 1                       | 3          | 4     |
| 8.     | PROBLEM SOLVING   | 1                       | 3          | 4     |
| 9.     | TEAM WORK         | 1                       | 3          | 4     |
| 10.    | LEADERSHIP        | 1                       | 3          | 4     |
| 11.    | STRESS MANAGEMENT | 1                       | 3          | 4     |
| TOTAL  |                   | 12                      | 33         | 45    |

**Note: No Written Examination; The total 45 hours are to be considered as Theory hours.**

**Marks:** Internal – 40; External – 60

#### OBJECTIVES:

***Upon the completion of this course, the student shall be able to***

#### **1.0 Understand the concept of Attitude**

- 1.1 Define 'Attitude'
- 1.2 Explain the importance of Attitude
- 1.3 Distinguish between Positive and Negative Attitudes
- 1.4 Life Response: Need for change of Attitude
- 1.5 Positive Attitude: Key to success in Personal and Professional Lives

#### **2.0 Understand the concept of Adaptability**

- 2.1 Define the term 'Adaptability'
- 2.2 Explain the concept of Adaptability
- 2.3 Advantages of Adaptability
- 2.4 Disadvantages of Lack of Adaptability
- 2.5 Need for positive response to change

### **3.0 Understand the concept of Goal setting**

- 3.1 Define the terms 'Goal' and 'Goal Setting'
- 3.2 Explain the significance of Goal setting & Long and Short term goals
- 3.3 Explain the following concepts
  - a) Wish b) Dream c) Goal
- 3.4 Explain the reasons for and consequences of not setting goals
- 3.5 The SMART features in Goal setting

### **4.0 Understand the concept of Motivation**

- 4.1 Define 'Motivation' ; Inspiration Vs Motivation
- 4.2 Importance of motivation in Goal setting
- 4.3 Distinguish between Internal (Self) Motivation and External Motivation
- 4.4 De-motivating Factors and how to overcome them
- 4.5 Motivating oneself and others

### **5.0 Understand Time Management skills**

- 5.1 Define 'Time Management'.
- 5.2 Comprehend the significance of Time Management.
- 5.3 Explain the Time Quadrant
- 5.4 Common Time wasters and how to overcome them.
- 5.5 How to meet deadlines and targets within time

### **6.0 Understand Critical Thinking**

- 6.1 Define "Critical Thinking",
- 6.2 Understand the importance of Critical Thinking
- 6.3 Distinguish between facts and opinions (assumptions)
- 6.4 Inculcating different perspectives
- 6.5 Developing Reasoning abilities and form sound judgments

### **7.0 Understand Creativity**

- 7.1 Understand the importance of and need for creative ideas
- 7.2 Distinguish between Linear Thinking and Lateral Thinking
- 7.3 Distinctive qualities of creative people
- 7.4 Unusual or creative use of familiar objects
- 7.5 Creative ways of solving problems

### **8.0 Understand Problem Solving**

- 8.1. Define the concept of Problem solving
- 8.2 Viewing the problems as challenges
- 8.3 Different steps in solving a problem
- 8.4 Selecting the best solution to solve a problem
- 8.5 Lateral thinking in Problem solving

### **9.0 Understand Team Work**

- 9.1 Define Team work
- 9.2 Develop Team skills
- 9.3 Advantages of team work
- 9.4 Understand responsibilities as a team player
- 9.5 Problems of working in a team and possible solutions

### **10.0 Understand Leadership**

- 10.1 Define Leadership
- 10.2 Identify Leadership qualities
- 10.3 Analyze one's strengths and limitations as a leader
- 10.4 Types of Leadership: Autocratic and Democratic
- 10.5 Leadership by example

## **11.0 Understand Stress Management**

- 11.1 Define Stress
  - 11.2 Explain the causes of stress
  - 11.3 Learn Stress Management skills
  - 11.4 Need for positive thinking and self esteem
  - 11.5 Practice Stress Management strategies
-

## **HEAT TRANSFER LAB**

|                           |          |                          |
|---------------------------|----------|--------------------------|
| <b>Subject Title</b>      | <b>:</b> | <b>Heat Transfer Lab</b> |
| <b>Subject Code</b>       | <b>:</b> | <b>CH – 409</b>          |
| <b>Periods / Week</b>     | <b>:</b> | <b>03</b>                |
| <b>Periods / Semester</b> | <b>:</b> | <b>45</b>                |

### **List of Experiments:**

1. Verification of fourier's law of heat conduction through composite walls.
2. Verification of fourier's law of heat conduction and determination of thermal conductivity of a metal bar.
3. Determination of overall heat transfer co-efficient in a double pipe heat exchanger for counter flow.
4. Determination of overall heat transfer co-efficient in a double pipe heat exchanger for parallel flow.
5. Determination of overall heat transfer co-efficient in a shell and tube heat exchanger for counter flow.
6. Determination of overall heat transfer co-efficient in a shell and tube heat exchanger for parallel flow.
7. Determination of heat transfer co-efficient for forced convection of air.
8. Determination of heat transfer co-efficient for natural convection of air.
9. Determination of Stefan boltzman constant.
10. Determination of emmisivity of a test plate.

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**V & VI Semesters  
(Industrial Training)**

**DIPLOMA IN CHEMICAL ENGINEERING**  
**SCHEME OF INSTRUCTIONS AND EXAMINATIONS**  
**C-16, V Semester (Industrial Training) CH -501**

| S.No. | Subject   | Scheme of Examination |           |   |            |
|-------|---|-----------------------|-----------|---|------------|
|       |   | Duration (hours)      | Nature    | Item Each spell of 6 months                           | Max. marks |
| 1.    | Practical Training in a Chemical or Allied Industry | 6 months              | Viva voce | 1.First assessment                                    | 100        |
|       |   |                       |           | 2.Second Assessment (written & viva-voce)             | 100        |
|       |   |                       |           | 3.At the institution after completion of the training |            |
|       |   |                       |           | (a) Log Book  | 30         |
|       |   |                       |           | (b) Training Report                                   | 30         |
|       |   |                       |           | (c) Seminar   | 40         |
| TOTAL |   |                       |           |   | 300        |



**DIPLOMA IN CHEMICAL ENGINEERING**  
**SCHEME OF INSTRUCTIONS AND EXAMINATIONS**  
**C-16, VI Semester (Industrial Training) CH - 601**

| S.No. | Subject   | Scheme of Examination |           |   |            |
|-------|---|-----------------------|-----------|---|------------|
|       |   | Duration (hours)      | Nature    | Item Each spell of 6 months                           | Max. marks |
| 1.    | Practical Training in a Chemical or Allied Industry | 6 months              | Viva voce | 1.First assessment                                    | 100        |
|       |   |                       |           | 2.Second Assessment (written & viva-voce)             | 100        |
|       |   |                       |           | 3.At the institution after completion of the training |            |
|       |   |                       |           | (a) Log Book  | 30         |
|       |   |                       |           | (b) Training Report                                   | 30         |
|       |   |                       |           | (c) Seminar   | 40         |
| TOTAL |   |                       |           |   | 300        |

## **SANDWICH DIPLOMA IN CHEMICAL ENGINEERING (CURRICULUM C-16)**

### **V/VI SEMESTERS (CH-501 and CH-601) (PRACTICAL TRAINING I/II SPELLS)**

**Duration : 6 months (Each spell)**

#### **OBJECTIVES**

On completion of a spell of practical training in a chemical or allied industry, the student will be able to

#### **1.0 Know the organizational set up from top executive to workmen level**

- 1.1 Know the function of each department/section
- 1.2 Know the inter relationship among various department/sections

#### **2.0 Know the various raw materials used as feed stock and chemical composition and their source.**

- 2.1 Understand the various intermediates produced and their further processing and/or waste disposal.
- 2.2 Know the final products, its composition and its commercial importance's, uses and applications.

#### **3.0 Understand the various stages involved in processing, sequential arrangement of different equipment.**

- 3.1 Draw the block flow diagram, detail flow diagram of each process after line tracing.
- 3.2 Understand the arrangement of various process equipment in systematic manner in a less possible area of site.

#### **4.0 Know importance process variables required to be maintained in each process equipment of each unit like temperature, pressure, flow P<sup>H</sup> etc.**

- 4.1 Understand the effects of changes of process parameters.

#### **5.0 Know the various unit operations in each process parameters.**

- 5.1 Understand the unit operations principles
- 5.2 Apply unit operations theory learned at the Institution
- 5.3 Know the various unit processes (Chemical reactions in each process plant)
- 5.4 Identify the side reactions in each process plant.

#### **6.0 Know the various analytical methods used in the quality control department**

- 6.1 Understand the experimental methods to find out the compositions and physical properties of various raw materials, intermediates and final products
- 6.2 Operate various analytical instruments that are used in laboratory.

#### **7.0 Know the trouble shooting in process operation**

- 7.1 Know preventive precautions of the same for each equipment in each process
- 7.2 Startup and shut down procedures for the equipment and plant.

**8.0 Know various measuring instrument, recording instruments and control instruments.**

8.1 Understand the D.C.S. in each process

8.2 Identify various sensing elements, transmission elements, indication devices.

**9.0 Know the importance of safety in chemical industries**

9.1 Understand the safety about personnel protection, equipment protection

9.2 Know the usage of various safety devices

9.3 Precautionary measures to be taken.

**10.0 Know the various effluents from each process plant.**

10.1 Understand effects of hazardous effluents

10.2 Understand treatment method and disposal.

10.3 Know the effective operation to minimize the effluents.

**COURSE CONTENTS**

Organizational set up

Raw materials, intermediates and end products

Process descriptions (Process flow diagrams and line tracing, detailed flow diagrams etc.)

