

CURRICULUM - 2023

C -23

DIPLOMA IN CHEMICAL ENGINEERING (PETRO CHEMICALS)



**STATE BOARD OF TECHNICAL EDUCATION & TRAINING
ANDHRA PRADESH**

**DIPLOMA IN CHEMICAL ENGINEERING(PETROCHEMICALS)
CURRICULUM- 2023 (C-23)**

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PREAMBLE

Technical Education is a key driver of economic development and plays a crucial role in providing individuals with the skills and knowledge necessary to thrive in the workplace. As technological advancements continue to reshape industries and create new opportunities, it is critical that technical education curricula remain relevant and up-to-date.

The curriculum has been designed with this in mind, with a focus on practical skills, critical thinking, and problem-solving. We believe that these skills are essential for success in both academic and professional spheres. The revamping of the technical education curriculum is made with collaborative effort from educators, industry experts, policymakers, and students.

At the heart of the curriculum, is the belief that the technical education should be **student-centered**, empowering learners to take ownership of their learning and pursue their passions. We aim to create a learning environment that is safe, supportive, and nurturing, where every student has the opportunity to reach their fullest potential. We acknowledge that learning is a lifelong journey, and our curriculum is designed to provide a solid foundation for continued growth and development. We hope that our students will not only leave with a diploma but with employability and passion for learning.

The State Board of Technical Education and Training, (SBTET) AP, has been offering Diploma programmes to meet the above said aspirations of the stake holders: industries, students, academia, parents and the society at large. **The Curriculum should be flexible, adaptable, and responsive to the changing needs of the industry and society.** As such, it has been the practice of SBTET, A.P., to keep the curriculum abreast with the advances in technology through systematic and scientific analysis of current curriculum and bring out an updated revised version at regular intervals.

The design of Curriculum C-23 was started in the month of January - 2023. Feedback was collected from all stake holders: Students, Lecturers, Senior Lecturers, Head of Sections and Principals for all programmes for this purpose. Accordingly, a workshop was convened on 15th February 2023 by Smt. C. Naga Rani, I.A.S, Director of Technical Education & Chairperson, SBTET, AP to discuss on revamping of C-20 curriculum to meet the needs of industries and for improvement of placements.

The meeting was attended by Sri. Saurab Gaur, I.A.S, Principal Secretary, Skill Development & Training, Smt. Lavanya Veni, I.A.S, Director, Employment & Training. Thirteen Representatives from Industries and Fourteen Academicians from Higher Level Institutions and officials of ITI, Skill Development, CTE&SBTET attended the workshop.

Smt. C Naga Rani, I.A.S., Commissioner of Technical Education while addressing in the workshop, emphasized the necessity of industrial training and on-hand experience, that the students need to undergo to support the industries and the Gaps in the Curriculum need to be fixed to make the students passionate to work in the industry in order to support economy of the country.

The committees of each branch consisting of experts from Industries, Higher Level Institutions and Faculty of Polytechnics are informed to study the possibility of incorporating the following aspects while preparation of the curriculum so as to improve employability.

- **To bring out industry oriented Diploma Engineers.**
- **Internet of Things (IoT) for all branches**
- **Theoretical & Practical subjects 50: 50 Ratio**
- **Industry 4.0 concepts.**
- **5G Technology.**
- **Critical Thinking (Quantitative Aptitude, Data Interpretation, Quantitative reasoning etc) to face the written tests conducted by the industries during placements.**
- **Dynamic, Student centric to suit the needs of the industry.**

In continuation, series of workshops with subject experts followed in the subsequent weeks for thorough perusal for preparation of draft curriculum. Also, the suggestions received from representatives from various industries, academic experts from higher level institutions, subject experts from Polytechnics, have been recorded, validated for incorporation into the **Curriculum C-23**. Finally, the draft curriculum was sent to academicians of higher-level institutions, industrial experts for Vetting.

The design of new Curricula C-23 for different diploma programmes has thus been finalised with the active participation of the members of the faculty teaching in the Polytechnics of Andhra Pradesh, and duly reviewed by Expert Committee constituted of academicians and representatives from industries. Thus, the primary objective of the curriculum change is to produce employable diploma holders in the country by correlating the growing needs of the industries with relevant academic input.

The outcome-based approach as given by NBA guidelines has been followed throughout the design of this curriculum and designed to meet the requirements of NBA Accreditation, too.

The Revised Curriculum i.e., Curriculum-2023 (C-23) is approved by 45th Academic Committee of SBTET, A.P for its implementation with effect from Academic Year 2023-24. Also, the SBTET, A.P under the aegis of the Department of Technical Education, Andhra Pradesh in it's 62nd Board Meeting held on 13-07-2023 (vide item no: 17) Approved to update the Polytechnic Curriculum C-23 with effect from the academic year 2023-2024 onwards after revamping the present C-20 curriculum, to meet the latest industrial technological developments including Industry 4.0 concepts.

2. HIGHLIGHTS OF CURRICULUM C-23

The following Courses / Topics are incorporated in this curriculum C-23 as per the suggestions received from industrial Experts, Faculty of Higher-Level Institutions and Polytechnics to improve the Employability Skills of the Polytechnic Students

- Modern materials of construction for various process equipment and storage vessels
- 2D Modelling, 3D Modelling, and Python tools in CAD lab for simulation of 'Fluid Mechanics' and 'Heat Transfer' operations

- A new course 'Industrial Hazards and Safety' which enlightens value added services like PSM, MSDS and HAZOP
- New Technology trends in the waste water Management in Chemical and allied process Industries
- Advanced digital sensors for concentration, temperature, pressure, flow and level in process analytical instrumentation
- IOT and IIOT fundamentals and applications in Instrumentation and Process Control
- Activity based Teaching - Learning Process in each semester

3. ACKNOWLEDGEMENTS

The Members of the working group are grateful to Smt C. Naga Rani I.A.S., Commissioner of Technical Education & Chairman of SBTET, for continuous guidance and valuable inputs during process of revising, modifying and updating the Curriculum C-20 to Curriculum C-23.

We are grateful to Sri. S. Suresh Kumar, I.A.S, Principal Secretary, Skills Development & Training for his valuable suggestions to bring the revamped curriculum C-23 in to a final form to meet latest Industry 4.0 concepts.

We are grateful to Sri. Saurab Gaur, I.A.S, former Principal Secretary, Skills Development & Training who actively participated in the Industry-Academia workshop conducted on 15th February, 2023 and offered valuable suggestions and insights into the learning needs and preferences so that the curriculum is engaging, inclusive, and effective.

It is pertinent to acknowledge the support of the following in the making of Curriculum C-23. A series of workshops in different phases were conducted by SBTET, AP, Guntur involving faculty from Polytechnics, Premier Engineering Colleges & representatives from various Industries and Dr. C. R. Nagendra Rao, Professor & Head, NITTTR-ECV to analyse the Previous C-20 Curriculum and in designing of C-23 Curriculum, is highly appreciated and gratefully acknowledged.

We also extend our sincere thanks to Sri. V. Padma Rao, Joint Director of Technical Education, Sri K.V. RamanaBabu, Secretary, SBTE&T, Andhra Pradesh, Sri K. VijayaBhaskar, Deputy Director (Academic) , Andhra Pradesh, officials of Directorate of Technical Education and the State Board of Technical Education, Andhra Pradesh and all teaching fraternity from the Polytechnics who are directly or indirectly involved in preparation of the curricula.

4. RULES AND REGULATIONS OF C-23 CURRICULUM

4.1 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 Bio-Medical course, the training will be in the seventh semester. **Run-through system is adopted for all the Diploma Courses, subject to eligibility conditions.**

4.2 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 the 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).
 - a. 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 applying for 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.
 - b. 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.
 - c. 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.
 - i). D.HMCT ii). D. Pharmacy

4.3 Medium of Instruction

The medium of instruction and examination shall be English.

4.4 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.

4.5 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 each 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 complete the syllabus.

4.6 Eligibility (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 up to 10% (65% and above and below 75%) in each semester or 1st 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 / 1st year when offered in the next subsequent academic semester/year.

For INDUSTRIAL TRAINING:

- i) During Industrial Training the candidate shall put in a minimum of 90% attendance.
- ii) If the student fails to secure 90% attendance during industrial training, the student shall reappear for 6 months industrial training at his own expenses.

4.7 Readmission

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

- a) (i) Within 15 days after commencement of class work in any semester (Except Industrial Training).
(ii) For Industrial Training: before commencement of the Industrial training.
- b) Within 30 days after commencement of class work 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.
- c) 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.

4.8 Scheme of Evaluation

a) First Year

Theory Courses: Each Course carries Maximum marks of 80 with an end examination of 3 hours duration, along with internal assessment for Maximum of 20 marks. (Sessional marks). However, there are no minimum marks prescribed for sessionals.

Laboratory Courses: There shall be 40/20 Marks for internal assessment i.e. sessional marks for each practical Course with an end examination of 3 hours duration carrying 60/30 marks. However, there are no minimum marks prescribed for sessional.

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

Theory Courses: End semester evaluation shall be of 3 hours duration and for a maximum of 80 marks.

Laboratory Courses: Each Course carry 60/30 marks of 3hours duration 40/20 sessional marks.

4.9 Internal Assessment Scheme

a) Theory Courses: Internal assessment shall be conducted for awarding Sessional marks on the dates specified. **Three-unit tests shall be conducted for I year students and two Unit Tests for semesters. The details are presented below.**

S. No.	Type of Assessment	Weightage Assigned
(i)	Testing of knowledge through mid-examination for year/sem as (Mid-1+Mid-2+Mid3) or (Mid-1 + Mid-2)	40
(ii)	Assignments	5
(iii)	<i>Dynamic Learning activities : Project Work/ Seminar/Tech-fest/Group Discussion, Quizzes etc./Extra-curricular activities/NSS/NCC/ IPSGM/Cleaning & Greening of Campus etc.</i>	5
TOTAL		50

Internal Assessment shall be of 90 minutes duration and for a maximum of 40 marks for each test.

At least one assignment should be completed for each unit which carries 10 marks. The total assignment marks should be reduced to 5.

The dynamic learning activity is to be conducted which carries 10 marks. The total marks should be reduced to 5.

The total 50 marks assigned to internal assignment is to be scaled down to 20 marks.

b) Practical Courses:

(i) Drawing Courses:

The award of Sessional marks for internal Assessment shall be as given in the following table:

Distribution of Marks for the Internal Assessment Marks			
First Year (Total:40 Marks)		Semesters (Total:40 Marks)	
Max:20 Marks	Max:20 Marks	Max:20 Marks	Max:20 Marks
From the Average of THREE Unit Tests.	From the Average of Assessment of Regular Class work Exercises.	From the Average of TWO Unit Tests.	From the Average of Assessment of Regular Class work Exercises.

- For first year engineering drawing each unit test will be conducted for a duration of 2 hours with maximum marks of 40.
- (Part - A: 4 questions x 5 marks = 20 Marks; Part -B: 2 questions x 10 marks = 20 marks).
- For the semester drawing examinations, Two Unit tests shall be conducted as per the Board End Examination Question Paper Pattern.
- All Drawing exercises are to be filed in serial order and secured for further scrutiny by a competent authority

(ii) Laboratory Courses:

- (a) Student's performance in Laboratories / Workshop shall be assessed during the year/ semester of study for 40 marks in each practical Course.
- (b) Evaluation for Laboratory Courses, other than Drawing courses:
 - i. Instruction (teaching) in laboratory courses (except for the course on Drawing) here after shall be task/competency based as delineated in the Laboratory sheets, prepared by SBTET, AP & NITTTR- ECV and posted in SBTET website.
 - ii. Internal assessment for Laboratory shall be done on the basis of task/s performed by the student as delineated in the laboratory sheets, prepared by SBTET, AP & NITTTR- ECV and posted in AP, SBTET website.
 - iii. Question paper for End semester Evaluation shall also be task/s based and shall be prepared and distributed by SBTET as done in case of theory courses be prepared as per SBTET rules in vogue.
- 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 Teacher.
- 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 in the order of preference.
 - i) Nearby Industry
 - ii) Govt / Semi Govt organization like R & B, PWD, PR, Railways, BSNL, APSRTC, APSEB etc.
 - iii) Govt / University Engg College.
 - iv) HoD/Senior Lecture (Selection Grade-II) from the Govt.Polytechnic
 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 (the experiments / exercise prescribed to test various) skills like handling, manipulating, testing, trouble shooting, repair, assembling and dismantling etc., from more than one experiment / exercise
- f) Records pertaining to internal assessment marks of both theory and practical Courses are to be maintained for official inspection.

- g) In case of Diploma programs having Industrial Training, Internal Assessment and Summative Evaluation, shall be done as illustrated in the following table:

Assessment no	Upon completion of	By	Based on	Max Marks
1	12 weeks	1.The faculty concerned (Guide) and 2. Training in charge (Mentor) of the industry	Learning outcomes as given in the scheme of assessment ,for Industrial Training	120
2	22 weeks			120
3. Final summative Evaluation	24 week	1.The faculty member concerned, 2.HoD concerned and 3.An external examiner	1.Demonstration of any one of the skills listed in learning outcomes	30
			2.Training Report	20
			3.Viva Voce	10
TOTAL				300

- h) Each staff member including Head of Section shall be assigned a batch of students 10 to 15 for making assessment during industrial training.

4.10 Minimum Pass Marks

a) Theory Examination:

For passing a theory Course, 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.

b) Practical Examination:

For passing a practical Course, 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 Courses of D.C.C.P course.

C) Industrial Training:

- I. Monitoring: Similar to project work each teacher may be assigned a batch of 10-15 students irrespective of the placement of the students to facilitate effective monitoring of students learning during industrial training.
- II. Assessment: The Industrial training shall carry 300 marks and pass marks is 50% in assessments at industry (first and second assessment) and final summative assessment at institution level put together i.e. 150 marks out of

300 marks. And also student has to secure 50% marks in final summative assessment at institution level.

III. In-Plant Industrial Training for 3-Year Diploma (C-23) Courses is scheduled as per the Academic Calendar of the SBTET every year.

4.11. Provision for Improvement

Improvement is allowed only after he / she has completed all the Courses from First Year to Final semester of the Diploma.

- a) Improvement is allowed in any 4 (Four) Courses of the Diploma.
- b) 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.
- c) No improvement is allowed in Practical / Lab Courses or Project work or Industrial Training assessment. However, improvement in drawing Course(s) is allowed.
- d) If improvement is not achieved, the marks obtained in previous Examinations hold good.
- e) Improvement is not allowed in respect of the candidates who are punished under Mal-practice in any Examination.
- f) Examination fee for improvement shall be paid as per the notification issued by State Board of Technical Education and Training from time to time.
- g) 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.

4.12. Rules of Promotion From 1ST YEAR TO 3rd, 4th, 5th, 6th and 7th 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 up to 10%) and pay the examination fee.
- ii) A candidate shall be promoted to 3rd 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, AP from time to time before commencement of 3rd semester.

A candidate is eligible to appear for the 3rd semester examination if he/she puts the required percentage of attendance in the 3rd semester and pays the examination fee.

- iii) A candidate shall be promoted to 4th semester provided he/she puts the required percentage of attendance in the 3rd semester and pay the examination fee. A candidate, who could not pay the 3rd semester exam fee, has to pay the promotion fee as prescribed by State Board of Technical Education and Training AP from time to time before commencement of 4th semester. A candidate is

eligible to appear for the 4th semester examination if he/she puts the required percentage of attendance in the 4th semester and pays the examination fee.

- iv) A candidate shall be promoted to 5th semester 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.

A candidate is eligible to appear for the 5th semester examination if he/she puts the required percentage of attendance in the 5th semester and pays the examination fee.

- v) A candidate shall be sent to Industrial training / VI semester provided he/she puts in the required percentage of attendance in the 5th semester and pay the examination fee/ promotion fee as prescribed by SBTET.
A candidate is eligible to appear for Industrial Training assessment (Seminar/Viva-voce) puts the required percentage of attendance, i.e., 90% in 6th semester Industrial Training.

For IVC & ITI Lateral Entry students:

- i.) A candidate shall be permitted to appear for Third Semester examination provided he / she puts in 75% attendance (which can be condoned on Medical grounds up to 10%) and pay the examination fee for Third semester.
- ii) A candidate shall be promoted to 4th semester provided he/she puts the required percentage of attendance in the 3rd semester and pay the examination fee. A candidate, who could not pay the 3rd semester exam fee, has to pay the promotion fee as prescribed by State Board of Technical Education and Training AP from time to time before commencement of 4th semester.

A candidate is eligible to appear for the 4th semester examination if he/she puts the required percentage of attendance in the 4th semester and pays the examination fee.

- ii) A candidate shall be promoted to 5th semester 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.

A candidate is eligible to appear for the 5th semester examination if he/she puts the required percentage of attendance in the 5th semester and pays the examination fee.

- iii) A candidate shall be sent to Industrial training / VI semester provided he/she puts in the required percentage of attendance in the 5th semester and pay the examination fee/ promotion fee as prescribed by SBTET.

A candidate is eligible to appear for Industrial Training assessment (Seminar/Viva-voce) puts the required percentage of attendance, i.e., 90% in 6th semester Industrial Training and pays the examination fee.

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

- i. A candidate shall be permitted to appear for 1st 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 3rd semester if he/she puts the required percentage of attendance in the 1st year and pays the examination fee. A candidate who could not pay the 1st 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 3rd semester.
- iii. A candidate shall be promoted to 4th semester provided he/she puts the required percentage of attendance in the 3rd semester and pay the examination fee. A candidate, who could not pay the 3rd 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 4th semester.
A candidate is eligible to appear for the 4th semester exam if he/she puts the required percentage of attendance in the 4th semester

For IVC & ITI Lateral Entry students:

- a) Puts the required percentage of attendance in the 4th semester
- iv. 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.
- v. 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 ie.,90 % of attendance and attends for the VIVA-VOCE examination at the end of training.
- vi. 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.
- vii. 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
 - a) Puts in the required percentage of attendance in the 7th semester

For IVC & ITI Lateral Entry students:

- a) Puts in the required percentage of attendance in the 7thsemester .

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 6th semester (3 years) of the course.

- 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 3rd 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 3rd semester.
- iii. A candidate shall be promoted to 4th semester provided he/she puts the required percentage of attendance in the 3rd semester and pay the examination fee. A candidate who could not pay the 3rd 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 4th semester.
A candidate is eligible to appear for the 4th semester examination if he/she
 - a) Puts in the required percentage of attendance in the 4th semester

For IVC & ITI Lateral Entry Students:

- A candidate is eligible to appear for the 4th semester examination if he/she puts the required percentage of attendance in the 4th semester
- iv. A candidate shall be promoted to 5th semester 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.
A candidate is eligible to appear for the 5th semester exam if he/she
 - a) Puts in the required percentage of attendance in the 5th semester.

For IVC & ITI Lateral Entry students:

- a) Puts in the required percentage of attendance in the 5th semester.
- v. A candidate shall be promoted to 6th semester provided he/she puts in the required percentage of attendance in the 5th semester and pays the examination fee.
A candidate who could not pay the 5th 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 6th semester.
A candidate is eligible to appear for 6th semester examination
 - a) Puts in the required percentage of attendance in 6th semester

IVC & ITI Lateral Entry students:

- a) Puts in the required percentage of attendance in 6th semester.

- vi. A candidate shall be promoted to 7th semester provided he/she puts in the required percentage of attendance in 6th semester and pay the examination fee. A candidate, who could not pay the 6th semester examination fee, has to pay the promotion fee prescribed by SBTET from time to time before commencement of the 7th semester (Industrial Training).

A candidate is eligible to appear for 7th semester Industrial Training assessment (Seminar/Viva-voce) if he/she

- a) Puts in the required percentage of attendance, i.e., 90% in 7th semester Industrial Training.

For IVC & ITI Lateral Entry students:

- a) Puts in the required percentage of attendance, i.e., 90% in 7th semester Industrial Training.

4.13. Students Performance Evaluation

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

- a) First Class with Distinction shall be awarded to the candidates who secure an overall aggregate of 75% marks and above.
- b) First Class shall be awarded to candidates who secure overall aggregate of 60% marks and above and below 75% marks.
- c) Second Class shall be awarded to candidates who secure a pass with an overall aggregate of below 60%.
- i. The Weightage of marks for various year/Semesters which are taken for computing overall aggregate shall be 25% of I year marks + 100% of 3rd and subsequent Semesters.
- ii. In respect IVC & ITI Lateral Entry candidates who are admitted directly into diploma course at the 3rd semester (i.e., second year) level the aggregate of (100%) marks secured at the 3rd 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.
- d) 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.

4.14. EXAMINATION FEE SCHEDULE:

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

4.15. Structure of Examination Question Paper:

I. Formative assessment (Internal examination)

a) For theory Courses:

Three-unit tests for first year and two-unit tests for semesters shall be conducted with a duration of 90 minutes for each test for maximum marks of 40. It consists of part A and Part B.

Part A contains five questions and carries 16 marks. Among these five questions first question consists of four objective items like one word or phrase answer/filling-in the blanks/true or false etc with one mark for each question. The other four questions are short answer questions and carry three marks each.

Part B carries 24 marks and consists of three questions with internal choice i.e., Either/Or type, and each question carries 8 marks.

The sum of marks of 3 tests for I year and 2 tests for semesters including assignments and Dynamic learning activities (50 marks) shall be reduced to 20 marks in each Course for arriving at final sessional marks.

b) For drawing Courses:

For I year:

Three-unit tests with duration of 90 minutes and for maximum marks of 40 marks shall be conducted for first year. It consists of part A and Part B.

Part A consists four questions for maximum marks of 16 and each question carries four marks (4×4 marks=16 marks).

Part B carries maximum marks of 24 and consists of five questions while the student shall answer any three questions out of these five questions. Each question in this part carries a maximum mark of 8, (3×8 marks=24 marks).

The sum of marks obtained in 3-unit test marks shall be reduced to 20 marks for arriving at final sessional marks. Remaining 20 marks are awarded by the Course teacher based on the student's performance during regular class exercise.

For semester: Two-unit tests with duration of 90 minutes and for maximum marks of 40 marks shall be conducted. The sum of marks obtained in 2-unit test marks shall be reduced to 20 marks for arriving at final sessional marks. Remaining 20 marks are awarded by the Course teacher based on the student's performance during regular class exercise.

c) For Laboratory /workshop: 50% of total marks for the Course shall be awarded based on continuous assessment of the student in laboratory/workshop classes and the remaining 50% shall be based on the sum of the marks obtained by the students in two tests.

II. Summative assessment (End examination)

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 Course be considered. End Examination paper is of 3 hours duration.

a) Each theory paper consists of Section 'A' and 'B'

Section 'A' with Max marks of 30, contains 10 short answer questions. All questions are to be answered and each carry 3 marks, i.e., $10 \times 3 = 30$.

Section 'B' with Max marks of 50 contains 8 essay type questions. Only 5 questions are to be answered and each carry 10 marks, i.e., Max. Marks: $5 \times 10 = 50$.

Thus, the total marks for theory examination shall be: 80.

b) **For Engineering Drawing Course (107) consist of section 'A' and section 'B'.**

Section 'A' with max marks of 20, contains four (4) questions. All questions in section 'A' are to be answered to the scale and each carries 5 marks, ie. $4 \times 5 = 20$.

Section 'B' with max marks of 40, contains six (6) questions. The student shall answer any four (4) questions out of the above six questions and each question carries 10 Marks, i.e., $4 \times 10 = 40$.

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 Max. Marks : 60

In case of practical examinations with 50 marks, the marks shall be distributed as

Max. Marks for an experiment / exercise : 25

Max. Marks for VIVA-VOCE : 05

Total Max. Marks : 30

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

d) **Note: Evaluation for Laboratory Courses, other than Drawing courses:**

- I. Instruction (teaching) in laboratory courses (except for the course on Drawing) hereafter shall be task/competency based as delineated in the Laboratory sheets, prepared by SBTET, AP and posted in its website.
- II. Internal assessment for Laboratory shall be done on basis of task/s performed by the student as delineated in the laboratory sheets, prepared by SBTET, AP and posted in its website.
- III. Question paper for End semester Evaluation shall be prepared as per SBTET rules in vogue.

4.16. ISSUE OF MEMORONDUM 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 from time to time.

4.17. MAXIMUM PERIOD FOR COMPLETION OF DIPLOMA PROGRAMMES:

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.

4.18. ELIGIBILITY FOR AWARD OF DIPLOMA

A candidate is eligible for award of Diploma Certificate if he / she fulfil 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 have completed all the Courses.

Students who fail to fulfil 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 Courses.

Students who fail to fulfil 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.

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

A) FOR ISSUE OF PHOTO COPIES OF VALUED ANSWER SCRIPTS

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

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

- i. 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.
- ii. Re-verification of valued answer script shall be done for all theory Courses' and Drawing Course(s).
- iii. The Re-verification committee constituted by the Secretary, SBTETAP with Course 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).

II. 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.
- (vii) After Re-verification of valued answer script the same or change if any therein on Re-verification, will be communicated to the candidate.
- (viii) 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.

Note: 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.

4.20. 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.

4.21. 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.

4.22. 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 AP from time to time.

4.23. 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.

4.24. 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, AP are within the jurisdiction of Mangalagiri.
- iii. In case of any ambiguity in the interpretation of the above rules, the decision of the Secretary, SBTET, A.P is final.

Vision

To come forth as a renowned centre in the field of Chemical Engineering with the best implementations in teaching, thus by giving more quest to practical knowledge.

Mission

M1. To accommodate compatible academic environment to the students for pursuing Diploma programme in Chemical Engineering.

M2. To assure moral, financial, social aegis to all the students to attain 0% dropout rate.

M3. To facilitate the Industry-Institute Interactions to expose students to latest industrial skills.

M4. To make sure that our students are trained in sound technical skills along with soft skills professional ethics, practical industrial training to get 100% placement.

Program Educational Objectives (PEOs):**PEO-1: Preparation towards Employment/Higher Studies:**

The Primary Objective is to produce best Diploma in Chemical Engineering (Petrochemicals) technicians by studying growing needs of the industries in modern topics which will be also useful to the higher level studies.

PEO-2: Core Competence:

To prepare the students towards core chemical Engineering skills. To expertise the student in practical content, communication skills, latest developments.

PEO-3: Breadth - 'T' Shaped Supervisor Engineer:

To give the depth of related skills and expertise in a single field, and the ability to collaborate across disciplines with experts in other areas and to apply knowledge in areas of expertise other than one's own to prepare the student as a 'T' shaped Engineer in the Supervisory cadre.

PEO-4: Professionalism - 3 Ps - Professional value-Knowledge development:

To promote the students in Professionalism, Personality and Presentation through the successful completion of the Diploma in Chemical Engineering (Petrochemicals) by emphasizing through Filed Practices in Industry.

PEO-5: Life Long learning - Environment:

To promote the students life-long self learning abilities.

PROGRAMME OUTCOMES (POs):

1. Basic and discipline specific knowledge: Apply knowledge of basic mathematics, science and engineering fundamentals and engineering specialization to solve the engineering problems.
2. Problem analysis: Identify and analyze well-defined engineering problems using codified standard methods.
3. Design / Development of solutions: Design solutions for well-defined technical problems and assist with the design of systems components or processes to meet specified needs.
4. Engineering tools, Experimentation and Testing: Apply modern engineering tools and appropriate technique to conduct standard tests and measurements.
5. Engineering practices for society, sustainability and environment: Apply appropriate technology in context of society, sustainability, environment and ethical practices.
6. Project Management: Use engineering management principles individually, as a team member or a leader to manage projects and effectively communicate about well defined engineering activities.
7. Life-long learning: Ability to analyze individual needs and engaging updating in the context of technological changes.

PROGRAMME SPECIFIC OUTCOMES (PSOs):

1. An ability to understand the concepts of Chemical Engineering and apply them to various Chemical industries.
2. An ability to solve complex Chemical engineering problems, using latest analytical skills to arrive appropriate solutions.
3. Wisdom of social and environmental awareness along with ethical responsibility to have a successful career in the field of Chemical engineering and sustain passion and zeal for real-world applications in the field of chemical engineering using optimal resources as an entrepreneur.

DIPLOMA IN CHEMICAL ENGINEERING (PETRO CHEMICALS)
SCHEME OF INSTRUCTIONS AND EXAMINATIONS
C23- (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
THEORY:								
CHPC -101	English	3	-	90	3	20	80	100
CHPC -102	Engineering Mathematics - I	5	-	150	3	20	80	100
CHPC -103	Engineering Physics	3	-	90	3	20	80	100
CHPC -104	Engineering Chemistry & Environmental Studies	3	-	90	3	20	80	100
CHPC -105	Introduction to Chemical & Petroleum Engineering	5	-	150	3	20	80	100
CHPC -106	Materials Technology	5	-	150	3	20	80	100
PRACTICAL:								
CHPC -107	Engineering Drawing	-	3	90	3	40	60	100
CHPC -108	Workshop Practice	-	6	180	3	40	60	100
CHPC -109	Physics Lab	-	1.5	45	3 (1.5+1.5)	20	30	100 (50+50)
CHPC -110	Chemistry Lab	-	1.5	45		20	30	
CHPC -111	Computer Fundamentals Lab	-	3	90	3	40	60	100
	Activities	-	3	90	-	-	-	-
TOTAL		24	18	720+ 540 =1260	-	280	720	1000

CHPC-101, 102, 103, 104, 107, 109, 110

: Common to all

CHPC-106, 108

: Common with DCHE, DCHE (PP), DCHE (OT)

CHPC-105

: Not common with any course

Note: For CHPC-109, CHPC-110, 30 students will go to Physics lab and the remaining 30 will go to Chemistry lab

DIPLOMA IN CHEMICAL ENGINEERING (PETROCHEMICALS)
SCHEME OF INSTRUCTIONS AND EXAMINATIONS
C23 - (III Semester)

Subject Code	Name of the Subject	Instruction period / week		Total Period / year		Scheme of Examination		
		Theory	Practical		Duration (hours)	Sessional Marks	End Exam Marks	Total Marks
THEORY:								
CHPC- 301	Engineering Mathematics - II	4	-	60	3	20	80	100
CHPC -302	Electrical Technology	4	-	60	3	20	80	100
CHPC -303	Organic and Physical Chemistry	5	-	75	3	20	80	100
CHPC -304	Unit Operations- I	5	-	75	3	20	80	100
CHPC -305	Mass and Energy Balance	6	-	90	3	20	80	100
PRACTICAL:								
CHPC -306	CAD Practice in Chemical Engineering	-	3	45	3	40	60	100
CHPC -307	Electrical Technology Lab	-	3	45	3	40	60	100
CHPC -308	Organic and Physical Chemistry Lab	-	3	45	3	40	60	100
CHPC -309	Unit Operations-I Lab	-	6	90	3	40	60	100
-	Activities	-	3	45	-	-	-	-
TOTAL		24	18	360+270=630	-	260	640	900

CHPC-301 : Common to AEI/BM/CH/CHPC/CHPP/CHOT/CHST/EC.
 CHPC-302, 303, 305, 306, 307 : Common to DCHE, DCHE(PP), DCHE(OT)
 CHPC-304, 308, 309 : Common to DCHE(PP), DCHE(OT)

DIPLOMA IN CHEMICAL ENGINEERING (PETROCHEMICALS)
SCHEME OF INSTRUCTIONS AND EXAMINATIONS
C23 - (IV Semester)

Subject Code	Name of the Subject	Instruction period / week		Total Period / year	Scheme of Examination			
		Theory	Practical		Duration (hours)	Sessional Marks	End Exam Marks	Total Marks
THEORY:								
CHPC - 401	Industrial Hazards and Safety	3	-	45	3	20	80	100
CHPC -402	Process Technology	6	-	90	3	20	80	100
CHPC -403	Petroleum Refining	5	-	75	3	20	80	100
CHPC -404	Petrochemical Technology-I	4	-	60	3	20	80	100
CHPC -405	Basic Mechanical Engineering	4	-	60	3	20	80	100
CHPC-406	Unit Operations-II	5	-	75	3	20	80	100
PRACTICAL:								
CHPC -407	Unit Operations – II Lab	-	3	45	3	40	60	100
CHPC -408	Communication skills	-	3	45	3	40	60	100
CHPC -409	Petroleum Refining-I Lab	-	3	45	3	40	60	100
CHPC -410	Process Technology Lab	-	3	45	3	40	60	100
-	Activities	-	3	45	-	-	-	-
TOTAL		27	15	405+225=630	-	280	720	1000

CHPC-408 : Common to all branches
 CHPC-401 : Common to DCHE, DCHE(PP), DCHE(OT)
 CHPC-402,405, 406, 407, 410 : Common to DCHE(PP), DCHE(OT)
 CHPC-403, 404, 409 : Not common to any course

DIPLOMA IN CHEMICAL ENGINEERING (PETROCHEMICALS)
SCHEME OF INSTRUCTIONS AND EXAMINATIONS
C23 - V Semester (I Spell Industrial Training)

Subject Title : **Industrial Training**
Subject Code : **CHPC-501**
Duration : **6 months**

S.NO	Code	TOPICS	Duration
1	CHPC-501	<input type="checkbox"/> Practical training in Industry <input type="checkbox"/> Training Report Preparation Report Preparation: Title Page, Certificate, Acknowledgements, Abstract, Contents(introduction of Industry, Plant Layout, Organization Chart, List of Major Equipments, List of Processes: Skills Acquired; Conclusions; References	Six Months

SI.No.	Subject	Duration	Scheme of evaluation		
			Item	Nature	Max. Marks
1	Industrial Training	6 months	1.First Assessment at Industry (After 12 Weeks)	Assessment of Learning outcomes by both the faculty and training Mentor of the industry	120
			2.Second Assessment at the Industry (After 22 weeks)	Assessment of Learning outcomes by both the faculty and training Mentor of the industry	120
			Final Summative assessment at institution level	Training Report	20
				Demonstration of any one of the skills listed in learning outcomes	30
				Viva Voce	10
TOTAL MARKS					300

DIPLOMA IN CHEMICAL ENGINEERING (PETROCHEMICALS)
SCHEME OF INSTRUCTIONS AND EXAMINATIONS
C23 - VI Semester (II Spell Industrial Training)

Subject Title : **Industrial Training**
Subject Code : **CHPC-601**
Duration : **6 months**

S.NO	Code	TOPICS	Duration
1	CHPC-601	<input type="checkbox"/> Practical training in Industry <input type="checkbox"/> Training Report Preparation Report Preparation: Title Page, Certificate, Acknowledgements, Abstract, Contents(introduction of Industry, Plant Layout, Organization Chart, List of Major Equipments, List of Processes: Skills Acquired; Conclusions; References	Six Months

SI.No.	Subject	Duration	Scheme of evaluation		
			Item	Nature	Max. Marks
1	Industrial Training	6 months	1.First Assessment at Industry (After 12 Weeks)	Assessment of Learning outcomes by both the faculty and training Mentor of the industry	120
			2.Second Assessment at the Industry (After 22 weeks)	Assessment of Learning outcomes by both the faculty and training Mentor of the industry	120
			Final Summative assessment at institution level	Training Report	20
				Demonstration of any one of the skills listed in learning outcomes	30
			Viva Voce	10	
TOTAL MARKS					300

DIPLOMA IN CHEMICAL ENGINEERING (PETROCHEMICALS)
SCHEME OF INSTRUCTIONS AND EXAMINATIONS
C23 - (VII Semester)

Subject Code	Name of the Subject	Instruction period / week		Total Period / year	Scheme of Examination			
		Theory	Practical		Duration (hours)	Sessional Marks	End Exam Marks	Total Marks
THEORY:								
CHPC-701	Industrial Management and Entrepreneurship	5	-	75	3	20	80	100
CHPC-702	Thermodynamics and Reaction Engineering	5	-	75	3	20	80	100
CHPC-703	Instrumentation & Process Control	5	-	75	3	20	80	100
CHPC-704	Unit Operations –III	4	-	60	3	20	80	100
CHPC-705	Petrochemical Technology-II	5	-	75	3	20	80	100
PRACTICAL:								
CHPC-706	Chemical Plant Equipment Drawing	-	3	45	3	40	60	100
CHPC-707	Instrumentation, process control & Reaction Engineering Lab	-	3	45	3	40	60	100
CHPC-708	Life skills	-	3	45	3	40	60	100
CHPC-709	Project Work/ Petroleum Refining II Lab	-	3	45	3	40 (20+20)	60 (30+30)	100 (50+50)
CHPC-710	Unit Operations-III Lab	-	3	45	3	40	60	100
-	Activities	-	3	45	-	-	-	-
TOTAL		24	18	360+270=630	-	300	700	1000

CHPC- 701,708

: Common to all

CHPC-702, 703, 706, 707

: Common to DCHE, DCHE(PP), DCHE(OT)

CHPC- 704,710

: Common DCHE(PP), DCHE(OT)

CHPC-705, 709

: Not common to any course

FIRST YEAR

DIPLOMA IN CHEMICAL ENGINEERING (PETRO CHEMICALS)
SCHEME OF INSTRUCTIONS AND EXAMINATIONS

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
THEORY:								
CHPC -101	English	3	-	90	3	20	80	100
CHPC -102	Engineering Mathematics - I	5	-	150	3	20	80	100
CHPC -103	Engineering Physics	3	-	90	3	20	80	100
CHPC -104	Engineering Chemistry & Environmental Studies	3	-	90	3	20	80	100
CHPC -105	Introduction to Chemical & Petroleum Engineering	5	-	150	3	20	80	100
CHPC -106	Materials Technology	5	-	150	3	20	80	100
PRACTICAL:								
CHPC -107	Engineering Drawing	-	3	90	3	40	60	100
CHPC -108	Workshop Practice	-	6	180	3	40	60	100
CHPC -109	Physics Lab	-	1.5	45	3 (1.5+1.5)	20	30	100 (50+50)
CHPC -110	Chemistry Lab	-	1.5	45		20	30	
CHPC -111	Computer Fundamentals Lab	-	3	90	3	40	60	100
	Activities	-	3	90	-	-	-	-
TOTAL		24	18	720+ 540 =1260	-	280	720	1000

CHPC-101, 102, 103, 104, 107, 109, 110: Common to all

CHPC-106, 108 : Common with DCHE, DCHE (PP), DCHE (OT)

CHPC-105 : Not common with any course

Note: For CHPC-109 , CHPC-110, 30 students will go to Physics lab and the remaining 30 will go to Chemistry lab

C23-COMMON-101: English

Course Code	Course Title	No. of Periods per Week	Total No. of Periods	Marks for FA	Marks for SA
CHPC-101	English	3	90	20	80

Time Schedule : C23-CHPC- 101 : ENGLISH						
S.no.	Title of the Unit	Periods allotted	Weightage of Marks	No. of Short answer questions	No. of Long Answer questions	Mapping of COs
1	English for Employability	8	16	2	1	CO1, CO2, CO3, CO4, CO5
2	Living in Harmony	8				CO1, CO2, CO3, CO4, CO5
3	Connect with Care	8	26	2	2	CO1, CO2, CO3, CO4, CO5
4	Humour for Happiness	8				CO1, CO2, CO3, CO4, CO5
5	Never Ever Give Up!	8	10	1	1	CO1, CO2, CO3, CO4, CO5
6	Preserve or Perish	9	23			2
7	The Rainbow of Diversity	8		2	CO1, CO2, CO3, CO4, CO5	
8	New Challenges - Newer Ideas	8	19	1	1	CO1, CO2, CO3, CO4, CO5
9	The End Point First	8				1
10	The Equal Halves	8	16	1	1	CO1, CO2, CO3, CO4, CO5
11	Dealing with Disaster	9				1
	Total	90	110	30	80	

Course Objectives	- To improve grammatical knowledge and enrich vocabulary.
	- To develop effective reading, writing and speaking skills.
	- To comprehend themes related to Personality, Society, Environment to exhibit Universal Human Values.

CO No.	Course Outcomes
CO1	Learn and apply various grammatical concepts to communicate in academic, professional and everyday situations
CO2	Use appropriate vocabulary in various contexts
CO3	Read and comprehend different forms of academic, professional and general reading material
CO4	Communicate effectively in speaking and writing in academic, professional and everyday situations.
CO5	Display human values by applying the knowledge of themes related to Self, Society, Environment, Science and Technology for holistic development and harmonious living through communication.

CO-PO Matrix

Course Code CHPC-101	Course Title: English Number of Course Outcomes: 5			No. of Periods: 90	
POs	Mapped CO No.	CO Periods Addressing PO in Column 1		Level of Mapping (1,2,3)	Remarks
		Number	Percentage		
PO1		Not directly Applicable for English course, however, the language activities make use of the content from Science and Technology relevant to the programme to enhance English communication skills.			
PO2					
PO3					
PO4					
PO5	CO5	16	18%	Level 1	Up to 20%: Level 1 21%-50%: Level 2 >50%: Level 3
PO6	CO1, CO2, CO3, CO4,	52	58%	Level 3	
PO7	CO1, CO2, CO3, CO4,CO5	22	24%	Level 2	

Level 3 – Strongly Mapped, Level 2- Moderately Mapped; Level 1- Slightly Mapped

Learning Outcomes

1. English for Employability

- 1.1. Perceive the need for improving communication in English for employability
- 1.2. Use adjectives and articles effectively while speaking and in writing
- 1.3. Write simple sentences

2. Living in Harmony

- 2.1. Develop positive self-esteem for harmonious relationships
- 2.2. Use affixation to form new words
- 2.3. Use prepositions and use a few phrasal verbs contextually

3. Connect with Care

- 3.1. Use social media with discretion
- 3.2. Speak about abilities and possibilities
- 3.3. Make requests and express obligations
- 3.4. Use modal verbs and main verbs in appropriate form
- 3.5. Write short dialogues about everyday situations

4. Humour for Happiness

- 4.1. Realize the importance of humour for a healthy living
- 4.2. Improve vocabulary related to the theme
- 4.3. Inculcate reading and speaking skills
- 4.4. Frame sentences with proper Subject – Verb agreement
- 4.5. Understand the features of a good paragraph and learn how to gather ideas as a preliminary step for writing a good paragraph.

5. Never Ever Give Up!

- 5.1. Learn to deal with failures in life
- 5.2. Use the present tense form for various every day communicative functions such as speaking and writing about routines, professions, scientific descriptions and sports commentary
- 5.3. Write paragraphs with coherence and other necessary skills

6. Preserve or Perish

- 6.1. Understand the ecological challenges that we face today and act to save the environment.
- 6.2. Narrate / Report past events and talk about future actions
- 6.3. Develop vocabulary related to environment
- 6.4. Write e-mails

7. The Rainbow of Diversity

- 7.1. Appraise and value other cultures for a happy living in multi-cultural workspace
- 7.2. Understand the usage of different types of sentences
- 7.3. Ask for or give directions, information, instructions
- 7.4. Use language to express emotions in various situations
- 7.5. Write letters in various real life situations

8. New Challenges – Newer Ideas

- 8.1. Understand the functional difference between Active Voice and Passive Voice
- 8.2. Use Passive Voice to speak and write in various contexts
- 8.3. Understand the major parts and salient features of an essay
- 8.4. Learn about latest innovations and get motivated

9. The End Point First!

- 9.1. Understand the importance of setting goals in life
- 9.2. Report about what others have said both in speaking and writing
- 9.3. Write an essay following the structure in a cohesive and comprehensive manner
- 9.4. Apply the words related to Goal Setting in conversations and in life

10. The Equal Halves

- 10.1. Value the other genders and develop a gender-balanced view towards life
- 10.2. Identify the use of different conjunctions in synthesising sentences
- 10.3. Write various types of sentences to compare and contrast the ideas

- 10.4. Apply the knowledge of sentence synthesis in revising and rewriting short essays
 10.5. Develop discourses in speech and writing

11. Dealing with Disasters

- 11.1. be aware of different kinds of disasters and the concept of disaster management
 11.2. Generate vocabulary relevant to disaster management and use it in sentences
 11.3. Analyze an error in a sentence and correct it
 11.4. Learn and write different kinds of reports

Textbook: ‘**INTERACT**’ (A Text book of English for I Year Engineering Diploma Courses) - by SBTET, AP

Reference Books:

Martin Hewings: *Advanced Grammar in Use*, Cambridge University Press

Murphy, Raymond : *English Grammar in Use*, Cambridge University Press

Sidney Greenbaum : *Oxford English Grammar*, Oxford University Press

Wren and Martin (Revised by N.D.V. Prasad Rao) : *English Grammar and Composition*, Blackie ELT Books, S. Chand and Co.

Sarah Freeman: *Strengthen Your Writing*, Macmillan

	End Exam (80 Marks)	1,2,3 Unit Tests (20 Marks each)
Part A	10 Question @ 3 Marks	5 Questions @ (1Q X4M) + (4Q X3M =12)
	Total = 30 Marks	Total = 16 Marks
Part B	5 Questions (+ 3 Choice) @10 Marks	3 Questions (with internal choice) @ 8 Marks
	Total = 50 Marks	Total = 24 marks
Grand Total	80 Marks	40 Marks

C-23 CHPC -102
ENGINEERING MATHEMATICS-I
(Common to all Branches)

Course Code	Course Title	No. of Periods/week	Total No. of periods	Marks for FA	Marks for SA
CHPC-102	Engineering Mathematics-I	5	150	20	80

TIME SCHEDULE

S.No.	Chapter	No. of Periods	Marks Allotted	Short type	Essay type	COs mapped
Unit - I: Algebra						
1	Functions	6	3	1	0	CO1
2	Partial Fractions	5	3	1	0	CO1
3	Matrices and Determinants	20	16	2	1	CO1
Unit - II: Trigonometry						
4	Trigonometric Ratios	2	0	0	0	CO2
5	Compound Angles	5	3	1	0	CO2
6	Multiple and Submultiple angles	8	3	1	0	CO2
7	Transformations	6	5	0	1/2	CO2
8	Inverse Trigonometric Functions	6	5	0	1/2	CO2
9	Trigonometric Equations	6	5	0	1/2	CO2
10	Properties of triangles	5	5	0	1/2	CO2
11	Complex Numbers	6	3	1	0	CO2
Unit III: Co-ordinate Geometry						
12	Straight Lines	5	3	1	0	CO3
13	Circles	6	5	0	1/2	CO3
14	Conic Sections	12	5	0	1/2	CO3
Unit - IV: Differential Calculus						
15	Limits and Continuity	6	3	1	0	CO4
16	Differentiation	28	23	1	2	CO4
Unit - V: Applications of Derivatives						
17	Geometrical Applications	4	5	0	1/2	CO5
18	Physical Applications	6	5	0	1/2	CO5
19	Maxima and Minima	4	5	0	1/2	CO5
20	Errors and Approximations	4	5	0	1/2	CO5
	Total	150	110	10	8	
			Marks	30	80	

Course Objectives	<ul style="list-style-type: none"> (i) To apply the principles of Algebra, Trigonometry and Co-ordinate Geometry to real-time problems in engineering. (ii) To comprehend and apply the concept of Differential Calculus in engineering applications.
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Course Outcomes	CO1	Identify functions as special relations, resolve partial fractions and solve problems on matrices and determinants.
	CO2	Solve problems using the concept of trigonometric functions, their inverses and complex numbers.
	CO3	Find the equations and properties of straight lines, circles and conic sections in coordinate system.
	CO4	Evaluate the limits and derivatives of various functions.

