

GOVERNMENT OF ANDHRA PRADESH



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



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



**DIPLOMA IN
CHEMICAL ENGINEERING
(PETRO CHEMICALS)**

Front Cover Page

Objective of the New Curriculum (C-16)

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



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



Highlights of the Curriculum (C-16)



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

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



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





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

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



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

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



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

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



Journal (JPAP)

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



**JOURNAL OF
POLYTECHNICS IN ANDHRA PRADESH**
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FACULTY	
1. COMPUTATION AND LAYOUT EXTRACTION OF SEF DECODER FOR BINARY LDPC CODES Dr. C. Chinnai Reddy	1-10
2. INFLUENCE OF NYLON FIBER REINFORCEMENT ON LIME STABILIZED CLAYEY SOIL Dr. P. Srikanth Naga	11-18
3. ANALYSIS OF COLOR IMAGE PROCESSING USING SPATIAL FILTER TECHNIQUES Dr. Ch. Subrahmanya, P. Kumar Babu	19-26
4. ASSESSMENT OF SEISMIC VULNERABILITY OF REINFORCED CONCRETE BUILDING FRAMES USING PUSHOVER ANALYSIS T. P. Sureshchandra, Ramana Varma	27-38
STUDENT	
5. STUDY OF ADVANCED DIGITAL MODULATION TECHNIQUES USING MATLAB Subashini Mahesh Rao, Palki Jagadee Siva Naga Raju, Manuella Rajkumar	39-48
6. IMPLEMENTATION OF PHASE LOCKED LOOP BY USING CLOSED LOOP SYSTEM Ragunuraj Sankhya, Puttapa Dhakshini, Sheshi Dhakshini	49-57
7. CNC MILLING PROCESS CAPABILITY -A CASE STUDY B. Raji Vivekanand, B. Anuragi Bhargavi, Dr. N. Chandra Shekhar	58-64
8. SELECTION OF A CAR THROUGH MULTIPLE CRITERIA DECISION MAKING (MCDM) APPROACH T. Sarath, Y. Raja Babu, K. V. S. Phani, A. Ravi Kumar	65-68
9. MODEL OF AIR LIFT PUMP Sheshi Mahesh Babu	67-68
10. MEASUREMENT SYSTEM ANALYSIS-AN ILLUSTRATIVE EXAMPLE B. Manoj Kumar, Ch. E. Nagendra, T. Maheswara Rao, M. Srinivas, M. A. Ganesi, K. Mallikarjuna Rao, K. Narayana Rao, M. Sureshbabu Rao	69-75
INDUSTRY	
11. SELF ASSESSMENT OF ISO 9001 IN A SMALL AND MEDIUM ENTERPRISE -A CASE STUDY V. Ramesh Babu, Partha Sarathi, S. V. Ramesh, Dr. B. Nagaswara Rao	76-81



CISCO ACADEMIES IN POLYTECHNICS

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

Curriculum-2016
(C-16)

Diploma in Chemical Engineering (Petrochemicals)

State Board of Technical Education & Training
Andhra Pradesh

**3 ½ Year Sandwich DIPLOMA IN CHEMICAL ENGINEERING (PETRO CHEMICALS)
(C-16)**

CONTENTS

S.NO.	SUBJECT CODE	SUBJECT	Page No
1.		Preamble	
2.		Scheme of Instruction and Examination of First year	
3.		Scheme of Instruction and Examination of III Semester	
4.		Scheme of Instruction and Examination of IV Semester	
5.		Scheme of Instruction and Examination of V and VI Semester	
6.		Scheme of Instruction and Examination of VII Semester	

FIRST YEAR

7.	CH-PC-101	English
8.	CH-PC-102	Engineering Mathematics - I
9.	CH-PC-103	Engineering Physics
10.	CH-PC-104	Engineering Chemistry and Environmental Studies
11.	CH-PC-105	Introduction to Chemical and Petroleum Engineering
12.	CH-PC-106	Materials Technology

PRACTICALS

13.	CH-PC-107	Engineering Drawing
14.	CH-PC-108	Workshop Practice
15.	CH-PC-109	Physics Lab
16.	CH-PC-110	Chemistry Lab
17.	CH-PC-111	Computer Fundamentals Lab

III SEMESTER

18.	CH-PC-301	Engineering Mathematics – II
19.	CH-PC-302	Electrical Technology

20. CH-PC-303 Physical, Organic and Petroleum Chemistry

21. CH-PC-304 Unit Operations-I

22. CH-PC-305 Mass and Energy Balance

PRACTICALS

23. CH-PC-306 Chemical Process Drawing Lab using CAD

24. CH-PC-307 Electrical Technology Lab and Physical, Organic and Petroleum Chemistry Lab

25. CH-PC-308 Communication Skills

26. CH-PC-309 Unit Operations-I Lab

IV SEMESTER

27. CH-PC-401 Unit Operations- II

28. CH-PC-402 General Chemical Technology

29. CH-PC-403 Petrochemical Technology - I

30. CH-PC-404 Petroleum Refining

31. CH-PC-405 Basic Mechanical Engineering

PRACTICALS

32. CH-PC-406 Chemical Technology Lab

33. CH-PC-407 Unit Operations- II Lab

34. CH-PC-408 Life Skills

35. CH-PC-409 Petroleum Refining - I Lab

V AND VI SEMESTERS

36. Industrial Training

VII SEMESTER

37. CH-PC-701 Industrial Management and Smart Technologies

38. CH-PC-702 Thermodynamics and Reaction Engineering

39. CH-PC-703 Instrumentation and Process Control

40. CH-PC-704 Unit Operations- III

41. CH-PC-705 Petrochemical Technology-II

PRACTICALS

- | | | |
|-----|-----------|---------------------------------------------------------------|
| 42. | CH-PC-706 | Unit Operations- III Lab |
| 43. | CH-PC-707 | Instrumentation, Process Control and Reaction Engineering Lab |
| 44. | CH-PC-708 | Petroleum Refining - II Lab |
| 45. | CH-PC-709 | Project Work/CAD in Chemical Engineering Lab |

CURRICULUM-2016

(C-16)

FOR DIPLOMA COURSES IN ANDHRA PRADESH

PREAMBLE

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

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

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

Salient Features:

1. Duration of course is either 3 years / 3½ years duration of Regular Academic Instruction.
2. The Curriculum is prepared in Semester Pattern. However, First Year is maintained as Year-wise pattern.
3. 6 Months/ 1 year Industrial Training is introduced for all the Diploma courses.
4. Fundamentals of Internet of Things (IOT) is introduced for all the Diploma courses in the subject.

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

RULES AND REGULATIONS

1 DURATION AND PATTERN OF THE COURSES

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

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

2 PROCEDURE FOR ADMISSION INTO THE DIPLOMA COURSES:

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

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

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

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

3 MEDIUM OF INSTRUCTION

The medium of instruction and examination shall be English.

4 PERMANENT IDENTIFICATION NUMBER (PIN)

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

5 NUMBER OF WORKING DAYS PER SEMESTER / YEAR:

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

6 ELIGIBILITY OF ATTENDANCE TO APPEAR FOR THE END EXAMINATION

- a). A candidate shall be permitted to appear for the end examination in all subjects, if he or she has attended a minimum of 75% of working days during the year/Semester.
- b). Condonation of shortage of attendance in aggregate upto 10% (65% and above and below 75%) in each semester or 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 next.

7 READMISSION

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

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

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

The percentage of attendance of the readmitted candidates shall be calculated from the first day of beginning of the regular class work for that year / Semester, as officially

announced by CTE/SBTET but not from the day on which he/she has actually reported to the class work, after readmission is granted.

8 SCHEME OF EXAMINATION

a) First Year

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

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

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

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

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

9 INTERNAL ASSESSMENT SCHEME

- a) Theory Subjects: Theory Subjects carry 20% sessional marks, Internal examinations will be conducted for awarding sessional marks on the dates specified. **Three unit tests will be conducted for I year students and two Unit Tests for semesters.** Average of marks obtained in all the prescribed tests will be considered for awarding the sessional marks.
- b) Practical Subjects: Student's performance in Laboratories / Workshop shall be assessed during the year/ semester of study for 40% marks in each practical subject. Allotment of marks should be discrete taking into consideration of the students' skills, accuracy, recording and performance of the task assigned to him / her. Each student has to write a record / log book for assessment purpose. In the subject of Drawing, which is also considered as a practical paper, the same rules hold good. Drawing exercises are to be filed in seriatum.
- c) Internal assessment in Labs / workshops / Survey field work etc., during the course of study shall be done and sessional marks shall be awarded by the concerned Lecturer / Senior Lecturer / Workshop superintendent as the case may be.

- d) For practical examinations, except in drawing, there shall be two examiners. External examiner shall be appointed by the Principal in consultation with respective Head of Section preferably choosing a qualified person from any local Industry/ nearby Government Polytechnic/ Local Government Organization. Internal examiner shall be the person concerned with internal assessment as in (c) above. The end examination shall be held along with all theory papers in respect of drawing.
- e) Question Paper for Practicals: Question paper should cover all the experiments / exercise prescribed.
- f) Records pertaining to internal assessment marks of both theory and practical subjects are to be maintained for official inspection.
- g) **In case of Diploma courses *having* Industrial Training**, the training assessment shall be done and the marks are to be awarded in the following manner.

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

TOTAL	:	300 marks

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

10. MINIMUM PASS MARKS

THEORY EXAMINATION:

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

PRACTICAL EXAMINATION:

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

11. PROVISION FOR IMPROVEMENT

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

12. RULES OF PROMOTION FROM 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 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 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 examination if he/she

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

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 examination if he/she

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

For IVC& ITI Lateral Entry students:

- i) Puts the required percentage of attendance in the 5th semester
- ii) Should not have failed in more than Four backlog subjects of 3rd 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 pay 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 Industrial Training assessment (Seminar/Viva-voce)

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

For IVC & ITI Lateral Entry students:

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

Important Note:

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

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

1. A candidate shall be permitted to appear for 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.
2. 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.
3. 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
 - i) Puts the required percentage of attendance in the 4th semester
 - ii) Should not have failed in more than Four backlog subjects of 1st year.

For IVC & ITI Lateral Entry students:

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

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

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

For IVC & ITI Lateral Entry students:

- i) Puts the required percentage of attendance in the 7th semester
- ii) Should not have failed more than four backlog subjects of 3rd Semester

OTHER DETAILS

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

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

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

1. A candidate shall be permitted to appear for first year examination provided he / she puts in 75% attendance (which can be condoned on Medical grounds upto 10%) i.e. attendance after condonation on Medical grounds should not be less than 65% and pay the examination fee.
2. A candidate shall be promoted to 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.
3. 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

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

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

4. 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

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

For IVC & ITI Lateral Entry students:

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

5. 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

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

For IVC & ITI Lateral Entry students:

- i) Puts the required percentage of attendance in 6th semester.
- ii) should get eligibility to appear for 5th Semester Examination.

6. A candidate shall be promoted to 7th semester provided he/she puts 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

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

For IVC & ITI Lateral Entry students:

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

Important Note:

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

OTHER DETAILS

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

13. STUDENTS PERFORMANCE EVALUATION

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

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

The Weightage of marks for various year/Semesters which are taken for computing overall aggregate shall be 25% of I year marks + 100% of 3rd and subsequent Semesters.

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.

4. Second Class shall be awarded to all students, who fail to complete the Diploma in the regular 3 years/ 3 ½ years and four subsequent examinations, from the year of first admission.

14. EXAMINATION FEE SCHEDULE:

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

15. STRUCTURE OF END EXAMINATION QUESTION PAPER:

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

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

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

Max.Marks: 5 x 10 = 50.

Total Maximum Marks: 80.

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

- c) Practical Examinations

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

Max. Marks for an experiment / exercise : 50%

Max. Marks for VIVA-VOCE : 10%

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

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

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

16. ISSUE OF MEMORANDUM OF MARKS

All candidates who appear for the end examination will be issued memorandum of marks without any payment of fee. However candidates who lose the original memorandum of marks have to pay the prescribed fee to the Secretary, State Board of Technical Education and Training, A.P. for each duplicate memo.

17. MAXIMUM PERIOD FOR COMPLETION OF DIPLOMA COURSES:

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

18. ELIGIBILITY FOR AWARD OF DIPLOMA

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

- i. He / She pursued a course of study for not less than 3 / 3 ½ academic years & not more than 6 / 7 academic years.
- ii. He / she has completed all the subjects.

Students who fail to fulfill all the academic requirements for the award of the Diploma within 6 / 7 academic years from the year of admission shall forfeit their seat in the course & their seat shall stand cancelled.

For IVC & ITI Lateral Entry students:

- i. He / She pursued a course of study for not less than 2 / 2 ½ academic years & not more than 4 / 5 academic years.
- ii. He / she has completed all the subjects.

Students who fail to fulfill all the academic requirements for the award of the Diploma within 4 / 5 academic years from the year of admission shall forfeit their seat in the course & their seat shall stand cancelled.

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

A) FOR ISSUE OF PHOTO COPIES OF VALUED ANSWER SCRIPTS

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

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

1. A candidate desirous of applying for Re-verification of valued answer script should apply within prescribed date from the date of the declaration of the result.
2. Re-verification of valued answer script shall be done for all theory subjects and Drawing subject(s).
3. The Re-verification committee constituted by the Secretary, SBTETAP with subject experts shall re-verify the answer scripts.

1) RE-COUNTING

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

2) RE-VERIFICATION

- (i) The Committee has to verify the intactness and genuineness of the answer script(s) placed for Re-verification.
- (ii) Initially single member shall carry out the re-verification.
- (iii) On re-verification by single member, if the variation is less than 12% of maximum marks, and if there is no change in the STATUS in the result of the candidate, such cases will not be referred to the next level i.e., for 2-Tier evaluation.
- (iv) On re-verification by a single member, if the variation is more than 12% of maximum marks, it will be referred to 2-Tier evaluation.
- (v) If the 2-Tier evaluation confirms variation in marks as more than 12% of maximum marks, the variation is considered as follows:

- a) If the candidate has already passed and obtains more than 12% of the maximum marks on Re-verification, then the variation is considered.
 - b) If the candidate is failed and obtains more than 12% of the maximum marks on Re-verification and secured pass marks on re-verification, then the status of the candidate changes to PASS.
 - c) If a candidate is failed and obtains more than 12% of the maximum marks on Re-verification and if the marks secured on re-verification are still less than the minimum pass marks, the status of the candidate remain FAIL only.
- (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.
4. No request for Photo copies/ Recounting /Re-verification of valued answer script would be entertained from a candidate who is reported to have resorted to Malpractice in that examination.

20. MAL PRACTICE CASES:

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

21. DISCREPANCIES/ PLEAS:

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

22. ISSUE OF DUPLICATE DIPLOMA

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

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

23. ISSUE OF MIGRATION CERTIFICATE AND TRANSCRIPTS:

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

24. GENERAL

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

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

Subject Code	Name of the Subject	Instruction periods / week		Total Periods / 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	4	-	120	3	20	80	100
CHPC -104	Engineering Chemistry & Environmental Studies	4	-	120	3	20	80	100
CHPC -105	Introduction to Chemical and Petroleum Engineering	5	-	150	3	20	80	100
CHPC -106	Materials Technology	3	-	90	3	20	80	100
PRACTICAL:								
CHPC -107	Engineering Drawing	-	6	180	3	40	60	100
CHPC -108	Workshop Practice	-	3	90	3	40	60	100
CHPC -109	Physics Laboratory	-	3	90	3	20	30	50
CHPC -110	Chemistry Laboratory	-	3	90	3	20	30	50
CHPC -111	Computer Fundamentals Laboratory	-	3	90	3	40	60	100
TOTAL		24	18	1260	3	280	720	1000

CH PC – 101,102,103,104, 107, 109,110 and 111 : Common to all
 CH PC – 105 : Not common with any course
 CH PC – 106 : Common to DCHE, DCHE(PP) & DCHE(OT)
 CH PC – 108 : Common to DCHE(PP) & DCHE(OT)

DIPLOMA IN CHEMICAL ENGINEERING (PETROCHEMICALS)
SCHEME OF INSTRUCTIONS AND EXAMINATIONS
(C16/III Semester)

Subject Code	Name of the Subject	Instruction periods / week		Total Periods/ year	Scheme of Examination			
		Theory	Practical /Tutorial		Duration (hours)	Sessional Marks	End Exam Marks	Total Marks
THEORY:								
CHPC-301	Engineering Mathematics - II	5	-	75	3	20	80	100
CHPC-302	Electrical Technology	4	-	60	3	20	80	100
CHPC-303	Physical, Organic and Petroleum Chemistry	5	-	75	3	20	80	100
CHPC-304	Unit operation -1	5	-	75	3	20	80	100
CHPC-305	Mass and Energy Balance.	5	-	75	3	20	80	100
PRACTICAL:								
CHPC-306	Chemical Process Drawing Lab using CAD	-	3	45	3	40	60	100
CHPC-307	Electrical Technology lab and Physical, Organic and Petroleum Chemistry Lab	-	6	90	3	40 (20+20)	60 (30+30)	100 (50+50)
CHPC-308	Communication Skills	-	3	45	3	40	60	100
CHPC-309	Unit operation -1 lab	-	6	90	3	40	60	100
TOTAL		24	18	630		260	640	900

CH PC – 301, 308 : Common to all
CH PC – 302, 305 : Common to DCHE, DCHE (PP) & DCHE (OT)
CH PC– 304, 306, 309 : Common to DCHE (PP) & DCHE (OT)
CH PC – 303, 307 : Not common with any course

DIPLOMA IN CHEMICAL ENGINEERING (PETROCHEMICALS)
SCHEME OF INSTRUCTIONS AND EXAMINATIONS
(C16/IV Semester)

Subject Code	Name of the Subject	Instruction periods / week		Total Periods / year	Scheme of Examination			
		Theory	Practical /Tutorial		Duration (hours)	Sessional Marks	End Exam Marks	Total Marks
THEORY:								
CHPC-401	Unit operation-II	6	-	90	3	20	80	100
CHPC-402	General Chemical Technology	6	-	90	3	20	80	100
CHPC-403	Petrochemical Technology-I	6	-	90	3	20	80	100
CHPC-404	Petroleum Refining	5	-	75	3	20	80	100
CHPC-405	Basic Mechanical Engineering	4	-	60	3	20	80	100
PRACTICAL:								
CHPC-406	Chemical Technology Lab	-	6	90	3	40	60	100
CHPC-407	Unit Operations- II lab	-	3	45	3	40	60	100
CHPC-408	Life Skills	-	3	45	3	40	60	100
CHPC-409	Petroleum Refining-I Lab	-	3	45	3	40	60	100
TOTAL		27	15	630		260	640	900

CHPC-401, 405, 406, 407

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

CHPC-402, 403, 404, 409

: Not common with any course

CHPC-408

: Common to all

DIPLOMA IN CHEMICAL ENGINEERING (PETROCHEMICALS)
SCHEME OF INSTRUCTIONS AND EXAMINATIONS
C16/V Semester (Industrial Training)

S.No.	Subject/Subject code	Scheme of Examination					
		Duration (hours)	Nature	Item	Max. marks		
1	Practical Training in a Chemical or Allied Industry/CHPC-501	6 months	Viva voce	1.First assessment	100		
				2.Second Assessment	100		
			3.At the institution after completion of the training				
			(a) Log Book				30
			(b) Training Report				30
			(c) Seminar				40
TOTAL					300		

DIPLOMA IN CHEMICAL ENGINEERING (PETROCHEMICALS)
 SCHEME OF INSTRUCTIONS AND EXAMINATIONS
 C16/VI Semester (Industrial Training)

S.No.	Subject/Subject code	Scheme of Examination					
		Duration (hours)	Nature	Item	Max. marks		
1	Practical Training in a Chemical or Allied Industry/CHPC-601	6 months	Viva voce	1.First assessment	100		
				2.Second Assessment	100		
			3.At the institution after completion of the training				
			(a) Log Book				30
			(b) Training Report				30
			(c) Seminar				40
TOTAL					300		

DIPLOMA IN CHEMICAL ENGINEERING (PETROCHEMICALS)
SCHEME OF INSTRUCTIONS AND EXAMINATIONS
(C16/VII Semester)

Subject Code	Name of the Subject	Instruction periods / week		Total Periods/ year	Scheme of Examination			
		Theory	Practical/ Tutorial		Duration (hours)	Sessional Marks	End Exam Marks	Total Marks
THEORY:								
CHPC -701	Industrial Management and Smart Technologies	5	-	75	3	20	80	100
CHPC -702	Thermodynamics and Reaction Engineering	5	-	75	3	20	80	100
CHPC -703	Instrumentation and Process Control	5	-	75	3	20	80	100
CHPC -704	Unit operations –III	6	-	90	3	20	80	100
CHPC -705	Petrochemical Technology-II	6	-	90	3	20	80	100
PRACTICAL:								
CHPC-706	Unit operations-III Lab	-	3	45	3	40	60	100
CHPC-707	Instrumentation, Process Control & Reaction Engineering Lab	-	3	45	3	40	60	100
CHPC-708	Petroleum Refining-II Lab	-	3	45	3	40	60	100
CHPC-709	Project Work/CAD in Chemical Engineering Lab	-	6	90	3	40 (20+20)	60 (30+30)	100 (50+50)
TOTAL		27	15	630		260	640	900

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

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

Subject Code	Name of the Subject	Instruction periods / week		Total Periods / 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	4	-	120	3	20	80	100
CHPC -104	Engineering Chemistry & Environmental Studies	4	-	120	3	20	80	100
CHPC -105	Introduction to Chemical and Petroleum Engineering	5	-	150	3	20	80	100
CHPC -106	Materials Technology	3	-	90	3	20	80	100
PRACTICAL:								
CHPC -107	Engineering Drawing	-	6	180	3	40	60	100
CHPC -108	Workshop Practice	-	3	90	3	40	60	100
CHPC -109	Physics Laboratory	-	3	90	3	20	30	50
CHPC -110	Chemistry Laboratory	-	3	90	3	20	30	50
CHPC -111	Computer Fundamentals Laboratory	-	3	90	3	40	60	100
TOTAL		24	18	1260	3	280	720	1000

CH PC – 101,102,103,104, 107, 109,110 and 111 : Common to all
 CH PC – 105 : Not common with any course
 CH PC – 106 : Common to DCHE, DCHE(PP) & DCHE(OT)
 CH PC – 108 : Common to DCHE(PP) & DCHE(OT)

C-16-COMMON-101- ENGLISH
(Common to all Branches)

Subject Title : ENGLISH
Subject Code : CHPC- 101
Periods per Week : 3
Periods per Year : 90

Time Schedule& Weightage

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

Rationale and Scope

Globalization has ushered in an era of opportunities for those who have the necessary competencies. Effective communication is one among them. This shift demands strengthening of

English in polytechnics. In C-16 Curriculum the focus is on the special needs of English for technicians.

. This course aims at integration of the four fold language abilities viz., listening, speaking, reading and writing. The use of English for learning technical subjects and for performing technical functions like, writing reports, giving instructions and interpreting graphics/data is of great importance.

Therefore the curriculum C-16 focuses on improving communicative abilities equipping the students to become industry- ready and employable.

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

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

1.0 Extend their vocabulary in the direction of their future needs

- 1.1 Locate words, learn spellings, understand meanings
- 1.2 Pronounce words intelligibly
- 1.3 Find synonyms and antonyms
- 1.4 Use affixation
- 1.5 Comprehend meanings of words by understanding meanings of roots

2.0 Learn various grammatical structures

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

3.0 Read and comprehend English

- 3.1 Identify the main ideas
- 3.2 Identify the specific details
- 3.3 Draw inferences
- 3.4 Give contextual meanings of the words

3.5 Perceive tone in a text

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

4.1 Identify components of a good paragraph

4.2 Write types of paragraphs

4.3 Distinguish between formal and informal letters

4.4 Write personal letters

4.5 Write leave letters

4.6 Write official letters

4.7 Write letters of complaints

4.8 Prepare a resume

4.9 Write a cover letter

4.10 Write short messages

4.11 Report incidents

4.12 Report experiments

4.13 Report Industrial visits

4.14 Write work done statements

4.15 Write maintenance reports

4.16 Make notes using Cue method and Mapping method

4.17 Summarize Paragraphs

4.18 Present and Interpret Data from flow charts, tree diagrams, bar graphs, tables, pie charts

Practice spoken communication suited to various situations.

4.19 Use appropriate expressions to greet and take leave

4.20 Use proper expressions to make requests

4.21 Use apt expressions for asking and giving directions

4.22 Use suitable expressions to seek and offer suggestions

4.23 Use suitable expressions to state intentions

4.24 Use suitable expressions to state feelings

4.25 Use appropriate expressions to state agreement and disagreement

4.26 Use proper expressions to make complaints

4.27 Use suitable expressions to express obligations

Course Material

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

Reference Books

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

Engineering Mathematics - I

(Common to all Branches)

Subject Title : Engineering Mathematics - I

Subject Code : CHPC- 102

Periods per Week : 5

Periods per Year : 150

Time Schedule

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

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

R: Remembering type 38 marks
U: Understanding type 37 marks
App: Application type 35 marks

ENGINEERING MATHEMATICS – I
COMMON TO ALL BRANCHES – 102

Objectives

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

UNIT – I

Algebra

1.0 Use Logarithms in engineering calculations

- 1.1 Define logarithm and list its properties.
- 1.2 Distinguish natural logarithms and common logarithms.
- 1.3 Explain the meaning of e and exponential function.
- 1.4 State logarithm as a function and its graphical representation.
- 1.5 Use the logarithms in engineering calculations.

2.0 Resolve Rational Fraction into sum of Partial Fractions in engineering problems

- 2.1 Define the following fractions of polynomials:
 1. Rational,
 2. Proper and
 3. Improper
- 2.2 Explain the procedure of resolving rational fractions of the type mentioned below into partial fractions

$$\begin{array}{ll} i) \quad \frac{f(x)}{(x+a)(x+b)(x+c)} & ii) \quad \frac{f(x)}{(x+a)^2(x+b)(x+c)} \\ iii) \quad \frac{f(x)}{(x^2+a)(x+b)} & iv) \quad \frac{f(x)}{(x+a)(x^2+b)^2} \end{array}$$

3.0 Use Matrices for solving engineering problems

- 3.1 Define a matrix and order of a matrix.
- 3.2 State various types of matrices with examples (upto 3rd order square matrices).
- 3.3 Compute sum, scalar multiplication and product of matrices.
- 3.4 Illustrate the properties of these operations such as associative, distributive, commutative properties with examples and counter examples.

- 3.5 Define the transpose of a matrix and write its properties.
- 3.6 Define symmetric and skew-symmetric matrices.
- 3.7 Resolve a square matrix into a sum of symmetric and skew-symmetric matrices with examples in all cases.
- 3.8 Define minor, co-factor of an element of 2X2 and 3x3 square matrices with examples.
- 3.9 Expand the determinant of a 3 x 3 matrix using Laplace expansion formula.
- 3.10 Distinguish singular and non-singular matrices.
- 3.11 State properties of determinants with simple examples.
- 3.12 Define multiplicative inverse of a matrix and list properties of adjoint and inverse.
- 3.13 Compute adjoint and multiplicative inverse of a square matrix.
- 3.14 Representation of system of linear equations (2 variables in 2 equations and 3 variables in 3 equations) in matrix form.
- 3.15 Solve system of linear equations using Cramer's rule.
- 3.16 Solve system of linear equations by matrix inversion method
- 3.17 State elementary row operations.
- 3.18 Solve a system of linear equations by Gauss- Jordan method

UNIT – II

Trigonometry :

- 4.0 Understand Trigonometric Ratios
- 4.1 Define trigonometric ratios of any angle.
- 4.2 List the values of trigonometric ratios at specified values.
- 4.3 Draw graphs of trigonometric functions
- 4.4 Explain periodicity of trigonometric functions.
- 5.0 Solve simple problems on Compound Angles**
- 5.1 Define compound angles and state the formulae of $\sin(A\pm B)$, $\cos(A\pm B)$, $\tan(A\pm B)$ and $\cot(A\pm B)$
- 5.2 Give simple examples on compound angles to derive the values of $\sin 15^\circ$, $\cos 15^\circ$, $\sin 75^\circ$, $\cos 75^\circ$, $\tan 15^\circ$, $\tan 75^\circ$ etc.
- 5.3 Derive identities like $\sin(A+B) \sin(A-B) = \sin^2 A - \sin^2 B$ etc.,
- 5.4 Solve simple problems on compound angles.
- 6.0 Solve problems using the formulae for Multiple and Sub- multiple Angles**
- 6.1 Derive the formulae of multiple angles $2A$, $3A$ etc and sub multiple angles $A/2$ in terms of angle A of trigonometric functions.

6.2 Derive useful allied formulas like $\sin A = (1 - \cos 2A)/2$ etc.,

6.3 Solve simple problems using the above formulae

7.0 Apply Transformations for solving the problems in Trigonometry

7.1 Derive the formulae on transforming sum or difference of two trigonometric ratios in to a product and vice versa- examples on these formulae.