Process parameters (such as temp., pressure, flow level etc.)

Unit operations and unit process in each process

Quality control of raw materials, intermediates and end products

Operational troubles and preventive measures

Process instrumentation

Safety aspects (personnel, equipment etc.)

Effluent treatment

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**INDUSTRIAL TRAINING SCHEME  
V & VI SEMESTERS (CH-501 and CH-601)**

1. A candidate shall be assessed twice in each spell of industrial training i.e. at the end of third month and finally (at the end of sixth month) before he/she completes the industrial training.
2. The assessment shall be carried out by a committee comprising of
  - (a) A representative of the Industry where the candidate is undergoing training
  - (b) A staff member of the concerned section of the polytechnic.
3. The assessment at the end of the third month and the end of training( at the end of sixth month) shall each carry 100 marks for the progress made during the corresponding period of training
4. The remaining 100 marks are allotted as follows for the training report 30 marks, log book 30 marks and for seminar 40 marks. These are to be evaluated at the institution at the end of each spell of training by a committee consisting following staff members
  - (1) Head of Section.
  - (2) External Examiner preferably from Industry
  - (3) Staff member who assessed the student during the Industrial Training.
5. The progress made during the end of each assessment will be evaluated on the basis of the following parameters.

**ASSESSMENT SCHEME**

| S. No. | Name of the Parameter                  | Max. Marks Allotted for each Parameter |
|--------|--|--|
| 1.     | Attendance and punctuality             | 5                                      |
| 2.     | Familiarity with Technical terms       | 10                                     |
| 3.     | Familiarity with tools and material    | 10                                     |
| 4.     | Attitude towards job                   | 5                                      |
| 5.     | Manual skills                          | 5                                      |
| 6.     | Application of knowledge               | 10                                     |
| 7.     | Problem solving skills                 | 10                                     |
| 8.     | Comprehension and observation          | 5                                      |
| 9.     | Safety and Environmental consciousness | 5                                      |
| 10.    | Human relations                        | 5                                      |
| 11.    | Ability to communicate                 | 8                                      |
| 12.    | Supervising ability                    | 6                                      |
| 13.    | General conduct during the period      | 6                                      |
| 14.    | Maintenance of dairy                   | 10                                     |
|        | <b>Total:</b>                          | <b>100</b>                             |

**V AND VI SEMESTERS – (INDUSTRIAL TRAINING)  
(CH-501 and CH-601)**

| S.No.                   | Subject   | Duration              | Scheme of Examination |   |       | Remarks   |
|-------------------------|---|-----------------------|-----------------------|---|-------|---|
|                         |   |                       | Nature<br>max         | Item  | marks |   |
| 1.                      | Practical training in a chemical or allied Industry | 6 Months (One spell ) | Viva-Voce             | First Assessment (at the end of Third month) (At the Industry)                        | 100   | As per the Assessment Scheme stipulated in the Curriculum |
|                         |   |                       |                       | Second Assessment (at the end of sixth month) (At the Industry) (written & viva-voce) | 100   |   |
|                         |   |                       |                       | 3. At the Institution after completion of Training                                    |       |   |
|                         |   |                       |                       | a). Log Book  | 30    |   |
| b). Training Report     | 30  |                       |                       |   |       |   |
| c). Seminar             |   | 40                    |                       |   |       |   |
| Total for each semester |   |                       |                       |   | 300   |   |

**No gap/ holidays between one spell to another**

## **VII Semester**

**DIPLOMA IN CHEMICAL ENGINEERING**  
**SCHEME OF INSTRUCTIONS AND EXAMINATIONS**  
**C-16, VII Semester**

| Subject Code      | Name of the Subject                                   | Instruction period / week |                     | Total Period / year | Scheme of Examination |                 |                |             |
|-------------------|---|---------------------------|---------------------|---------------------|-----------------------|-----------------|----------------|-------------|
|                   |   | Theory                    | Practical /Tutorial |                     | Duration (hours)      | Sessional Marks | End Exam Marks | Total Marks |
| <b>THEORY:</b>    |   |                           |                     |                     |                       |                 |                |             |
| CH-701            | Industrial Management and smart Technologies          | 5                         | --                  | 75                  | 3                     | 20              | 80             | 100         |
| CH-702            | Thermodynamics and Reaction Engineering               | 5                         | --                  | 75                  | 3                     | 20              | 80             | 100         |
| CH-703            | Instrumentation and Process Control                   | 5                         | --                  | 75                  | 3                     | 20              | 80             | 100         |
| CH-704            | Environmental studies & Pollution Control Engineering | 4                         | --                  | 60                  | 3                     | 20              | 80             | 100         |
| CH-705            | Energy Technology                                     | 5                         | --                  | 75                  | 3                     | 20              | 80             | 100         |
| <b>PRACTICAL:</b> |   |                           |                     |                     |                       |                 |                |             |
| CH-706            | Chemical plant equipment drawing                      | --                        | 6                   | 90                  | 3                     | 40              | 60             | 100         |
| CH-707            | Instrumentation and Process Control Lab               | --                        | 3                   | 45                  | 3                     | 40              | 60             | 100         |
| CH-708            | Energy Technology and Reaction Engineering Lab        | --                        | 6                   | 90                  | 3                     | 40              | 60             | 100         |
| CH-709            | Project work  | --                        | 3                   | 45                  | 3                     | 40              | 60             | 100         |
| <b>TOTAL</b>      |   | 24                        | 18                  | 630                 |                       | 260             | 640            | 900         |

CH-701 Common to all branches

CH-702 Common to CHPC/PP/OT-702

CH-703 Common to CHPC/PP/OT-703

**Industrial Management & Smart Technologies**

Subject Title : Industrial Management & Smart Technologies  
 Subject Code : CH-701  
 Periods/Week : 5  
 Period/Semester : 75

**TIME SCHEDULE**

| S. No. | Major Topics                                      | Periods   | Weightage Of Marks | Short Answer Questions | Essay Type Questions |
|--------|---|-----------|--------------------|------------------------|----------------------|
| 1.     | Basics of Industrial Management                   | 06        | 13                 | 1                      | 1                    |
| 2.     | Organisation structure & Organisational behaviour | 10        | 18                 | 1                      | 1 <sup>1/2</sup>     |
| 3.     | Production Management                             | 10        | 18                 | 1                      | 1 <sup>1/2</sup>     |
| 4.     | Materials Management                              | 08        | 13                 | 1                      | 1                    |
| 5      | Maintenance management & Industrial Safety        | 08        | 13                 | 1                      | 1                    |
| 6      | Entrepreneurship Development                      | 08        | 13                 | 1                      | 1                    |
| 7      | Total Quality Management                          | 05        | 06                 | 2                      |                      |
| 8      | Smart technologies                                | 20        | 16                 | 2                      | 1                    |
|        | Total   | <b>75</b> | <b>110</b>         | <b>10</b>              | <b>08</b>            |

**1. Basics of Industrial Management**

*On completion of the course the student will be able to*

**1.0 Understand the principles of management as applied to industry.**

- 1.1 Define industry, commerce (Trade) and business.
- 1.2 Know the need for management.
- 1.3 Understand the evolution of management
- 1.4 Understand functions of Management.
- 1.5 Explain the principles of scientific management.
- 1.6 Explain the principles of management.
- 1.7 Differentiate between management and administration.
- 1.8 Understand the nature of management as a profession
- 1.9 Differentiate between supervisory, middle and Top level management
- 1.10 Explain the importance of managerial skills (Technical, Human, Conceptual)

**2. Organisation Structure & organisational behaviour**

*Know types of ownerships, the organisation structure of an industry and the behaviour of an individual in an organisation.*

- 2.1 Understand the philosophy and need of organisation structure of an industry.
- 2.2 Understand the line, staff and Functional organisations
- 2.3 Understand the Authority and Responsibility Relationships
- 2.4 Understand the differences between Delegation and decentralization
- 2.5 Explain the factors of effective organisation.
- 2.6 Outline the communication process



- 2.7 State motivation theories.
- 2.8 State Maslow's Hierarchy of needs.
- 2.9 List out different leadership models.
- 2.10 Explain the trait theory of leadership.
- 2.11 Explain behavioural theory of Leadership.
- 2.12 Explain the process of decision making.
- 2.13 Assessing Human resource requirements
- 2.14 Know the concept of Job analysis, Job description and specifications
- 2.15 Understand the process of recruitment, selection, training and development
- 2.16 Understand types of business ownerships
- 2.17 Differentiate between the business ownerships
- 2.18 Know the objectives of Employee participation
- 2.19 Understand the meaning and definition social responsibilities
- 2.20 Corporate social responsibility

### **3. Production management**

*Understand the different aspects of production management.*

- 3.1 Identify the factors of Plant Location
- 3.2 Know the objectives of plant Layout
- 3.3 Understand the principles of plant Layouts
- 3.4 Explain the types of plant Layouts
- 3.5 Relate the production department with other departments.
- 3.6 State the need for planning and it's advantages.
- 3.7 Explain the stages of Production, planning and control.
- 3.8 Know the basic methods demand forecasting
- 3.9 Explain routing methods.
- 3.10 Explain scheduling methods.
- 3.11 Explain dispatching.
- 3.12 Explain Break Even Analysis
- 3.13 Define supply chain Management, competitive strategy, Supply chain strategy
- 3.14 Draw PERT/CPM networks.
- 3.15 Identify the critical path