	CO5	Find solutions for engineering problems using differentiation.
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Learning Outcomes:

UNIT - I

C.O. 1 Identify functions, resolve partial fractions and solve problems on matrices and determinants.

- L.O.** 1.1 Define Set, Ordered pair and Cartesian product of two sets - examples.
 1.2 Explain Relations and Functions - examples
 1.3 Find Domain & Range of functions - simple examples.
 1.4 Define one-one and onto functions.
 1.5 Find the inverse of a function - simple examples.
 1.6 Define rational, proper and improper fractions of polynomials.
 1.7 Explain the procedure of resolving proper fractions of the types mentioned below into partial fractions

$$i) \frac{f(x)}{(ax+b)(cx+d)} \quad ii) \frac{f(x)}{(ax+b)^2(cx+d)}$$

- 1.8 Define a matrix and order of a matrix.
 1.9 State various types of matrices with examples (emphasis on 3rd order square matrices).
 1.10 Compute sum, difference, scalar multiplication and product of matrices. Illustrate the properties of these operations such as commutative, associative and distributive properties with examples and counter examples.
 1.11 Define the transpose of a matrix and state its properties - examples.
 1.12 Define symmetric and skew-symmetric matrices with examples. Resolve a square matrix into a sum of symmetric and skew-symmetric matrices and provide examples.
 1.13 Define determinant of a square matrix; minor, co-factor of an element of a 3x3 square matrix with examples. Expand the determinant of a 3 x 3 matrix using Laplace expansion formula. State and apply the properties of determinants to solve problems.
 1.14 Distinguish singular and non-singular matrices. Define multiplicative inverse of a matrix and list properties of adjoint and inverse. Compute adjoint and multiplicative inverse of a square matrix.
 1.15 Solve a system of 3 linear equations in 3 unknowns using Cramer's rule and matrix inversion method.

UNIT - II

C.O. 2 Solve problems using the concept of trigonometric functions, their inverses and complex numbers.

- L.O.** 2.1 Define trigonometric ratios of any angle - List the values of trigonometric ratios at specified values.
 2.2 Draw graphs of trigonometric functions - Explain periodicity of trigonometric functions.
 2.3 Define compound angles and state the formulae of $\sin(A\pm B)$, $\cos(A\pm B)$, $\tan(A\pm B)$ and $\cot(A\pm B)$.
 2.4 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.
 2.5 Derive identities like $\sin(A+B) \sin(A-B) = \sin^2 A - \sin^2 B$ etc.
 2.6 Solve simple problems on compound angles.
 2.7 Derive the formulae of multiple angles $2A$, $3A$ etc and sub multiple angle $A/2$ in terms of angle A of trigonometric functions.
 2.8 Derive useful allied formulae like $\sin^2 A = (1 - \cos 2A)/2$ etc.
 2.9 Solve simple problems using the multiple and submultiple formulae.
 2.10 Derive the formulae on transforming sum or difference of two trigonometric ratios in to a product and vice versa - examples on these formulae.
 2.11 Solve problems by applying these formulae to sum or difference or product of two terms.
 2.12 Explain the concept of the inverse of a trigonometric function by selecting an appropriate domain and range.
 2.13 Define inverses of six trigonometric functions along with their domains and ranges.
 2.14 Derive relations between inverse trigonometric functions so that the given inverse trigonometric function can be expressed in terms of other inverse trigonometric functions with examples.
 2.15 State various properties of inverse trigonometric functions and identities like

Syllabus for Unit test-I completed

$$\sin^{-1}x + \cos^{-1}x = \frac{\pi}{2}, \text{ etc.}$$

2.16 Apply formulae like $\tan^{-1}x + \tan^{-1}y = \tan^{-1}\left(\frac{x+y}{1-xy}\right)$, where $x \geq 0, y \geq 0, xy < 1$ etc.,

to solve Simple problems.

2.17 Explain what is meant by solution of trigonometric equations and find the general solutions of $\sin x=k$, $\cos x=k$ and $\tan x=k$ with appropriate examples.

2.18 Solve models of the type $a \sin^2 x + b \sin x + c=0$ and $a \sin x + b \cos x=c$.

2.19 State sine rule, cosine rule, tangent rule and projection rule and solve a triangle using these formulae.

2.20 List various formulae for the area of a triangle with examples.

2.21 Define a complex number, its modulus, conjugate, amplitude and list their properties.

2.22 Define arithmetic operations on complex numbers with examples.

2.23 Represent the complex number in various forms like modulus-amplitude (polar) form, Exponential (Euler) form with examples.

UNIT - III

Coordinate Geometry

C.O. 3 Find the equations and properties of straight lines, circles and conic sections in coordinate system.

L.O. 3.1 Write different forms of a straight line - general form, point-slope form, slope-intercept form, two-point form, intercept form and normal form (or perpendicular form).

3.2 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.

3.3 Define locus of a point and circle.

3.4 Write the general equation of a circle and find its centre and radius.

3.5 Find the equation of a circle, given (i) centre and radius, (ii) two ends of the diameter (iii) three non collinear points of type $(0,0)$ $(a,0)$, $(0, b)$.

3.6 Define a conic section - Explain the terms focus, directrix, eccentricity, axes and latus-rectum of a conic with illustrations.

3.7 Find the equation of a conic when focus, directrix and eccentricity are given.

3.8 Describe the properties of Parabola, Ellipse and Hyperbola in standard forms whose axes are along the co-ordinate axes and solve simple examples on these conics.

Syllabus for Unit test-II

C.O.4 Evaluate the limits and derivatives of various functions.

L.O. 4.1 Explain the concept of limit and meaning of $\lim_{x \rightarrow a} f(x)=l$ and state the properties of limits.

4.2 Evaluate the limits of the type $\lim_{x \rightarrow a} \frac{f(x)}{g(x)}$ and $\lim_{x \rightarrow \infty} \frac{f(x)}{g(x)}$

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

$\lim_{x \rightarrow 0} \frac{e^x - 1}{x}$, $\lim_{x \rightarrow 0} (1+x)^{\frac{1}{x}}$, $\lim_{x \rightarrow \infty} \left(1 + \frac{1}{x}\right)^x$ (without proof) and solve simple problems

using these standard limits.

4.4 Explain the concept of continuity of a function at a point and on an interval

4.5 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.

4.6 Explain the significance of derivative in scientific and engineering applications.

- 4.7 Find the derivative of standard algebraic, logarithmic, exponential and trigonometric functions using the first principle.
- 4.8 Find the derivatives of inverse trigonometric, hyperbolic and inverse hyperbolic functions.
- 4.9 State the rules of differentiation of sum, difference, scalar multiplication, product and quotient of functions with simple illustrative examples.
- 4.10 Explain the method of differentiation of a function of a function (Chain rule) with illustrative examples.
- 4.11 Explain the method of differentiation of parametric functions with examples.
- 4.12 Explain the procedure for finding the derivatives of implicit functions with examples.
- 4.13 Explain the need of taking logarithms for differentiating some functions of $[f(x)]^{g(x)}$ type - examples on logarithmic differentiation.
- 4.14 Explain the concept of finding the second order derivatives with examples.
- 4.15 Explain the concept of functions of several variables, finding partial derivatives and difference between the ordinary and partial derivatives with simple examples.
- 4.16 Explain the concept of finding second order partial derivatives with simple problems.

C.O. 5 Evaluate solutions for engineering problems using differentiation

- L.O. 5.1 State the geometrical meaning of the derivative - Explain the concept of derivative to find the slopes of tangent and normal to a given curve at any point on it with examples.
- 5.2 Find the equations of tangent and normal to to a given curve at any point on it - simple problems.
- 5.3 Explain the derivative as a rate of change in distance-time relations to find the velocity and acceleration of a moving particle with examples.
- 5.4 Explain the derivative as a rate measurer in the problems where the quantities like areas, volumes vary with respect to time- illustrative examples.
- 5.5 Define the concept of increasing and decreasing functions - Explain the conditions to find points where the given function is increasing or decreasing with illustrative examples.
- 5.6 Explain the procedure to find the extreme values (maxima or minima) of a function of single variable- simple problems for quadratic and cubic polynomials.
- 5.7 Apply the concept of derivatives to find the errors and approximations - simple problems.

Syllabus for Unit test-III completed

CO/PO - Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	3	2	2	3				3	2	2
CO2	3	3	2	2				3	2	2
CO3	3	3	2	2				3	2	2
CO4	3	3	3	3				3	3	3
CO5	3	3	3	3				3	3	3
Avg.	3	2.8	2.4	2.6				3	2.4	2.4

3 = Strongly mapped (High), 2 =moderately mapped (Medium), 1 =slightly mapped (Low)

Note: The gaps in CO/PO mapping can be met with appropriate activities as follows:

For PO5: Appropriate quiz programmes may be conducted at intervals and duration as decided by concerned faculty.

For PO6: Seminars on applications of mathematics in various engineering disciplines are to be planned and conducted.

For PO7: Plan activities in such a way that students can visit the Library to refer standard books on Mathematics and access the latest updates in reputed national and international journals. Additionally, encourage them to attend seminars and learn mathematical software tools.

PO- CO - Mapping strength

PO No	Mapped with CO no	CO periods addressing PO in column I		Level (1,2 or 3)	Remarks
		No	%		
1	CO1, CO2, CO3, CO4, CO5	150 (31+44+23+34+18)	100%	3	>40% Level 3 Highly addressed 25% to 40% Level 2 Moderately addressed 5% to 25% Level 1 Low addressed <5% Not addressed
2	CO1, CO2, CO3, CO4, CO5	80 (8+23+12+22+15)	53.3%	3	
3	CO1, CO2, CO3, CO4, CO5	61 (9+14+9+14+15)	40.6%	3	
4	CO1, CO2, CO3, CO4, CO5	61 (14+9+9+14+15)	40.6%	3	
PSO 1	CO1, CO2, CO3, CO4, CO5	150 (31+44+23+34+18)	100%	3	
PSO 2	CO1, CO2, CO3, CO4, CO5	62 (10+14+9+14+15)	41.3%	3	
PSO 3	CO1, CO2, CO3, CO4, CO5	62 (10+14+9+14+15)	41.3%	3	

COURSE CONTENT

**Unit-I
Algebra**

1. Functions:

Definitions of Set, Ordered pair, Cartesian product of two sets, Relations, Functions, Domain & Range of functions - One-one and onto functions, inverse of a function.

2. Partial Fractions:

Definitions of rational, proper and improper fractions of polynomials. Resolve rational fractions (proper fractions) into partial fractions covering the types mentioned below.

$$i) \frac{f(x)}{(ax+b)(cx+d)} \qquad ii) \frac{f(x)}{(ax+b)^2(cx+d)}$$

3. Matrices:

Definition of a matrix, types of matrices - Algebra of matrices, equality of two matrices, sum, difference, scalar multiplication and product of matrices. Transpose of a matrix, Symmetric, skew-symmetric matrices - Determinant of a square matrix, minor and cofactor of an element, Laplace's expansion, properties of determinants - Singular and non-singular matrices, Adjoint and multiplicative inverse of a square matrix-System of linear equations in 3 variables-Solutions by Cramer's rule and Matrix inversion method.

**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.

6. Multiple and sub multiple angles:

Formulae for trigonometric ratios of multiple angles $2A$, $3A$ and sub multiple angle $A/2$.

7. Transformations:

Transformations of products into sums or differences and vice versa.

8. Inverse trigonometric functions:

Definition, domains and ranges-basic properties.

9. Trigonometric equations:

Concept of a solution, principal value and general solution of trigonometric equations:

$\sin x = k$, $\cos x = k$, $\tan x = k$, where k is a constant. Solutions of simple quadratic equations and equations of type $a \sin x + b \cos x = c$.

10. Properties of triangles:

Relations between sides and angles of a triangle- sine rule, cosine rule, tangent rule and projection rule-area of a triangle.

11. Complex Numbers:

Definition of a complex number, modulus, conjugate and amplitude of a complex number - Arithmetic operations on complex numbers - Modulus-Amplitude (polar) form, Exponential form (Euler form) of a complex number.

UNIT-III

Coordinate geometry

12 Straight lines: Various forms of a straight line - Angle between two lines, perpendicular distance from a point, intersection of non-parallel lines and distance between parallel lines.

13. Circle: Locus of a point, Circle definition - Circle equation given (i) centre and radius, (ii) two ends of a diameter (iii) three non-collinear points of type (0,0), (a,0), (0, b) - General equation of a circle -its centre and radius.

14. Definition of a conic section - Equation of a conic when focus, directrix and eccentricity are given - Properties of parabola, ellipse and hyperbola in standard forms.

UNIT-IV

Differential Calculus

15. Concept of Limit- Definition and Properties of Limits and Standard Limits - Continuity of a function at a point.

16. Concept of derivative- Definition (first principle)- different notations - Derivatives of standard algebraic, logarithmic, exponential, trigonometric, inverse trigonometric, hyperbolic and inverse hyperbolic functions - Derivatives of sum, difference, scalar multiplication, product, quotient of functions - Chain rule, derivatives of parametric functions, derivatives of implicit functions, logarithmic differentiation - Second order derivatives - Functions of several variables, first and second order partial derivatives.

UNIT-V

Applications of Derivatives

17. Geometrical meaning of the derivative, equations of tangent and normal to a curve at any point.

18. Physical applications of derivatives - Velocity, acceleration, derivative as a rate measurer.

19. Applications of the derivative to find the extreme values - Increasing and decreasing functions, maxima and minima for quadratic and cubic polynomials.

20. Absolute, relative and percentage errors - Approximate values due to errors in measurements.

Textbook:

Engineering Mathematics-I, a textbook for first year diploma courses, prepared & prescribed by SBTET, AP.

Reference Books:

1. Shanti Narayan, A Textbook of matrices, S.Chand&Co.
2. Robert E. Moyer & Frank Ayers Jr., Schaum's Outline of Trigonometry, 4th Edition, Schaum's Series.
3. G.B.Thomas, R.L.Finney, Calculus and Analytic Geometry, Addison Wesley, 9th Edition, 1995.
4. Frank Ayers & Elliott Mendelson, Schaum's Outline of Calculus, Schaum's Series.
5. M.Vygodsky, Mathematical Handbook, Mir Publishers, Moscow.

Unit Test Syllabus

Unit Test	Syllabus
Unit Test-I	From L.O. 1.1 to L.O. 2.9
Unit Test-II	From L.O. 2.10 to L.O. 3.8
Unit Test-III	From L.O.4.1 to L.O. 5.7

C-23 - ENGINEERING PHYSICS

Course code	Course title	No.of periods per week	Total no. of periods	Marks for FA	Marks for SA
CHPC -103	Engineering Physics	03	90	20	80

TIME SCHEDULE

S.No	Major topics	No. of Periods	Weightage of Marks	Short Answer type (3 marks)	Essay type (10 marks)	COs mapped
1.	Units and measurements	09	03	1		CO1
2.	Statics	11	13	1	1	
3.	Gravitation	12	20	-	2	CO2
4.	Concepts of energy	10	13	1	1	
5.	Thermal physics	10	13	1	1	CO3
6.	Sound	12	16	2	1	
7.	Electricity & Magnetism	13	16	2	1	CO4
8.	Modern physics	13	16	2	1	
	Total:	90	110	10	8	

Course title : Engineering Physics	
Course objectives	<p>(1) To understand the basic concepts of physics for various Engineering applications as required for industries.</p> <p>(2) To equip the students with the scientific advances in technology and make the student suitable for any industrial or scientific organization.</p>

COURSE OUTCOMES	CO1	Familiarize with various physical quantities, their SI units and errors in measurements; understand the concepts of vectors and various forces in statics.
	CO2	Understand the concepts of gravitation with reference to applications in satellites, provide the knowledge of various forms of energy and their working principles.
	CO3	Familiarize with the knowledge of transmission of heat and gas laws; provide the knowledge on musical sound and noise as pollution and also the concepts of echo and reverberation.
	CO4	Provide basic knowledge of electricity and concepts of magnetism and magnetic materials; familiarize with the advances in Physics such as photoelectric cell, optical fibers, semiconductors, superconductors and nanotechnology.

MATRIX SHOWING MAPPING OF COURSE OUTCOMES WITH PROGRAMME OUTCOMES

Course code CHPC -103	Engineering Physics No of Course Objectives : 4				No of periods 90
POs	Mapped with CO No	CO addressing PO in Col 1 NO	periods 1,2,3 %	1,2,3	remarks
PO1	CO1,CO2,CO3,CO4	44	48.9 %	3	>40% level 3 (highly addressed) 25% to 40% level 2 (moderately addressed) 5% to 25% level 1 (Low addressed) < 5% (not addressed)
PO2	CO1,CO2, CO4	11	12.2%	1	
PO3	CO1, CO2,CO3, CO4	10	11.1%	1	
PO4	CO1, CO2,CO4	8	8.9%	1	
PO5	CO2,CO3, CO4	8	8.9%	1	
PO6					
PO7	CO1, CO2, CO3, CO4	9	10.0%	1	

CO-PO Mapping Strength

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	3	2	2	1			2	2		2
CO2	3	2	2	2	2		2	1		2
CO3	2		1		2		1		1	1
CO4	3	2	3	2	2		3	2		2

3 = strongly mapped, 2 = moderately mapped, 1 = slightly mapped

Note: The gaps in CO and PO mapping will be achieved by one or more appropriate activities from the following.

- | | | | | | |
|------------------------|----------------|------------------------|------------------|--------------------------------|---------------------|
| (i) Seminars | (ii) Tutorials | (iii) Guest Lecturers | (iv) Assignments | | |
| (v) Quiz competitions | | (vi) Industrial visits | | (vii) Tech fest | (viii) Mini project |
| (ix) Group discussions | | (x) Virtual classes | | (xi) Library visit for e-books | |

Learning outcomes

Upon completion of the course the student shall be able to

1.0 Understand the concept of units and measurements

- 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 for fundamental and some derived quantities
- 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 What are direct and indirect measurements
- 1.10 Define accuracy and least count
- 1.11 Define error in measurement
- 1.12 Define absolute, relative and percentage errors with their formulae
- 1.13 Solve simple problems on absolute, relative and percentage errors

2.0 Understand the concepts of statics

- 2.1 Explain the concept of Vectors
- 2.2 Define scalar and vector quantities with examples
- 2.3 Represent vectors geometrically
- 2.4 Define the types of vectors (equal, negative, unit, co-initial, co-planar, position vector)
- 2.5 Resolve the vector into rectangular components
- 2.6 State and explain triangle law of addition of vectors
- 2.7 Define concurrent forces, co-planar forces and equilibrant.
- 2.8 State and explain Lami's theorem
- 2.9 State the parallelogram law of addition of forces with diagram.
- 2.10 Write the expressions for magnitude and direction of resultant (no derivation)
- 2.11 Illustrate parallelogram law with examples (i) flying of bird and (ii) working of sling.
- 2.12 Define moment of force and couple.
- 2.13 Write the formulae and S.I units of moment of force and couple.
- 2.14 Solve simple problems on (i) Resolution of force and (ii) Parallelogram law of forces (finding R, α and θ).

3.0 Understand the concepts of Gravitation

- 3.1 State and explain Newton's universal law of gravitation.
- 3.2 Define G and mention its value.
- 3.3 Explain the acceleration due to gravity (g)
- 3.4 Explain the factors affecting the value of g
- 3.5 Derive the relationship between g and G.
- 3.6 State and explain the Kepler's laws of planetary motion
- 3.7 Define a satellite.
- 3.8 What are natural and artificial satellites, Give examples.
- 3.9 Define orbital velocity and write its formula.
- 3.10 Define escape velocity and write its formula.
- 3.11 Write a brief note on Polar satellites.
- 3.12 Write a brief note on Geo-stationary satellites.

- 3.13 Mention the applications of artificial satellites.
- 3.14 Solve simple problems on (i) Newton's law of gravitation and (ii) calculation of orbital and escape velocities.

4.0 Understand the concepts of Energy.

- 4.1 Define work done and energy. Mention their SI units.
- 4.2 List various types of energy.
- 4.3 Define P.E with examples. Write its equation.
- 4.4 Define K.E with examples. Write its equation.
- 4.5 Derive relationship between K.E and momentum.
- 4.6 State the law of conservation of energy. Give various examples.
- 4.7 Write a brief note on solar energy.
- 4.8 Explain the principle of solar thermal conversion.
- 4.9 Explain the principle of photo voltaic effect
- 4.10 Solve simple problems on (i) work done (ii) P.E & K.E and (iii) Relation between K.E & momentum.

5.0 Understand the concepts of thermal physics

- 5.1 Define the concepts of heat and temperature
- 5.2 State different modes of transmission of heat
- 5.3 Explain conduction, convection and radiation with two examples each.
- 5.4 State and explain Boyle's law
- 5.5 Define absolute zero temperature
- 5.6 Explain absolute scale of temperature
- 5.7 State the relationship between degree Celsius, Kelvin and Fahrenheit temperatures
- 5.8 State Charle's law and write its equation
- 5.9 State Gay-Lussac's law and write its equation
- 5.10 Define ideal gas
- 5.11 Derive ideal gas equation
- 5.12 Explain why universal gas constant (R) is same for all gases in nature
- 5.13 Calculate the value of R for 1 gram mole of gas.
- 5.14 Solve simple problems on (i) Inter conversion of temperatures between °C, K and F
(ii) Gas laws and (iii) Ideal gas equation.

6.0 Understand the concepts of Sound

- 6.1 Define the term sound
- 6.2 Define longitudinal and transverse waves with one example each
- 6.3 Explain the factors which affect the velocity of sound in air
- 6.4 Distinguish between musical sound and noise
- 6.5 Explain noise pollution and state SI unit for intensity of sound
- 6.6 Explain sources of noise pollution
- 6.7 Explain effects of noise pollution
- 6.8 Explain methods of minimizing noise pollution
- 6.9 Define Doppler effect.
- 6.10 List the Applications of Doppler effect
- 6.11 Define reverberation and reverberation time
- 6.12 Write Sabine's formula and name the physical quantities in it.
- 6.13 Define echoes and explain the condition to hear an echo.
- 6.14 Mention the methods of reducing an echo
- 6.15 Mention the applications of an echo
- 6.16 What are ultrasonics
- 6.17 Mention the applications of ultra sonics, SONAR
- 6.18 Solve simple problems on echo

7.0 Understand the concepts of Electricity and Magnetism

- 7.1 Explain the concept of P.D and EMF
- 7.2 State Ohm's law and write the formula
- 7.3 Explain Ohm's law
- 7.4 Define resistance and specific resistance. Write their S.I units.
- 7.5 State and explain Kichoff's first law.
- 7.6 State and explain Kirchoff's second law.

- 7.7 Describe Wheatstone bridge with legible sketch.
- 7.8 Derive an expression for balancing condition of Wheatstone bridge.
- 7.9 Describe Meter Bridge experiment with necessary circuit diagram.
- 7.10 Write the formulae to find resistance and specific resistance in meter bridge
- 7.11 Explain the concept of magnetism
- 7.12 What are natural and artificial magnets (mention some types)
- 7.13 Define magnetic field and magnetic lines of force.
- 7.14 Write the properties of magnetic lines of force
- 7.15 State and explain the Coulomb's inverse square law of magnetism
- 7.16 Define magnetic permeability
- 7.17 Define para, dia, ferro magnetic materials with examples
- 7.18 Solve simple problems on (i) Ohm's law (ii) Kirchoff's first law (iii) Wheatstone bridge (iv) meter bridge and (v) Coulomb's inverse square law

8.0 Understand the concepts of Modern physics

- 8.1 State and explain Photo-electric effect.
- 8.2 Write Einstein's Photo electric equation and name the physical quantities in it.
- 8.3 State laws of photo electric effect
- 8.4 Explain the Working of photo electric cell
- 8.5 List the Applications of photoelectric effect
- 8.6 Recapitulate refraction of light and its laws
- 8.7 Define critical angle
- 8.8 Explain the Total Internal Reflection
- 8.9 Explain the principle and working of Optical Fiber
- 8.10 List the applications of Optical Fiber
- 8.11 Explain the energy gap based on band structure
- 8.12 Distinguish between conductors, semiconductors and insulators based on energy gap
- 8.13 Define doping
- 8.14 Explain the concept of hole
- 8.15 Explain the types of semiconductors , Intrinsic and extrinsic
- 8.16 Explain n-type and p-type semiconductors
- 8.17 Mention the applications of semiconductors
- 8.18 Define superconductor and superconductivity
- 8.19 List the applications of superconductors
- 8.20 Nanotechnology definition, nano materials and applications

COURSECONTENT

1. Units and measurements

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 - Direct and indirect measurements - Accuracy and least count - Errors : Absolute, relative and percentage errors -Problems.

2. Statics

Scalars and Vectors- Representation of a vector - Types of vectors - Resolution of vector into rectangular components - Triangle law of vectors - Concurrent forces - Lami's theorem - Parallelogram law of forces : Statement, equations for magnitude and direction of resultant, examples - Moment of force and couple - Problems.

3. Gravitation

Newton's law of gravitation and G - Concept of acceleration due to gravity (g) - Factors affecting the value of g - Relation between g and G- Kepler's laws - Satellites : Natural and artificial - Orbital velocity and escape velocity - Polar and geostationary satellites - Applications of artificial satellites - Problems.

4. Concepts of energy

Work done & Energy-Definition and types of energy - potential energy - kinetic energy-- K.E and momentum relation - Law of Conservation of energy, examples - Solar energy, principles of thermal and photo conversion - Problems.

5. Thermal physics

Modes of transmission of heat - Expansion of Gases - Boyle's law - Absolute scale of temperature - Thermometric scales and their inter conversion - Charle's law - Gay-Lussac's law - Ideal gas equation - Universal gas constant (R) - Problems.

6. Sound

Sound - Nature of sound - Types of wave motion, Longitudinal and transverse - Factors affecting the velocity of sound in air - musical sound and noise - Noise pollution - Causes & effects - Methods of reducing noise pollution - Doppler effect - Echo- Reverberation -Reverberation time-Sabine 's formula - Ultrasonics & applications - SONAR - Problems.

7. Electricity & Magnetism

Concept of P.D and EMF - Ohm's law and explanation-Specific resistance - Kirchoff's laws - Wheat stone's bridge - Meter bridge.

Natural and artificial magnets - magnetic field and magnetic lines of force - Coulomb's inverse square law - Permeability - Magnetic materials - Para, dia, ferro - Examples - Problems.

8. Modern Physics

Photoelectric effect - laws of photoelectric effect - photoelectric cell - Applications of photoelectric cell - Total internal reflection - Fiber optics - Principle and working of an optical fiber - Applications of optical fibers - Semiconductors : Based on Energy gap - Doping - Hole - Intrinsic and extrinsic semiconductors (n-type & p-type) - Applications of semiconductors - Superconductivity - applications - Nanotechnology definition, nano materials, applications.

REFERENCES

1. Intermediate physics - Volume - I & 2 Telugu Academy (English version)
2. Unified physics Volume 1, 2, 3 and 4 Dr. S.L.Guptha and Sanjeev Guptha
3. Concepts of Physics, Vol 1 & 2 H.C. Verma
4. Text book of physics Volume I & 2 Resnick & Halliday
5. Fundamentals of physics Brijlal & Subramanyam
6. Text book of applied physics Dhanpath Roy
7. NCERT Text Books of physics Class XI & XII Standard
8. e-books/e-tools/websites/Learning Physics software/eLMS

Table showing the scope of syllabus to be covered for unit tests

Unit test	Learning outcomes to be covered
Unit test - 1	From 1.1 to 3.14
Unit test - 2	From 4.1 to 6.18
Unit test - 3	From 7.1 to 8.20

Engineering Chemistry and Environmental Studies (C-23)

CHPC-104

Course code	Course Title	No. of Periods per week	Total No. of Periods	Marks for FA	Marks for SA
CHPC-104	Engineering Chemistry and Environmental Studies	3	90	20	80

Model Blue Print with Weightage for Blooms category and questions for each chapter and COs mapped

S.No	Unit Title/Chapter	No of Periods	Weight age of marks	Question wise distribution		Mapped with CO
				Essay	Short	
1	Fundamentals of Chemistry	14	21	1½*	2	CO1
2	Solutions, Acids and Bases	16	21	1½*	2	CO1
3	Electrochemistry	12	13	1	1	CO2
4	Corrosion	8	13	1	1	CO2
5	Water Treatment	8	13	1	1	CO3
6	Polymers & Engineering materials.	12	13	1	1	CO4
7	Fuels	6	3	0	1	CO4
8	Environmental Studies	14	13	1	1	CO5
Total		90	110	8	10	

*One question of 10 marks should be given with 50% weightage from unit title 1 and 2

Course Objectives

Course Title: Engineering Chemistry & Environmental Studies	
Course Objectives	<ol style="list-style-type: none"> 1. To familiarize with the concepts of chemistry involved in the process of various Engineering Industrial Applications. 2. To know the various natural and man-made environmental issues and concerns with an interdisciplinary approach that include physical, chemical, biological and socio cultural aspects of environment. 3. to reinforce theoretical concepts by conducting relevant experiments/exercises

Course outcomes

Course Outcomes	CO1	Explain Bohr's atomic model, chemical bonding, mole concept, acids and bases, P ^H and Buffer solutions.
	CO2	Explain electrolysis, Galvanic cell, batteries and corrosion
	CO3	Explain the chemistry involved in the treatment of hardness in water.
	CO4	Explain the methods of preparation and applications of Polymers and Elastomers, chemical composition and applications of Alloys, Composite Materials, Liquid Crystals, Nano Materials and Fuels.
	CO5	Explain Global impacts due to air pollution, causes, effects and controlling methods of water pollution and understand the environment, forest resources, e-Pollution and Green Chemistry Principles.

CHPC-104	Engineering. Chemistry and Environmental studies No of Course Outcomes:5				No Of periods 90
POs	Mapped with CO No	CO periods addressing PO in Col NO. 1	%	Level 1,2,3	remarks
PO1	CO1,CO2,CO3	42	46.7 %	3	>40% level 3 (highly addressed) 25% to 40% level 2(moderately addressed) 5% to 25% level 1 (Low addressed) < 5%(not addressed)
PO2	CO2,CO3	16	17.8%	1	
PO3	CO4	12	13.3%	1	
PO4	CO4	6	6.7%	1	
PO5	CO5	14	15.5%	1	
PO6	-	-	-	-	
PO7	-	-	-	-	

COs-POs mapping strength (as per given table)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	-	-	-	-
CO2	3	1	-	-	-	-	-	-	-	-
CO3	3	1	-	-	-	-	-	-	-	-
CO4	-	-	1	1	-	-	-	-	-	-
CO5	-	-	-	-	1	-	-	-	-	-
Average	3	1	1	1	1	-	-	-	-	-

3=strongly mapped 2= moderately mapped 1= slightly mapped

Note: The gaps in CO and PO mapping will be achieved by one or more appropriate activities from the following:

- i) Seminars ii) Tutorials iii) Guest Lectures iv) Assignments v) Quiz competitions vi) Industrial visit vii) Tech Fest viii) Mini project ix) Group discussions x) Virtual classes xi) Library visit for e-books

Upon completion of the course, the student shall be able to learn out

ENGINEERING CHEMISTRY AND ENVIRONMENTAL STUDIES

1.0 Atomic structure

- 1.1 Explain the charge, mass of fundamental particles of an atom (electron, proton and neutron) and the concept of atomic number and mass number.
1.2 State the Postulates of Bohr's atomic theory and its limitations.
1.3 Explain the significance of four Quantum numbers and draw the atomic structures of Silicon

and Germanium.

- 1.4 Define Orbital of an atom and draw the shapes of s,p and d-orbitals.
- 1.5 Explain 1. Aufbau principle, 2. Pauli's exclusion principle 3. Hund's principle.
- 1.6 Write the electronic configuration of elements up to atomic number 30.
- 1.7 Explain the significance of chemical bonding.
- 1.8 Explain the Postulates of Electronic theory of valency.
- 1.9 Define and explain Ionic and Covalent bonds with examples of NaCl , *H₂,*O₂ and *N₂.(* Lewis dot method).
- 1.10 List out the Properties of Ionic compounds and covalent compounds and distinguish between their properties.

2.0 Solutions, Acids and Bases

- 2.1 Define the terms 1. Solution, 2. Solute and 3. Solvent.
- 2.2 Classify solutions based on solubility.
- 2.3 Define the terms 1. Atomic weight, 2. Molecular weight and 3. Equivalent weight.
Calculate Molecular weight and Equivalent weight of the given acids (HCl, H₂SO₄, H₃PO₄) Bases (NaOH, Ca(OH)₂, Al(OH)₃ and Salts (NaCl, Na₂CO₃, CaCO₃).
- 2.4 Define mole and solve numerical problems on mole concept.
- 2.5 Define molarity, normality and solve numerical problems on molarity and normality.
 - a) Calculate the Molarity or Normality, if weight of solute and volume of solution are given.
 - b) Calculate the weight of solute, if Molarity or Normality with volume of solution are given.
 - c) Problems on dilution to convert high concentrated solutions to low concentrated solutions.
- 2.6 Explain Arrhenius theory of Acids and Bases and give its limitations.
- 2.7 Define ionic product of water, pH and solve numerical problems on pH (Strong Acids and Bases).
- 2.8 Define buffer solution and classify buffer solutions with examples. Give its applications.

3.0 Electrochemistry

- 3.1 Define the terms 1. Conductor 2. Semiconductor 3. Insulator, 4. Electrolyte 5. Non-electrolyte. Give two examples each.
- 3.2 Distinguish between Metallic conduction and Electrolytic conduction.
- 3.3 Explain electrolysis by taking an example of used NaCl and list out the applications of electrolysis.
- 3.4 Define Galvanic cell. Explain the construction and working of Galvanic cell.
- 3.5 Distinguish between electrolytic cell and galvanic cell.
- 3.6 Define battery and list the types of batteries with examples.
- 3.7 Explain the construction, working and applications of i) Dry cell (Leclanche cell), ii) Lead storage battery, iii) Lithium-Ion battery and iv) Hydrogen-Oxygen fuel cell.

4.0 Corrosion

- 4.1 Define the term corrosion.
- 4.2 state the Factors influencing the rate of corrosion.
- 4.3 Describe the formation of (a) composition cell (b) stress cell (c) concentration cell during corrosion.
- 4.4 Define rusting of iron and explain the mechanism of rusting of iron.
- 4.5 Explain the methods of prevention of corrosion by
 - (a) Protective coatings (anodic and cathodic coatings).
 - (b) Cathodic protection (Sacrificial anode process and Impressed-voltage process).

5.0 Water Treatment

- 5.1 Define soft water and hard water with respect to soap action.
- 5.2 Define and classify the hardness of water.
- 5.3 List out the salts that causing hardness of water (with Formulae).
- 5.4 State the disadvantages of using hard water in industries.
- 5.5 Define Degree of hardness and units of hardness (mg/L and ppm).
- 5.6 Solve numerical problems on hardness.
- 5.7 Explain the methods of softening of hard water by (i) Ion-exchange process and (ii) Reverse Osmosis process.

6.0 Polymers & Engineering materials.

A) Polymers

- 6.1 Explain the concept of polymerization.

- 6.2 Describe the methods of polymerization (a) addition polymerization of ethylene (b) condensation polymerization of Bakelite (Only flowchart).
- 6.3 Define plastic. Explain a method of preparation and uses of the following plastics:
1. PVC 2. Teflon 3. Polystyrene 4. Nylon 6,6.
- 6.4 Define elastomers. Explain a method of preparation and applications of the following:
1. Buna- S 2. Neoprene.

B) Engineering Materials

- 6.5 Define an alloy. Write the composition and applications of the following:
1. Nichrome 2. Duralumin 3. Stainless Steel.
- 6.6 Define Composite Materials and give any two examples. State their Properties and applications.
- 6.7 Define Liquid Crystals and give any two examples. State their Properties and applications.
- 6.8 Define Nano Materials and give any two examples. State their Properties and applications.

7.0 Fuels

- 7.1 Define the term fuel.
- 7.2 Classify the fuels based on occurrence.
- 7.3 Write the composition and uses of the following:
1. LPG 2. CNG 3. Biogas 4. Power alcohol
- 7.4 Write the commercial production of Hydrogen as future fuel. Give its advantages and disadvantages.

8.0 ENVIRONMENTAL STUDIES

- 8.1 Explain the scope and importance of environmental studies.
- 8.2 Define environment. Explain the different segments of environment.
1. Lithosphere 2. Hydrosphere 3. Atmosphere 4. Biosphere
- 8.3 Define the following terms:
1. Pollutant 2. Pollution 3. Contaminant 4. Receptor 5. Sink 6. Particulates 7. Dissolved oxygen (DO) 8. Threshold Limit Value (TLV) 9. BOD 10. COD 11. Eco system 12. Producers 13. Consumers 14. Decomposers with examples.
- 8.4 State the renewable and non-renewable energy sources with examples.
- 8.5 State the uses of forest resources.
- 8.6 Explain the causes and effects of deforestation.
- 8.7 Define air pollution and explain its Global impacts 1. Greenhouse effect, 2. Ozone layer depletion and 3. Acid rain.
- 8.8 Define Water pollution. Explain the causes, effects and controlling methods of Water pollution.
- 8.9 Define e-Pollution, State the sources of e-waste. Explain its health effects and control methods.
- 8.10 Define Green Chemistry. Write the Principles and benefits of Green Chemistry.

COURSE CONTENT

ENGINEERING CHEMISTRY AND ENVIRONMENTAL STUDIES

1. Fundamentals of Chemistry

Atomic Structure: Introduction - Fundamental particles - Bohr's theory - Quantum numbers - Atomic structure of Silicon and Germanium - Orbitals, shapes of s, p and d orbitals - Aufbau's principle - Hund's rule - Pauli's exclusion Principle - Electronic configuration of elements.

Chemical Bonding: significance-Electronic theory of valency- Types of chemical bonds - Ionic and covalent bond with examples-Properties of Ionic and Covalent compounds.

2. Solutions, Acids and Bases

Solutions: Types of solutions - Mole concept - Numerical problems on mole concept -Methods of expressing concentration of a solution - Molarity and Normality - Numerical problems on molarity and normality.

Acids and Bases: Arrhenius theory of acids and bases - Ionic product of water- pH-Numerical problems on pH-Buffer solutions - Classification- applications.

3. Electrochemistry

Conductors, semiconductors, insulators, electrolytes and non-electrolytes - Electrolysis of fused NaCl- Applications of electrolysis - Galvanic cell - Battery-Types- Dry Cell (Leclanche Cell), Lead- Storage battery- Lithium-Ion battery -Hydrogen-Oxygen Fuel cell.

4. Corrosion

Introduction - Factors influencing corrosion - Composition, Stress and Concentration Cells- Rusting of iron and its mechanism - Prevention of corrosion by Protective Coating methods, Cathodic Protection methods.

5. Water treatment

Introduction- Soft and Hard water- Causes of hardness- Types of hardness- Disadvantages of hard water - Degree of hardness (ppm and mg/lit) - Numerical problems on hardness - Softening methods - Ion-Exchange process- Reverse Osmosis process.

6. Polymers & Engineering materials

Polymers:

Concept of polymerization - Types of polymerization - Addition, condensation with examples - Plastics - Preparation and uses of i).PVC ii) Teflon iii) Polystyrene and iv) Nylon 6,6.

Elastomers: Preparation and application of i)Buna-s and ii) Neoprene.

Engineering Materials:

Alloys- Composition and applications of i) Nichrome, ii) Duralumin and iii) Stainless Steel.

Composite Materials- Properties and applications.

Liquid Crystals- Properties and applications.

Nano Materials- Properties and applications.

7. Fuels

Definition and classification of fuels - Composition and uses of i) LPG ii) CNG iii) Biogas and iv) Power alcohol - Hydrogen as a future fuel-production- advantages and disadvantages.

8. ENVIRONMENTAL STUDIES

Scope and importance of environmental studies - Environment - Important terms related to environment- Renewable and non-renewable energy sources-Forest resources - Deforestation -Air pollution-Global impacts on environment -Water pollution - causes - effects - control measures- e-Pollution -Sources of e-waste - Health effects - Control methods - Green Chemistry- Principles -Benefits.

Table specifying the scope of syllabus to be covered for Unit Test- 1, Unit Test- 2 and Unit Test -3

Unit Test	Learning outcomes to be covered
Unit Test - 1	From 1.1 to 2.8
Unit Test - 2	From 3.1 to 5.7
Unit Test - 3	From 6.1 to 8.10

REFERENCE BOOKS

- | | |
|---------------------------|---------------------------------|
| 1. Telugu Academy | Intermediate chemistry Vol. 1&2 |
| 2. Jain & Jain | Engineering Chemistry |
| 3. O.P. Agarwal, Hi-Tech. | Engineering Chemistry |
| 4. D.K.Sharma | Engineering Chemistry |
| 5. A.K. De | Engineering Chemistry |

INTRODUCTION TO CHEMICAL AND PETROLEUM ENGINEERING

Course Code	Course title	No of periods/week	Total no of periods	Marks for FA	Marks for SA
CHPC-105	INTRODUCTION TO CHEMICAL AND PETROLEUM ENGINEERING	05	150	20	80

TIME SCHEDULE

S.No	Chapter/Unit title	No Of periods	Weight age Allocated	SHORT ANSWER TYPE QUESTIONS	ESSAY TYPE QUESTIONS	CO's Mapped
1	Introduction to Chemical Engineering	15	13	1	1	CO1, CO2, CO4
2	Material and Energy Balances	15	13	1	1	CO1, CO2, CO5
3	Fluid Mechanics	15	13	1	1	CO1, CO2, CO3, CO4
4	Heat Transfer	20	13	1	1	CO1, CO2, CO3, CO4, CO5
5	Mass Transfer	20	13	1	1	CO1, CO2, CO3, CO4
6	Chemical Kinetics	10	3	1	0	CO1
7	Measuring Devices	15	13	1	1	CO1, CO3
8	Natural Resources and their Utilization	10	3	1	0	CO1, CO4
9	Fundamentals of Upstream operations	15	13	1	1	CO1, CO3, CO4
10	Fundamentals of downstream operations	15	13	1	1	CO1, CO3, CO4
Total		150	110	10	8	

Course Objectives

Course Objectives	<ol style="list-style-type: none"> 1. To familiarize with the knowledge of importance of Chemical Engineering, Physico-Chemical calculations and Material and energy balances, equipment for flow of fluids, Chemical kinetics, measuring devices, natural resources and their utilization 2. To know the various Unit operations like heat and mass transfer operations 3. To familiarize with the aspects of upstream and downstream activities.
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Course outcomes

CO No		Course Outcomes
CO1	CHPC-105.1	Explain the basic laws, principles, theories, fundamentals in Chemical and Petroleum Engineering
CO2	CHPC-105.2	Formulate Mathematical Equations, formulae involved in Chemical and Petroleum Engineering.
CO3	CHPC-105.3	Illustrate the Operation, working and construction of measuring devices related to Chemical and Petroleum Engineering with diagrams and line diagrams.
CO4	CHPC-105.4	Appraise the Importance, applications and properties related to Chemical and Petroleum Engineering.
CO5	CHPC-105.5	Familiarize with the problems related to the aspects of Chemical Engineering.

CO-PO/PSO MATRIX

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CHPC-105.1	3							3		
CHPC-105.2		2								
CHPC-105.3			2						3	
CHPC-105.4		1								2
CHPC-105.5		2								
Average	3	2	2					3	3	2

3 = Strongly mapped
 2 = Moderately mapped
 1 = Slightly mapped

Learning Outcome (Max 6 to 8 per each chapter, to facilitate learning and testing):

Chapter-1: Introduction to Chemical Engineering:

- 1.1. Know the importance of Chemical Engineering.
- 1.2. List industries of various fields of Chemical Engineering.

- 1.3. List industrial applications of various fields of Chemical Engineering.
- 1.4. Know the definition, principle, types of Unit Operations with examples.
- 1.5. Know the definition, principle, types of Unit Processes with examples.
- 1.6. Understand the basic laws, statement of the laws, mathematical forms of the laws related to Chemical Engineering.
- 1.7. List the useful mathematical methods of Chemical Engineering

Chapter-2: Material and Energy Balances:

- 2.1. Know the list of Fundamental and Derived quantities.
- 2.2. Define atom, molecule, mole, gram-atom, gram-molecule, gram molar volume.
- 2.3. Define density and specific gravity, variation of density and specific gravity with temperature.
- 2.4. Know the kinetic theory of gases.
- 2.5. Know about gas laws
- 2.6. Know about ideal gas equation and ideal gas constant
- 2.7. Know about stoichiometry, application of stoichiometry, stoichiometric equations, stoichiometric coefficients, and stoichiometric proportions. Give suitable examples.
- 2.8. Explain the terms internal energy and enthalpy.
- 2.9. Know the terms sensible heat and latent heat.
- 2.10. Define a) Heat capacity and b) Specific heat.
- 2.11. Know different methods of expression concentration.
- 2.12. Know about partial and complete combustion.
- 2.13. Define calorific value.
- 2.14. Solve problems on the above concepts.

Chapter-3: Fluid Mechanics:

- 3.1. State the importance of flow of fluids.
- 3.2. Define a fluid and know about the types of fluids.
- 3.3. State the important physical properties of fluid and give their units.
- 3.4. List out different types of fluids based on physical properties.
- 3.5. Explain fluid statics and principles of fluid statics.
- 3.6. Describe the measurement of gauge pressure, absolute pressure and pressure measurement by U-tube manometer and mathematical expressions involved to measure pressure.
- 3.7. Explain Fluid dynamics and its significance.
- 3.8. State Newton's law of viscosity with mathematical expression.
- 3.9. Distinguish Laminar and Turbulent flow.
- 3.10. Know about the continuity equation.
- 3.11. Know the energies associated with a flowing fluid.
- 3.12. Understand Bernoulli's equation.
- 3.13. Know about momentum balance equation.
- 3.14. Know the definition and the importance of Reynold's number.
- 3.15. List different types of valves and their applications with line diagrams.
- 3.16. Know the Classification of pumps.
- 3.17. Discuss Functioning of pumps, Fan, Blower and compressor with line diagrams and their uses.