8.0 Use Inverse Trigonometric Functions for solving engineering problems

8.1 Explain the concept of the inverse of a trigonometric function by selecting an appropriate domain and range.

8.2 Define inverses of six trigonometric functions along with their domains and ranges.

8.3 Derive relations between inverse trigonometric functions so that given $A = \sin^{-1}x$, express angle A in terms of other inverse trigonometric functions - with examples.

8.4 State various properties of inverse trigonometric functions and identities like $\sin^{-1}x + \cos^{-1}x = \frac{\pi}{2}$ etc.

8.5 Derive 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., and solve simple problems.

9.0 Solve Trigonometric Equations in engineering applications

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

9.2 Solve models of the type $a \sin^2 x + b \sin x + c = 0$, $a \cos x + b \sin x = c$ etc., and problems using simple transformations.

10.0 Appreciate Properties of triangles and their solutions

10.1 State sine rule, cosine rule, tangent rule and projection rule.

10.2 Explain the formulae for $\sin A/2$, $\cos A/2$, $\tan A/2$ and $\cot A/2$ in terms of semi-perimeter and sides a, b, c .

10.3 List various formulae for the area of a triangle.

10.4 Solve problems using the above formulae.

10.5 Solve a triangle when (i) three sides, (ii) two sides and an included angle, (iii) two sides and an opposite angle-case of two solutions and (iv) one side and two angles are given.

11.0 Represent the Hyperbolic Functions in terms of logarithm functions

11.1 Define Sinh x, cosh x and tanh x and list the hyperbolic identities.

11.2 Represent inverse hyperbolic functions in terms of logarithms.

12.0 Represent Complex numbers in various forms

- 12.1 Define complex number, its modulus , conjugate and list their properties.
- 12.2 Define the operations on complex numbers with examples.
- 12.3 Define amplitude of a complex number
- 12.4 Represent the complex number in various forms like modulus-amplitude (polar) form, Exponential (Euler) form – illustrate with examples.
- 12.5 State DeMoivre's theorem and its applications to complex numbers e.g., finding the roots, powers, simplifications of a complex number with illustrative examples

UNIT - III

Coordinate Geometry

13.0 Solve the problems on Straight lines

- 13.1 Write the different forms of a straight line – point slope form, two point form, intercept form, normal form and general form
- 13.2 Solve simple problems on the above forms
- 13.3 Find distance of a point from a line, acute angle between two lines, intersection of two non-parallel lines and distance between two parallel lines.

14.0 Solve the problems on Circles

- 14.1 Define locus of a point – circle and its equation.
- 14.2 Find the equation of a circle given
 - (i) Center and radius
 - (ii) Two ends of a diameter
 - (iii) Centre and a point on the circumference
 - (iv) Three non collinear points
- 14.3 Write the general equation of a circle and find the centre and radius.

15.0 Appreciate the properties of Conics in engineering applications

- 15.1 Define a conic section.
- 15.2 Explain the terms focus, directrix, eccentricity, axes and latus rectum of a conic with illustrations.
- 15.3 Find the equation of a conic when focus, directrix and eccentricity are given
- 15.4 Describe the properties of Parabola, Ellipse and Hyperbola in standard form.

UNIT - IV

Differential Calculus

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

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

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

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

16.3 Solve the problems using the above standard limits

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

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

17.0 Appreciate Differentiation and its meaning in engineering situations

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

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

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

17.3 Find the derivatives of elementary functions like x^n , a^x , e^x , $\log x$, $\sin x$, $\cos x$, $\tan x$, $\text{Sec}x$, $\text{Cosec}x$ and $\text{Cot} x$ using the first principles.

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

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

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

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

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

- 17.8 Explain the method of differentiation of a function with respect to another function and also differentiation of parametric functions with examples.
- 17.9 Find the derivatives of hyperbolic functions.
- 17.10 Explain the procedures for finding the derivatives of implicit function with examples.
- 17.11 Explain the need of taking logarithms for differentiating some functions with examples like $[f(x)]^{g(x)}$.
- 17.12 Explain the concept of finding the higher order derivatives of second and third order with examples.
- 17.13 Explain the concept of functions of several variables, partial derivatives and difference between the ordinary and partial derivatives with simple examples.
- 17.14 Explain the definition of Homogenous function of degree n
- 17.15 Explain Euler's theorem for homogeneous functions with applications to simple problems.

UNIT - V

Applications of the Differentiation

18.0 Understand the Geometrical Applications of Derivatives

- 18.1 State the geometrical meaning of the derivative as the slope of the tangent to the curve $y=f(x)$ at any point on the curve.
- 18.2 Explain the concept of derivative to find the slope of tangent and to find the equation of tangent and normal to the curve $y=f(x)$ at any point on it.
- 18.3 Find the lengths of tangent, normal, sub-tangent and sub normal at any point on the curve $y=f(x)$.
- 18.4 Explain the concept of angle between two curves and procedure for finding the angle between two given curves with illustrative examples.

19.0 Understand the Physical Applications of Derivatives

- 19.1 Explain the derivative as a rate of change in distance-time relations to find the velocity and acceleration of a moving particle with examples.
- 19.2 Explain the derivative as a rate measurer in the problems where the quantities like volumes, areas vary with respect to time- illustrative examples.

20.0 Use Derivatives to find extreme values of functions

- 20.1 Define the concept of increasing and decreasing functions.
- 20.2 Explain the conditions to find points where the given function is increasing or decreasing with illustrative examples.
- 20.3 Explain the procedure to find the extreme values (maxima or minima) of a function of single variable - simple problems yielding maxima and minima.

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

21.0 Use Derivatives to find Errors and Approximations

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

COURSE CONTENT

Unit-I

Algebra

1. Logarithms :

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

2. Partial Fractions :

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

$$\begin{array}{ll} i) \frac{f(x)}{(x+a)(x+b)(x+c)} & ii) \frac{f(x)}{(x+a)^2(x+b)(x+c)} \\ iii) \frac{f(x)}{(x^2+a)(x+b)} & iv) \frac{f(x)}{(x+a)(x^2+b)^2} \end{array}$$

Matrices:

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

Unit-II

Trigonometry :

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

5. Compound angles: Formulas of $\sin(A\pm B)$, $\cos(A\pm B)$, $\tan(A\pm B)$, $\cot(A\pm B)$, and related identities with problems.
6. Multiple and sub multiple angles: trigonometric ratios of multiple angles $2A, 3A$ and submultiple angle $A/2$ with problems.
7. Transformations of products into sums or differences and vice versa simple problems
8. Inverse trigonometric functions : definition, domains and ranges-basic properties- problems.
9. Trigonometric equations: concept of a solution, principal value and general solution of trigonometric equations :
 $\sin x = k$, $\cos x = k$, $\tan x = k$.
 Solutions of simple quadratic equations, equations involving usage of transformations- problems.
10. Properties and solutions of triangles: relation between sides and angles of a triangle- sine rule, cosine rule, tangent rule and projection rule-area of a triangle- solving a triangle- problems.
11. Hyperbolic functions: Definitions of hyperbolic functions, identities of hyperbolic functions, inverse hyperbolic functions and expression of inverse hyperbolic functions in terms of logarithms.
12. Complex Numbers: Definition of a complex number, Modulus and conjugate of a complex number, Arithmetic operations on complex numbers, Modulus- Amplitude (polar) form, Exponential form (Euler) form of a complex number- Problems. DeMoivre's Theorem and its applications in complex numbers- Simple problems.

UNIT-III

Coordinate geometry

13. Straight lines: various forms of straight lines, angle between lines, perpendicular distance from a point, distance between parallel lines-examples.
14. Circle: locus of a point, Circle definition-Circle equation given (i) center and radius, (ii) two ends of a diameter (iii) centre and a point on the circumference (iv) three non collinear points - general equation of a circle - finding center, radius.
15. Definition of a conic section, equation of a conic when focus directrix and eccentricity are given. Properties of parabola, ellipse and hyperbola, standard forms.

UNIT-IV

Differential Calculus

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

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

UNIT-V

Applications of Derivatives:

18. Geometrical meaning of the derivative, equations of Tangent and normal to a curve at any point. Lengths of tangent, normal, sub tangent and subnormal to the curve at any point. Angle between the curves - problems.
19. Physical applications of the derivative – velocity, acceleration, derivative as a rate Measure – Problems.
20. Applications of the derivative to find the extreme values – Increasing and decreasing functions, finding the maxima and minima of simple functions - problems leading to applications of maxima and minima.
21. Applications of derivative in finding errors and approximations of functions and simple problems.

Reference Books :

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

ENGINEERING PHYSICS

Subject Title	:	Engineering Physics
Subject Code	:	CHPC -103
Periods per week	:	04
Total periods per year	:	120

TIME SCHEDULE

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

OBJECTIVES

Upon completion of the course the student shall be able to

1.0 Understand the concept of Units and dimensions

- 1.1 Explain the concept of Units
- 1.2 Define the terms
 - a) Physical quantity, b) Fundamental physical quantities and
 - c) Derived physical quantities
- 1.3 Define unit
- 1.4 Define fundamental units and derived units
- 1.5 State SI units with symbols
- 1.6 State Multiples and submultiples in SI system
- 1.7 State Rules of writing S.I. units
- 1.8 State advantages of SI units
- 1.9 Define Dimensions
- 1.10 Write Dimensional formulae
- 1.11 Derive dimensional formulae of physical quantities
- 1.12 List dimensional constants and dimensionless quantities
- 1.13 State the principle of Homogeneity of Dimensions
- 1.14 State the applications of Dimensional analysis
- 1.15 State the limitations of dimensional analysis
- 1.16 Solve problems

2.0 Understand the concept of Elements of Vectors

- 2.1 Explain the concept of Vectors
- 2.2 Define Scalar and Vector quantities
- 2.3 Give examples for scalar and vector quantities
- 2.4 Represent vectors graphically

- 2.5 Classify the Vectors
- 2.6 Resolve the vectors
- 2.7 Determine the Resultant of a vector by component method
- 2.8 Represent a vector in space using unit vectors (i, j, k)
- 2.9 State triangle law of addition of vectors
- 2.10 State parallelogram law of addition of vectors
- 2.11 Illustrate parallelogram law of vectors in case of flying bird and sling.
- 2.12 Derive expression for magnitude and direction of resultant of two vectors
- 2.13 State polygon law of addition of vectors
- 2.14 Explain subtraction of vectors
- 2.15 Define Dot product of two vectors with examples (Work done, Power)
- 2.16 Mention the properties of Dot product
- 2.17 Define Cross products of two vectors with examples (Torque, Linear velocity)
- 2.18 Mention the properties of Cross product.
- 2.19 Solve the related numerical problems

3.0 Understand the concept of Kinematics

- 3.1 Write the equations of motion in a straight line
- 3.2 Explain the acceleration due to gravity
- 3.3 Derive expressions for vertical motion
 - a) Maximum Height, b) time of ascent, c) time of descent, and d) time of flight
- 3.4 Derive height of a tower when a body projected vertically upwards from the top of a tower.
- 3.5 Explain projectile motion with examples
- 3.6 Explain Horizontal projection
- 3.7 Derive an expression for the path of a projectile in horizontal projection
- 3.8 Explain oblique projection
- 3.9 Derive an expression for the path of projectile in oblique projection
- 3.10 Derive formulae for projectile in oblique projection
 - a) Maximum Height, b) time of ascent, c) time of descent, and d) time of flight
 - e) Horizontal Range, f) Maximum range
- 3.11 Solve the related numerical problems

4.0 Understand the concept of Friction

- 4.1 Define friction
- 4.2 Classify the types of friction and define
- 4.3 Explain the concept of Normal reaction
- 4.4 State the laws of friction
- 4.5 Define coefficients of friction
- 4.6 Explain the Angle of friction
- 4.7 Derive an expression for acceleration of a body on a rough horizontal surface
- 4.8 Derive an expression for the displacement and time taken to come to rest over a rough horizontal surface
- 4.9 Define Angle of repose
- 4.10 Derive expressions for acceleration of a body on a smooth inclined plane (up and down)
- 4.11 Derive expressions for acceleration of a body on a rough inclined plane (up and down)
- 4.12 List the Advantages and Disadvantages of friction
- 4.13 Mention the methods of minimizing friction
- 4.14 Solve the related numerical problems

5.0 Understand the concepts of Work, Power, and Energy

- 5.1 Define the terms 1. Work, 2. Power and Energy
- 5.2 State SI units and dimensional formulae for 1. Work, 2. Power, and Energy
- 5.3 Define potential energy and state examples
- 5.4 Derive the expression for Potential energy
- 5.5 Define kinetic energy and state examples
- 5.6 Derive the expression for kinetic energy
- 5.7 State and derive Work- Energy theorem
- 5.8 Derive the relation between Kinetic energy and momentum
- 5.9 State the law of conservation of energy and mention examples
- 5.10 Verify the law of conservation of energy in the cases of a freely falling body and vertically projected body in the upward direction
- 5.11 Solve the related numerical problems

6.0 Understand the concept of Simple harmonic motion

- 6.1 Define Simple harmonic motion
- 6.2 Give examples for Simple harmonic motion
- 6.3 State the conditions of Simple harmonic motion
- 6.4 Explanation of SHM in terms of projection of circular motion on any one of the diameters of the circular path
- 6.5 Derive expression for displacement
- 6.6 Derive expression for velocity
- 6.7 Derive expression for acceleration
- 6.8 Derive expression for Time period and frequency of S H M
- 6.9 Define phase of S H M and explain from the expression of displacement
- 6.10 Define Ideal simple pendulum and derive expression for Time period of simple pendulum
- 6.11 State the laws of motion of simple pendulum and mention formulae
- 6.12 Solve the related numerical problems

7.0 Understand the concept of Heat and thermodynamics

- 7.1 Explain the concept of expansion of gases
- 7.2 State and explain Boyle's law and also express it in terms of density
- 7.3 Define absolute zero temperature
- 7.4 Explain absolute scale of temperature
- 7.5 State Charles laws in terms of absolute temperature and explain
- 7.6 Define ideal gas and distinguish from real gas
- 7.7 Derive Ideal gas equation
- 7.8 Define Specific gas constant and Universal gas constant
- 7.9 Explain why universal gas constant is same for all gases
- 7.10 State SI unit and dimensional formula of universal gas constant
- 7.11 Calculate the value of universal gas constant
- 7.12 State the gas equation in different forms (as a function of density and mass)
- 7.13 Distinguish between r and R
- 7.14 State and Explain Isothermal process
- 7.15 State and Explain adiabatic process
- 7.16 Distinguish between isothermal and adiabatic processes
- 7.17 State first and second laws of thermodynamics and state applications
- 7.18 Define specific heats & molar specific heats of a gas and differentiate them
- 7.19 Derive the relation $C_p - C_v = R$ (Mayer's Equation)
- 7.20 Solve the related numerical problems

8.0 Understand the concept of Sound

- 8.1 Define the term sound
- 8.2 Explain longitudinal and transverse wave motion and state differences
- 8.3 Distinguish between musical sound and noise
- 8.4 Explain noise pollution and state SI unit for intensity level of sound
- 8.5 Explain causes of noise pollution
- 8.6 Explain effects of noise pollution
- 8.7 Explain methods of minimizing noise pollution
- 8.8 Explain the phenomenon of beats
- 8.9 State the applications of beats
- 8.10 Define Doppler effect
- 8.11 List the Applications of Doppler effect
- 8.12 Define reverberation and reverberation time
- 8.13 Write Sabine's formula and name the parameters contained
- 8.14 Define and Explain echoes and also state its applications
- 8.15 State conditions of good auditorium
- 8.16 Solve the related numerical problems

9.0 Understand the properties of matter

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

10.0 Understand the concept of Electricity and Magnetism

- 10.1 Explain the concept of Electricity
- 10.2 State Ohm's law and write the formula
- 10.3 Explain Ohm's law
- 10.4 Define specific resistance, conductance and state their units
- 10.5 State Kichoff's laws
- 10.6 Explain Kichoff's laws
- 10.7 Describe Wheatstone's bridge with legible sketch
- 10.8 Derive an expression for balancing condition of Wheatstone's bridge

- 10.9 Describe Meter Bridge experiment for the determination of resistivity with a neat circuit diagram
- 10.10 Write the formula in Meter Bridge to determine specific resistance
- 10.11 Explain the concept of magnetism
- 10.12 State the Coulomb's inverse square law of magnetism
- 10.13 Define magnetic field and magnetic lines of force and write the properties of magnetic lines of force
- 10.14 State the Magnetic induction field strength and mention its units and dimensional formula
- 10.15 Derive an expression for the moment of couple on a bar magnet placed in a uniform magnetic field
- 10.16 Derive Magnetic induction field strength at a point on the axial line
- 10.17 Derive Magnetic induction field strength at a point on the equatorial line
- 10.18 Solve the related numerical problems

11.0 Understand the concept of Modern physics

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

COURSE CONTENT

1. Units and Dimensions:

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

2. Elements of Vectors:

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

3. **Kinematics**
Introduction- Concept of acceleration due to gravity- Equations of motion for a freely falling body and for a body thrown up vertically- Projectiles- Horizontal and Oblique projections- Expressions for maximum height, time of flight, range - problems
4. **Friction:**
Introduction to friction- Causes- Types of friction- Laws of friction- Angle of repose-Angle of friction— Motion of a body over a horizontal surface- smooth inclined plane- rough inclined plane- Advantages and disadvantages of friction- Methods of reducing friction – Problems
5. **Work, Power and Energy:**
Work, Power and Energy- Definitions and explanation- potential energy- kinetic energy- Derivations of Potential and Kinetic energies-K.E and Momentum relation - Work-Energy theorem- Law of Conservation of energy- Problems
6. **Simple Harmonic Motion:**
Introduction- Conditions of SHM- Definition- Examples- Expressions for displacement, velocity, acceleration, Time period, frequency and phase in SHM- Time period of a simple pendulum- Laws of simple pendulum-seconds pendulum- Problems
7. **Heat and Thermodynamics:**
Expansion of Gases- Boyle's law- Absolute scale of temperature- Charles laws- Ideal gas equation- Universal gas constant- Differences between r and R - Isothermal and adiabatic processes- Laws of thermodynamics- Specific heats - molar specific heats of a gas – Derivation of Mayer's Equation- Problems
8. **Sound:**
Sound- Nature of sound- Types of wave motion -musical sound and noise- Noise pollution – Causes & effects- Methods of reducing noise pollution- Beats- Doppler effect- Echo- Reverberation-Reverberation time-Sabine 's formula-Conditions of good auditorium-Problems
9. **Properties of matter**
Definition of Elasticity –Definition of stress and strain -the units and dimensional formulae for stress and strain-The Hooke's law- Definition of surface tension- Explanation of Surface tension with reference to molecular theory - Definition of angle of contact - Definition of capillarity -The formula for surface tension based on capillarity - Explanation of concept of Viscosity - Examples for surface tension and Viscosity - Newton's formula for viscous force- Definition of co-efficient of viscosity- The effect of temperature on viscosity of liquids and gases - Poiseuille's equation for Co-efficient of viscosity- The related numerical problems
10. **Electricity & Magnetism:**
Ohm's law and explanation- Specific resistance- Kirchoff 's laws- Wheatstone's bridge - Meter bridge- Coulomb's inverse square law magnetic field- magnetic lines of force-Magnetic induction field strength- magnetic induction field strength at a point on the axial line - magnetic induction field strength at a point on the equatorial line –problems.
11. **Modern Physics;**
Photoelectric effect –Einstein's photoelectric equation-laws of photoelectric effect - photoelectric cell –Applications of photo electric effect- Total internal reflection- fiber optics- - principle and working of an optical fiber-types of optical fibers - Applications of optical fibers- superconductivity - applications

REFERENCE BOOKS

- | | |
|---------------------------------------------|------------------------------------|
| 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. Text book of physics Volume I | Resnick & Holiday |
| 4. Text book of applied physics | Dhanpath Roy |
| 5. Fibre optics | D.A Hill |
| 6. NCERT Text Books ----- XI & XII Standard | |

Blue Print for setting question paper at different levels

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

**C – 16, ENGINEERING CHEMISTRY & ENVIRONMENTAL STUDIES
(Common to all Branches)**

Subject Title : Engineering Chemistry & Environmental Studies
Subject Code : CHPC-104
Periods per week : 04
Total periods per year : 120

Scheme of instruction and examination Time Schedule

S.No	Major topic	No of Periods	Weight age of marks	Short type (3marks)			Essay type (10 marks)			remarks
				R	U	A	R	U	A	
A. ENGINEERING CHEMISTRY										
1	Fundamentals of Chemistry	18	16	1	0	1	0	1	0	
2	Solutions	10	8	1	0	0	0	0	1/2	5 mark
3	Acids and bases	10	8	0	0	1	0	1/2	0	5 mark
4	Principles of Metallurgy	10	10	0	0	0	1	0	0	
5	Electrochemistry	14	13	0	1	0	0	0	1	
6	Corrosion	8	10	0	0	0	0	1	0	
7	Water Technology	14	13	1	0	0	1	0	0	
8	Polymers	12	13	1	0	0	1	0	0	
9	Fuels	6	3	1	0	0	0	0	0	
B. ENVIRONMENTAL STUDIES		18	16	1	1	0	0	1	0	
total		120	110	6	2	2	3	3	1	
				18	6	6	30	35	15	

OBJECTIVES

Upon completion of the course the student shall be able to

A. ENGINEERING CHEMISTRY

1.0 Understand the concept of Atomic structure

- 1.1 Explain the charge and mass of fundamental particles of an atom (electron, proton and neutron)
- 1.2 Explain the concept of atomic number and mass number.
- 1.3 State the Postulates of Bohr's atomic theory and its limitations.
- 1.4 Explain the significance of four Quantum numbers.
- 1.5 Explain 1. Aufbau principle, 2 Pauli's exclusion principle 3 Hund's rule.

- 1.6 Define Orbital in an atom.
- 1.7 Draw the shapes of s, p and d - Orbitals .
- 1.8 Distinguish between Orbit and Orbital
- 1.9 Write the electronic configuration of elements up to atomic number 30
- 1.10 Explain the significance of chemical bonding
- 1.11 Explain the Postulates of Electronic theory of valency
- 1.12 Define the types of Chemical bonding viz., Ionic, Covalent bonds.
- 1.13 Explain the types of Chemical bonding viz., Ionic, Covalent bonds with examples.
- 1.14 Explain bond formation in NaCl and MgO.
- 1.15 List Properties of Ionic compounds
- 1.16 Explain bond formation in Hydrogen molecule, Oxygen molecule, and Nitrogen molecule using Lewis dot method.
- 1.17 List Properties of Covalent compounds
- 1.18 Distinguish between properties of ionic compounds and covalent compounds.
- 1.19 Structures of ionic solids-define a) Unit cell b) co-ordination number.
- 1.20 Structures of Unit cells of NaCl and CsCl.
- 1.21 Define the term. Oxidation number.
- 1.22 Calculate the Oxidation Number of underlined atoms in the following examples
a) $\underline{K}\underline{Mn}O_4$ b) $K_2\underline{Cr}_2O_7$ c) $H\underline{N}O_3$ d) $H_2\underline{S}O_4$ e) $\underline{Cl}O_4^-$ f) $\underline{N}H_4^+$
- 1.23 Differentiate between Oxidation Number and Valency

2.0 Calculate Molarity and Normality of given Solution

- 2.1 Define the terms 1. Solution, 2. Solute and 3. Solvent
- 2.2 Classify solutions based on physical state and solubility
- 2.3 Define mole
- 2.4 Problems on 'Mole concept'
- 2.5 Define the terms 1. Atomic weight, 2. Molecular weight and 3. Equivalent weight
- 2.6 Calculate Molecular weight and Equivalent weight of given Acids, (HCl, H₂SO₄, HNO₃) Bases (NaOH, KOH, Ca(OH)₂) and Salts (NaCl, Na₂CO₃, CaCO₃)
- 2.7 Define 1. Molarity, 2. Normality of solutions
- 2.8 Solve Numerical problem 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

3.0 Understand the concepts of Acids and bases

- 3.1 Explain Arrhenius theory of Acids and Bases
- 3.2 State the limitations of Arrhenius theory of Acids and Bases
- 3.3 Explain Bronsted – Lowry theory of acids bases
- 3.4 State the limitations of Bronsted – Lowry theory of acids bases
- 3.5 Explain Lewis theory of acids and bases
- 3.6 State the limitations of Lewis theory of acids and bases
- 3.7 Explain the Ionic product of water
- 3.8 Define pH and explain Sorens on scale
- 3.9 Solve the Numerical problems on pH(Strong Acids and Bases)
- 3.10 Define Buffer solution
- 3.11 Give atleast three examples for Buffer solutions
- 3.12 State the applications of Buffer solution

4.0 Understand the Principles of Metallurgy

- 4.1 List at least eight Characteristics of Metals
- 4.2 Distinguish between Metals and Non Metals
- 4.3 Define the terms 1.Mineral, 2.Ore, 3. Gangue, 4.Fluxand 5.Slag
- 4.4 Describe the methods of concentration of Ore; 1.Handpicking,2.Levigation, and 3. Froth Floatation
- 4.5 Describe the methods involved in extraction of crude metal- Roasting, Calcination and Smelting.
- 4.6 Explain the purification of Metals by Electrolytic Refining
- 4.7 Define an Alloy
- 4.8 Write the Composition of the following alloys:1.Brass, 2. Germansilver, 3 Nichrome
- 4.9 List the uses of the following Alloys: 1. Brass, 2.Germansilver, 3.Nichrome

5.0 Understand the concepts of Electrochemistry

- 5.1 Define the terms1. Conductor, 2. Insulator, 3.Electrolyte 4.Non–electrolyte
- 5.2 Distinguish between metallic conduction and Electrolytic conduction
- 5.3 Explain electrolysis by taking example fused NaCl
- 5.4 Explain Faraday's laws of electrolysis
- 5.5 Define 1. Chemical equivalent (E) 2. Electrochemical equivalent (e) and their relation.
- 5.6 Solve the Numerical problems based on Faraday's laws of electrolysis
- 5.7 Define Galvanic cell
- 5.8 Explain the construction and working of Galvanic cell
- 5.9 Distinguish between electrolytic cell and galvanic cell

- 5.10 Explain the electrode potentials and standard electrode potentials
- 5.11 Explain the electro chemical series and its significance
- 5.12 Explain the emfofa cell.
- 5.13 Solve the numerical problems on emfof the cell based on standard electrode potentials.

6.0 Understand the concept of Corrosion

- 6.1 Define the term corrosion
- 6.2 state the Factors influencing the rate of corrosion
- 6.3 Describe the formation of a)composition cell, b)stress cell ,c) concentration cell during corrosion.
- 6.4 Define rusting of iron and Explain the mechanism of rusting of iron.
- 6.5 Explain the methods of prevention of corrosion:
 - a)Protective coatings (anodic and cathodic coaitings)
 - b) Cathodic protection (Sacrificial anode process and Impressed–voltage process)

7. 0 Understand the concept of Water Technology

- 7.1 State the various Sources of water like Surface water and sub-surface water.
- 7.2 Define the terms soft water and hard water with respect to soap consumption.
- 7.3 Define the term hardness of water
- 7.4 Types of hardness of water 1.Temporary hardness 2. Permanent hardness
- 7.5 List the salts that causing hardness of water(with Formulae)
- 7.6 State the disadvantages of using hard water in industries
- 7.7 Define Degree of hardness, units of hardness(mg/L) or ppm.
- 7.8 Explain the methods of softening of hard water:a) Ion-Exchange process, b)Permutit process or zeolite process
- 7.9 Concept of Osmosis and Reverse Osmosis with examples .
- 7.10 State the applications of Reverse Osmosis.
- 7.11 State essential qualities of drinking water.