### **4. Materials Management**

*Understand the role of materials management industries.*

- 4.1 Explain the importance of materials management in Industry.
- 4.2 Know Functions of Materials Management
- 4.3 Derive expression for inventory control.
- 4.4 Explain ABC analysis.
- 4.5 Define safety stock.
- 4.6 Define reorder level.
- 4.7 Derive an expression for economic ordering quantity.
- 4.8 Know the functions of Stores Management,
- 4.9 Explain types of store layouts.
- 4.10 List out stores records.
- 4.11 Explain the Bin card.
- 4.12 Describe Cardex method.
- 4.13 Explain general purchasing procedures
- 4.14 Explain tendering, E-tendering and E-procurement procedures
- 4.15 List out purchase records.
- 4.16 Know the applications of RFID (Radio Frequency Identification Device)
- 4.17 Understand the applications of RFID in material management

### **5. Maintenance Management & Industrial Safety**

## **Comprehend the Importance of Maintenance Management & Safety procedures**

- 5.1 Explain the importance of maintenance management in Industry.
- 5.2 Know the Objectives of maintenance management
- 5.3 Know the activities of maintenance management
- 5.4 Understand the importance of Preventive maintenance
- 5.5 Understand the need for scheduled maintenance
- 5.6 Differentiate between scheduled and preventive maintenance
- 5.7 Know the principles of 5 s for good house keeping
- 5.8 Explain the importance of safety at Work place.
- 5.9 List out the important provisions related to safety.
- 5.10 Explain hazard and accident.
- 5.11 List out different hazards in the Industry.
- 5.12 Explain the causes of accidents.
- 5.13 Explain the direct and indirect cost of accidents.
- 5.14 Understand the types of emission from process Industries, their effects on environment and control
- 5.15 Understand the principles of solid waste management

## **6. Entrepreneurship Development.**

*Understand the role of entrepreneur in economic development and in improving the quality of life.*

- 6.1 Define the word entrepreneur.
- 6.2 Explain the requirements of an entrepreneur.
- 6.3 Determine the role of entrepreneurs in promoting Small Scale Industries.
- 6.4 Describe the details of self-employment schemes.
- 6.5 Characteristic of successful entrepreneurs
- 6.6 Explain the method of site selection.
- 6.7 List the financial assistance programmes.
- 6.8 List out the organisations that help an entrepreneur
- 6.9 Know the use of EDP Programmes
- 6.10 Understand the concept of make in India, Zero defect and zero effect
- 6.11 Understand the importance for startups
- 6.12 Explain the conduct of demand surveys
- 6.13 Explain the conduct of a market survey
- 6.14 Evaluate Economic and Technical factors.
- 6.15 Prepare feasibility report study

## **7. Total Quality Management:**

*Understand the concepts adopted in total quality management*

- 7.1 Explain the concept of quality.
- 7.2 List the quality systems and elements of quality systems.
- 7.3 State the principles of quality Assurance.
- 7.4 Understand the basic concepts of TQM
- 7.5 Know the Pillars of TQM
- 7.6 List the evolution of ISO standards.
- 7.7 Explain ISO standards and ISO 9000 series of quality systems.
- 7.8 List the beneficiaries of ISO 9000.
- 7.9 Explain the concepts of ISO 14000
- 7.10 Know the overview of PDCA cycle

## **8. Smart Technologies**

- 8.1 Get an overview of IoT
  - 8.1.1 Define the term IoT
  - 8.1.2 Know how IoT work

- 8.1.3 List the key features of IoT
- 8.1.4 List the components of IoT : hardware, software, technology and protocols
- 8.1.5 List the advantages and disadvantages of IoT
- 8.2 IoT Applications
  - 8.2.1 Smart Cities
  - 8.2.2 Smart Energy and the Smart Grid
  - 8.2.3 Smart Transportation and Mobility
  - 8.2.4 Smart Home, Smart Buildings and Infrastructure
  - 8.2.5 Smart Factory and Smart Manufacturing
  - 8.2.6 Smart Health
  - 8.2.7 Food and Water Tracking and Security
  - 8.2.8 Social Networks and IoT

## Course Content

### 1. Basics of Industrial Management

Introduction: Industry, Commerce and Business; Definition of management; Characteristics of management; Functions of management - Planning, Organizing, Staffing, Directing, Co-ordination, Controlling, Motivating, Communication, Decision Making; Principles of scientific management: – F.W.Taylor, Principles of Management: Henry Fayol; Administration and management; Nature of management; levels of management; managerial skills;

### 2. Organisation Structure & organisational behaviour

Organizing - Process of Organizing; Line/Staff and functional Organizations, Decentralization and Delegation, Effective Organizing; Communication, Motivational Theories; Leadership Models; Human resources development; Forms of Business ownerships: Types – Sole proprietorship, Partnership, Joint Stock Companies, Cooperative types of Organizations; Employee participation in management; Corporate Social responsibility;

### 3. Production management

Definition and importance; Plant location and layout; Types of production -job, batch and mass; production Planning and Control: Demand forecasting, routing, scheduling, dispatching and follow up; Break even analysis; Supply chain Management (Definition, Competitive strategy Vs Supply chain Strategy, Supply chain drivers); Project scheduling; Application of CPM and PERT techniques; simple numerical problems;

### 4. Materials Management

Materials in industry, Basic inventory control model, ABC Analysis, Safety stock, re-order level, Economic ordering quantity, Stores Management: Stores layout, stores equipment, Stores records, purchasing procedures, e-tendering, e-procurement; purchase records, Bin card, Cardex RFID (Radio Frequency Identification Device) application in materials management;

### 5. Maintenance Management & Industrial Safety

Objectives and importance of plant maintenance, Different types of maintenance, Nature of maintenance problems, Range of maintenance activities, Schedules of preventive maintenance, Advantages of preventive maintenance, 5 S principles; Importance of Safety at work places; Causes of accidents-psychological, physiological and other industrial hazards; Domino sequence; methods of promoting safe practices; Pollution control in process industries; Introductory concepts on Solid waste management (General introduction including definitions of solid waste including municipal, hospital and industrial solid waste, Waste reduction at source – municipal and industrial wastes)

### 6. Entrepreneurship Development.

Definition of Entrepreneur; Role of Entrepreneur; Concept of Make In India, ZERO defect, Zero Effect, Concept of Start-up Company, Entrepreneurial Development: Role of SSI, MSME, DICs, Entrepreneurial development schemes; Institutional support, financial assistance programmes; Market survey and Demand survey; Preparation of Feasibility study reports

### **7. Total Quality Management:**

Total Quality Management (TQM)- Concept of quality discussed by B. Crosby W. Edward, Deming, Joseph M. Juran, Kooru Ishikawa, Genichi Taguchi, Shigco Shingo. Quality systems – Definitions of the terms used in quality systems like, quality policy, quality management, quality systems, Stages of development of ISO 9000 series , ISO-14000, Deming's PDCA Cycle (Plan, Do, Check and Action). Japanese Quality Management, culture, Kaizen Strategy (continuous improvement).

### **8. Smart Technologies :**

Overview of IoT - Define IoT, how IoT work, key features of IoT, components of IoT : hardware, software, technology and protocols, advantages and disadvantages of IoT - IoT Applications - Smart Cities, Smart Energy and the Smart Grid, Smart Transportation and Mobility, Smart Home, Smart Buildings and Infrastructure, Smart Factory and Smart Manufacturing, Smart Health, Food and Water Tracking and Security, Participatory Sensing, Social Networks and IoT.

## **REFERENCE BOOKS**

1. Industrial Engineering and Management -by O.P Khanna
2. Production Management- by Buffa.
3. Engineering Economics and Management Science - by Banga & Sharma.
4. Personnel Management by Flippo.
5. Production and Operations Management –S.N. Chary
6. [Converging\\_Technologies\\_for\\_Smart\\_Environments\\_and\\_Integrated\\_Ecosystems\\_IERC\\_Book\\_Open\\_Access\\_2013\\_pages-54-76](#)
7. Supply Chain Management –Sunil Chopra and Meindl, PHI publishers
8. 5 S made easy by David Visco

## THERMODYNAMICS AND REACTION ENGINEERING

**Subject Title** : Thermodynamics and Reaction Engineering  
**Subject Code** : CH-702  
**Periods per week** : 05  
**Periods / Semester** : 75

### TIME SCHEDULE

| S. No.       | Major topics  | No. of periods | Weightage Of Marks | Short answer type | Essay type |
|--------------|---|----------------|--------------------|-------------------|------------|
| 1.           | Introduction, First law and Basic concepts of thermodynamics  | 10             | 13                 | 1                 | 1          |
| 2.           | Volumetric properties of pure fluids  | 12             | 16                 | 2                 | 1          |
| 3.           | The second law of thermodynamics  | 12             | 16                 | 2                 | 1          |
| 4.           | Refrigeration and Liquefaction  | 10             | 13                 | 1                 | 1          |
| 5.           | Chemical Reaction Equilibria  | 10             | 13                 | 1                 | 1          |
| 6.           | Introduction to Chemical Reaction Engineering, Kinetics of homogeneous Reactions, Interpretation of Batch reactor data, Single ideal reactors | 15             | 26                 | 2                 | 2          |
| 7.           | Catalysis and Industrial reactors   | 06             | 13                 | 1                 | 1          |
| <b>Total</b> |   | <b>75</b>      | <b>110</b>         | <b>10</b>         | <b>08</b>  |

### OBJECTIVES:

After completion of the course, the student will be able to

#### 1.0 Introduction and First law of thermodynamics.

- 1.1 Know the scope of thermodynamics.
- 1.2 Know about system and surroundings
- 1.3 Define open, closed and isolated systems
- 1.4 Define internal energy, enthalpy and their units in SI system.
- 1.6 Know the statement for 1<sup>st</sup> law of thermodynamics.
- 1.7 Derive an expression of first law of thermodynamics for the following :
  - (a) Closed system
  - (b) Steady state flow process.
- 1.8 Differentiate between state and path functions.
- 1.9 Understand extensive and intensive properties.
- 1.10 Define heat capacity and specific heat
- 1.11 Application of heat capacity and specific heat
- 1.12 State and explain (a) Equilibrium (b) Phase rule (c) Reversible process.
- 1.13 Simple problems on fundamentals and first law of thermodynamics.