Chapter-4: Heat Transfer:

- 4.1. Understand the nature of heat flow.
- 4.2. Understand various mechanisms of heat flow such as conduction, convection and Radiation.
- 4.3. Define conduction, convection and Radiation.
- 4.4. Define steady state and unsteady state heat flow
- 4.5. Explain the Fourier's law of heat flow by conduction with mathematical expression.
- 4.6. Define natural convection and forced convection
- 4.7. Explain emission of radiation and emissive power.

- 4.8. Know about black body and laws of black body radiation.
- 4.9. Know the operation, classification of heat exchangers with line diagrams.
- 4.10. Know about the uses of heat exchangers.
- 4.11. Understand about the operation of different types of evaporators with line diagrams.
- 4.12. Know about the uses of evaporators.
- 4.13. Solve problems on the above concepts.

Chapter-5: Mass Transfer:

- 5.1. Define the mass transfer operation and mention the applications.
- 5.2. Understand the process of molecular diffusion with examples.
- 5.3. Know about the Fick's law of molecular diffusion, its equation.
- 5.4. Know about Eddy diffusion with examples.
- 5.5. Know the batch, continuous contact operations.
- 5.6. Know the co-current, counter- current contact and cross current operations.
- 5.7. Know about operation of distillation with examples and line diagrams.
- 5.8. Know about operation of absorption and stripping with examples and line diagrams.
- 5.9. Know about operation of extraction and leaching with examples and line diagrams.
- 5.10. Know about the types and operation of adsorption with examples and line diagrams.
- 5.11. Know about the operation of drying with examples and line diagrams.
- 5.12. Know about principles of crystallization, operation of crystallization with examples and line diagrams.

Chapter-6: Chemical Kinetics:

- 6.1. Know about the progress of a chemical reaction.
- 6.2. Know about molecularity of a chemical reaction.
- 6.3. Know about order of a chemical reaction.
- 6.4. Know about collision theory.
- 6.5. Know about catalysts and list of catalysts.
- 6.6. List of catalytic reactions.
- 6.7. Describe Characteristics of a catalyst-activity and selectivity
- 6.8. Know about catalyst carriers
- 6.9. Know about Promoters and list of promoters.

Chapter-7: Measuring Devices:

- 7.1. Know about measurement of density.
- 7.2. Know about measurement of density using Hydrometer with line diagram.
- 7.3. Know about measurement of density using specific gravity bottle with line diagram.
- 7.4. Know about measurement of Viscosity.
- 7.5. Know about measurement of Viscosity using Redwood viscometer with line diagram.
- 7.6. Know about measurement of Viscosity using Saybolt viscometer with line diagram.
- 7.7. Know the measurement of Pressure and list devices to measure pressure with line diagram.
- 7.8. Know the measurement of Temperature, devices to measure temperature with line diagram.
- 7.9. Know the measurement of flow rate and list devices to measure flow rate with line diagram.

Chapter-8: Natural Resources and their Utilization:

- 8.1. Define Renewable sources.
- 8.2. Sources and applications of Renewable sources.
- 8.3. Define Non- Renewable sources
- 8.4. Sources and applications of Non- Renewable sources.
- 8.5. Renewable Energy Resources
 - a. Solar Energy
 - b. Hydro power

- c. Geothermal Energy
- d. Wind Power
- e. Tidal Energy
- f. Biomass
- 8.6. Non- Renewable Energy Resources.
 - a) Fossil Fuels
 - b) Nuclear Energy
 - c) Natural Energy

Chapter-9: Fundamentals of Upstream operations:

- 9.1 Know the industries that perform activities under upstream operations.
- 9.2 Understand about magnetic method, gravity method and seismic method to locate a reservoir of crude petroleum.
- 9.3 Understand about the Petroleum Source rocks, Sedimentary rocks and Reservoir rocks.
- 9.4 Know the characteristics of Reservoir rocks.
- 9.5 Know the classification of Reservoir rocks.
- 9.6 Know the physical properties of Reservoir rocks.
- 9.7 Explain about the theories of origin of hydrocarbon fluids.
- 9.8 Know the definition of permeability, effective and relative permeability and their significance.
- 9.9 State Darcy's law and its significance.
- 9.10 Know the methods of locating a crude petroleum reservoir

Chapter-10: Fundamentals of Downstream operations:

- 10.1 Know the industries that perform activities under downstream operations.
- 10.2 List the petroleum products obtained from crude petroleum.
- 10.3 Know the boiling range of the petroleum products obtained from crude petroleum.
- 10.4 Understand the applications of petroleum products obtained from crude petroleum.
- 10.5 Know the definition of a) Octane number b) Flash and Fire point c) Smoke Point d) Aniline point e) Cloud and pour point f) Softening point g) Drop point of grease.
- 10.6 List the tests to be conducted for the petroleum products obtained from crude petroleum.
- 10.7 Know the significance of the test methods a) Flash and Fire Point b) Smoke point c) Aniline point d) Cloud and Pour Point e) Carbon residue test.
- 10.8 Know about the methods of obtaining refinery products from crude petroleum.
- 10.9 Know the operation and diagrams of equipment required for obtaining refinery products from crude petroleum.
- 10.10 Identify the methods employed to obtain refinery products with good octane number.

COURSE CONTENTS:

1.0 Introduction:

Importance of Chemical Engineering-List of Industries of various fields of Chemical Engineering and their applications-Definition of unit operation, Types, Principles of Unit Operations like Filtration, Evaporation, Drying, Mixing, Crystallization, Distillation, Extraction, Leaching, Adsorption, Absorption, Stripping-Discuss only the principle of unit operation -Definition of Unit Processes, types of unit processes, Principle of unit processes like Nitration, Sulphonation, Halogenation, Oxidation, Hydrogenation, Hydrolysis and polymerization-Basic Laws of Chemical Engineering, their statements, mathematical expressions-Laws- Law of conservation of mass and energy, Steady state and unsteady state balance for mass and energy, Momentum balance, Steady state, rate, gradient, Ideal gas laws, Dalton's law and Amagat's law, List the Useful Mathematical Methods.

2.0 Material and Energy Balances

List of Fundamental and Derived quantities their definitions, units and dimensions-Fundamental quantities (Mass, Length, Temperature, Time), Derived quantities (Density, Specific volume, Specific gravity, Force, Pressure, Work, Energy, Latent heat, Sensible heat, Specific heat, Heat capacity, Mass flux, Molar flux, Heat Flux, Mass flow rate, Momentum,

Acceleration due to gravity)- Define Atom, Molecule, Mole, Gram-atom, Gram-molecule, Gram molar volume- variation of density and specific gravity with temperature-Kinetic theory of gases and its postulates-Energies of gas molecules-Differences between ideal gas and real gas-Gas laws and Ideal gas equation-Vander Waal's equation of state-Ideal gas constant in (lit atm/gmol K)-STP/NTP conditions-Stoichiometry-application of stoichiometry-stoichiometric equations-stoichiometric coefficients-stoichiometric proportions-Internal energy and enthalpy-Partial and Complete Combustion-Calorific value definition and its classification-example for values of calorific values of few fuels-Simple substitution type Problems on topics listed in this chapter.

3.0 **Fluid Mechanics:**

State the importance of flow of fluids-Define a fluid and types of fluids-Newtonian fluids with examples-Non-Newtonian Fluids with examples-Important physical properties of fluid and their units-Viscosity, density, Surface tension, Vapor pressure-List out different types of fluids based on physical properties-Fluid statics and principles of fluid statics-Variation of pressure with depth of a fluid-Pascal's principle-Archimedes principle-Measurement of gauge pressure, absolute pressure and pressure measurement by U-tube manometer and mathematical expressions involved to measure pressure-Fluid dynamics-Continuity equation-Momentum balance - Bernoulli's equation-Energies associated with a flowing fluid-Newton's law of Viscosity-Distinguish Laminar and turbulent flow-Importance of Reynold's number- Different types of valves and their functioning with diagram-Classification of pumps-Functioning of Fan, Blower and compressor.

4.0 **Heat Transfer:**

Introduction to heat transfer with examples-Thermal equilibrium- Steady state and unsteady state heat flow - Nature of heat flow-Mechanisms of heat flow - Conduction, convection and Radiation -Fourier's law of heat flow by conduction-Thermal conductivity, its definition and units in SI system-Simple problems on Fourier's law of heat conduction-Natural convection and forced convection-Emission of Radiation and emissive power-Black body-Laws of radiation-Kirchoff's law, Stefan Boltzmann law, Plank's law, Wein's displacement law-Classification of heat exchangers-Evaporation-Different types of evaporators.

5.0 **Mass Transfer:**

Mass transfer operation-Process of diffusion-Process of molecular diffusion with example-Molar flux-Eddy diffusion-Fick's law of molecular diffusion-Chemical Equilibrium-Batch, continuous contact operations-Co-current, counter-current contact and cross current operations-Distillation and its block diagram-Drying operation with block diagram-Absorption with examples-Stripping operation with examples-Extraction and leaching operations with-Adsorption with examples-Types of adsorption- Crystallization operation with block diagram-Principles of crystallization.

6.0 **Chemical Kinetics:**

Progress of a chemical reaction-Definition of rate of a reaction-Expression for rate of a reaction-factors effecting the rate of a reaction-Molecularity of a chemical reaction-Order of a chemical reaction-Differences between order and molecularity of a reaction-Collision theory-Catalysts-Role of a catalyst-List of catalysts-List of catalytic reactions-Characteristics of a catalyst-activity and selectivity-catalyst carriers-Promoters.

7.0 **Measuring Devices**

Measurement of density-Measurement of density using Hydrometer and specific gravity bottle-Measurement of Viscosity-Measurement of Viscosity using Redwood viscometer-Measurement of Viscosity using Saybolt viscometer-Measurement of Pressure-U Tube manometer-Pressure gauge- Measurement of Temperature - Principle involved in thermometer working-Mercury in glass thermometer-Principle involved in thermocouple working-Thermocouple-Measurement of flow rate- Pitot tube-rotameter.

8.0 **Natural Resources and their Utilization**

Renewable sources-Sources and applications of Renewable sources-Non-Renewable sources-Sources and applications of Non- Renewable sources-Renewable Energy Resources-Solar Energy, Hydro power, Geothermal Energy, Wind Power, Tidal Energy, Biomass-Non- Renewable Energy Resources-Advantages and Disadvantages-Fossil Fuels, Nuclear Energy.

9.0 Fundamentals of Upstream operations:

List of industries that perform activities under upstream operations-Petroleum Source rocks, Sedimentary rocks and Reservoir rocks-Characteristics of Reservoir rocks-Porosity and Permeability-Classification of Reservoir rocks-Physical properties of Reservoir rocks-Theories of origin of hydrocarbon fluids-Definition of permeability, effective and relative permeability and their significance-Darcy's law and its significance-Methods of locating a crude petroleum reservoir- Magnetic method, gravity method and seismic method to locate a reservoir of crude petroleum.

10.0 Fundamentals of Downstream operations:

List industries that perform activities under downstream operations-Petroleum products obtained from crude petroleum-Boiling range of the petroleum products obtained from crude petroleum-Applications of petroleum products obtained from crude petroleum-Definition of a) Octane number b) Flash and Fire point c) Smoke Point d) Aniline point e) Cloud and pour point f) Softening point g) Drop point of grease-Tests to be conducted to the petroleum products and their Significance a) Flash and Fire Point b) Smoke point c) Aniline point d) Cloud and Pour Point e) Carbon residue test -Methods of obtaining refinery products from crude petroleum-Diagrams of equipment required for obtaining refinery products from crude petroleum-Methods employed to obtain refinery products with good octane number.

Reference books:

1. Introduction to Chemical Engineering by Sanyal, Ghoshal and Dutta.
2. Unit operations in Chemical Engineering by Mc-Cabe, Smith and Harriot
3. Modern Petroleum Refining by B.K.Bhaskara Rao

Table specifying the scope of syllabus to be covered for Unit Tests

Unit Test	Learning Outcomes to be covered
Unit Test-I	From 1.1 to 3.15
Unit Test-II	From 4.1 to 6.6
Unit Test-III	From 7.1 to 10.10

MATERIALS TECHNOLOGY

Course code	Course title	No. of periods/week	Total no of periods	Marks of FA	Marks for SA
CHPC - 106	Materials Technology	5	150	20	80

TIME SCHEDULE

S.NO	Chapter/ unit title	No. of periods	Weightage Allocated	Short Answer Questions	Essay type questions	Cos Mapped
1	Introduction	05	03	1	-	CO1
2	Mechanical properties of metals and testing of materials	20	23	1	2	CO1, CO3
3	Structure of metals and alloys	13	13	1	1	CO1
4	Thermal equilibrium diagram	17	10	-	1	CO2
5	Production of iron and steel	22	23	1	2	CO1, CO3, CO4, CO5
6	Plain carbon and alloy steels	10	6	2	-	CO1, CO4, CO5
7	Non - ferrous metals and alloys	15	13	1	1	CO1, CO4
8	Miscellaneous materials	25	06	2	-	CO1, CO4, CO5
9	Corrosion	23	13	1	1	CO1, CO3
	TOTAL	150	110	10	8	

COURSE OBJECTIVES	i. Definition and classification of engineering materials and their applications, mechanical properties and testing of materials, structure of metals and alloys. ii. Thermal equilibrium diagram, cooling and allotropic forms of pure iron, manufacturing methods of iron and steel, classification, composition, properties and applications of plain carbon & alloys steel. ii. Composition, properties and applications of non-ferrous, metals & alloys, applications of miscellaneous materials, types of corrosion, prevention methods of corrosion
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CO NO.		Course Outcomes
CO1	CHPC- 106.1	Describe the basics, definitions, structure, phenomenon of various concepts related to Engineering materials.
CO2	CHPC -106.2	Illustrate the concepts related to Thermal Equilibrium diagrams.
CO3	CHPC -106.3	Explain about the construction and working of various testing machines to test the properties, Corrosion prevention methods, manufacturing methods of various Engineering materials with the aid of block diagrams, flow diagrams and neat sketches.
CO4	CHPC -106.4	Analyse the properties of various Engineering materials.
CO5	CHPC -106.5	Appraise the applications of various Engineering materials.

CO-PO/PSO MATRIX:

CO NO.	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CHPC -106.1	3	-	-	-	-	-	-	1	3	1
CHPC -106.2	-	2	-	-	-	-	-	-	3	-
CHPC -106.3	-	-	3	-	-	-	-	-	3	1
CHPC -106.4	-	-	-	2	-	-	-	-	3	-
CHPC -106.5	-	-	2	-	-	-	-	-	-	1
AVERAGE	3	2	2.5	2	-	-	-	1	3	1

Learning outcome:

CHAPTER – 1

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

CHAPTER – 2

- 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 Distinguish between destructive and non-destructive methods of testing to identify various defects of materials and their applications..
 - 2.3 Explain tensile strength and Compressive strength's by universal testing machine
 - 2.4 Describe the hardness by Brinell hardness testing and Rockwell hardness testing machines.
 - 2.5 Illustrate the determination of impact strength by Izod and Charpy's testing machines.
 - 2.6 Summarize the procedures to detect the internal defects of a metal by radiography and ultrasonic tests.

CHAPTER -3

- 3.1 Quote Unit cell and space lattice.
- 3.2 Describe the arrangements of atoms in FCC (Face Centered Cubic), BCC (Body Centered Cubic) and HCP (Hexagonally 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.

CHAPTER – 4

- 4.1 Explain Cooling curve and Allotropic forms of pure iron.
- 4.2 Draw Iron - Carbon thermal equilibrium diagram.
- 4.3 Locate the Peritectic, eutectic, eutectoid points from the iron - carbon diagram.

CHAPTER – 5

- 5.1 List the various raw materials required for the production of iron.
- 5.2 Describe the block diagram of various manufacture methods of steel and iron.
- 5.3 Explain the production of Pig iron using Blast Furnace.
- 5.4 Explain the production of Cast iron using Cupola Furnace.
- 5.5 Explain the manufacturing methods of steel.
- 5.6 List different types of cast iron.
- 5.7 Mention the properties of cast Iron
- 5.8 Mention applications of cast iron.

CHAPTER – 6

- 6.1 List the classification of plain carbon steels.
- 6.2 Describe the need for alloying the steel with other elements.
- 6.3 List the composition of alloy steels.
- 6.4 Mention the properties of alloy steels.
- 6.5 Mention the industrial applications of alloy steels.
- 6.6 Select the proper alloy steel for the given Engineering application.

CHAPTER - 7

- 7.1 Explain the importance of various non - ferrous metals and alloys - Aluminium, copper, Nickel, lead, Tin, Zinc, titanium, Zirconium.
- 7.2 List the properties of Aluminium, copper, zinc, tin, lead, and their applications.
- 7.3 Explain the effects of the alloying elements (a) Copper (b) Silica (c) Magnesium (d) Manganese with Aluminium.
- 7.4 List the types of copper alloys (Brass & Bronze).
- 7.5 Mention the properties of copper alloys (Brass & Bronze).
- 7.6 Mention the applications of copper alloys (Brass & Bronze).
- 7.7 List the types of Nickel alloys (Monel, Hastalloy).
- 7.8 Mention the properties of Nickel alloys (Monel, Hastalloy).
- 7.9 Mention the applications of Nickel alloys (Monel, Hastalloy).

CHAPTER – 8

- 8.1 Explain the Importance and types of Glass
- 8.2 Mention the applications of Glass
- 8.3 Describe the importance of glass and its lining as materials of construction for the process equipment
- 8.4 List the properties of carbon and graphite
- 8.5 List the applications of carbon and graphite
- 8.6 Explain the composition of stoneware
- 8.7 Mention the properties of stoneware
- 8.8 Mention the applications of stoneware
- 8.9 List the applications of asbestos, Rubber, Elastomers
- 8.10 List the applications of polymers
- 8.11 Define refractories
- 8.12 State the applications of refractories
- 8.13 List the applications of Glass ceramics, Ceramites and Glass wool

CHAPTER – 9

- 9.1 Define corrosion and explain the causes of corrosion
- 9.2 Explain electro chemical theory of corrosion
- 9.3 Describe (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 Explain briefly about the methods of prevention corrosion by
a) proper selection of materials (b) organic coatings (c) inorganic coatings (d) Anodic andCathodic protection (e)Anodic and Cathodic inhibitors.
- 9.6 Know the materials of construction for various process equipment for Storing various chemicals

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 Hazra Chowdhery.
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.
11. Materials Science and Engineering by Raghavan V
12. Engineering Materials by R K Rajput

POs	POs Mapped with CO No.	PO in column 1		Level (1,2,3)	REMARKS
		NO	%		
PO1	CO1	40	44	3	>40% level3
PO2	CO2	5	6	1	Highly addressed
PO3	CO3, CO5	33	36	2	25% level2
PO4	CO4	12	14	1	Moderately addressed
PO5					5 to 25% level1
PO6					Low addressed
PO7					<5% not addressed

Hyponated course contents:

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, \square – 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 of plain carbon steels, application – alloying of steels – industrial applications of alloy steels, 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, polymers, epoxy resin, fibre glass, reinforced plastics,refractories,Glass ceramics, Ceramites ,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.

Syllabus split up for Unit Test

Unit test No.	Learning out comes to be covered
Unit test-I	Objectives from 1.1 to 4.3
Unit test-II	Objective from 5.1 to 7.9
Unit test-III	Objective from 8.1 to 9.6

ENGINEERING DRAWING

Course code	Course Title	No. of periods /week	Total No. of periods	Marks for FA	Marks for SA
CHPC-107	ENGINEERING DRAWING	3	90	40	60

TIME SCHEDULE

S.No	Unit Title	No. of Periods	Weightage Allocated	Short Answer Questions	Essay type questions	CO'S Mapped
1	Use of Drawing Instruments, Free Hand Lettering and Dimensioning Practice	10	10	2		CO1
2	Principles of Geometric Constructions	15	15	1	1	CO2
3	Projections of points, lines, planes and solids	20	25	1	2	CO3
4	Sectional Views	20	10		1	CO4
5	Orthographic projection	25	20		2	CO5
Total		90	80	4	6	

Course Objectives and Course Outcomes

Course Objectives	Upon completion of the course the student shall be able to understand the basic graphic skills and use them in preparation, reading and interpretation of engineering drawings.
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Course Outcomes	CO1	CHPC - 107.1	Practice the use of engineering drawing instruments and Familiarise with the conventions to be followed in engineering drawing as per BIS
	CO2	CHPC- 107.2	Construct the i) basic geometrical constructions ii) engineering curves
	CO3	CHPC - 107.3	Visualise and draw the projections of i) Points ii) Lines iii) Regular Planes iv) Regular Solids
	CO4	CHPC - 107.4	Visualise and draw the sectional views of components
	CO5	CHPC - 107.5	Visualise and draw the orthographic projections of components

LEARNING OUTCOMES

Upon completion of the course the student shall able to

1.0 Use of Drawing Instruments, Free Hand Lettering and Dimensioning Practice

- 1.1 State the importance of drawing as an engineering communication medium
- 1.2 Select the correct instruments to draw the different lines / curves.
- 1.3 Use correct grade of pencil and other instruments to draw different types of lines and for different purposes
- 1.4 Identify the steps to be taken to keep the drawing clean and tidy.
- 1.5 Write titles using vertical and sloping (inclined) lettering and numerals of 7mm, 10mm and 14mm height.
- 1.6 Acquaint with the conventions, notations, rules and methods of dimensioning in engineering drawing as per the B.I.S.
- 1.7 Dimension a given drawing using standard notations and desired system of dimensioning.

2.0 Principles of Geometric Constructions

- 2.1 Practice the basic geometric constructions like i) dividing a line into equal parts
i) Exterior and interior tangents to the given two circles
ii) Tangent arcs to two given lines and arcs
- 2.2 Draw any regular polygon using general method when i) side length is given
i) Inscribing circle radius is given ii) describing circle radius is given
- 2.3 Draw the engineering curves like i) involute ii) cycloid

3.0 Projections of points, lines, planes and solids (All in first quadrant only)

- 3.1 Explain the basic principles of the orthographic projections
- 3.2 Visualise and draw the projection of a point with respect to reference planes (HP & VP)
- 3.3 Visualise and draw the projections of straight lines with respect to two reference Planes (up to lines parallel to one plane and inclined to other plane)
- 3.4 Visualise and draw the projections of planes (up to planes perpendicular to one plane and inclined to other plane)
- 3.5 Visualise and draw the projections of regular solids like Prisms, Pyramids, Cylinder, Cone (up to axis of solids parallel to one plane and inclined to other plane)

4.0 Sectional Views

- 4.1 Identify the need to draw sectional views.
- 4.2 Draw sectional views of regular solids by applying the principles of hatching.

5.0 Orthographic projection

- 5.1 Draw the orthographic views of an object from its pictorial drawing.
- 5.2 Draw the minimum number of views needed to represent a given object fully.

Competencies and Key competencies to be achieved by the student

S.No	Major topic	Key Competency
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1.	Use of Drawing Instruments, Free Hand Lettering and Dimensioning Practice	<ul style="list-style-type: none"> • Explain the linkages between Engineering drawing and other subjects of study in Diploma course.
		<ul style="list-style-type: none"> • Select the correct instruments to draw various entities in different orientation
		<ul style="list-style-type: none"> • Write titles using sloping and vertical lettering and numerals as per B.I.S (Bureau of Indian standards)
		<ul style="list-style-type: none"> • Dimension a given drawing using standard notations and desired system of dimensioning
2.	Geometrical construction	<ul style="list-style-type: none"> • Dividing a line into equal parts, tangents to circles, Construct involute, cycloid from the given data.
3.	Projection of points, Lines, Planes & Solids	<ul style="list-style-type: none"> • Draw the projections of points, straight lines, planes & solids with respect to reference planes (HP& VP)
4.	Sectional Views	<ul style="list-style-type: none"> • Differentiate between true shape and apparent shape of section • Apply principles of hatching. • Draw simple sections of regular solids
5.	Orthographic Projection	<ul style="list-style-type: none"> • Draw the minimum number of views needed to represent a given object fully.

COURSE CONTENTS:

- NOTES: 1. B.I.S Specification should invariably be followed in all the topics.
2. A-3 Size Drawing Sheets are to be used for all Drawing Practice Exercises.

1.0 Use of Drawing Instruments, Free Hand Lettering and Dimensioning Practice

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 - Basic Tools, tools for drawing– Mentioning of names under each classification and their brief description -Scales: Recommended scales reduced & enlarged -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,

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

Purpose of engineering Drawing, Need of B.I.S code in dimensioning -Shape description of an Engineering object - Definition of Dimensioning size description -Location of 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 dimension of narrow spaces.

2.0 Geometric Constructions

Division of a straight line into given number of equal parts –Drawing interior and exterior tangents to two circles of given radii and centre distance-Drawing tangent arc of given radius to touch two lines inclined at given angle (acute, right and obtuse angles), Tangent arc of given radius touching a circle or an arc and a given line, Tangent arcs of radius R, touching two given circles internally and externally-Construction of any regular polygon by general method for given side length, inscribing circle radius and describing/superscripting circle radius - Involute, Cycloid, explanations as locus of a moving point, their engineering application, viz., Gear tooth profile, screw threads, springs etc. – their construction

3.0 Projection of points, lines and planes and Solids (All in first quadrant only)

Classification of projections, Observer, Object, Projectors, Projection, Reference Planes, Reference Line, Various angles of projections –Differences between first angle and third angle projections

Projections of points -Projections of straight line –(a) Parallel to both the planes, (b)Perpendicular to one of the planes and (c) Inclined to one plane and parallel to other planes-Projections of regular planes-(a) Plane parallel to one of the reference planes, (b) Plane perpendicular to HP and inclined to VP and vice versa- Projections of regular solids- (a) Axis perpendicular to one of the planes, (b) Axis parallel to VP and inclined to HP and vice versa.

4.0 Sectional Views

Need for drawing sectional views – what is a sectional view - Hatching – Section of regular solids inclined to one plane and parallel to other plane

5.0 Orthographic Projections

Meaning of orthographic projection - Using a viewing box and a 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 a 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 meter 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.

REFERENCE BOOKS

- 1 Engineering Graphics by P I Varghese – (McGraw-hill)
- 2 Engineering Drawing by Basant Agarwal & C.M Agarwal - (McGraw-hill)
- 3 Engineering Drawing by N.D.Bhatt.
- 4 T.S.M. & S.S.M on “ Technical Drawing” prepared by T.T.T.I., Madras.
- 5 SP-46-1998 – Bureau of Indian Standards.

PO-CO Mapping

EE-107	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	3	2	2		1		1	2	3	1
CO2	3	2	2			2	1	2	3	1

CO3	3	2	2	1	1		1	2	3	1
CO4	3	2	2	1		2	1	2	3	1
CO5	3	2	2	1	1	2	1	2	3	1
CO6	3	2	2	1	1	2	1	2	3	1
AVERAGE	3	3	3	1	1	2	1	2	3	1

3: High, 2: Moderate,1: Low

Table specifying syllabus to be covered for UNIT TEST I, II and III.

Unit Test	Learning Outcomes to be Covered
Unit Test – I	From 1.1 to 2.3
Unit Test – II	From 3.1 to 3.5
Unit Test – III	From 4.1 to 5.2

WORKSHOP PRACTICE

Course code	Course title	No. of periods/week	Total no. of periods	Marks for FA	Marks for SA
CHPC-108	Workshop practice	6	180	40	60

S.No.	Major Topics	No. of periods
1.	Carpentry	48
2.	Fitting and welding	72
3.	Basic machine operations	44
4.	Plumbing	16
TOTAL		180

Course title : Workshop Practice	
Course Objectives	(i) To familiarize with the knowledge different materials tools used in general Engineering processes (ii) To use various basic implements used in general Engineering processes (iii) To know the etiquette of working with the fellow workforce (iv) To reinforce theoretical concepts by conducting relevant experiments/exercises
Course Outcomes	C01 Study and practice on machine tools and their operations
	C02 Identify and apply suitable tools for various machining processes
	C03 Perform manufacturing/fabrication operation of components in different w/s sections
	C04 Observe all safety rules and regulations
	C05 Practice ethics & etiquette while working in a group and display professionalism while Communicating as a member and leader in a group

CO & PO's, PSO's matrix:

CO's/PO's	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	3	1	2	2	2	1	2	1	1	1
CO2	3	2	2	2	2	1	2	1	1	1
CO3	3	1	2	3	2	1	2	1	1	1
CO4	3	1	2	2	2	1	2	1	1	1
CO5	3	2	2	2	2	1	2	1	1	1
Avg.	3	1.4	2	2.2	2	1	2	1	1	1

Learning outcome:

- 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 roads 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.
 - a. Understand the symbols.
 - b. Know the materials used in pipes
 - c. Assembling, threading, joining of pipes.
 - d. 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 chiselling
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

1. Exercise on turning the given rod to get three different diameters using lathe.]
2. Make a bolt and cut threads using lathe.
3. Cut the threads to G.I. Pipe using lathe.

4. Prepare a centre punch and knurl its head.
5. 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.,

ENGINEERING PHYSICS LAB

SUBJECT	SUBJECT CODE	TOTAL PERIODS	NUMBER OF PERIODS PER WEEK
PHYSICS LAB	CHPC -109	45	03

Course objectives	<p>(1) To provide strong practical knowledge of Physics to serve as a tool for various device applications in Engineering.</p> <p>(2) To enhance scientific skills of the students by incorporating new experiments so as to enrich the technical expertise of the students as required for industries.</p>
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COURSE OUTCOMES	CO1	Improving accuracy in various measurements; understanding the nature of the forces keeping the body in equilibrium.
	CO2	Estimating the acceleration caused by the gravity of earth; Practical study of the concepts of refraction of light at curved/plane surface
	CO3	Understanding the pressure of the gas as function of its volume; study of the combined magnetic field of the earth and an artificial magnet to estimate its pole strength; Estimating the velocity of sound in air through resonance phenomenon.
	CO4	Applying Kirchoff's laws to evaluate the specific resistance of a wire; Study of exchange of heat from system to surrounding by graphical analysis; Conversion of light energy to micro currents as potential engineering application.

CO-PO MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	2	2	2	2	1	2
CO2	3		1	1	1	1	1
CO3	3	2			1		
CO4	3	2	2			1	2

CO-PO Mapping Strength

Course code Common -109	Engineering Physics No of Course Objectives : 4			No of periods 45
POs	Linked with CO No	periods addressing PO in Col 1 NO	%	1,2,3 remarks

PO1	CO1,CO2,CO3,CO4	15	33.3 %	2	>40% level 3 (highly addressed) 25% to 40% level 2 (moderately addressed) 25% level 1 (Low addressed) < 5% (not addressed)
PO2	CO1,CO3, CO4	8	17.8%	1	
PO3	CO1, CO2, CO4	6	13.3%	1	
PO4	CO1, CO2	3	6.7%	1	
PO5	CO1,CO2, CO3	5	11.1%	1	
PO6	CO1, CO2, CO4	3	6.7%	1	
PO7	CO1, CO2, CO4	5	11.1%	1	

3 = strongly mapped, 2 = moderately mapped, 1 = slightly mapped

Note: The gaps in CO and PO mapping will be achieved by one or more appropriate activities from the following.

- (i) Seminars (ii) Viva-voce (iii) Assignments
 (iv) Quiz competitions (v) Industrial visits (vi) Tech fest (vii) Mini project
 (viii) Group discussions (ix) Virtual labs (x) Library visit for e-books

ENGINEERING PHYSICS LAB

Subject Title : Engineering Physics Lab
 Subject Code : Common-109
 Periods per week : 03
 Total periods per year : 45

TIMESCHEDULE

S.No	List of experiments	No.of Periods
1.	Vernier calipers	03
2.	Micrometer (Screw gauge)	03
3.	Verification of Lami's theorem using concurrent forces	03
4.	Determination of 'g' using simple pendulum	03
5.	Focal length and focal power of convex lens	03
6.	Refractive index of solid using travelling microscope	03
7.	Verification of Boyle's law using Quill tube	03
8	Determination of pole strength of the bar magnet through magnetic field lines	03

9	Resonance apparatus - Determination of velocity of sound in air	03
	Experiments for demonstration	
10	Meter bridge - Determination of resistance and specific resistance of a wire	03
11	Verification of Newton's law of cooling	03
12	Photo electric cell - Study of its characteristics	03
	Revision	06
	Test	03
	Total:	45

completion of the course the student shall be able to

- 1.0 Practice with Vernier calipers to determine the volumes of cylinder and sphere.
- 2.0 Practice with Screw gauge to determine thickness of a glass plate and cross sectional area of a wire.
- 3.0 Verify the Lami's theorem using concurrent forces.
- 4.0 Determine the value of acceleration due to gravity (g) using Simple Pendulum. To verify the result from $l-T^2$ graph.
- 5.0 Calculate the Focal length and focal power of convex lens using distant object method and U-V method. To verify the result from U-V graph and $1/U - 1/V$ graph methods.
- 6.0 Determine the refractive index of a solid using travelling microscope
- 7.0 Verify the Boyle's law using Quill tube. To draw a graph between P and $1/l$.
- 8.0 Determination of magnetic pole strength of a bar magnet by drawing magnetic lines of force and locating null points (either N - N or N - S method)
- 9.0 Determine the velocity of sound in air at room temperature and its value at zero degree Centigrade using resonance apparatus.
- 10.0 Determine the resistance and specific resistance of material of a wire using Meter Bridge
- 11.0 To verify the Newton's law of cooling.
- 12.0 To study the characteristics of photo electric cell.

Course Outcomes

S.No	List of experiments	No.of Periods	COs
1.	Vernier calipers	03	CO1
2.	Micrometer (Screw gauge)	03	
3.	Verification of Lami's theorem using concurrent forces	03	
4.	Determination of g using simple pendulum	03	CO2
5.	Focal length and power of convex lens	03	
6.	Refractive index of solid using travelling microscope	03	
7.	Verification of Boyle's law using Quill tube	03	

8	Determination of pole strength of the bar magnet through magnetic field lines	03	CO3
9	Resonance apparatus - Determination of velocity of sound in air	03	
10	Meter bridge - Determination of resistance and specific resistance of a wire	03	CO4
11	Verification of Newton's law of cooling	03	
12	Photo electric cell - Study of its characteristics	03	

Competencies and Key competencies to be achieved by the student

Name of the Experiment (Nu)	Competencies	Key competencies
1 . Practice on Vernier Calipers (03)	<ul style="list-style-type: none"> Find the Least count Fix the specimen in position Read the scales Calculate the physical quantities of given object 	<ul style="list-style-type: none"> Read the scales Calculate the requisite physical quantities of given objects Calculating volumes of the cylinder and sphere
2. Practice on Screw gauge(03)	<ul style="list-style-type: none"> Find the Least count Fix the specimen in position Read the scales Calculate thickness of glass plate and cross section of wire from radius 	<ul style="list-style-type: none"> Read the scales Noting zero error Calculate thickness of given glass plate Calculate cross section of wire from radius
3. Verification of Lami's theorem forces(03)	<ul style="list-style-type: none"> Making experimental set up Fix suitable weights Note the positions of threads on drawing sheet Find the angles between the concurrent forces Changing weights appropriately Verify Lami's theorem 	<ul style="list-style-type: none"> Measuring angles between the forces Marking the directions of forces on a paper Verifying Lami's theorem from the weights and measured angles between the forces.

4. Simple pendulum(03)	<ul style="list-style-type: none"> • Fix the simple pendulum to the stand • Adjust the length of pendulum • Find the time for number of oscillations (say 20) • Find the time period • Calculate the acceleration due to gravity • Draw $l-T^2$ graph 	<ul style="list-style-type: none"> • Find the time for number of oscillations • Find the time period • Calculate the acceleration due to gravity • Verify form $l-T^2$ graph
5. Focal length and Focal power of convex lens (03)	<ul style="list-style-type: none"> • Fix the object distance • Find the Image distance • Calculate the focal length and power of convex lens • Draw $u-v$ and $1/u - 1/v$ graphs 	<ul style="list-style-type: none"> • Find focal length from distant object method. • Calculate the focal length and power of convex lens • Verify result from $u-v$ and $1/u - 1/v$ graphs
6 Refractive index of solid using traveling microscope(03)	<ul style="list-style-type: none"> • Find the least count of Vernier on microscope • Place the graph paper below microscope • Read the scales • Calculate the refractive index of glass slab 	<ul style="list-style-type: none"> • Reading the scales on Microscope. • Finding real and apparent thickness of the slab • Calculate the refractive index of
7 . Boyle's law verification (03)	<ul style="list-style-type: none"> • Note the atmospheric pressure • Fix the Quill tube to retort stand • Find the length of air column • Find the pressure of enclosed air • Find and compare the calculated values of $P \times l$ 	<ul style="list-style-type: none"> • Fixing Quill tube in various positions on retort stand. • Find the length of air column • Find the pressure of enclosed air • Find the values of $P \times l$ • Verify Boyle's law.
8. Mapping of magnet lines of force (03)	<ul style="list-style-type: none"> • Draw magnetic meridian • Place the bar magnet in N-N or N-S directions • Draw magnetic lines of force • Locate the neutral points 	<ul style="list-style-type: none"> • Draw the pattern of magnetic lines of force • Locate the neutral points • Calculating pole strength of the bar magnet

<p>9. Velocity of sound in air – Resonance method (03)</p>	<ul style="list-style-type: none"> • Arrange the resonance apparatus • Adjust the reservoir level for booming sound • Find the first and second resonating lengths • Calculate velocity of sound . 	<ul style="list-style-type: none"> • Adjust the reservoir level • Find the first and second resonating lengths • Calculate velocity of sound at room temperature and at 0° C
<p>10. Meter bridge(03)</p>	<ul style="list-style-type: none"> • Make the circuit connections • Find the balancing length • Calculate unknown resistance • Find the radius of wire • Calculate the specific resistance 	<ul style="list-style-type: none"> • Making connections as per circuit diagram. • Find the balancing length • Calculate unknown resistance • Calculate the specific resistance of the given wire
<p>11. Verification of Newton's law of Cooling (03)</p>	<ul style="list-style-type: none"> • Heating liquid in a beaker using a heating element • Inserting thermometer in liquid in calorimeter • Stirring liquid • Measuring temperatures as a function of time using thermometer • Plotting a cooling curve 	<ul style="list-style-type: none"> • Measuring temperature of a liquid as function of time. • Plotting a cooling curve. • Verifying Newton's law of cooling.
<p>12. Photo electric cell - Study of its Characteristics (03)</p>	<ul style="list-style-type: none"> • Experimental set up and making connections • Verifying intensity of light by varying distances between light source and photocell. • Measuring Voltage and current values. 	<ul style="list-style-type: none"> • Making connections for experimental set up. • Varying distances appropriately • Measuring Voltage and current values. • Study of V- I Characteristics form graph.

Scheme of Valuation for End Practical Examination :

Activity	Marks
For writing, Apparatus, formulae, least count (if applicable)	5
Procedure & precautions	5
Drawing Tables	3
Readings, calculations, graph (if applicable), reporting the findings	12
Viva-voce	5
Total marks	30

CHEMISTRY LABORATORY
(C-23 curriculum common to all Branches)

Subject Title : Chemistry Laboratory
 Subject Code : CHPC -110
 Periods per week : 03
 Total periods per year : 45

CO1	Operate and practice volumetric apparatus and preparation of standard solution.
CO2	Evaluate and judge the neutralization point in acid base titration.
CO3	Evaluate the end point of reduction and oxidation reaction.
CO4	Judge the stable end point of complex formation, stable precipitation.
CO5	Judge operate and demonstrate and perform precise operations with instrument for investigation of water pollution parameters.

PO- CO mapping

Course code Common- 110	Chemistry Laboratory No. of CO's:5				No. of periods : 45
POs	Mapped with CO No.	No periods addressing PO in Col. No. 1	%	Level 1,2,3	Remarks
PO1	CO1,CO2,CO3, CO4,CO5	12	6.66	2	>40% Level 3 (highly addressed) 25% to 40% Level 2 (moderately addressed) 5% to 25% Level1 (Low addressed) < 5%(not addressed)
PO2	CO1,CO2,CO3, CO4,CO5	9	20	1	
PO3					
PO4	CO1,CO2,CO3, CO4,CO5	12	6.66	2	
PO5	CO2,CO3, CO4,CO5	12	6.66	2	
PO6	-	-	-	-	
PO7	-	-	-	-	

COs POs mapping strength (as per given table)

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	2	1	-	2	-	-	-	-	-	-
CO2	2	1	-	2	2	-	-	-	-	-
CO3	2	1	-	2	2	-	-	-	-	-
CO4	2	1	-	2	2	-	-	-	-	-
CO5	2	1	-	2	2	-	-	-	-	-

3=strongly mapped 2= moderately mapped 1= slightly mapped

Note: The gaps in CO and PO mapping will be achieved by one or more appropriate activities from the following: i) Seminars ii) Tutorials iii) Guest Lectures iv) Assignments v) Quiz competitions vi) Industrial visit vii) Tech Fest viii) Mini project ix) Group discussions x) Virtual classes xi) Library visit for e-books

TIME SCHEDULE

S.No	Name of the Experiment	No. of Periods	Mapped with COs
1.	Cognition of chemical substances and solutions used in the laboratory by senses. Familiarization of methods for Volumetric analysis.	03	CO 1
2.	Preparation of Std. Na ₂ CO ₃ solution and making solutions of different dilutions	03	CO1
3.	Estimation of HCl solution using Std. Na ₂ CO ₃ solution.	03	CO2
4.	Estimation of NaOH using Std. HCl solution.	03	CO2
5.	Determination of acidity of water sample.	03	CO2
6.	Determination of alkalinity of water sample.	03	CO2
7.	Preparation of Mohr's Salt using Std. KMnO ₄ Solution.	03	CO3
8.	Preparation of Ferrous ion by using Std. K ₂ Cr ₂ O ₇ solution.	03	CO3
9.	Determination of total hardness of water sample using Std. EDTA solution.	03	CO4
10.	Determination of Chlorides present in water sample by using Std. AgNO ₃ solution.	03	CO4
11.	Determination of Dissolved Oxygen(D.O) in water sample by using Std. hypo solution	03	CO5
12.	Determination of pH using pH meter..	03	CO 5
13.	Determination of conductivity of water and adjusting ionic strength required	03	CO 5
14.	Determination of turbidity of water.	03	CO 5
15.	Estimation of total solids present in water sample.	03	CO 5
	Total:	45	

Objectives:

Upon completion of the course the student shall be able to

- 1.0 To identify the chemical compounds and solutions by senses.
Practice volumetric measurements (using pipettes, measuring jars, volumetric flask, burettes) and gravimetric measurements (using different types of balances), making dilutions, etc.
- 2.0 Practice making standard solutions with pre weighed salts and to make solutions of desired dilutions using appropriate techniques.
- 3.0 Conduct titrations adopting standard procedures and using Std. Na_2CO_3 solution for estimation of HCl.
- 4.0 Conduct titrations adopting standard procedures and using Std. HCl solution for estimation of NaOH.
- 5.0 Conduct titrations adopting standard procedures to determine the acidity of given samples of water (One ground water and one surface / tap water, and rain water if available).
- 6.0 Conduct titrations adopting standard procedures to determine the alkalinity of given samples of water (One ground water and one surface / tap water).
- 7.0 Conduct titrations adopting standard procedures and using Std. KMnO_4 solution for estimation of Mohr's Salt.
- 8.0 Conduct titrations adopting standard procedures and using Std. $\text{K}_2\text{Cr}_2\text{O}_7$ solution for estimation of Ferrous ion.
- 9.0 Conduct titrations adopting standard procedures to determine the total hardness of given samples of water (One ground water and one surface / tap water) using Std. EDTA solution.
10. Conduct titrations adopting standard procedures to determine the chlorides present in the given samples of water (One ground water and one surface / tap water) using Std. AgNO_3 solution.
11. Conduct the test using titrimetric / electrometric method to determine. Dissolved Oxygen (D.O) in the given water samples (One sample from closed container and one from open container / tap water) by Std. Hypo solution.
12. Conduct the test on given samples of water / solutions (like soft drinks, sewage, etc.) to determine their pH using standard pH meter.
13. Conduct the test on given samples of water / solutions.
 - a) to determine conductivity.
 - b) to adjust the ionic strength of the sample to the desired value.
14. Conduct the test on given samples of solutions (coloured and non-coloured) to determine their turbidity in NTU.
15. Determine the total solids present in given samples of water (One ground water and one surface / tap water).

Competencies and Key competencies to be achieved by the student

Name of the Experiment (No of Periods)	Competencies	Key competencies
Recognition of chemical substances and solutions. Familiarization of methods for Volumetric analysis.	-	--
Preparation of Std. Na ₂ CO ₃ solution and making solutions of different dilutions. (03)	<ul style="list-style-type: none"> ▪ Weighing the salt to the accuracy of .01 mg. ▪ Measuring the water with volumetric flask, measuring jar, volumetric pipette and graduated pipette. ▪ Making appropriate dilutions. 	<ul style="list-style-type: none"> ▪ Weighing the salt to the accuracy of 0.01 mg. ▪ Measuring the water with volumetric flask, measuring jar, volumetric pipette and graduated pipette. ▪ Making appropriate dilutions.
Estimation of HCl solution using Std. Na ₂ CO ₃ solution. (03)	<ul style="list-style-type: none"> ▪ Cleaning the glassware and rinsing with appropriate solutions. ▪ Making standard solutions. ▪ Measuring accurately the standard solutions and titrants. ▪ Filling the burette with titrant. ▪ Fixing the burette to the stand. ▪ Effectively Controlling the flow of the titrant. ▪ Identifying the end point. ▪ Making accurate observations. ▪ Calculating the results. 	<ul style="list-style-type: none"> ▪ Making standard solutions. ▪ Measuring accurately the standard solutions and titrants. ▪ Effectively Controlling the flow of the titrant. ▪ Identifying the end point. ▪ Making accurate observations.
Estimation of NaOH using Std. HCl solution. (03)		
Determination of acidity of water sample. (03)		
Determination of alkalinity of water sample. (03)		
Determination of Mohr's Salt using Std. KMnO ₄ solution. (03)		
Determination of Ferrous ion by using Std. K ₂ Cr ₂ O ₇ solution (03)		
Determination of total hardness of water using Std. EDTA solution. (03)		
Determination of Chlorides present in water sample using Std. AgNO ₃ solution (03)		
Determination of Dissolved Oxygen(D.O) in water sample (By titration method) (03)		
Determination of pH using pH meter. (03)	<ul style="list-style-type: none"> ▪ Familiarize with instrument. ▪ Choose appropriate 'Mode' / 'Unit'. 	<ul style="list-style-type: none"> ▪ Prepare standard solutions / buffers, etc.