8.0 Understand the concepts of Polymers

- 8.1 Explain the concept of polymerisation
- 8.2 Describe the methods of polymerization a) addition polymerization of Ethylene b)condensation polymerization of phenol and formaldehyde(Only flow chart i.e. without chemical equations)

- 8.3 Define the term plastic
- 8.4 Classify the plastics with examples
- 8.5 Distinguish between the thermo and thermo setting plastics
- 8.6 List the Characteristics of plastics
- 8.7 State the advantages of plastics over traditional materials
- 8.8 State the disadvantages of using plastics.
- 8.9 Explain the methods of preparation of the following plastics:
1.Polythene, 2. PVC, 3.Teflon, 4. Polystyrene and 5. Urea formaldehyde
- 8.10 Explain the uses of the following plastics:
1.Polythene, 2. PVC, 3.Teflon, 4.Polystyrene and 5. Urea formaldehyde
- 8.11 Define the term natural rubber
- 8.12 write the structural formula of Natural rubber
- 8.13 Explain the processing of Natural rubber from latex
- 8.14 List the Characteristics of natural rubber
- 8.15 Explain the process of Vulcanization
- 8.16 List the Characteristics of Vulcanized rubber
- 8.17 Define the term Elastomer
- 8.18 Describe the preparation of the following synthetic rubbers a) Buna-s and b)Neo prene rubber
- 8.19 List the uses of the following synthetic rubbers a) Buna-s and b)Neo prene rubber

9.0 Understand the concepts of Fuels

- 9.1 Define the term fuel
- 9.2 Classify the fuels based on physical state—solid, liquid and gaseous fuels,
- 9.3 Classify the fuels based on occurrence-primary and secondary fuels
- 9.4 List the characteristics of good fuel
- 9.5 State the composition and uses of gaseous fuels:
a)water gas, b)producer gas, c)natural gas, d)coal gas, e)Biogas and f) acetylene

B. ENVIRONMENTAL STUDIES

- 1.1 Define the term environment
- 1.2 Explain the scope and importance of environmental studies
- 1.3 Segments of environment 1).Lithosphere, 2).Hydrosphere, 3).Atmosphere, 4).Biosphere,
- 1.4 Define the following terms 1)Pollutant, 2).Pollution, 3).Contaminant, 4)receptor, 5)sink, 6) particulates, 7)dissolved oxygen, 8)Threshold limit value, 9).BOD, and 10).COD 11) eco system .
- 1.5 State the renewable and non renewable energy sources with examples.
- 1.6 Define the terms:

- 1). Producers, 2). Consumers and 3). Decomposers with examples.
- 1.7 Explain bio diversity and threatst obiodiversity
 - 1.8 Define air pollution
 - 1.9 Classify the air pollutants-based on origin and physical state of matter.
 - 1.10 Explain the causes of Air pollution.
 - 1.11 Explain the effects of air pollution on human beings, plants and animals.
 - 1.12 State the uses of forest resources.
 - 1.13 State the deforestation and its causes and effects.
 - 1.14 Explain the 1.) Green house effect , 2) Ozone layer depletion and 3) Acidrain.
 - 1.15 Explain the methods of control of Air pollution
 - 1.16 Define Water pollution
 - 1.17 Explain the causes of Water pollution
 - 1.18 Explain the effects of Water pollution on living and Non-living things.
 - 1.19 Explain the methods of control of Water pollution.

COURSE CONTENT

A. ENGINEERINGCHEMISTRY

1. Fundamentals of Chemistry

Atomic Structure: Introduction - Fundamental particles – Bohr’s theory – Quantum numbers – Aufbau principle - Hund’s rule - Pauli’s exclusion Principle- Orbitals, shapes of s, p and d orbitals - Electronic configurations of elements

Chemical Bonding: Introduction – types of chemical bonds – Ionic and covalent bond with examples–Properties of Ionic and Covalent compounds- structures of ionic crystals NaCl, CsCl.

,**Oxidation Number**- calculations, differences between Oxidation Number and Valency.

2. Solutions

Introduction-concentration methods – Mole concept, Molarity, Normality, Equivalent weights, Numerical problems on Mole, Molarity and Normality.

3. Acids and Bases

Introduction – Theories of acids and bases and limitations – Arrhenius theory-Bronsted – Lowry theory – Lewis acid base theory – Ionic product of water– pH and related numerical problems–Buffer solutions–Applications.

4. Principles of Metallurgy

Characteristics of Metals and distinction between Metals and Non Metals, Metallurgy, ore, Gangue, Flux, Slag - Concentration of Ore –Hand picking, Levigation, Froth floatation – Methods of Extraction of crude Metal – Roasting, Calcination, Smelting – Alloys – Composition and uses of Brass, German silver and Nichrome

5. Electrochemistry

Conductors, insulators, electrolytes– electrolysis – Faraday’s laws of electrolysis-numerical problems – Galvanic cell – standard electrode potential – electrochemical series–

emf and numerical problems on emfofa cell

6. Water technology

Introduction–soft and hard water–causes of hardness–types of hardness

–dis advantages of hard water – degree of hardness (ppm) – softening methods – permut it process – ion exchange process– drinking water –Osmosis, Reverse Osmosis –Applications of Reverse osmosis

7. Introduction - factors influencing corrosion - composition, stress and concentration cells– rusting of iron and its mechanism – prevention of corrosion by coating methods, cathodic protection

8. Polymers

Introduction – polymerization – types of polymerization – addition, condensation with examples – plastics – types of plastics – advantages of plastics over traditional materials – Disadvantages of using plastics – preparationandusesofthefollowingplastics:1.Polythene 2.PVC 3.Teflon 4.Polystyrene 5. Urea formal dehyde – Rubber – Natural rubber – processing from latex –Vulcanization – Elastomers, Buna-s, Neoprene rubber and their uses.

9. Fuels

Definition and classification of fuels–characteristicsofgoodfuel- compositionandusesofgaseousfuels.

B. ENVIRONMENTAL STUDIES

Introduction– environment –scope and importance of environmental studies important terms– renewable and non-renewable energy sources–Concept of ecosystem, producers, consumers and decomposers – Biodiversity, definition and threats to Bio diversity.

Air pollution – causes-Effects– forest resources: uses and over exploitation, deforestation, acid rain, greenhouse effect –ozone depletion – control of air pollution – Water pollution – causes – effects – control measures,

REFERENCE BOOKS

- | | | |
|----|--------------------------------|---------------------------------------|
| 1. | Intermediate chemistry Vol 1&2 | Telugu Academy |
| 2. | Intermediate chemistry Vol 1&2 | Vikram Publishers |
| 3. | Intermediate chemistry Vol 1&2 | Vignan Publishers &Deepthi Publishers |
| 4. | Engineering Chemistry | Jain & Jain |
| 5. | Engineering Chemistry | O.P. Agarwal, Hi-Tech. |
| 6. | Engineering Chemistry | Sharma |
| 7. | Engineering Chemistry | A.K. De |

INTRODUCTION TO CHEMICAL AND PETROLEUM ENGINEERING

Subject Title : Introduction to Chemical and Petroleum Engineering

Subject Code : CH-PC-105

Periods / Week : 05

Periods / Semester : 150

TIME SCHEDULE

S.No.	Major topics	No. of Periods	Weightage of marks	Short answer type	Essay Type
1	Introduction	05	3	1	-
2	Material and Energy Balances	20	16	2	1
3	Fluid Mechanics	15	13	1	1
4	Heat Transfer	15	13	1	1
5.	Mass Transfer	20	13	1	1
6.	Chemical Kinetics	10	3	1	-
7.	Measuring Devices	15	10	-	1
8.	Natural Resources and their Utilization	10	3	1	-
9.	Basic Petroleum Geology	10	10	-	1
10.	Basic Petroleum Exploration & Drilling Engineering	15	13	1	1
11.	Basic Reservoir Engineering	15	13	1	1
Total		150	110	10	08

OBJECTIVES:

1.0 Introduction:

- 1.1 Know the importance of Chemical Engineering.
- 1.2 Know the types of Unit Operations and Unit Processes.
- 1.3 Understand the basic laws of Chemical Engineering
- 1.4 List the useful mathematical methods of Chemical Engineering

2.0 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 concept of hydrostatic head.
- 2.5 Know the kinetic theory of gases.
- 2.6 Know about gas laws and ideal gas equation.
- 2.7 Know about ideal gas constant
- 2.8 Know about degrees of Freedom.
- 2.9 Know about steady and un-steady state mass balance.
- 2.10 Know about stoichiometry, application of stoichiometry, stoichiometric equations, stoichiometric coefficients, and stoichiometric proportions. Give suitable examples.
- 2.11 Explain the terms internal energy and enthalpy.
- 2.12 Know the terms sensible heat and latent heat.
- 2.13 Define ‘heat capacity’ and ‘specific heat’.
- 2.14 Know about partial and complete combustion.
- 2.15 Define calorific value.

3.0 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 static pressure.

- 3.6 State Newton's law of viscosity.
- 3.7 Distinguish Laminar and Turbulent flow.
- 3.8 Explain the importance of Reynold's number.
- 3.9 Know about the continuity equation.
- 3.10 Know about momentum balance.
- 3.11 List different types of valves.
- 3.12 Classification of pumps.
- 3.13 Distinguish among Fan, Blower and compressor

4.0 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
- 4.6 Define natural convection and forced convection
- 4.7 Explain emission of radiation and emissive power.
- 4.8 Know about black body
- 4.9 Know the classification of heat exchangers.
- 4.10 Understand evaporation
- 4.11 Know the different types of evaporators

5.0 Mass Transfer

- 5.1 Define the mass transfer operation.
- 5.2 Understand the process of diffusion
- 5.3 Know about the process of molecular diffusion with example
- 5.4 Know about Eddy diffusion.
- 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 distillation with examples.
- 5.8 Know about absorption with examples.
- 5.9 Know about stripping with examples
- 5.10 Know about extraction and leaching with examples

- 5.11 Know about adsorption with examples
- 5.12 Know about the types of adsorption
- 5.13 Know about drying operation with examples.
- 5.14 Define various terms involved in humidification & dehumidification operations
- 5.15 Know about the humidity of a gas system
- 5.16 Know about crystallization with examples.
- 5.17 Know the principles of crystallization.

6.0 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.
- 6.6 Know about Promoters.

7.0 Measuring Devices

- 7.1 Know about measurement of density.
- 7.2 Know about measurement of density using Hydrometer.
- 7.3 Know about measurement of density using specific gravity bottle
- 7.4 Know about measurement of Viscosity.
- 7.5 Know about measurement of Viscosity using Ostwald viscometer.
- 7.6 Know about measurement of Viscosity using Saybolt viscometer.
- 7.7 Know about measurement of Humidity of a gas.
- 7.8 Know about measurement of Humidity of a gas using Psychrometer.
- 7.9 Know about measurement of Humidity of a gas Hygrometers.
- 7.10 Know about measurement of P^H .
- 7.11 Know the measurement of Pressure.
- 7.12 Know the measurement of Temperature.
- 7.13 Know the measurement of flow rate.

8.0 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
- 8.6 Non- Renewable Energy Resources .
 - a) Fossil Fuels
 - b) Nuclear Energy
 - c) Natural Energy

9.0 Basic Petroleum Geology:

- 9.1 List the elements that control the origin and occurrence of petroleum.
- 9.2 Define Geological mapping.
- 9.3 Know the applications of remote sensing techniques in Hydrocarbon exploration.
- 9.4 Know the Definition of source rock.
- 9.5 Know about organic rich sediments as source rocks.
- 9.6 Understand the nature of source rock.
- 9.7 List the types of source rocks.
- 9.8 Describe the evaluation of petroleum source rock potential.
- 9.9 Know the definition of permeability, effective and relative permeability and their significance.
- 9.10 State the relationship between porosity, permeability and texture.
- 9.11 Know about source bed and carrier bed.
- 9.12 Describe the concept of hydrocarbon migration from source beds to the carrier beds.
- 9.13 Know about the migration of hydrocarbon from carrier beds to the reservoir.

10.0 Basic Petroleum Exploration & Drilling Engineering:

- 10.1 Know about the basic concepts of magnetic methods.
- 10.2 Understand about the geomagnetic field.
- 10.3 Explain about basic concepts of gravity methods.
- 10.4 State the application of gravity methods.
- 10.5 Know about the basic concepts of Seismic methods.

- 10.6 Know about interpretation of results obtained by using seismic methods.
- 10.7 State the types and structure of drilling rigs and Rig components.
- 10.8 Know about Offshore rigs-for shallow and deep waters.
- 10.9 Know about Pre-drill operations in on-land and offshore environments.
- 10.10 State the types of casings.
- 10.11 Know about blow out preventer.
- 10.12 Know about cementation of wells.

11.0 Basic Reservoir Engineering

- 11.1 Know the Scope and importance of reservoir engineering.
- 11.2 Know the Characteristics of Reservoir rocks.
- 11.3 Know the classification of reservoir rocks.
- 11.4 Understand the nomenclature associated with reservoir rock.
- 11.5 Know the definition of Reservoir pore space and its significance.
- 11.6 Know about Sedimentary rock formations suitable for hydrocarbon reservoirs.
- 11.7 Explain about the description of 'origin' processes of hydrocarbon fluids.
- 11.8 Explain about 'accumulation' processes of hydrocarbon fluids.
- 11.9 State the physical properties of reservoir rocks.
- 11.10 Know about porosity (total and effective).
- 11.11 Know about permeability (absolute, effective and relative).
- 11.12 Know about grain-size distribution.
- 11.13 Know about compressibility and wettability.
- 11.14 State Darcy's law.

COURSE CONTENTS:

1.0 Introduction:

Importance of Chemical Engineering-Types of Unit Operations-Basic Laws related to Chemical Engineering-List the Useful Mathematical Methods-Comprehend Units and Dimensions.

2.0 Material and Energy Balances

List of Fundamental and Derived quantities-Define Atom, Molecule, Mole, Gram-atom, Gram-molecule, Gram molar volume-Define Density and Specific gravity, Variation of density and specific gravity with temperature-Concept of Hydrostatic head-Kinetic theory of gases-Gas laws and Ideal gas equation-Ideal gas constant-Unit operation and Unit Process-Degrees of Freedom-Steady and un-steady state mass balance-Stoichiometry- application of stoichiometry-stoichiometric equations-stoichiometric coefficients-stoichiometric proportions-Internal energy and enthalpy-Sensible heat and latent heat-Heat capacity and Specific heat-Partial and Complete Combustion-Calorific value.

3.0 Fluid Mechanics:

State the importance of flow of fluids-Define a fluid and types of fluids-Important physical properties of fluid and give their units-List out different types of fluids based on physical properties-Fluid statics and static pressure-Newton's law of Viscosity-Distinguish Laminar and turbulent flow-Importance of Reynold's number-Continuity equation-Momentum balance-Different types of valves-Classify pumps-Distinguish among Fan, Blower and compressor.

4.0 Heat Transfer:

Nature of heat flow-Mechanisms of heat flow such as conduction, convection and Radiation-Conduction, convection and Radiation-Steady state and unsteady state heat flow-Fourier's law of heat flow by conduction-Natural convection and forced convection-Emission of Radiation and emissive power-Black body-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-Eddy diffusion-Batch, continuous contact operations-Co-current, counter-current contact and cross current operations-Distillation-Absorption with examples-Stripping operation with examples-Extraction and leaching operations-Examples of extraction and leaching-Adsorption with examples-Types of adsorption-Drying operation with examples-Various terms involved in humidification & dehumidification operations-Humidity of a gas system-Crystallization-Principles of crystallization.

6.0 Chemical Kinetics:

Progress of a chemical reaction-Molecularity of a chemical reaction-Order of a chemical reaction-Collision theory-Catalysts-Promoters.

7.0 Measuring Devices

Measurement of density-Measurement of density using Hydrometer-Measurement of density using Pycnometer-Measurement of Viscosity-Measurement of Viscosity using Ostwald viscometer-Measurement of Viscosity using Saybolt viscometer-Measurement of Humidity of a gas-Measurement of Humidity of a gas using Psychrometer-Measurement of Humidity of a gas Hygrometers-Measurement of P^H -Measurement of Pressure-Measurement of Temperature-Measurement of flow rate.

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-Non- Renewable Energy Resources-Fossil Fuels, Nuclear Energy, Natural Energy-Natural Gas Metal Ores

9.0 Basic Petroleum Geology:

List the elements that control the origin and occurrence of petroleum-Geological mapping-Applications of remote sensing techniques in Hydrocarbon exploration-Definition of source rock-Organic rich sediments as source rocks-Nature of source rock-Types of source rocks-Evaluation of petroleum source rock potential-Definition of permeability, effective and relative permeability and their significance-Relationship between porosity, permeability and texture-Source bed and carrier bed-Concept of hydrocarbon migration from source beds to the carrier beds-Migration of hydrocarbon from carrier beds to the reservoir-

10.0 Basic Petroleum Exploration & Drilling Engineering:

Basic concepts of magnetic methods-Geomagnetic field-Basic concepts of gravity methods-Application of gravity methods-Basic concepts of Seismic methods-Interpretation of results obtained by using seismic methods-Types and structure of drilling rigs and Rig components-Offshore rigs-for shallow and deep waters-Pre-drill operations in on-land and offshore environments-Types of casings-Blow out preventer-Cementation of wells

11.0 Basic Reservoir Engineering:

Scope and importance of reservoir engineering-Characteristics of Reservoir rocks-Classification of reservoir rocks-Nomenclature associated with reservoir rock-Definition of Reservoir pore space and its significance-Sedimentary rock formations-Suitable for hydrocarbon reservoirs-Description of 'origin' processes of hydrocarbon fluids-Accumulation' processes of hydrocarbon fluids-Physical properties of reservoir rocks-Porosity (total and effective)-Permeability (absolute, effective and relative)-Grain-size distribution-Compressibility and wettability-Darcy's law.

REFERENCE BOOKS :

1. Physical Chemistry by Bahl and Tuli.
2. Organic Chemistry by Ball and Ball.
3. Unit Operations in Chemical engineering, Mc Cabe, Smith, Harriot
4. Introduction to Chemical Engineering by Badger and Bencharo
5. Introduction to Chemical Engineering by Ghoshal, Sanyal and Dutta
6. Organic Geochemistry for Exploration Geologists, by Douglas Waples, 1984, Berger Publications, Minnesta USA.
7. Elements of Petroleum Geology by Richard, C. Selley, 1998, Academic Press, London.
8. Petroleum Geology by North, F.K., 1990. Unwin Hyman Publications, Boston, USA.
9. 6. Fundamental aspects of Petroleum Geochemistry by Nagy, B and Colombo, V. 1967. Elsevier Publications, Amsterdam.
10. Geochemistry of Oil Field waters by Collins by A.J., 1975, Elsevier Publications, Amsterdam.
11. Petroleum Geochemistry and Geology by Hunt, J.M., 1979, Freeman, San Francisco, USA.

MATERIALS TECHNOLOGY

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

TIME SCHEDULE

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

Objectives:

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

1.0 Introduction

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

2.0 Mechanical properties of metals and testing of materials

- 2.1 Define the following properties

- a. Strength of a material
- b. Ultimate Strength
- c. Stress
- d. Strain
- e. Elasticity
- f. Tensile and compressive strength
- g. Ductility
- h. Hardness
- i. Toughness
- j. Brittleness
- k. Impact strength
- l. Fatigue and creep strength.

2.2 Know about the various destructive methods of testing and non destructive methods of testing to identify various defects of materials and their applications.

2.3 Know the determination of tensile strength and Compressive strength's by universal testing machine.

2.4 Know the determination of hardness by Brinell hardness testing and Rockwell hardness testing machines.

2.5 Know the determination of impact strength by Izod and Charpy's testing machines.

2.6 Identify the procedures to detect the internal defects of a metal by x – ray, γ – ray (Gamma ray) and ultrasonic tests.

3.0 Understand the structure of metals and alloys

3.1 Define Unit cell and space lattice.

3.2 Understand the 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.

4.0 Understand thermal equilibrium diagram

4.1 Explain Cooling curve for pure iron

4.2 know Allotropic forms of pure iron

- 4.3 Draw Iron – Carbon thermal equilibrium diagram.
- 4.4 Locate the peritectic, eutectic, eutectoid points from the iron – carbon diagram.

5.0 Know the methods of producing iron and steel

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

6.0 Know the plain carbon steels and alloy steels.

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

7.0 Understand non – ferrous metals and their alloys

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

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

8.0 Know the commonly need miscellaneous materials

8.1 Know the Importance of Glass , types and applications

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

8.3 State the properties and applications of carbon and graphite.

8.4 Know the composition, properties and applications of stoneware.

8.5 Know the application of asbestos, Rubber, Elastomers.

8.6 Know the application of polymers.

8.7 Know about refractories and their applications

8.8 Know about Glass ceramics , Ceramites and Glass wool

9.0 Understand corrosion and its prevention

9.1 Define corrosion and explain the causes of corrosion.

9.2 Explain electro chemical theory of corrosion

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

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

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

COURSE CONTENTS:

1. Introduction – Definition, Classification of engineering materials, need and applications.

2. Mechanical properties of metals & Testing of materials – define the terms ,Ultimate Strength , Stress , Strain ,Elasticity , tensile and compressive strength, ductility, hardness, toughness, brittleness, impact strength, fatigue and creep strength- various destructive testing methods of tensile strength,

compressive strength, hardness, impact strength and various non destructive testing methods – x ray, γ – 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.

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.*
4. *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*

Subject Title : **Engineering Drawing**
Subject Code : **107 (Common to all Branches)**
Periods/Week : **06**
Periods Per Year : **180**

Time Schedule

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

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

OBJECTIVES

Upon completion of the subject the student shall be able to

1) Understand the basic concepts of Engineering Drawing

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

2) Use of Engineering Drawing Instruments

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

3) Write Free Hand Lettering and Numbers

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

4) Understand Dimensioning Practice

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

5) Apply Principles of Geometric Constructions

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

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

- a) Visualize the objects
- b) Explain the I-angle and III-angle projections
- c) Practice the I-angle projections
- d) Draw the projection of a point with respect to reference planes (HP&VP)
- e) Draw the projections of straight lines with respect to two reference planes (cases of lines parallel to one plane and inclined to other plane only)

- f) Draw the projections of planes (cases of planes perpendicular to one plane and inclined to other plane only)
 - g) Draw the projections of solids (cases of axis perpendicular to one plane and inclined to other plane only)
- 7) Understand the need of auxiliary views**
- a) State the need of Auxiliary views for a given engineering drawing
 - b) Draw the auxiliary views of a given engineering component
 - c) Differentiate between auxiliary view and apparent view
- 8) Appreciate the need of Sectional Views**
- a) Explain the need to draw sectional views
 - b) Select the section plane for a given component to reveal maximum information
 - c) Explain the positions of section plane with respect to reference planes
 - d) Differentiate between true shape and apparent shape of section
 - e) Draw sectional views and true sections of regular solids discussed in chapter-6 above
 - f) Apply principles of hatching
- 9) Apply principles of orthographic projection**
- a) Explain the principles of orthographic projection with simple sketches
 - b) Draw the orthographic view of an object from its pictorial drawing
 - c) Draw the minimum number of views needed to represent a given object fully
- 10) Prepare pictorial drawings**
- a) State the need of pictorial drawings
 - b) Differentiate between isometric scale and true scale
 - c) Prepare Isometric views for the given orthographic drawings
- 11) Interpret Development of surfaces of different solids**
- a) State the need for preparing development drawing
 - b) Prepare development of simple engineering objects (cubes, prisms, cylinders, cones, pyramids) using parallel line and radial line methods
 - c) Prepare development of surface of engineering components like trays, funnels, 90° elbows & rectangular ducts

COURSE CONTENT

NOTE

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

1) The importance of Engineering Drawing

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

2) Engineering drawing Instruments

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

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

3) Free hand lettering & numbering

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

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

4) Dimensioning practice

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

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

5) Geometric Constructions

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

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

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

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

6) Projection of points, lines, planes & solids

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

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

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

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

7) Auxiliary views

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

Drawing plate 10: Consisting of four exercises on auxiliary views

8) Sectional views

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

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

9) Orthographic Projections

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

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

10) Pictorial Drawings

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

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

11) Development of Surfaces

Need for preparing development of surface with reference to sheet metal work -Concept of true length of a line with reference to its orthographic projection when the line is (i) parallel to the plane of projection (ii) inclined to one principal plane and parallel to the other -Development of simple solids like cubes, prisms, cylinders, cones, pyramids -Types of development: Parallel line and radial line development -Procedure of drawing development - drawings of trays, funnels, 90⁰ elbow pipes and rectangular ducts.

Drawing plate 14: Consisting of 5 exercises on development problems

REFERENCE BOOKS

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

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

Engineering Drawing by N.D.Bhatt.

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

SP-46-1998 – Bureau of Indian Standards.

WORKSHOP PRACTICE

Subject title : Workshop practice
Subject Code : CH-PC-108
Periods per Week : 03
Periods per Year : 90

TIME SCHEDULE :

S.No.	Major Topics	No. Of periods
1	Identification of workshop tools	12
2	Carpentry	15
3	Fitting	10
4	welding	10
5	Basic machine operations	15
6	Plumbing	08
7	Electrical wiring single phase	10
8	Electrical wiring multi phase	10
TOTAL		90

OBJECTIVES:

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

1. Use of different tools in carpentry, fitting, welding and turning section of workshop.
2. Prepare various carpentry joints, panel boards and cabinet boxes.
3. Hacksaw cutting, grinding, thread cutting for metal conduit; G.I. Pipes and roads etc, in fitting section.

4. Handle welding transformer and make lap and butt joints.
5. (a) Exercise on lathe like simple turning like simple turning, step turning, taper turning and knurling.
(b) Exercise on thread cutting for pipes and rods on Lathes.
(c) Handle drilling machines and grinding machine.
- 6.0 Know the basics of plumbing work and applications.
 - (i) 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.
- 7.0 Know about single phase electrical wiring
- 8.0 Know about multi phase electrical wiring

COURSE CONTENT:

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

1.0 Use of different tools in

- (a) Carpentry
- (b) fitting
- (c) Welding
- (d) turning
- (e) electrical wiring

2.0 CARPENTRY:

- 2.1 Exercises on planning, sawing and chiseling
- 2.2 Prepare a half lap joint
- 2.3 Prepare a Dovetail joint.
- 2.4 Prepare a Mortise joint.
- 2.5 Prepare a 20 cm X 15 cm Teakwood switch board with hinges and bottom hook.
- 2.6 Fix the laminate sheet to the above box and cut suitable holes to mount tone flush type switch, socket.

3.0 FITTING:

- 3.1 Exercises to cut a metal conduit, G.I. Pipe and solid rod using hack saw.
- 3.2 3 & 4 Thread cutting of G.I.pipe, metal conduit and solid rod using Die set.
- 3.3 4. & 6. Internal thread cutting using Tap set and cleaning the threads using reamers and make a hexagonal nut from a round rod.

4.0 WELDING:

- 4.1 Prepare a job and to make a lap joint and finish it using grinder.
- 4.2 Prepare a job and make a butt joint and finish it with grinder.
- 4.3 Prepare the job and make 'T' joint.

5.0 MACHINE SHOP:

- 5.1 Exercise on turn the given rod to get three different diameters using lathe.

- 5.2 Make a bolt and cut threads using lathe.
- 5.3 Cut the threads to G.I. Pipe using lathe.
- 5.4 Prepare a centre punch and knurl its head.
- 5.5 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.