## 2.0 Volumetric properties of pure fluids

- 2.1 Know the PVT behavior of pure substances.
- 2.2 Define ideal gas, know the characteristics of ideal gas.
- 2.3 Define compressibility factor and know about compressibility Charts.
- 2.4 Cubic Equation of state (a) Vanderwaal's equation (b) Redlich-Kwong's Equation
- 2.5 Derive  $C_p - C_v = R$  for a mole of an ideal gas.
- 2.6 State and explain about the following processes.  
(a) Isochoric (b) Isobaric (c) Isothermal and (d) Adiabatic.
- 2.7 Derive different expression for  $\Delta U$ ,  $\Delta H$ ,  $Q$  and  $W$  for (a) Isochoric (b) Isobaric (c) Isothermal and (d) Adiabatic processes connecting PVT properties.
- 2.8 Solve problems on calculation of  $\Delta U$ ,  $\Delta H$ ,  $Q$  and  $W$  in the above processes connecting PVT Properties.

## 3.0 The second law of thermodynamics.

- 3.1 Know the statements of second law of thermodynamics.
- 3.2 Distinguish between heat engine and heat pump.
- 3.3 Know the schematic representation of heat engine and heat pump.
- 3.4 Define efficiency of heat engine and COP of heat pump.
- 3.5 Know the thermodynamic temperature scales
- 3.6 Know Carnot cycle principle
- 3.7 Derive thermodynamic temperature and the ideal gas scale.
- 3.8 State and explain Carnot cycle principle.
- 3.9 Define entropy and its SI units.
- 3.10 Know the entropy characteristics.
- 3.11 Know the entropy changes of an ideal gas.
- 3.12 Know the mathematical statement of 2<sup>nd</sup> law of thermodynamics
- 3.13 Solve simple problems on heat engine, heat pump
- 3.14 Solve simple problems on entropy and adiabatic mixing.
- 3.15 State third law of thermodynamics.
- 3.16 Know the property relations for homogeneous phases  
(a)  $H=U+PV$  (b)  $A=U-TS$  (c)  $G=H-TS$   
(d) fundamental property relations (e) Maxwell's equations

## 4.0 Refrigeration and Liquefaction.

- 4.1 Define refrigeration.
- 4.2 Explain the cycle of refrigeration.

- 4.3 Know about various methods of refrigeration.
- 4.4 Know about various applications of refrigeration.
- 4.5 Define refrigerant.
- 4.6 Know about classification of refrigerants with examples (primary and secondary).
- 4.7 Know the principle of Carnot cycle refrigerator.
- 4.8 Know about choice of refrigerant.
- 4.9 Explain the method of obtaining vapor compression refrigeration.
- 4.10 Explain the method of obtaining vapor absorption refrigeration.
- 4.11 Solve simple problems on refrigeration capacity and COP.
- 4.12 Know about liquefaction
- 4.13 State Various methods of liquefaction
- 4.14 Explain Linde liquefaction process
- 4.15 Explain Claude liquefaction process

### **5.0 Chemical-Reaction Equilibria**

- 5.1 Know the reaction coordinate
- 5.2 Simple problems on reaction coordinate
- 5.3 Application of equilibrium criteria to chemical reactions
- 5.4. Derive the relation between standard Gibbs free energy change( $\Delta G^0$ ) and the equilibrium constant(K).
- 5.5 Derive an expression for the effect of temperature on equilibrium constant.
- 5.6 Explain the Lechatlier's Principle for (a) Haber's process (b)Contact's process.
- 5.7 Solve Simple problems on(a)  $\Delta G^0 = -RT \ln K$  (b)  $\ln(k_1/k_2) = (\Delta H^0/R)(1/T_2 - 1/T_1)$

### **6.0 Introduction to Chemical Reaction Engineering, Kinetics of homogeneous Reactions, Interpretation of Batch reactor data, Single ideal reactors**

- 6.1 Introduction.
- 6.2 Know the importance of reaction kinetics in chemical industries.
- 6.3 To know about classification of reactions.
- 6.4 Define reaction rate and know its units.
- 6.5 Know the variables affecting the rate of reaction.
- 6.6 Define single, multiple, elementary and non-elementary reactions.
- 6.7 To know about molecularity and order of reaction.
- 6.8 Define rate constant **k** and know representation of a rate equation.
- 6.9 Know about temperature – dependent term of a rate equation.
- 6.10 Explain temperature dependency from Arrhenius law.
- 6.11 Know about constant – volume batch reactor.
- 6.12 Know about

- a) Integral method of analysis of data.
- b) Differential method of analysis of data.

6.13 Define the following with examples.

- a) Zero order
- b) First order
- c) Second order .

6.14 Explain broad classification of reactor types.

6.15 Explain ideal batch reactor with diagram and design equation.

6.16 Define space time and space velocity.

6.17 Know the steady state mixed flow reactor with diagram and design equation.

6.18 Explain steady state plug flow reactor with diagram and design equation.

6.19 Simple problems on Batch, CSTR and PFR

## **7.0 Catalysis and Industrial reactors.**

7.1 Understand the catalysis.

7.2 Know the types of catalysis.

7.3 Comprehend the characteristics of a catalytic reactions.

7.4 Define auto catalysis.

7.5 State the function of promoters, accelerators, carriers, inhibitors in catalytic reaction with examples.

7.6 Explain catalyst poisoning.

7.7 List out some important commercially available catalysts.

7.8 Name some industrial catalytic processes.

7.9 Understand the working principle of the following with the help of neat sketches.

- a) Fixed bed reactors
- b) Moving bed reactors
- c) Fluidized bed reactors



## **COURSE CONTENTS:**

### **1. Introduction and First law of thermodynamics.**

The scope of thermodynamics- System, surroundings- Open, closed and isolated systems-Internal energy –enthalpy- Formulation of first law for closed system –First law for Steady state flow process – State functions and path functions- heat capacity and specific heat- applications of heat capacity and specific heat - Equilibrium – Phase rule-Reversible process-Simple problems on fundamentals and first law.

### **2. Volumetric properties of pure fluids.**

PVT behavior of pure substances – Ideal gas —Definition of compressibility factor-cubic equation of state-Vanderwaal's equation, Redlich Kwong equation-derivation of  $C_p - C_v = R$  for a mole of an ideal gas-thermodynamic processes : a) Isochoric b) Isobaric c) Isothermal and d) Adiabatic.- expressions for  $\Delta U$ ,  $\Delta H$ ,  $Q$  and  $W$  for the above processes connecting PVT properties- Problems on calculation of  $\Delta U$ ,  $\Delta H$ ,  $Q$  and  $W$  in the above processes.

### **3. The second law of thermodynamics:**

Statements of second law – The heat engine and heat pump- Carnot principle-thermodynamic temperature scales- Carnot cycle for an ideal gas – Entropy – Entropy changes of an ideal gas – Mathematical statement of the second law – The third law of thermodynamics, Statement -property relations for homogeneous phases-enthalpy, Helmholtz energy, Gibb's energy –fundamental property relations-Maxwell's equations-Simple problems on heat engine and heat pump-Problems on entropy and adiabatic mixing.

### **4. Refrigeration and Liquefaction:**

The Carnot refrigerator – Vapor Compression cycle –Vapor Absorption refrigeration- Comparison of refrigeration cycles – Industrial refrigerants- – Choice of refrigerant – – Heat pump-Liquefaction- Linde liquefaction process- Claude liquefaction process-Simple problems on refrigeration capacity.

### **5. Chemical Reaction Equilibria :**

Reaction coordinate-Application of equilibrium criteria to chemical reactions – The standard Gibbs energy change and the equilibrium constant – Effect of temperature on the equilibrium constant – Lechatlier's principle - Lechatlier's principle for Haber's Process and Contact's process-Evaluation of equilibrium constants and standard Gibb's Free energy

### **6. Introduction to Chemical Reaction Engineering, Kinetics of homogeneous Reactions, Interpretation of Batch reactor data, Single ideal reactors**

Importance of Chemical kinetics – Classification of reactions –Variables affecting the rate of reaction – Reaction rate- Concentration dependent term of a rate equation – Single and multiple reactors, elementary and non elementary reactions – Molecularity and order of a reaction- Rate constant  $K$  -representation of a reaction rate – Temperature dependent term of rate equation-Arrhenius Law-Constant volume batch reactor – Integral method of analysis of data-irreversible unimolecular first order reaction-irreversible bimolecular type second order reactions-empirical rate equation for nth order-over all order of irreversible reactions from the Half life-

differential method of analysis of data. – Broad classification of reactor types – Ideal batch reactor – Space time and space velocity – Steady state mixed flow reactor – Steady stated plug flow reactor – Holding time and space time for flow systems – Problems on various reactors .