Determination of conductivity of water and adjusting ionic strength to required level. (03)	<ul style="list-style-type: none"> ▪ Prepare standard solutions / buffers, etc. ▪ Standardize the instrument with appropriate standard solutions. ▪ Plot the standard curve. ▪ Make measurements accurately. ▪ Follow Safety precautions. 	<ul style="list-style-type: none"> ▪ Standardize the instrument with appropriate standard solutions. ▪ Plot the standard curve. ▪ Make measurements accurately.
Determination of turbidity of water. (03)		
Estimation of total solids present in water sample. (03)	<ul style="list-style-type: none"> ▪ Measuring the accurate volume and weight of sample. ▪ Filtering and air drying without losing any filtrate. ▪ Accurately weighing the filter paper, crucible and filtrate. ▪ Drying the crucible in an oven. 	<ul style="list-style-type: none"> ▪ Measuring the accurate volume and weight of sample. ▪ Filtering and air drying without losing any filtrate. ▪ Accurately weighing the filter paper, crucible and filtrate.

SCHEME OF VALUATION

A) Writing Chemicals, apparatus, principle and procedure.	5M
B) Demonstrated competencies. Making standard solutions. Measuring accurately the standard solutions and titrants. Effectively controlling the flow of the titrant. Identifying the end point. Making accurate observations.	20M
C) Viva-voce.	5M
Total	30M

Computer Fundamentals Lab

Course code	Course Title	No. of Periods/Weeks	Total No. of periods	Marks for FA	Marks for SA
CHPC-111	Computer Fundamentals Lab	3	90	40	60

Time schedule:

S.No.	Chapter/Unit Title	No. of sessions each of 3 periods duration	No. of Periods
1.	Computer hardware Basics	2	6
2.	Windows Operating System	2	6
3.	MS Word	8	24
4.	MS Excel	7	21
5.	MS PowerPoint	5	15
6.	Adobe Photoshop	6	18
Total periods		30	90

S.No.	Chapter/Unit Title	No. of Periods	CO's Mapped
1.	Computer hardware Basics	6	CO1
2.	Windows Operating System	6	CO1
3.	MS Word	24	CO2
4.	MS Excel	21	CO3
5.	MS PowerPoint	15	CO4
6.	Adobe Photoshop	18	CO5
Total periods		90	

Course Objectives	i) To know Hardware Basics ii) To familiarize operating systems iii) To use MS Office effectively to enable to students use these skills in future courses iv) To use Adobe Photoshop in image editing.
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Course Outcomes	At the end of the course students will be able to		
	CO1	CHPC-111.1	Identify hardware and software components
	CO2	CHPC-111.2	Prepare documents with given specifications using word processing software

	CO3	CHPC-111.3	Use Spread sheet software to make calculation and to draw various graphs / charts.
	CO4	CHPC-111.4	Use Power point software to develop effective presentation for a given theme or topic.
	CO5	CHPC-111.5	Edit digital or scanned images using Photoshop

CO-PO/PSO MATRIX

CO NO.	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CHPP-111.1	3	3	3	3	3	3	3	3	2	3
CHPP-111.2	3	3	3	3	3	3	3	3	2	3
CHPP-111.3	3	3	3	3	3	3	3	3	2	3
CHPP-111.4	3	3	3	3	3	3	3	3	2	3
CHPP-111.5	3	3	3	3	3	3	3	3	2	3
Average	3	3	3	3	3	3	3	3	2	3

3=Strongly mapped , 2=moderately mapped, 1=slightly mapped

Learning Outcomes:

I. Computer Hardware Basics

- 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

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 sort and filter data in table.
20. To present data using Excel Graphs and Charts.
21. To develop lab reports of respective discipline.
22. To format a Worksheet in Excel, Page Setup and Print

V. Practice with MS-POWERPOINT

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

VI. Practice with Adobe Photoshop

33. To familiarize with standard toolbox
34. To edit a photograph.
35. To insert Borders around photograph.
36. To change Background of a Photograph.
37. To change colours of Photograph.
38. To prepare a cover page for the book in your subject area.
39. To adjust the brightness and contrast of the picture so that it gives an elegant look.
40. To type a word and apply the shadow emboss effects.

Key competencies:

Expt No	Name of Experiment	Competencies	Key competencies
1 (a).	To familiarize with Computer system and hardware connections	<ol style="list-style-type: none"> a. Identify the parts of a Computer system: i). CPU ii). Mother Board iii) Monitor iv) CD/DVD Drive v) Power Switch vi) Start Button vii) Reset Button b. Identify and connect various peripherals c. Identify and connect the cables used with computer system d. Identify various ports on CPU and connect Keyboard & Mouse 	Connect cables to external hardware and operate the computer

1 (b).	To Start and Shut down Computer correctly	<ul style="list-style-type: none"> a. Log in using the password b. Start and shut down the computer c. Use Mouse and Key Board 	<ul style="list-style-type: none"> a. Login and logout as per the standard procedure b. Operate mouse &Key Board
1 (c).	To Explore Windows Desktop	<ul style="list-style-type: none"> a. Familiarize with Start Menu, Taskbar, Icons and Shortcuts b. Access application programs using Start menu, Task manager c. Use Help support 	<ul style="list-style-type: none"> a. Access application programs using Start menu b. Use taskbar and Task manager
2.	To check the software details of the computer	<ul style="list-style-type: none"> a. Find the details of Operating System being used b. Find the details of Service Pack installed 	Access the properties of computer and find the details

3.	To check the hardware present in your computer	<ul style="list-style-type: none"> a. Find the CPU name and clock speed b. Find the details of RAM and Hard disk present c. Access Device manager using Control Panel and check the status of devices like mouse and key board d. Use My Computer to check the details of Hard drives and partitions e. Use the Taskbar 	<ul style="list-style-type: none"> a. Access device manager and find the details b. Type /Navigate the correct path and Select icon related to the details required
4.	Working with Files and Folders	<ul style="list-style-type: none"> a. Create folders and organizing files in different folders b. Use copy / paste move commands to organize files and folders 	<ul style="list-style-type: none"> a. Create files and folders Rename , arrange and search for the required folder/file

	Working with Files and Folders Continued....	<ul style="list-style-type: none"> c. Arrange icons – name wise, size, type, Modified d. Search a file or folder and find its path e. Create shortcut to files and folders (in other folders) on Desktop f. Familiarize with the use of My Documents g. Familiarize with the use of Recycle Bin 	<ul style="list-style-type: none"> b. Restore deleted files from Recycle bin
5.	To use Windows Accessories: Calculator – Notepad – WordPad – MS Paint	<ul style="list-style-type: none"> a. Familiarize with the use of Calculator b. Access Calculator using Run command c. Create Text Files using Notepad and WordPad and observe the difference in file size d. Use MS paint and create .jpeg, .bmp files using MS Paint 	<ul style="list-style-type: none"> a. Use windows accessories and select correct text editor based on the situation. b. Use MS pain to create /Edit pictures and save in the required format.
6.	To familiarize with Ribbon layout of MS word. – Home – Insert- page layout- References- Review-View	<ul style="list-style-type: none"> a. Create/Open a document b. Use Save and Save as features c. Work on two Word documents simultaneously d. Choose correct Paper size and Printing options 	<ul style="list-style-type: none"> a. Create a Document and name appropriately and save b. Set paper size and print options
7.	To practice Word Processing Basics	<ul style="list-style-type: none"> a. Typing text b. Keyboard usage c. Use mouse (Left click / Right click / Scroll) d. Use Keyboard shortcuts e. Use Find and Replace features in MS-word f. Use Undo and Redo Features g. Use spell check to correct Spellings and Grammar 	<ul style="list-style-type: none"> a. Use key board and mouse to enter/edit text in the document. b. Use shortcuts c. Use spell check/ Grammar features for auto corrections.

8.	To practice Formatting techniques	<ul style="list-style-type: none"> a. Formatting Text b. Formatting Paragraphs c. Setting Tabs d. Formatting Pages e. The Styles of Word f. Insert bullets and numbers g. Themes and Templates h. Insert page numbers, header and footer 	<ul style="list-style-type: none"> a. Format Text and paragraphs and use various text styles. b. Use bullets and numbers to create lists c. Use Templates /Themes d. Insert page numbers date, headers and footers
9.	To insert a table of required number of rows and columns	<ul style="list-style-type: none"> 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. Changing the background colour of the table c. Use table design tools d. Use auto fit – fixed row/column height/length – Even distribution of rows / columns features e. Convert Text to table and Table to Text f. Use Sort feature of the Table to arrange data in ascending/descending order 	<ul style="list-style-type: none"> a. Insert table in the word document and edit b. Use sort option for arranging data.
10.	To Insert objects, clipart and Hyperlinks	<ul style="list-style-type: none"> a. Create a 2-page document. & Insert hyperlinks and t Bookmarks. b. Create an organization chart c. Practice examples like preparing an Examination schedule notice with a hyperlink to Exam schedule table. 	<ul style="list-style-type: none"> a. Insert hyperlinks & Bookmarks b. Create organization charts/flow charts
11.	To Use Mail merge feature of MS Word	<ul style="list-style-type: none"> a. Use mail merge to prepare individually addressed letters b. Use mail merge to print envelopes. 	Use Mail merge feature
12.	To use Equations and symbols features.	<ul style="list-style-type: none"> a. Explore various symbols available in MS Word b. Insert a symbol in the text c. Insert mathematical 	Enter Mathematical symbols and Equations in the word document

		equations in the document	
13.	To Practice with MS-EXCEL	<ul style="list-style-type: none"> a. Open /create an MS Excel spreadsheet and familiarize with MS Excel 2007 layout like MS office Button- b. Use Quick Access Toolbar- Title Bar- Ribbon-Worksheets- Formula Bar-Status Bar 	<ul style="list-style-type: none"> a. Familiarize with excel layout and use b. Use various features available in toolbar
14.	To access and Enter data in the cells	<ul style="list-style-type: none"> a. Move Around a Worksheets- Quick access -Select Cells b. Enter Data-Edit a Cell-Wrap Text-Delete a Cell Entry-Save a File-Close Excel 	<ul style="list-style-type: none"> a. Access and select the required cells by various addressing methods b. Enter data and edit
15.	To edit spread sheet Copy, Cut, Paste, and selecting cells	<ul style="list-style-type: none"> a. Insert and Delete Columns and Rows-Create Borders-Merge and Center b. Add Background ColorChange the Font, Font Size, and Font Color c. Format text with Bold, Italicize, and Underline-Work with Long Text-Change a Column's Width 	Format the excel sheet
16.	To use built in functions and Formatting Data	<ul style="list-style-type: none"> a. Perform Mathematical Calculations verify -AutoSum b. Perform Automatic Calculations-Align Cell Entries 	Use built in functions in Excel
17.	To enter a Formula for automatic calculations	<ul style="list-style-type: none"> a. Enter formula b. Use Cell References in Formulae c. Use Automatic updating function of Excel Formulae d. Use Mathematical Operators in Formulae e. Use Excel Error Message and Help 	Enter formula for automatic calculations

18.	To Create Excel Functions, Filling Cells	<ul style="list-style-type: none"> a. Use Reference Operators b. Work with sum, Sum if , Count and Count If Functions c. Fill Cells Automatically 	<ul style="list-style-type: none"> a. Create Excel sheets involving cross references and equations b. Use the advanced functions for conditional calculations
19.	To sort and filter data in table	<ul style="list-style-type: none"> a. Sort data in multiple columns b. Sort data in a row c. Sort data using Custom order d. Filter data in work sheet 	<ul style="list-style-type: none"> a. Refine the data in a worksheet and keep it organized b. Narrow a worksheet by selecting specific choice
20.	To Practice Excel Graphs and Charts	<ul style="list-style-type: none"> a. Produce an Excel Pie Chart b. Produce c. Excel Column Chart 	<ul style="list-style-type: none"> a. Use data in Excel sheet to Create technical charts and graphs Produce Excel Line Graph b. Produce a Pictograph in Excel
21.	To develop lab reports of respective discipline	ate Lab reports using MS Word and Excel	<ul style="list-style-type: none"> a. Insert Practical subject name in Header and page numbers in Footer
22.	To format a Worksheet in Excel, page setup and print	<ul style="list-style-type: none"> a. Shade alternate rows of data b. Add currency and percentage symbols c. Change height of a row and width of a column d. Change data alignment e. Insert Headers and Footers f. Set Print Options and Print 	<ul style="list-style-type: none"> a. Format Excel sheet b. Insert headers & footers and print

23.	To familiarize with Ribbon layout & features of PowerPoint 2007.	Use various options in PowerPoint a. Home b. Insert c. Design d. Animation e. Slideshow f. View g. Review	Access required options in the tool bar
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24.	To create a simple PowerPoint Presentation	a. Insert a New Slide into PowerPoint b. Change the Title of a PowerPoint Slide c. PowerPoint Bullets d. Add an Image to a PowerPoint Slide e. Add a Textbox to a PowerPoint slide	a. Create simple PowerPoint presentation with photographs/Clip Art and text boxes b. Use bullets option
25.	To Set up a Master Slide in PowerPoint and add notes	a. Create a PowerPoint Design Template b. Modify themes c. Switch between Slide master view and Normal view d. Format a Design Template Master Slide e. Add a Title Slide to a Design Template f. The Slide Show Footer in PowerPoint g. Add Notes to a PowerPoint Presentation	a. Setup Master slide and format b. Add notes
26.	To Insert Text and Objects	a. Insert Text and objects b. Set Indents and line spacing c. Insert pictures/ clipart d. Format pictures e. Insert shapes and word art f. Use 3d features g. Arrange objects	Insert Text and Objects Use 3d features
27.	To insert a Flow Chart / Organizational Charts	a. Create a Flow Chart in PowerPoint b. Group and Ungroup Shapes c. Use smart art	Create organizational charts and flow charts using smart art

28.	To insert a Table	<ul style="list-style-type: none"> a. PowerPoint Tables b. Format the Table Data c. Change Table Background d. Format Series Legend 	Insert tables and format
29.	To insert a Charts/Graphs	<ul style="list-style-type: none"> a. Create 3D Bar Graphs in PowerPoint b. Work with the PowerPoint Datasheet c. Format a PowerPoint Chart Axis d. Format the Bars of a Chart e. Create PowerPoint Pie Charts f. Use Pie Chart Segments g. Create 2D Bar Charts in PowerPoint h. Format the 2D Chart e. Format a Chart Background 	Create charts and Bar graphs, Pie Charts and format.

30.	To Insert audio & video, Hyperlinks in a slide Add narration to the slide	<ul style="list-style-type: none"> a. Insert sounds in the slide and hide the audio symbol b. Adjust the volume in the settings c. Insert video file in the format supported by PowerPoint in a slide d. Use automatic and on click options e. Add narration to the slide f. Insert Hyperlinks 	<ul style="list-style-type: none"> a. Insert Sounds and Video in appropriate format. b. Add narration to the slide c. Use hyperlinks to switch to different slides and files
31.	To Practice Animation effects	<ul style="list-style-type: none"> a. Apply transitions to slides b. To explore and practice special animation effects like Entrance, Emphasis, Motion Paths & Exit 	Add animation effects
32.	Reviewing presentation	<ul style="list-style-type: none"> a. Checking spelling and grammar b. Previewing presentation c. Set up slide show d. Set up resolution e. Exercise with Rehearse Timings feature in PowerPoint f. Use PowerPoint Pen Tool during slide show g. Saving h. Printing presentation <ul style="list-style-type: none"> (a) Slides (b) Hand-out 	<ul style="list-style-type: none"> a. Use Spell check and Grammar feature b. Setup slide show c. Add timing to the slides d. Setup automatic slide show

33	To familiarize with standard toolbox	<ul style="list-style-type: none"> a. Open Adobe Photoshop b. Use various tools such as <ul style="list-style-type: none"> i. The Layer Tool ii. The Color& Swatches Tool iii. Custom Fonts & The Text Tool iv. Brush Tool v. The Select Tool vi. The Move Tool vii. The Zoom Tool viii. The Eraser Tool ix. The Crop Tool x. The Fill Tool 	Open a photograph and save it in Photoshop
34	To edit a photograph	<ul style="list-style-type: none"> a. Use the Crop tool b. Trim edges c. Change the shape and size of a photo d. Remove the part of photograph including graphics and text 	a. Able to edit image by using corresponding tools.
35	To insert Borders around photograph	<ul style="list-style-type: none"> a. Start with a single background layer b. Bring the background forward c. Enlarge the canvas d. Create a border color e. Send the border color to the back f. Experiment with different colors 	Able to create a border or frame around an image to add visual interest to a photo
36	To change Background of a Photograph	<ul style="list-style-type: none"> a. open the foreground and background image b. Use different selection tools to paint over the image c. Copy background image and paste it on the foreground. d. Resize and/or drag the background image to reposition. e. In the Layers panel, drag the background layer below the foreground image layer. 	Able to swap background elements using the Select and Mask tool and layers.
37	To change colors of Photograph	<ul style="list-style-type: none"> a. Change colors using: <ul style="list-style-type: none"> i) Color Replacement tool ii) Hue/Saturation adjustment layer tool 	Able to control color saturation

38	To prepare a cover page for the book in subject area	<ul style="list-style-type: none"> a. open a file with height 500 and width 400 for the cover page. b. apply two different colors to work area by dividing it into two parts using Rectangle tool. c. Copy any picture and place it on work area→ resize it using free transform tool. d. Type text and apply color and style e. Apply effects using blended options 	Able to prepare cover page for the book
39	To adjust the brightness and contrast of picture to give an elegant look	<ul style="list-style-type: none"> a. open a file. b. Go to image→ adjustments→ Brightness/Contrast. c. adjust the brightness and contrast. d. Save the image. 	Able to control brightness/contrast.
40	To type a word and apply the shadow emboss effects	<ul style="list-style-type: none"> a. open a file b. Select the text tool and type text. c. Select the typed text go to layer→ layer style→ blended option→ drop shadow, inner shadow, bevel and emboss→ contour→ satin→ gradient overlay d. Save the image. 	Able to apply shadow emboss effects

Table specifying the scope of syllabus to be covered for unit tests

Unit Test	Learning outcomes to be covered
Unit test-1	From 1 to 8
Unit test-2	From 9 to 22
Unit test-3	From 23 to 40

III SEMESTER

DIPLOMA IN CHEMICAL ENGINEERING (PETROCHEMICALS)
SCHEME OF INSTRUCTIONS AND EXAMINATIONS
C23 - (III Semester)

Subject Code	Name of the Subject	Instruction period / week		Total Period / year		Scheme of Examination		
		Theory	Practical		Duration (hours)	Sessional Marks	End Exam Marks	Total Marks
THEORY:								
CHPC- 301	Engineering Mathematics - II	4	-	60	3	20	80	100
CHPC -302	Electrical Technology	4	-	60	3	20	80	100
CHPC -303	Organic and Physical Chemistry	5	-	75	3	20	80	100
CHPC -304	Unit Operations- I	5	-	75	3	20	80	100
CHPC -305	Mass and Energy Balance	6	-	90	3	20	80	100
PRACTICAL:								
CHPC -306	CAD Practice in Chemical Engineering	-	3	45	3	40	60	100
CHPC -307	Electrical Technology Lab	-	3	45	3	40	60	100
CHPC -308	Organic and Physical Chemistry Lab	-	3	45	3	40	60	100
CHPC -309	Unit Operations-I Lab	-	6	90	3	40	60	100
-	Activities	-	3	45	-	-	-	-
TOTAL		24	18	360+270=630	-	260	640	900

CHPC-301 : Common to AEI/BM/CH/CHPC/CHPP/CHOT/CHST/EC.
 CHPC-302, 303, 305, 306, 307, 308 : Common to DCHE, DCHE(PP), DCHE(OT)
 CHPC-304, 309 : Common to DCHE(PP), DCHE(OT)

C-23 CHPC-301
ENGINEERING MATHEMATICS-II
(Common to AEI/BM/CH/CHOT/CHPP/CHPC/CHST/EC)

Course Code	Course Title	No. of Periods/week	Total No. of periods	Marks for FA	Marks for SA
CHPC-301	Engineering Mathematics-II	4	60	20	80

TIME SCHEDULE

S.No.	Chapter/Unit title	No. of Periods	Marks Allotted	Short Type	Essay Type	COs mapped
Unit - I: Indefinite integration						
1	Indefinite integration	20	32	4	2	CO1
Unit - II: Definite Integration and its applications						
2	Definite Integrals	5	11	2	1/2	CO2
3	Area of curves	2	3	1	0	CO2
4	Mean and RMS values	3	8	1	1/2	CO2
Unit - III: Differential Equations						
5	Introduction to Differential Equations	5	3	1	0	CO3
6	Solution of first order differential equations	4	10	0	1	CO3
7	Solution of second order homogeneous differential equations	4	10	0	1	CO3
Unit - IV Laplace transforms & Fourier series						
8	Laplace Transforms	5	10		1	CO4
9	Inverse Laplace Transforms	5	10		1	CO4
10	Fourier Series	7	13	1	1	CO4
Total		60	110	10	8	
Marks				30	80	

Course Objectives	<ul style="list-style-type: none"> (i) To understand the concepts of indefinite integrals and definite integrals with applications to engineering problems. (ii) To understand the formation of differential equations and learn various methods of solving first order differential equations. (iii) To learn the principles of solving homogeneous differential equations of second order. (iv) To comprehend and understand the concepts of Laplace transformations and Fourier series.
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Course Outcomes	CO1	Integrate various functions using different methods.
	CO2	Evaluate definite integrals and learn its applications.
	CO3	Obtain differential equations and solve differential equations of first order and first degree, and solve homogeneous differential equations of second order.
	CO4	Find Laplace Transforms of various functions and expand the given functions as Fourier series.

C-23 CHPC-301
ENGINEERING MATHEMATICS - II
(Common to AEI/BM/CH/CHOT/CHPP/CHPC/CHST/EC)

Learning Outcomes

Unit-I

C.O. 1 Integrate various functions using different methods.

L.O.1.1. Explain the concept of Indefinite integral as an anti derivative.

1.2. State the indefinite integral of standard functions and properties of $\int (u + v) dx$ and $\int k u dx$ where u, v are functions of x and k is constant.

1.3. Solve problems involving standard functions using these properties.

1.4. Evaluate integrals involving simple functions of the following type by the method of substitution.

i) $\int f(ax + b) dx$, where $f(x)$ is in standard form.

ii) $\int (f(x))^n f'(x) dx$, $n \neq -1$

iii) $\int \frac{f'(x)}{f(x)} dx$

iv) $\int [f(g(x))]g'(x) dx$

1.5. Find the integrals of $\tan x$, $\cot x$, $\sec x$ and $\operatorname{cosec} x$ w.r.t. x .

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

1.7. Evaluate integrals using decomposition method.

1.8. Solve problems using integration by parts.

1.9 Use Bernoulli's rule for evaluating the integrals of the form $\int u.v dx$.

1.10. Evaluate the integrals of the form $\int e^x [f(x) + f'(x)] dx$

Unit -II

C.O.2 Evaluate definite integrals with applications.

L.O.2.1. State the fundamental theorem of integral calculus

2.2. Explain the concept of definite integral.

2.3. Solve simple problems on definite integrals.

2.4. State various properties of definite integrals.

2.5. Evaluate simple problems on definite integrals using these properties.

2.6. Find the area bounded by a curve and axes.

2.7. Obtain the mean and R.M.S values of the simple functions.

Syllabus for Unit test-I completed

Unit -III

C.O. 3 Form differential equations and solve differential equations of first order and first degree and Solve homogeneous differential equation of second order.

- L.O.3.1. Define a Differential equation, its order and degree
 3.2 Find order and degree of a given differential equation.
 3.3 Form a differential equation by eliminating arbitrary constants.
 3.4 Solve the first order and first degree differential equations by variables separable method.
 3.5 Solve linear differential equation of the form $\frac{dy}{dx} + Py = Q$, where P and Q are functions of x only or constants.
 3.6 Solve Differential equations of the type $(aD^2 + bD + c)y = 0$ where $a(\neq 0)$, b , c are real numbers and provide examples.

Unit-IV

Laplace transforms & Fourier series

C.O. 4 Find Laplace Transforms of various functions and expand the given functions as Fourier series.

- L.O. 4.1 Define Laplace Transform and explain the sufficient conditions for the existence of Laplace Transform.
 4.2. Obtain Laplace transforms of elementary functions and solve simple problems.
 4.3 State linearity property, first shifting theorem of Laplace transforms (without proof) and solve simple problems.
 4.4 Define Inverse Laplace Transform.
 4.5 Obtain Inverse Laplace Transforms for standard functions and solve simple problems.
 4.6 State linearity property, first shifting theorem of Inverse Laplace transforms (without proof) and solve simple problems.
 4.7 Define orthogonality of functions in an interval.
 4.8 Define Fourier series of a function in the interval $(c, c + 2\pi)$ and Euler's formulae for Fourier coefficients.
 4.9 Write sufficient conditions for the existence of Fourier series expansion of a function in an interval.
 4.10 Expand the functions $f(x) = k$ (constant) and $f(x) = x$ as Fourier series in the intervals $(0, 2\pi)$ and $(-\pi, \pi)$

Syllabus for Unit test-II completed

C-23 CHPC-301

Engineering Mathematics - II

(Common to AEI/BM/CH/CHOT/CHPP/CHPC/CHST/EC)

CO/PO - Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	3	2	2	1				3	2	2
CO2	3	3	3	3				3	3	3
CO3	3	3	3	3				3	3	3
CO4	3	3	3	3				3	3	3
Avg.	3	2.75	2.75	2.5				3	2.75	2.75

Note: The gaps in CO/PO mapping can be met with appropriate activities as follows:

For PO5: Appropriate quiz programmes may be conducted at intervals and duration as decided by concerned faculty.

For PO6: Seminars on applications of mathematics in various engineering disciplines are to be planned and conducted.

For PO7: Plan activities in such a way that students can visit the Library to refer standard books on Mathematics and access the latest updates in reputed national and international journals. Additionally, encourage them to attend seminars and learn mathematical software tools.

C-23 CHPC-301
Engineering Mathematics - II
(Common to AEI/BM/CH/CHOT/CHPP/CHPC/CHST/EC)
PO- CO - Mapping strength

PO no	Mapped with CO no	CO periods addressing PO in column I		Level (1,2 or 3)	Remarks
		Number	%		
1	CO1, CO2, CO3,CO4	60 (20+10+13+17)	100%	3	>40% Level 3 Highly addressed 25% to 40% Level 2 Moderately addressed 5% to 25% Level 1 Low addressed
2	CO1, CO2, CO3,CO4	29 (6+5+6+12)	48.3%	3	
3	CO1, CO2, CO3,CO4	29 (6+5+6+12)	48.3%	3	
4	CO1, CO2, CO3,CO4	27 (4+5+6+12)	45%	3	
5					
6					
7					
PSO 1	CO1, CO2, CO3,CO4	60	100%	3	<5% Not addressed
PSO 2	CO1, CO2, CO3,CO4	29 (6+5+6+12)	48.3%	3	
PSO 3	CO1, CO2, CO3,CO4	29 (6+5+6+12)	48.3%	3	

C-23 CHPC-301
ENGINEERING MATHEMATICS - II
(Common to AEI/BM/CH/CHOT/CHPP/CHPC/CHST/EC)

COURSE CONTENTS

Unit-I

Indefinite Integration:

1. Integration regarded as anti-derivative - Indefinite integrals of standard functions. Properties of indefinite integrals. Integration by substitution or change of variable. Integrals of $\tan x$, $\cot x$, $\sec x$, $\operatorname{cosec} x$.

Evaluation of integrals which are of the following forms:

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

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

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

Integration by decomposition of the integrand into simple rational, algebraic functions.

Integration by parts, Bernoulli's rule and integrals of the form $\int e^x [f(x) + f'(x)] dx$.

Unit-II

Definite Integral and its applications:

2. Definite integral, fundamental theorem of integral calculus, properties of definite integrals, evaluation of simple definite integrals - Area bounded by a curve and axes, Mean and RMS values of a function on a given interval.

Unit -III

Differential Equations:

3. Definition of a differential equation, order and degree of a differential equation, formation of differential equations - Solutions of differential equations of first order and first degree using variables separable method and linear differential equation of the type $\frac{dy}{dx} + Py = Q$ - Solutions of homogenous linear differential equations of second order with constant coefficients.

Unit IV:

Laplace transforms & Fourier series

4. Definition, sufficient conditions for the existence of Laplace transform, Laplace transforms of elementary functions, linearity property, state first shifting theorem with simple problems - Definition of inverse Laplace transform, Inverse Laplace transforms of elementary functions, linearity property, first shifting theorem.

5. Orthogonality of trigonometric functions, Representation of a function in Fourier series over the interval $(c, c+2\pi)$, Euler's formulae, sufficient conditions for the existence of Fourier series expansion of a function, Fourier series expansion of basic functions limited to k (constant), x over the intervals $(0, 2\pi), (-\pi, \pi)$.

Textbook:

Engineering Mathematics-II, a textbook for second year third semester diploma courses, prepared & prescribed by SBTET, AP.

Reference Books:

1. B. S. Grewal, Higher Engineering Mathematics, Khanna Publishers.
2. Schaum's Outlines Differential Equations, Richard Bronson & Gabriel B. Costa
3. M. R. Spiegel, Schaum's Outline of Laplace Transforms, Schaums' Series.
4. M. Vygodsky, Mathematical Handbook: Higher Mathematics, Mir Publishers, Moscow.

C-23 CHPC-301
Engineering Mathematics - II
(Common to AEI/BM/CH/CHOT/CHPP/CHPC/CHST/EC)
Unit Test Syllabus

Unit Test	Syllabus
Unit Test-I	From L.O 1.1 to L.O 2.7
Unit Test-II	From L.O 3.1 to L.O 4.10

Electrical Technology common with DCHE/DCHEPC/DCHEPP/DCHEOT/DPET

Course code	Course title	No. of periods/week	Total no. of periods	Marks for FA	Marks for SA
CHPC-302	Electrical Technology	4	60	20	80

TIME SCHEDULE

S.No	Chapter/unit title	No. of periods	Weightage allocated	Short Answer Questions	Essay type questions	CO's Mapped
1	D.C & A.C Circuits	15	26	2	2	CO1
2	Electromagnetism and Electromagnetic Induction	10	19	3	1	CO2
3	D.C & A.C Machines	20	29	3	2	CO2
4	Electrical Measuring Instrument	05	13	1	1	CO3
5	Understand the different equipments & safety procedures used in industry.	05	13	1	1	CO4
6	Electronic Devices	05	10		1	CO5
Total		60	60	10	8	1

Course objectives

Course objectives	<ul style="list-style-type: none"> (i) To know DC and AC circuits, electromagnetism and electromagnetic induction (ii) To understand classification, application, construction and working principles of AC and DC machines (iii) To understand different components, safety precautions in industries and working of electronic devices
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Course Outcomes

Course Outcomes	CO1	Illustrate with example various terminology of electrical circuits and calculate different types of power quantities
	CO2	Analyse the principles of operations required for working of DC and AC machines
	CO3	Recognize different types of measuring instruments.
	CO4	Describe different methods and applications of heating, welding and safety procedures and devices.
	CO5	Explain about semiconductors and various semiconductor devices

Learning Outcome

Chapter-1

- 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 - Φ 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.

Chapter-2

- 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.

Chapter-3

- 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.

Chapter-4

- 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.

Chapter-5

- 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.

Chapter-6

- 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 3phase 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

C-20, CH/CHPC/CHPP/CHOT-302
Subject Name: Electrical Technology
III semester
Syllabus split up for Unit Test

nit test NO	Learning out comes to be covered
Unit test-I	Objectives from 1.1 to 3.5
Unit test-II	Objective from 3.6 to 6.5

ORGANIC AND PHYSICAL CHEMISTRY

Course code	Course title	No.Of Periods / week	Total number of periods	Marks for FA	Marks for SA
CHPC-303	Organic and physical chemistry	5	75	20	80

TIME SCHEDULE

S.No.	Major Topics	No of Periods	Weightage allocated	Short Answer Questions	Essay type questions	Cos mapped
1.	Chemistry of Aliphatic compounds-I	12	13	1	1	CO1, CO2, CO3, CO4
2.	Chemistry of Aliphatic compounds-II	16	26	2	2	CO1, CO2, CO3, CO4
3.	Chemistry of Aromatic compounds	13	23	1	2	CO1, CO2, CO3, CO4
4.	Electro Chemistry	12	19	3	1	CO1, CO2, CO5
5.	Chemical Equilibrium	14	23	1	2	CO1, CO2
6.	Thermo Chemistry	08	6	2		CO1
Total		75	110	10	8	

Course objectives:

1. To familiarize with the knowledge of classification, nomenclature, isomerism, preparation and properties of organic compounds.
2. To familiarize with the knowledge of electrochemistry, chemical equilibrium and thermochemistry
3. To understand and reinforce the concept in various chemical processes for better production results.

Course outcomes	CO1	CHPC-303.1	Appraise basic concepts of thermochemistry, Electrolysis, Physical and organic chemistry,
	CO2	CHPC-303.2	Find the applications of aliphatic and aromatic hydrocarbons, electrochemistry
	CO3	CHPC-303.3	Explain the Preparation methods of aliphatic and aromatic hydrocarbons
	CO4	CHPC-303.4	Find the Properties of aliphatic and aromatic hydrocarbons
	CO5	CHPC-303.5	Solve problems in electro chemistry, thermochemistry and equilibrium

CO-PO/PSO MATRIX

CO NO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CHPP-303.1		2						3		
CHPP-303.2	3								3	
CHPP-303.3		2							3	
CHPP-303.4		3								2
CHPP-303.5		2							3	
AVERAGE	3	1.8						3	3	2

3=STRONGLY MAPPED

2=MODERATELY MAPPED

1=SLIGHTLY MAPPED

Learning outcomes

1. Chemistry of Aliphatic Compounds-I.

- 1.1 Give introduction to organic chemistry.
- 1.2 Explain the unique characteristics of carbon.
- 1.3 Explain hybridization of carbon in organic compounds i.e., sp^3 , sp^2 and sp .
- 1.4 Give the classification of organic compounds.
- 1.5 Explain IUPAC nomenclature of organic compounds.
- 1.6 Explain homologous series and characteristics.
- 1.7 Explain isomerism: Structural isomerism and Stereo isomerism (Geometrical and optical) with examples.
- 1.8 Explain the preparation of Alkanes:
Preparation of Methane and Ethane by (i) 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. Explain the preparation of alkenes:
Preparation of Ethylene by: (i) Dehydration of ethyl alcohol (ii) Dehydrohalogenation of ethyl bromide (iii) Dehalogenation of 1, 2 - dibromo ethane.
- 1.11 Explain the Properties of Ethylene: Reaction with (i) H_2 , (ii) Br_2/CCl_4 (iii) Ozone (iv) Oxidation by $KMnO_4$.
- 1.12 Explain the preparation of alkynes:
Preparation of Acetylene from (i) Calcium carbide (ii) Dehydro halogenation of 1,2 di-bromo ethane (iii) Dehalogenation of 1, 1, 2, 2 -tetra bromo ethane.

1.13 Explain the 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% $HgSO_4$.

1.14 list the uses of ethane, methane, ethylene and acetylene.

2. Chemistry of Aliphatic Compounds-II.

2.1 A. Explain ethyl chloride preparation from

(i) Grove's process (ii) PCl_3 (iii) Ethylene

B. Explain the reaction of Ethyl Chloride with

(i) KOH (ii) KCN (iii) $AgCN$ (iv) Wurtz Reaction

List the uses of Ethyl chloride

2.2 A. Explain Chloroform preparation from

(i) Ethyl alcohol (ii) Methane (iii) CCl_4

B. Properties of

Chloroform

(i) Reimer-Tiemann reaction

(ii) Carbylamine or isocyanide test

(iii) Oxidation

(iv) HNO_3

2.3 Alcohols:

Classification of alcohols into primary, secondary and tertiary alcohols.

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

Explain the Preparation of Ethyl alcohol from

i) Ester hydrolysis

ii) Grignard reagent

iii) Fermentation of molasses

Explain the reaction of Ethyl alcohol with

i) Acetic acid

ii) Conc. H_2SO_4

iii) Bleaching powder

iv) PCl_3

List the uses of ethyl alcohol

2.4 Aldehydes:

Explain Preparation of acetaldehyde from

i) Oxidation of ethyl alcohol

ii) Distillation of calcium acetate and calcium formate.

iii) Acetylene.

Explain Properties of Acetaldehyde

i) Addition of Grignard reagent

ii) Reaction with hydrazine

iii) Aldol condensation

iv) Silver mirror test

v) Fehling's test

Uses of acetaldehyde.

2.5 Ketones:

Explain the Preparation of acetone from

i) Oxidation of Isopropyl alcohol

ii) Distillation of calcium acetate

iii) Propyne.

Explain Properties of acetone

i) Addition of Grignard reagent

- ii) Reaction with hydrazine
- iii) Iodoform reaction

Uses of acetone

2.6 Carboxylic Acids:

Explain the Preparation of Acetic acid from

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

Explain the Properties of Acetic acid

- i) Reaction with sodium
- ii) Reaction with ethyl alcohol
- iii) Reaction with Cl_2/P (Hell - Volhard - Zelinsky reaction)

Uses of Acetic acid.

2.7 Ethers:

Explain the Preparation of diethyl ether

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

Explain the Properties of ether

- i) Halogenation
- ii) Hydrolysis by dil. H_2SO_4
- iii) Action HI.

Uses of ether.

3 Chemistry of Aromatic compounds.

- 3.1 Explain aromaticity and Huckel's rule.
- 3.2 Explain the nomenclature of aromatic compounds.
- 3.3 Explain the preparation, properties and uses of benzene.
- 3.4 Explain the preparation, properties and uses of nitrobenzene
- 3.5 Explain the preparation, properties and uses of Aniline
- 3.6 Explain the preparation, properties and uses of Phenol
- 3.7 Explain the preparation, properties and uses of toluene
- 3.8 Explain the preparation, properties and uses of benzoic acid

4 Electro Chemistry.

- 4.1 Give introduction to electrochemistry.
- 4.2 Explain about electrolytes and non-electrolytes with examples.
- 4.3 Define electrolytic conduction and metallic conduction
- 4.4 Differentiate electrolytic conduction and metallic conduction
- 4.5 Explain about Strong electrolytes and weak electrolytes with examples.
- 4.6 Explain Faraday's laws of electrolysis.
- 4.7 Solve simple problems based on Faraday's laws.
- 4.8 List applications of electrolysis.

5 Chemical equilibrium

- 5.1 Define chemical Equilibrium:
Reversible and irreversible reactions - examples. Homogeneous and heterogeneous Equilibria - examples.
- 5.2 Explain chemical equilibrium and its characteristics.
- 5.3 Explain law of Mass Action
- 5.4 Apply law of mass action to a general reaction i.e. $m\text{A} +$



- 5.5 Explain the effect of (i) concentration (ii) pressure
(iii) temperature and (iv) catalyst on chemical equilibrium.
- 5.6 Explain Lechatelier's principle -
- 5.7 Apply Lechatelier's principle to (i) manufacture of NH_3 by Haber's process
(ii) Formation of SO_3 in contact process.

6 Thermo chemistry.

- 6.1 Give Introduction to thermochemistry.
- 6.2 Define 1st law of thermo dynamics and know the equations for "E", "Q", "W" and "H".
- 6.3 Define Internal energy and Enthalpy.
- 6.4 Explain 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.
3. Preparation, properties and uses of - Benzene, Nitro benzene, Aniline, toluene, benzoic acid.
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.

C-23, CHPC-303

Subject Name: Organic and Physical chemistry

III semester

Syllabus split up for Unit Test

Unit test No.	Learning out comes to be covered
Unit test-I	Objectives from 1.1 to 3.8
Unit test-II	Objective from 4.1 to 6.5

UNIT OPERATIONS-1

Course code	Course title	No. of periods /week	Total no of periods	Marks of FA	Marks for SA
CHPC- 304	UNIT OPERATIONS-1	5	75	20	80

TIME SCHEDULE

S.NO	Chapter/ unit title	No. of periods	Weight age Allocated	Short Answer Questions	Essay type questions	Cos Mapped
1	Introduction to fluid flow phenomena and basic equations of fluid flow.	12	16	2	1	CO1, CO2, CO5
2	Flow of incompressible fluids in pipe and flow past immersed bodies.	12	16	2	1	CO2, CO3, CO4
3	Know about flow measurement & transportation of fluids.	17	23	1	2	CO3, CO5
4	Heat transfer by conduction.	7	13	1	1	CO1, CO4, CO5
5	Principles of heat flow in fluids.	7	13	1	1	CO1, CO4, CO5
6	Heat transfer to fluids with and without phase change.	7	03	1		CO4, CO5
7	Radiation heat transfer.	3	03	1		CO1, CO3
8	Heat exchange equipment and Evaporation.	10	23	1	2	CO3
	Total	75	110	10	8	

COURSE OBJECTIVES	<ul style="list-style-type: none"> i. Introduction to fluid flow, and basic equations of fluid in pipes flow meters, problems based on above topics ii. Modes of heat transfer, heat transfer to fluids with at without phase change problems based on above topics. iii. Types of heat exchanges and evaporators, evaporator accessories, performance of an evaporator.
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CO NO		COURSE OUTCOMES
CO1	CHPC-304.1	Compose the types of fluids, Definitions, Laws of heat transfer and mechanisms.
CO2	CHPC-304.2	Formulate the basic equations of mass and momentum, Laminar and turbulent flow, Friction factor in pipes.
CO3	CHPC-304.3	Describe the Working and constructions of Flow meters, pressure measuring devices, heat exchange equipment.
CO4	CHPC-304.4	Deduce the derivations of Bernoulli's equation, Hagen-Poiseuille's equation, Pressure drop equations, Composite wall, Cylindrical wall and LMTD.
CO5	CHPC-304.5	Solve Problems based on Bernoulli's equation, Hagen-Poiseuille's equation, Pressure drop equations, Composite wall, Cylindrical wall and LMTD.

Course outcomes :

CO-PO/PSO MATRIX:

CO NO	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CHPP-304.1	3							3		
CHPP-304.2		2	2					2	2	
CHPP-304.3			2						2	
CHPP-304.4		2						2		2
CHPP-304.5		3	2						3	
AVERAGE	3	2.33	2					2.33	2.33	2

3=STRONGLY MAPPED

2=MODERATELY MAPPED

1=SLIGHTLY MAPPED

Learning outcome

CHAPTER – 1:

- 1.1 Definition of a fluid, types of fluid physical properties of fluid and their units, Newton's law of viscosity.
- 1.2 List the Fluid pressures, concept of pressure, measurement of pressure. Using Working and Manometers .
- 1.3 Describe Reynolds experiment, laminar and turbulent flow, boundary layers formation.
- 1.4 Explain the boundary layer separation, boundary layer effects on fluid flow. Mass balance and momentum balance equations.
- 1.5 Evaluate the equation of continuity derivation, Bernoulli's, modified Bernoulli's equations and problems based on their equations.
- 1.6 Problems based on Reynolds number, pressure drop.

CHAPTER – 2:

- 2.1 Describe the flow in incompressible fluids in pipes, shear stress distribution in pipe, equation and friction factor for laminar flow.

- 2.2 Define laminar flow in pipes, average velocity, Kinetic energy factor, explain the Hagen Poiseuille equation for pressure drop calculations.
- 2.3 Explain friction factor in turbulent flow, the roughness parameter, effect of roughness, and the friction factor contraction.
- 2.4 Illustrate the energy loss due to flow in pipe fittings sudden expansion and contraction, solve simple problems on energy losses in fluid flow through pipes, friction factor in laminar and turbulent flow.
- 2.5 Solve simple problems on energy losses in fluid flow through pipes, friction factor in laminar and turbulent flow
- 2.6 Predict the equivalent length, drag, drag coefficient and different types of drag.
- 2.7 Compare the relationship between drag coefficient and Reynolds number in laminar and turbulent flow.
- 2.8 Differentiate free settling and hindered settling, quote Stokes law, solve problems on Stokes law.
- 2.9 Summarize the packed bed and the equations of pressure drop in packed beds, the process of fluidization and application of fluidization.

CHAPTER – 3:

- 3.1 List the classification of flow meters, pumps, and various types of pipe fittings.
- 3.2 Explain the principle, construction and working of flow meters, reciprocating, centrifugal pump.
- 3.3 Summarize the classification and pipes and tubes, schedule number, gauge for pipes and tubes.
- 3.4 Describe the functions of pump in fluid handling, the principle, construction and working of reciprocating positive displacement pump
 - i) Piston pump
 - ii) Plunger pump
 - iii) Diaphragm pump.
- 3.5 Explain the principle, construction and working of rotary positive displacement pumps.
 - i) Gear pump
 - ii) Screw pump
- 3.6 Inventory the terms related to a pump
 - i) Suction head
 - ii) Discharge head
 - iii) Total head
 - iv) NPSH
 - v) Cavitation
 - vi) Priming
 - vii) Mechanical efficiency
 - viii) Power required
- 3.7 Describe the working of i) fan ii) blower iii) vacuum pump and differentiate between the fan and a blower.
- 3.8 Solve the problems based on flow meters, and centrifugal pump.

CHAPTER – 4:

- 4.1 List the mechanism of heat flow.
- 4.2 Define the steady state and unsteady state heat flow and the Fourier's law heat conduction.
- 4.3 Quote the thermal conductivity of a substance of its units.
- 4.4 Evaluate the derivation of equation for heat conduction through a single plane

walls a cylindrical wall and composite wall.

- 4.5 Differentiate the significance of lagging, economic lagging, thickness and insulating materials.
- 4.6 Explain the compound resistances in series and solve problems in case of heat conduction through a flat wall, cylindrical wall and composite wall.

CHAPTER – 5

- 5.1 Define modes of how transfer with examples.
- 5.2 Explain the working of typical heat exchange and the terms approach and range.
- 5.3 Differentiate the counter current and parallel current flows in a heat exchanger and locate the temperature variations along the length of the heat exchanger curve in both cases.
- 5.4 Explain the enthalpy balances in heat exchangers and in Total condensers, the rate of heat transfer heat flux, average temperature of fluid stream and overall heat transfer coefficient.
- 5.5 Evaluate the logarithmic mean temperature difference, variable overall heat transfer coefficient.
- 5.6 Explain the film concept in heat transfer by convection and the film coefficient analogy to thermal conductivity.
- 5.7 Evaluate the overall heat transfer coefficient from individual heat transfer coefficients.
- 5.8 Solve problems based on calculate of LMTD, and overall heat transfer coefficients.