6.0 PLUMBING:

Plumbing work and applications

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

7.0 ELECTRICAL WIRING SINGLE PHASE:

- (a) Series connection
- (b) Parallel connection

8.0 ELECTRICAL WIRING MULTI PHASE:

- (a) Series connection
- (b) Parallel connection

PHYSICS LABORATORY

Subject Title	:	Physics Laboratory
Subject Code	:	CH-PC-109
Periods per week	:	03
Total periods per year	:	45

TIME SCHEDULE

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

Objectives:

Upon completion of the course the student shall be able to

- 1.0 Practise with Vernier calipers to determine the volumes and areas of a cylinder and sphere and their comparison etc .
- 2.0 Practise with Screw gauge to determine thickness of a glass plate, cross sectional area of a wire and volumes of sphere and also their comparison etc
- 3.0 Verify the parallelogram law and Triangle law
- 4.0 Determine the value of acceleration due to gravity using Simple Pendulum
- 5.0 Determine the velocity of sound in air at room temperature and its value at zero degree centigrade
- 6.0 Calculate the Focal length and focal power of convex lenses using distant object method , U-V method , U-V graph and $1/U - 1/V$ graph methods and their comparison,
- 7.0 Determine the refractive index of a solid using travelling microscope
- 8.0 Determine the surface tension of a liquid using travelling microscope

- 9.0 Determine the viscosity of a liquid using capillary method
 10.0 Verify the Boyle's law employing a Quill tube
 11.0 Determine the specific resistance of material of a wire using Meter Bridge
 12.0 Drawing magnetic lines of force under N-S and N-N methods and locate null points

Competencies and Key competencies to be achieved by the student

Name of the Experiment (No of Periods)	Competencies	Key competencies
1. Hands on practice on Vernier Calipers(03)	<ul style="list-style-type: none"> • Find the Least count • Fix the specimen in posit • 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
2. Hands on practice on Screw gauge(03)	<ul style="list-style-type: none"> • Find the Least count • Fix the specimen in posit • Read the scales • Calculate thickness of glass place and cross section of wire and other quantities 	<ul style="list-style-type: none"> • Read the scales • Calculate thickness of given glass plate • Calculate cross section of wire and other quantities
3. Verification of Parallelogram law of forces and Triangle law of forces(03)	<ul style="list-style-type: none"> • Fix suitable weights • Note the positions of threads on drawing sheet • Find the angle at equilibrium point • Construct parallelogram • Compare the measured diagonal • Construct triangle • Find the length of sides • Compare the ratios 	<ul style="list-style-type: none"> • Find the angle at equilibrium point • Constructing parallelogram • Construct triangle • Compare the ratios of force and length
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 • Find the time period • Calculate the acceleration due to gravity • Draw I-T and I-T² graph 	<ul style="list-style-type: none"> • Find the time for number of oscillations • Find the time period • Calculate the acceleration due to gravity • Draw I-T and I-T² graph

Name of the Experiment(Periods)	Competencies	Key competencies
5. Velocity of sound in air –Resonance method (03)	<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 • Calculate velocity of sound at 0° C
6. Focal length and Focal power of convex lens (Separate & Combination) (03)	<ul style="list-style-type: none"> • Fix the object distance • Find the Image distance • Calculate the focal length and power of convex lens and combination of convex lenses • Draw u-v and 1/u – 1/v graphs 	<ul style="list-style-type: none"> • Calculate the focal length and power of convex lens • Draw u-v and 1/u – 1/v graphs
7. 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 scale • Calculate the refractive index of glass slab 	<ul style="list-style-type: none"> • Read the scale • Calculate the refractive index of glass slab
8. Surface tension of liquid using traveling microscope(03)	<ul style="list-style-type: none"> • Find the least count of vernier on microscope • Focus the microscope to the lower meniscus & bent pin • Read the scale • Calculate height of liquid rise • Calculate the surface tension of water 	<ul style="list-style-type: none"> • Read the scale • Calculate height of liquid rise • Calculate the surface tension of water

Name of the Experiment	Competencies	Key competencies
9. Coefficient of viscosity by capillary method(03)	<ul style="list-style-type: none"> • Find the least count of vernier • Fix the capillary tube to aspiratory bottle • Find the mass of collected water • Find the pressure head • Calculate rate of volume of liquid collected • Find the radius of capillary tube • Calculate the viscosity of water using capillary method 	<ul style="list-style-type: none"> • Find the pressure head • Calculate rate of volume of liquid collected • Find the radius of capillary tube • Calculate the viscosity of water
10. 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 value $P \times l$ 	<ul style="list-style-type: none"> • Find the length of air column • Find the pressure of enclosed air • Find the value $P \times l$
11. Meter bridge(03)	<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"> • Find the balancing length • Calculate unknown resistance • Calculate the specific resistance
12. Mapping of magnet lines of force(03)	<ul style="list-style-type: none"> • Draw magnetic meridian • Placed the bar magnet in NN and NS directions • Draw magnetic lines of force • Locate the neutral points along equatorial and axial lines 	<ul style="list-style-type: none"> • Draw magnetic lines of force • Locate the neutral points along equatorial and axial lines

CHEMISTRY LABORATORY

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

TIME SCHEDULE

S.No	Name of the Experiment	No. of Periods
1.	Familiarization of methods for Volumetric analysis	03
2.	Preparation of Std Na_2CO_3 and making solutions of different	03
3.	Estimation of HCl solution using Std. Na_2CO_3 solution	03
4.	Estimation of NaOH using Std. HCl solution	03
5.	Estimation of H_2SO_4 using Std. NaOH solution	03
6.	Estimation of Mohr's Salt using Std. KMnO_4	03
7.	Determination of acidity of water sample	03
8.	Determination of alkalinity of water sample	03
9.	Determination of total hardness of water using Std. EDTA	03
10.	Estimation of Chlorides present in water sample	03
11.	Estimation of Dissolved Oxygen (D.O) in water sample	03
12.	Determination of pH using pH meter	03
13.	Determination of conductivity of water and adjusting ionic strength	03
14.	Determination of turbidity of water	03
15.	Estimation of total solids present in water sample	03
	Total:	45

Objectives:

Upon completion of the course the student shall be able to

- 1.0 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 and using Std. NaOH solution for estimation of H_2SO_4
- 6.0 Conduct titrations adopting standard procedures and using Std. KMnO_4 solution for estimation

- of Mohr's Salt
- 7.0 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)
 - 8.0 Conduct titrations adopting standard procedures to determine the alkalinity of given samples of water (One ground water and one surface / tap water)
 - 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
 - 10.0 Conduct titrations adopting standard procedures to determine the chlorides present in the given samples of water and wastewater (One ground water and one surface / tap water)
 - 11.0 Conduct the test using titrometric / electrometric method to determine Dissolved Oxygen (D.O) in given water samples (One sample from closed container and one from open container / tap water)
 - 12.0 Conduct the test on given samples of water / solutions (like soft drinks, sewage, etc.) to determine their pH using standard pH meter
 - 13.0 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
 - 14.0 Conduct the test on given samples of solutions (coloured and non coloured) to determine their turbidity in NTU
 - 15.0 Conduct titrations adopting standard procedures to 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
Familiarization of methods for Volumetric analysis (03)	--	--
Preparation of Std Na_2CO_3 and making solutions of different dilution (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 .01 mg ▪ Measuring the water with volumetric flask, measuring jar, volumetric pipette and graduated pipette ▪ Making appropriate dilutions

Name of the Experiment (No of Periods)	Competencies	Key competencies
Estimation of HCl solution using Std. Na_2CO_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)		
Estimation of H_2SO_4 using Std. NaOH solution (03)		
Estimation of Mohr's Salt using Std. KMnO_4 (03)		
Determination of acidity of water sample (03)		
Determination of alkalinity of water sample (03)		
Determination of total hardness of water using Std. EDTA solution (03)		
Estimation of Chlorides present in water sample (03)		
Estimation of Dissolved Oxygen (D.O) in water sample (By titration method) (03)		
Estimation of Dissolved Oxygen (D.O) in water sample (By electrometric method) (03)	<ul style="list-style-type: none"> ▪ Familiarize with instrument ▪ Choose appropriate 'Mode' / 'Unit' ▪ 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"> ▪ Prepare standard solutions / buffers, etc. ▪ Standardize the instrument with appropriate standard solutions ▪ Plot the standard curve ▪ Make measurements accurately
Determination of pH using pH meter (03)		
Determination of conductivity of water and adjusting ionic strength to required level (03)		
Determination of turbidity of water (03)		

Name of the Experiment (No of Periods)	Competencies	Key competencies
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

COMPUTER FUNDEMENTALS LABORATORY
(Common to all Branches)

Subject Title : Computer Fundamentals Laboratory
Subject Code : CHPC-111
Periods/Week : 03
Periods/Year : 90

Time Schedule

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

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

I. Computer Hardware Basics (Not for end examination)

1. a) To familiarize with a Computer System and its hardware connections.
b) To start and Shutdown a Computer correctly.
c) To check the software details of the computer
d) To practice Internal and External DOS commands
2. To check the hardware present in your computer.

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

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

III. Practice with MS-WORD

6. To familiarize with Ribbon layout of MS Word
Home - Insert - Page layout – References – Review - View
7. To practice Word Processing Basics
8. To practice Formatting techniques
9. To insert a table of required number of rows and columns

10. To insert Objects, Clipart and Hyperlinks
11. To use Mail Merge feature of MS Word
12. To use Equations and symbols features

IV. Practice with MS-EXCEL

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

V. Practice with MS-POWERPOINT

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

Competencies and Key Competencies to be achieved by the students

Exp No.	Name of the Experiment	Competencies	Key Competencies
1 (a).	To familiarize with Computer system and hardware connections	<ul style="list-style-type: none"> a. Identify the Parts of a Computer system a). CPU b) Monitor c) CD/DVD Drive d) Power Switch e) Start Button f) Reset Button b. 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 Keyboard 	<ul style="list-style-type: none"> a. Login and logout as per the standard procedure b. Operate mouse & Keyboard
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
1(d).	To practice Internal and External DOS commands	<ul style="list-style-type: none"> a. Practice Internal commands b. Practice External commands 	Familiarize with MS-DOS Commands
2.	To check the software details of the computer	<ul style="list-style-type: none"> c. Find the details of Operating System being used d. 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 Disk 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 or 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

Exp No.	Name of the Experiment	Competencies	Key Competencies
	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 for 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 Paint 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 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 keyboard 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

Exp No.	Name of the Experiment	Competencies	Key Competencies
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 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 equations in the document 	Enter Mathematical symbols and Equations in the word 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 Worksheet-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

Exp No.	Name of the Experiment	Competencies	Key Competencies
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 Color-Change 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. Sort and filter data in a worksheet b. Perform Mathematical Calculations verify -AutoSum c. 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 Practice Excel Graphs and Charts	<ul style="list-style-type: none"> a. Produce an Excel Pie Chart b. Produce an Excel Column Chart c. Practice creating any 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
20.	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 percent 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
21.	To familiarize with Ribbon layout & features of PowerPoint 2007.	Use various options in Home, insert, design, animation , slideshow, Review & View in the PowerPoint	Access required options in the tool bar

Exp No.	Name of the Experiment	Competencies	Key Competencies
22.	To create a simple PowerPoint Presentation	<ul style="list-style-type: none"> 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 	<ul style="list-style-type: none"> a. Create simple PowerPoint presentation with photographs/ClipArt and text boxes b. Use bullets option
23.	To Set up a Master Slide in PowerPoint and add notes	<ul style="list-style-type: none"> 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 f. Add Notes to a PowerPoint Presentation 	<ul style="list-style-type: none"> a. Setup Masterslide and format b. Add notes
24.	To Insert Text and Objects	<ul style="list-style-type: none"> a. Insert Text and objects b. Set Indents and line spacing c. Insert pictures/ clipart d. Format pictures e. Insert shapes and WordArt f. Use 3d features g. Arrange objects 	<ul style="list-style-type: none"> Inset Text and Objects Use 3d features
25.	To insert a Flow Chart / Organizational Charts	<ul style="list-style-type: none"> a. Create a Flow Chart in PowerPoint b. Group and Ungroup Shapes c. Use smart art 	<ul style="list-style-type: none"> Create organizational charts and flow charts using smart art
26.	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 	<ul style="list-style-type: none"> Insert tables and format
27.	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 	<ul style="list-style-type: none"> Create charts and Bar graphs, Pie Charts and format.

Exp No.	Name of the Experiment	Competencies	Key Competencies
28.	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
29.	To Practice Animation effects	<ul style="list-style-type: none"> a. Apply transitions to slides b. To explore and practice special animation effects like <i>Entrance, Emphasis, Motion Paths & Exit</i> 	Add animation effects
30.	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) Handout 	<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

DIPLOMA IN CHEMICAL ENGINEERING (PETROCHEMICALS)
SCHEME OF INSTRUCTIONS AND EXAMINATIONS
(C16/III Semester)

Subject Code	Name of the Subject	Instruction periods / week		Total Periods/ year	Scheme of Examination			
		Theory	Practical /Tutorial		Duration (hours)	Sessional Marks	End Exam Marks	Total Marks
THEORY:								
CHPC-301	Engineering Mathematics - II	5	-	75	3	20	80	100
CHPC-302	Electrical Technology	4	-	60	3	20	80	100
CHPC-303	Physical, Organic and Petroleum Chemistry	5	-	75	3	20	80	100
CHPC-304	Unit operation -1	5	-	75	3	20	80	100
CHPC-305	Mass and Energy Balance.	5	-	75	3	20	80	100
PRACTICAL:								
CHPC-306	Chemical Process Drawing Lab using CAD	-	3	45	3	40	60	100
CHPC-307	Electrical Technology lab and Physical, Organic and Petroleum Chemistry Lab	-	6	90	3	40 (20+20)	60 (30+30)	100 (50+50)
CHPC-308	Communication Skills	-	3	45	3	40	60	100
CHPC-309	Unit operation -1 lab	-	6	90	3	40	60	100
TOTAL		24	18	630		260	640	900

CH PC – 301, 308 : Common to all
CH PC – 302, 305 : Common to DCHE, DCHE (PP) & DCHE (OT)
CH PC– 304, 306, 309 : Common to DCHE (PP) & DCHE (OT)
CH PC – 303, 307 : Not common with any course

ENGINEERING MATHEMATICS – II
(Common to all Branches)

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

Blue print

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

R: Remembering type 37 marks
 U: Understanding type 34 marks
 App: Application type 39 marks

Upon completion of the subject the student shall be able to

OBJECTIVES

Unit-I

1.0 Indefinite Integration

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

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

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

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

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

- 1.9 Evaluate the integrals of the type

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

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

Unit-II

(a) Understand definite integral and its properties

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

(b) Real life applications of definite integrals

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

(c) Certain special integrals: Laplace Transforms

- 2.11 Write the definition of Laplace Transform and explain sufficient conditions for its existence.
- 2.12 Provide formulae for Laplace transforms of standard functions.
- 2.13 State Linear property, First shifting property, Change of Scale property for Laplace transforms. Solve simple problems using these properties.
- 2.14 Write formulae for Laplace transform of $t^n f(t)$, $\frac{f(t)}{t}$, $f^{(n)}(t)$, $\int_0^t f(u) du$ in terms of Laplace transform of $f(t)$. Provide simple examples on these functions.
- 2.15 Define unit step function and write the Laplace Transform of unit step function. State second shifting property.
- 2.16 Define inverse Laplace Transform and write inverse Laplace Transform of standard functions. Solve simple problems.
- 2.17 Write first shifting property of inverse Laplace Transform with examples
- 2.18 Define convolution of two functions and state convolution theorem with few examples for understanding only.

(d) Understand the Fourier series expansion of functions

- 2.19 Define Fourier series of a function on the interval $(c, c + 2l)$ and state sufficient conditions for its existence. Write the Euler's formulae for determining the Fourier coefficients.
- 2.20 Find Fourier series of simple functions in the range $(0, 2l)$, $(0, 2\pi)$, $(-l, l)$ and $(-\pi, \pi)$.
- 2.21 Find Fourier coefficients for even and odd functions in the interval $(-l, l)$ and $(-\pi, \pi)$ in simple examples.
- 2.22 Define half range Fourier sine and cosine series of a function over the interval $(0, l)$ with examples.

3.0 Introduction to Differential Equations

- 3.1 Define a Differential equation, its order, degree
- 3.2 Form a differential equation by eliminating arbitrary constants.
- 3.3 Solve the first order first degree differential equations by the following methods:
- Variables Separable.
 - Homogeneous Equations.
 - Exact Differential Equations

- iv. Linear differential equation of the form $dy/dx + Py = Q$, where P and Q are functions of x or constants.
 - iv. Bernoulli's Equation (Reducible to linear form.)
- 3.4 Solve Differential equations of the type $(aD^2 + bD + c)y = 0$ when the roots of the auxiliary equation are real and different, real and repeated, Complex conjugates.
- 3.5 Solve the higher order homogeneous differential equations with constant coefficients.
- 3.6 Explain the concept of complementary function, particular Integral and general solution of a differential equation.
- 3.7 Solve n^{th} order differential equation of the type $f(D)y = X$ where $f(D)$ is a polynomial of nth order and X is a function of the form $k, e^{ax}, \text{Sin}ax, \text{Cos}ax, x^n$.
- 3.8 Solve simple problems leading to engineering applications

COURSE CONTENT :

Unit-I

Indefinite Integration:

1. Integration regarded as anti-derivative – Indefinite integral of standard functions. Properties of indefinite integral. Integration by substitution or change of variable. Integrals of the form $\sin^m\theta, \cos^n\theta$. where m and n are positive integers. Integrals of $\tan x, \cot x, \sec x, \text{cosec } x$ and powers of $\tan x, \sec x$ by substitution.

Evaluation of integrals which are reducible to the following forms :

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

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

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

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

Unit-II

Definite Integral and its applications:

2. Definite integral-fundamental theorem of integral calculus, properties of definite integrals, evaluation of simple definite integrals. Definite integral as the limit of a sum. Area under plane curves – Area enclosed between two curves. Volumes of solids of revolution. Mean and RMS

values of a function on a given interval. Trapezoidal rule, Simpson's 1/3 rule to evaluate an approximate value of a definite integral.

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

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

Unit -III

Differential Equations:

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

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

Non-homogeneous linear differential equations with constant coefficients of the form $f(D)y = X$, where X is in the form $k, e^{ax}, \sin ax, \cos ax, x^n$, ($n = 1, 2$) – complementary function, particular integral and general solution.

Reference Books:

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

ELECTRICAL TECHNOLOGY

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

TIME SCHEDULE

S. No.	Major Topics	No. of Periods	Weightage of Marks	Short answer type	Essay type
1	D.C & A.C Circuits	15	24	3	1½
2	Electromagnetism and Electromagnetic Induction	10	18	1	1½
3	D.C. & A.C. Machines	20	39	3	3
4	Electrical Measuring Instruments	05	13	1	1
5	Different equipments & safety procedures used in Industry	05	08	1	½
6	Electronic Devices	05	08	1	½
Total Periods		60	110	10	08

OBJECTIVES:

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

Unit-1: D.C & A.C Circuits

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

Unit-2: Electromagnetism and Electromagnetic Induction

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

Unit-3: DC & AC machines

- 3.1 List the parts and function of each part of the D.C. Machine.
- 3.2 Classify the D.C. Machines as D.C. Generators and D.C. Motors – State their working principle.
- 3.3 State generated EMF equation. (No derivation).
- 3.4 State and explain Back EMF (No derivation).
- 3.5 State torque equation. (No derivation).
- 3.6 Solve simple problems on above.
- 3.7 Explain the necessity of starter and explain 3 point starter with neat diagram.
- 3.8 Explain speed control of D.C. Shunt motor by armature control and (b) Field control methods.
- 3.9 State the applications of D.C. Generators and D.C. Motors
- 3.10 Explain the principle of working of a transformer.
- 3.11 Classify the types of transformers basing on construction of the transformers. (Core type and shell type).
- 3.12 State EMF equation of a transformer. Solve simple problems. (No derivation).
- 3.13 State step – up and step – down transformers.
- 3.14 Explain Auto transformers.
- 3.15 Classify the three phase induction motors and single phase Induction motors – state the application of each motor.
- 3.16 Explain the construction and working principles of 3 – phase Induction Motors
- 3.17 Explain the construction and working principles of 1 – phase Induction Motors
- 3.18 Explain the necessity of starter in 3-phase induction motor
- 3.19 Explain i) DOL starter ii) Star Delta Starter with neat diagrams.
- 3.20 State the applications of 1 phase and 3-phase induction motors.

Unit-4: Electrical measuring instruments

- 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.

Unit-5: Different equipments & safety procedures used in industry

- 5.1 Explain the basic principles of electric Heating.
- 5.2 State applications of electric Heating.
- 5.3 Explain the basic principles of electric welding.
- 5.4 Classify the methods of electric welding, state applications of each method.
- 5.5 Describe the working of DC welding generator with neat diagram.
- 5.6 Describe the working of welding transformer with neat diagram.
- 5.7 State the function of the following i) Switch ii) Fuse iii) Circuit breaker iv) Relay v) Capacitor banks.
- 5.8 State safety precautions to be adopted for prevention of electric shock to persons working on electric equipments or live wires.
- 5.9 State procedures for first aid to a person came into contact with live wires.

Unit-6: Electronic Devices

- 6.1 Classify the materials like conductors, insulators and semi conductors based on i) Valence electrons ii) Conductivity iii) Energy band diagrams.
- 6.2 Explain the P- type semiconductor and N – type semiconductor.
- 6.3 Explain P – N Junction diode.
- 6.4 State the applications of a P – N Junction diode (as a rectifier).
- 6.5 Explain the P– N – P and N – P – N transistors and their applications.

Course Content:

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, and R-L-C in series – define power factor – Solve simple A.C circuits – expression– active power and reactive power- apparent power in single phase circuits- star and delta connections in 3-phase circuits - expression– active power and reactive power- apparent power – simple problems on above.
2. Concepts of different terms related to Electromagnetism – electromagnetic induction – expressions for field strength due to straight current carrying conductor and on the axis of solenoid - Dynamically induced EMF – statically induced EMF – self and mutually induced EMF – self inductance and mutual inductance – Simple Problems.
3. D.C & A.C. Machines – working – construction – types of D.C generators – types of D.C motors – Generated EMF – Back EMF – torque – equations – 3 – point starter – speed control – Applications of D.C Generators D.C. Motors- Single – phase– Auto transformers –

Construction and working principles of 3-phase and single phase induction motors – DOL starter and Star delta starter Applications - Single – phase and Three – Phase induction motors.

4. Electrical Measuring Instruments – Construction and working of moving iron and moving coil instruments – Megger, Multi-meter – 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 - 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

PHYSICAL, ORGANIC AND PETROLEUM CHEMISTRY

Subject Title : Physical, Organic and Petroleum Chemistry
Subject Code : CH-PC-303
Periods / Week : 05
Periods / Semester : 75

TIME SCHEDULE

S.No.	Major topics	No. of Periods	Weightage of marks	Short answer type	Essay type
1	Thermo chemistry	6	13	1	1
2	Chemical equilibrium and Kinetics	9	16	2	1
3	Solutions, Colloids and Emulsions	10	16	2	1
4	Chemistry of Aliphatic compounds	25	26	2	2
5	Chemistry of Aromatic compounds	15	26	2	2
6	Petroleum Chemistry	10	13	1	1
Total		75	110	10	08

OBJECTIVES:

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

Unit-1: Thermo-chemistry

- 1.1 State First law of Thermodynamics, Second law of Thermodynamics and Third law of Thermodynamics.
- 1.2 Know the types of thermodynamic systems.
- 1.3 Know the types of thermodynamic properties.
- 1.4 Know the types of thermodynamic processes.
- 1.5 Know about Internal energy (E).
- 1.6 Know about Enthalpy.
- 1.7 Mathematics form of First law of thermodynamics.
- 1.8 Derive the equation for Internal Energy (E), Heat Flow (Q), Work done (W) and Enthalpy (H).
- 1.9 Solve Simple problems on the above topics.

Unit-2: Chemical Equilibrium and Kinetics

- 2.1 Know about reversible reactions.
- 2.2 Know about the characteristics of Chemical equilibrium.
- 2.3 State and explain the law of mass action.
- 2.4 Describe the Equilibrium constant.
- 2.5 Know the equilibrium constant expression in terms of partial pressure and concentration.
- 2.6 Solve simple problems on equilibrium constant.
- 2.7 Know the effect of concentration, temperature, pressure and catalyst on Equilibrium constant
- 2.8 Know about Vant Hoff's equation and solve simple problems on Vant Hoff's equation.

- 2.9 State and explain the Lechatelier's principle and its application in the synthesis of ammonia and sulfur dioxide.
- 2.10 Define order of reaction.
- 2.11 Explain the first order reaction – reaction rate of pseudo, unimolecular reaction.
- 2.12 Describe the Acid hydrolysis of an Ester.
- 2.13 Describe the Inversion of Cane Sugar.

Unit-3: Solutions, Colloids and Emulsions:

- 3.1 Know the types of solutions.
- 3.2 Define a Solution, Colloid and Emulsion.
- 3.3 Describe the various methods of expressing concentrations.
- 3.4 Define dilute solution and Raoult's law.
- 3.5 Explain about vapor pressure concept.
- 3.6 Know the colligative properties of dilute solutions.
- 3.7 Define vapour pressure and determine by Ostwald's method.
- 3.8 Explain the elevation of boiling point by Control's method.
- 3.9 Describe the depression of freezing point.
- 3.10 Define a colloid.
- 3.11 Know the types of colloidal systems.
- 3.12 Explain the nature of colloids.
- 3.13 Explain the methods of preparation of colloids.
- 3.14 Explain the properties of colloids.
- 3.15 List the applications of colloids.
- 3.16 Know the types of Emulsions.
- 3.17 Explain the nature of emulsions.
- 3.18 Explain the preparations of Emulsions.
- 3.19 Explain the properties of Emulsions.
- 3.20 Explain the applications of emulsifier.

Unit-4: Chemistry of Aliphatic compounds

- 4.1 Know about Hybridization in Carbon.
- 4.2 Know about the types of Hybridization of Carbon
- 4.3 Know the classification of reagents.
- 4.4 Know the types of organic reactions.
- 4.5 Know the types of mechanisms of reactions.
- 4.6 Know about Isomerism.
- 4.7 Know about nomenclature of organic compounds.
- 4.8 Know the list of functional groups.
- 4.9 Know the methods of preparation of alkanes (Methane & Ethane).
- 4.10 Know the physical properties and applications of alkanes (Methane & Ethane).
- 4.11 Know the Chemical properties of alkanes (Methane & Ethane).
- 4.12 Know the methods of preparation of alkenes (Ethylene).
- 4.13 Know the physical properties and applications of alkenes (Ethylene).
- 4.14 Know the Chemical properties of alkenes (Ethylene).
- 4.15 Know the methods of preparation of alkynes (Acetylene).
- 4.16 Know the physical properties and applications of alkynes (Acetylene).

- 4.17 Know the Chemical properties of alkynes (Acetylene).
- 4.18 Know the Classification of alcohols into Primary, Secondary and Tertiary alcohols.
- 4.19 Know the distinction of Primary, Secondary and Tertiary alcohols using Lucas reagent.
- 4.20 Know the methods of preparation of alcohols (Ethyl alcohol).
- 4.21 Know the physical properties and applications of alcohols (Ethyl alcohol).
- 4.22 Know the Chemical properties of alcohols (Ethyl alcohol).
- 4.23 Know the methods of preparation of aldehydes (Acetaldehyde).
- 4.24 Know the physical properties and applications of aldehydes (Acetaldehyde).
- 4.25 Know the Chemical properties of aldehydes (Acetaldehyde).
- 4.26 Know the methods of preparation of Ketones (Acetone).
- 4.27 Know the physical properties and applications of Ketones (Acetone).
- 4.28 Know the Chemical properties of Ketones (Acetone).
- 4.29 Know the methods of preparation of Halo-alkanes (Chloroform & Ethyl Chloride).
- 4.30 Know the physical properties and applications of Halo-alkanes (Chloroform & Ethyl Chloride).
- 4.31 Know the Chemical properties of Halo-alkanes (Chloroform & Ethyl Chloride).
- 4.32 Know the methods of preparation of carboxylic acids (Acetic acid).
- 4.33 Know the physical properties and applications of carboxylic acids (Acetic acid).
- 4.34 Know the Chemical properties of carboxylic acids (Acetic acid).
- 4.35 Know the methods of preparation of Ethers (Diethyl Ether).
- 4.36 Know the physical properties and applications of Ethers (Diethyl Ether).
- 4.37 Know the Chemical properties of Ethers (Diethyl Ether).
- 4.38 Know about Polymerization.
- 4.39 Know about Types of Polymerization.
- 4.40 Know the methods of preparation of Oil & Fats.
- 4.41 Know the physical properties and applications of Oil & Fats.
- 4.42 Know the Chemical properties of Oil & Fats.

Unit-5: Chemistry of Aromatic compounds

- 5.1 Know the nomenclature of aromatic compounds.
- 5.2 Know the methods of preparation of Benzene.
- 5.3 Know the physical properties and applications of Benzene.
- 5.4 Know the Chemical properties of Benzene.
- 5.5 Know the methods of preparation of Phenol.
- 5.6 Know the physical properties and applications of Phenol.
- 5.7 Know the Chemical properties of Phenol.
- 5.8 Know the methods of preparation of Benzoic acid.
- 5.9 Know the physical properties and applications of Benzoic acid.
- 5.10 Know the Chemical properties of Benzoic acid.
- 5.11 Know the methods of preparation of Benzaldehyde.
- 5.12 Know the physical properties and applications of Benzaldehyde.
- 5.13 Know the Chemical properties of Benzaldehyde.
- 5.14 Know the methods of preparation of Aniline.
- 5.15 Know the physical properties and applications of Aniline.
- 5.16 Know the Chemical properties of Aniline.
- 5.17 Know the methods of preparation of Toluene.
- 5.18 Know the physical properties and applications of Toluene.

- 5.19 Know the Chemical properties of Toluene.
- 5.20 Know the methods of preparation of Nitrobenzene.
- 5.21 Know the physical properties and applications of Nitrobenzene.
- 5.22 Know the Chemical properties of Nitrobenzene.

Unit-6: Petroleum Chemistry

- 6.1 Elementary compositions of crude oil.
- 6.2 Hydrocarbon constituents of straight-run distillates, Monomer hydrocarbon constituents of gasoline, structural group constituents of diesel and vacuum distillates.
- 6.3 Non-hydrocarbon constituents like Sulfur compounds, nitrogen compounds, oxygen compounds.
- 6.4 Know about composition of Resin and Asphalt components of petroleum products.
- 6.5 Know the composition and characteristics of liquid petroleum hydrocarbons.
- 6.6 Know the composition of gaseous Petroleum Hydrocarbons.
- 6.7 Know about oil field waters and their classification.
- 6.8 Know about definitions and characteristics of some oil field waters.
- 6.9 Know about Meteoric water, interstitial water, connate water and Diagenetic water.
- 6.10 Know about chemistry of Thermal Cracking
- 6.11 Know about chemistry of Catalytic cracking.
- 6.12 Know about chemistry of Reforming.
- 6.13 Know about chemistry of Alkylation.
- 6.14 Know about chemistry of Isomerization.

COURSE CONTENTS:

1.0 Thermo-chemistry:

State First law of Thermodynamics, Second law of Thermodynamics and Third law of Thermodynamics-Types of thermodynamic systems-Isolated system, Closed system, Open system, adiabatic system-Types of thermodynamic properties-Intensive and Extensive properties-Types of thermodynamic processes-Isothermal Process, Adiabatic Process, Isobaric Process, Isochoric Process, Cyclic Process-Internal energy (E)-Enthalpy-Mathematics form of First law of thermodynamics-Derive the equation for Internal Energy (E), Heat Flow (Q), Work done (W) and Enthalpy (H)-Solve Simple problems on the above topics.