**7. Catalysis and Industrial Reactors :**

Types of catalysis – Characteristics of catalytic reactions – Auto catalysis – Accelerators, Promoters, inhibitors, poisons- some important catalysts- industrial catalytic processes-Important industrial reactors

**REFERENCE BOOKS:**

1. Introduction to Chemical Engineering Thermodynamics – by Smith and Vannes, 4<sup>th</sup> Edition.
2. Chemical reaction Engineering – by Octave Levenspiel, 2<sup>nd</sup> edition.
3. Introduction to Chemical Reaction Engineering – by K.A. Gavane, Nirali Publications.
4. Chemical Kinetics – by J.M. Smith.

## INSTRUMENTATION & PROCESS CONTROL

**Subject title : Instrumentation & Process Control**  
**Subject code : CH-703**  
**Periods per week : 05**  
**Periods per semester : 75**

### TIME SCHEDULE

| S.No.        | Major Topics  | Periods | Weightage Of marks | SAQ | EAQ |
|--------------|---|---------|--------------------|-----|-----|
| 1.           | Introduction and Qualities of measurement   | 8       | 13                 | 1   | 1   |
| 2.           | Measurement of Temperature.   | 12      | 23                 | 1   | 2   |
| 3.           | Measurement of pressure and Vacuum:   | 10      | 16                 | 2   | 1   |
| 4.           | Measurement of Liquid level, Density and Viscosity.   | 10      | 13                 | 1   | 1   |
| 5.           | Measurement of composition.   | 10      | 13                 | 1   | 1   |
| 6.           | Process Instrumentation & Instrumentation diagrams for Chemical Engineering processes and operations: | 10      | 16                 | 2   | 1   |
| 7.           | Principles of automatic process control and modes available for process control.                      | 15      | 16                 | 2   | 1   |
| <b>Total</b> |   | 75      | 110                | 10  | 08  |

### OBJECTIVES:

#### Unit-1: Introduction and Qualities of measurement

- 1.5 Know the importance of Instrumentation and process control in Chemical Industries.
- 1.6 Know the meaning of measurement.
- 1.7 Know the differences between direct and in-direct measurement.
- 1.8 Know about different elements of an instrument.
- 1.9 Know about the Static characteristics of an instrument.
- 1.10 Know about the Dynamic characteristics of an instrument.
- 1.11 Know about a First order system and physical examples of first order system.
- 1.12 Know about a Second order system and physical examples of second order system.

- 1.13 Know about various input functions like Step input, Impulse input, Sinusoidal input and Linear input.
- 1.10 Know about the response of a first order system for a given input functions with derivations.
- 1.11 Know about the parameters that characterize a first order system and a second order system.

## **Unit-2 Measurement of Temperature.**

- 2.1 Know about different temperature scales in different units.
- 2.2 Know about Principle, construction and working of expansion thermometers.
- 2.3 Know about Vapor actuated thermometer.
- 2.4 Know about the sources of static error in industrial pressure spring thermometers.  
Know about thermo-electricity and thermo-electric circuit or Thermocouple.
- 2.5 Know about Seebeck effect, Peltier effect and Thomson effect.
- 2.6 Know the types of industrial thermocouples.
- 2.7 Know about the accessories of an industrial thermocouple.
- 2.8 Know the mechanical properties of thermal well materials.
- 2.9 Know the effect of location of reference junction and lead wires for a thermocouple.
- 2.10 Know about the principle, construction, working of Milli-voltmeter and its application.
- 2.11 Know about the principle, construction, working of Null Potentiometer circuit and its and its application.
- 2.12 Know about temperature coefficient of resistance.
- 2.13 Know about industrial resistance thermometer bulbs.
- 2.14 Know about resistance thermometer elements.
- 2.15 Know about thermal wells and lead wires for resistance thermometers.
- 2.16 Know the indicating elements of industrial resistance thermometers like Wheat stone bridge circuit and Modified wheat stone bridge circuit also known as "Callender Griffith circuit".
- 2.17 Know about radiation temperature measurement.
- 2.18 Know about radiation receiving elements.
- 2.19 Know the types of radiation pyrometers.
- 2.20 Know about Optical pyrometer and its principle, construction and working.

## **Unit-3: Measurement of pressure and Vacuum:**

- 3.1 Know the basic concepts of pressure measurement.
- 3.2 Know different types of pressures.
- 3.3 Know about different types of liquid column manometers, their principle construction and working.
- 3.4 Know different types of pressure measuring elements.
- 3.5 Know the mechanical indicating elements.
- 3.6 Know about inductance coil method of an indicating element.
- 3.7 Know about resistance rod indicating element.
- 3.8 Know about electric pressure gauge of indicating element.
- 3.9 Know about different types of vacuum gauges.

#### **Unit-4: Measurement of Liquid level, Density and Viscosity.**

- 4.1 Know the principle construction and working of liquid level method of measuring density.
- 4.2 Know the direct methods of liquid level measurement.
- 4.3 Know the principle construction and working of bubbler system for measurement of liquid level.
- 4.4 Know the level measurement in pressure vessels.
- 4.5 Know about principle construction and working of displacement float liquid level system.
- 4.6 Know about principle construction and working of pneumatic balance displacement float liquid level system.
- 4.7 Know the basic concepts for measuring density.
- 4.8 Know the principle construction and working of displacement-meter for measuring density by republic flow-meter Company.
- 4.9 Know the principle construction and working of hydrometer for density measurement.
- 4.10 Know the basic concept of viscosity measurement.
- 4.11 Know the principle construction and working of viscosity measurement by Viscosity meter-Brabender Corporation.
- 4.12 Know the principle construction and working of viscosity measurement by Continuous Viscosity meter.

#### **Unit-5: Measurement of composition.**

- 5.1 Know the determination of gas analysis by thermal conductivity method.
- 5.2 Know the determination of moisture content in gases by Psychrometer.
- 5.3 Know the determination of moisture in Paper and Lumber.
- 5.4 Know the determination of PH of a solution by PH cell (Measuring cell & Calomel cell) method.
- 5.5 Know about Spectroscopic methods of analysis
- 5.6 Know about the working principle of spectro photo meter
- 5.7 Know about the working principle of gas liquid chromatography

#### **Unit-6: Process Instrumentation & Instrumentation diagrams for Chemical Engineering processes and operations:**

- 6.1 Know about recording instruments used for process instrumentation.
- 6.2 Know about indicating and signaling instruments.
- 6.3 Know about control center.
- 6.4 Know about signal conversion devices.
- 6.5 Know about the instrumentation diagrams.
- 6.6 Know about the instrumentation diagram for a distillation column.
- 6.7 Know about the instrumentation diagram for an evaporator.
- 6.8 Know about the instrumentation diagram for a reactor.
- 6.9 Know about the instrumentation diagram for extractor

#### **Unit-7: Principles of automatic process control and modes available for process control.**

- 7.1 Know about a simple automatic process control.
- 7.2 Know about components of a control system.
- 7.3 Know about types of control systems.
- 7.4 Know the basic nomenclature associated with a control system.
- 7.5 Know about control actions.

- 7.6 Know the expressions for the transfer function for the proportional control, Proportional-Derivative, Proportional-Integral, Proportional-Integral-Derivative control actions.
- 7.7 Know about the components of a hydraulic system.
- 7.8 Know about the construction, working of a hydraulic system incorporated with Proportional, Proportional-Integral, Proportional-Derivative and Proportional-Integral-Derivative control action.
- 7.9 Know about the components of a pneumatic system.
- 7.10 Know about the construction, working of a Pneumatic system incorporated with Proportional, Proportional-Integral, Proportional-Derivative and Proportional-Integral-Derivative control action.
- 7.11 Know about Control valve, its components, working and characteristics.
- 7.12 Elaborate explanation of programmable logic control and Distributive control system.

## **COURSE CONTENT:**

### **Unit-1: Introduction and Qualities of measurement**

Importance of instrumentation --Meaning of measurement - Different elements of an instrument - Static characteristics of an instrument - Dynamic characteristics of an instrument - First order system and physical examples - Second order system and physical examples of second order system -Various input functions like Step input, Impulse input, Sinusoidal input and Linear input

### **Unit-2: Measurement of Temperature.**

Different temperature scales in different units—Principle, working and working of expansion thermometers like Mercury in glass thermometer, Bi-metallic thermometer and Pressure spring thermometer - Vapor actuated thermometer--Sources of static error in industrial pressure spring thermometers - Thermo-electricity and thermo-electric circuit or Thermocouple - Accessories of an industrial thermocouple - Milli-voltmeter and its application - Null Potentiometer circuit and its and its application - Resistance thermometer elements - Wheat stone bridge circuit and Modified wheat stone bridge circuit -Radiation temperature measurement - Radiation receiving elements - construction and working - Optical pyrometer and Radiation pyrometer.