CHAPTER – 6:

- 6.1 Explain the regimes of heat transfer in fluids, thermal boundary layer.
- 6.2 Explain the heat transfer by forced convection
- 6.3 Predict Graetz and Peclet numbers.
- 6.4 Practice the various empirical equations used to calculate 'h' such as i) Dittus - Boelter equation ii) Sieder - Tate equation iii) Colburn equation.
- 6.5 Explain the mechanism of heat transfer from condensing vapours, boiling liquids, pool boiling, nucleate boiling and film boiling.
- 6.6 Distinguish the drop wise and film type condensation.
- 6.7 Solve problem based on dimension less numbers and heat transfer coefficient using various empirical equations.

CHAPTER – 7:

- 7.1 Define the terms related to radiation such as absorptivity, reflectivity and Transmissivity, emission power, black body emissivity and Kirchoff's law.
- 7.2 Describe the Stefan Boltzmann law, Planck's law and Wien's displacement law.
- 7.3 Explain the process and radiation between surfaces.
- 7.4 Explain the angle of vision and view factor.
- 7.5 Solve the problem related to the laws of radiation.
- 7.6 Explain and evaluate the combined heat transfer by conduction, convection and radiation.

CHAPTER – 8:

- 8.1 List the classification and evaporators and heat exchangers.
- 8.2 Explain the principle, construction and working of a double pipe heat exchanger, shell and tube heat exchanger.
- 8.3 Explain the principle. Construction and working of multi pass heat exchanger and temperature patterns in multi pass exchanges with sketches.
- 8.4 List the external surface heat exchangers i) fin type ii) plate type with a neat diagram.

- 8.5 Explain the function of a condenser, kettle type boiler, calandrias with a neat sketch.
- 8.6 Illustration the term evaporation, the different liquid properties to be considered in evaporation.
- 8.7 List the evaporator accessories such as a) steam traps b) condensers c) entrainment separators d) barometric leg e) ejectors f) salt removal systems.
- 8.8 Explain the principle, constructions and working of standard vertical tube evaporates, falling film and climbing film evaporators and forced circulation evaporates, multiple effect evaporator system with a sketch.
- 8.9 Give the performance of an evaporator a) economy b) capacity of an evaporator, the boiling point elevation at the effect of hydrostatics head capacity and economy of a multiple effect evaporators.
- 8.10 Explain the enthalpy balance equations for the single effect evaporator's enthalpy concentration diagram.
- 8.11 Solve the problems on calculation of the heat transfer area, steam requirement and economy in case of a single effect evaporation.
- 8.12 Explain the various methods of feeding the multiple effect evaporator system with its advantages and disadvantages.

Course contents:

- 1. Introduction to fluid flow phenomena and basic equations of fluid flow:**
Fluid: definition of fluid, ideal fluid, real fluid, compressible and incompressible fluids, Newtonian and Non-Newtonian fluids; physical properties of fluids- density, viscosity, velocity head, pressure head, static head, pressure concept; manometers: U-tube manometer, inverted U-tube manometer, inclined manometer- differential manometer – flow pattern in circular tubes important of Reynold's number, laminar flow, turbulent flow, Reynold's experiment - flow in boundary layer- solve problems on Reynolds number and pressure drop in manometers, boundary layer separation and its effects on flow. Mass balance, momentum balance, stream line and stream tube, continuity equation- average velocity, mass velocity, Bernoulli's equation, modified Bernoulli's equation for frictional flow, pump work, kinetic energy correction, solve problems on various heads using Bernoulli's equation and pump work in Bernoulli's equation.
- 2. Flow of incompressible fluids in pipes and flow past immersed bodies:**
Friction -skin friction, wall shear, equations for friction factor, relationship between skin friction parameters, flow of incompressible fluids, shear stress distribution in pipes, equation for friction factor, laminar flow in pipes, average velocity, kinetic energy factor, momentum correction factor for laminar flow of Newtonian fluids, Hagen Poiseuille equation, average velocity, effect of 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 and energy losses in fluid flow through pipes. Drag- Types of drag, drag coefficient, stokes law, drag coefficient Vs Reynolds number Curve, fanning friction factor, friction in flow through beds of solids, equivalent particle diameter, Sphericity, packed bed, void fraction, pressure drop equations- flow of particles through fluids, free settling, hindered settling, equations for terminal velocities for different particles, Reynolds number ranges, fluidization, fluidization velocities and pressure drops, applications of fluidization, simple

problems on Stoke's law.

3. Know about flow measurement & transportation of fluids:

Flow meters- head meters, area meters, orifice meter, Venturi meter, Pitot tube , Rota meter- turbine meter- schedule number, gauge for pipes, pipes and tubes, pipe fitting and joints; Valves – gate valve, globe valve, plug valve, check valve, diaphragm valve, butterfly valve, ball valve, safety valve or relief valve, Pumps- functions of a pump, classification of pumps, positive displacement pumps, Reciprocating pumps, piston pumps, plunger pumps, diaphragm pumps, rotary pumps, gear pump, screw pump; Centrifugal pumps – single and multistage centrifugal pumps, different types of casings, suction head, discharge head, total developed head, NPSH, priming, cavitation, characteristic curves, equipment for gas flow- fans, blowers, compressors; Vacuum producing equipment- ejectors- solve simple problems on calculation of velocities, volumetric flow rates using Venturi and orifice meters, power required by a centrifugal pump.

4. Heat transfer by conduction:

Mechanisms of heat flow, Fourier's law of heat conduction, thermal conductivity, steady state and unsteady state conduction, derivation of equation for heat conduction through a single plane wall, a cylindrical wall and composite wall, compound resistances in series, significance of lagging, economic lagging thickness, heat insulating materials, solve simple problems on calculation of rate of heat flow, intermediate temperatures in case of heat conduction through a flat wall, cylindrical wall and composite walls.

5. Principles of heat flow in fluids:

Convection: convection, natural convection and forced convection, working of typical heat exchanger, approach and range, counter current and parallel current flows in an heat exchanger, temperature variations along the length of the heat exchanger in both cases, enthalpy balances in heat exchangers and in total condensers, rate of heat transfer, heat flux, average temperature of fluid stream and overall heat transfer coefficient, logarithmic mean temperature difference (LMTD), variable overall heat transfer coefficient and Solve simple problems on calculation of LMTD, film co-efficient (individual heat transfer coefficients), analogy between film co-efficient and thermal conductivity, Nusselt number, Prandtl number, fouling factors, Calculation of Overall heat transfer coefficients from individual coefficients, Classification of Individual heat transfer coefficients and its magnitude – solve simple problems on calculation of overall heat transfer coefficients

6. 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 and turbulent flow, Graetz and Peclet numbers, various empirical equations used to calculate H_i such as 1. Dittus – Boelter equation 2. Sieder – Tate equation 3. Colburn equation, heat transfer from condensing vapors, drop wise and film wise condensation, heat transfer to boiling liquids-pool boiling, nucleate boiling and film boiling, Solve simple problems to calculate various dimensionless numbers and heat transfer coefficient using various empirical equations.

7. Radiation Heat transfer:

Fundamentals of radiation, absorptivity, reflectivity and transitivity, emission of radiation, wave length, emissive power, black body radiation , black body emissivity, emissivity of solids, laws of Black body radiation, Stefan Boltzmann law, Planck's law and Wien's displacement law, absorption of radiation by opaque

solids, reflectivity, absorptivity, Kirchoff's law, radiation between surfaces, angle of vision, view factor, combined heat transfer by conduction, convection and radiation.

8. Heat exchange equipment and evaporation:

Classification of heat exchangers; principle, construction and working of a double pipe heat exchanger, shell and tube heat exchanger, floating head heat exchanger, multi pass heat exchanger, temperature patterns in multi pass exchangers, extended surface heat exchangers – Fin type and plate type heat exchangers, function of a condenser, a) Kettle type boilers b) Calandrias
Evaporation: Definition, different liquid properties to be considered in evaporation, Types of evaporators: Principle, construction and working of a) standard vertical tube evaporator, b) falling film and climbing film evaporators, c) forced circulation evaporators, evaporator accessories such as a) Steam traps b) Condensers c) Entrainment separators d) Barometric leg e) Ejectors f) Salt removal systems, performance of an evaporator, economy and capacity of an evaporator, boiling point elevation, and the effect of hydrostatics head, Duhring's rule, enthalpy balance equation for the single effect evaporator, enthalpy balance equation for the single effect evaporator, enthalpy concentration diagram, solve simple problems on calculation of the heat transfer area, steam requirement and economy in case of a single effect evaporator, working principle of the multiple effect evaporator system, methods of feeding the multiple effect evaporator system with its advantages and disadvantages, capacity and economy of a 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

C-20, CHPC-304
Subject Name: Unit Operations-I
Syllabus split up for Unit Test

Unit test NO	Learning out comes to be covered
Unit test-I	Objective from 1.1 to 3.8
Unit test-II	Objective from 4.1 to 8.12

MASS AND ENERGY BALANCE

Course code	Course title	No. of Periods / week	Total number of periods	Marks for FA	Marks for SA
CHPC-305	Mass and Energy Balance	6	90	20	80

TIME SCHEDULE

S.No	Major Topics	No of Periods	Weightage allocated	Short Answer Questions	Essay type questions	COS mapped
1.	Units and Dimensions	12	6	2		CO1, CO2
2.	Basic Calculations	24	26	2	2	CO1, CO2
3.	Material balance without Chemical Reactions	18	23	1	2	CO2, CO4, CO5
4.	Material balance with Chemical Reactions	12	16	2	1	CO2, CO4, CO5
5.	Energy balance	14	23	1	2	CO2, CO4, CO5
6.	Combustion	10	16	2	1	CO3
Total		90	110	10	8	

Course objectives:

1. To familiarize with the terms used in Mass and Energy Balance, Physico-Chemical relations and Combustion.
2. To calculate Mass Balance Problems and Energy balance problems and evaluating various parameters used in chemical engineering.
3. To understand and reinforce the Physico-Chemical relation concepts in solving material and energy balance problems of chemical engineering for better production results.

	CO1	CHPC-305.1	Define, list, memorize and state the Basic concepts related to Physico-Chemical relations, basic laws, unit conversions,
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Course outcomes			material and energy balance equations.
	CO2	CHPC-305.2	Understand the Principles, Theories, Equations, formulas involved in mass and Energy balances, combustion and Physico-Chemical relations.
	CO3	CHPC-305.3	Derive and differentiate the equations related to unit conversion, Physico-Chemical relations, combustion, mass and energy balance
	CO4	CHPC-305.4	Solve the problems related to unit conversion, Physico-Chemical relations, combustion, mass and energy balance
	CO5	CHPC-305.5	Analyze the mass and energy balance for the processes of chemical engineering and flue gas analysis in combustion processes.

CO-PO/ PSO MATRIX:

CO _s \PO _s	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO 1	3	1	1	1	2	1	1	3	1	1
CO 2	2	3	2	3	3	3	2	3	2	1
CO 3	2	1	3	1	1	1	1	3	1	1
CO 4	3	3	2	1	2	2	1	3	1	2
CO 5	3	2	1	1	2	1	2	3	3	2
Average	2.6	2	1.8	1.4	2	1.6	1.4	3	1.6	1.4

Learning outcomes

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

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 an 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) Behaviour of ideal gases**
- 2.6 Kinetic theory of gases
- 2.7 Know about Gas laws: Boyle's law, Charles law, Gay-Lussac's law, Avogadro's law,
- 2.8 Derivation of Ideal gas equation
- 2.9 Know about Vander Waal's equation of state, Critical properties of substances
- 2.10 Ideal gas constant-Derive the value of ideal gas constant in different system of units
- 2.11 state and explain Dalton's law of partial pressures, Amagat's law of partial volumes for gaseous mixtures
- 2.12 Explain the characteristics of an Ideal gas, Differences between Ideal gas and Real gas
- 2.13 (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
- 2.14 Know the evaluation procedure for the density of a gaseous mixture
- 2.15 Numerous problems on all the above topics
- (c) Vapour Pressures:**
- 2.16 Define vapour pressure, understand the relation between vapor pressure and boiling point
- 2.17 Know the effect of temperature on vapor pressure
- 2.18 Know the methods of evaluation of vapor pressure
 - (a) Antoine equation
 - (b) Clausius - Clapeyron equation.
 - (b) Vapor pressure reference substance plot - Cox chart, Duhring's lines
- 2.19 Ideal solutions and Non-Ideal solutions. Differences between Ideal and Non-Ideal solutions
- 2.20 Define (a) Raoult's Law (b) Henry's Law for solutions
- 2.21 Numerous problems on all the above topics
- (d) Humidity and Saturation:**
- 2.22 Define and explain the following.
 - (a) Un-saturation, Saturation
 - (b) Humidity, Absolute humidity, Relative Humidity, Molal absolute humidity, % Saturation

- (c) Dew Point
- 2.23 Know about Dry and wet bulb temperature
- 2.24 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
- 3.20 Material balance around multiple effect evaporator using specific data
- 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 1st law of thermodynamics - problems related to 1st 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
- 5.12 Energy balance around short tube vertical evaporator using specific data
- 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

Hyponated course content with Reference books:

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, Grashoff 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) Behaviour 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 volume % = mole % = 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 vapour pressure-Methods of vapor pressure determination-Antoine equations, Clausius-Clapeyron equation- Vapor pressure reference substance plot -Cox chart, Duhring's lines-Ideal solutions and Non-Idealsolutions-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:

3.21 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-Blow down streams in continuous chemical processes with examples-Numerous problems on all the above topics, Material balance around multiple effect evaporator using specific data

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-1st law of thermodynamics-Problems related to 1st 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, Energy balance around short tube vertical evaporator using specific data

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 2. Kenneth M. Watson 3. Ronald A. Ragatz	Asia Publishing House
2	Basic Principles and calculations in Chemical Engineering	1. David M. Himmelbleau	
3	Introduction to Stoichiometry (SI units)	1. K.A. Gavhane	Nirali Prakashan
4	Stoichiometry and Process Calculations	1. K.V. Narayanan 2. B. Lakshmi Kutty	Prentice Hall of India Pvt Limited, New Delhi
5	Stoichiometry (SI Units)	1. B.I. Bhatt 2. S.M. Vora	Tata McGraw-Hill Publishing company Limited, New Delhi
6.	Process Calculations	1. V. Venkataramani 2. N. Anantharaman	Prentice Hall of India Pvt Limited, New Delhi
7.	Process calculations for Chemical Engineers	1. Ch. Durga Prasad Rao 2. D.V.S. Murthy	MAC-Millan India Limited

Course code CHPC-305	Course Title: Mass and Energy Balance No of Course outcomes 07				No of periods: 75
POs	Mapped with CO No		CO periods addressing PO in Column 1	Level (1, 2, 3)	Remarks
			NO	%	
PO1	CO1, CO3, CO4, CO5	30	40	2	CO1, CO3, CO4, CO5 >40%- level 3
PO2	CO2, CO3, CO4	29	39	2	CO2, CO3, CO4 25%-40% level 2
PO3	CO2	16	21	1	CO2

PO4						5-25% : level 1 <5%: not addressed
PO5						
PO6						
PO7						

C-23, CHPC-305
Subject Name: Mass and Energy Balance
Syllabus split up for Unit Test

Unit test No.	Learning out comes to be covered
Unit test-I	Chapters from 1 to 3
Unit test-II	Chapters from 4 to 6

CAD PRACTICE IN CHEMICAL ENGINEERING

Course code	Course title	No. of periods /week	Total no. of periods	Marks for FA	Marks for SA
CHPC-306	CAD practice in Chemical Engineering	3	45	40	60

Course Objectives	(i) To familiarize with the knowledge different materials tools used in general Engineering processes (ii) To use various basic implements used in general Engineering processes (iii) To know the etiquette of working with the fellow workforce (iv) To reinforce theoretical concepts by conducting relevant experiments/exercises	
Course Outcomes	CO1	Demonstrate the skill of planning and learning basics of CAD In chemical engineering
	CO2	Practice commands, modifying commands and different equipment symbols
	CO3	Dimensioning commands and three dimensional modeling
	CO4	Practice plant layout using CAD

CO-PO MATRIX:

CO'S\PO'S	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	-	-	-	2
CO2	-	-	3	-	-	3	3	3	-	-
CO3	-	-	3	-	2	3	3	-	-	1
CO4	-	-	3	2	2	-	3	2	-	3
Average	3	-	3	2	2	3	3	2.5	-	2

Learning outcome

1. Introduction to CAD and its applications
 - a. Features of CAD
 - 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 modelling
 - 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 CAD 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, Rota meter, 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 CAD
 - a. Sugar Industry
 - b. Cement Industry
- 16. Know about 2D modelling and 3 D modelling .
- 17. Simulation of fluid mechanics and heat transfer operations .
- 18. Know about Python tool.

Course code	Course title	No. of periods/week	Totalno.of periods	Marks for FA	Marks for SA
CHPC-307	Electrical Technology Lab	3	45	40	60

Course Objectives	(i) To familiarize with the knowledge different materials tools used in general Engineering processes (ii) To use various basic implements used in general Engineering processes (iii) To know the etiquette of working with the fellow workforce (iv) To reinforce theoretical concepts by conducting relevant experiments/exercises	
Course Outcomes	C01	Demonstrate the skill of planning and organizing experimental set up for a desired purpose
	C02	Perform precise operations/tasks with Engineering equipment or instrument for investigation of Engineering problems
	C03	Observe various parameters, their variations and graphically represent the same
	C04	Analyse the experimental results to draw inferences to make recommendations
	C05	Practice ethics & etiquette while working in a group and display professionalism while communicating as a member and leader in a group

CO NO.	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CHPP-309.1	3	2	2	2	-	-	-	3	1	2
CHPP-309.2	3	2	3	3	-	-	-	3	3	3
CHPP-309.3	2	3	3	3	-	-	-	2	2	2
CHPP-309.4	3	3	2	2	-	-	-	3	2	3
CHPP-309.5	3	2	3	3	-	-	-	3	3	3
Average	2.8	2.4	2.6	2.6	-	-	-	2.8	2.2	2.6

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.

ORGANIC & PHYSICAL CHEMISTRY LAB

Course code	Course title	No. of periods /week	Total no. of periods	Marks for FA	Marks for SA
CHPC-308	Organic & physical chemistry lab	3	45	40	60

S. No.	Major Topics	No. of periods
1.	Determination of Melting point of Solid Organic compounds. Determination of Boiling points of liquid organic compounds	06
2.	Detection of Elements	09
3.	Reactions of Functional groups	06
4.	Systematic identification of functional groups in an Organic Compound	15
5.	Preparation of Organic Compounds.	9
Total		45

Course Objectives	(i) To familiarize with the knowledge different materials tools used in general Engineering processes (ii) To use various basic implements used in general Engineering processes (iii) To know the etiquette of working with the fellow workforce (iv) To reinforce theoretical concepts by conducting relevant experiments/exercises	
Course Outcomes	C01	Demonstrate the skill of planning and organizing experimental set up for a desired purpose
	C02	Perform precise operations/tasks with Engineering equipment or instrument for investigation of Engineering problems
	C03	Observe various parameters, their variations and graphically represent the same
	C04	Analyse the experimental results to draw inferences to make recommendations
	C05	Practice ethics & etiquette while working in a group and display professionalism while communicating as a member and leader in a group

CO-PO/PSO MATRIX:

COs\POs	P01	P02	P03	P04	P05	P06	P07	PS01	PS02	PS03
C01	1	-	-	3	-	-	-	1	-	-
C02	3	1	-	1	-	2	-	2	3	2
C03	1	1	-	-	-	-	-	1	2	-
C04	-	2	1	-	-	-	-	2	3	2
C05	-	-	1	-	2	3	-	-	2	-
Average	1.67	1.33	1	2	2	2.5	-	1.5	2.5	2

Learning outcome

List of experiments in Organic and Physical Chemistry Lab.

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 Phenol-formaldehyde.
- 5.2 Preparation of Azodye.
- 5.3 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, -NH₂, -CONH₂, -COOR.
- 4. Identification of functional groups in an Organic Compound.
- 5. Preparation of organic Compounds - phenol-formaldehyde, Azodye - Aspirin.

UNIT OPERATIONS-I LAB

Course code	Course title	No. of periods/week	Total no. of periods	Marks for FA	Marks for SA
CHPC-309	Unit Operations-I Lab	6	90	40	60

Course title : Unit Operations-I Lab (CHPC-309)	
Course Objectives	(i) To familiarize with the knowledge different materials tools used in general Engineering processes (ii) To use various basic implements used in general Engineering processes (iii) To know the etiquette of working with the fellow workforce (iv) To reinforce theoretical concepts by conducting relevant experiments/exercises
Course Outcomes	C01 Demonstrate the skill of planning and organizing experimental set up for a desired purpose
	C02 Perform precise operations/tasks with Engineering equipment or instrument for investigation of Engineering problems
	C03 Observe various parameters, their variations and graphically represent the same
	C04 Analyse the experimental results to draw inferences to make recommendations
	C05 Practice ethics & etiquette while working in a group and display professionalism while communicating as a member and leader in a group

CO-PO MATRIX:

CO's/PO's	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	3	2	2	2	-	-	-	3	1	2
CO2	3	2	3	3	-	-	-	3	3	3
CO3	2	3	3	3	-	-	-	2	2	2
CO4	3	3	2	2	-	-	-	3	2	3
CO5	3	2	3	3	-	-	-	3	3	3
Average	2.8	2.4	2.6	2.6	-	-	-	2.8	2.2	2.6

List of experiments:

1. Calibration of a given Rota meter
2. Verify the Bernoulli's equation using Bernoulli's apparatus.
3. Determination of frictional losses in various pipes and fittings
4. Determination of friction factor of various pipes in the given experimental set up.
5. Calculates the coefficient of discharge of Venturi meter and draw graph between Cd Vs N_{Re} .
6. Calculates the coefficient of discharge of orifice meter and draw graph between

Cd Vs N_{Re} .

7. Perform the test to determine the characteristics of a centrifugal pump and draw the characteristic curves.
8. Identification of the laminar and turbulent flow using Reynolds apparatus.
9. Verification of Fourier's law of heat conduction through composite walls.
10. Verification of Fourier's law of heat conduction and determination of thermal conductivity of a metal bar.
11. Determination of overall heat transfer co-efficient in a double pipe heat exchanger for a Counter current flow.
12. Determination of overall heat transfer co-efficient in a double pipe heat exchanger for a Co-current flow
13. Determination of overall heat transfer co-efficient in a shell and tube heat exchanger for a Counter current flow
14. Determination of overall heat transfer co-efficient in a shell and tube heat exchanger for a Co-current flow
15. Determination of heat transfer co-efficient for natural convection of air.
16. Determination of heat transfer co-efficient for forced convection of air
17. Determination of Stefan Boltzmann's constant.
18. Determination of emissivity of a test plate

IV SEMESTER

DIPLOMA IN CHEMICAL ENGINEERING (PETROCHEMICALS)
SCHEME OF INSTRUCTIONS AND EXAMINATIONS
C23 - (IV Semester)

Subject Code	Name of the Subject	Instruction period / week		Total Period / year	Scheme of Examination			
		Theory	Practical		Duration (hours)	Sessional Marks	End Exam Marks	Total Marks
THEORY:								
CHPC - 401	Industrial Hazards and Safety	3	-	45	3	20	80	100
CHPC -402	Process Technology	6	-	90	3	20	80	100
CHPC -403	Petroleum Refining	5	-	75	3	20	80	100
CHPC -404	Petrochemical Technology-I	4	-	60	3	20	80	100
CHPC -405	Basic Mechanical Engineering	4	-	60	3	20	80	100
CHPC-406	Unit Operations-II	5	-	75	3	20	80	100
PRACTICAL:								
CHPC -407	Unit Operations – II Lab	-	3	45	3	40	60	100
CHPC -408	Communication skills	-	3	45	3	40	60	100
CHPC -409	Petroleum Refining-I Lab	-	3	45	3	40	60	100
CHPC -410	Process Technology Lab	-	3	45	3	40	60	100
-	Activities	-	3	45	-	-	-	-
TOTAL		27	15	405+25=630	-	280	720	1000

CHPC-408 : Common to all branches
 CHPC-401 : Common to DCHE, DCHE(PP), DCHE(OT)
 CHPC-402,405, 406, 407, 410 : Common to DCHE(PP), DCHE(OT)
 CHPC-403, 404, 409 : Not common to any course

Course Code	Course title	No of periods/week	Total no of periods	Marks for FA	Marks for SA
CHPC-401	INDUSTRIAL HAZARDS AND SAFETY	03	45	20	80

TIME SCHEDULE

S.N O	Name of the Chapter	Periods	Weightage of marks	Short answer type questions	Essay type questions	CO's mapped
01.	Industrial Hygiene & safety	6	13	01	01'	CO1, CO2,
02.	Industrial Hazards and fire Hazards	8	26	02	02	CO1, CO2,
03.	Personal Protection & Equipment Protection	8	16	02	01	CO1, CO2
04.	Fire Protection and Extinguishing	7	13	01	01	CO3, CO5
05.	Occupational Diseases & First aid	8	16	02	01	CO1, CO3, CO5
06.	Chemical Process Safety & MSDS,HAZOP	8	26	02	02	CO1, CO3,
Total		45	110	10	08	

Course Objectives	<ol style="list-style-type: none"> 1. To familiarize with the knowledge of industrial hygiene, safety, industrial hazards and fire hazards 2. To know the various personal protection, equipment protection, fire protection and extinguishing 3. To familiarize with the occupational diseases,first aid, chemical process safety, MSDS and HAZOP
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CO NO		Course Outcomes
CO1	CHPC-401.1	Explain the concept of industrial hygiene, safety, industrial and fire hazards
CO2	CHPC-401.2	Illustrate the methods of personal protection, equipment protection, fire protection and extinguishing
CO3	CHPC-401.3	Demonstrate the information about occupational diseases and first aid methods
CO4	CHPC-401.4	Identify the various methods for chemical process safety
CO5	CHPC-401.5	Examine the principles and standard procedures for MSDS AND HAZOP

CO's / PO's	PO	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO
CHPC-401.1	1	-	3	-	-	-	-	3	-	-
CHPC-401.2	1	-	-	2	-	-	-	3	-	-
CHPC-401.3	-	2	-	-	-	-	-	3	-	-
CHPC-401.4	-	2	3	-	-	-	-	3	-	2
CHPC-401.5	1	2	-	-	-	-	-	3	2	-
AVERAGE	1	2	3	2	-	-	-	3	2	2

Objectives:

I .Industrial Hygiene and safety:-

- 1.1. Define and understand industrial hygiene.
- 1.2. Understand the recognition of chemical hazards
- 1.3. Industrial evaluation and monitoring of hazard
- 1.4. Know about the controlling techniques of hazards
- 1.5. Explain the toxicity of hazardous chemicals in the work plan.
- 1.6. Know the physical classification of chemicals.
- 1.7. Explain the industrial process /operations that may produce health hazards..

II. Industrial Hazards and fire Hazard

- 2.1 Know the importance of safety in work plan.
- 2.2 Understand the economic aspects and direct and indirect costs of hazards.
- 2.3 Know about the safety in the storage of hazardous chemicals
- 2.4 Understand the specific guidelines for the storage of chemicals such as ammonia, Chlorine, LPG.
- 2.5 Know about the storage inspections.
- 2.6 Know about general recommendations for storage of chemicals in an industry.
- 2.7 List out various industrial hazards and fire hazards while processing the following:
 - a) Hazardous gases
 - b) acids
 - c) alkalies
 - d) Corrosive substances
 - e) flammable substances /explosives
- 2.8 Know about safety instructions.

III: Personal Protection & Equipment Protection

- 3.1 Know about safety practices
- 3.2 Know about safety in steps of maintenance works.
 - a) Vessel entry
 - b) Welding operations
- 3.3 Know the types of personal protection equipment and their applications
- 3.4 Know about selection of protective equipment for the handling of different chemical substances.
- 3.5 Know about the equipment protection with the following items:
 - a) guards
 - b) rupture discs
 - c) safety valves.

IV: Fire prevention and extinguishing

- 4.1 Know the causes of fire.
- 4.2 Know about the safety triangle.
- 4.3 Know about the detection of fire through automatic fire alarms
- 4.4 Know about classification of fires.
- 4.5. Know about portable and fixed fire extinguishers.
- 4.6 Know about dust explosion.

V: Occupational diseases and first aid

- 5.1 Know about the occupational diseases
- 5.2 Know about the diseases notified in factories act 1987.
- 5.3 Know about diseases namely pneumoconiosis, silicosis, Bagassosis.
- 5.4 Know about the health hazards due to lead, mercury, chromium, arsenic, manganese, Benzene.
- 5.5 Explain first aid operations
- 5.6 Explain the precautions to be taken in toxic atmospheres.
- 5.7 Explain the steps to be taken in case of
 - a) Chemical Contact
 - b) Spilling of hazardous solids, Liquids, and gases.
- 5.8 Know about electric shocks and burns and first aid given in shocks & burns.

VI: Chemical process safety

- 6.1 Know about risks associated with industrial activity.
- 6.2 Understand the hazardous chemical processes.
- 6.3 Know about hazards in chemical reactors.
- 6.4 Know about hazards in certain chemical reactions such as nitration, halogenations, polymerization, oxidation
- 6.5 Know about operational deviations such as pressure, Temperature & flow.
- 6.6 Understand technical report of a chemical plant for chemical process safety.
- 6.7 Know about material safety data sheet (MSDS).
- 6.8 Understand hazard operative procedure (HAZOP).

COURSE CONTENTS:

1. Industrial Hygiene:

Industrial hygiene - Recognition of chemical hazards -Industrial evaluation and monitoring of hazard- controlling techniques of hazards - Toxicity of hazardous chemicals in the work place - Physical classification of chemicals- industrial process /operations that produce health hazards.

2. Industrial Hazards and fire Hazard

Importance of safety - economic aspects- Direct and indirect costs of hazards - Safety in the storage of hazardous chemicals - Guidelines for the storage of chemicals Ammonia, Chlorine, LPG.- Storage inspections - General recommendations for storage of chemicals in an industry- Industrial hazards and fire hazards processing the Hazardous gases, acids, alkalies, Corrosive substances, flammable substances /explosives safety instructions.

3. Personal Protection & Equipment Protection

Safety practices - safety in maintenance works like Vessel entry, Welding operations, Types of personal protection equipment , applications- selection of protective equipment for different chemical substances- equipment protection : guards, rupture discs, safety valves.

4. Fire prevention and extinguishing

Causes of fire - safety triangle - detection of fire through automatic fire alarms - classification of fires - portable and fixed fire extinguishers- dust explosion.

5. Occupational diseases and first aid

Occupational diseases - diseases notified in factories act 1987 - pneumoconiosis, silicosis, Bagassosis - Health hazards due to lead, mercury, chromium, arsenic, manganese, Benzene -

First aid operations- precautions taken in toxic atmospheres- steps to be taken in case of Chemical Contact, Spilling of hazardous solids, Liquids, and gases - electric shocks and burns and first aid given in shocks & burns.

6. Chemical process safety

Risks associated with industrial activity - hazardous chemical processes - hazards in chemical reactors- Hazards in chemical reactions such as nitration, halogenations, polymerization, oxidation - operational deviations in pressure, Temperature & flow -Technical report of a chemical plant for chemical process safety - material safety data sheet(MSDS)-hazrd operative procedure(HAZOP).

Text Book: 1. Industrial hygiene & Chemical safety By M.H.Fulekar , I.K.International
2. Industrial health and safety management by A.M. Sarma ,
Himalaya publishing house

Reference:

1. Industrial Accident prevention - Heinrich HW
2. Injury Prevention and Control - Geetam Mohan and Tiwari
3. Fire and Explosion Protection Handbook - Denis P Nolan
4. Loss Prevention in process industries-Lees FP

Course code CHPP-401	Course Title: INDUSTRIAL HAZARDS AND SAFETY Number of course Outcomes: 05			No. of periods 45	
	PO's	Pos Mapped with CO No.	CO periods addressing PO in column 1 No. of Periods	Level (1,2,3)	Remarks
PO1	CO1	20	21	1	25% Level2 Moderately addressed
PO2	CO2, CO4, CO5	38	41	3	>40% Level3 Highly addressed
PO3	CO2, CO3, CO5.	32	37	2	5 to 25% level1 Low addressed
PO4					5 to 25% level1 Low addressed

C-23, CHPC -401

Subject Name: INDUSTRIAL HAZARDS AND SAFETY

Syllabus split up for Unit Test

Unit test NO	Learning out comes to be covered
Unit test-I	Learning objectives from 1.1 to 3.5
Unit test-II	Learning objectives from 4.1 to 6.8

PROCESS TECHNOLOGY

Course code	Course title	No. of Periods / week	Total number of periods	Marks for FA	Marks for SA
CHPC-402	Process Technology	6	90	20	80

TIME SCHEDULE

S.No.	Major Topics	No of Periods	Weightage allocated	Short Answer Questions	Essay type questions	Cos mapped
1.	Basic industrial chemicals	12	13	1	1	CO1, CO2, CO4, CO5
2.	Water and Fertilizer industry	19	26	2	2	CO1, CO2, CO5
3.	Industrial gases and Inorganic products	15	16	2	1	CO1, CO2, CO5
4.	Coal chemicals, Petroleum refining and Petrochemical industry	17	26	2	2	CO1, CO3, CO5
5.	Oils, fats, soap, Pulp, Paper and Sugar industry	16	16	2	1	CO1, CO3, CO5
6.	Polymerization, Rubber polymer and Rubber industries	11	13	1	1	CO1, CO3, CO5
Total		90	110	10	8	

Course objectives	To know the use of unit operations in the manufacturing processes
	To know the use of unit operations in the manufacturing processes.
	To understand and reinforce the unit operations concepts in various chemical processes for better production results

Course outcomes	CO1	CHPC-402.1	Describe the basic concepts, fundamentals, sources and raw materials(feed stocks) involved in the manufacture of various inorganic and organic products
	CO2	CHPC-402.2	Summarise the properties and applications of various inorganic and organic products.
	CO3	CHPC-402.3	Illustrate the manufacturing processes of various inorganic and organic products.
	CO4	CHPC-402.4	Identify the specific unit operations used in the manufacturing processes.

CO5	CHPC-402.5	Detect the troubleshooting involved in various unit operations and processes
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CO-PO/PSO MATRIX:

CO's/PO's	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CHPC-402.1	3	-	-	-	-	-	-	2	-	-
CHPC-402.2	-	-	3	-	-	-	-	-	2	1
CHPC-402.3	-	-	3	-	-	-	-	-	-	1
CHPC-402.4	-	-	-	2	-	-	-	-	2	-
CHPC-402.5	-	-	2	-	-	-	-	-	2	-
Average	3	-	2.67	2	-	-	-	2	2	1

Course code CHPP-402	Course Title: Process Technology No of Course outcomes 06				No of periods: 90
POs	Mapped with CO No	CO periods addressing PO in Column 1		Level (1, 2, 3)	Remarks
		NO	%		
PO1	CO1	27	30	2	>40%- level 3
PO2					25%-40% level 2
PO3	CO2, CO3, CO5	53	59	3	
PO4	CO4	10	11	1	5-25% : level 1
					<5%: not addressed

Learning outcome:

1.0 Basic industrial chemicals.

- 1.1 State different industrial manufacturing methods HCl and its uses
- 1.2 State and explain the manufacturing of sodium carbonate by Solvay process and uses of soda ash
- 1.3 State and explain the manufacturing of sodium hydroxide through electrolytic process, and its properties and uses.



- 1.4 State and explain the manufacturing of ammonia through steam reforming of naphtha or natural gas, properties and uses of ammonia
- 1.5 State and explain the manufacture of nitric acid, properties and uses of HNO_3
- 1.6 State and explain the manufacturing process of sulfuric acid by double absorption and double contact process, properties and uses of H_2SO_4
- 1.7 State and explain the manufacturing method of sodium sulfate from naturally occurring Glauber's salt, properties and uses of sodium sulphate

2.0 Water and Fertilizer industry.

- 2.1 List four sources of water.
- 2.2 State the impurities and mineral matter present in water.
- 2.3 Classify various scales formed and method of removal of scales due to impurities in water.
- 2.4 Explain the process of purification of water by ion - exchange method.
- 2.5 Explain Permutit method of water purification.
- 2.6 Explain the stages involved in municipal water treatment.
- 2.7 Explain sewage water treatment of process plants.
- 2.8 List the industrial uses of urea, phosphoric acid, ammonium phosphate, ammonium sulphate, super phosphate and N-P-K fertilizers
- 2.9 Explain the manufacturing method of urea by total recycle using ammonia and carbon dioxide.
- 2.10 Explain the manufacturing of phosphoric acid by wet process
- 2.11 Explain the manufacturing process of mono-ammonium phosphate (MAP) and di-ammonium phosphate (DAP).
- 2.12 Explain the process of making of ammonium sulphate.
- 2.13 Explain the manufacturing process of single super phosphate and triple super phosphate.
- 2.14 Explain the manufacture of mixed fertilizers (n-p-k) grades.

3.0 Industrial gases and Inorganic products.

- 3.1 State two methods of manufacturing of oxygen and nitrogen.
- 3.2 Explain the concept of conventional Linde cycle.
- 3.3 Explain the manufacturing of oxygen and nitrogen by liquefaction and rectification of air using conventional Linde double column rectifier and main condenser.
- 3.4 List the industrial applications of nitrogen, oxygen, carbon dioxide, silicon carbide, calcium carbide and glass.
- 3.5 State 4 sources of carbon dioxide.
- 3.6 Explain the manufacture of carbon dioxide from molasses fermentation method
- 3.7 Explain the manufacture of cement by wet and dry process.
- 3.8 Explain the manufacturing of silicon carbide and calcium carbide.
- 3.9 Explain the manufacturing of soda glass.

4.0 Coal chemicals, Petroleum refining and petrochemical industry.

- 4.1 Explain the formation of coal.
- 4.2 List the grades of coal, chemicals obtained from coal, coal tar.
- 4.3 Explain about coke, coal gas, water gas, producer gas and synthesis gas,
- 4.4 Explain high temperature carbonization of coal.
- 4.5 Explain the recovery of chemicals when coal is subjected to coking.
- 4.6 Explain coal tar distillation
- 4.7 Describe the origin of crude petroleum.
- 4.8 Explain the atmospheric distillation and vacuum distillation of crude petroleum in a refinery to obtain different cuts.

- 4.9 Explain the principles of cracking and process of catalytic cracking.
- 4.10 Explain the principles of catalytic reforming and process of catalytic reforming.
- 4.11 State the feed stocks desirable to manufacture different petrochemicals.
- 4.12 State the petrochemicals obtained from methane, ethylene, propylene and butylene
- 4.13 Explain the manufacturing process of chloro-methanes from methane.
- 4.14 State the uses of methane, ethylene, propylene and butylene.
- 5.0 Oils, fats, soaps, Pulp, Paper and Sugar industry.**
- 5.1 Distinguish between oils and fats
- 5.2 Explain the process of extraction of vegetable oil from seeds using mechanical expeller and solvent extraction method.
- 5.3 List the raw materials required in the manufacture of soap, pulp and paper.
- 5.4 Explain the continuous process for the production of soap.
- 5.5 Explain the recovery of glycerine from soap industry.
- 5.6 State the two processes followed to produce pulp.
- 5.7 Explain the sulphate or Kraft process to manufacture pulp.
- 5.8 Explain the industrial method of manufacturing paper from sulphate pulp.
- 5.9 Explain the process to which the black liquor should be subjected to recover its chemical constituents for reuse in the manufacture of pulp.
- 5.10 Explain inversion of sugar.
- 5.11 Explain the manufacture of sugar from sugar cane.
- 5.12 Explain the manufacture of industrial alcohol (ethyl alcohol) from molasses.
- 5.13 List the industrial applications of alcohol (ethyl-alcohol), sugar, glycerine
- 6.0 Polymerization and Rubber industries.**
- 6.1 Differentiate polymer compounds from plastics.
- 6.2 State the different varieties of polymers and plastics.
- 6.3 Distinguish between thermoset and thermo plastic.
- 6.4 Explain the manufacturing method of LDPE, HDPE.
- 6.5 State the industrial applications of polyethylene.
- 6.6 Understand the classification of rubbers.
- 6.7 Explain the manufacturing process of ethyl benzene
- 6.8 Explain the manufacturing process of styrene from ethyl benzene.
- 6.9 Explain the manufacturing of butadiene.
- 6.10 Explain the manufacturing process of styrene- butadiene rubber.

Course contents

1. Basic industrial chemicals:

Industrial uses of hydrochloric acid, soda ash, caustic soda, ammonia, nitric acid, sulphuric acid, sodium sulphate-Industrial manufacturing methods of sodium carbonate, NaOH, HNO₃, sulphuric acid, sodium sulphate- manufacturing processes of HCl, Na₂CO₃, NaOH, NH₃, HNO₃, H₂SO₄, Na₂SO₄-types of electrolytic cells- cell notations of diaphragm cells, membrane cells and mercury cells

2. Water and Fertilizer industry :

Sources of water-impurities and mineral material present in water-scale formation

- methods of removal of scales-, softening of water by ion – exchange and Permutit methods- stages involved in municipal water treatment, sewage water treatment. Manufacture of Urea, H₃PO₄, mono and di calcium phosphates, MAP and DAP, Ammonium phosphate, single super phosphate, Triple super phosphate, mixed fertilizers, Industrial applications of urea, H₃PO₄, Ammonium sulphate.

3. Industrial gases and Inorganic products:

Industrial manufacturing methods of oxygen and nitrogen, CO₂, cement, glass - Linde cycle concept- manufacturing processes of oxygen and nitrogen, CO₂, SiC, CaC₂, Cement, glass- applications of O₂ and N₂, Carbon dioxide, SiC, CaC₂, soda glass.

4. Coal chemicals, Petroleum refining and Petrochemicals:

Formation of coal- grades of coal- chemicals from coal-coal gas, water gas, producer gas and synthesis gas and their applications-high temperature carbonization of coal-recovery of chemicals when coal is subjected to coking-coal tar distillation - chemicals obtained from coal tar distillation. Origin of crude petroleum-crude petroleum distillation and various refinery products-catalytic cracking, reforming principles. Feed stocks desirable to manufacture petrochemicals- petrochemicals obtained from methane, ethylene, propylene and butylene-manufacturing process of chloro ethanes from methane.

5. Oils, fats, soaps, Pulp, Paper and Sugar industry:

Difference between Fats and oil -oil extraction by expeller and solvent extraction method - sources of raw materials required to soap production- production of soap, recovery of glycerine from soap Raw materials for pulp - major process to produce pulp, Kraft or sulphate process to manufacture of pulp-manufacturing of paper from sulphate pulp- recovery of chemicals from black liquor manufacture of sugar from sugar cane-inversion of sugar-manufacturing of industrial alcohol (ethyl alcohol)-industrial applications of alcohol and sugar.

6. Polymerization and rubber industries:

Differentiate between polymer and plastics- thermo set and thermo plastic-manufacturing of LDPE, HDPE, and polyester, applications of polyethylene. Classification of rubbers-manufacturing of styrene from ethyl benzene, butadiene and SBR.

REFERENCE BOOKS :

1. Shreves Chemical Process Industries - George T Austin.
2. Chemtech IIT - Vol. II, III and IV
3. Outlines of Chemical Technology by Gopala Rao (Dryden).
4. Chemical Technology Vol - I and Vol - II by Sukla and Pandey.

C-23, CHPC -402
Subject Name: PROCESS TECHNOLOGY
Syllabus split up for Unit Test

Unit test NO	Learning out comes to be covered
Unit test-I	Objectives from 1.1 to 3.9
Unit test-II	Objective from 4.1 to 6.10

PETROLEUM REFINING

Course Code	Course title	No of periods /week	Total no of periods	Marks for FA	Marks for SA
CHPC-403	PETROLEUM REFINING	05	75	20	80

S.No	Chapter/Unit title	No . of periods	Wei ghta ge allo cate d	Short Answer Questions	Essay type questions	CO's Mapped
1	Petroleum Refining in India, Composition and Classification of Crude Petroleum	10	13	1	1	CO1,CO5
2	Refinery Products	10	16	2	1	CO1,CO3,CO4, CO5
3	Test methods for Gasoline, Kerosene, Aviation Turbine fuel, Diesel fuel	10	16	2	1	CO1,CO2,CO5
4	Test methods for Lubricating Oil, Petroleum waxes, Bitumen, Petroleum coke	10	13	1	1	CO1,CO3,CO4, CO5
5	Evaluation of crude petroleum, Desalting of crude petroleum, Treatment of Petroleum Products (Gasoline, Kerosene, Aviation turbine fuels and Lube oils)	10	16	2	1	CO1,CO3
6	Atmospheric and Vacuum Distillation	5	13	1	1	CO1,CO3, CO5
7	Processes to increase the Octane number of fuels (Thermal cracking, Catalytic cracking, Coking, Hydro cracking, Hydro treatment, Reforming, Naphtha cracking, Deasphalting)	20	23	1	2	CO1,CO3
Total		75	110	10	8	-

Course Objectives	1. To familiarize with the different aspects of Crude Petroleum, Refinery products, Test methods of Petroleum products, Evaluation and Treatment of Petroleum products. 2. To use various aspects of mass transfer operation in the fractionation of crude petroleum. 3. To familiarize with the aspects of processes to manufacture Petroleum products with increased Octane ratings and other refinery processes like Naphtha cracking.	
Course Outcomes	CO1	Explain the concepts, formation laws related to crude petroleum
	CO2	Explain the Operation (construction and working) of experimental setups to test the refinery products obtained from crude petroleum with the aid of diagrams.
	CO3	Describe the manufacture methods of petroleum products (using Mass transfer operation and process methods of preparation) with the aid of flow diagrams.
	CO4	Summarize the Uses of various Petroleum products
	CO5	Appraise the Properties of various Petroleum products

CO-PO/ PSO MATRIX:

CO NO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	3	1	1	1	1	1	1	3	1	1
CO2	1	2	1	2	1	-	1	1	2	1
CO3	1	1	3	2	2	1	1	2	2	1
CO4	1	1	2	2	3	-	1	2	1	2
CO5	1	2	1	1	1	1	1	1	1	2
AVERAGE	1	1	2	2	2	1	1	2	1	1

COs-POs mapping strength (as per given table):

Course code CHPC-403	Course Title: Petroleum Refining Number of Course Outcomes: 05			No. of Periods 75	
POs	Mapped with CO No.	CO Periods addressing PO In Column 1		Level (1, 2, 3)	Remarks
		No	%		
PO1	CO1	34	45	3	>40%- level 3 25%-40% level 2 5-25% : level 1 <5%: not addressed
PO2	CO2, CO5	14	19	1	
PO3	CO3, CO4	21	28	2	
PO4	CO2	6	8	1	
PO5					
PO6					
PO7					

Learning Outcomes:

Chapter-1: Petroleum Refining in India, Composition and Classification of Crude Petroleum:

- 1.1 Describe the introduction regarding Energy.
- 1.2 Explain about upstream & downstream activities.