2.0 Chemical equilibrium and Kinetics:

Reversible reactions-Characteristics of Chemical equilibrium-Law of mass action-Equilibrium constant-Equilibrium constant expression in terms of partial pressure and concentration-Simple problems on equilibrium constant-Effect of concentration, temperature, pressure and catalyst on Equilibrium constant- Vant Hoff's equation and solve simple problems on Vant Hoff's equation-Lechatelier's principle and its application in the synthesis of ammonia and sulfur dioxide-Order of reaction-First order reaction – reaction rate of pseudo, unimolecular reaction-Acid hydrolysis of an Ester- Inversion of Cane Sugar.

3.0 Solutions, Colloids and emulsion:

Types of solutions-Gas-Gas, Gas-Liquid, Gas-Solid, Liquid-Liquid, Liquid-Solid, Solid-Liquid, Solid-Solid, Define a Solution, Colloid and Emulsion-Variou methods of expressing concentrations-Dilute solution and Raoult's law-Vapor pressure concept-Colligative properties of dilute solutions-Lowering of vapor pressure, Elevation of Boiling Point, Depression of Freezing Point, Osmotic Pressure-Define vapour pressure and determine by Ostwald's method-Elevation of boiling point by Control's method-Depression of freezing point-Define a colloid-Types of colloidal systems-Lyophilic and Lyophobic-Nature of colloids-Methods of preparation of colloids-Dispersion methods-Mechanical Dispersion method, Bredig's Arc Method, Peptization-Aggregation methods-Properties of colloids-Optical Properties, Kinetic properties, Electrical properties-Applications of colloids-Types of Emulsions-Nature of emulsions-Preparations of Emulsions-Properties of Emulsions-Applications of emulsifier.

4.0 Chemistry of aliphatic compounds:

Hybridization in Carbon-Types of Hybridization of Carbon(SP^3 , SP^2 and SP)-Classification of reagents(Electrophilic, Nucleophilic)-Types of organic reactions(Substitution, Addition, Elimination, Rearrangement)-Types of mechanisms of reactions(Ionic, Free radical)- Isomerism(Structural, Stereo (Geometrical and Optical Isomerism with examples) and nomenclature of organic compounds-List of functional groups

Methods of preparation of methane & ethane by De-Carboxylation, Wurtz reaction (Ethane only), Reduction of Alkyl Halides -Physical& chemical properties, applications of methane & ethane-halogenation, nitration and combustion-Methods of preparation of ethylene from ethyl alcohol, ethyl bromide, 1,2-dibromo ethane-Physical, chemical properties, applications of ethylene-Reaction of ethylene with H_2 , Br_2/CCl_4 , Ozone and Oxidation by $KMnO_4$ -methods of preparation of acetylene from calcium carbide, 1,2 di-bromo ethane, 1,1,2,2-tetra bromo ethane-physical, chemical properties, applications of acetylene-Reaction of acetylene with H_2/Ni ; Br_2/CCl_4 ; H_2O

Methods of preparation of ethyl alcohol from ester hydrolysis, grignard reagent, fermentation of molasses-physical,chemical properties, applications of ethyl alcohol-Reaction of ethyl alcohol with acetic acid, Conc. H_2SO_4 , bleaching powder, PCl_3 -Methods of preparation acetaldehyde from Ethyl alcohol, calcium acetate, calcium Formate, acetylene-Physical, chemical properties,applications of acetaldehyde-Reaction of acetaldehyde with Grignard Reagent, Hydrazine, Aldol condensation, Silver Mirror test, Fehling's test-Methods of preparation of acetone from Isopropyl alcohol, Calcium Acetate, Propyne-Physical, Chemical properties, applications of acetone-Reactions of acetone with Grignard reagent, Hydrazine and Iodoform reaction-Methods of preparation of chloroform & ethyl chloride-Preparation of Chloroform from Ethyl alcohol-Preparation of Ethyl chloride from Grove's process-Physical, chemical properties, applications of chloroform & ethyl chloride -Reimer Tiemann reaction,Carbyl amine or IsoCyanide test, Oxidation for Chloroform-Reaction of Chloroform with HNO_3 -Reaction of Ethyl Chloride with KOH , KCN , $AgCN$ and Wurtz reaction -Methods of preparation of acetic acid from Esters, ethyl Alcohol, methyl cyanide-Physical properties, Chemical properties, applications of acetic acid-Reactions of Acetic acid -Hell-Volhard-Zelinsky reaction-

Methods of preparation of diethyl ether from Williamson's Synthesis, ethyl alcohol-Physical, Chemical properties, applications of diethyl ether- chemical properties of diethyl ether- reactions of diethyl ether- Halogenation, Hydrolysis , HI -Definition of Polymerization-Types of Polymerization-

Addition,condensation polymerization -Methods of preparation of Oil & Fats-Physical properties, Chemical properties, applications of Oil & Fats..

5.0 Chemistry of aromatic compounds:

Nomenclature of aromatic compounds-Methods of preparation of Benzene-Physical properties and applications of Benzene-Chemical properties of Benzene-Methods of preparation of Phenol-Physical properties and applications of Phenol-Chemical properties of Phenol-Methods of preparation of Benzoic acid-Physical properties and applications of Benzoic acid-Chemical properties of Benzoic acid-Methods of preparation of Benzaldehyde-Physical properties and applications of Benzaldehyde-Chemical properties of Benzaldehyde-Methods of preparation of Aniline-Physical properties and applications of Aniline-Chemical properties of Aniline-Methods of preparation of Toluene-Physical properties and applications of Toluene-Chemical properties of Toluene-Methods of preparation of Nitrobenzene-Physical properties and applications of Nitrobenzene-Chemical properties of Nitrobenzene.

6.0 Petroleum Chemistry:

Elementary compositions of crude oil-Hydrocarbon constituents of straight-run distillates, Monomer hydrocarbon constituents of gasoline, structural group constituents of diesel and vacuum distillates-Non-hydrocarbon constituents like Sulfur compounds, nitrogen compounds, oxygen compounds-Composition of Resin and Asphalt components of petroleum products-Composition and characteristics of liquid petroleum hydrocarbons-Composition of gaseous Petroleum Hydrocarbons-Oil field waters and their classification-Definitions and characteristics of some oil field waters-Meteoric water, interstitial water, connate water and Diagenetic water-Chemistry of Thermal Cracking- Chemistry of Catalytic cracking- Chemistry of Reforming-Chemistry of Alkylation-Chemistry of Isomerization.

REFERENCE BOOKS:

1. Physical Chemistry by Bahl and Tuli.
2. Organic Chemistry by Bahl and Bahl.
3. Petroleum Geochemistry by Dr.D.Satyanarayana, Daya Publishing House.

UNIT OPERATIONS- I

Subject Title : **Unit Operations-I**
Subject Code : **CH- PC– 304**
Periods per week : **05**
Total periods/ semester : **75**

S.No.	Major topics	No. of periods	Weightage of marks	Short answer type	Essay type
1.	Introduction to fluid flow phenomena and basic equations of fluid flow	12	13	1	1
2.	Flow of incompressible fluids in pipes and flow past immersed bodies	13	16	2	1
3.	Know about flow measurement & transportation of fluids	16	26	2	2
4.	Heat transfer by conduction	07	13	1	1
5.	Principles of heat flow in fluids	07	13	1	1
6.	Heat transfer to fluids with and without phase change	07	13	1	1
7.	Radiation heat transfer	03	03	1	-
8.	Heat exchange equipment and Evaporation.	10	13	1	1
Total		75	110	10	08

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

1.0 Understand the fluid flow phenomena and basic equations of fluid flow:

- 1.1 Know about the definition of a fluid, various types of fluids.
- 1.2 Know about the important physical properties of fluid and their units.
- 1.3 Know about the fluid statics and static pressure.
- 1.4 Know about the concepts of pressure and its measurement.
- 1.5 Know about the working of ‘U’ tube manometer inverted ‘U’ tube manometer, inclined manometer.

- 1.6 Know about the 'Newton's law of viscosity'.
- 1.7 Know about the differences between a laminar and a turbulent flow
- 1.8 Know about the Reynold's experiment and the importance of Reynold's number.
- 1.9 Solve simple problems on calculation of Reynolds number and pressure drop in manometers.
- 1.10 Know about the flow in boundary layers.
- 1.11 Know about the boundary layer separation and its effects on fluid flow.
- 1.12 Know about the mass balance .and momentum balance equations.
- 1.13 Know about the derivation of continuity equation
- 1.14 Solve simple problems on Continuity equation
- 1.15 Know about the Statement and derivation of Bernoulli's theorem without friction
- 1.16 Know about the derivation of modified Bernoulli's theorem including the friction correction factor, Kinetic energy correction factor and pump work.
- 1.17 Solve simple problems on calculation of various heads using Bernoulli's equation
- 1.18. Solve simple problems on calculation of pump work using Bernoulli's equation

2.0 Know about the flow of incompressible fluids in conduits and flow past immersed bodies

- 2.1 Know about the flow of incompressible fluids in pipes and shear stress distribution in pipes
- 2.2 Know about the equation of friction factor for laminar flow.
- 2.3 Know about the laminar flow in pipes, average velocity, kinetic energy factor.
- 2.4 Know about the Hagen Poiseuille equation.
- 2.5 Solve simple problems on Hagen Poiseuille equation for pressure drop calculation.
- 2.6 Know about the friction factor in turbulent flow
- 2.7 Know about the roughness parameter, effect of roughness and the friction factor chart.
- 2.8 Understand the energy loss due to flow in pipe fittings, sudden expansion and contraction..
- 2.9 Solve simple problems on friction factor in Laminar & turbulent flow and energy losses in fluid flow through pipes.
- 2.10 Know about the equivalent length
- 2.11 Know about the drag. different types of drag and drag coefficient.
- 2.12 Know about the relationship between drag coefficient and Reynolds number.
- 2.13 Know about the stokes law, free settling and hindered settling.

- 2.14 Know about the packed bed and the equations of pressure drop in it.
- 2.15 Know about the process of fluidization. and applications of fluidization.
- 2.16 Solve simple problems on Stoke's Law.

3.0 Know about flow measurement & transportation of fluids:

- 3.1 Know about the classification of flow meters
- 3.2 Know about the principle, construction and working of Venturi meter, Orifice meter, pitot tube, rotameter.
- 3.3 Know about the classification of pipes and tubes, schedule number and gauge for pipes and tubes.
- 3.4 Know about the various types of pipe fittings.
- 3.5 Explain the classification of valves and functions of gate valve, globe valve, plug valve, needle valve, check valve and diaphragm valve.
- 3.6 Know about the functions of pump in fluid handling.
- 3.7 Know about the classification of pumps.
- 3.8 Know about the differences between positive displacement and centrifugal pumps.
- 3.9 Know about the principle, construction and working of the following reciprocating positive displacement pumps, (i) Piston pump (ii) Plunger Pump (iii) Diaphragm Pump
- 3.10 Know about the principle, construction and working of the following rotary positive displacement pumps, (i) Gear pump (ii) Screw pump
- 3.11 Know about the principle, construction and working of Centrifugal pump.
- 3.12 Know about the principle, construction and working of reciprocating piston pump.
- 3.13 Know about the following terms related to a pump
(a)suction head (b) discharge head (c) total head (d) NPSH (e) cavitation (f) priming
(g) mechanical efficiency (h) power required.
- 3.14 Know about the characteristic curves of centrifugal pumps.
- 3.15 Know about the working of (i) fan (ii) blower (iii) vacuum pump (iv) ejectors.
Differentiate between a fan and a blower.
- 3.16 Solve problems based on calculation of velocity, volumetric flow rates of fluids flowing through venturi and orifice meters.
- 3.17 Solve simple problems based on calculation of velocities, volumetric flow rates using venturi meter and orifice meter.
- 3.18 Solve simple problems on calculation of NPSH, power required by a centrifugal pump.

4.0 Know the heat flow through conduction

- 4.1 Know about the various mechanisms of heat flow
- 4.2 Know about the steady state and unsteady state heat flow.
- 4.3 Know about the fourier's law of heat conduction
- 4.4 Know about the thermal conductivity of a substance and its units.
- 4.5 Know about the derivation of equation for heat conduction through a single plane wall, a cylindrical wall and composite wall.
- 4.6 Know about the significance of lagging, economic lagging thickness and heat insulating materials.
- 4.7 Know about the compound resistances in series
- 4.8 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.

5.0 Know about the principles of heat flow in fluids:

- 5.1 Know about convection, natural convection and forced convection
- 5.2 Know the working of typical heat exchanger and the terms approach and range.
- 5.3 Know about the counter current and parallel current flows in an heat exchanger and understand the temperature variations along the length of the heat exchanger in both cases.
- 5.4 Know about the enthalpy balances in heat exchangers and in total condensers
- 5.5 Know about the Rate of heat transfer, heat flux, average temperature of fluid stream and overall heat transfer coefficient
- 5.6 Know about the logarithmic mean temperature difference (LMTD), variable overall heat transfer coefficient and Solve simple problems on calculation of LMTD.
- 5.7 Know about the film concept in heat transfer by convection.
- 5.8 Know about the film co-efficient (Individual heat transfer coefficient) and the analogy between film co-efficient and thermal conductivity.
- 5.9 Know about the Nusselt number, Prandtl number and fouling factors.
- 5.10 Know about the derivation of an equation for calculation of overall heat transfer coefficient from individual heat transfer coefficients.
- 5.11 Know about the calculation of overall heat transfer coefficient in terms of resistances and solve simple problems on calculation of overall heat transfer coefficients

6.0 Understand the heat transfer to fluids without and with phase change.

- 6.1 Know about the regimes of heat transfer in fluids, thermal boundary layer
- 6.2 Know about the heat transfer by forced convection in laminar flow and turbulent flow.
- 6.3 Know about the Graetz and Peclet numbers
- 6.4 Know about the various empirical equations used to calculate ' h_i ' such as
 - 1. Dittus – Boelter equation
 - 2. Sieder – Tate equation
 - 3. Colburn equation.
- 6.5 Know about the mechanism of heat transfer from condensing vapors.
- 6.6 Know about the dropwise and film type condensation.
- 6.7 Know about the heat transfer mechanism to boiling liquids, pool boiling, nucleate boiling and film boiling.
- 6.8 Solve simple problems to calculate various dimensionless numbers and heat transfer coefficient using various empirical equations.

7.0 Radiation.

- 7.1 Know about the various terms related to radiation such as absorptivity, reflectivity and transitivity, emission of radiation, wave length, emissive power, black body emissivity.
- 7.2 Know about the Stefan Boltzmann law, Planck's law and Wien's displacement law.
- 7.3 Know about the Kirchoff's law
- 7.4 Know about the process of radiation between surfaces.
- 7.5 Know about the angle of vision and view factor and simple problem related to the laws of radiation
- 7.6 Understand the combined heat transfer by conduction, convection and Radiation and explain an equation for it.

8.0 Know the different types of heat exchangers used in Industry and Evaporation.

- 8.1 Know about the classification of heat exchangers and principle, construction and working of a double pipe heat exchanger.
- 8.2 Know about the principle, construction and working of a shell and tube heat exchanger
- 8.3 Know about the principle, construction and working of a floating head heat exchanger
- 8.4 Know about the principle, construction and working of a multipass heat exchanger. and temperature patterns in multipass exchanges with sketches.
- 8.5 Know about the extended surface heat exchangers i.e. i) Fin Type and ii) Plate type with a neat diagram

- 8.6 Know the function of a condenser and explain about a) Kettle type boilers b) Calandrias with a neat sketch
- 8.7 Understand the term evaporation the different liquid properties to be considered in evaporation.
- 8.8 Know about the different types of evaporators and evaporator accessories such as
 a) Steam traps b) Condensers c) Entrainment separators.
 d) Barometric leg e) Ejectors f) Salt removal systems.
- 8.9 Know about the principle, construction and working of the following type of evaporators.
 a) Standard vertical tube evaporator.
 b) Falling film and climbing film evaporators.
 c) Forced circulation evaporators.
- 8.10 Know about the performance of an evaporator
- 8.11 Know about the terms economy and capacity of an evaporator.
- 8.12 Know about the boiling point elevation, and the effect of hydrostatics head.
- 8.13 Know about the Duhring's rule.
- 8.14 Know about the enthalpy balance equation for the single effect evaporator
- 8.15 Know about enthalpy concentration diagram.
- 8.16 Solve simple problems on calculation of the heat transfer area, steam requirement and economy in case of a single effect evaporator.
- 8.17 Know about the working principle of the multiple effect evaporator system with a sketch.
- 8.18 Know about the various methods of feeding the multiple effect evaporator system with its advantages and disadvantages
- 8.19 Know about the capacity and economy of a multiple effect evaporators.

COURSE CONTENT:

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 , rotameter- 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, emissivities of solids, laws of Black body radiation, stefan boltzmann law, planck's law and wiens 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, multipass heat exchanger, temperature patterns in multipass 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.

MASS AND ENERGY BALANCE

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

TIME SCHEDULE

S. No.	Major Topics	No. of periods	Weightage of Marks	Short Answer type	Essay Answer type
1	Units and Dimensions	10	6	2	0
2	Basic Calculations	20	26	2	2
3	Material balance without Chemical Reactions	15	23	1	2
4	Material balance with Chemical Reactions	10	16	2	1
5	Energy balance	12	26	2	2
6	Combustion	08	13	1	1
Total		75	110	10	08

OBJECTIVES:

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

Unit-1: Units and Dimensions

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

- 1.11 Know the conversion of a equation from one system of units into another system of units.
- 1.12 Numerical problems on all the above topics

Unit-2: Basic Calculations

(a) Stoichiometric and composition relationships

- 2.1 Define Atom, Molecule, Mole, Gram-atom, Gram-molecule, Gram molar volume
- 2.2 Define Molarity, Normality, Molality, PPM, Weight percent, Volume percent, Mole percent, Analysis on dry basis and wet basis
- 2.3 Define Density and Specific gravity, different gravity scales, and relation between gravity scale and Specific gravity.
- 2.4 Know the Variation of density and specific gravity with temperature
- 2.5 Numerous problems on all the above topics

(b) Behavior of ideal gases

- 2.6 Know about the Kinetic theory of gases
- 2.7 Know about Gas laws: Boyle's law, Charles law, Gay-Lussac's law, Avogadro's law, Derivation of Ideal gas equation
- 2.8 Know about Vander Waal's equation of state, Critical properties of substances
- 2.9 Know Ideal gas constant-Derive the value of ideal gas constant in different system of units
- 2.10 State and explain Dalton's law of partial pressures, Amagat's law of partial volumes for gaseous mixtures
- 2.11 Explain the characteristics of an Ideal gas, Differences between Ideal gas and Real gas
- 2.12 (i) Derive the equation volume % = mole % = pressure % for an ideal gas mixture
(ii) Know about average molecular weight of a gas mixture and the evaluation procedure
- 2.13 Know the evaluation procedure for the density of a gaseous mixture
- 2.14 Numerous problems on all the above topics

(c) Vapour Pressures

- 2.15 Define vapour pressure, understand the relation between vapor pressure and boiling point
- 2.16 Know the effect of temperature on vapor pressure
- 2.17 Know the methods of evaluation of vapor pressure
 - (a) Antoine equation
 - (b) Clausius – Clapeyron equation.
 - (c) Vapor pressure reference substance plots - Cox chart, Duhring's lines
- 2.18 Ideal solutions and Non-Ideal solutions. Differences between Ideal and Non-Ideal solutions
- 2.19 Define (a) Raoult's Law (b) Henry's Law for solutions
- 2.20 Numerous problems on all the above topics

(d) Humidity and Saturation:

- 2.21 Define and explain the following.
 - (a) Un-saturation, Saturation
 - (b) Humidity, Absolute humidity, Relative Humidity, Molal absolute humidity, % Saturation
 - (c) Dew Point

- 2.22 Know about Dry and wet bulb temperature
- 2.23 Numerous problems on all the above topics

Unit-3: 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

Unit-4: 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

Unit-5: 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

Unit-6: Combustion process

- 6.1 Distinguish between Partial and Complete Combustion
- 6.2 Define and explain Calorific values (Gross and Net Calorific values)
- 6.3 Calculate the calorific value of a fuel using Dulong's Formulae
- 6.4 Know about net hydrogen
- 6.5 Solve combustion problems related to refuse analysis
- 6.6 Explain the proximate and ultimate analysis of coal
- 6.7 Know about the composition of flue gas obtained after combustion of a fuel
- 6.8 Calculate the air requirement for combustion of a specific fuel
- 6.9 Know the compositions of fuel and flue gases, and calculate the flue gas analysis using fuel analysis
- 6.10 Calculate the fuel analysis using flue gas analysis for complete combustion and incomplete combustion
- 6.11 Solve problems related to combustion

COURSE CONTENTS:

Unit-1: Units and Dimensions

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

Unit-2: Basic Calculations

(a) Stoichiometric and composition relationships

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

(b) Behavior of ideal gases

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

(c) Vapor Pressures

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

(d) Humidity and Saturation:

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

Unit-3: Material balance without chemical reactions

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

Unit-4: 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.

Unit-5: 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.

Unit-6: 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	Stoichiometry (SI Units)	1. B.I.Bhatt 2. S.M.Vora	Tata McGraw-Hill Publishing company Limited, New Delhi
3	Basic Principles and calculations in Chemical Engineering	1. David M.Himmel Bleau	
4	Introduction to Stoichiometry (SI units)	1. K.A.Gavhane	Nirali Prakashan
4	Stoichiometry and Process Calculations	1. K.V.Narayanan 2. B.Lakshmikutty	Prentice Hall of India Pvt 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 Prasada Rao 2. D.V.S.Murthy	MACMillan India Limited

CHEMICAL PROCESS DRAWING LAB USING CAD

Subject Title : Chemical Process Drawing Lab using CAD
Subject Code : CH-PC-306
Periods/week : 03
Periods/ Semester : 45

I. Drawing of the following using DRAWING INSTRUMENTS

1. Drawing of symbols for heat transfer equipment; heat exchanger, water cooler, Steam Heater, Reboiler and Condenser
2. Drawing of symbols for pumps and compressors.
3. Drawing of symbols for vertical and horizontal boiler.
4. Drawing of symbols for agitator, jacketed kettle, absorbers, stripper, fractionating column
5. Drawing of symbols for pipe lines.
6. Drawing of symbols for flow meters.
7. Drawing of symbols for instruments such as flow measurement, temperature, pressure, level, density.
8. Draw the following chemical equipments
 - a) Double pipe heat exchanger
 - b) Mixer
 - c) Short tube vertical evaporator
 - d) Continuous distillation column

II. Drawing of the following using AUTO CAD

9. Introduction
10. Auto CAD screen and various tool bars and menus.
11. Use of various commands like mirror, rotate, array and move.
12. Explain dimensioning and hatching.
13. Draw the 2D drawings; Knuckle joint, screw jack.
14. Draw the following chemical equipments using AUTO-CAD
 - a) Double pipe heat exchanger
 - b) Mixer
 - c) Jacketed vessel

**ELECTRICAL TECHNOLOGY LAB
AND
PHYSICAL ORGANIC AND PETROLEUM CHEMISTRY LAB**

Subject Title : **Electrical Technology lab and Physical, Organic and Petroleum Chemistry lab**
Subject Code : **CH-PC-307**
Periods / week : **6**
Periods / Semester : **90**

List of experiments for 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) and (Single lamp controlled by two-way switch).

List of experiments for Physical, Organic and Petroleum Chemistry lab:

1. Determination of Melting Points of organic compound.
2. Determination of Boiling Point of Organic Compound.
3. Detection of elements Carbon, Hydrogen, Oxygen, Nitrogen, Sulphur, Halogens.
4. Reactions of functional groups R–OH, R-COOH, R-CHO, R-CO-R, R-NH₂, R-CONH₂, R-COOR.
5. Identification of functional groups in an Organic Compound.
6. Determine the ⁰API gravity of the given sample.
7. Determine the moisture content of the given sample by using Dean and Stark method.
8. Determine the Sand content present in the given sample by using Retort kit analysis.
9. Determine the P^H of the given sample using P^H meter.
10. Determine the Total Dissolved solids present in the given sample using TDS (Total Dissolved Solids) meter.

COMMUNICATION SKILLS
(Common to all Branches)

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

Introduction:

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

Objectives:

On completion of the course the students will be able to

- Strengthen their listening skills
- Strengthen their speaking skills

Time Schedule

S.No.	Topic	Periods	Weightage of marks (End Exam)	Sessional marks	Total
1	Listening I	3	10	10	20
2	Listening II	3			
3	Introducing oneself	3	50	30	80
4	Describing objects	3			
5	Describing events	3			
6	Reporting past incidents	3			
7	Speaking from observation / reading	3			
8	JAM	6			
9	Group discussion	6			
10	Mock interviews	6			
11	Making presentations	6	60	40	100
		45			

Competencies and key competencies to be achieved by the student

Topic	Teacher's input/ methodology	Students competence
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Listening I Listening II	Pre- Listening –eliciting, pictures While - Listening Post –Listening –project , writing	Identifying the main idea, Identifying specific details, Identifying parallel and contradictory ideas Drawing inferences, Reasoning
Introducing oneself	Kinds of introduction --official/ personal, dynamic vocabulary, Body language, Model introduction, Use of line ups	Use of simple present tense, Sequencing, Appropriate vocabulary
Reporting incidents	Group work /pair work, Elicit, Use of past tense, Student presentations	Use of past tense, Relevant vocabulary
Describing objects	Vocabulary , Use of adjectives, Games-I spy, Group presentations	Use of adjectives, Dimensions, shapes Compare and contrast, sequence
Describing events	Group work/pair work Use of appropriate tense	Use of appropriate tense, sequencing
Reporting past incidents	Use of past tense, Vocabulary Student presentations	Use of past tense , sequencing
Speaking from observation/reading	Group work/pair work, Reading techniques ,	Use of past tense, Summarizing, evaluating, comprehension
JAM	Effective techniques , Good beginning , conclusion, tips, Use of line ups	Vocabulary, Sequencing, Fluency, Thinking spontaneously
Group discussion	Expressing opinion, body language,	Expressing opinion, agree/ disagree, fluency, Persuasive and leadership skills
Mock interview	FAQs , body language	Role play, body language,
Making presentations	Student presentations	Using charts , pictures, interpreting data, sequencing, PPTs

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

Note:

* This subject is a theory subject.

** The workload should be calculated as theory workload.

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

UNIT OPERATIONS-I LAB

Subject title : Unit Operations-I Lab
Subject Code : CH-PC-309
Periods / Week : 06
Periods / Semester : 90

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.
4. Calculates the coefficient of discharge of venturi meter and draw graph between C_d Vs N_{Re} .
6. Calculates the coefficient of discharge of orifice meter and draw graph between C_d 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
(C16/IV Semester)

Subject Code	Name of the Subject	Instruction periods / week		Total Periods / year	Scheme of Examination			
		Theory	Practical /Tutorial		Duration (hours)	Sessional Marks	End Exam Marks	Total Marks
THEORY:								
CHPC-401	Unit operation-II	6	-	90	3	20	80	100
CHPC-402	General Chemical Technology	6	-	90	3	20	80	100
CHPC-403	Petrochemical Technology-I	6	-	90	3	20	80	100
CHPC-404	Petroleum Refining	5	-	75	3	20	80	100
CHPC-405	Basic Mechanical Engineering	4	-	60	3	20	80	100
PRACTICAL:								
CHPC-406	Chemical Technology Lab	-	6	90	3	40	60	100
CHPC-407	Unit Operations- II lab	-	3	45	3	40	60	100
CHPC-408	Life Skills	-	3	45	3	40	60	100
CHPC-409	Petroleum Refining-I Lab	-	3	45	3	40	60	100
TOTAL		27	15	630		260	640	900

CHPC-401, 405, 406, 407

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

CHPC-402, 403, 404, 409

: Not common with any course

CHPC-408

: Common to all

UNIT OPERATIONS-II

Subject title : Unit Operations-II
Subject code : CH-PC-401
Periods / week : 6
Periods / semester : 90

TIME SCHEDULE

S.No.	Major Topics	Periods	Weightage Of marks	SAQ	EAQ
1	Fundamentals of mass transfer or separation operations	20	26	2	2
2	Distillation	20	26	2	2
3	Absorption and Stripping	10	13	1	1
4	Humidification and Drying	15	16	2	1
5	Extraction and Leaching	15	16	2	1
6	Crystallization and Adsorption	10	13	1	1
TOTAL		90	110	10	08

OBJECTIVES:

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

1.0 Fundamentals of mass transfer or separation operations:

- 1.1 Know the basics of mass transfer operations.
- 1.2 Know the experimental illustrations of mass transfer separation techniques.
- 1.3 Know the role of mass transfer operations in an industrial chemical processes.
- 1.4 Know the classification of mass transfer or separation operations.
- 1.5 Know the significance of equilibrium in mass transfer operations.
- 1.6 Know the difference between molecular diffusion and eddy diffusion.
- 1.7 Know the definition of molar flux.
- 1.8 Know the statement of Fick's law of molecular diffusion.
- 1.9 Know the derivation of equation for steady state molecular diffusion in fluids at rest and in laminar flow.
- 1.10 Know the molecular diffusion in gases.
- 1.11 Know the derivation of equation for steady state diffusion of A through non-diffusing B in gases.
- 1.12 Know the derivation of equation for steady state Equi-molal counter diffusion in gases.
- 1.13 Know the molecular diffusion in liquids.
- 1.14 Know the derivation of equation for steady state diffusion of A through non-diffusing B in liquids.
- 1.15 Know the derivation of equation for steady state Equi-molal counter diffusion in liquids.