### **Unit-3: Measurement of pressure and Vacuum:**

Basic concepts of pressure measurement - liquid column manometers - pressure spring gauge, Bellow pressure element, Diaphragm element, Differential pressure indicating manometer, Bell differential pressure gauge--Mechanical indicating elements, Principle, working and construction of Pressure tight shaft and torque tube shaft--Principle, construction and working of inductance coil method of an indicating element--Principle, construction and working of resistance rod indicating element--Principle construction and working of electric pressure gauge of indicating element--Principle construction and working of different types of vacuum gauges like Mc-leod vacuum gauge, Pirani vacuum gauge, Thermocouple vacuum gauge, Thermionic type ionization vacuum gauge.

### **Unit-4: Measurement of Liquid level, Density and Viscosity:**

Basic concepts for measuring density--Principle construction and working of displacement-meter for measuring density by republic flow-meter Company--Principle construction and working of hydrometer for density measurement--Principle construction and working of liquid level method of measuring density--Direct methods of liquid level measurement, Float and tape liquid level system, Hydraulic remote transmission of liquid level system--Principle construction and working of bubbler system for measurement of liquid level--Level measurement in pressure vessels, Principle construction and working of differential pressure manometer for measuring liquid level in pressure vessels-- Principle construction and working of displacement float liquid level system--Principle construction and working of pneumatic balance displacement float liquid level system--Basic concepts of viscosity measurement--Principle construction and working of viscosity measurement by Viscosity meter-Brabender Corporation--Principle construction and working of viscosity measurement by Continuous Viscosity meter.

**Unit-5: Measurement of composition:**

Gas analysis by thermal conductivity method--Determination of moisture content in gases by Psychrometer--Determination of moisture in Paper and Lumber--Determination of  $P^H$  of a solution by  $P^H$  cell (Measuring cell & Calomel cell) method--Spectroscopic analysis methods, Absorption spectroscopy, Emission spectroscopy, Mass spectroscopy, working principle of spectro photo meter, working principle of gas liquid chromatography

**Unit-6: Process Instrumentation & Instrumentation diagrams for Chemical Engineering processes and operations:**

Recording instruments used for process instrumentation, Circular recording chart and concentric indicating scale, Strip recording chart and linear indicating scale, Multi-record recorder-- Indicating and signaling instruments, Eccentric scale indicator, Concentric indicating scale--Control center--Signal conversion devices, Transducer, Amplifier--Instrumentation diagrams--Instrumentation diagram of Control schemes for heat exchangers--Instrumentation diagram for a distillation column--Instrumentation diagram for an evaporator--Instrumentation diagram for a reactor, Instrumentation diagram for extractor.

**Unit-7: Principles of automatic process control and modes available for process control.**

Simple automatic process control system--Components of a control system, Process, measuring element, Controller, Comparator, Final control element, Types of control systems, Feedback control system or closed loop control system - Feed forward control system (Open loop control system)--Basic nomenclature associated with a control system, Load, Controlled variable, set point, error, measured variable, manipulated variable, Proportional gain, Proportional band, Offset--Control actions, Proportional control action, Integral control action, Derivative control action, Proportional-Integral control action, Proportional-Derivative control action, ON-OFF Control action, Proportional-Integral-Derivative control action--Expressions for the transfer function for the proportional control, Proportional-Derivative, Proportional-Integral, Proportional-Integral-Derivative control actions-- Know about the components of a hydraulic system--Construction, working of a hydraulic system incorporated with Proportional, Proportional-Integral, Proportional-Derivative and Proportional-Integral-Derivative control action--Components of a pneumatic system, Construction, working of a Pneumatic system incorporated with Proportional, Proportional-Integral, Proportional-Derivative and Proportional-Integral-Derivative control action--Control valve, its components, working and characteristics—Elaborate explanation of programmable logic control and Distributive control system.

**REFERENCE BOOKS:**

1. Industrial Instrumentation by Donald P. Eckmann
2. Industrial Instrumentation & Control by S K Singh.
3. Process systems analysis & Control by Donald R. Coughanowr.
4. Chemical Process Control by George Stephanopoulos.
5. Process Control by Peter Harriot.
6. Instrumentation & Process Measurements by W Bolton.



## ENVIRONMENTAL STUDIES AND POLLUTION CONTROL ENGINEERING

**Subject Title** : Environmental Studies and pollution control Engineering.  
**Subject Code** : CH – 704  
**Periods / Week** : 04  
**Periods / Semester** : 60

### TIME SCHEDULE

| Sl. No. | Major Topics                                     | No. of periods | Weightage Of Marks | Short answer type | Essay type |
|---------|--|----------------|--------------------|-------------------|------------|
| 01.     | Environmental Studies& Introduction to pollution | 16             | 24                 | 3                 | 1½         |
| 02.     | Water pollution                                  | 10             | 21                 | 2                 | 1½         |
| 03.     | Air pollution                                    | 10             | 18                 | 1                 | 1½         |
| 04.     | Solid waste management                           | 08             | 16                 | 2                 | 1          |
| 05.     | Pollution control in process industries          | 10             | 18                 | 1                 | 1½         |
| 06.     | Legal aspects of pollution                       | 06             | 13                 | 1                 | 1          |
|         | Total  | 60             | 110                | 10                | 08         |

### OBJECTIVES

On completion of the course the student will be able to

#### 1.0 Environmental studies and Introduction to Pollution

- 1.1 Define terms environment and environmental studies.
- 1.2 Explain the scope and importance of environmental studies.
- 1.3 Know the segments of environment– lithosphere, hydrosphere, atmosphere, biosphere, biotic component and energy component,
- 1.4 Understand the terms- pollutant, pollution, contaminant, receptor, sink, particulates, dissolved oxygen, Threshold limit value.
- 1.5 Know the impact of human being on environment.
- 1.6 Know the effect of environment on human being.
- 1.7 Classify the different types of pollution.
- 1.8 Understand the types of pollutants and their effects

- 1.9 Explain the use and over exploitation of forest resources and deforestation.
- 1.10 Explain the green house effect- ozone layer depletion and acid rain
- 1.11 Know the importance of land resources, land degradation, soil erosion and desertification.
- 1.12 Define an ecosystem.
- 1.13 Define producers, consumers and decomposers with examples.
- 1.14 Define biodiversity.
- 1.15 Understand the values of biodiversity.
- 1.16 Know the threats to biodiversity.
- 1.17 Explain conservation of biodiversity.
- 1.18 Explain water conservation, rain water harvesting and watershed management.
- 1.19 Explain the pollution case studies and natural disasters.
- 1.20 Know about HIV / AIDS

## **2.0 Water pollution**

- 2.1 Define water pollution.
- 2.2 Know the origin of waste water.
- 2.3 List and classify various pollutants in industrial waste waters.
- 2.4 Know the characteristics of waste water like oxygen demanding wastes, disease causing agents , synthetic organic compounds.
- 2.5 Define BOD and COD and understand in detail their significance.
- 2.6 Describe the methods of treatment of waste water
- 2.7 Describe the methods of primary treatment of waste water
- 2.8 Describe secondary treatment methods
  - (a). Activated Sludge process
  - (b). Trickling Filter (c). Lagoons
- 2.9 Describe Tertiary treatment/ Advanced treatment methods.
- 2.10 Describe the methods of disposal of sludge

## **3.0 Understand air pollution**

- 3.1 Define and understand air pollution.
- 3.2 Know the classification of air pollutants and properties of air pollutants.
- 3.3 Know the sources of air pollutants and their effects.
- 3.4 Understand the air pollution control methods.
- 3.5 Describe particulate emission control – Gravity settling chamber, cyclone separator, fabric filter, electrostatic precipitator & wet scrubber
- 3.6 Describe the gaseous emission control-Absorption by liquids, absorption by solids, cleaning of gaseous effluents.

## **4.0 Know the solid waste management**

- 4.1 Define solid waste and know the classification.
- 4.2 Know the sources of solid wastes and the characteristics of solid wastes.
- 4.3 Know the effect of solid waste on public health.
- 4.4 Explain the methods of collection of solid waste
- 4.5 Know about Transfer station
- 4.6 Know the potential methods of disposal of solid waste-a) Open dumping b)Sanitary Land filling c) Land composting d) Incineration e) pyrolysis)
- 4.1 Know about Hazardous Waste management

4.8 Know about recycling and reuse.

### **5.0 Pollution control in process industries**

- 5.1 Know the characteristics of wastes from pulp and paper industries.
- 5.2 Know the treatment methods of wastes from pulp and paper industries.
- 5.3 Know the characteristics of wastes from fertilizer industries.
- 5.4 Know the treatment methods of wastes from fertilizer industries.
- 5.5 Know the characteristics of wastes from petroleum refinery industries.
- 5.6 Know the treatment methods of wastes from petroleum industries.
- 5.7 Know the characteristics of wastes from sugar industries
- 5.8 Know the treatment methods of wastes from sugar industries.

### **6.0 Legal aspects of pollution**

- 6.1 Know the various legal aspects involved in pollution control.
- 6.2 Know the salient features of air act.
- 6.3 Know the salient features of water act.
- 6.4 Know the salient features of environmental protection act.
- 6.5 Understand the functions of State pollution control board
- 6.6 Understand the functions of Central pollution control board.