- 1.3 Generalize the exploration activities in India.
- 1.4 Explain the conditions under which crude oil is produced.
- 1.5 Illustrate about the origin of crude oil and the theories of formation of crude oil.
- 1.6 Summarize the statistics of crude oil production at any five refineries situated in India.
- 1.7 Describe about major expansions regarding refineries located in India
- 1.8 Understand about composition of crude oil.
- 1.9 Describe about the introduction regarding the classification of crude oil
- 1.10 Explain about the methods of classification of crude oil
- 1.11 Describe about different types of crude oils
- 1.12 Explain about introduction and the properties of various crude oil

Chapter-2: Refinery Products:

- 2.1 Understand the spectrum of various refinery products obtained from crude oil and discuss their boiling range
- 2.2 Know about the way in which the refinery products can be grouped into various finished Products
- 2.3 Know about the applications of various refinery products
- 2.4 Know about the classification of volatile products
- 2.5 Know about gasoline
- 2.6 Know about the methods of production, applications, grades of gasoline
- 2.7 Know about the factors that affect the performance of gasoline
- 2.8 Know about gum content, types of gum content and reasons for gum formation
- 2.9 Know about gum inhibitors
- 2.10 Know about sulphur content in gasoline that affects its performance
- 2.11 Know about the difficulties due to the presence of sulphur content and additives to combat the effects due to the presence of sulphur in gasoline
- 2.12 Know about odour, colour, additives of gasoline
- 2.13 Know about anti icing agents and detergents used for gasoline
- 2.14 Know about knocking, reasons for knocking
- 2.15 Know about octane number & give its definition and the standards for octane number
- 2.16 Know the method to determine octane number and octane number of various hydrocarbons
- 2.17 Know about the additives for improving the octane number

Chapter-3: Test methods for Gasoline, Kerosene, Aviation Turbine fuel, Diesel fuel:

- 3.1 Know about the tests of gasoline
- 3.2 Know about kerosene & give its boiling range
- 3.3 Know about the composition, properties and tests of kerosene
- 3.4 Know about aviation turbine fuel & give its boiling range
- 3.5 Know about the composition, properties and additives of aviation turbine fuel
- 3.6 Know about tests of aviation turbine fuel
- 3.7 Know about diesel fuel & give its boiling range
- 3.8 Know about the composition, properties, additives and tests of diesel fuel

Chapter-4: Test methods for Lubricating Oil, Petroleum waxes, Bitumen, Petroleum coke:

- 4.1 Know about lubricating oil & give its boiling range
- 4.2 Know about the composition of lubricating oil
- 4.3 Know about the properties of lubricating oil
- 4.4 Know about the additives of lubricating oil

- 4.5 Know about the tests of lubricating oil
- 4.6 Know about types of petroleum waxes
- 4.7 Know about properties of petroleum wax
- 4.8 Know about manufacture of petroleum wax
- 4.9 Know about the tests of petroleum wax
- 4.10 Know about the uses of petroleum wax
- 4.11 Know about bitumen, its tests, & uses
- 4.12 Know about petroleum coke, its tests & uses
- 4.13 Know about Carbon black

Chapter-5: Evaluation of crude petroleum, Desalting of crude petroleum, Treatment of Petroleum Products (Gasoline, Kerosene, Aviation turbine fuels and Lube oils):

- 5.1 Know about the evaluation of crude oil
- 5.2 Know about the impurities that are present in crude oil
- 5.3 Know about the methods of desalting of crude oil
- 5.4 Know about the methods available for the treatment of gasoline
- 5.5 Know about the methods available for the treatment of Kerosene
- 5.6 Know about the operating conditions & their impact on separation
- 5.7 Know about the methods available for the treatment of lube oils

Chapter-6: Atmospheric and Vacuum Distillation:

- 6.1 Know about introduction of Atmospheric distillation unit & Vacuum distillation unit
- 6.2 Know about pre-fractionation
- 6.3 Know about the basic concepts of distillation
- 6.4 Know about atmospheric distillation unit with the help of a neat sketch
- 6.5 Know about Vacuum distillation unit with the help of a neat sketch
- 6.6 Know about steam ejectors to produce vacuum
- 6.7 Know about the operating conditions of fractionating column
- 6.8 Know about temperature to be maintained in a fractionating column
- 6.9 Know about column pressure to be maintained in fractionating column
- 6.10 Know about flow rate parameters to be maintained in fractionating column
- 6.11 Know about reflux
- 6.12 Know about reboiler/condenser/steam stripping
- 6.13 Know about stability of column operation

Chapter-7: Processes to increase the Octane number of fuels (Thermal cracking, Catalytic cracking, Coking, Hydro cracking, Hydro treatment, Reforming, Naphtha cracking, Deasphalting):

- 7.1 Know about Thermal cracking, reactions involved in thermal cracking
- 7.2 Know about Mechanism of thermal cracking
- 7.3 Know about different Thermal cracking methods
- 7.4 Know about introduction, methods available and uses of coking
- 7.5 Know about catalytic cracking and its mechanism.
- 7.6 Know about the catalysts available for catalytic cracking
- 7.7 Know the methods available for catalytic cracking
- 7.8 Know about the introduction, reactions involved in hydro cracking
- 7.9 Know about the catalysts employed for hydro cracking.
- 7.10 Know the methods available for hydro cracking
- 7.11 Know about hydro-desulphurization and hydro-treatment process with the help of a neat sketch
- 7.12 Know about introduction regarding reforming
- 7.13 Know about the reactions, reaction conditions, catalysts and feed stock selection of catalytic reforming
- 7.14 Know the methods of Reforming

- 7.15 Know about naphtha cracking process with the help of a neat sketch
7.16 Know about Deasphalting using liquid propane

COURSE CONTENT:

1.0 Petroleum Refining in India, Composition and Classification of Crude oil:

Introduction regarding Energy--Upstream & downstream activities--Exploration activities in India--Conditions under which crude oil is produced--Origin of crude oil--Theories that formation of crude oil, Inorganic theory of formation of crude oil, Organic theory of formation of crude oil-- Statistics of crude oil production in India--Various refineries situated in India--Major expansions regarding refineries located in India--Introduction regarding composition of crude oil--Composition of crude oil, O₂ containing compounds, N₂ containing compounds, sulphur containing compounds present in crude oil, Salt containing compounds, other components present in crude oil--Various hydrocarbons series present in crude oil, Paraffin series present in crude oil, Olefin series present in crude oil, Naphthene series present in crude oil, Aromatic series present in crude oil, Di-olefin series present in crude oil, Acetylene series present in crude oil, Cyclic series present in crude oil--Introduction regarding the classification of crude oil--Various methods of classification of crude oil, Classification based on residuum, Classification based on ρ API gravity, Classification based on Characterization factor, Classification based on viscosity index, Classification based on Corelation index-- Different types of crude oils--Introduction regarding the properties of various crude oil, Properties of paraffin based crude oil, Properties of mixed based crude oil, Properties of naphthenic based crude oil.

2.0 Refinery products:

Spectrums of various refinery products obtained from crude oil and discuss their boiling range--Way in which the refinery products can be grouped into various finished products--Applications of various refinery products-- Classification of volatile products, Natural gas, Refinery off gas, Associated gas, Dissolved gas, Casing head gas, Liquefied petroleum gas (LPG)--Know the storage facilities regarding LPG--Natural gasoline--Composition of natural gasoline--Method of preparation of natural gasoline--Blending of natural gasoline--Gasoline--Methods of production of gasoline--Applications of gasoline--Grades of gasoline--Factors that effect the performance of gasoline--Gum content and types of gum content, existent gum & potential gum--Reasons for gum formation--Gum inhibitors-- Sulphur content in gasoline that effects its performance--Difficulties due to the presence of sulphur content--Additives to combat the effects due to the presence of sulphur in gasoline--Odour of gasoline--Colour of gasoline--Additives for gasoline, Ethyl alcohol, Metal deactivators, Corrosion inhibitors, Preignition preventors--Anti icing agents, Surface active agents, Cryoscopic agents--Detergents--Knocking--Reasons for knocking--Octane number & give its definition--Standards for octane number--Method to determine octane number--Data regarding the octane number of various hydrocarbons-- Additives for improving the octane number.

3.0 Test methods for Gasoline, Kerosene, Aviation Turbine fuel, Diesel fuel:

Tests of gasoline, ASTM distillation, Reid vapor pressure--Kerosene & give its boiling range--Composition of kerosene--Methods of preparation of kerosene--Properties of kerosene-- Tests of kerosene, Burning oil test, smoke point, flash & fire point, flash & fire point apparatus--Aviation turbine fuel & give its boiling range--Composition of aviation turbine fuel--Properties of aviation turbine fuel--Additives of aviation turbine fuel--Tests of aviation turbine fuel- Diesel fuel & give its boiling range--Composition of diesel fuel--Properties of diesel fuel--Additives of diesel fuel-- Tests of diesel fuel-Aniline point test.

4.0 Test methods for Lubricating Oil, Petroleum waxes, Bitumen, Petroleum coke

Lubricating oil & give its boiling range--Composition of lubricating oil--Properties of lubricating oil--Additives of lubricating oil--Tests of lubricating oil--Kinematic viscosity using Redwood Viscometer-I and II--Saybolt Viscometer--Types of petroleum waxes--Properties of petroleum wax--Manufacture of petroleum wax--Tests of petroleum wax-- Congealing oint of wax--Uses of petroleum wax--Bitumen, its tests, & uses--Penetration number of Bitumen--Petroleum coke, its tests & uses--Ramsbottom and Conradson Carbon residue test.

5.0 Desalting of crude oil and treatment of gasoline, kerosene, aviation turbine fuel and lube oils:

Evaluation of crude oil, True boiling point analysis, Equilibrium flash vaporization--Impurities present in crude oil-- Methods of desalting of crude oil, Chemical treatment & settling method of desalting of crude oil, Electrical desalting of crude oil-- Methods available for the treatment of gasoline, Treatment of gasoline using NaOH with the help of a neat sketch, Treatment of gasoline using CuCl_2 with the help of a neat sketch, Treatment of gasoline using Unisol or caustic & CH_3OH with the help of a neat sketch, Treatment of gasoline using Dualayer process with the help of a neat sketch, Treatment of gasoline using Merox process with the help of a neat sketch-- Methods available for the treatment of Kerosene, Treatment of kerosene using Batch process with the help of a neat sketch, Treatment of kerosene using Edeleanu process with the help of a neat sketch- Operating conditions & their impact on separation-- Methods available for the treatment of lube oils, Treatment of lube oils using contact process with the help of a neat sketch, Treatment of lube oils using phenol extraction process with the help of a neat sketch, Treatment of lube oils using furfural extraction process with the help of a neat sketch, Treatment of lube oils using solvent dewaxing process with the help of a neat sketch.

6.0 Atmospheric and Vacuum distillation:

Atmospheric distillation unit & Vacuum distillation unit--Pre-fractionation--Basic concepts of distillation--Atmospheric distillation unit with the help of a neat sketch--Vacuum distillation unit with the help of a neat sketch--Steam ejectors to produce vacuum--Operating conditions of fractionating column--Temperature to be maintained in a fractionating column--Column pressure to be maintained in fractionating column --Flow rate parameters to be maintained in fractionating column—Reflux--Reboiler/condenser/steam stripping--Stability of column operation.

7.0 Processes to increase the Octane number of fuels (Thermal cracking, Catalytic cracking, Coking, Hydro cracking, Hydro treatment, Reforming, Naphtha cracking, Deasphalting):

Thermal cracking--Reactions involved in thermal cracking--Operating conditions required for thermal cracking-- Mechanism of thermal cracking--Different cracking methods—Visbreaking with the help of a neat sketch--Dubbs two coil cracking with the help of a neat sketch-coking--Methods available for coking-- Delayed coking with the help of a neat sketch—Fluid coking with the help of a neat sketch--Uses of coking--Catalytic cracking--Mechanism of catalytic cracking--Operating conditions for catalytic cracking--Catalysts available for catalytic cracking-- Methods available for catalytic cracking --Fixed bed catalytic cracking with the help of a neat sketch--Moving bed catalytic cracking with the help of a neat sketch-Fluidized bed catalytic cracking with the help of a neat sketch--Hydro cracking—Reactions involved in hydro cracking--Operating conditions required for hydro cracking—Catalysts employed for hydro cracking- - Methods available for hydro cracking-- Isomax process for hydro cracking with the with the help of a neat sketch--Single stage process for hydro cracking with the help of a neat sketch--Double stage process for hydro cracking with the help of a neat sketch--Moving bed process for hydro cracking with the help of a neat sketch-Hydro-desulphurization with the help of a neat sketch--Hydro-treatment process with the help of a neat sketch-Reforming--Reactions and reaction conditions of catalytic reforming--Catalysts employed for catalytic reforming reactions--Feed selection for catalytic reforming reactions-Methods of reforming-- Catalytic process--Platforming process of reforming-Naphtha cracking process with the help of a neat sketch--Deasphalting using liquid propane--Bitumen and its manufacturing methods--Carbon black and the methods of manufacture of carbon black.

REFERENCE BOOKS:

1. Petroleum Refining Engineering by W.L.Nelson.
2. Modern Petroleum Refining Processes by B.K.Bhaskara Rao.
3. Petroleum Refining Technology, Dr. Ram Prasad.

PETROCHEMICAL TECHNOLOGY-I

Course code	Course title	No. of periods/week	Total no of periods	Marks for FA	Marks for SA
CHPC-404	Petrochemical Technology-I	4	60	20	80

S.No.	Chapter/Unit title	No. of periods	Weightage allocated	Short Answer Questions	Essay type questions	CO's Mapped
1.	Introduction to Petrochemicals	4	06	2		CO1
2.	Sources and production of C-1 Petrochemicals and their derivatives	10	23	1	2	CO1,CO2,CO3,CO4, CO5
3.	Sources and production of C-2 Petrochemicals and their derivatives	8	13	1	1	CO1,CO2,CO3,CO4
4.	Sources and production of C-3 Petrochemicals and their derivatives	8	13	1	1	CO1,CO2,CO3,CO4
5.	Sources and production of C-4 Petrochemicals and their derivatives	10	23	1	2	CO1,CO2,CO3,CO4
6.	Sources and production of aromatics	10	16	2	1	CO1,CO2,CO3,CO4, CO5
7.	Polymerization	10	16	2	1	CO1,CO2,CO3,CO4
	TOTAL	60	110	10	8	

Course Objectives	<ul style="list-style-type: none"> i. To know the manufacturing methods of various petrochemicals from C1, C2, C3, C4 and aromatic compounds. ii. To know the uses of various petrochemicals derived from C1, C2, C3, C4 and aromatic compounds. iii. To know the sources of methane, natural gas, naphtha, synthesis gas, ethane, propylene, butane, butylenes, BTX Aromatics.
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CO No		Course Outcomes
CO1	CHPC-404.1	Explain the manufacturing processes of petrochemicals derived from C1, C2, C3, C4 and aromatic compounds.
CO2	CHPC-404.2	Find various uses of petrochemicals derived from C1, C2, C3, C4 and aromatic compounds.
CO3	CHPC-404.3	Explain the specific unit operations used in the manufacturing processes of petrochemicals.

CO4	CHPC-404.4	Analyse the products manufactured through instrumentation used in the industry.
CO5	CHPC-404.5	Explain the Structure of a petrochemical complex, types of petrochemicals, Sources of petrochemical feed stocks.

CO-PO/ PSO MATRIX:

CO NO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	-	-	3	-	-	-	-	-	-	-
CO2	-	3	-	-	-	-	-	-	-	-
CO3	-	-	3	2	-	-	-	-	-	-
CO4	-	3	-	-	-	-	-	-	-	-
CO5	-	-	3	-	-	-	-	-	-	-
AVERAGE	3	3	3	2	-	-	--	3	-	-

Learning Outcomes:

1.0 Introduction to Petrochemicals

- 1.1 Define Petro chemical
- 1.2 Describe the history of Petrochemical Industry
- 1.3 Explain the development of Petrochemical Industry in India.
- 1.4 List the various Petrochemical complexes in India.
- 1.5 List the various Petrochemical feed stocks in India
- 1.6 Describe the structure of Petrochemical complex
- 1.7 List the various sources of Petrochemical feed stocks
- 1.8 Describe the classification of Petrochemicals

2.0 Sources and production of C-1 Petrochemicals and their derivatives

- 2.1 List the various sources of methane, natural gas and naphtha.
- 2.2 Describe the various separation techniques of gases into their individual constituents such as Absorption-Desorption, Compression-Liquefaction, Low-temperature fractionation and Adsorption
- 2.3 List the various Petrochemicals obtained from methane
- 2.4 List the uses of methane.
- 2.5 List the various sources of synthesis gas
- 2.6 Describe the manufacturing process of synthesis gas by steam reforming of naphtha, steam reforming of natural gas and partial oxidation of fuel oil techniques.
- 2.7 List the various derivatives obtained from Synthesis gas.
- 2.8 List the uses of Synthesis gas.
- 2.9 Explain the manufacturing process of methanol from natural gas/naphtha
- 2.10 Describe the manufacturing process of methanol from synthesis gas.
- 2.11 List the various Petrochemicals obtained from methanol.
- 2.12 List the uses of methanol.

3.0 Sources and production of C-2 Petrochemicals and their derivatives

- 3.1 List the various sources of ethane.
- 3.2 Describe the production of ethylene by Pyrolysis of naphtha.
- 3.3 List the various Petrochemicals obtained from ethylene
- 3.4 List the uses of ethylene
- 3.5 Explain the production of ethylene oxide by ethylene oxidation process
- 3.6 List the Uses of ethylene oxide
- 3.7 Describe the production of mono ethylene glycol by hydrolysis of ethylene oxide
- 3.8 List the uses of mono ethylene glycol

- 3.9 Explain the production of ethanol amines from ethylene oxide and ammonia
- 3.10 List the uses of ethanol amines
- 3.11 Describe the production of isoprene from acetone and acetylene
- 3.12 List the uses of isoprene.
- 4.0 Sources and production of C-3 Petrochemicals and their derivatives**
- 4.1 List the various sources of propylene
- 4.2 Describe the production of propylene from catalytic cracking of petroleum distillate.
- 4.3 List the various Petrochemicals obtained from propylene.
- 4.4 Explain the production of propylene oxide by Chloro hydrin route
- 4.5 List the uses of propylene oxide
- 4.6 Describe the production of Isopropyl alcohol from propylene by sulfuric acid hydration process
- 4.7 List the uses of isopropyl alcohol
- 4.8 Explain the production of Acrylonitrile by propylene Ammoxidation process
- 4.9 List the uses of Acrylonitrile by propylene Ammoxidation process
- 4.10 Describe the production of glycerine from propylene oxide and acetaldehyde
- 4.11 List the uses of glycerine
- 5.0 Sources and production of C-4 Petrochemicals and their derivatives**
- 5.1 List the various sources of Butane and Butylene
- 5.2 List the various Petrochemicals obtained from Butadiene
- 5.3 List the various Petrochemicals obtained from Iso-Butylene
- 5.4 Describe the production of Butanol by propylene hydration process
- 5.5 List the uses of Butanol
- 5.6 Explain the production of butadiene by dehydrogenation of butane
- 5.7 List the uses of butadiene
- 5.8 Describe the production of Methacrylate by acetone Cynohydrin process
- 5.9 List the uses of Methacrylate
- 5.10 Explain the production of Maleic anhydride by catalytic vapor phase oxidation of C₄ unsaturated compounds
- 5.11 List the uses of Maleic anhydride
- 5.12 Describe the production of Butyraldehyde by Hydroformylation of propylene
- 5.13 List the uses of Butyraldehyde
- 5.14 Explain the production of 2-ethyl Hexanol by Aldolization of n-Butyraldehyde
- 5.15 List the uses of 2-ethylHexanol
- 6.0 Sources and production of aromatics**
- 6.1 List the various sources of BTX Aromatics
- 6.2 Describe the various separation techniques of aromatics such as Crystallization (for separation of aromatics), Azeotropic separation of toluene, Extractive distillation (for separation of styrene), Aromatics separation from reformates.
- 6.3 List the various Petrochemicals obtained from Benzene, Toluene and Xylene.
- 6.4 Explain the production of styrene by dehydrogenation of ethyl benzene
- 6.5 List the uses of styrene
- 6.6 Describe the production of Maleic acid by oxidation of benzene
- 6.7 List the uses of Maleic acid
- 6.8 Explain the production of benzoic acid by liquid phase oxidation of Toluene
- 6.9 List the uses of benzoic acid
- 6.10 Describe briefly about the production of Phthalic anhydride by oxidation of O-Xylene
- 6.11 List the uses of Phthalic anhydride
- 7.0 Polymerization**
- 7.1 Define a polymer and polymerization process.

- 7.2 List the various types of polymers and their applications
- 7.3 Explain the various characteristics of a polymer and classification of polymers
- 7.4 List the various types of polymerization reactions
- 7.5 Describe the production of Low Density Polyethylene(LDPE)
- 7.6 List the uses of Low Density Polyethylene
- 7.7 Explain the production of High Density Polyethylene(HDPE)
- 7.8 List the uses of High Density Polyethylene(HDPE)
- 7.9 Describe the production of Polypropylene
- 7.10 List the uses of Polypropylene
- 7.11 Explain the production of Polystyrene
- 7.12 List the uses of Polystyrene
- 7.13 Explain the classification of rubber
- 7.14 List the various types of synthetic rubber and their applications
- 7.15 Describe the production and uses of Styrene Butadiene Rubber (SBR).

COURSE CONTENTS:

1.0 Introduction to Petrochemicals:

Definition of Petrochemical, history of Petrochemical Industry, development of Petrochemical Industry in India, various Petrochemical complexes in India, Petrochemical feed stocks in India, structure of Petrochemical complex, sources of Petrochemical feed stocks, classification of Petrochemicals

2.0 Sources and production of C-1 Petrochemicals and their derivatives

The various sources of methane, natural gas and naphtha, separation techniques of gases into their individual constituents such as Absorption-Desorption, Compression- Liquefaction, Low-temperature fractionation and Adsorption, the various Petrochemicals obtained from methane, Uses of methane, Various sources of synthesis gas, the manufacturing process of Synthesis gas by steam reforming of naphtha, steam reforming of natural gas and partial oxidation of fuel oil techniques, the various derivatives obtained from Synthesis gas, Uses of Synthesis gas, the manufacturing process of methanol from natural gas/ naphtha, the manufacturing process of methanol from Synthesis gas, Various Petrochemicals obtained from methanol, Uses of methanol.

3.0 Sources and production of C-2 Petrochemicals and their derivatives

The various sources of ethane, the production of ethylene by Pyrolysis of naphtha, the various Petrochemicals obtained from ethylene, Uses of ethylene, the production of ethylene oxide by ethylene oxidation process, Uses of ethylene oxide, the production of mono ethylene glycol by hydrolysis of ethylene oxide, Uses of mono ethylene glycol, the production of ethanol amines from ethylene oxide and ammonia, Uses of ethanol amines, the production of Isoprene from acetone and acetylene, Uses of Isoprene.

4.0 Sources and production of C-3 Petrochemicals and their derivatives

The various sources of propylene, the production of propylene from catalytic cracking of petroleum distillate, the various Petrochemicals obtained from propylene, the production of propylene oxide by Chlorohydrin route, Uses of propylene oxide, the production of Isopropyl alcohol from propylene by sulfuric acid hydration process, Uses of Isopropyl alcohol, the production of Acrylonitrile by propylene Ammoxidation process, Uses of Acrylonitrile, the production of glycerine from Propylene oxide and acetaldehyde, Uses of glycerine.

5.0 Sources and production of C-4 Petrochemicals and their derivatives

The various sources of butane and butylenes, the various Petrochemicals obtained from butadiene, Know about the various Petrochemicals obtained from Iso-Butylene, the production of Butanol by propylene hydration process, Uses of

Butanol, the production of butadiene by dehydrogenation of butane, Uses of butadiene, the production of Methacrylate by acetone Cynohydrin process, Uses of Methacrylate, the production of Maleic anhydride by catalytic vapor phase oxidation of C4 unsaturated compounds, Uses of Maleic anhydride, the production of Butyraldehyde by Hydroformylation of propylene, Uses of Butyraldehyde, the production of 2-Ethyl Hexanol by Aldolization of n-Butyraldehyde , Uses of 2-ethyl Hexanol.

6.0 Sources and production of aromatics

The various sources of BTX Aromatics, the various separation techniques of aromatics such as Crystallization (for separation of aromatics), Azeotropic separation of toluene, Extractive distillation (for separation of styrene), aromatics separation from reformates, the various Petrochemicals obtained from Benzene, Toluene and Xylene, the production of styrene by dehydrogenation of ethyl benzene, Uses of Styrene, the production of Maleic acid by oxidation of benzene, Uses of Maleic acid, the production of benzoic acid by liquid phase oxidation of toluene, Uses of benzoic acid the production of Phthalic anhydride by oxidation of O-Xylene, Uses of Phthalic anhydride.

7.0 Polymerization

Definition of a polymer and polymerization process, the various types of polymers and their applications, Know about the various characteristics of a polymer, the classification of polymers, Know about the various types of polymerization reactions, the production of Low Density Polyethylene(LDPE), Uses of Low Density Polyethylene, the production of High Density Polyethylene (HDPE), Uses of High Density Polyethylene (HDPE), the production of Polypropylene, Uses of Polypropylene, the production of Polystyrene, Uses of Polystyrene, the classification of rubber, the various types of synthetic rubber and their applications, the production of Styrene Butadiene Rubber (SBR), Uses of Styrene Butadiene Rubber(SBR).

REFERENCE BOOKS:

1. A Text book on Petrochemicals by B.K.B. Rao, Khanna Publications
2. Advanced Petrochemicals by G.N.Sarkar, Khanna Publications
3. Petrochemical process technology by I.D.Mall, Macmillan India Ltd.
4. Introduction to Petrochemicals by Sukumar Maiti, Oxford and IBH Publishing Co.Pvt.Ltd.

Table specifying the scope of syllabus to be covered for Unit Tests

Unit Test	Learning Outcomes to be covered
Unit Test-I	From 1.1 to 4.11
Unit Test-II	From 5.1 to 7.15

Basic Mechanical Engineering

Course code	Course title	No. of periods/week	Total no of periods	Marks for FA	Marks for SA
CH-PC-405	Basic Mechanical Engineering	04	60	20	80

TIME SCHEDULE

S.No.	Chapter/Unit title	No.of periods	Weightage allocated	Short Answer Questions	Essay type questions	CO's Mapped
1	Measuring Instruments	10	16	2	1	C01,C02,C03,C04,C05
2	Friction and Lubrication	05	13	1	1	C01,C02,C03,C04,C05
3	I C Engines	15	26	2	2	C01,C02,C03,C04,C05
4	Steam Boilers	10	26	2	2	C01,C02,C03,C04,C05
5	Air Compressors	10	13	1	1	C01,C02,C03,C04,C05
6	Steam Turbines & Nozzles	10	16	2	1	C01,C02,C03,C04,C05
Total:		60	110	10	8	C01,C02,C03,C04,C05

Course objectives:

Course Objectives	(i)	To familiarize with the knowledge of different tools, equipment and machinery used in the field of Mechanical Engineering
	(ii)	To use various tools for mechanical measurements and to know fabricating methods of mechanical products
	(iii)	To know the different methods of producing and transmitting mechanical power

Course outcomes:

Course outcomes	C01	CHPC-405.1	Familiarize with the concepts of measurement and measuring instruments.
	C02	CHPC-405.2	Explain about friction and lubrication in various mechanical tools & equipment.
	C03	CHPC-405.3	Enumerate the working of IC Engines and Boilers.
	C04	CHPC-405.4	Describe the working of Air compressors with the help of diagrams.
	C05	CHPC-405.5	Explain about the concept of steam turbines and nozzles.

CO-PO/PSO MATRIX:

CO NO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CHPC-405.1	3						2	2		
CHPC-405.2	3	2					2		3	
CHPC-405.3	3	2					2			

CHPC-405.4	3						2	2		2
CHPC-405.5	3	2					2			
AVERAGE	3	2					2	2	3	2

3=STRONGLY MAPPED

2=MODERATELY MAPPED

1=SLIGHTLY MAPPED **Learning**

outcome:

Objectives:

1.0 Know about Measuring Instruments.

- 1.1 Know about Measurement, types of measurement
- 1.2 Familiarise 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. Differentiate measuring and checking Instruments.

2.0 Friction and Lubrication

- 2.1 To appreciate the existence of friction in elements of power transmission
- 2.2 Understand the concept of friction
- 2.3 Explain the necessity of lubrication
- 2.4 Give the classification of lubricants
- 2.5 Explain the properties of good lubricant
- 2.6 State different methods of lubrication

3.0 I.C. Engines

- 3.1 Define Heat engine
- 3.2 Classify Heat engines.
- 3.3 Give examples for each type.
- 3.4 Summarize the advantages of I.C.engines and E.C.engines.
- 3.5 Give the classification of I.C.engines.
- 3.6 Draw a neat sketch of an I.C engine and name the various parts.
- 3.7 Explain the working of 4 stroke petrol engine with a line diagram
- 3.8 Explain the working of 2 stroke petrol engine with a line diagram
- 3.9 Explain the working of a 4 stroke and 2 stroke diesel engine with a line diagram.
- 3.10 Compare two stroke engine with 4 stroke engine
- 3.11 Compare SI engine with CI engine
- 3.12 Explain the help of a line sketch ignition system of an SI engine.
- 3.13 Explain the help of a line sketch ignition system of an CI engine.
- 3.14 Necessity of scavenging and super charging

4.0 Boilers

- 4.1 Define Boiler
- 4.2 Give the classification of Boiler
- 4.3 Differentiate fire tube and water tube boiler
- 4.4 Name different types of Boilers
- 4.5 Explain the construction and working of a simple Vertical Boiler with a line diagram 4.6 Explain Lancashire Boiler with a line diagram.
- 4.7 Explain the construction and working of a Babcock and Wilcox Boiler with a line diagram.
- 4.8 List the different Boiler mountings
- 4.9 State the specific use of each mounting.
- 4.10 List the different Boiler accessories.
- 4.11 State the functions of the boiler accessories.

5.0 Air Compressors

- 5.1 State the functions of air compressors.
- 5.2 Enumerate the uses of compressed air.
- 5.3 Name the different types of compressors.
- 5.4 Explain with line diagram the working of a single acting reciprocating air compressor.
- 5.5 State the advantages of multi stage compressors over single stage compressors.

- 5.6 Explain the use of inter cooler.
- 5.7 Name the types of rotary compressors.
- 5.8 Explain with line diagram the working of a centrifugal compressor.
- 5.9 Explain with line diagram the working of an axial flow type compressor.
- 6.0 Steam Turbines & Nozzles**
- 6.1 State the function of steam nozzle in a turbine.
- 6.2 Name different types of nozzles.
- 6.3 Define steam turbine
- 6.4 Explain the working of impulse turbine with a line diagram
- 6.5 Explain the working of a Reaction turbine with a line diagram

COs-POs mapping strength:

Hyponated Course contents with Reference books:

1. Measuring Instruments

Dividers:- Sizes and uses, Combination square, Bevel protractor, Universal bevel protractor, Sinebar, Universal surface gauge, Engineers parallels, Slip gauges, Screw pitch gauge, Vernier caliper, Vernier height gauge – least count of the measuring tools – comparison between measuring and checking instruments.

2. Friction and Lubrication

Friction in elements of power Transmission. Concept of friction - different types of friction- lubrication – concept – necessity of lubrication – classification of lubricants – properties of a good lubricant - different methods of lubrication – wick lubrication – ring lubrication – splash lubrication – forced lubrication.

3. I.C. Engine

Heat engines - examples for each type – advantages- classification of I.C.engines- neat sketch of I C engine indicating component parts, the function of each part – cylinder, crank case, crank pin, crank, crank shaft, connecting rod, wrist pin, piston, cooling fins, cylinder head, exhaust valve, inlet valve. 4 stroke petrol engine- 2 stroke petrol engine - 4 stroke and 2 stroke diesel engines – Comparison of 4 stroke with 2 stroke engine – Diesel engine with Petrol engine – Fuel and ignition system of SI engines (fuel tank, fuel pump, fuel filter, carburetor and spark plug) – injection system of CI engine (fuel tank, fuel feed pump, fuel filter, injection pump and injector) with simple sketch and explanation of each component of the above systems – importance of scavenging and super charging.

4. Boilers

Classification of Boilers - fire tube and water tube boilers- construction and working of a simple Vertical Boiler - Lancashire Boiler – Babcock and Wilcox Boiler – Boiler mountings: water level indicator – pressure gauge – safety valve – steam stop valve – feed check valve – blow off cock – fusible plug . Boiler accessories – steam trap and separator – economizer – super heater – air pre heater - feed water pump.

5. Air Compressors

Functions of air compressor – uses of compressed air – types of air compressors – single stage reciprocating air compressor , its construction and working with a line diagram – multistage compressors – advantages over single stage compressors – use of air cooler – rotary compressors – types – centrifugal compressor – axial flow type compressor.

6. Steam Nozzles & Steam turbines

Steam nozzles – functions – types – convergent – divergent – convergent and divergent – Steam turbines – classification – impulse – reaction turbines – working principle with line diagram of the above two types – governing of steam turbines – throttle – by pass – nozzle control.

REFERENCE BOOKS :

1. Basic Mechanical Engineering : Roy and Chowdary
2. Workshop Technology I & II by Hazra Chowdary
3. Elements of Heat Engines vol II by R C Patel &Karmachandani 4. Thermodynamic & II by Pakirappa.
5. General Mechanical Engg. By Pakirappa.
6. Hydraulic Machinery by R S Kurmi.

COs POs mapping strength:

Course code CH-PC-405	Course Title: Basic Mechanical Engineering			No. of Periods 60	
POs	Mapped with CO No.	CO Periods addressing PO In Column 1		Level (1, 2, 3)	Remarks
		No	%		
PO1	CO1 to CO5	25	42	3	
PO2	CO2, CO3, CO5	20	33	2	
PO3					
PO4					
PO5					
PO6					
PO7	CO1 to CO5	15	25	2	

C-20, CHPC-405
Subject Name: BASICS OF MECHANICAL ENGINEERING
IV SEMESTER
Syllabus split up for Unit Test

Unit test NO	Learning out comes to be covered
Unit test-I	Objective from 1.1 to 3.14
Unit test-II	Objective from 4.1 to 6.5

UNIT OPERATIONS – II

Course code	Course title	No. of periods /week	Total no of periods	Marks of FA	Marks for SA
CHPC -406	Unit operations– II	05	75	20	80

TIME SCHEDULE

S.NO	Chapter/ unit title	No. of periods	Weight age Allocated	Short Answer Questions	Essay type questions	Cos Mapped
1	Fundamental of mass transfer operations	18	26	2	2	CO1
2	Distillation	18	26	2	2	CO2, CO3, CO4, CO5
3	Absorption and Stripping	08	13	1	1	CO2, CO3, CO4, CO5
4	Humidification and Drying	12	16	2	1	CO2, CO3, CO4, CO5
5	Extraction and Leaching	11	16	2	1	CO2, CO3, CO4, CO5
6	Crystallization and Adsorption	08	13	1	1	CO2, CO3, CO4, CO5
	Total	75	110	10	8	

COURSE OBJECTIVES	<p>i. To familiarize with the knowledge of fundamentals of mass transfer or separation operations, diffusion, types of diffusion, in gases and liquids, study state diffusion of A through non-diffusing B , molar flux and statement of Fick's Law, concept of phase equilibria , Azeotrope equilibrium curves Bubble point and Dew point diagrams.</p> <p>ii. To use various basic industrial applications of Distillation and absorption and stripping types of distillations, equilibrium driving force in distillation , industrial equipment of distillation, (HETP) , types of packing materials, packed bed columns, Mc-Cabe Thiele method of determine the number of stages, limiting operating conditions, stage and efficiency of distillation of column.</p> <p>iii. To know the operating equation for absorption and stripping, equilibrium diagrams, stages, characteristics, equipment used, problems based on for absorptions and stripping Humidification and drying equipment , basic terminology associated, psychrometer charts, constant rate and falling rate, drying rate curves problems on drying.</p> <p>iv. To reinforce theoretical concepts of extraction and Leaching, crystallization and adsorption, equipment required for conducting extraction and leaching, crystallization and adsorption.</p>
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CO1	CHPP-406.1	Develop the basics of mass transfer operations like distillation absorption, stripping, humidification, drying ,extraction, Leaching, and crystallization - adsorption
CO2	CHPC-406.2	Deduce the derivation for the equation related to 1) Molecular diffusion in gases and liquids 2) Operating equations for various mass transfer operations.
CO3	CHPC-406.3	Describe the Construction and working of equipments used for distillation, absorption, humidification, extraction, Leaching and crystallization.
CO4	CHPC-406.4	Explain the various applications of mass transfer operations.
CO5	CHPC-406.5	Solve numerical problems related to various mass transfer operations.

Learning outcome

CHAPTER – 1

- 1.1 List the basics of mass transfer operations, diffusivity in gases and liquids
- 1.2 Illustrations of mass transfer separation techniques, the role of mass transfer operations in an industrial chemical processes.
- 1.3 Give the classification of mass transfer diffusivity in gases separation operations, significance of equilibrium in mass transfer operations
- 1.4 Distinguish between molecular diffusion and eddy diffusion, molecular diffusion in gases and liquids.
- 1.5 Define molar flux, statement of Fick's law of molecular diffusion, phase, phase rule and degrees of freedom.
- 1.6 Evaluate the derivation of equation for steady state molecular diffusion in fluids at rest and in laminar flow.
- 1.7 Evaluate the derivation of equation for steady state diffusion of A through non-diffusing B in gases and liquids
- 1.8 Evaluate the derivation of equation for steady state Equi-molar counter diffusion gases and liquids.
- 1.9 Solve the simple problems on Fick's law, steady state diffusion of A through non-diffusing B and steady state Equi-molar counter diffusion in gases and liquids.

CHAPTER – 2

- 2.1 Distinguish between distillation and absorption or stripping, stage, equilibrium or Ideal or theoretical stage.
- 2.2 List the industrial applications of distillation, feed stage conditions, the limiting operating conditions of a distillation column, a stage and efficiency.
- 2.3 Explain the flash vaporization or equilibrium distillation, differential distillation and Rayleigh's equation.
- 2.4 Describe steam distillation and steam distillation law, equilibrium and driving force in distillation.
- 2.5 Explain the continuous rectification or distillation or fractionation column with stripping section and enriching section, industrial equipment required for distillation.
- 2.6 Demonstrate Height equivalent to theoretical plate (HETP), the arrangements of condensers, trays, reboilers for distillation column.
- 2.7 Categorize the different types of packing material used in the packed bed columns.
- 2.8 Use the Mc-Cabe Thiele method to determine the number of stages required to

obtain certain degree of separation.

2.9 Solve the problems on Mc-Cabe Thiele method to determine the number of stages.

CHAPTER – 3

- 3.1 List the basics of absorption and stripping, industrial applications of absorption and stripping.
- 3.2 Evaluate the operating equation for absorption and stripping.
- 3.3 Explain the equilibrium diagrams for absorption and stripping, minimum absorbent flow rate.
- 3.4 Explain the about number of equilibrium stages for absorption and stripping, operating characteristics of absorption and stripping column.
- 3.5 Describe the equipment used for absorption and stripping.
- 3.6 Solve the problems in absorption and stripping.

CHAPTER – 4

- 4.1 List the basics of humidification, dehumidification operations, industrial applications of humidification, drying operations.
- 4.2 Define dry and wet bulb temperatures, basic terminology associated with drying.
- 4.3 Explain the psychrometer charts, cooling towers.
- 4.4 Describe the various humidification equipment, drying equipment and its classification.
- 4.5 Practice the constant rate and falling rate period associated with drying, drying rate curves, the factors that influence the rate of drying.
- 4.6 Solve the problems on time of drying, the time of drying and related problems

CHAPTER – 5

- 5.1 Differentiate among liquid-liquid extraction, absorption and distillation.
- 5.2 List the industrial applications of extraction - Leaching and basics of Leaching
- 5.3 Select the criteria for solvent required for conducting extraction.
- 5.4 Explain the single stage and multistage extraction.
- 5.5 Explain the different kinds of equipment required for conducting extraction.
- 5.6 Explain the different types of equipment required for leaching.

CHAPTER – 6

- 6.1 List basics, industrial applications of crystallization and adsorption
- 6.2 List the classification of crystallizers, major types of adsorbents and their properties.
- 6.3 Explain the solubility, un-saturation, saturation and super saturation, mechanism crystallization.
- 6.4 Explain the equipment required for crystallization.
- 6.5 Distinguish between chemisorption and physical adsorption.
- 6.6 Explain the various devices employed for conducting adsorption.

Course Contents:

1.0 Fundamentals of mass transfer or separation operations:

Definition of mass transfer operation--Separation by phase creation, separation by phase addition, separation by barrier, separation by solid agent, separation by force field or gradient- -Experimental illustrations of mass transfer operations-
-Direct contact of two immiscible phases, Phases separated by membrane, Direct contact of miscible phases, Use of surface phenomenon, Examples regarding various mass transfer operations involving all possible combination of

the three aggregates of matter i.e. solid, liquid and gas--Industrial applications of mass transfer operations-- Significance of equilibrium in mass transfer operations--Molecular diffusion and eddy diffusion-- Molar flux and statement of Fick's law of molecular diffusion--Diffusion in gases and liquids-- Steady state diffusion of A through non-diffusing B and steady state equi-molal counter diffusion in gases-- Steady state diffusion of A through non-diffusing B and steady state equi-molal counter diffusion in liquids--Diffusivity or diffusion coefficient of gases and liquids-- Phase, phase rule and degrees of freedom-- Concept of phase equilibria in terms of temperature, pressure, chemical potential, activity, activity coefficient and other thermodynamic variables-- Concept of vapor pressure, Characteristics of ideal solution and non-ideal solution and differences between ideal and non-ideal solutions--Raoult's law and Henry's law-- Vapor-liquid equilibria and equilibrium curves (x-y curve and T-x-y curve)-- Relative volatility between two components of a vapor-liquid mixture--Azeotrope, their equilibrium curves and their formation reasons--Bubble point and dew point--Triangular phase diagram for ternary systems--Definition of mass transfer coefficient

2.0 Distillation:

Difference between distillation and absorption or stripping-Industrial applications of distillation-Flash vaporization or equilibrium distillation--Differential distillation and Rayleigh's equation-Steam distillation and steam distillation law-Equilibrium and driving force in distillation-Stage, Equilibrium or Ideal or Theoretical stage-Continuous rectification, Feed line equation, Operating equations for stripping section and enriching section-Equipment for conducting distillation, Tray columns, Packed columns, Bubble cap columns, Condensers for distillation column, Reboilers for distillation column, Arrangement of condensers and reboilers, Effect of pressure drop on distillation, Packing material, Random packing and regular packing, Height equivalent to theoretical plate (HETP)-- Assumptions of Mc-Cabe Thiele methods and Use of Mc-Cabe Thiele method to calculate the number of stages required for separation--Feed stage conditions, Sub-cooled liquid, Bubble point liquid, Partially vaporized feed, Dew point vapor, Super heated vapor--Limiting operating conditions of a distillation column, Minimum reflux ratio, Total reflux ratio, Optimum reflux ratio, stage, point efficiency, Murphree tray efficiency, overall efficiency.

3.0 Absorption and Stripping:

Basics of absorption and stripping-Definition of absorption and stripping-Industrial applications of absorption and stripping-Operating equation for absorption and stripping-Equilibrium diagrams for absorption and stripping--minimum absorbent flow rate -equilibrium stages for absorption and stripping-- General operating characteristics of absorption and stripping column, Liquid entrainment, High pressure drop, Flooding, Loading, Coning, Weeping, Dumping-- Equipment used for absorption and stripping, Tray tower, Packed column, Packing material, Random packing and Random packing, Spray tower, Bubble column, Centrifugal contractor, Venturi scrubber.

4.0 Humidification and Drying:

Industrial applications of humidification operations, Absolute humidity, Molal absolute humidity, Relative humidity, Percentage saturation-- Dry and wet bulb temperatures-- Psychrometer charts-- Various humidification equipments, Tray tower, Spray chamber, Spray ponds, Cooling towers--Natural draft cooling tower,

Mechanical draft cooling tower, Induced draft cooling tower--Typical cooling tower arrangements, Atmospheric cooling tower, Counter current induced draft, Cross-flow induced draft cooling tower- Industrial applications of drying-- Basic terminology associated with drying, Moisture content on wet basis, Moisture content on dry basis, Equilibrium moisture content, Bound and Un-bound moisture, Free moisture content, Critical moisture content--Constant rate and falling rate period associated with drying-Drying rate curves, Moisture content Vs time, Drying rate Vs moisture content--Time of drying and related problems on time of drying--Factors that influence the rate of drying, Gas velocity, Humidity of gas, Area of drying surface, Temperature--Drying equipment and its classification, Batch dryer, Continuous dryer, Tray dryer, Rotary dryer, Drum dryer, Spray dryer.

5.0 Extraction and Leaching:

Industrial applications of extraction--Selection criteria for solvent required for conducting extraction, Selectivity, Recoverability, Distribution coefficient, Capacity, Density, Insolubility of solvent, Interfacial tension-- single stage and multistage extraction--Different kinds of equipment required for conducting extraction-- industrial applications of leaching--Different types of equipment required for leaching, Batch extractors for leaching of oil from seeds, Bollman extractor or Basket extractor, Rotocell extractor, Pachuca tank and Continuous extractors for leaching.

6.0 Crystallization and Adsorption:

Industrial applications of crystallization--Solubility, un-saturation, saturation and super saturation-Methods of super saturation--Mechanism of crystallization-- Equipment required for crystallization, Batch crystallizer, Continuous crystallizer, Stirred tank crystallizer, Swenson walker crystallizer, Agitated tank crystallizer, Double pipe crystallizer, Vacuum crystallizer, Evaporative crystallizer, Double tube baffle crystallizer --Classification of crystallizers--Industrial applications of adsorption, Pressure swing adsorption--Major types of adsorbents and their properties--Differences between chemisorption and physical adsorption-- Devices employed for conducting adsorption, Stirred tank, cyclic models, continuous counter current operation models.