- 1.16 Simple problems on Fick's law, steady state diffusion of A through non-diffusing B and steady state Equi-molal counter diffusion in gases and liquids.
- 1.17 Know the diffusivity in gases.
- 1.18 Know the diffusivity in liquids.
- 1.19 Know about a phase, phase rule and degrees of freedom.

2.0 Distillation:

- 2.1 Know the difference between distillation and absorption or stripping.
- 2.2 Know the industrial applications of distillation.
- 2.3 Know about flash vaporization or equilibrium distillation.
- 2.4 Know about differential distillation and Rayleigh's equation.
- 2.5 Know about steam distillation and steam distillation law.
- 2.6 Know about equilibrium and driving force in distillation.
- 2.7 Know about a stage, equilibrium or Ideal or theoretical stage.
- 2.8 Know about continuous rectification or distillation or fractionation column with stripping section and enriching section.
- 2.9 Know about industrial equipment required for distillation.
- 2.10 Know about Height equivalent to theoretical plate (HETP).
- 2.11 Know about the arrangements of condensers, trays, reboilers for distillation column.
- 2.12 Know about different types of packing material used in the packed bed columns.
- 2.13 Know the Mc-Cabe Thiele method to determine the number of stages required to obtain certain degree of separation.
- 2.14 Related problems on Mc-Cabe Thiele method to determine the number of stages.
- 2.15 Know the feed stage conditions.
- 2.16 Know about the limiting operating conditions of a distillation column.
- 2.17 Know about a stage and efficiency.

3.0 Absorption and Stripping:

- 3.1 Know the basics of absorption and stripping.
- 3.2 Know few industrial applications of absorption and stripping.
- 3.3 Know about operating equation for absorption and stripping.
- 3.4 Know about the equilibrium diagrams for absorption and stripping.
- 3.5 Know about minimum absorbent flow rate.
- 3.6 Know about number of equilibrium stages for absorption and stripping.
- 3.7 Know about the general operating characteristics of absorption and stripping column.
- 3.8 Know about the equipment used for absorption and stripping.
- 3.9 Know to solve problems in absorption and stripping.

4.0 Humidification and Drying:

- 4.1 Know the basics of humidification operations.
- 4.2 Know about industrial applications of humidification operations.
- 4.3 Know about dry and wet bulb temperatures.
- 4.4 Know about Psychrometer charts.
- 4.5 Know about various humidification equipments.
- 4.6 Know about dehumidification operation.
- 4.7 Know about cooling towers.

- 4.8 Know the basics of drying.
- 4.9 Know the industrial applications of drying.
- 4.10 Know the basic terminology associated with drying.
- 4.11 Know about constant rate and falling rate period associated with drying.
- 4.12 Know about drying rate curves.
- 4.13 Know about the time of drying and related problems on time of drying.
- 4.14 Know about the factors that influence the rate of drying
- 4.15 Know about the drying equipment and its classification.

5.0 Extraction and Leaching:

- 5.1 Know the differences among liquid-liquid extraction, absorption and distillation.
- 5.2 Know the industrial applications of extraction.
- 5.3 Know about the selection criteria for solvent required for conducting extraction.
- 5.4 Know about single stage and multistage extraction.
- 5.5 Know about different kinds of equipment required for conducting extraction.
- 5.6 Know about the basics of leaching
- 5.7 Know about the industrial applications of leaching.
- 5.8 Know about different types of equipment required for leaching.

6.0 Crystallization and Adsorption:

- 6.1 Know the basics of crystallization.
- 6.2 Know the industrial applications of crystallization.
- 6.3 Know about solubility, un-saturation, saturation and super saturation.
- 6.4 Know about the methods of super saturation.
- 6.5 Know about the mechanism of crystallization.
- 6.6 Know about the equipment required for crystallization.
- 6.7 Know the classification of crystallizers.
- 6.8 Know about the basics of adsorption.
- 6.9 Know about the industrial applications of adsorption.
- 6.10 Know about major types of adsorbents and their properties.
- 6.11 Know about the differences between chemisorption and physical adsorption.
- 6.12 Know about various devices employed for conducting adsorption.

Course Content:

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-molar 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, Countercurrent 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

GENERAL CHEMICAL TECHNOLOGY

Subject title : General Chemical Technology
Subject Code : CH-PC-402
Periods / Week : 6
Periods / Year : 90

TIME SCHEDULE

S.No.	Major Topics	Periods	Weightage marks	of Short answer type	Essay type
1.	Basic industrial chemicals	10	13	1	1
2.	Water and Fertilizer industry	25	26	2	2
3.	Industrial gases and Inorganic products	10	12	4	-
4.	Coal chemicals	15	13	1	1
5.	Oils, fats, soap, Pulp, Paper and Sugar industry	15	23	1	2
6.	Polymerization, Rubber polymer and Rubber industries	15	23	1	2
Total		90	110	10	08

OBJECTIVES:

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

1.0 Basic industrial chemicals.

- 1.1 State various industrial uses of hydrochloric acid.
- 1.2 Explain the manufacturing process of HCl
- 1.3 State different industrial manufacturing methods of sodium carbonate.
- 1.4 Explain the manufacturing of sodium carbonate by Solvay process.
- 1.5 State various industrial applications of sodium carbonate.
- 1.6 State different industrial manufacturing methods of sodium hydroxide.
- 1.7 Explain the various cells involved in the manufacture of sodium hydroxide by electrolytic process – diaphragm cells, membrane cells and mercury cells.
- 1.8 Explain the manufacturing of sodium hydroxide through electrolytic process.
- 1.9 Various industrial applications of sodium hydroxide.
- 1.10 State different industrial manufacturing methods of Ammonia.
- 1.11 Explain the manufacturing of ammonia through steam reforming of naphtha or natural gas.
- 1.12 State various industrial applications of ammonia.
- 1.13 Explain the manufacturing of Nitric acid by ammonia oxidation process
- 1.14 State various industrial application of nitric acid.
- 1.15 State different industrial manufacturing methods of sulfuric acid.

- 1.16 Explain the manufacturing process of sulfuric acid by double contact and double absorption process
- 1.17 State various industrial applications of sulfuric acid.
- 1.18 State different methods of manufacturing sodium sulfate.
- 1.19 State various industrial application of sodium sulphate.

2.0 Water and Fertilizer industry

- 2.1 State different sources of water.
- 2.2 State different impurities and mineral material present in various sources of water.
- 2.3 State different scales formed due to impurities in water.
- 2.4 Explain the methods of removal of scales formed due to impurities in water.
- 2.5 Explain the process of purification of water by ion – exchange method.
- 2.6 Explain Permutit method of water purification.
- 2.7 Understand the stages involved in municipal water treatment.
- 2.8 State various industrial manufacturing methods of urea.
- 2.9 Explain the manufacturing methods of urea – total recycle method of manufacturing urea using ammonia and carbon dioxide.
- 2.10 State various industrial application of urea.
- 2.11 Explain the manufacturing methods of phosphoric acid by Sulphuric acid leaching
- 2.12 State various industrial applications of phosphoric acid.
- 2.13 Explain the manufacturing process of mono ammonium phosphate (MAP) and di ammonium phosphate (DAP) and also state its applications.
- 2.14 Explain the process of making ammonium sulfate.
- 2.15 Explain the manufacturing process of single super phosphate and triple super phosphate and also state its applications.
- 2.16 Explain the manufacture of mixed fertilizers (N-P-K) grades.

3.0 Industrial gases and Inorganic products.

- 3.1 State the industrial methods of manufacturing oxygen and nitrogen.
- 3.2 Explain the concept of conventional Linde cycle.
- 3.3 Explain the manufacturing of oxygen and nitrogen by means of liquefaction and Rectification of air using conventional Linde double column rectifier and main condenser.
- 3.4 State various industrial applications of nitrogen and oxygen.
- 3.5 State various methods of manufacturing carbon dioxide industrially.
- 3.6 Explain the manufacture of carbon dioxide from molasses fermentation method
- 3.7 State the industrial applications of carbon dioxide.
- 3.8 Explain the manufacture of cement by wet and dry process.
- 3.9 Explain the manufacturing of silicon carbide.
- 3.10 Explain the manufacturing of calcium carbide.
- 3.11 State the applications of SiC and CaC₂
- 3.12 Explain the manufacturing of soda glass.
- 3.13 State the applications of soda glass

4.0 Coal chemicals

- 4.1 Understand the formation of coal and list out various grades of coal.
- 4.2 List the different chemicals obtained from coal

- 4.3 State briefly about coke, coal gas, water gas, producer gas and synthesis gas. List their applications.
- 4.4 Explain high temperature carbonization of coal.
- 4.5 State and explain the recovery of chemicals when coal is subjected to coking.
- 4.6 Explain coal tar distillation and list out various chemicals obtained from coal tar distillation.

5.0 Oils, Fats, Soaps, Pulp, Paper and Sugar industry.

- 5.1 Distinguish between fats and oils by briefly explain about them.
- 5.2 Understand oil expelling using an expeller.
- 5.3 Explain the solvent extraction method of oil extraction.
- 5.4 State the different steps involved in refining of crude oil obtained by extraction.
- 5.5 Understand about soap and state various sources of raw materials required in the manufacture of soap.
- 5.6 Explain the continuous process for the production of soap.
- 5.7 Explain the recovery of glycerin from soap industry.
- 5.8 State the raw materials required to manufacture pulp and paper.
- 5.9 State the major processes followed to produce pulp.
- 5.10 Explain the sulphate or Kraft process to manufacture pulp.
- 5.11 Explain the industrial method of manufacturing paper from sulphate pulp.
- 5.12 Explain the process to which the black liquor should be subjected to recover its chemical constituents for reuse in the manufacture of pulp.
- 5.13 Understand the inversion of sugar.
- 5.14 Explain the manufacture of sugar from sugar cane.
- 5.15 Explain the manufacture of industrial alcohol (ethyl alcohol) from molasses.
- 5.16 State various industrial applications of alcohol (ethyl-alcohol) and sugar.

6.0 Polymerization, Rubber polymer 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.
- 6.5 Explain the manufacturing method of HDPE.
- 6.6 State various applications of polyethylene.
- 6.7 Understand the classification of rubbers.
- 6.8 Explain the manufacturing process of ethyl benzene and styrene.
- 6.9 Explain the manufacturing of butadiene.
- 6.10 Explain the manufacturing process of styrene- butadiene rubber.
- 6.11 Safety aspects in Chemical Industries

COURSE CONTENTS:

1. Basic industrial chemicals

Industrial manufacturing methods of hydrochloric acid-Industrial uses of hydrochloric acid-Industrial manufacturing methods of sodium carbonate- manufacturing of sodium carbonate by Solvay process - industrial applications of sodium carbonate-Industrial manufacturing methods of sodium hydroxide- various electrolytic cells involved in the manufacture of sodium hydroxide-

diaphragm cells- membrane cells and mercury cells- manufacturing of sodium hydroxide through electrolytic process and various industrial applications of sodium hydroxide.

Industrial manufacturing methods of Ammonia-manufacturing of ammonia through steam reforming of naphtha or natural gas - industrial applications of ammonia. Manufacture of nitric acid by ammonia oxidation process. Various industrial application of nitric acid. Industrial manufacturing methods of sulfuric acid- manufacturing process of sulfuric acid by DCDA process- industrial applications of sulfuric acid-Industrial manufacturing methods of sodium sulfate-various industrial applications of sodium sulphate.

2. Water and Fertilizer industry:

Different sources of water- impurities and mineral material present in various sources of water-scale formation and methods of its removal-softening of water by ion- exchange method, permutitt method-stages involved in municipal water treatment.

Industrial manufacturing methods of urea-manufacturing methods of urea by total recycle method using ammonia and carbon dioxide - various industrial applications of urea-manufacturing methods of phosphoric acid by sulphuric acid leaching-industrial application of phosphoric acid-manufacturing of monoammonium phosphate and diammonium phosphate and their applications-ammonium sulfate-manufacturing of single super phosphate and triple super phosphate and its applications-manufacturing of mixed fertilizers (n-p-k) grades.

3. Industrial gases and Inorganic products:

Industrial manufacturing methods of oxygen and nitrogen- concept of conventional Linde cycle, manufacturing of oxygen and nitrogen by means of liquefaction and rectification of air using conventional Linde double column rectifier and main condenser - various applications of nitrogen and oxygen- industrial methods of manufacturing carbon dioxide, manufacturing of carbon dioxide from molasses fermentation method and various industrial applications of carbon dioxide.

Manufacturing of cement clinker by wet and dry process-manufacturing of silicon carbide-applications of silicon carbide-manufacturing of calcium carbide-industrial applications of calcium carbide-manufacturing of soda glass-industrial applications of soda glass.

4. Coal chemicals:

Formation of coal- various grades of coal- different chemicals obtained from coal like 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 and various chemicals obtained from coal tar distillation.

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

Fats and oil and the basic difference between them- oil expelling using an expeller- solvent extraction method of oil extraction- steps involved in refining of crude oil obtained by extraction-, soap, various sources of raw materials required to manufacture of soap, continuous process for the production of soap, recovery of glycerin from soap industry.

Raw materials required manufacturing of pulp and major process followed to produce pulp- Kraft or sulphate process to manufacture of pulp- manufacturing of paper from sulphate pulp and process to which the black liquor should be subjected to recover its chemical content for reuse in the manufacture of pulp.

Introduction of sugar, manufacture of sugar from sugar cane- manufacturing of industrial alcohol (ethyl alcohol) from molasses and industrial applications of alcohol and sugar.

6. Polymerization, Rubber polymer and Rubber industries:

Differentiate between polymer and plastics- different varieties of polymers and plastics-distinguish between thermo set and thermo plastic- manufacturing method of LDPE- HDPE-applications of polyethylene.

Classification of rubbers, manufacturing process of monomers styrene, ethylbenzene and butadiene, manufacturing process of styrene butadiene rubber and various types of rubbers. Safety aspects in Chemical Industries

REFERENCE BOOKS:

1. Chemical Process Industries – Shreves.
2. Chemtech IIT – Vol. II, III and IV
3. Test books : Outlines of Chemikcal Technology by Dryden.
4. Chemical Technology Vol – I and Vol – II by Sukla and Pandey.

PETROCHEMICAL TECHNOLOGY – I

Subject title : Petrochemical Technology - I
Subject Code : CH-PC-403
Periods / Week : 6
Periods / Semester : 90

TIME SCHEDULE

S.No.	Major Topics	Periods	Weightage of marks	Short answer type	Essay type
1.	Introduction to Petrochemicals	10	3	1	-
2.	Sources and production of C-1 Petrochemicals and their derivatives	20	26	2	2
3.	Sources and production of C-2 Petrochemicals and their derivatives	10	13	1	1
4.	Sources and production of C-3 Petrochemicals and their derivatives	10	13	1	1
5.	Sources and production of C-4 Petrochemicals and their derivatives	15	26	2	2
6.	Sources and production of aromatics	15	16	2	1
7.	Polymerization	10	13	1	1
Total		90	110	10	08

OBJECTIVES:

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

1.0 Introduction to Petrochemicals

- 1.1 Definition of Petrochemical
- 1.2 Know about the history of Petrochemical Industry
- 1.3 Know about the development of Petrochemical Industry in India.
- 1.4 Know about the various Petrochemical complexes in India.
- 1.5 Know about the Petrochemical feedstocks in India
- 1.6 Know about the structure of Petrochemical complex
- 1.7 Know about the various sources of Petrochemical feedstocks
- 1.8 Know about the classification of Petrochemicals

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

- 2.1 Know about the various sources of methane, natural gas and naphtha.

- 2.2 Know about the various separation techniques of gases into their individual constituents such as Absorption-Desorption, Compression-Liquefaction, Low-temperature fractionation and Adsorption
- 2.3 Know about the various Petrochemicals obtained from methane
- 2.4 Know about the uses of methane.
- 2.5 Know about the various sources of synthesis gas
- 2.6 Describe briefly about 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 Know about the various derivatives obtained from Synthesis gas.
- 2.8 Know about the uses of Synthesis gas.
- 2.9 Describe briefly about the manufacturing process of methanol from natural gas/ naphtha
- 2.10 Describe briefly about the manufacturing process of methanol from synthesis gas.
- 2.11 Know about the various Petrochemicals obtained from methanol.
- 2.12 Know about the uses of methanol.

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

- 3.1 Know about the various sources of ethane.
- 3.2 Describe briefly about the production of ethylene by Pyrolysis of naphtha.
- 3.3 Know about the various Petrochemicals obtained from ethylene
- 3.4 Know about the uses of ethylene
- 3.5 Describe briefly about the production of ethylene oxide by ethylene oxidation process
- 3.6 Uses of ethylene oxide
- 3.7 Describe briefly about the production of mono ethylene glycol by hydrolysis of ethylene oxide
- 3.8 Know about the uses of mono ethylene glycol
- 3.9 Describe briefly about the production of ethanol amines from ethylene oxide and ammonia
- 3.10 Know about the uses of ethanol amines
- 3.11 Describe briefly about the production of isoprene from acetone and acetylene
- 3.12 Know about the uses of isoprene.

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

- 4.1 Know about the various sources of propylene
- 4.2 Describe briefly about the production of propylene from catalytic cracking of petroleum distillate.
- 4.3 Know about the various Petrochemicals obtained from propylene.
- 4.4 Describe briefly about the production of propylene oxide by Chlorohydrin route
- 4.5 Know about the uses of propylene oxide
- 4.6 Describe briefly about the production of Isopropyl alcohol from propylene by sulfuric acid hydration process
- 4.7 Know about the uses of isopropyl alcohol
- 4.8 Describe briefly about the production of Acrylonitrile by propylene Ammoxidation process
- 4.9 Know about the uses of Acrylonitrile by propylene Ammoxidation process
- 4.10 Describe briefly about the production of glycerin from propylene oxide and acetaldehyde
- 4.11 Know about the uses of glycerin

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

- 5.1 Know about the various sources of Butane and Butylene
- 5.2 Know about the various Petrochemicals obtained from Butadiene
- 5.3 Know about the various Petrochemicals obtained from Iso-Butylene
- 5.4 Describe briefly about the production of Butanol by propylene hydration process
- 5.5 Know about the uses of Butanol
- 5.6 Describe briefly about the production of butadiene by dehydrogenation of butane
- 5.7 Know about the uses of butadiene
- 5.8 Describe briefly about the production of Methacrylate by acetone Cynohydrin process
- 5.9 Know about the uses of Methacrylate
- 5.10 Describe briefly about the production of Maleic anhydride by catalytic vapor phase oxidation of C₄ unsaturated compounds
- 5.11 Know about the uses of Maleic anhydride
- 5.12 Describe briefly about the production of Butyraldehyde by Hydroformylation of propylene
- 5.13 Know about the uses of Butyraldehyde
- 5.14 Describe briefly about the production of 2-ethyl Hexanol by Aldolization of n-Butyraldehyde
- 5.15 Know about the uses of 2-ethyl Hexanol

6.0 Sources and production of aromatics

- 6.1 Know about the various sources of BTX Aromatics
- 6.2 Know about 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 Know about the various Petrochemicals obtained from Benzene, Toluene and Xylene.
- 6.4 Describe briefly about the production of styrene by dehydrogenation of ethyl benzene
- 6.5 Know about the uses of styrene
- 6.6 Describe briefly about the production of Maleic acid by oxidation of benzene
- 6.7 Know about the uses of Maleic acid
- 6.8 Describe briefly about the production of benzoic acid by liquid phase oxidation of Toluene
- 6.9 Know about the uses of benzoic acid
- 6.10 Describe briefly about the production of Phthalic anhydride by oxidation of O-Xylene
- 6.11 Know about the uses of Phthalic anhydride

7.0 Polymerization

- 7.1 Definition of a polymer and polymerization process.
- 7.2 Know about the various types of polymers and their applications
- 7.3 Know about the various characteristics of a polymer
- 7.4 Know about the classification of polymers
- 7.5 Know about the various types of polymerization reactions
- 7.6 Describe briefly about the production of Low Density Polyethylene (LDPE)
- 7.7 Know about the uses of Low Density Polyethylene
- 7.8 Describe briefly about the production of High Density Polyethylene (HDPE)
- 7.9 Know about the uses of High Density Polyethylene (HDPE)
- 7.10 Describe briefly about the production of Polypropylene
- 7.11 Know about the uses of Polypropylene
- 7.12 Describe briefly about the production of Polystyrene
- 7.13 Know about the uses of Polystyrene

- 7.14 Know about the classification of rubber
- 7.15 Know about the various types of synthetic rubber and their applications
- 7.16 Describe briefly about the production of Styrene Butadiene Rubber (SBR)
- 7.17 Know about the 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 glycerin from Propylene oxide and acetaldehyde, Uses of glycerin.

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.

PETROLEUM REFINING

Subject title : Petroleum Refining
Subject code : CH-PC-404
Periods / week : 05
Periods / semester : 75

Time schedule

S.No.	Major Topics	Periods	Weightage Of marks	SAQ	EAQ
1	Petroleum Refining in India, Composition and Classification of Crude oil.	08	16	2	1
2	Refinery products and test methods for gasoline, kerosene and aviation turbine fuels	18	26	2	2
3	Test methods for diesel fuels, lubricating oils, Petroleum waxes, Bitumen, Petroleum coke, evaluation of crude oil, Desalting of crude oil and treatment of gasoline, kerosene, aviation turbine fuel and lube oils	18	23	1	2
4	Atmospheric and Vacuum distillation	08	13	1	1
5	Thermal cracking, Coking, Catalytic cracking, Hydro cracking and Hydro treating	12	16	2	1
6	Reforming, Naphtha Cracking, Deasphalting, Bitumen and carbon black	11	16	2	1
Total		75	110	10	08

OBJECTIVES:

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

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

- 1.1 Know the introduction regarding Energy.
- 1.2 Know about upstream & downstream activities.
- 1.3 Know about the exploration activities in India.
- 1.4 Know the conditions under which crude oil is produced.
- 1.5 Know about the origin of crude oil.
- 1.6 Know about the theories of formation of crude oil
- 1.7 Know about the statistics of crude oil production in India
- 1.8 Know about various refineries situated in India
- 1.9 Know about major expansions regarding refineries located in India
- 1.10 Understand about introduction regarding composition of crude oil
- 1.11 Know the composition of crude oil

- 1.12 Know about the introduction regarding the classification of crude oil
- 1.13 Know about various methods of classification of crude oil
- 1.14 Know about different types of crude oils
- 1.15 Know about introduction and the properties of various crude oil

2.0 Refinery products and test methods for gasoline, kerosene and aviation turbine fuels:

- 2.1 Know about 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 the storage facilities regarding LPG
- 2.6 Know about natural gasoline
- 2.7 Know about composition of natural gasoline
- 2.8 Know about the method of preparation of natural gasoline
- 2.9 Know about blending of natural gasoline
- 2.10 Know about gasoline
- 2.11 Know about the methods of production of gasoline
- 2.12 Know about the applications of gasoline
- 2.13 Know about the grades of gasoline
- 2.14 Know about the factors that affect the performance of gasoline
- 2.15 Know about gum content & types of gum content
- 2.16 Know about the reasons for gum formation
- 2.17 Know about gum inhibitors
- 2.18 Know about sulphur content in gasoline that affects its performance
- 2.19 Know about the difficulties due to the presence of sulphur content
- 2.20 Know about the additives to combat the effects due to the presence of sulphur in gasoline
- 2.21 Know about odour of gasoline
- 2.22 Know about colour of gasoline
- 2.23 Know about additives for gasoline
- 2.24 Know about anti icing agents
- 2.25 Know about detergents
- 2.26 Know knocking
- 2.27 Know about the reasons for knocking
- 2.28 Know about octane number & give its definition
- 2.29 Know about the standards for octane number
- 2.30 Know the method to determine octane number
- 2.31 Know the data regarding the octane number of various hydrocarbons
- 2.32 Know about the additives for improving the octane number
- 2.33 Know about the tests of gasoline
- 2.34 Know about kerosene & give its boiling range
- 2.35 Know about the composition of kerosene
- 2.36 Know about the methods of preparation of kerosene

- 2.37 Know about the properties of kerosene
- 2.38 Know about the tests of kerosene
- 2.39 Know about aviation turbine fuel & give its boiling range
- 2.40 Know about the composition of aviation turbine fuel
- 2.41 Know about the properties of aviation turbine fuel
- 2.42 Know about the additives of aviation turbine fuel
- 2.43 Know about tests of aviation turbine fuel

3.0 Test methods for diesel fuels, lubricating oils, Petroleum waxes, Bitumen, Petroleum coke, evaluation of crude oil, Desalting of crude oil and treatment of gasoline, kerosene, aviation turbine fuel and lube oils:

- 3.1 Know about diesel fuel & give its boiling range
- 3.2 Know about the composition of diesel fuel
- 3.3 Know about the properties of diesel fuel
- 3.4 Know about the additives of diesel fuel
- 3.5 Know about the tests of diesel fuel
- 3.6 Know about lubricating oil & give its boiling range
- 3.7 Know about the composition of lubricating oil
- 3.8 Know about the properties of lubricating oil
- 3.9 Know about the additives of lubricating oil
- 3.10 Know about the tests of lubricating oil
- 3.11 Know about types of petroleum waxes
- 3.12 Know about properties of petroleum wax
- 3.13 Know about manufacture of petroleum wax
- 3.14 Know about the tests of petroleum wax
- 3.15 Know about the uses of petroleum wax
- 3.16 Know about bitumen, its tests, & uses
- 3.17 Know about petroleum coke, its tests & uses
- 3.18 Know about the evaluation of crude oil
- 3.19 Know about the impurities that are present in crude oil
- 3.20 Know about the methods of desalting of crude oil
- 3.21 Know about the methods available for the treatment of gasoline
- 3.22 Know about the methods available for the treatment of Kerosene
- 3.23 Know about the operating conditions & their impact on separation
- 3.24 Know about the methods available for the treatment of lube oils

4.0 Atmospheric and Vacuum distillation:

- 4.1 Know about introduction of Atmospheric distillation unit & Vacuum distillation unit
- 4.2 Know about pre-fractionation
- 4.3 Know about the basic concepts of distillation
- 4.4 Know about atmospheric distillation unit with the help of a neat sketch
- 4.5 Know about Vacuum distillation unit with the help of a neat sketch
- 4.6 Know about steam ejectors to produce vacuum
- 4.7 Know about the operating conditions of fractionating column
- 4.8 Know about temperature to be maintained in a fractionating column
- 4.9 Know about column pressure to be maintained in fractionating column

- 4.10 Know about flow rate parameters to be maintained in fractionating column
- 4.11 Know about reflux
- 4.12 Know about reboiler/condenser/steam stripping
- 4.13 Know about stability of column operation
- 5.0 Thermal cracking, Coking, Catalytic cracking, Hydro cracking and Hydro treating:**
- 5.1 Know about introduction to Thermal cracking
- 5.2 Know about the reactions involved in thermal cracking
- 5.3 Know about the operating conditions required for thermal cracking
- 5.4 Know about Mechanism of thermal cracking
- 5.5 Know about different Thermal cracking methods
- 5.6 Know about introduction regarding coking
- 5.7 Know about the methods available for coking
- 5.8 Know the uses of coking
- 5.9 Know about the introduction regarding catalytic cracking
- 5.10 Know the mechanism of catalytic cracking
- 5.11 Know about the operating conditions for catalytic cracking
- 5.12 Know about the catalysts available for catalytic cracking
- 5.13 Know the methods available for catalytic cracking
- 5.14 Know about the introduction regarding hydro cracking
- 5.15 Know about the reactions involved in hydro cracking
- 5.16 Know about the operating conditions required for hydro cracking
- 5.17 Know about the catalysts employed for hydro cracking.
- 5.18 Know the methods available for hydro cracking
- 5.19 Know about hydro-desulphurization with the help of a neat sketch
- 5.20 Know about hydro-treatment process with the help of a neat sketch

- 6.0 Reforming, Naphtha Cracking, Deasphalting, Bitumen and carbon black:**
- 6.1 Know about introduction regarding reforming
- 6.2 Know about the reactions and reaction conditions of catalytic reforming
- 6.3 Know about the catalysts employed for catalytic reforming reactions
- 6.4 Know about the feed selection for catalytic reforming reactions
- 6.5 Know the methods of Reforming
- 6.6 Know about naphtha cracking process with the help of a neat sketch
- 6.7 Know about Deasphalting using liquid propane
- 6.8 Know about Bitumen and its manufacturing methods
- 6.9 Know about carbon black and the methods of manufacture of carbon black

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 ⁰API gravity, Classification based on Characterization factor, Classification based on viscosity index, Classification based on Correlation 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 and test methods and evaluation of crude oil:

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, Pre-ignition 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--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

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

Diesel fuel & give its boiling range--Composition of diesel fuel--Properties of diesel fuel--Additives of diesel fuel--Tests of diesel fuel--Lubricating oil & give its boiling range--Composition of lubricating oil--Properties of lubricating oil--Additives of lubricating oil--Tests of lubricating oil-- Types of petroleum waxes--Properties of petroleum wax--Manufacture of petroleum wax--Tests of petroleum wax--Uses of petroleum wax--Bitumen, its tests, & uses--Petroleum coke, its tests & uses--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 Cu_2Cl_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.