## **COURSE CONTENTS:**

### **1.0 Environmental studies**

Environment and environmental studies - scope and importance of environmental studies - segments of environment– energy component - pollutant, pollution, contaminant, receptor, sink, particulates, dissolved oxygen, Threshold limit value – Environmental pollution - types of pollution - types of pollutants and their effect - deforestation - green house effect- ozone layer depletion - acid rain - land resources, land degradation, soil erosion – desertification – ecosystem - producers, consumers, decomposers – biodiversity - values of biodiversity - threats to biodiversity - conservation of biodiversity - water conservation, rain water harvesting and watershed management - pollution case studies and natural disasters - HIV/ AIDS

### **2.0 Introduction to pollution and Water pollution**

water pollution - origin of waste water - industrial waste waters - characteristics of waste water - BOD and COD - primary treatment, secondary treatment- Activated sludge process,Trickling filter,Lagoons and tertiary treatment - - disposal of sludge.

### **3.0 Air pollution**

Air pollution - classification – properties - sources of air pollutants and their effects - air pollution control methods - particulate emission control –Gravity settling chamber, cyclone separator, and fabric filter electrostatic precipitator wet scrubber - gaseous emission control-Absorption by liquids, absorption by solids, cleaning of gaseous effluents.

#### **4.0 Solid waste management**

Solid waste - classification – sources - characteristics - effect on public health - collection of solid waste, Transfer station, Disposal methods – Open dumping, Land composting, sanitary land filling , incineration and pyrolysis – Hazardous waste management- recycling and reuse.

#### **5.0 Pollution control in process industries**

Characteristics of wastes from pulp and paper, fertilizer, petroleum refinery, sugar industries - treatment methods of wastes from pulp and paper , fertilizer, petroleum refinery, sugar industries.

#### **6.0 Legal aspects of pollution**

Legal aspects- air act. - water act - environmental protection act - functions of state pollution control board, central pollution control board.

#### **REFERENCE BOOKS:**

1. Environmental pollution control engineering by C.S.Rao, Wiley eastern Ltd., New age international Ltd.
2. Pollution control in process industries by S P Mahajan, T.M.H Publications.
3. Environmental chemistry & pollution control by S.S.Dhara, S.Chand. Company Ltd.
4. Environmental Engineering by G.N.Pandey, G.C.Carney: T.M.H Publishers.

## ENERGY TECHNOLOGY

**Subject Title** : ENERGY TECHNOLOGY  
**Subject Code** : CH – 705  
**Periods/week** : 05  
**Periods/ Semester** : 75

### TIME SCHEDULE

| S.No.        | Major topics                                   | No. of Periods | Weightage of Marks | Short answer type | Essay type |
|--------------|--|----------------|--------------------|-------------------|------------|
| 1.           | Introduction to energy Sources and Solid fuels | 14             | 13                 | 1                 | 1          |
| 2.           | Liquid & Gaseous fuels                         | 18             | 26                 | 2                 | 2          |
| 3.           | Combustion Principles, furnaces & Refractories | 19             | 29                 | 3                 | 2          |
| 4.           | Non Conventional energy sources                | 16             | 26                 | 2                 | 2          |
| 5.           | Energy conservation                            | 08             | 16                 | 2                 | 1          |
| <b>Total</b> |  | <b>75</b>      | <b>110</b>         | <b>10</b>         | <b>08</b>  |

### OBJECTIVES:

On completion of the course the student will be able to

#### **1.0 Introduction to Energy Sources and Solid fuels**

- 1.1 Classification of energy sources with examples
- 1.2 Conventional energy sources viz solid, liquid & gaseous fuels
- 1.3 Information of coal and constituents of coal
- 1.4 Manufacture of coke by High Temperature carbonization of coal includes by-products recovery.
- 1.5 Know the selection of coal for different applications
- 1.6 Know the Classification of chemical Energy systems
- 1.7 Understand Rank of coal and Classification of coal by rank.
- 1.8 Understand proximate analysis of coal
- 1.9 Understand Ultimate analysis of coal.

#### **2.0 Liquid and gaseous fuels.**

- 2.1 Know about Occurrence of crude petroleum and exploration of crude petroleum.
- 2.2 Understand Crude petroleum refinery operations-CDU.
- 2.3 Know Conversion process like cracking, reforming.
- 2.4 Know about Fluid Catalytic Cracking
- 2.5. Understand Catalytic reforming
- 2.6 Explain Analysis of liquid fuels to determine Flash point, fire point by Abel's apparatus, Pensky-Martin apparatus
- 2.7 Know about Octane number, Diesel index, Cetane number and Knocking Tendency.
- 2.8 Know the procedure of determination of the viscosity of an oil using Redwood viscometer.

- 2.9 Classification of gaseous fuels-  
(a). Natural Gas (b). Coke Oven Gas (c) BF Gas (d).Water Gas  
(e). Producer Gas (f). LPG

**3.0 Combustion Principles, furnaces and Refractories.**

- 3.1 Combustion Principles of solid fuels.  
3.2 Determination of calorific value of solid fuel (coal) by Bomb calorimeter.  
3.3 Function of stoker and comparison between hand firing & mechanical firing devices.  
3.4 Know the firing of liquid and gaseous fuels.  
3.6 Know the classification of furnaces on various factors  
3.7 Know the general features of the furnace.  
3.8 Know the furnace used in cement manufacture  
3.9 Know the factors for fuel economy of a furnace  
3.10 Know the classification of Refractories  
3.11 Know the Properties of refractories  
3.12 Know the Causes for failure of refractories  
3.13 Know Applications of refractories  
3.14 Explain Manufacture of fire clay and silica refractories.

**4.0 Non conventional energy sources**

- 4.1 Know the nuclear energy  
4.2 Know the nuclear raw materials  
4.3 Know the fission – fusion  
4.4 Know the classification of nuclear reactors  
4.5 Know the manufacture of heavy water (D<sub>2</sub>O)  
4.6 Know the solar energy  
4.7 Know the wind energy and applications  
4.8 Know the Bio energy and applications  
4.9 Know the geothermal energy  
4.10 Know the Hydal – Tidal – ocean wave energy

**5.0 Energy conservation**

- 5.1 Know the importance of energy conservation  
5.2 Know the factors affecting fuel economy in furnace  
5.3 Know the energy conservation with reference to thermal insulation  
5.4 Know the energy conservation in iron and steel plants

## **COURSE CONTENT:**

**1.0 Introduction to Energy sources and solid fuels:** Classification of energy sources conventional energy – Non conventional energy. Coal – origin – constituents of coal- Low and high temperature carbonization (LTC and HTC)- manufacture of coke & Byproducts recovery – Coal classification by Rank – Ultimate and proximate analysis- Applications of coal for different uses.

**2.0 Liquid and Gaseous Fuels:** Crude Petroleum - Refining operations – CDU, FCC, Catalytic Reforming – Abel's apparatus, Octane number, Diesel index, Cetane number, Knocking tendency- Viscosity using red wood viscometer-Classification of gaseous fuels.

### **3.0 Combustion Principles, Furnaces and Refractories:**

**Combustion Principles of Fuels:** Solid fuels calorific value by bomb calorimeter, solid fuel firing by stokers. Liquid and gaseous fuel firing by burners.

**Furnaces:** Classification on various factors – General Features of a furnace – Furnaces used in in cement Industry – Fuel economy of furnace.

**Refractories:** Classification of refractories – properties of refractory – manufacture of refractory – Fire clay/silica - causes for failure of refractory – applications of refractories.

**4.0 Non conventional energy sources:** Nuclear energy – nuclear fuels – fission fusion – Classification of Nuclear Reactors - Heavy water (D<sub>2</sub>O).

Solar Energy - Wind energy - Bio Energy –Geothermal - Hydal, Tidal, ocean- wave energy Applications

**5.0 Energy Conservation:** Importance - Factors effecting fuel Economy in furnace, Energy conservation with reference to thermal insulation - Energy conservation in selected Industries like iron and steel industries.

## **REFERENCE BOOKS:**

1. Elements of fuels furnaces & Refractories – O.P.Gupta, Khanna Publishers, New Delhi.
2. Fuel Combustion and Energy Technology, S.N.Saha, Dhanpatrai Publishing Co., New Delhi.
3. Dryden's Outlines of Chemical Technology, 3<sup>rd</sup> edition, M.Gopal Rao, Marshall Sittig, East West Press Pvt. Ltd., New Delhi

4. Shreeves -Chemical process Industries,5<sup>th</sup> Edition, Geoge T Austin, Mc.Graw-Hill.

### CHEMICAL PLANT EQUIPMENT DRAWING

**Subject Title** : **Chemical plant equipment drawing**  
**Subject Code** : **CH – 706**  
**Periods / Week** : **06**  
**Periods / Semester** : **90**

### TIME SCHEDULE

| Sl. No. | Major Topics  | No. of Periods | Weightage of Marks | Short answer type | Essay type |
|---------|---|----------------|--------------------|-------------------|------------|
| 01.     | Drawing of Chemical equipments                                  | 30             | 20                 | -                 | 1          |
| 02.     | Process flow diagrams using process description.(Flow sheeting) | 20             | 20                 | -                 | 1          |
| 03.     | Process instrumentation diagrams of equipments                  | 20             | 20                 | -                 | 1          |
| 04.     | Process equipment layouts                                       | 12             | 12                 | 3                 | -          |
| 05.     | Plant layouts and location identification                       | 08             | 08                 | 2                 | -          |
|         | Total   | 90             | 80                 | 05                | 03         |