REFERENCE BOOKS:

1. Mass transfer operations by Robert E. Treybal.
2. Unit Operations of Chemical Engineering by Warren L. McCabe, Julian C. Smith, Peter Harriot.
3. Mass Transfer-I by Kiran D. Patil.
4. Mass Transfer-II by K.A. Gavhane.
5. Separation Process Principles by J.D. Seader, Ernest J. Henley

Course code CHPC-406	Course Title: Unit operations -II Number of course Outcomes: 08			No. of periods 75	
POs	Mapped with CO No.	CO periods addressing PO in column 1		Level (1,2,3)	Remarks
		NO.	%		
PO1	CO1, CO2, CO4, CO5	42	57	3	>40% Level3 Highly addressed 25% to 40% Level2 Moderately addressed 5 to 25 % Level1 Low addressed <5% Not addressed
PO2	CO2, CO5	15	20	2	
PO3	CO3	18	23	1	

Syllabus split up for Unit Test

Unit test NO	Learning out comes to be covered
Unit test-I	Objectives from 1.1 to 3.6
Unit test-II	Objective from 4.1 to 6.6

UNIT OPERATIONS -II LAB

Course Code	Course Title	No. of Periods/Week	Total No. of Periods	Marks for FA	Marks for SA
CHPC-407	Unit Operations -II Lab	3	45	40	60

Course title :Unit Operations -II Lab(CHPC--407)	
Course Objectives	(i) To familiarize with the knowledge different materials tools used in general Engineering processes. (ii) To use various basic implements used in general Engineering processes (iii) To know the etiquette of working with the fellow workforce (iv) To reinforce theoretical concepts by conducting relevant experiments/exercises
Course Outcomes	CO1 Demonstrate the skill of planning and organizing experimental set up for a desired purpose
	CO2 Perform precise operations/tasks with Engineering equipment or instrument for investigation of Engineering problems
	CO3 Observe various parameters, their variations and graphically represent the same
	CO4 Analyse the experimental results to draw inferences to make recommendations
	CO5 Practice ethics & etiquette while working in a group and display professionalism while communicating as a member and leader in a group

CO-PO Relationship Matrix:

CO's / PO's	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO 1	3	2	1	-	-	-	-	3	2	1
CO 2	3	3	-	-	-	-	-	3	2	1
CO 3	3	3	2	1	1	-	-	3	2	1
CO 4	3	3	2	1	1	-	-	3	2	1
CO 5	3	3	2	1	3	2	2	3	2	1
Average	3	2.8	1.75	1	1.25	2	2	3	2	1

List of experiments:

1. Draw a standard plot between mole fraction of more volatile component and specific gravity of the liquid mixture.
2. Draw a standard plot between mole fraction of more volatile component and refractive index of the liquid the mixture.
3. Verify Rayleigh's equation by conducting simple distillation experiment.
4. Verify Steam distillation law by conducting steam distillation experiment.

5. To determine the height equivalent to theoretical plate (HETP).
6. To obtain the liquid- liquid equilibrium data and determine the distribution coefficient ($K= y/x$) for the system Toluene, water and acetic acid and to plot a liquid-liquid- equilibrium (L-L-E) diagram between y and x.
7. To obtain the vapour liquid equilibrium data and to plot a V-L-E diagram for a given mixture.
8. To obtain the solid liquid equilibrium data and to plot a Langmuir adsorption isotherm for the system activated charcoal, acetic acid and water.
9. To determine the vapour diffusion coefficient for a highly volatile liquid (acetone).
10. To determine the rate of drying of a given sample and plot the drying rate curve

C23-CHPC-408: English Communication Skills (Lab Practice)

Course Title : English Communication Skills	Course code: C23-Common- 408 (Common to all Branches)
Year/ Semester : IV Semester	Number of Periods : 45 (3 periods per week)
Type of Course : Practical	Max Marks : 100 (Internal 40 + External 60)

Course Objectives:	- to communicate effectively in diverse academic, professional and everyday situations
	- exhibit appropriate body language and etiquette at workplace
	- be employable through preparing appropriate job applications and attend interviews confidently with all necessary skills

CO No.	
CO1	Listen and comprehend the listening inputs related to different genres effectively
CO2	Communicate effectively in interpersonal interactions, interviews, group discussions and presentations
CO3	Acquire employability skills: job hunting, resume writing, attending interviews
CO4	Practise appropriate body language and professional etiquette

Course Delivery: Text book: **“English Communication Skills”**
by State Board of Technical Education and Training, AP

Sl No	Unit	Teaching Hours
1	Listening Skills	6
2	Workplace Etiquette	3
3	Introducing Oneself	3
4	Short presentation (JAM)	6
5	Group Discussion	6
6	Resume Writing and Cover Letter	3
7	Interview Skills	9
8	Presentation Skills	9
<i>Total</i>		<i>45</i>

Course Content:

UNIT I: Listening Skills

6 periods

Pre – While- Post-listening activities- Listening to audio content (dialogues/ speech/ narrations) - answering the questions and fill in the blanks- vocabulary

UNIT 2: Workplace Etiquette

3 periods

Basics of Etiquette- politeness/ courtesy, good manners- features of work place etiquette- adaptability, positive attitude,

body language.

UNIT 3: Introducing Oneself

3 periods

Speak about oneself - introduce oneself to a gathering/ formal & informal situations- Know about others- filling in the grid- introducing oneself in interviews

UNIT 4: Short Presentation

6 periods

Dos and Don'ts in short presentation- speak for a minute without repetition, deviation & hesitation - the techniques to speak fluently – defining and describing objects, people, phenomena, events.- speaking on randomly chosen topics.

UNIT 5: Group Discussion

6 periods

Fundamentals of Group Discussion- Dos and Don'ts- filling the Grid- possible list of topics- practice sessions- sample videos-Group activity

UNIT 6: Resume Writing and Cover Letter

3 periods

Pre activity: answer the questions- jotting down biographical information- sample resumes- tips, Dos and Don'ts- model resumes- practice exercises on Resume writing

UNIT 7: Interview Skills

9 periods

Pre –while-post activities: - things to do at three stages – respond to notifications- know the information about the organisation-practice FAQs - preparation of good/ suitable C V, Body language, tips for success in interviews, model / mock interviews.

UNIT 8: Presentation Skills

9 periods

Preparatory work: observe pictures and answer questions- different kinds of presentations- PPTs, Flash cards, Posters, Charts. - tips to prepare aids, slide show, model PPTs, - checklist on pre, while and post presentations.

Mapping Course Outcomes with Programme Outcomes:

PO	1	2	3	4	5	6	7
CO	POs 1 to 5 are applications of Engineering Principles, can't be directly mapped to English Communication Skills					1,2,3,4	1,2,3,4

Unit wise Mapping of CO –PO

CO	Course Outcome	COs / Unit Mapped	POs mapping	Cognitive levels as per Bloom's Taxonomy R/U/A/An (Remembering / Understanding / Applying/ Analysing)
CO 1	Listen and comprehend listening inputs related to different genres effectively	Unit 1	6,7	R/U/A
CO2	Communicate effectively in interpersonal interactions, interviews, group discussions and presentations	Units 3,4,5,7,8	6,7	R/U/A/An
CO3	Acquire employability skills: job hunting, resume writing, attending interviews	Units 6,7	6,7	R/U/A/An
CO4	Practise appropriate body language and professional etiquette	Units 2, 3, 4,5,7,8	6,7	R/U/A

PETROLEUM REFINING-I LAB

Course Code	Course Title	No. of Periods/Week	Total No. of Periods	Marks for FA	Marks for SA
CHPC-409	Petroleum Refining-I Lab	3	45	40	60

Course Objectives	(i) To familiarize with the knowledge different materials tools used in general Engineering processes	
	(ii) To use various basic implements used in general Engineering processes	
	(iii) To know the etiquette of working with the fellow workforce	
	(iv) To reinforce theoretical concepts by conducting relevant experiments/exercises	
Course Outcomes	CO1	Demonstrate the skill of planning and organizing experimental set up for a desired purpose
	CO2	Perform precise operations/tasks with Engineering equipment or instrument for investigation of Engineering problems
	CO3	Observe various parameters, their variations and graphically represent the same
	CO4	Analyse the experimental results to draw inferences to make recommendations
	CO5	Practice ethics & etiquette while working in a group and display professionalism while communicating as a member and leader in a group

CO-PO/ PSO MATRIX:

CO NO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	3	1	1	2	1	-	-	2	1	1
CO2	2	1	2	3	1	1	1	1	1	1
CO3	1	1	1	3	2	1	1	1	3	1
CO4	1	3	1	2	1	1	1	1	2	1
CO5	1	2	1	1	1	3	2	1	1	1
AVERAGE	2	2	1	2	1	1	1	1	2	1

List of experiments:

1. Conduct ASTM distillation experiment for a given sample of fuel and to plot the ASTM distillation curve.
2. Determine the flash and fire point of a given sample of fuel using Abel's closed cup apparatus.
3. Determine the aniline point for a given sample of fuel and to assess the ignition quality of the fuel using aniline point apparatus.
4. Determine the smoke point of an illuminating oil to test its ability to burn without producing smoke using a smoke point apparatus.
5. Determine the viscosity of a given sample oil by using Redwood viscometer-I and

- to assess the variation of viscosity with temperature by plotting a graph.
6. Determine the viscosity of a given sample oil by using Saybolt Viscometer and to assess the variation of viscosity with temperature by plotting a graph.
 7. Determine the Density and Specific gravity of the given sample.
 8. Determine the penetration number of a sample and to study the consistency of the sample by using a Penetrometer.
 9. Determine the Congealing point of Wax.
 10. Determine the carbon residue by using Conradson carbon residue method and also by using Rams bottom method.

PROCESS TECHNOLOGY LAB (CHPC-410)

Course code	Course title	No. of Periods/week	Total number of periods	Marks for FA	Marks for SA
CHPC-410	Process Technology Lab	3	45	40	60

Course objectives:

- i. To familiarize with the knowledge of different chemicals, tools and instruments used in the laboratory.
- ii. To know the etiquette of working with the fellow workforce.
- iii. To reinforce theoretical concepts by conducting relevant experiments.

Course outcomes	CO1	Demonstrate the skill of planning and organising experimental set up for a desired purpose.
	CO2	Observe various parameters and graphically represent the same.
	CO3	Analyse the experimental results to draw inferences.
	CO4	Practice ethics and etiquette while working in a group and display professionalism while communicating as a member and leader in a group

CO-PO Relationship Matrix:

Program Outcomes Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO 1	3	2	1	-	-	-	-	3	2	1
CO 2	3	3	-	-	-	-	-	3	2	1
CO 3	3	3	2	1	1	-	-	3	2	1
CO 4	3	3	2	1	1	-	-	3	2	1
CO 5	3	3	2	1	3	2	2	3	2	1
Average	3	2.8	1.75	1	1.25	2	2	3	2	1

Learning objects:

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

- 1 Determination of total and dissolved solids in ppm in tap water/sea water
- 2 Determination of the total hardness & permanent hardness in water by E.D.T.A method
- 3 Determination of chlorides present in water/ common salt
- 4 Estimation of BOD and COD of given sample of water
- 5 Estimation of sulphates present in water/common salt.
- 6 Determination of acid value of coconut oil / vegetable oil.
- 7 Estimation of saponification value of the given sample.
- 8 Determination of iodine value of given vegetable oil.
- 9 Determination of pH of the given sample of solution by using P^H meter.

- 10 Estimation of sugar content in a given sample by using polarimeter.
- 11 Determination of conductivity of the give sample of solution by conductivity meter.
- 12 Calculate the flash and fire point of oil sample using Abel's apparatus
- 13 Calculate the flash and fire point of oil sample using Pensky Marten's apparatus
- 14 Find the percentage composition of moisture content, volatile matter, ash content and fixed carbon content of coal using proximate analysis of coal
- 15 Find the percentage of CO, CO₂ and O₂ of a sample of flue gas by Orsat apparatus

V & VI SEMESTER

V & VI Semesters (Industrial Training)
DIPLOMA IN CHEMICAL ENGINEERING (PETROCHEMICALS)
SCHEME OF INSTRUCTIONS AND EXAMINATIONS

INDUSTRIAL TRAINING

Subject Title : **Industrial Training**
Subject Code : **CHPC-501**
Duration : **6 months**

Time schedule

S.NO	Code	TOPICS	Duration
1	CHPP-501	* Practical training in Industry * Training Report Preparation Report Preparation: Title Page, Certificate, Acknowledgements, Abstract, Contents(introduction of Industry, Plant Layout, Organization Chart, List of Major Equipments, List of Processes: Skills Acquired; Conclusions; References	Six Months

Course Objectives and Course Outcomes

Upon completion of the course the student shall be able to	
Course Objectives	1.Expose to real time working environment 2. Enhance knowledge and skill already learnt in the institution. 3. Acquire the required skills of manufacturing processes, assembling, servicing, supervising in the engineering fields. 4. Install the good qualities of integrity, responsibility and self confidence.
COURSE OUT COMES	CO1 Apply theory to practical work situations
	CO2 Cultivate sense of responsibility and good work habits
	CO3 Exhibit the strength, teamwork spirit and self-confidence
	CO4 Write report in technical projects

PO CO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	2				2		1	3		2
CO2						3		3		2
CO3						3		3		2
CO4						3		3		2

3: High, 2: Moderate,1: Low

Learning Outcomes

The student shall be able to display the following skill sets

- 1) Technical Skills (Manufacturing/Service/Drafting/Maintenance etc)
- 2) Reading drawings and analysing Specifications
- 3) Recognize and Practice safety Measures
- 4) Handling Tools/Instruments/Materials/Machines
- 5) Assess and Control of quality parameters
- 6) Planning, Organizing and recording Skills

<i>Sl.No.</i>	<i>Subject</i>	<i>Duration</i>	<i>Scheme of evaluation</i>		
			<i>Item</i>	<i>Nature</i>	<i>Max. Marks</i>
<i>1</i>	<i>Industrial Training</i>	<i>6 months</i>	<i>1.First Assessment at Industry (After 12 Weeks)</i>	<i>Assessment of Learning outcomes by both the faculty and training Mentor of the industry</i>	<i>120</i>
			<i>2.Second Assessment at the Industry (After 22 weeks)</i>	<i>Assessment of Learning outcomes by both the faculty and training Mentor of the industry</i>	<i>120</i>
			<i>Final Summative assessment at institution level</i>	<i>Training Report</i>	<i>20</i>
				<i>Demonstration of any one of the skills listed in learning outcomes</i>	<i>30</i>
				<i>Viva Voce</i>	<i>10</i>
<i>TOTAL MARKS</i>					<i>300</i>

Weightage of marks for Assessment of Skill sets during first and second assessment

<i>Skill Set Sl.No</i>	<i>SKILL SET</i>	<i>Max Marks Allotted For each parameter</i>
<i>1</i>	Handling of various Equipments/Instruments	<i>15</i>
<i>2</i>	Supervising the Process of various manufacturing units in Chemical Engineering	<i>20</i>
<i>3</i>	Working with equipments, Instruments	<i>25</i>
<i>4</i>	Troubleshooting Skills	<i>25</i>
<i>5</i>	Safety aspects and crisis management	<i>15</i>
<i>6</i>	Soft skills and Reporting skills	<i>20</i>
	<i>Total</i>	<i>120</i>

During assessment the performance of the students shall be assessed in those skills in which the student has been trained and be awarded the marks as per the weightage assigned as above. In case the student has undergone training in a few skill sets then the total marks obtained shall be raised to 120 marks for the given assessment i.e. either assessment 1 or 2. However the performance of the student shall be

assessed at the most skill sets listed above but not less than three skill sets. **Illustration**

If the student has undergone training in only 4 skill sets (namely serial number 1, 3, 4, 5 of above skill sets) and marks awarded during assessment is 50 out of 80 marks, then the marks of 50 shall be enhanced to 120 proportionately as $(50/80)*120=75$.

GUIDELINES FOR INDUSTRIAL TRAINING

1. Duration of the training: 6 months.
2. Eligibility: The As per SBTET norms
3. Training Area: Students may be trained in the fields
Fabrication/Foundry/Manufacturing/Service/Drafting/Maintenance etc.
4. The candidate shall put a minimum of 90% attendance during Industrial Training.
5. If the student fails to secure 90% attendance during industrial training, the student shall reappear for 6 months industrial training.
6. Formative assessment at industry level shall be carried out by the Mentor from of the industry, where the student is undergoing training and the faculty in charge (Guide) from the concerned section in the institution.
7. The Industrial training shall carry 300 marks and pass marks is 50% in assessments at industry (first and second assessment) and final summative assessment at institution level put together i.e. 150 marks out of 300 marks.
8. If the student fails to secure 50% marks in final summative assessment at institution level, the student should reappear for final summative assessment in the subsequent board examination.
9. Final Summative assessment at institution level is done by a committee including
1. Head of the section(Concerned discipline ONLY),
2. External examiner and
3. Faculty members who assessed the students during Industrial Training as members.

No gap/holidays between one spell to another

Guidelines and responsibilities of the faculty members who are assessing the students' performance during Industrial Training:

1. Every Teacher (Including HoD, if not holding any FAC) shall be assigned a batch of students of 10 to 15 for Industrial Training irrespective of students' placements for training
2. Shall guide the students in all aspects regarding training.
3. Shall create awareness regarding safety measures to be followed in the industry during the training period, and shall check it scrupulously.
4. Shall check the logbook of the students during the time of their visit for the assessment.
5. Shall monitor progress at regular intervals and make appropriate suggestions for improvement.
6. Shall visit the industry and make first and second assessments as per stipulated schedules.
7. Shall assess the skill sets acquired by the students during their assessment.
8. Shall award the marks for each skill set as per the marks allotted for that skill set during 1st and 2nd assessments
9. Shall voluntarily supplement students learning through appropriate materials like photographs, articles, videos etc.
10. Shall act as co-examiner along with other examiners in the final assessment at institution.

11. Shall act as liaison between the student and mentor.
12. Shall maintain a diary indicating his observation with respect to the progress of students learning in all three domains (Cognitive, Psychomotor and Affective).

Guidelines to the Training Mentor in the Industry:

1. Shall train the students in all the skill sets as far as possible.
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5. Shall report to the guide about student's progress, personality development or any misbehaviour as the case may be.

Department of Technical Education

Name of the institution:

PIN:

the student:

training

Semester:

Name of the Industry

Visit (I /II)

Date of visit

Name of

Period of

Maximum marks (120)

<i>Skill Set Sl. No</i>	<i>SKILL SET</i>	<i>Max Marks Allotted For each parameter</i>	<i>Precisely completes the task</i>	<i>Completes the task, mistakes are absent, but not Precise</i>	<i>Completes the task, Mistakes are a few</i>	<i>Makes attempt, Mistakes are many</i>
1	Handling of various Equipments/Instruments(15) <i>(i) Specifications of equipment and instruments</i>	10	10	8	6	2
	<i>(ii) Measuring the process parameters</i>	5	5	4	3	1
2	Supervising the Process of various manufacturing units in Chemical Engineering (20) <i>(i) Raw materials and Product, byproducts</i>	4	4	3	2	1
	<i>(ii) Process Flow diagram, Line diagrams</i>	3	3	2	1	1
	<i>(iii) Process monitoring</i>	5	5	4	3	1
	<i>(iv) Design aspects</i>	4	4	3	2	1
	<i>(v) Quality control and Quality assurance</i>	4	4	3	2	1
3	Working with equipments, Instruments (25) <i>(i) Working condition parameters</i>	8	8	6	5	2
	<i>(ii) Startup-Shutdown</i>	5	5	4	3	1
	<i>(iii) Maintenance</i>	12	12	10	7	3
4	Troubleshooting Skills (25) <i>(i) Fault-Finding</i>	15	15	12	9	3
	<i>(ii) Rectification</i>	10	10	8	6	2
5	Safety aspects and crisis management (15) <i>(i) Safety procedures</i>	4	4	3	2	1
	<i>(ii) Use of Personnel Protection Equipment</i>	5	5	4	3	1
	<i>(iii) Crisis management during hazards, accidents</i>	3	3	3	2	1
	<i>(iv) Pollution control techniques</i>	3	3	3	2	1
6	Soft skills and Reporting skills(20) <i>(i) Communication Skills (oral/writing skills) (ii) Human relations.</i>	4	4	3	2	1
	<i>(iii) Supervisory abilities.</i>	4	4	3	2	1
	<i>(iv) Reporting technical issues</i>	4	4	3	2	1
	<i>(v) Maintenance of records in the industry.</i>	4	4	3	2	1

(Marks in words:

Signature of the Training In-charge (Mentor)

Name

Designation:

Signature of the visiting staff Name(Guide)

Name:

Designation:

INDUSTRIAL TRAINING

Subject Title : **Industrial Training**
Subject Code : **CHPC-601**
Duration : **6 months**

Time schedule

S.NO	Code	TOPICS	Duration
1	CHPP-601	* Practical training in Industry * Training Report Preparation Report Preparation: Title Page, Certificate, Acknowledgements, Abstract, Contents(introduction of Industry, Plant Layout, Organization Chart, List of Major Equipments, List of Processes: Skills Acquired; Conclusions; References	Six Months

Course Objectives and Course Outcomes

Upon completion of the course the student shall be able to									
Course Objectives	1.Expose to real time working environment 2. Enhance knowledge and skill already learnt in the institution. 3. Acquire the required skills of manufacturing processes, assembling, servicing, supervising in the engineering fields. 4. Install the good qualities of integrity, responsibility and self confidence.								
COURSE OUTCOMES	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 15%; text-align: center;">CO1</td> <td>Apply theory to practical work situations</td> </tr> <tr> <td style="text-align: center;">CO2</td> <td>Cultivate sense of responsibility and good work habits</td> </tr> <tr> <td style="text-align: center;">CO3</td> <td>Exhibit the strength, teamwork spirit and self-confidence</td> </tr> <tr> <td style="text-align: center;">CO4</td> <td>Write report in technical projects</td> </tr> </table>	CO1	Apply theory to practical work situations	CO2	Cultivate sense of responsibility and good work habits	CO3	Exhibit the strength, teamwork spirit and self-confidence	CO4	Write report in technical projects
CO1	Apply theory to practical work situations								
CO2	Cultivate sense of responsibility and good work habits								
CO3	Exhibit the strength, teamwork spirit and self-confidence								
CO4	Write report in technical projects								

PO-CO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	2				2		1	3		2
CO2						3		3		2
CO3						3		3		2
CO4						3		3		2

3: High, 2: Moderate, 1: Low

Learning Outcomes

The student shall be able to display the following skill sets

- 1) Technical Skills (Manufacturing/Service/Drafting/Maintenance etc)
- 2) Reading drawings and analysing Specifications

- 3) Recognize and Practice safety Measures
- 4) Handling Tools/Instruments/Materials/Machines
- 5) Assess and Control of quality parameters
- 6) Planning, Organizing and recording Skills

<i>Sl.No.</i>	<i>Subject</i>	<i>Duration</i>	<i>Scheme of evaluation</i>		
			<i>Item</i>	<i>Nature</i>	<i>Max. Marks</i>
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				<i>Demonstration of any one of the skills listed in learning outcomes</i>	<i>30</i>
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<i>TOTAL MARKS</i>					<i>300</i>

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Department of Technical Education

Visit (I /II)

Date of visit Name of the

Period of training

Maximum marks (120)

Name of the institution:

PIN:

student:

Semester:

Name of the Industry

<i>Skill Set Sl.No</i>	<i>SKILL SET</i>	<i>Max Marks Allotted For each parameter</i>	<i>Precisely completes the task</i>	<i>Completes the task, mistakes are absent, but not Precise</i>	<i>Completes the task, Mistakes are a few</i>	<i>Makes attempt, Mistakes are many</i>
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	Supervising the Process of various manufacturing units in Chemical Engineering (20) Raw materials and Product, byproducts (i) Process Flow diagram, Line diagrams (ii) Process monitoring (iii) Design aspects (iv) Quality control and Quality assurance	4 3 5 4 4	4 3 5 4 4	3 2 4 3 3	2 1 3 2 2	1 1 1 1 1
	Working with equipments, Instruments (25) Working condition parameters (i) Startup-Shutdown (ii) Maintenance	8 5 12	8 5 12	6 4 10	5 3 7	2 1 3
	Troubleshooting Skills (25) (i) Fault-Finding (ii) Rectification	15 10	15 10	12 8	9 6	3 2
	Safety aspects and crisis management (15) Safety procedures (i) Use of Personnel Protection Equipment (ii) Crisis management during hazards, accidents (iii) Pollution control techniques	4 5 3 3	4 5 3 3	3 4 3 3	2 3 2 2	1 1 1 1
	Soft skills and Reporting skills(20) (i) Communication Skills (oral/writing skills) (ii) Human relations. (iii) Supervisory abilities. (iv) Reporting technical issues (v) Maintenance of records in the industry.	4 4 4 4 4	4 4 4 4 4	3 3 3 3 3	2 2 2 2 2	1 1 1 1 1

(Marks in words:)

Signature of the Training In-charge (Mentor)
Name

Signature of the visiting staff Name(Guide)
Name:

Designation:

Designation:

VII SEMESTER

DIPLOMA IN CHEMICAL ENGINEERING (PETROCHEMICALS)
SCHEME OF INSTRUCTIONS AND EXAMINATIONS
C23 - (VII Semester)

Subject Code	Name of the Subject	Instruction period / week		Total Period / year	Scheme of Examination			
		Theory	Practical		Duration (hours)	Sessional Marks	End Exam Marks	Total Marks
THEORY:								
CHPC-701	Industrial Management and Entrepreneurship	5	-	75	3	20	80	100
CHPC-702	Thermodynamics and Reaction Engineering	5	-	75	3	20	80	100
CHPC-703	Instrumentation & Process Control	5	-	75	3	20	80	100
CHPC-704	Unit Operations –III	4	-	60	3	20	80	100
CHPC-705	Petrochemical Technology-II	5	-	75	3	20	80	100
PRACTICAL:								
CHPC-706	Chemical Plant Equipment Drawing	-	3	45	3	40	60	100
CHPC-707	Instrumentation, process control & Reaction Engineering Lab	-	3	45	3	40	60	100
CHPC-708	Life skills	-	3	45	3	40	60	100
CHPC-709	Project Work/ Petroleum Refining II Lab	-	3	45	3	40 (20+20)	60 (30+30)	100 (50+50)
CHPC-710	Unit Operations-III Lab	-	3	45	3	40	60	100
-	Activities	-	3	45	-	-	-	-
TOTAL		24	18	360+270=630	-	300	700	1000

CHPC- 701,708 : Common to all
 CHPC- 702, 703, 706, 707 : Common to DCHE, DCHE(PP), DCHE(OT)
 CHPC-704,710 : Common DCHE(PP), DCHE(OT)
 CHPC-705, 709 : Not common to any course

INDUSTRIAL MANAGEMENT AND ENTREPRENEURSHIP

Course code	Course title	No.Of Periods / week	Totalnumber of periods	Marks for FA	Marks for SA
CHPC-701	Industrial Management and Entrepreneurship	5	75	20	80

TIME SCHEDULE

S.No.	Major Topics	No of Periods	Weightage allocated	Short Answer Questions	Essay type questions	Cos mapped
1.	Principles and functions of Management	5	06	2		CO1
2.	Organisation structure & organisational behaviour	14	26	2	2	CO1
3.	Production Management	10	13	1	1	CO2
4.	Materials Management	10	13	1	1	CO2
5.	Marketing ,Sales & Feasibility study	10	13	1	1	CO1
6.	Industrial legislation & safety	8	13	1	1	CO4, CO1
7	Introduction to ISO 9000 & T.Q.M.	8	13	1	1	CO4
8	Role of Enterprenuer and Enterprenuerial Development	10	13	1	1	CO3
Total		75	110	10	8	

objectives:

1. To familiarize with different management, productionand material principles and different structures of organization.
2. To know the role and expectations of entrepreneur.
3. To understand and reinforce the subject to establish a small scale industry

Course outcomes	CO1	CHPC-701.1	To familiarize with the basics, principles and functions of management, ownership and marketing
	CO2	CHPC-701.2	To familiarize with materials and production management
	CO3	CHPC-701.3	To know the role of entrepreneur and feasibility report
	CO4	CHPC-701.4	To understand safety , quality and iso standards to in the industry

CO-PO/PSO Matrix:

CO NO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CHPC-701.1	3		2			1		3		2
CHPC-701.2	3							3		
CHPC-701.3	3	1		1	1				1	
CHPC-701.4	3	1		1	1	1			1	
AVERAGE	3	1	2	1	1	1		3	1	2

3=STRONGLY MAPPED**2=MODERATELY MAPPED****1=SLIGHTLY MAPPED****Learning out comes:****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 Explain the principles of scientific management.
- 1.5 Understand functions of Management.
- 1.6 Differentiate between management and administration.

2.0 Know the organisation structure of an industry and the behaviour of an individual in an organisation.

- 2.1 Understand types of ownerships
- 2.2 Differentiate types of ownerships.
- 2.3 Understand salient features of joint stock companies.
- 2.4 Understand the philosophy and need of organisation structure of an industry.
- 2.5 Understand the line and staff organisations.
- 2.6 List the advantages and limitations of line and staff organisations.
- 2.7 List different departments in a large scale industry.
- 2.8 Explain the factors of effective organisation.
- 2.9 Understand organisational behaviour.
- 2.10 Conduct for analysis.
- 2.11 Assess the incurring applicants.
- 2.12 Outline the selection process.
- 2.13 Understand the sources of manpower.
- 2.14 State motivation theories.
- 2.15 State Maslow's Hierarchy of needs.
- 2.16 Explain the phenomena of satisfaction.
- 2.17 Explain the performance levels.
- 2.18 Design reward system
- 2.19 Explain quality of work life.
- 2.20 Explain socio-technical and socio-psychological approach.
- 2.21 List out different leadership models.
- 2.22 Explain the trait theory of leadership.
- 2.23 Explain behavioural theory of Leadership.
- 2.24 Explain the process of decision Making.
- 2.25 Outline the communication process.

- 2.26 Analyse the behaviour of groups in an organisation.
- 2.27 Explain group dynamics.
- 2.28 Detail the process of managing conflict.
- 2.29 Explain conflict resolution strategies.

3.0 Understand the different aspects of production management.

- 3.1 Differentiate and integrate production, planning and control.
- 3.2 Relate the production department with other departments.
- 3.3 State the need for planning and its advantages.
- 3.4 Explain the stages of Production, planning and control.
- 3.5 Explain routing methods.
- 3.6 Explain scheduling methods.
- 3.7 Explain dispatching.
- 3.8 Draw PERT/CPM networks.
- 3.9 Identify the critical path.

4.0 Understand the role of materials management industries.

- 4.1 Explain the role of the materials in Industry.
- 4.2 Derive expression for inventory control.
- 4.3 Explain ABC analysis.
- 4.4 Define safety stock.
- 4.5 Define reorder level.
- 4.6 Derive an expression for economic ordering quantity.
- 4.7 Explain stock layout.
- 4.8 List out stores records.
- 4.9 Explain the Bin card.
- 4.10 Describe Cardex method.
- 4.11 Explain purchasing procedures.
- 4.12 List out purchase records.
- 4.13 Describe the stores equipment
- 4.14 Describe material handling methods and need.
- 4.15 Describe material lifting methods. List out hoists, cranes, conveyers, trucks, and forklift trucks.
- 4.16 Explain the concept of cost.
- 4.17 List out the elements of cost.
- 4.18 Explain the concept of contribution.
- 4.19 Explain break-even analysis.

5.0 Understand marketing, sales and feasibility study.

- 5.1 Explain marketing functions.
- 5.2 Explain Sales function.
- 5.3 List out market conditions.
- 5.4 Differentiate Sellers and Buyers' market.
- 5.5 Differentiate monopoly, oligarchy, and perfect competition.
- 5.6 Conduct market and demand surveys.
- 5.7 Differentiate product and production analysis.
- 5.8 Identify the input materials, i.e. Bill of materials
- 5.9 Define the main policy requirements.
- 5.10 Decide the location.
- 5.11 Evaluate Economic and Technical factors.
- 5.12 Preparation of feasibility study.
- 5.13 List out different products currently in demand with market or industry. 5.14 Role of advertising, media of advertising and selection of media

6.0 Comprehend the provisions of industrial legislation in India. & Safety procedures

- 6.1 Describe employer and employee relations.
- 6.2 Describe the mechanics of Trade Unions.
- 6.3 Describe mechanics of settlement of in outs.
- 6.4 Explain the significance of collective bargain.
- 6.5 List out Welfare activities.
- 6.6 List out subsidy schemes.
- 6.7 Explain the Totalwelfare concept.
- 6.8 List out the rights and responsibilities of employees and employers.
- 6.9 List out the salient features of Indian Factories Act.
- 6.10 List out the salient features of Minimum Wages Act.
- 6.11 List out the salient features of Industrial Disputes Act.
- 6.12 List out the salient features of Workmen’s Compensation Act 6.13 List out the salient features of E. S .I. Act.
- 6.14 List out the salient features of consumer protection rights Act
- 6.15 Explain the importance of safety at Work place.
- 6.16 List out the important provisions related to safety.
- 6.17 Explain the significance and mechanics of safety education.
- 6.18 Explain hazard and accident.
- 6.19 List out different hazards in the Industry.
- 6.20 Explain the causes of accidents.
- 6.21 Explain the direct and indirect cost of accidents.
- 6.22 List out Electrical Hazards.
- 6.23 List out types of fire extinguishers.
- 6.24 Describe the method of artificial Respiration.
- 6.25 Describe the method of CPR.
- 6.26 Describe the mechanics of safety Drills.
- 6.27 List out provisions of Indian Electricity Rules laid in the electricity act1923.

7.0 Understand ISO 9000 & TQM.

- 7.1 Understand the concept of quality.
- 7.2 Know the quality systems and elements of quality systems.
- 7.3 Know the principles of quality Assurance.
- 7.4 Know the Indian Standards on quality systems.
- 7.5 Know the evolution of ISO standards.
- 7.6 Discuss ISO standards and ISO 9000 series of quality systems.
- 7.7 State the constituents of ISO 9000 series of standards for quality systems.
- 7.8 State the outstanding features and drawbacks of ISO 9000 series of standards.
- 7.9 List the beneficiaries of ISO 9000.
- 7.10 Understand 5-Principles and ZERO DEFECT.

8.0 Understand the role of entrepreneur in economic development and in improving the quality of life.

- 8.1 Outline the concepts of Entrepreneurship.
- 8.2 Define the word entrepreneur.
- 8.3 Determine the role of Entrepreneurship.
- 8.4 Describe the profile of an entrepreneur.
- 8.5 Explain the requirements of an entrepreneur.
- 8.6 Outline the expectations of Entrepreneurship.
- 8.7 Determine the role of entrepreneurs in promoting Small Scale Industries.
- 8.8 Describe the details of self-employment schemes.
- 8.9 Explain the method of product selection.
- 8.10 Explain the method of site selection.
- 8.11 Outline the method of plant layout.

- 8.12** State the needs for a planned and co-ordinated effect.
- 8.13** State the importance of follow up.
- 8.14** Describe the small business scheme.
- 8.15** List the financial assistance programmes.
- 8.16** List out the organisations that help an entrepreneur.
- 8.17** Conduct a demand survey.
- 8.18** Conduct a market survey.

Hyponated course outcomes

1. Principles and functions of management :

Definitions of Industry, Commerce and Business. Evolution of management theories. Principles of Scientific Management, functions of management. Difference of administration and management.

2. Organisation Structure & organisational behaviour :

Role of industry, Types of ownership – Sole proprietorship, Partnership, Private limited, Public limited company, Industrial Cooperatives, Philosophy, types of Organisations, Line and Staff and functional organisations. Advantages and limitations, departments in a large scale industry. Effective organisation. Job analysis, Assessing applicants, selection, motivation, different theories, satisfaction, performance reward systems quality of work life, socio-technical and socio-psychological approaches, Leadership in organisation, decision making, communication, group dynamics, Managing conflict.

3. Production Management :

Production, planning and control, relation with other departments, need for planning and advantages Routing, scheduling, despatching, PERT and CPM, simple problems.

4. Materials Management :

Materials in industry, inventory control model, ABC Analysis, Safety stock, re-order, level, Economic ordering quantity, Cost Elements of Cost, Contribution, Break even analysis, Stores layout, stores equipment, Stores records, purchasing procedures, purchase records, Bin card, Cardex, Material handling, Manual lifting, Hoist, Cranes, conveyors, trucks, fork trucks.

5. Marketing, Sales & Feasibility Study :

Sellers and Buyers markets, Marketing, Sales, Market conditions, monopoly, oligarchy, perfect competition, Budgets, Pricing Policies. Market Survey, Product and production Analysis, Materials input, Manpower, Location, Economic and Technical Evaluation, preparation of Feasibility study reports, - different products – Mechanical, Electrical, Electronics, consumer items, Consumer desires etc.

6. Industrial Legislation & safety :

Employer – Employee relations, Trade, Union Settlement of disputes, collective bargaining, Welfare activities, subsidies, TotalWelfare concept, rights and responsibilities and Employers and employees. Salient features of (i) Indian Factories Act, (ii) Minimum Wages Act, (iii) Industrial Disputes Act, (iv) Workmen’s compensation Act, (v) E.S.I Act. (Vi) Consumer protection act Important of Safety at work places, factories Act- Provisions, Safety Education, Hazards, causes of accidents, Cost of accidents, Electrical Hazards, Fire Extinguishers Artificial respiration, safety drills, Indian Electricity rules.

7. Introduction to ISO 9000 and TQM :Concept of quality discussed by B. Crosby W. Edward, Deming, Joseph M. Jura Kooru Ishikawa, Genichi Taguchi, ShigcoShingo. Quality systems – Definitions of the terms used in quality systems like, quality policy, quality management, quality systems, quality control and quality assurance.Elements quality systems : Management responsibility, Quality system, contract review, design control, document control, purchasing, purchaser – supplied product, product identification and traceability, process control, Inspection and testing.Principles

of quality assurance – Definition of quality assurance. Indian standards on quality systems – Main features of IS 13999 : 1990, IS 14000 : 1990, IS 14004 : 1990, IS 14001: 1990, IS 14002 :

1990, IS 14003: 1990. Know the necessity of International standards – Evolution of ISO. 5-S principles – importance – meaning – approach – benefits. Various standards under ISO – Outstanding features of ISO 9000 series of standards – ISO 9000 Phenomenon ISO 9000 series of quality systems – Constituents of ISO 9000 series of standards for quality systems. Drawbacks of ISO 9000 series of standards, list the beneficiaries of ISO 9000 (Whom does ISO 9000 help).

8. Role of Entrepreneur & Entrepreneurial Development :

Concept, definition, role, expectation, entrepreneurship Vs Management, promotion of S.S.I. Self – employment schemes. Product selection, site selection, plant layout, profile and requirement, need for a planned and co-coordinated effort, following, Institutional support needed, Financial assistance programmes, Demand survey, Market survey.

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. S.S.I Hand Book by S.B.P. Publishers.
5. Personnel Management by Flippo.
6. Industrial Management and Entrepreneurship by ZakriaBaig.
7. Entrepreneurship – by NITTT&R, Chennai.

Course code CHPC-701	Course Title: Industrial management and entrepreneurship			No of periods: 75	
POs	Mapped with CO No	CO periods addressing PO in Column 1		Level (1, 2, 3)	Remarks
		NO	%		
PO1	CO1, CO2, CO3, CO4	75	54	3	>40%- level 3
PO2	CO3, CO4	26	19	1	25%-40% level 2
PO3	CO1	38	27	2	5-25% : level 1
					<5%: not addressed

C-20, CHPC-701

Subject Name: Industrial Management and Entrepreneurship Syllabus split up for Unit Test

Unit test NO	Learning out comes to be covered
Unit test-I	Objective from 1.1 to 4.19
Unit test-II	Objective from 5.1 to 8.18

THERMODYNAMICS AND REACTION ENGINEERING

Course code	Course title	No. of Periods/week	Total no of periods	Marks for FA	Marks for SA
CHPC-702	Thermodynamics and Reaction Engineering	5	75	20	80

TIME SCHEDULE

S.No.	Major Topics	No of Periods	Weightage allocated	Short Answer Questions	Essay type questions	COS mapped
1.	Introduction and First law of thermodynamics Volumetric properties of pure fluids	18	26	2	2	CO1, CO2, CO3, CO4, CO5
2.	The second law of thermodynamics	12	16	2	1	CO2, CO3, CO4, CO5
3.	Refrigeration and Liquefaction	10	13	1	1	CO2, CO4, CO5
4.	Chemical reaction equilibria	10	16	2	1	CO1, CO2, CO3, CO5
5.	Chemical kinetics and ideal reactors	18	26	2	2	CO2, CO3, CO5
6.	Catalysis and Industrial reactors	07	13	1	1	CO1, CO2, CO4
Total		75	110	10	8	

Course objectives	To familiarize with the terms used in thermodynamics, thermodynamic processes, properties of fluids, second law of thermodynamics, refrigeration and liquefaction, Lechatlier's principle, rate of reaction, factors affecting rate of reaction, methods to analyse rate data, industrial reactors and catalysis
	To apply thermodynamic laws for steady state flow process and feasibility of a chemical process, Lechatlier's principle to Haber's and contact process
	To understand and reinforce the thermodynamic concepts in various chemical processes for better production results.

Course outcomes

CO1	CHPC-702.1	Interpret the basic concepts and definitions of thermodynamics, reaction engineering and catalysis
CO2	CHPC - 702.2	Understand various thermodynamic properties and their evaluation, applications of thermodynamics, reactors and catalysts
CO3	CHPC - 702.3	Deduce the derivations of thermodynamics and reaction engineering
CO4	CHPC - 702.4	Illustrate with the help of neat diagrams the construction and working of heat engines, heat pumps and various reactors
CO5	CHPC - 702.5	Solve the problems on first and second law of thermodynamics and reaction engineering

CO's/PO's	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PS01	PS02	PS03
CO 1	3	-	-	-	-	-	-	2	-	-
CO 2	-	2	-	-	-	-	-	1	-	-
CO 3	2	2	-	-	-	-	-	-	2	-
CO 4	-	-	2	-	-	-	-	-	2	-
CO 5	2	2	-	-	-	-	-	-	-	-
Average	2.33	2	2	-	-	-	-	1.5	2	-

Course code CHPC-702	Course Title: thermodynamics and reaction engineering No of Course outcomes 07				No of periods: 75
POs	Mapped with CO No	CO periods addressing PO in Column 1		Level (1, 2, 3)	Remarks
		NO	%		
PO1	CO1, CO3, CO5	43	44	3	>40%- level 3
PO2	CO2, CO3, CO5	25	33	2	
PO3	CO4	17	23	1	25%-40% level 2
PO4					5-25% : level 1
PO5					<5%: not addressed
PO6					
PO7					

Learning outcome

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

1.0 Introduction, First law of thermodynamics and volumetric properties of pure fluids

1.1 Describe importance of thermodynamics.

1.2 Define internal energy, enthalpy and their units in SI system.

- 1.3 Define the statement for 1st law of thermodynamics.
- 1.4 Derive an expression of first law of thermodynamics for the following processes: a) Closed process b) Steady state flow process.
- 1.5 Differentiate between state and path functions.
- 1.6 Distinguish extensive and intensive properties.
- 1.7 Derive the relation of constant volume and constant pressure processes
- 1.8 Define heat capacity and specific heat
- 1.9 Explain (a) Equilibrium (b) Reversible process.
- 1.10 Describe the PVT behaviour of pure substances.
- 1.11 Define ideal gas and the characteristics of ideal gas.
- 1.12 Define compressibility factor and know about compressibility Charts.
- 1.13 Derive $C_P - C_V = R$ for a mole of an ideal gas.
- 1.14 Explain about the following processes.
a) Isobaric b) Isochoric c) Isothermal and d) Adiabatic.
- 1.15 Derive expression for ΔU , ΔH , Q and W for the above processes connecting PVT properties.
- 1.16 Solve problems on calculation of ΔU , ΔH , Q and W for the above processes connecting PVT Properties.

2.0 The second law of thermodynamics.

- 2.1 Explain second law of thermodynamics.
- 2.2 Distinguish between heat engine and heat pump.
- 2.3 Give the schematic representation of heat engine and heat pump.
- 2.4 Define cop in heat engine and heat pump.
- 2.5 Define and explain Carnot cycle for an ideal gas.
- 2.6 Explain Carnot cycle principle.
- 2.7 Define entropy and its SI units.
- 2.8 Explain the entropy characteristics.
- 2.9 Describe the entropy changes of an ideal gas.
- 2.10 Derive the mathematical statement of 2nd law of thermodynamics.
- 2.11 Define third law of thermodynamics.

3.0 Refrigeration and Liquefaction.

- 3.1 Define refrigeration.
- 3.2 Explain the cycle of refrigeration.
- 3.3 List the methods of refrigeration.
- 3.4 list the applications of refrigeration.
- 3.5 Define refrigerant.
- 3.6 Describe classification of refrigerants (primary and secondary).
- 3.7 Explain the principle of Carnot cycle refrigerator.
- 3.8 Explain about choice of refrigerant.
- 3.9 Explain the method of obtaining vapour compression refrigeration.
- 3.10 Explain the method of obtaining vapour absorption refrigeration.
- 3.11 Solve simple problems on ton of refrigeration, COP on refrigeration
- 3.12 Explain about liquefaction
- 3.13 Explain Linde and Claude liquefaction processes

4.0 Chemical reaction equilibria.

- 4.1 Define equilibrium.
- 4.2 Explain about the standard Gibbs free energy change and the equilibrium constant.
- 4.3 Explain the effect of temperature on the equilibrium constants.
- 4.4 Evaluation of equilibrium constants.
- 4.5 Explain the relation between equilibrium constants and composition.