4.0 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.

5.0 Thermal cracking, Coking, Catalytic cracking, Hydro cracking and Hydro treating:

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

6.0 Reforming, Naphtha Cracking, Deasphalting, Bitumen and carbon black:

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.

BASIC MECHANICAL ENGINEERING

Subject Title : Basic Mechanical Engineering
Subject Code : CH-PC-405
Periods/ Week : 04
Periods /Semester : 60

TIME SCHEDULE

S.No	Major Topics	No. of Periods	Weightage of Marks	Short answer type	Essay type
1	Measuring Instruments	10	16	2	1
2	Friction and Lubrication	05	13	1	1
3	I.C. Engines	15	26	2	2
4	Steam Boilers	10	26	2	2
5	Air Compressors	10	13	1	1
6	Steam Turbines & Steam Nozzles	10	16	2	1
Total		60	110	10	08

Objectives:

Unit-1: Measuring Instruments:

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

Unit-2: Friction & Lubrication:

- 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

Unit-3: I C Engines:

- 3.0 I.C. Engine
- 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 engines with 4 stroke engine
- 3.11 Compare SI engine with CI engine
- 3.12 Explain with the help of a line sketch ignition system of an SI engine.
- 3.13 Explain with the help of a line sketch ignition system of a CI engine.
- 3.14 Necessity of scavenging and super charging

Unit-4: Steam Boilers:

- 4.0 Boilers
- 4.1 Define Boiler
- 4.2 Give the classification of Boilers.
- 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.

Unit-5: Air compressor:

- 4.0 Air Compressor
- 4.1 State the functions of air compressors.
- 4.2 Enumerate the uses of compressed air.
- 4.3 Name the different types of compressors.
- 4.4 Explain with line diagram the working of a single acting reciprocating air compressor.
- 4.5 State the advantages of multi stage compressors over single stage compressors.
- 4.6 Explain the use of inter cooler.
- 4.7 Name the types of rotary compressors.
- 4.8 Explain with line diagram the working of a centrifugal compressor.
- 4.9 Explain with line diagram the working of an axial flow type compressor.

Unit-6: Steam turbines & Nozzles:

- 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

Course content:

1. Measuring Instruments

Dividers- Sizes and uses- combination square, bevel protractor, universal bevel protractor, sine bar, 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

Importance of 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 lubricator – 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, state 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 – ignition system of SI engines (fuel tank, fuel pump, fuel filter, carburetor and spark plug) – ignition 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 Volume-II by R C Patel & Karmachandani
4. Thermodynamic Volume I & II by Pakirappa.
5. General Mechanical Engineering By Pakirappa.
6. Hydraulic Machinery by R S Kurmi.

CHEMICAL TECHNOLOGY LAB

Subject Title : Chemical Technology Lab
Subject Code : CH-PC-406
Periods/week : 6
Periods/ Semester : 90

OBJECTIVES:

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

- 1 Determination of total solids in PPM in tap water/Sea water.
- 2 Estimation of dissolved solids PPM in tap water/sea water
- 3 Determination of the total hardness & permanent hardness in water by E.D.T.A method
- 4 Determination of the total hardness and permanent hardness in water by soap solution method
- 5 Determination of chlorides present in water
- 6 Estimation of sulphates present in water.
- 7 Estimate the percentage loss on ignition in sample of Portland cement
- 8 Determination of acid value of coconut oil / vegetable oil.
- 9 Estimation of Saponification value of the given sample.
- 10 Determination of iodine value of given vegetable oil.
- 11 Determination of pH of the given sample of solution by using pH meter.
- 12 Estimation of sugar content in a given sample by using polari meter.
- 13 Determination of conductivity of the give sample of solution by conductivity meter.
- 14 Determine the R.I of the given sample by Refractometer.
- 15 Calculate the flash and fire point of oil sample using Abel's apparatus
- 16 Calculate the flash and fire point of oil sample using Pensky Martin's apparatus
- 17 Find the percentage composition of moisture content, volatile matter, ash content and fixed carbon content of coal using proximate analysis of coal
- 18 Find the percentage of CO.CO₂ and O₂ of a sample of flue gas by Orsat apparatus

Analysis of common salt

- 19 Estimating of chlorides content present in common salt.
- 20 Determination of sulphates content in a given sample.

UNIT OPERATIONS-II LAB

Subject Title : Unit Operations-II Lab
Subject Code : CH-PC-407
Periods per week : 03
Periods per Semester : 45

List of experiments:

1. Draw a standard plot between mole fraction of more volatile component and specific gravity of the mixture.
2. Draw a standard plot between mole fraction of more volatile component and refractive index of 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 ($K = \frac{y}{x}$) 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 vapor 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 vapor 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

LIFE SKILLS

Subject Title : Life Skills
Subject Code : CH-PC-408
Scheme : C-16
Periods/ Week : 03
Periods/Semester : 45

TIME SCHEDULE

SI No.	UNITS	No. of periods Allotted		
		Explanation	Activities	Total
1.	ATTITUDE	1	3	4
2.	ADAPTABILITY	1	3	4
3.	GOAL SETTING	1	3	4
4.	MOTIVATION	1	3	4
5.	TIME MANAGEMENT	1	3	4
6.	CRITICAL THINKING	2	3	5
7.	CREATIVITY	1	3	4
8.	PROBLEM SOLVING	1	3	4
9.	TEAM WORK	1	3	4
10.	LEADERSHIP	1	3	4
11.	STRESS MANAGEMENT	1	3	4
TOTAL		12	33	45

Note: No Written Examination; The total 45 hours are to be considered as Theory hours.

Marks: Internal – 40; External – 60

OBJECTIVES:

Upon the completion of this course, the student shall be able to

1.0 Understand the concept of Attitude

- 1.1 Define 'Attitude'
- 1.2 Explain the importance of Attitude
- 1.3 Distinguish between Positive and Negative Attitudes
- 1.4 Life Response: Need for change of Attitude
- 1.5 Positive Attitude: Key to success in Personal and Professional Lives

2.0 Understand the concept of Adaptability

- 2.1 Define the term 'Adaptability'
- 2.2 Explain the concept of Adaptability
- 2.3 Advantages of Adaptability
- 2.4 Disadvantages of Lack of Adaptability
- 2.5 Need for positive response to change

3.0 Understand the concept of Goal setting

- 3.1 Define the terms 'Goal' and 'Goal Setting'
- 3.2 Explain the significance of Goal setting & Long and Short term goals
- 3.3 Explain the following concepts
 - a) Wish b) Dream c) Goal
- 3.4 Explain the reasons for and consequences of not setting goals
- 3.5 The SMART features in Goal setting

4.0 Understand the concept of Motivation

- 4.1 Define 'Motivation' ; Inspiration Vs Motivation
- 4.2 Importance of motivation in Goal setting
- 4.3 Distinguish between Internal (Self) Motivation and External Motivation
- 4.4 De-motivating Factors and how to overcome them
- 4.5 Motivating oneself and others

5.0 Understand Time Management skills

- 5.1 Define 'Time Management'.
- 5.2 Comprehend the significance of Time Management.
- 5.3 Explain the Time Quadrant
- 5.4 Common Time wasters and how to overcome them.
- 5.5 How to meet deadlines and targets within time

6.0 Understand Critical Thinking

- 6.1 Define "Critical Thinking",
- 6.2 Understand the importance of Critical Thinking
- 6.3 Distinguish between facts and opinions (assumptions)
- 6.4 Inculcating different perspectives
- 6.5 Developing Reasoning abilities and form sound judgments

7.0 Understand Creativity

- 7.1 Understand the importance of and need for creative ideas
- 7.2 Distinguish between Linear Thinking and Lateral Thinking
- 7.3 Distinctive qualities of creative people
- 7.4 Unusual or creative use of familiar objects
- 7.5 Creative ways of solving problems

8.0 Understand Problem Solving

- 8.1. Define the concept of Problem solving
- 8.2 Viewing the problems as challenges
- 8.3 Different steps in solving a problem
- 8.4 Selecting the best solution to solve a problem
- 8.5 Lateral thinking in Problem solving

9.0 Understand Team Work

- 9.1 Define Team work

9.2 Develop Team skills

9.3 Advantages of team work

9.4 Understand responsibilities as a team player

9.5 Problems of working in a team and possible solutions

10.0 Understand Leadership

10.1 Define Leadership

10.2 Identify Leadership qualities

10.3 Analyze one's strengths and limitations as a leader

10.4 Types of Leadership: Autocratic and Democratic

10.5 Leadership by example

11.0 Understand Stress Management

11.1 Define Stress

11.2 Explain the causes of stress

11.3 Learn Stress Management skills

11.4 Need for positive thinking and self esteem

11.5 Practice Stress Management strategies

PETROLEUM REFINING-I LAB

Subject Title : Petroleum Refining-I Lab
Subject Code : CH-PC-409
Periods / week : 03
Periods / Semester : 45

List of experiments with objectives:

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.

V and VI semester

DIPLOMA IN CHEMICAL ENGINEERING (PETROCHEMICALS)
SCHEME OF INSTRUCTIONS AND EXAMINATIONS
C16/V Semester (Industrial Training)

S.No.	Subject/Subject code	Scheme of Examination					
		Duration (hours)	Nature	Item	Max. marks		
1	Practical Training in a Chemical or Allied Industry/CHPC-501	6 months	Viva voce	1.First assessment	100		
				2.Second Assessment	100		
			3.At the institution after completion of the training				
			(a) Log Book				30
			(b) Training Report				30
			(c) Seminar				40
TOTAL					300		

DIPLOMA IN CHEMICAL ENGINEERING (PETROCHEMICALS)
SCHEME OF INSTRUCTIONS AND EXAMINATIONS
C16/VI Semester (Industrial Training)

S.No.	Subject/Subject code	Scheme of Examination					
		Duration (hours)	Nature	Item	Max. marks		
1	Practical Training in a Chemical or Allied Industry/CHPC-601	6 months	Viva voce	1.First assessment	100		
				2.Second Assessment	100		
			3.At the institution after completion of the training				
			(a) Log Book				30
			(b) Training Report				30
			(c) Seminar				40
TOTAL					300		

SANDWICH DIPLOMA IN CHEMICAL ENGINEERING (PETRO CHEMICALS)
(CURRICULUM C-16)
V/VI SEMESTERS
(PRACTICAL TRAINING I/II SPELLS)
Duration: 6 months (Each spell)

OBJECTIVES:

On completion of a spell of practical training in a chemical or allied industry, the student will be able to

- 1.0 Know the organizational set up from top executive to workmen level**
 - 1.1 Know the function of each department/section
 - 1.2 Know the inter relationship among various department/sections

- 2.0 Know the various raw materials used as feed stock and chemical composition and their source.**
 - 2.1 Understand the various intermediates produced and their further processing and/or waste disposal.
 - 2.2 Know the final products, its composition and its commercial importance's, uses and applications.

- 3.0 Understand the various stages involved in processing, sequential arrangement of different equipment.**
 - 3.1 Draw the block flow diagram, detail flow diagram of each process after line tracing.
 - 3.2 Understand the arrangement of various process equipment in systematic manner in a less possible area of site.

- 4.0 Know importance process variables required to be maintained in each process equipment of each unit like temperature, pressure, flow P^H etc.**
 - 4.1 Understand the effects of changes of process parameters.

- 5.0 Know the various unit operations in each process parameters.**
 - 5.1 Understand the unit operations principles
 - 5.2 Apply unit operations theory learned at the Institution
 - 5.3 Know the various unit processes (Chemical reactions in each process plant)
 - 5.4 Identify the side reactions in each process plant.

- 6.0 Know the various analytical methods used in the quality control department**
 - 6.1 Understand the experimental methods to find out the compositions and physical properties of various raw materials, intermediates and final products
 - 6.2 Operate various analytical instruments that are used in laboratory.

- 7.0 Know the trouble shooting in process operation**
 - 7.1 Know preventive precautions of the same for each equipment in each process
 - 7.2 Startup and shut down procedures for the equipment and plant.

8.0 Know various measuring instrument, recording instruments and control instruments.

8.1 Understand the D.C.S. in each process

8.2 Identify various sensing elements, transmission elements, indication devices.

9.0 Know the importance of safety in chemical industries

9.1 Understand the safety about personnel protection, equipment protection

9.2 Know the usage of various safety devices

9.3 Precautionary measures to be taken.

10.0 Know the various effluents from each process plant.

10.1 Understand effects of hazardous effluents

10.2 Understand treatment method and disposal.

10.3 Know the effective operation to minimize the effluents.

COURSE CONTENT:

Organizational set up

Raw materials, intermediates and end products

Process descriptions (Process flow diagrams and line tracing, detailed flow diagrams etc.)

Process parameters (such as temp., pressure, flow level etc.)

Unit operations and unit process in each process

Quality control of raw materials, intermediates and end products

Operational troubles and preventive measures

Process instrumentation

Safety aspects (personnel, equipment etc.)

Effluent treatment

**INDUSTRIAL TRAINING SCHEME
V & VI SEMESTERS**

1. A candidate shall be assessed twice in each spell of industrial training i.e. at the end of third month and finally (at the end of sixth month) before he/she completed the industrial training.
2. The assessment shall be carried out by a committee comprising of
 - (a) A representative of the Industry where the candidate is undergoing training
 - (b) A staff member of the concerned section of the polytechnic.
3. The assessment at the end of the third month and the end of training(at the end of sixth month) shall each carry 100 marks for the progress made during the corresponding period of training
4. The remaining 100 marks are allotted as follows for the training report 30 marks, log book 30 marks and for seminar 40 marks. These are to be evaluated at the institution at the end of each spell of training by a committee consisting following staff members
 - (1) Head of Section.
 - (2) External Examiner preferably from Industry
 - (3) Staff member who assessed the student during the Industrial Training.
5. The progress made during the end of each assessment will be evaluated on the basis of the following parameters.

ASSESSMENT SCHEME

S. No.	Name of the Parameter	Max. Marks Allotted for each Parameter
1.	Attendance and punctuality	5
2.	Familiarity with Technical terms	10
3.	Familiarity with tools and material	10
4.	Attitude towards job	5
4.	Manual skills	5
6.	Application of knowledge	10
7.	Problem solving skills	10
8.	Comprehension and observation	5
9.	Safety and Environmental consciousness	5
10.	Human relations	5
11.	Ability to communicate	8
12.	Supervising ability	6
13.	General conduct during the period	6
14.	Maintenance of dairy	10
Total:		100

V AND VI SEMESTERS – (INDUSTRIAL TRAINING)

S.No.	Subject/Subject code	Scheme of Examination					
		Duration (hours)	Nature	Item	Max. marks		
1	Practical Training in a Chemical or Allied Industry/CHPC-501	6 months	Viva voce	1.First assessment	100		
				2.Second Assessment	100		
			3.At the institution after completion of the training				
			(a) Log Book				30
			(b) Training Report				30
			(c) Seminar				40
TOTAL					300		

S.No.	Subject/Subject code	Scheme of Examination					
		Duration (hours)	Nature	Item	Max. marks		
1	Practical Training in a Chemical or Allied Industry/CHPC-601	6 months	Viva voce	1.First assessment	100		
				2.Second Assessment	100		
			3.At the institution after completion of the training				
			(a) Log Book				30
			(b) Training Report				30
			(c) Seminar				40
TOTAL					300		

No gap/ holidays between one spell to another

VII Semester

DIPLOMA IN CHEMICAL ENGINEERING (PETROCHEMICALS)
SCHEME OF INSTRUCTIONS AND EXAMINATIONS
(C16/VII Semester)

Subject Code	Name of the Subject	Instruction periods / week		Total Periods/ year	Scheme of Examination			
		Theory	Practical/ Tutorial		Duration (hours)	Sessional Marks	End Exam Marks	Total Marks
THEORY:								
CHPC -701	Industrial Management and Smart Technologies	5	-	75	3	20	80	100
CHPC -702	Thermodynamics and Reaction Engineering	5	-	75	3	20	80	100
CHPC -703	Instrumentation and Process Control	5	-	75	3	20	80	100
CHPC -704	Unit operations –III	6	-	90	3	20	80	100
CHPC -705	Petrochemical Technology-II	6	-	90	3	20	80	100
PRACTICAL:								
CHPC-706	Unit operations-III Lab	-	3	45	3	40	60	100
CHPC-707	IPC & Reaction Engineering Lab	-	3	45	3	40	60	100
CHPC-708	Petroleum Refining-II Lab	-	3	45	3	40	60	100
CHPC-709	Project Work/CAD in Chemical Engineering Lab	-	6	90	3	40 (20+20)	60 (30+30)	100 (50+50)
TOTAL		27	15	630		260	640	900

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

Industrial Management & Smart Technologies

Subject Title	:	Industrial Management & Smart Technologies
Subject Code	:	CHPC-701
Periods/Week	:	5
Period/Semester	:	75

TIME SCHEDULE

S. No.	Major Topics	Periods	Weightage Of Marks	Short Answer Questions	Essay Type Questions
1.	Basics of Industrial Management	06	13	1	1
2.	Organisation structure & Organisational behaviour	10	18	1	1 ^{1/2}
3.	Production Management	10	18	1	1 ^{1/2}
4.	Materials Management	08	13	1	1
5	Maintenance management & Industrial Safety	08	13	1	1
6	Entrepreneurship Development	08	13	1	1
7	Total Quality Management	05	06	2	
8	Smart technologies	20	16	2	1
	Total	75	110	10	08

1. Basics of Industrial Management

On completion of the course the student will be able to

1.0 Understand the principles of management as applied to industry.

- 1.1 Define industry, commerce (Trade) and business.
- 1.2 Know the need for management.
- 1.3 Understand the evolution of management
- 1.4 Understand functions of Management.
- 1.5 Explain the principles of scientific management.
- 1.6 Explain the principles of management.
- 1.7 Differentiate between management and administration.
- 1.8 Understand the nature of management as a profession
- 1.9 Differentiate between supervisory, middle and Top level management
- 1.10 Explain the importance of managerial skills (Technical, Human, Conceptual)

2. Organisation Structure & organisational behaviour

Know types of ownerships, the organisation structure of an industry and the behaviour of an individual in an organisation.

- 2.1 Understand the philosophy and need of organisation structure of an industry.
- 2.2 Understand the line, staff and Functional organisations
- 2.3 Understand the Authority and Responsibility Relationships

- 2.4 Understand the differences between Delegation and decentralization
- 2.5 Explain the factors of effective organisation.
- 2.6 Outline the communication process
- 2.7 State motivation theories.
- 2.8 State Maslow's Hierarchy of needs.
- 2.9 List out different leadership models.
- 2.10 Explain the trait theory of leadership.
- 2.11 Explain behavioural theory of Leadership.
- 2.12 Explain the process of decision making.
- 2.13 Assessing Human resource requirements
- 2.14 Know the concept of Job analysis, Job description and specifications
- 2.15 Understand the process of recruitment, selection, training and development
- 2.16 Understand types of business ownerships
- 2.17 Differentiate between the business ownerships
- 2.18 Know the objectives of Employee participation
- 2.19 Understand the meaning and definition social responsibilities
- 2.20 Corporate social responsibility

3. Production management

Understand the different aspects of production management.

- 3.1 Identify the factors of Plant Location
- 3.2 Know the objectives of plant Layout
- 3.3 Understand the principles of plant Layouts
- 3.4 Explain the types of plant Layouts
- 3.5 Relate the production department with other departments.
- 3.6 State the need for planning and it's advantages.
- 3.7 Explain the stages of Production, planning and control.
- 3.8 Know the basic methods demand forecasting
- 3.9 Explain routing methods.
- 3.10 Explain scheduling methods.
- 3.11 Explain dispatching.
- 3.12 Explain Break Even Analysis
- 3.13 Define supply chain Management, competitive strategy, Supply chain strategy
- 3.14 Draw PERT/CPM networks.
- 3.15 Identify the critical path

4. Materials Management

Understand the role of materials management industries.

- 4.1 Explain the importance of materials management in Industry.
- 4.2 Know Functions of Materials Management
- 4.3 Derive expression for inventory control.
- 4.4 Explain ABC analysis.
- 4.5 Define safety stock.
- 4.6 Define reorder level.
- 4.7 Derive an expression for economic ordering quantity.
- 4.8 Know the functions of Stores Management,
- 4.9 Explain types of store layouts.
- 4.10 List out stores records.
- 4.11 Explain the Bin card.
- 4.12 Describe Cardex method.
- 4.13 Explain general purchasing procedures

- 4.14 Explain tendering, E-tendering and E-procurement procedures
- 4.15 List out purchase records.
- 4.16 Know the applications of RFID (Radio Frequency Identification Device)
- 4.17 Understand the applications of RFID in material management

5. Maintenance Management & Industrial Safety

Comprehend the Importance of Maintenance Management & Safety procedures

- 5.1 Explain the importance of maintenance management in Industry.
- 5.2 Know the Objectives of maintenance management
- 5.3 Know the activities of maintenance management
- 5.4 Understand the importance of Preventive maintenance
- 5.5 Understand the need for scheduled maintenance
- 5.6 Differentiate between scheduled and preventive maintenance
- 5.7 Know the principles of 5 s for good house keeping
- 5.8 Explain the importance of safety at Work place.
- 5.9 List out the important provisions related to safety.
- 5.10 Explain hazard and accident.
- 5.11 List out different hazards in the Industry.
- 5.12 Explain the causes of accidents.
- 5.13 Explain the direct and indirect cost of accidents.
- 5.14 Understand the types of emission from process Industries, their effects on environment and control
- 5.15 Understand the principles of solid waste management

6. Entrepreneurship Development.

Understand the role of entrepreneur in economic development and in improving the quality of life.

- 6.1 Define the word entrepreneur.
- 6.2 Explain the requirements of an entrepreneur.
- 6.3 Determine the role of entrepreneurs in promoting Small Scale Industries.
- 6.4 Describe the details of self-employment schemes.
- 6.5 Characteristic of successful entrepreneurs
- 6.6 Explain the method of site selection.
- 6.7 List the financial assistance programmes.
- 6.8 List out the organisations that help an entrepreneur
- 6.9 Know the use of EDP Programmes
- 6.10 Understand the concept of make in India, Zero defect and zero effect
- 6.11 Understand the importance for startups
- 6.12 Explain the conduct of demand surveys
- 6.13 Explain the conduct of a market survey
- 6.14 Evaluate Economic and Technical factors.
- 6.15 Prepare feasibility report study

7. Total Quality Management:

Understand the concepts adopted in total quality management

- 7.1 Explain the concept of quality.
- 7.2 List the quality systems and elements of quality systems.
- 7.3 State the principles of quality Assurance.
- 7.4 Understand the basic concepts of TQM

- 7.5 Know the Pillars of TQM
- 7.6 List the evolution of ISO standards.
- 7.7 Explain ISO standards and ISO 9000 series of quality systems.
- 7.8 List the beneficiaries of ISO 9000.
- 7.9 Explain the concepts of ISO 14000
- 7.10 Know the overview of PDCA cycle

8. Smart Technologies

8.1 Get an overview of IoT

- 8.1.1 Define the term IoT
- 8.1.2 Know how IoT work
- 8.1.3 List the key features of IoT
- 8.1.4 List the components of IoT : hardware, software, technology and protocols
- 8.1.5 List the advantages and disadvantages of IoT

8.2 IoT Applications

- 8.2.1 Smart Cities
- 8.2.2** Smart Energy and the Smart Grid
- 8.2.3** Smart Transportation and Mobility
- 8.2.4** Smart Home, Smart Buildings and Infrastructure
- 8.2.5** Smart Factory and Smart Manufacturing
- 8.2.6** Smart Health
- 8.2.7** Food and Water Tracking and Security
- 8.2.8** Social Networks and IoT

Course Content

1. Basics of Industrial Management

Introduction: Industry, Commerce and Business; Definition of management; Characteristics of management; Functions of management - Planning, Organizing, Staffing, Directing, Co-ordination, Controlling, Motivating, Communication, Decision Making; Principles of scientific management: – F.W.Taylor, Principles of Management: Henry Fayol; Administration and management; Nature of management; levels of management; managerial skills;

2. Organisation Structure & organisational behaviour

Organizing - Process of Organizing; Line/Staff and functional Organizations, Decentralization and Delegation, Effective Organizing; Communication, Motivational Theories; Leadership Models; Human resources development; Forms of Business ownerships: Types – Sole proprietorship, Partnership, Joint Stock Companies, Cooperative types of Organizations; Employee participation in management; Corporate Social responsibility;

3. Production management

Definition and importance; Plant location and layout; Types of production -job, batch and mass; production Planning and Control: Demand forecasting, routing, scheduling, dispatching and follow up; Break even analysis; Supply chain Management (Definition, Competitive strategy Vs Supply chain Strategy, Supply chain drivers); Project scheduling; Application of CPM and PERT techniques; simple numerical problems;

4. Materials Management

Materials in industry, Basic inventory control model, ABC Analysis, Safety stock, re-order level, Economic ordering quantity, Stores Management: Stores layout, stores equipment, Stores records, purchasing procedures, e-tendering, e-procurement; purchase records, Bin card, Cardex RFID (Radio Frequency Identification Device) application in materials management;

5. Maintenance Management & Industrial Safety

Objectives and importance of plant maintenance, Different types of maintenance, Nature of maintenance problems, Range of maintenance activities, Schedules of preventive maintenance, Advantages of preventive maintenance, 5 S principles; Importance of Safety at work places; Causes of accidents-psychological, physiological and other industrial hazards; Domino sequence; methods of promoting safe practices; Pollution control in process industries; Introductory concepts on Solid waste management (General introduction including definitions of solid waste including municipal, hospital and industrial solid waste, Waste reduction at source – municipal and industrial wastes)

6. Entrepreneurship Development.

Definition of Entrepreneur; Role of Entrepreneur; Concept of Make In India, ZERO defect, Zero Effect, Concept of Start-up Company, Entrepreneurial Development: Role of SSI, MSME, DICs, Entrepreneurial development schemes; Institutional support, financial assistance programmes; Market survey and Demand survey; Preparation of Feasibility study reports

7. Total Quality Management:

Total Quality Management (TQM)- Concept of quality discussed by B. Crosby W. Edward, Deming, Joseph M. Juran, Kooru Ishikawa, Genichi Taguchi, Shigco Shingo. Quality systems – Definitions of the terms used in quality systems like, quality policy, quality management, quality systems, Stages of development of ISO 9000 series , ISO-14000, Deming's PDCA Cycle (Plan, Do, Check and Action). Japanese Quality Management, culture, Kaizen Strategy (continuous improvement).

8. Smart Technologies :

Overview of IoT - Define IoT, how IoT work, key features of IoT, components of IoT : hardware, software, technology and protocols, advantages and disadvantages of IoT - IoT Applications - Smart Cities, Smart Energy and the Smart Grid, Smart Transportation and Mobility, Smart Home, Smart Buildings and Infrastructure, Smart Factory and Smart Manufacturing, Smart Health, Food and Water Tracking and Security, Participatory Sensing, Social Networks and IoT.

REFERENCE BOOKS

1. Industrial Engineering and Management -by O.P Khanna
2. Production Management- by Buffa.
3. Engineering Economics and Management Science - by Banga & Sharma.
4. Personnel Management by Flippo.
5. Production and Operations Management –S.N. Chary
6. Converging_Technologies_for_Smart_Environments_and_Integrated_Ecosystems_IERC_Book_Open_Access_2013 pages-54-76
7. Supply Chain Management –Sunil Chopra and Meindl, PHI publishers
8. 5 S made easy by David Visco

THERMODYNAMICS AND REACTION ENGINEERING

Subject Title : Thermodynamics and Reaction Engineering
Subject Code : CH-PC-702
Periods per week : 05
Periods / Semester : 75

TIME SCHEDULE

S. No.	Major topics	No. of periods	Weightage Of Marks	Short answer type	Essay type
1.	Introduction, First law and Basic concepts of thermodynamics	10	13	1	1
2.	Volumetric properties of pure fluids	12	16	2	1
3.	The second law of thermodynamics	12	16	2	1
4.	Refrigeration and Liquefaction	10	13	1	1
5.	Chemical Reaction Equilibria	10	13	1	1
6.	Introduction to Chemical Reaction Engineering, Kinetics of homogeneous Reactions, Interpretation of Batch reactor data, Single ideal reactors	15	26	2	2
7.	Catalysis and Industrial reactors	06	13	1	1
Total		75	110	10	08

OBJECTIVES:

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

1.0 Introduction, First law and Basic Concepts of thermodynamics

- 1.1 Know the scope of thermodynamics.
- 1.2 Know about system and surroundings
- 1.3 Define open, closed and isolated systems
- 1.4 Define internal energy, enthalpy and their units in SI system.
- 1.5 Know the statement for 1st law of thermodynamics.
- 1.6 Derive an expression of first law of thermodynamics for the following :
 - (a) Closed system
 - (b) Steady state flow process.
- 1.7 Differentiate between state and path functions.
- 1.8 Understand extensive and intensive properties.
- 1.9 Define heat capacity and specific heat
- 1.10 Application of heat capacity and specific heat
- 1.11 State and explain (a) Equilibrium (b) Phase rule (c) Reversible process.
- 1.12 Simple problems on fundamentals and first law of thermodynamics.