**QP Pattern: Part-A** 5 X 4 Marks = 20 Marks (Answer All Five Questions)

**Part-B** 2 X 20 Marks = 40 Marks (Answer any Two from Three)

### OBJECTIVES:

On completion of the course the student may be able to

#### **1.0 Know the drawings of various Chemical equipment**

- 1.1 Draw a neat sketch of Shell & tube heat exchanger (1-1)
- 1.2 Draw a neat sketch of 2-4 Shell & tube heat exchanger
- 1.3 Draw a neat sketch of Short tube vertical evaporator
- 1.4 Draw a neat sketch of Long tube forced circulation evaporator
- 1.5 Draw a neat sketch of Rotary drum vacuum filter
- 1.6 Draw a neat sketch of Bubble cap plate
- 1.7 Draw the neat sketch of Jaw crusher
- 1.8 Draw a neat sketch of Plate & Frame filter press
- 1.9 Draw a neat sketch of Basket centrifuge
- 1.10 Draw a neat sketch of Rotary drum driers
- 1.11 Draw a neat sketch of Crystallizer



**2.0 Understand the drawing of process block diagrams/utility diagrams/flow diagrams using process description**

- 2.1 Draw the sketch for the production of glacial acetic acid using acetaldehyde
- 2.2 Draw the sketch for the production of para-nitroaniline from Para -nitrochlorobenzene
- 2.3 Draw the sketch for the production of acetone from Iso-propanol
- 2.4 Draw the sketch for the production of Diethyl oxalate from oxalic acid and ethanol
- 2.5 Draw the sketch for the conversion of ethanol to alcohol by azeotropic distillation
- 2.6 Draw the sketch for the manufacture of any fertilizer /any petrochemical product.

**3.0 Understand the process instrumentation diagram of the equipments**

- 3.1 Draw the Instrumentation diagram for Reactor temperature control
- 3.2 Draw the Instrumentation diagram for Hot fluid temperature control in heat exchanger
- 3.3 Draw the Instrumentation diagram for Spray drier temperature control
- 3.4 Draw the Instrumentation diagram for Vaporizer temperature control
- 3.5 Draw the Instrumentation diagram for Forced circulation evaporator control with Vertical heat exchanger
- 3.6 Draw the Instrumentation diagram for Control of mechanically agitated vessel used for gas absorption
- 3.7 Draw the Instrumentation diagram for Distillation column tower pressure control
- 3.8 Draw the Instrumentation diagram for Distillation column level control and condenser reflux control with pump reflux.
- 3.9 Draw the Instrumentation diagram for Steam flow rate and level control of re- boiler
- 3.10 Draw the Instrumentation diagram for Cooler temperature control.

**4.0 Know the process equipment layout**

- 4.1 Understand the important Equipment layout in Ammonia plant
- 4.2 Understand the important Equipment layout in water treatment plant
- 4.3 Understand the important Equipment layout in sugar manufacturing unit
- 4.4 Understand the important Equipment layout in paper industry
- 4.5 Understand the important Equipment layout in cement plant

**5.0 Know the sketching of project layout and identification of location for the proposed plant and various factors to be considered.**

- 5.1 Know the diagram of project layout for phosphoric acid, urea plant in fertilizer Industry
- 5.2 Know the diagram of project layout consisting various units like Ammonia phosphoric acid, utilities of DAP plant
- 5.3 Know the diagram of a project layout consisting various units of pulp and paper Industry
- 5.4 Know the diagram of project layout of petroleum refinery consisting various units like CDU, FCCU, utilities etc.
- 5.5 Understand the diagrams of a project layout of vegetable oil industry including Glycerin, vanaspathi, soap etc.

## **COURSE CONTENTS:**

### **Unit-1: Drawings of Chemical Engineering equipment**

Draw the neat sketches of Shell & tube heat exchanger (1-1)- 2-4 Shell & tube heat exchanger - Short tube vertical evaporator - Long tube forced circulation evaporator - Rotary drum vacuum filter - Bubble cap plate - Jaw crusher- Plate & Frame filter press- Basket centrifuge- Rotary drum driers- Crystallizer.

### **Unit-2: Process flow diagrams using process description (Flow sheeting)**

Production of glacial acetic acid using acetaldehyde solution- Para-nitro aniline from Para-nitrochlorobenzene.- acetylene from Isopropanol- Diethyl oxalate from oxalic acid and ethanol - Conversion of ethanol to alcohol by Azeotropic distillation – fertilizer / a petrochemical product.

### **Unit-3: Process instrumentation diagrams of equipments**

Reactor temperature control- Hot fluid temperature control in heat exchanger - Spray drier temperature control-Vaporizer temperature control-Forced circulation evaporator control with vertical heat exchanger-Control of mechanically agitated vessel used for gas absorption-Distillation column tower pressure control-Distillation column control of level and reflux condenser with pumped reflux column-Steam flow rate and level control of re-boiler-Cooler temperature control.

### **Unit-4: Process equipment layout**

Equipment layout in Ammonia plant - water treatment plant - sugar manufacturing unit- paper industry - cement plant

### **Unit-5: Plant layouts and location identification**

Plant layout for phosphoric acid - urea plant in fertilizer industry - D.A.P plant- pulp and paper industry - petroleum refinery - Vegetable oil industry for vanaspathi.

## **REFERENCE BOOKS:**

1. Chemical Engineering drawing by KA Ghavane, Nirali publications
2. Chemical Engineering drawing by R.S.Hiremath. Nirali Publications.
3. Introduction to Chemical Engineering by Badger & Bencherio, Mc Graw Hill Publications
4. Unit operation of Chemical Engineering by Mc Cabe and smith –Mc Graw Hill publications
5. Plant design drawing by vibrant & Dryden, Mc Graw Hill publications

## **INSTRUMENTATION PROCESS CONTROL LAB**

**Subject Title** : **Instrumentation Process Control Lab**  
**Subject Code** : **CH-707**  
**Periods/week** : **03**  
**Periods/Semester** : **45**

### **OBJECTIVES:**

On completion of the practicals the student will be able to:

1. Perform the experiment to calibrate the following thermocouples.  
(a). Iron- constantan (b). Copper- constanton (c). Chromel- Alumel
2. Measure the temperature using resistance thermometer.
3. Calibrate an unknown pressure gauge using dead weight piston gauge.
4. Determine the time constant and response in two tank interacting system by conducting experiment.
5. Determine time constant and response in two tank non-interacting system by performing experiment.
6. Determine the time constant and response in single tank system by conducting experiment.
7. Perform an experiment to study the Control valve characteristics.
8. Perform an experiment to study the response. of “on-off” control system.

### **COURSE CONTENTS:**

1. Thermocouple calibration.
2. Resistance thermometer.
3. Pressure gauge calibration.
4. Two tank interacting system.
5. Two tank non-interacting system.
6. Single tank system.
7. Control Valve characteristics.
8. On-off control system.

## **ENERGY TECHNOLOGY AND REACTION ENGINEERING LAB**

**Subject Title** : Energy Technology and Reaction Engineering Lab  
**Subject Code** : CH-708  
**Periods per week** : 06  
**Periods / Semester** : 90

### **List of Experiments:**

1. Determine the moisture content, Volatile matter in a given a sample of Coal.
2. Determine the fixed carbon and ash content given sample of coal.
3. Determine the carbon and Hydrogen in coal by ultimate analysis.
4. Determine the Calorific value of solid fuel by using Bomb calorimeter.
5. Determine the flash and fire point of a given sample of oil using Abel's closed cup apparatus.
6. Determine the flash and fire point of a given sample of oil using Pensky marten's apparatus.
7. Determine the viscosity of a lubricating oil by Red wood viscometer-I.
8. Determine the viscosity of lubricating oil by Red wood viscometer-II.
9. Determine the CO, CO<sub>2</sub> and O<sub>2</sub> content present in the flue gas using Orsat apparatus.
10. Determine the smoke point of Kerosene.
11. Perform an experiment to calculate the volume required for constant volume batch reactor.
12. Perform an experiment to calculate the volume required for constant volume steady state mixed flow reactor.
13. Perform an experiment to calculate the volume required for constant volume steady state plug flow reactor.

## **PROJECT WORK**

|                           |          |                     |
|---------------------------|----------|---------------------|
| <b>Subject Title</b>      | <b>:</b> | <b>Project Work</b> |
| <b>Subject Code</b>       | <b>:</b> | <b>CH – 709</b>     |
| <b>Periods / Week</b>     | <b>:</b> | <b>03</b>           |
| <b>Periods / Semester</b> | <b>:</b> | <b>45</b>           |

### **A list of topics suggested for project work**

1. Basic design and cost estimating of the following equipment based on the problems suggested by teachers on topics;
  - a) Heat exchangers and condensers
  - b) Distillation units
  - c) Pumping installation
  - d) Absorption system
  - e) Extraction system
  - f) Water purification system
  - g) Crystallizer unit
  - h) Evaporator system
  - i) Dryers
2. Prepare a process report on industrially important chemicals.
3. Design and fabricate small prototype chemical engineering equipments useful for doing experiments in the laboratory.
4. To conduct a survey of a chemical industry and produce a report on
  - a) Various safety methods being followed
  - b) Various pollution control methods being carried out.
  - c) Production, planning and control systems
  - d) Process instrumentation of the plant
  - e) Maintenance schedule of chemical engineering equipment
  - f) Material transportation and storage of chemicals
5. To understand safety procedures in chemical Industries
6. To know the softwares connected with Chemical Engineering and prepare a project by using MATLAB, ASPEN PLUS, HYSIS, COMSOL etc

**Note :-The project as suggested by industry or any allied institution**