- 4.6 Simple problem in equilibrium constant calculations
- 5.0 Chemical kinetics and ideal reactors.**
- 5.1 Introduction to chemical kinetics
- 5.2 Explain the importance of reaction kinetics in chemical industries.
- 5.3 Explain the classification of reactions.
- 5.4 Define reaction rate and know its units.
- 5.5 Explain the variables affecting the rate of reaction.
- 5.6 Define single, multiple, elementary and non-elementary reactions.
- 5.7 Explain about molecularity and order of reaction.
- 5.8 Explain about rate constant k , representation of a rate equation.
- 5.9 Explain about temperature - dependent term of a rate equation.
- 5.10 Explain temperature dependency from Arrhenius' law.
- 5.11 Explain about constant - volume batch reactor.
- 5.12 Describe about
- Integral method of analysis of data.
 - Differential method of analysis of data.
- 5.13 Define the following with examples.
- Zero order
 - First order
 - Second order.
- 5.14 Explain broad classification of reactor types.
- 5.15 Explain ideal batch reactor with diagram and design equation.
- 5.16 Define space time and space velocity.
- 5.17 Explain the steady state mixed flow reactor with diagram and design equation.
- 5.18 Explain steady state plug flow reactor with diagram and design equation.
- 6.0 Catalysis and Industrial reactors.**
- 6.1 Define catalysis.
- 6.2 Describe about the types of catalysis.
- 6.3 Describe the characteristics of catalytic reactions.
- 6.4 Define auto catalysis.
- 6.5 Explain the function of promoters, accelerators, carriers, inhibitors in catalytic reaction with examples.
- 6.6 Explain catalyst poisoning.
- 6.7 List out some important commercially available catalysts.
- 6.8 List six industrial catalytic processes.
- 6.9 Explain the working principle of the following with the help of neat sketches.
- Fixed bed reactors
 - Moving bed reactors
 - Fluidized bed reactors

HYPONATED COURSE CONTENT:

1. Introduction and First law of thermodynamics.

The importance of thermodynamics- Internal energy - Formulation of first law -closed process State functions and path functions - Enthalpy - Steady state flow process - Constant volume and constant pressure processes - heat capacity and specific heat- Equilibrium - Reversible process.

Volumetric properties of pure fluids.

PVT behaviour of pure substances – Ideal gas -Definition of compressibility factor- Derivation of $C_p - C_v = R$ for a mole of an ideal gas-State and explain about the following processes: a) Isobaric b) Isochoric c) Isothermal and d) Adiabatic. The different expressions for ΔU , ΔH , Q and W for the above processes connecting PVT properties- Problems on calculation of ΔU , ΔH , Q and W for the above processes.

2. The second law of thermodynamics:

Statement - The heat engine and heat pump- 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 - Problems.

3. Refrigeration and Liquefaction:

The Carnot refrigerator - Vapor - Compression cycle - Comparison of refrigeration cycles - Refrigerant - Choice of refrigerant - Absorption refrigeration - Heat pump- Liquefaction- Linde and Claude liquefaction processes.

4. Chemical reaction equilibria:

Application of equilibrium criteria to chemical reactions – The standard Gibbs energy change and the equilibrium constant - Effect of temperature on the equilibrium constant - Evaluation of equilibrium constants - Relation between equilibrium constants and composition.

5. Chemical Kinetics and Ideal reactors:

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 rate equation - Constant volume batch reactor - Integral method of analysis of data and 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.

6. 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 Reaction Engineering - by K.A. Gavhane, Nirali Publications.
2. Chemical Kinetics - by J.M. Smith.
- 3 Introduction to Chemical Engineering Thermodynamics - by Smith and Vannes, 4th Edition.
4. Chemical reaction Engineering - by Octave Levenspiel, 2nd edition.

Syllabus split up for Unit Test

Unit test No.	Learning out comes to be covered
Unit test-I	Objective from 1.1 to 3.13
Unit test-II	Objective from 4.1 to 6.9

INSTRUMENTATION AND PROCESS CONTROL

Course code	Course title	No. of periods/week	Totalno.of periods	Marks for FA	Marks for SA
CH-PC-703	Instrumentation & Process Control	05	75	20	80

TIME SCHEDULE

S.No.	Major Topics	No of Periods	Weightage allocated	Short Answer Questions	Essay type questions	Cos mapped
1.	Introduction and Qualities of measurement	8	13	1	1	CO1
2.	Measurement of Temperature.	12	26	2	2	CO2, CO3, CO4 CO5
3.	Measurement of pressure and Vacuum:	9	13	1	1	CO2, CO3, CO4 CO5
4.	Measurement of Liquid level, Density and Viscosity.	10	13	1	1	CO2, CO3, CO4 CO5
5.	Measurement of composition.	9	13	1	1	CO2, CO3, CO4 CO5
6.	Process Instrumentation & Instrumentation diagrams for Chemical Engineering processes and operations:	9	13	1	1	CO2, CO3, CO4 CO5
7	Principles of automatic process control and modes available for process control.	14	16	2	1	CO4
8	Digital instruments	4	3	1		CO5
Total		75	110	10	8	

Course objectives

Course objectives	<ul style="list-style-type: none"> (i) To familiarize with the measurement, control of process and process instrumentation. (ii) To use various instruments to measure the temperature, pressure, vacuum, level, density, viscosity and composition. (iii) To know the principle ,construction ,and working of different instruments.
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Course Outcomes

CO1	CHPC-703.1	Illustrate with example the Definitions and concepts of First and Second order systems with various inputs and responses.
CO2	CHPC-703.2	Derive the response equations for various inputs related to First and Second order systems.
CO3	CHPC-703.3	Illustrate the Principle, Construction and working of various instruments to measure temperature, pressure, vacuum, level, density, viscosity and composition with diagram.
CO4	CHPC-703.4	Compare the applications of the temperature, pressure, vacuum, level, density, viscosity and composition measuring instruments
CO5	CHPC-703.5	Describe the Instrumentation diagrams and working of automatic process control systems both pneumatic and hydraulic operated.

CO-PO/PSO Matrix:

CO NO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CHPC-703.1	3	2	-	-	-	-	-	2	-	-
CHPC-703.2	2	2	-	-	-	-	-	2	-	-
CHPC-703.3	-	-	2	-	-	-	-	-	2	-
CHPC-703.4	2	-	-	-	2	-	-	2	-	2
CHPC-703.5	-	-	2	-	-	-	-	-	2	-
AVERAGE	2.33	2	2	-	2	-	-	2	2	2

3=STRONGLY MAPPED

2=MODERATELY MAPPED

1=SLIGHTLY MAPPED

Course code CH-PC-703	Course title : Instrumentation & Process Control Number of course outcomes: 05				No. of periods:75
POs	Mapped with CO No.	CO Periods addressing PO in Column 1		Level (1,2,3)	Remarks
		No	%		
PO1	CO2, CO3	35	38	2	>40% Level 3 Highly addressed 25% to 40% Level 2 Moderately addressed 5 to 25% Level 1 Low addressed <5% Not addressed
PO2	CO4, CO5	45	50	3	
PO3	CO1	20	22	1	
PO4					
PO5					
PO6					
PO7					

Learning Outcome

Unit-1: Introduction and Qualities of measurement

Know the importance of Instrumentation and process control in Chemical Industries.

- 1.0 Know the meaning of measurement.
- 1.1 Know the differences between direct and in-direct measurement.
- 1.2 Know about different elements of an instrument.
- 1.3 Know about the Static characteristics of an instrument.
- 1.4 Know about the Dynamic characteristics of an instrument.
- 1.5 Know about a First order system and physical examples of first order system.
- 1.6 Know about a Second order system and physical examples of second order system.
- 1.7 Know about various input functions like Step input, Impulse input, Sinusoidal input and Linear input.
- 1.8 Know about the response of a first order system for a given input functions with derivations.
- 1.9 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. Know about Seebeck effect, Peltier effect and Thomson effect.
- 2.5 Know the types of industrial thermocouples.
- 2.6 Know about the accessories of an industrial thermocouple.
- 2.7 Know the mechanical properties of thermal well materials.
- 2.8 Know the effect of location of reference junction and lead wires for a Thermocouple.
- 2.9 Know about the principle, construction, working of Milli-voltmeter and its application.
- 2.10 Know about the principle, construction, working of Null Potentiometer circuit and its application.
- 2.11 Know about temperature coefficient of resistance.
- 2.12 Know about industrial resistance thermometer bulbs.
- 2.13 Know about resistance thermometer elements.
- 2.14 Know about thermal wells and lead wires for resistance thermometers.
- 2.15 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".
- 2.16 Know about radiation temperature measurement.
- 2.17 Know about radiation receiving elements.
- 2.18 Know the types of radiation pyrometers.
- 2.19 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 Working Principle of Spectro-Photometer.
- 5.7 Know about 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 signalling instruments.
- 6.3 Know about control centre.
- 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, ProportionalDerivative, 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 roportional, 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-IntegralDerivative control action.
- 7.11 Know about Control valve, its components, working and characteristics.
- 7.12 Know about the Elaborate Explanation of programmable logic control and Distributive control system.

8. Digital Instruments

- 8.1 Know IOT (Internet of Things) and IIOT (Industry Internet of Things) fundamentals
- 8.2 List various digital sensors for concentration, thermal, pressure, flow and level.

Course contents:

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 displacementmeter 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 -Photometer, 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 signalling instruments, Eccentric scale indicator, Concentric indicating scale--Control centre--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-IntegralDerivative control action-- Components of a pneumatic system, Construction, working of a Pneumatic system incorporated with Proportional, Proportional-Integral, ProportionalDerivative and Proportional-Integral-Derivative control action--Control valve, its components, working and characteristics—Elaborate Explanation of programmable logic control and Distributive control system.

Unit-8. Digital Instruments

IOT and IIOT fundamentals- Digital sensors for concentration ,thermal ,pressure, flow and level.

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.

C-23-CHPC-703

CH-PC-703, Instrumentation & Process Control VII SEMESTER

Syllabus split up for Unit Test

Unit test NO	Learning out comes to be covered
Unit test-I	Learning Objective from 1.1 to 4.12
Unit test-II	Learning Objective from 5.1 to 8.2

UNIT OPERATIONS-III

Course code	Course title	No. of periods/week	Total no of periods	Marks for FA	Marks for SA
CHPC-704	Unit Operations-III	4	60	20	80

TIME SCHEDULE

S.No.	Chapter/Unit title	No. of periods	Weightage allocated	Short Answer Questions	Essay type questions	CO's Mapped
1.	Introduction and Properties of particulate solids	10	16	2	1	CO1,CO2, CO4, CO5
2.	Storage and conveyance	6	13	1	1	CO1,CO2, CO5
3.	Mixing	7	13	1	1	CO1,CO2, CO5
4.	Size Reduction	17	26	2	2	CO1,CO2, CO3,CO4, CO5
5.	Mechanical Separations	10	26	2	2	CO1,CO2, CO3,CO4, CO5
6.	Filtration	10	16	2	1	CO1,CO2, CO3,CO4, CO5,
	Total	60	110	10	8	

Course objectives

Course Objectives	To Impart the basic concepts of mechanical operations and develop an understanding of Size analysis, Size reduction and solid handling.
	To Familiarize with mechanical separation method such as filtration, sedimentation, transportation of solids etc. and associated equipment used for achieving these methods.
	The students are exposed to basic theory, calculations and machines involved in various solid handling operations.

CO NO.		Course Outcomes
CO1	CHPC-704.1	Understand Mechanical Unit Operations and their role in chemical engineering industries.
CO2	CHPC-04.2	Summarize the Characterization of particulate solids, phenomenon of screening and principle involved in various separation techniques, size reduction operations ,agitators, mixers, conveyers etc.
CO3	CHPC-704.3	Operate various mechanical separations, size reduction equipments etc.
CO4	CHPC-704.4	Estimate the power consumption of the equipments for mixing ,size reduction operations
CO5	CHPC-704.5	Apply the concept of filtration, size reduction and other mechanical separations in chemical and allied industries.

- **CO PO/PSO Matrix:**

CO NO	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CHPP-704.1	2	-	-	-	1	-	-	2	-	-
CHPP-704.2	2	-	2	-	-	-	-	-	2	-
CHPP-704.3	-	-	2	-	-	-	-	-	3	-
CHPP-704.4	2	1	-	-	-	-	-	2	-	-
CHPP-704.5	2	-	2	-	-	-	-	-	2	-
AVERAGE	2	1	2	-	1	-	-	2	2.33	-

3=STRONGLY MAPPED

2=MODERATELY MAPPED

1=SLIGHTLY MAPPED

Cos-Pos mapping strength (as per given time table)

Course Code:	Course Title: Unit Operations-III			No of periods	
CHPC-704	Number of course outcomes: 05			60	
POs	Mapped with CO No.	CO Periods addressing PO in Column 1		Level (1,2,3)	Remarks
		No.	%		
PO1	CO1,CO2	27	17	1	
PO2	CO2,CO3,CO4	44	27	2	
PO3	CO2,CO3	39	24	1	
PO4	CO3,CO4	25	16	1	
PO5	CO3	20	12	1	
PO6	CO2,CO3	39	24	1	
PO7	CO5	8	1	-	

Learning Outcome

1.0 Understand properties of particulate solids.

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

2.0 Understand the storage and conveyance 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
- 2.4 Know about silos and hoppers.
- 2.5 List out various conveyors.
- 2.6 know the working principles of various conveyors-belt conveyors, screw conveyors, Bucket Elevators, pneumatic conveyors
- 3.0 Understand the objective of mixing.**
- 3.1 State the various mixing equipments.
- 3.2 Explain the mixing of various systems like liquid-liquid, solid-liquid, gas-liquid, solid-solids.
- 3.3 Explain the working principle of mixing equipments used for liquid-liquid mixing-propellers, Paddles and turbines.
- 3.4 Describe the working principle of mixing equipments used for solid mixing-Ribbon blenders, Tumbling mixers, kneading machines, and Banbury mixer
- 3.5 Draw the diagrams of Ribbon blender and Banbury mixer.
- 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 operation.**
- 4.1 Explain the principle involved in size Reduction.
- 4.2 Calculate the mechanical efficiency and crushing efficiency.
- 4.3 State and explain (a) Rittinger's Law (b) Kick's Law (c) Bond's crushing law and work index.
- 4.4 Evaluate the power requirement for crushing and grinding.
- 4.5 Classify the size reduction equipment.
- 4.6 Distinguish the crushing and grinding equipment.
- 4.7 Explain the working principles of following crushing equipment: Jaw crusher, Gyratory Crusher and Roll crusher.
- 4.8 Explain the working principles of the following grinding equipment: Hammer mill, Rod mill, Ball mill and Ultrafine grinders.
- 4.9 Draw the line sketches of Jaw crusher, Roll mill and Ball mill.
- 4.10 Evaluate angle of nip in crushing rolls.
- 4.11 Evaluate the critical speed of Ball mill.
- 4.12 Mention the applications of various crushers and grinders.
- 4.13 Distinguish between closed circuit grinding and open circuit grinding.
- 4.14 Solve simple problems based on Rittinger's Law, Kick's Law and Bond's crushing law.
- 4.15 Solve problems on evaluating critical speed of a ball mill
- 4.16 Solve problems on evaluating angle of nip of Roll Crusher
- 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 various classifiers.
- 5.4 Know about hydraulic classifiers-Mineral jig, Wilfley table
- 5.5 know the working principle of froth flotation.
- 5.6 Know about magnetic separation and electro 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 Stokes law and Newton's law.
- 5.12 Know about free settling and hindered settling.
- 5.13 Define terminal velocity.

- 5.14 know the principle of working of industrial thickener with diagram.
- 5.15 Solve simple problems on terminal velocity.
- 6.0 Know about filtration.**
- 6.1 State the principles of cake filtration.
- 6.2 State the principles of constant rate filtration and constant pressure filtration.
- 6.3 Know about working principle of plate and frame filter press and leaf filter.
- 6.4 Draw a neat sketch of rotary drum filter.
- 6.5 Know about working principle of continuous rotary drum vacuum filter.
- 6.6 Know the various types of filter medium used and its requirements.
- 6.7 Know the functions of filter aid and mention various filter aid.
- 6.8 State the principles of centrifugal filtration.
- 6.9 Know the application and selection of various filters.
- 6.10 Draw the neat sketches of centrifugal filters.
- 6.11 Explain the working principle of Batch and continuous centrifugal filters.

Course contents:

1. **Properties of particulate solids:** 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-problems on screen Effectiveness.
2. **Storage and conveyance of solids :**Various types of storage of solids- Bin storage- flat Bottomed bin, sloped bottomed bin, silos, hoppers and bulk storage-Conveying-types of Conveyors- Working principles- Belt conveyor, screw conveyor, pneumatic conveyor and Bucket elevator.
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 equipment (crushers and grinders)-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:** 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 Engineering" by Warren L. McCabe, Julian C. Smith, Peter Harriot. Mc. Graw Hill Publication, Fifth Edition.
2. Introduction to chemical Engineering by Warren L. Badger & Julius T. Banchero,

McGraw – Hill publication.
3. Unit Operations -I & II, K.A.Ghavane, NiraliPrakasham Publications.

Syllabus split up for Unit Test

Unit test No.	Learning out comes to be covered
Unit test-I	Objective from 1.1 to 3.7
Unit test-II	Objective from 4.1 to 6.11

PETROCHEMICAL TECHNOLOGY-II

Course code	Course title	No. of periods/week	Total no of periods	Marks for FA	Marks for SA
CHPC-705	Petrochemical Technology-II	5	75	20	80

S.No.	Chapter/Unit title	No. of period	Weight age allocated	Short Answer Questions	Essay type questions	CO's Mapped
1.	Thermodynamic and Kinetic considerations, Unit Operations and Unit process	3	3	1	-	CO1
2.	Principles of Nitration	13	16	2	1	CO1, CO2, CO3, CO4, CO5
3.	Principles of Amination by reduction and ammonolysis	8	13	1	1	CO1, CO2, CO3, CO4, CO5
4.	Principles of Halogenation	18	26	2	2	CO1, CO2, CO3, CO4, CO5
5.	Principles of Oxidation	8	13	1	1	CO1, CO2, CO3, CO4, CO5
6.	Principles of Hydrogenation and alkylation	16	26	2	2	CO1, CO2, CO3, CO4, CO5
7.	Principles of Esterification	9	13	1	1	CO1, CO2, CO3, CO4, CO5
	TOTAL	75	110	10	8	

Course Objectives	<ul style="list-style-type: none"> (i) To know the basic concepts involved in the unit processes such as Nitration, Amination, Halogenation, Oxidation, Hydrogenation, Esterification, Alkylation (ii) To know the manufacturing methods based on the unit processes such as Nitration, Amination, Halogenation, Oxidation, Hydrogenation, Esterification, Alkylation (iii) To know the uses of various petrochemicals derived from unit processes such as Nitration, Amination, Halogenation, Oxidation, Hydrogenation, Esterification, Alkylation
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Course outcomes (max8) (Representing the outcome of each or two chapters together)

CO No		Course Outcomes
CO1	CHPC-705.1	Explain the basic concepts involved in the unit processes such as Nitration, Amination, Halogenation, Oxidation, Hydrogenation, Esterification, Alkylation
CO2	CHPC-705.2	Explain the manufacturing processes of petrochemicals derived from unit processes such as Nitration, Amination, Halogenation, Oxidation, Hydrogenation, Esterification, Alkylation
CO3	CHPC-705.3	List three uses of petrochemicals derived from unit processes such as Nitration, Amination, Halogenation, Oxidation, Hydrogenation, Esterification, Alkylation
CO4	CHPC-705.4	Explain the specific unit operations used in the manufacturing processes of petrochemicals
CO5	CHPC-705.5	Analyse the products manufactured through instrumentation used in the industry

CO-PO/PSO MATRIX

CO No	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CHPC-705.1	3	-	-	-	-	-	-	3	-	-
CHPC-705.2	-	-	2	-	-	-	-	-	2	-
CHPC-705.3	-	-	1	-	-	-	-	-	-	-
CHPC-705.4	-	-	2	-	-	-	-	-	-	-
CHPC-705.5	-	3	-	-	-	-	-	-	-	-
AVERAGE	3	3	2	-	-	-	-	3	2	-

Cos-Pos mapping strength (as per given time table)

Course Code: CHPC-705	Course Title: Petrochemical Technology-II Number of course outcomes: 05			No of periods 75	
POs	Mapped with CO No.	CO Periods addressing PO in Column 1		Level (1,2,3)	Remarks
		No.	%		
PO1	CO1	26	35	2	>40%- level 3
PO2	CO5	10	13	1	
PO3	CO2,CO3, CO4	39	52	3	
PO4					25%-40% level 2
PO5					
PO6					
PO7					5-25% : level 1
					<5%: not addressed

Learning Outcomes:

Unit-1: To know about the Thermodynamic and Kinetic considerations, Unit operations and Unit processes

- 1.1 Explain thermodynamic and kinetic considerations for industrial purposes.
- 1.2 Explain the concepts of unit processes.

Unit-2: Principles of Nitration

- 2.1 Define nitration.
- 2.2 List three nitrating agents
- 2.3 Explain aromatic nitration, nitration of paraffinic hydrocarbons
- 2.4 Explain liquid phase nitration and gas phase nitration
- 2.5 Explain advantages and disadvantages of batch nitration
- 2.6 Describe the advantages and disadvantages of continuous nitration
- 2.7 Explain the types of nitrators such as Schmid nitrator, Biazzi nitrator
- 2.8 List three properties and uses of nitrobenzene
- 2.9 Describe the production of nitrobenzene from benzene
- 2.10 List three properties and uses of α - nitro naphthalene
- 2.11 Explain the production of α - nitro naphthalene from naphthalene
- 2.12 List three properties and uses of nitroparaffins
- 2.13 Describe the production of nitroparaffins from paraffin's
- 2.14 List three properties and uses of trinitro toluene (TNT)
- 2.15 Explain the production of trinitro toluene (TNT) from toluene

Unit-3: Principles of Amination by reduction and ammonolysis

- 3.1 Define amination by reduction

- 3.2 List the types of amines
- 3.3 Explain the methods of production of primary amines
- 3.4 Describe the reduction methods for preparation of amines
- 3.5 Explain Bechamp reduction.
- 3.6 Describe amination by ammonolysis
- 3.7 Explain ammonolysis reactions
- 3.8 List three aminating agents
- 3.9 List three properties and uses of aniline
- 3.10 Describe the production of aniline by vapor phase reduction of nitrobenzene
- 3.11 List three properties and uses of ethanol
- 3.12 Explain the production of ethanol
- 3.13 List three properties and uses of benzene sulphonic acid
- 3.14 Describe the production of benzene sulphonic acid
- 3.15 Explain synthetic detergents

Unit-4: Principles of Halogenation

- 4.1 Define halogenation
- 4.2 List the methods of production of chlorinated compounds
- 4.3 List three catalysts used in chlorination
- 4.4 Explain the effect of catalyst on chlorination reaction and Photo halogenation
- 4.5 List three properties and uses of ethylene dichloride, chloropentanes, mono chloro acetic acid, chloral, DDT, mono chloro benzene, Benzene hexa chloride (BHC), chlorinated methanes, vinyl chloride
- 4.6 Describe the production of ethylene dichloride from ethylene
- 4.7 Explain the production of chloropentanes from pentanes
- 4.8 Describe the production of mono chloro acetic acid from acetic acid
- 4.9 Explain the production of chloral from ethyl alcohol
- 4.10 Describe the production of DDT from chloral and monochloro benzene
- 4.11 Explain the production of mono chloro benzene from benzene
- 4.12 Describe the production of Benzene hexa chloride (BHC) by liquid phase chlorination of benzene
- 4.13 Explain the production of chlorinated methanes by vapor phase thermal chlorination of methane
- 4.14 Describe the production of vinyl chloride from ethylene

Unit-5: Principles of Oxidation

- 5.1 Define oxidation
- 5.2 Explain the types of oxidative reactions
- 5.3 List three oxidizing agents
- 5.4 Describe the liquid phase oxidation process and vapor phase oxidation process
- 5.5 List three properties and uses of acetic acid
- 5.6 Explain the production of acetic acid by liquid phase oxidation of acetaldehyde
- 5.7 List three properties and uses of formaldehyde
- 5.8 Describe the production of formaldehyde by vapor phase oxidation of methanol
- 5.9 List three properties and uses of acetone
- 5.10 Explain the production of acetone by catalytic vapor phase dehydrogenation of isopropanol
- 5.11 List three properties and uses of styrene
- 5.12 Describe the production of styrene by dehydrogenation of ethyl benzene

Unit-6: Principles of Hydrogenation and Alkylation

- 6.1 Define hydrogenation
- 6.2 List three catalysts used in hydrogenation
- 6.3 Explain the catalytic hydrogenation and its advantages

- 6.4 Describe the various methods of production of hydrogen
- 6.5 Explain Hydrogenolysis and Selective Hydrogenation, types of hydrogenation
- 6.6 Define alkylation
- 6.7 Explain the types of alkylation reactions
- 6.8 Describe the various products of alkylation and alkylating agents
- 6.9 List three properties and uses of methanol
- 6.10 Describe the production of methanol from carbon monoxide and hydrogen
- 6.11 Explain the process of hydrogenation of heavy oils
- 6.12 Explain the process of hydrogenation of olefins
- 6.13 List three properties and uses of ethyl benzene
- 6.14 Describe the production of ethyl benzene by alkylation of benzene
- 6.15 List three properties and uses of phenol
- 6.16 Explain the production of phenol by Dow's process
- 6.17 Explain the production of phenol by Benzene sulfonic acid process
- 6.18 Describe the production of phenol by Regenerative process

Unit-7: Principles of Esterification

- 7.1 Define esterification
- 7.2 Explain catalytic esterification and the completion of esterification reaction
- 7.3 List three properties and uses of ethyl acetate
- 7.4 Describe the production of ethyl acetate from acetic acid and ethanol (batch and continuous process).
- 7.5 List three properties and uses of vinyl acetate
- 7.6 Explain the production of vinyl acetate by vapor phase reaction of acetylene and acetic acid
- 7.7 List three properties and uses of cellulose acetate
- 7.8 Describe the production of cellulose acetate from cotton linters
- 7.9 List three properties and uses of nitro glycerine
- 7.10 Explain the production of nitro glycerine by nitration of glycerine
- 7.11 List three properties and uses of poly ester resin
- 7.12 Describe the production of poly ester resin from glycol, maleic anhydride and styrene

COURSE CONTENTS:

1.0 To know about the Thermodynamic and Kinetic considerations, Unit operations and Unit process

Thermodynamic and kinetic considerations for industrial purposes, the concepts of unit processes.

2.0 Principles of Nitration

Definition of nitration, various nitrating agents, aromatic nitration, nitration of paraffinic Hydrocarbons, liquid phase nitration, gas phase nitration, advantages and disadvantages of batch nitration, advantages and disadvantages of continuous nitration, various types of nitrators such as Schmid nitrator, Biazzi nitrator, properties and uses of Nitrobenzene the production of nitrobenzene from benzene, properties and uses of α – nitro naphthalene, the production of α – nitro naphthalene from naphthalene, properties and uses of nitroparaffin's, the production of nitroparaffin's from paraffin's, properties and uses of Trinitro toluene(TNT), production of Trinitro toluene(TNT) from toluene

3.0 Principles of Amination by reduction and ammonolysis

Definition of amination by reduction, types of amines, methods of production of

primary amines, reduction methods for preparation of amines, Bechamp Reduction, definition of amination by ammonolysis, classification of ammonolysis reactions, various aminating agents, the properties and uses of aniline, production of aniline by vapor phase reduction of nitrobenzene, the properties and uses of ethanol, production of ethanol, properties and uses of benzene sulphonic acid, the production of benzene sulphonic acid, synthetic detergents

4.0 Principles of Halogenation

Definition of halogenation, methods of production of chlorinated compounds, various catalysts used in chlorination, the effect of catalyst on chlorination reaction, Photo halogenation, the properties and uses of ethylene dichloride, the production of ethylene dichloride from ethylene, properties and uses of chloropentanes, production of chloropentanes from pentanes, properties and uses of mono chloro acetic acid, production of mono chloro acetic acid from acetic acid, properties and uses of chloral, production of chloral from ethyl alcohol, properties and uses of DDT, production of DDT from chloral and monochloro benzene, properties and uses of mono chloro benzene, production of mono chloro benzene from benzene, properties and uses of Benzene hexa chloride(BHC), production of Benzene hexa chloride(BHC) by liquid phase chlorination of benzene, properties and uses of chlorinated methane's, production of chlorinated methane's by vapor phase thermal chlorination of methane, properties and uses of vinyl chloride, production of vinyl chloride from ethylene

5.0 Principles of Oxidation

Definition of oxidation, types of oxidative reactions, various oxidizing agents, liquid phase oxidation process, vapor phase oxidation process, properties and uses of acetic acid, production of acetic acid by liquid phase oxidation of acetaldehyde, properties and uses of formaldehyde, production of formaldehyde by vapor phase oxidation of methanol, properties and uses of acetone, production of acetone by catalytic vapor phase dehydrogenation of isopropanol, properties and uses of styrene, production of styrene by dehydrogenation of ethylbenzene

6.0 Principles of Hydrogenation and alkylation

Definition of hydrogenation, catalytic hydrogenation and its advantages, various catalysts used in hydrogenation, various methods of production of hydrogen, Hydrogenolysis, Selective Hydrogenation, various types of hydrogenation, properties and uses of methanol, production of methanol from carbon monoxide and hydrogen, process of hydrogenation of heavy oils, process of hydrogenation of olefins

Definition of alkylation, various types of alkylation reactions, various products of alkylation, the various alkylating agents, properties and uses of ethyl benzene, production of ethyl benzene by alkylation of benzene, various manufacturing methods of phenol, properties and uses of phenol, production of phenol by Dow's process, production of phenol by Benzene sulphonic acid process, production of phenol by Regenerative process

7.0 Principles of Esterification

Definition of esterification, Catalytic esterification, completion of esterification reaction, properties and uses of ethyl acetate, production of ethyl acetate from acetic acid and ethanol (batch and continuous process), properties and uses of vinyl acetate, production of vinyl acetate by vapour phase reaction of

acetylene and acetic acid, properties and uses of cellulose acetate, production of cellulose acetate from cotton linters, properties and uses of nitro glycerine, production of nitro glycerine by nitration of glycerine, the properties and uses of poly ester resin, the production of poly ester resin from glycol, maleic anhydride and styrene

REFERENCE BOOKS:

1. Unit Processes in Organic Synthesis, by Groggins P.H., 5th edition, Mc.Graw Hill. Publications
2. Introduction to Chemical Engineering Thermodynamics by J.M. Smith and Vanness, 4th edition, McGraw-Hill Publications.
3. Outlines of Chemical Technology by Dryden

Table specifying the scope of syllabus to be covered for Unit Tests

Unit Test	Learning Outcomes to be covered
Unit Test-I	From 1.1 to 4.14
Unit Test-II	From 5.1 to 7.12

CHEMICAL PLANT EQUIPMENT DRAWING

Course code	Course title	No. of periods/week	Total no. of periods	Marks for FA	Marks for SA
CHPC-706	Chemical Plant Equipment drawing	3	45	40	60

TIME SCHEDULE

S.No	Chapter/unit title	No. of periods	Weightage allocated	Short Answer Questions	Essay type questions	CO's Mapped
1	Drawing of heat transfer equipment	12	20		1	CO1
2	Drawing of mass transfer and mechanical unit operations	13	20		1	CO1
3	Process flow diagrams using process description (flow sheeting)	10	20		1	CO2
4	Process instrumentation diagrams, process equipment layouts and plant layouts	10	20	5		CO1
	total	45	80	5	3	

Course objectives	To draw various heat transfer, mass transfer and mechanical unit operations equipment
	To draw process block diagram/flow diagram using process description
	To draw process instrumentation diagrams, process layouts and plant layouts

Course Outcomes

Course Outcomes	CO1	Demonstrate the skill of drawing and labelling heat transfer, mass transfer and mechanical unit operations equipments
	CO2	Practice the flow sheeting of process flow diagrams using process description for the production of various chemical compounds
	CO3	Sketch the instrumentation diagrams of the equipments for unit operations
	CO4	Follow the principles of process equipment layout in chemical process industries
	CO5	List the factors in identification of plant location for the proposed chemical process plant layout

CO's/PO's	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	3	3	3	3	-	-	-	2	2	3
CO2	2	3	3	3	-	-	-	3	2	2
CO3	2	3	2	2	-	-	-	3	2	3
CO4	3	2	2	3	-	-	-	2	3	3
CO5	2	2	2	2	-	-	-	3	3	2

Average	2.4	2.6	2.4	2.6	-	-	-	2.6	2.4	2.6
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Learning Outcome

Chapter-1

- 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

Chapter-2

- 2.1 Draw a neat sketch of Rotary drum vacuum filter
- 2.2 Draw a neat sketch of Bubble cap plate
- 2.3 Draw the neat sketch of Jaw crusher
- 2.4 Draw a neat sketch of Plate & Frame filter press
- 2.5 Draw a neat sketch of Basket centrifuge
- 2.6 Draw a neat sketch of Rotary drum driers
- 2.7 Draw a neat sketch of Crystallizer

Chapter-3

- 3.1 Draw the sketch for the production of glacial acetic acid using acetaldehyde
- 3.2 Draw the sketch for the production of Para-nitro aniline from Para -nitro chlorobenzene
- 3.3 Draw the sketch for the production of acetone from Iso-propanol
- 3.4 Draw the sketch for the production of Diethyl oxalate from oxalic acid and ethanol
- 3.5 Draw the sketch for the conversion of ethanol to alcohol by azeotropic distillation
- 3.6 Draw the sketch for the manufacture of any fertilizer /any petrochemical product.

Chapter-4

Part-A

- 4.1 Draw the Instrumentation diagram for Reactor temperature control
- 4.2 Draw the Instrumentation diagram for Hot fluid temperature control in heat exchanger
- 4.3 Draw the Instrumentation diagram for Spray drier temperature control
- 4.4 Draw the Instrumentation diagram for Control of mechanically agitated vessel used for gas absorption
- 4.5 Draw the Instrumentation diagram for Distillation column tower pressure control

Part-B

- 4.6 Understand the important Equipment layout in Ammonia plant
- 4.7 Understand the important Equipment layout in water treatment plant
- 4.8 Understand the important Equipment layout in sugar manufacturing unit
- 4.9 Understand the important Equipment layout in paper industry
- 4.10 Understand the important Equipment layout in cement plant

Part-C

- 4.11 Know the diagram of project layout for phosphoric acid, urea plant, ammonia plant and utilities of DAP plant in fertilizer Industry
- 4.12 Know the diagram of a project layout consisting various units of pulp and paper Industry
- 4.13 Know the diagram of project layout of CDU, FCCU, utilities etc in petroleum refinery
- 4.14 Understand the diagrams of a project layout of Glycerine, vanaspathi, soap of

vegetable oil industry.

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 .

Unit-2: Draw the neat sketches of Rotary drum vacuum filter - Bubble cap plate - Jaw crusher- Plate & Frame filter press- Basket centrifuge- Rotary drum driers- Crystallizer.

Unit-3 Process flow diagrams using process description (Flow sheeting)

Production of glacial acetic acid using acetaldehyde solution- Para-nitro aniline from Para- nitro chlorobenzene.- acetylene from Isopropanol- Diethyl oxalate from oxalic acid and ethanol -Conversion of ethanol to alcohol by Azeotropic distillation – fertilizer / a petrochemical product.

Unit-4: Process instrumentation diagrams of equipments

Reactor temperature control-Hot fluid temperature control in heat exchanger -Spray drier temperature control-Control of mechanically agitated vessel used for gas absorption-Distillation column tower pressure control.

Process equipment layout

Equipment layout in Ammonia plant - water treatment plant - sugar manufacturing unit- paper industry - cement plant

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 Gavhane, Nirali publications
2. Chemical Engineering drawing by R.S.Hiremath. Nirali Publications.
3. Introduction to Chemical Engineering by Badger & Bencher, 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

IPC AND RE LAB

Course Code	Course Title	No. of Periods/Week	Total No. of Periods	Marks for FA	Marks for SA
CHPC-707	IPC and RE Lab	3	45	40	60

Course title : IPC and RE Lab (CHPC-707)	
Course Objectives	i. To familiarize with the knowledge different materials tools used in general Engineering processes ii. To use various basic instruments in general Engineering processes iii. To know the etiquette of working with the fellow workforce iv. To reinforce theoretical concepts by conducting relevant experiments/exercises
Course Outcomes	CO1 Demonstrate the skill of planning and organizing experimental set up for a desired purpose.
	CO2 Perform precise operations/tasks with Engineering equipment or instrument for investigation of Engineering problems.
	CO3 Observe various parameters, their variations and graphically represent the same.
	CO4 Analyse the experimental results to draw inferences to make recommendations.
	CO5 Practice ethics & etiquette while working in a group and display professionalism while communicating as a member and leader in a group.

CO's/PO'S	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	3	2	2	2	-	-	-	3	1	2
CO2	3	3	3	3	-	-	-	3	3	3
CO3	3	3	2	3	-	-	-	3	2	3
CO4	3	3	2	3	-	-	-	3	2	3
CO5	3	3	3	3	-	-	-	3	3	3
Average	3	2.8	2.4	2.8	-	-	-	3	2.2	2.8

List of experiments for Instrumentation Process Control Lab:

- Determine the response of a bare thermometer and plot the response curve.
- Determine the response of a thermometer with thermal well and plot the response curve.
- Calibrate a given thermocouple and plot a graph between the experimentally obtained thermal EMF and temperature data against the theoretical thermal EMF and temperature data.
- Obtain the resistance and temperature data for a given resistance thermometer.
- Calibrate a given pressure gauge by using a Dead weight piston gauge.

6. Determine the response of a single tank liquid level system for a given step input and determine the time constant. Plot the response by using a complete response method and incomplete response method.
7. Determine the response of a second tank of a two tank interacting liquid level system for a given step input and determine the time constants. plot the response by using an incomplete response method.
8. Determine the response of a second tank of a two tank non-interacting liquid level system for a given step input and determine the time constants. plot the response by using an incomplete response method.
9. Determine the response of an air oven incorporated with ON-OFF control system and determine the offset for the system.
10. Determine the valve coefficient CV for a linear type control valve and plot the control valve characteristics.
11. Determine the valve coefficient CV for an Equal percentage type control valve and plot the control valve characteristics.
12. Determine the damping coefficient for critical, over and under damped condition of a second order U-tube manometer.

List of experiments for Reaction Engineering Lab:

13. Perform an experiment to calculate the volume required for constant volume batch reactor.
14. Perform an experiment to calculate the volume required for constant volume steady state mixed flow reactor.
15. Perform an experiment to calculate the volume required for constant volume steady state plug flow reactor.

C23- CHPC-708: Life Skills

Course Title : Life Skills	Course code : C23- Common-508 (Common to all Branches)
Year/ Semester : V/ VI Semester	Total periods : 45
Type of Course : Lab Practice	Max Marks : 100 (Sessional 40 + External 60)

Course Objectives:	understand the relevance of life skills in both personal and professional lives
	practise life skills complementarily in life-management to lead a happy and successful life

	Course Outcomes:
CO1	exhibit right attitude and be adaptable in adverse and diverse situations
CO2	set appropriate goals and achieve them through proper planning, time management and self-motivation
CO3	solve diverse real-life and professional problems with critical thinking and creativity for a stress-free life
CO4	be an ideal team player and manifest as a leader

Course Delivery:

Text book: “Life Skills” – by State Board of Technical Education and Training, AP

Sl no	Unit	Teaching Hours
1	Attitude	4
2	Adaptability	4
3	Goal Setting	4
4	Motivation	4
5	Time Management	4
6	Critical Thinking	4
7	Creativity	4
8	Problem Solving	5
9	Team work	4
10	Leadership	4
11	Stress Management	4
	Total	45

Course Content:

UNIT I: Attitude *matters!*

Preparatory activity-Role play; Generating word bank; Types of attitude. Read the passage and answer the related

questions, read the story and discuss issues raised; Express opinions on the given topic and fill the grid with relevant words.

UNIT 2: Adaptability... *makes life easy!*

Pair work-Study the given pictures and understand adaptability -read the anecdote and discuss, read the story and answer the questions, role play

UNIT 3: Goal Setting... *life without a goal is a rudderless boat!*

Short term goals and long term goals-SMART features, observe the pictures and answer questions- matching- read the passage and answer questions-filling the grid.

UNIT 4: Motivation... *triggers success!*

Types of motivation-difference between motivation and inspiration- matching different personalities with traits - dialogue followed by questions - writing a paragraph based on the passage.

UNIT 5: Time Management ... *the need of the hour!*

Effective Time Management- Time quadrant - Group task on management of time- Time wasters-fill in the grid, read the story and answer the questions- prioritising tasks.

UNIT 6: Critical Thinking... *Logic is the key!*

Preparatory activity-read the passage and answer the questions- differentiate between facts and assumptions- components of critical thinking- complete the sets of analogies- choose the odd one out- true or false statements- decide which of the conclusions are logical.

UNIT 7: Creativity.... *The essential YOU!!*

Definition- Pre-activity-read the anecdote and answer the questions- matching celebrities with their fields of specialisation- think of creative uses of objects- think creatively in the given situations.

UNIT 8: Problem Solving... *there is always a way out!*

Preparatory activity-read the story and answer the questions- discuss the given problem and come out with three alternative solutions- group activity to select the best solution among available alternatives- discuss the problem and plan to analyse it.

UNIT 9: Team Work... *Together we are better!*

Advantages of team work- Characteristics of a team player- Activity-Observe the pictures and classify them into two groups- team game - read the story and answer the questions- fill in the grid.

UNIT 10 : Leadership... *the making of a leader!*

Characteristics of effective leadership- styles of leadership- Activity-read the dialogue and answer the questions- identify the people in the picture and describe them- discuss leadership qualities of the given leaders- filling the grid- read the quotes and write the name of the leader.

UNIT 11: Stress Management ... *live life to the full !!*

Types of stress- Strategies for Stress Management- Activity-read the passage and answer the questions, read the situation and write a paragraph about how to manage stress.

Mapping COs with POs

POs	1	2	3	4	5	6	7
COs	POs 1 to 5 are applications of Engineering Principles, can't directly be mapped with Life Skills					1,2,3,4	1,2,3,4

Unit wise Mapping of COs- POs

CO	Course Outcome	CO Unit Mapped	PO mapped	Cognitive levels as per Bloom's Taxonomy R/U/Ap/An/Ev/Cr (Remembering / Understanding/ Applying/Analysing/ Evaluating/ Creating)
CO 1	To exhibit right attitude and be adaptable to adverse and diverse situations	All Units (1 to 11)	6,7	U/Ap/ An
CO2	To set appropriate goals and achieve them through proper planning, time management and self-motivation	Units 3,4,5	6,7	U/Ap/An
CO3	To solve diverse real-life and professional problems with critical thinking and creativity for a stress-free life	Units 6,7,8,11	6,7	U/Ap/An/ Ev/ Cr.
CO4	To be an ideal team player and manifest as a leader	Units 9,10	6,7	U/Ap/An/ Ev

PROJECT WORK/ PETROLEUM REFINING- II LAB

Course Code	Course Title	No. of Periods/Week	Total No. of Periods	Marks for FA	Marks for SA
CHPC-709	Project Work/ Petroleum Refining- II Lab	3	45	40	60

Course Objectives	(i) To familiarize with the knowledge different materials tools used in general Engineering processes (ii) To use various basic implements used in general Engineering processes (iii) To know the etiquette of working with the fellow workforce (iv) To reinforce theoretical concepts by conducting relevant Experiments / exercises.	
Course Outcomes	CO1	Demonstrate the skill of planning and organizing experimental set up for a desired purpose.
	CO2	Perform precise operations/tasks with Engineering equipment or instrument for investigation of Engineering problems.
	CO3	Observe various parameters, their variations and graphically represent the same.
	CO4	Analyse the experimental results to draw inferences to make recommendations.
	CO5	Practice ethics & etiquette while working in a group and display professionalism while communicating as a member and leader in a group.

CO-PO/ PSO MATRIX:

CO NO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	3	1	1	2	1	-	-	2	1	1
CO2	2	1	2	3	1	1	1	1	1	1
CO3	1	1	1	3	2	1	1	1	3	1
CO4	1	3	1	2	1	1	1	1	2	1
CO5	1	2	1	1	1	3	2	1	1	1
AVERAGE	2	2	1	2	1	1	1	1	2	1

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) Absorber
 - e) Extractor
 - f) Water purification system
 - g) Crystallizer

- h) Evaporator
 - i) Dryer
 - j) Project works related to pollution control of solid, liquid and gaseous pollutants
2. Prepare a detailed project report on the production of a chemical.
 3. Design and fabricate small prototype Chemical Engineering equipment's useful for doing experiments in the laboratory.
 4. To conduct a survey of a Petroleum refinery/ Petrochemical / 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 plan
 - e) Maintenance schedule of Chemical Engineering Equipment
 - f) Material transportation and storage of chemicals

List of experiments for Petroleum Refining –II Lab:

1. Determine the flash and fire point of a given sample of fuel using Pensky- Martens Closed cup apparatus.
2. Determine the viscosity of a given sample oil by using Redwood viscometer-II and to assess the variation of viscosity with temperature by plotting a graph.
3. Determine the viscosity of a given sample oil by using Engler Viscometer and to assess the variation of viscosity with temperature by plotting a graph.
4. Determine the Cloud and pour point of a given sample oil using Cloud and pour point apparatus.
5. Determine the Oxidation stability of a motor fuel.
6. Determine the Drop point of Grease.
7. Determine the rate of corrosion present in a petroleum product by using Copper strip corrosion test.
8. Determine the vapor pressure of a give sample by using Reid vapor pressure apparatus.
9. Determine the softening point of a sample by using Ring & ball method.
10. Determine the Refractive Index of the given sample hydrocarbon using Refractometer.

UNIT OPERATIONS-III LAB

Course Code	Course Title	No. of Periods/Week	Total No. of Periods	Marks for FA	Marks for SA
CHPC-710	Unit operations-III Lab	3	45	40	60

Course title: Unit operations-III Lab(CHPP-710)	
Course Objectives	i. To familiarize with the knowledge different materials tools used in general Engineering processes ii. To use various basic implements used in general Engineering processes iii. To know the etiquette of working with the fellow workforce iv. To reinforce theoretical concepts by conducting relevant experiments/exercises
Course Outcomes	CO1 Demonstrate the skill of planning and organizing experimental set up for a desired purpose
	CO2 Perform precise operations/tasks with Engineering equipment or instrument for investigation of Engineering problems
	CO3 Observe various parameters, their variations and graphically represent the same
	CO4 Analyse the experimental results to draw inferences to make recommendations
	CO5 Practice ethics & etiquette while working in a group and display professionalism while communicating as a member and leader in a group

CO-PO/ PSO MATRIX:

CO NO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	3	2	2	2	2	2	3	3	2	1
CO2	2	1	2	3	1	-	1	3	2	1
CO3	1	2	2	2	1	-	1	3	1	1
CO4	1	2	3	2	2	2	1	3	2	2
CO5	3	1	1	2	2	3	1	2	2	3
AVERAGE	2	1.8	2	2.2	1.6	1.4	1.4	2.8	1.8	1.6

List of Experiments:

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.