2.0 Volumetric properties of pure fluids

- 2.1 Know the PVT behavior of pure substances.
- 2.2 Define ideal gas. Know the characteristics of ideal gas.
- 2.3 Define compressibility factor and know about compressibility Charts.

- 2.4 Cubic Equation of state (a) Vanderwaal's equation (b) Redlich Knowng's Equation
- 2.5 Derive $C_p - C_v = R$ for a mole of an ideal gas.
- 2.6 State and explain about the following processes.
 - a) Isochoric b) Isobaric c) Isothermal and d) Adiabatic
- 2.7 Derive different expression for ΔU , ΔH , Q and W for (a) Isochoric (b) Isobaric c) Isothermal d) Adiabatic processes connecting PVT properties.
- 2.8 Solve problems on calculation of ΔU , ΔH , Q and W in the above processes connecting PVT Properties.

3.0 The second law of thermodynamics.

- 3.1 Know the statements of second law of thermodynamics.
- 3.2 Distinguish between heat engine and heat pump.
- 3.3 Know the schematic representation of heat engine and heat pump.
- 3.4 Define efficiency of heat engine and COP of heat pump.
- 3.5 Know the thermodynamic temperature scales
- 3.6 Know Carnot cycle principle
- 3.7 Derive thermodynamic temperature and the ideal gas scale.
- 3.8 State and explain Carnot cycle principle.
- 3.9 Define entropy and its SI units.
- 3.10 Know the entropy characteristics.
- 3.11 Know the entropy changes of an ideal gas.
- 3.12 Know the mathematical statement of 2nd law of thermodynamics
- 3.13 Solve simple problems on heat engine, heat pump
- 3.14 Solve simple problems on entropy and adiabatic mixing.
- 3.15 State third law of thermodynamics.
- 3.16 Know the property relations for homogeneous phases
 - (a) $H = U + PV$ (b) $A = U - TS$ (c) $G = H - TS$
- 3.17 Fundamental property relations (e) Maxwell's equations

4.0 Refrigeration and Liquefaction.

- 4.1 Define refrigeration.
- 4.2 Explain the cycle of refrigeration.
- 4.3 Know about various methods of refrigeration.
- 4.4 Know about various applications of refrigeration.
- 4.5 Define refrigerant.
- 4.6 Know about classification of refrigerants with examples (primary and secondary).
- 4.7 Know the principle of Carnot cycle refrigerator.
- 4.8 Know about choice of refrigerant.
- 4.9 Explain the method of obtaining vapor compression refrigeration.
- 4.10 Explain the method of obtaining vapor absorption refrigeration.
- 4.11 Solve simple problems on refrigeration capacity and COP.
- 4.12 Know about liquefaction
- 4.13 State various methods of liquefaction
- 4.14 Explain Linde liquefaction process
- 4.15 Explain Claude liquefaction process

5.0 Chemical-Reaction Equilibria

- 5.1 Know the reaction coordinate.

- 5.2 Simple problems on reaction coordinate.
- 5.3 Application of equilibrium criteria to chemical reactions.
- 5.4 Derive the relation between standard Gibbs free energy change (ΔG^0) and the equilibrium constant (K).
- 5.5 Derive an expression for the effect of temperature on equilibrium constant.
- 5.6 Explain the Lechatelier's Principle for (a) Haber's process (b) Contact process.
- 5.7 Solve Simple problems on (a) $\Delta G^0 = -RT\ln K$ (b) $\ln(k_1/k_2) = (\Delta H^0/R)(1/T_2 - 1/T_1)$

6.0 Introduction to Chemical Reaction Engineering, Kinetics of homogeneous Reactions, Interpretation of Batch reactor data, Single ideal reactors

- 6.1 Introduction.
- 6.2 Know the importance of reaction kinetics in chemical industries.
- 6.3 To know about classification of reactions.
- 6.4 Define reaction rate and know its units.
- 6.6 Know the variables affecting the rate of reaction.
- 6.7 Define single, multiple, elementary and non-elementary reactions.
- 6.8 To know about molecularity and order of reaction.
- 6.9 Define rate constant (k) and know representation of a rate equation.
- 6.10 Know about temperature – dependent term of a rate equation.
- 6.11 Explain temperature dependency from Arrhenius law.
- 6.12 Know about constant – volume batch reactor.
- 6.13 Know about
 - a) Integral method of analysis of data.
 - b) Differential method of analysis of data.
- 6.14 Define the following with examples.
 - a) Zero order
 - b) First order
 - c) Second order
- 6.15 Explain broad classification of reactor types.
- 6.16 Explain ideal batch reactor with diagram and design equation.
- 6.17 Define space time and space velocity.
- 6.18 Know the steady state mixed flow reactor with diagram and design equation.
- 6.19 Explain steady state plug flow reactor with diagram and design equation.
- 6.20 Simple problems on Batch, CSTR and PFR

7.0 Catalysis and Industrial reactors

- 7.1 Understand the catalysis.
- 7.2 Know the types of catalysis
- 7.3 Comprehend the characteristics of a catalytic reactions.
- 7.4 Define auto catalysis.
- 7.5 State the function of promoters, accelerators, carriers, inhibitors in catalytic reaction with examples.
- 7.6 Explain catalyst poisoning.
- 7.7 List out some important commercially available catalysts.
- 7.8 Name some industrial catalytic processes.
- 7.9 Understand the working principle of the following with the help of neat sketches.

- a) Fixed bed reactors
- b) Moving bed reactors
- c) Fluidized bed reactors

COURSE CONTENTS:

1. Introduction and First law of thermodynamics.

The scope of thermodynamics- System, surroundings- Open, closed and isolated systems- Internal energy –enthalpy- Formulation of first law for closed system –First law for Steady state flow process – State functions and path functions- heat capacity and specific heat- applications of heat capacity and specific heat - Equilibrium – Phase rule-Reversible process- Simple problems on fundamentals and first law.

2. Volumetric properties of pure fluids.

PVT behavior of pure substances – Ideal gas —Definition of compressibility factor- cubic equation of state-Vanderwaal's equation, Redlich Kwong equation-derivation of $C_p - C_v = R$ for a mole of an ideal gas-thermodynamic processes : a) Isochoric b) Isobaric c) Isothermal and d) Adiabatic.- expressions for ΔU , ΔH , Q and W for the above processes connecting PVT properties- Problems on calculation of ΔU , ΔH , Q and W in the above processes.

3. The second law of thermodynamics:

Statements of second law – The heat engine and heat pump- Carnot principle-thermodynamic temperature scales- Carnot cycle for an ideal gas – Entropy – Entropy changes of an ideal gas – Mathematical statement of the second law – The third law of thermodynamics, Statement - property relations for homogeneous phases-enthalpy, Helmholtz energy, Gibb's energy – fundamental property relations-Maxwell's equations-Simple problems on heat engine and heat pump-Problems on entropy and adiabatic mixing.

4. Refrigeration and Liquefaction:

The Carnot refrigerator – Vapor Compression cycle –Vapor Absorption refrigeration- Comparison of refrigeration cycles – Industrial refrigerants- – Choice of refrigerant — Heat pump-Liquefaction- Linde liquefaction process- Claude liquefaction process- Simple problems on refrigeration capacity.

5. Chemical Reaction Equilibria :

Reaction coordinate-Application of equilibrium criteria to chemical reactions – The standard Gibbs energy change and the equilibrium constant – Effect of temperature on the equilibrium constant – Lechatlier's principle - Lechatlier's principle for Haber's Process and Contact's process-Evaluation of equilibrium constants and standard Gibb's Free energy

6. Introduction to Chemical Reaction Engineering, Kinetics of homogeneous Reactions, Interpretation of Batch reactor data, Single ideal reactors

Importance of Chemical kinetics – Classification of reactions –Variables affecting the rate of reaction – Reaction rate- Concentration dependent term of a rate equation – Single and multiple reactors, elementary and non elementary reactions – Molecularity and order of a reaction- Rate constant K -representation of a reaction rate –Temperature dependent term of rate equation-Arrhenius Law-Constant volume batch reactor – Integral method of analysis of data-irreversible unimolecular first order reaction-irreversible bimolecular type second order reactions-empirical rate equation for nth order-over all order of irreversible reactions

from the Half life- differential method of analysis of data. – Broad classification of reactor types – Ideal batch reactor – Space time and space velocity – Steady state mixed flow reactor – Steady stated plug flow reactor – Holding time and space time for flow systems – Problems on various reactors.

7. Catalysis and Industrial Reactors:

Types of catalysis – Characteristics of catalytic reactions – Auto catalysis – Accelerators, Promoters, inhibitors, poisons- some important catalysts- industrial catalytic processes- Important industrial reactors

REFERENCE BOOKS:

1. Introduction to Chemical Engineering Thermodynamics – by Smith and Vannes, 4th Edition.
2. Chemical reaction Engineering – by Octave Levenspiel, 2nd edition.
3. Introduction to Chemical Reaction Engineering – by K.A. Gavane, Nirali Publications.
4. Chemical Kinetics – by J.M. Smith.

INSTRUMENTATION & PROCESS CONTROL

Subject title : Instrumentation & Process Control
Subject code : CH-PC-703
Periods per week : 05
Periods per semester : 75

TIME SCHEDULE

S.No.	Major Topics	Periods	Weightage Of marks	SAQ	EAQ
1.	Introduction and Qualities of measurement	8	13	1	1
2.	Measurement of Temperature	12	23	1	2
3.	Measurement of pressure and Vacuum:	10	16	2	1
4.	Measurement of Liquid level, Density and Viscosity.	10	13	1	1
5.	Measurement of composition.	10	13	1	1
6.	Process Instrumentation & Instrumentation diagrams for Chemical Engineering processes and operations:	10	16	2	1
7.	Principles of automatic process control and modes available for process control.	15	16	2	1
Total		75	110	10	8

OBJECTIVES:

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

Unit-1: Introduction and Qualities of measurement

- 1.0 Know the importance of Instrumentation and process control in Chemical Industries.
- 1.1 Know the meaning of measurement.
- 1.2 Know the differences between direct and in-direct measurement.
- 1.3 Know about different elements of an instrument.
- 1.4 Know about the Static characteristics of an instrument.
- 1.5 Know about the Dynamic characteristics of an instrument.
- 1.6 Know about a First order system and physical examples of first order system.

- 1.7 Know about a Second order system and physical examples of second order system.
- 1.8 Know about various input functions like Step input, Impulse input, Sinusoidal input and Linear input.
- 1.9 Know about the response of a first order system for a given input functions with derivations.
- 1.10 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.
- 2.5 Know about thermo-electricity and thermo-electric circuit or Thermocouple.
- 2.6 Know about Seebeck effect, Peltier effect and Thomson effect.
- 2.7 Know the types of industrial thermocouples.
- 2.8 Know about the accessories of an industrial thermocouple.
- 2.9 Know the mechanical properties of thermal well materials.
- 2.10 Know the effect of location of reference junction and lead wires for a thermocouple.
- 2.11 Know about the principle, construction, working of Milli-voltmeter and its application.
- 2.12 Know about the principle, construction, working of Null Potentiometer circuit and its application.
- 2.13 Know about temperature coefficient of resistance.
- 2.14 Know about industrial resistance thermometer bulbs.
- 2.15 Know about resistance thermometer elements.
- 2.16 Know about thermal wells and lead wires for resistance thermometers.
- 2.17 Know the indicating elements of industrial resistance thermometers like
- 2.18 Wheat stone bridge circuit and Modified wheat stone bridge circuit also known as “Callender Griffith circuit”.
- 2.19 Know about radiation temperature measurement.
- 2.20 Know about radiation receiving elements.
- 2.21 Know the types of radiation pyrometers.
- 2.22 Know about Optical pyrometer and its principle, construction and working.

Unit-3: Measurement of pressure and Vacuum:

- 3.1 Know the basic concepts of pressure measurement.
- 3.2 Know different types of pressures.
- 3.3 Know about different types of liquid column manometers, their principle construction and working.
- 3.4 Know different types of pressure measuring elements.
- 3.5 Know the mechanical indicating elements.
- 3.6 Know about inductance coil method of an indicating element.
- 3.7 Know about resistance rod indicating element.
- 3.8 Know about electric pressure gauge of indicating element.
- 3.9 Know about different types of vacuum gauges.

Unit-4: Measurement of Liquid level, Density and Viscosity.

- 4.1 Know the principle construction and working of liquid level method of measuring density.
- 4.2 Know the direct methods of liquid level measurement.
- 4.3 Know the principle construction and working of bubbler system for measurement of liquid level.
- 4.4 Know the level measurement in pressure vessels.
- 4.5 Know about principle construction and working of displacement float liquid level system.
- 4.6 Know about principle construction and working of pneumatic balance displacement float liquid level system.
- 4.7 Know the basic concepts for measuring density.
- 4.8 Know the principle construction and working of displacement-meter for measuring density by republic flow-meter Company.
- 4.9 Know the principle construction and working of hydrometer for density measurement.
- 4.10 Know the basic concept of viscosity measurement.
- 4.11 Know the principle construction and working of viscosity measurement by Viscosity meter-Brabender Corporation.
- 4.12 Know the principle construction and working of viscosity measurement by Continuous Viscosity meter.

Unit-5: Measurement of composition.

- 5.1 Know the determination of gas analysis by thermal conductivity method.
- 5.2 Know the determination of moisture content in gases by Psychrometer.
- 5.3 Know the determination of moisture in Paper and Lumber.
- 5.4 Know the determination of PH of a solution by PH cell (Measuring cell & Calomel cell) method.
- 5.5 Know about Spectroscopic methods of analysis
- 5.6 Know about the working principle of spectro photo meter
- 5.7 Know about the working principle of gas-liquid chromatography

Unit-6: Process Instrumentation & Instrumentation diagrams for Chemical Engineering processes and operations:

- 6.1 Know about recording instruments used for process instrumentation.
- 6.2 Know about indicating and signaling instruments.
- 6.3 Know about control center.
- 6.4 Know about signal conversion devices.
- 6.5 Know about the instrumentation diagrams.
- 6.6 Know about the instrumentation diagram for a distillation column.
- 6.7 Know about the instrumentation diagram for an evaporator.
- 6.8 Know about the instrumentation diagram for a reactor.
- 6.9 Know about the instrumentation diagram for extractor

Unit-7: Principles of automatic process control and modes available for process control.

- 7.1 Know about a simple automatic process control.
- 7.2 Know about components of a control system.

- 7.3 Know about types of control systems.
- 7.4 Know the basic nomenclature associated with a control system.
- 7.5 Know about control actions.
- 7.6 Know the expressions for the transfer function for the proportional control, Proportional-Derivative, Proportional-Integral, Proportional-Integral-Derivative control actions.
- 7.7 Know about the components of a hydraulic system.
- 7.8 Know about the construction, working of a hydraulic system incorporated with Proportional, Proportional-Integral, Proportional-Derivative and Proportional-Integral-Derivative control action.
- 7.9 Know about the components of a pneumatic system.
- 7.10 Know about the construction, working of a Pneumatic system incorporated with Proportional, Proportional-Integral, Proportional-Derivative and Proportional-Integral-Derivative control action.
- 7.11 Know about Control valve, its components, working and characteristics.
- 7.12 Elaborate explanation of programmable logic control and Distributive control system.

COURSE CONTENT:

Unit-1: Introduction and Qualities of measurement

Importance of instrumentation --Meaning of measurement - Different elements of an instrument - Static characteristics of an instrument - Dynamic characteristics of an instrument - First order system and physical examples - Second order system and physical examples of second order system -Various input functions like Step input, Impulse input, Sinusoidal input and Linear input

Unit-2: Measurement of Temperature.

Different temperature scales in different units—Principle, working and working of expansion thermometers like Mercury in glass thermometer, Bi-metallic thermometer and Pressure spring thermometer - Vapor actuated thermometer--Sources of static error in industrial pressure spring thermometers - Thermo-electricity and thermo-electric circuit or Thermocouple - Accessories of an industrial thermocouple - Milli-voltmeter and its application - Null Potentiometer circuit and its and its application - Resistance thermometer elements - Wheat stone bridge circuit and Modified wheat stone bridge circuit -Radiation temperature measurement - Radiation receiving elements - construction and working - Optical pyrometer and Radiation pyrometer.

Unit-3: Measurement of pressure and Vacuum:

Basic concepts of pressure measurement - liquid column manometers - pressure spring gauge, Bellow pressure element, Diaphragm element, Differential pressure indicating manometer, Bell differential pressure gauge--Mechanical indicating elements, Principle, working and construction of Pressure tight shaft and torque tube shaft--Principle, construction and working of inductance coil method of an indicating element--Principle, construction and working of resistance rod indicating element--Principle construction and working of electric pressure gauge of indicating element--Principle construction and working of different types of vacuum gauges like Mc-leod vacuum gauge, Pirani vacuum gauge, Thermocouple vacuum gauge, Thermionic type ionization vacuum gauge.

Unit-4: Measurement of Liquid level, Density and Viscosity:

Basic concepts for measuring density--Principle construction and working of displacement-meter for measuring density by republic flow-meter Company--Principle construction and working of hydrometer for density measurement--Principle construction and working of liquid level method of measuring density--Direct methods of liquid level measurement, Float and tape liquid level system, Hydraulic remote transmission of liquid level system--Principle construction and working of bubbler system for measurement of liquid level--Level measurement in pressure vessels, Principle construction and working of differential pressure manometer for measuring liquid level in pressure vessels-- Principle construction and working of displacement float liquid level system--Principle construction and working of pneumatic balance displacement float liquid level system--Basic concepts of viscosity measurement--Principle construction and working of viscosity measurement by Viscosity meter-Brabender Corporation--Principle construction and working of viscosity measurement by Continuous Viscosity meter.

Unit-5: Measurement of composition:

Gas analysis by thermal conductivity method--Determination of moisture content in gases by Psychrometer--Determination of moisture in Paper and Lumber--Determination of P^H of a solution by P^H cell (Measuring cell & Calomel cell) method--Spectroscopic analysis methods, Absorption spectroscopy, Emission spectroscopy, Mass spectroscopy, Working principle of spectro photo meter, working principle of gas-liquid chromatography

Unit-6: Process Instrumentation & Instrumentation diagrams for Chemical Engineering processes and operations:

Recording instruments used for process instrumentation, Circular recording chart and concentric indicating scale, Strip recording chart and linear indicating scale, Multi-record recorder-- Indicating and signaling instruments, Eccentric scale indicator, Concentric indicating scale--Control center--Signal conversion devices, Transducer, Amplifier--Instrumentation diagrams--Instrumentation diagram of Control schemes for heat exchangers-- Instrumentation diagram for a distillation column--Instrumentation diagram for an evaporator--Instrumentation diagram for a reactor, Instrumentation diagram for extractor.

Unit-7: Principles of automatic process control and modes available for process control.

Simple automatic process control system--Components of a control system, Process, measuring element, Controller, Comparator, Final control element, Types of control systems, Feedback control system or closed loop control system - Feed forward control system (Open loop control system)--Basic nomenclature associated with a control system, Load, Controlled variable, set point, error, measured variable, manipulated variable, Proportional gain, Proportional band, Offset--Control actions, Proportional control action, Integral control action, Derivative control action, Proportional-Integral control action, Proportional-Derivative control action, ON-OFF Control action, Proportional-Integral-Derivative control action--Expressions for the transfer function for the proportional control, Proportional-Derivative, Proportional-Integral, Proportional-Integral-Derivative control actions--Know about the components of a hydraulic system--Construction, working of a hydraulic system incorporated with Proportional, Proportional-Integral, Proportional-Derivative and Proportional-Integral-Derivative control action--Components of a pneumatic system, Construction, working of a Pneumatic system incorporated with Proportional, Proportional-Integral, Proportional-Derivative and

Proportional-Integral-Derivative control action--Control valve, its components, working and characteristics-- Elaborate explanation of programmable logic control and Distributive control system.

REFERENCE BOOKS:

1. Industrial Instrumentation by Donald P. Eckmann
2. Industrial Instrumentation & Control by S K Singh.
3. Process systems analysis & Control by Donald R. Coughanowr.
4. Chemical Process Control by George Stephanopoulos.
5. Process Control by Peter Harriot.
6. Instrumentation & Process Measurements by W Bolton.

UNIT OPERATIONS -III

Subject Title : **Unit Operations-III**

Subject Code : **CH-PC – 704**

Periods per week : **06**

Total periods/ semester : **90**

TIME SCHEDULE:

S.No.	Major topics	No. of periods	Weightage of Marks	Short answer type	Essay type
1.	Introduction and Properties of particulate solids	15	16	2	1
2.	Storage and conveyance	10	13	1	1
3.	Mixing	10	13	1	1
4.	Size Reduction	25	26	2	2
5.	Mechanical Separations	15	26	2	2
6.	Filtration	15	16	2	1
Total		90	110	10	08

OBJECTIVES:

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 conveyor, 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, 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 Newtons 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 CONTENT:

- 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, Nirali Prakasham Publications.

PETROCHEMICAL TECHNOLOGY - II

Subject title : Petrochemical Technology - II
Subject Code : CH-PC-705
Periods / Week : 6
Periods / Semester : 90

TIME SCHEDULE

S. No.	Major Topics	Periods	Weightage of marks	Short answer type	Essay type
1	Thermodynamic and Kinetic considerations, Unit Operations and Unit process	5	06	2	-
2	Principles of Nitration	10	13	1	1
3	Principles of Amination by reduction and ammonolysis	15	16	2	1
4	Principles of Halogenation	25	23	1	2
5	Principles of Oxidation	10	13	1	1
6	Principles of Hydrogenation	10	13	1	1
7	Principles of Esterification	10	13	1	1
8	Principles of Alkylation	5	13	1	1
Total		90	110	10	8

OBJECTIVES:

Unit-1: To know about the Thermodynamic and Kinetic considerations, Unit operations and Unit process

- 1.1 Know about thermodynamic and kinetic considerations for industrial purposes.
- 1.2 Know about the concepts of unit processes.

Unit-2: Principles of Nitration

- 2.1 Know about the definition of nitration.
- 2.2 Know about the various nitrating agents
- 2.3 Know about the aromatic nitration
- 2.4 Know about the nitration of paraffinic hydrocarbons
- 2.5 Know about the liquid phase nitration
- 2.6 Know about the gas phase nitration
- 2.7 Know about the advantages and disadvantages of batch nitration
- 2.8 Know about the advantages and disadvantages of continuous nitration
- 2.9 Know about the various types of nitrators such as Schmid nitrator, Biazzini nitrator
- 2.10 Know about the properties and uses of nitrobenzene
- 2.11 Describe briefly about the production of nitrobenzene from benzene
- 2.12 Know about the properties and uses of α - nitro naphthalene
- 2.13 Describe briefly about the production of α - nitro naphthalene from naphthalene
- 2.14 Know about the properties and uses of nitroparaffins

- 2.15 Describe briefly about the production of nitroparaffins from paraffin's
- 2.16 Know about the properties and uses of trinitro toluene (TNT)
- 2.17 Describe briefly about the production of trinitro toluene (TNT) from toluene

Unit-3: Principles of Amination by reduction and ammonolysis

- 3.1 Know about the definition of amination by reduction
- 3.2 Know about the types of amines
- 3.3 Know about the methods of production of primary amines
- 3.4 Know about the reduction methods for preparation of amines
- 3.5 Know about the Bechamp reduction.
- 3.6 Know about the definition of amination by ammonolysis
- 3.7 Know about the classification of ammonolysis reactions
- 3.8 Know about the various aminating agents
- 3.9 Know about the properties and uses of aniline
- 3.10 Describe briefly about the production of aniline by vapor phase reduction of nitrobenzene
- 3.11 Know about the properties and uses of ethanol
- 3.12 Describe briefly about the production of ethanol
- 3.13 Know about the properties and uses of benzene sulphonic acid
- 3.14 Describe briefly about the production of benzene sulphonic acid
- 3.15 Know about the synthetic detergents

Unit-4: Principles of Halogenation

- 4.1 Know about the definition of halogenation
- 4.2 Know about the methods of production of chlorinated compounds
- 4.3 Know about the various catalysts used in chlorination
- 4.4 Know about the effect of catalyst on chlorination reaction
- 4.5 Know about the Photo halogenation
- 4.6 Know about the properties and uses of ethylene dichloride
- 4.7 Describe briefly about the production of ethylene dichloride from ethylene
- 4.8 Know about the properties and uses of chloropentanes
- 4.9 Describe briefly about the production of chloropentanes from pentanes
- 4.10 Know about the properties and uses of mono chloro acetic acid
- 4.11 Describe briefly about the production of mono chloro acetic acid from acetic acid
- 4.12 Know about the properties and uses of chloral
- 4.13 Describe briefly about the production of chloral from ethyl alcohol
- 4.14 Know about the properties and uses of DDT
- 4.15 Describe briefly about the production of DDT from chloral and monochloro benzene
- 4.16 Know about the properties and uses of mono chloro benzene
- 4.17 Describe briefly about the production of mono chloro benzene from benzene
- 4.18 Know about the properties and uses of Benzene hexa chloride (BHC)
- 4.19 Describe briefly about the production of Benzene hexa chloride (BHC) by liquid phase chlorination of benzene
- 4.20 Know about the properties and uses of chlorinated methanes
- 4.21 Describe briefly about the production of chlorinated methanes by vapor phase thermal chlorination of methane
- 4.22 Know about the properties and uses of vinyl chloride

4.23 Describe briefly about the production of vinyl chloride from ethylene

Unit-5: Principles of Oxidation

- 5.1 Know about the definition of oxidation
- 5.2 Know about the types of oxidative reactions
- 5.3 Know about the various oxidizing agents
- 5.4 Know about the liquid phase oxidation process
- 5.5 Know about the vapor phase oxidation process
- 5.6 Know about the properties and uses of acetic acid
- 5.7 Describe briefly about the production of acetic acid by liquid phase oxidation of acetaldehyde
- 5.8 Know about the properties and uses of formaldehyde
- 5.9 Describe briefly about the production of formaldehyde by vapor phase oxidation of methanol
- 5.10 Know about the properties and uses of acetone
- 5.11 Describe briefly about the production of acetone by catalytic vapor phase dehydrogenation of isopropanol
- 5.12 Know about the properties and uses of styrene
- 5.13 Describe briefly about the production of styrene by dehydrogenation of ethyl benzene

Unit-6: Principles of Hydrogenation

- 6.1 Know about the definition of hydrogenation
- 6.2 Know about the catalytic hydrogenation and its advantages
- 6.3 Know about the various catalysts used in hydrogenation
- 6.4 Know about the various methods of production of hydrogen
- 6.5 Know about the Hydrogenolysis
- 6.6 Know about the Selective Hydrogenation
- 6.7 Know about the various types of hydrogenation
- 6.8 Know about the properties and uses of methanol
- 6.9 Describe briefly about the production of methanol from carbon monoxide and hydrogen
- 6.10 Describe briefly about the process of hydrogenation of heavy oils
- 6.11 Describe briefly about the process of hydrogenation of olefins

Unit-7: Principles of Esterification

- 7.1 Know about the definition of esterification
- 7.2 Know about the catalytic esterification
- 7.3 Know about the completion of esterification reaction
- 7.4 Know about the properties and uses of ethyl acetate
- 7.5 Describe briefly about the production of ethyl acetate from acetic acid and ethanol (batch and continuous process).
- 7.6 Know about the properties and uses of vinyl acetate
- 7.7 Describe briefly about the production of vinyl acetate by vapor phase reaction of acetylene and acetic acid
- 7.8 Know about the properties and uses of cellulose acetate
- 7.9 Describe briefly about the production of cellulose acetate from cotton linters
- 7.10 Know about the properties and uses of nitro glycerin
- 7.11 Describe briefly about the production of nitro glycerin by nitration of glycerine
- 7.12 Know about the properties and uses of poly ester resin

- 7.13 Describe briefly about the production of poly ester resin from glycol, maleic anhydride and styrene

Unit-8: Principles of Alkylation

- 8.1 Know about the definition of alkylation
- 8.2 Know about the various types of alkylation reactions
- 8.3 Know about the various products of alkylation
- 8.4 Know about the various alkylating agents
- 8.5 Know about the properties and uses of ethyl benzene
- 8.6 Describe briefly about the production of ethyl benzene by alkylation of benzene
- 8.7 Know about the various manufacturing methods of phenol
- 8.8 Know about the properties and uses of phenol
- 8.9 Describe briefly about the production of phenol by Dow's process
- 8.10 Describe briefly about the production of phenol by Benzene sulfonic acid process
- 8.11 Describe briefly about the production of phenol by Regenerative process

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, Biazzini 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 ethyl benzene

6.0 Principles of Hydrogenation

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

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 vapor 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 glycerin, production of nitro glycerin by nitration of glycerine, the properties and uses of poly ester resin, the production of poly ester resin from glycol, maleic anhydride and styrene

8.0 Principles of Alkylation

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

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 Van Ness, 4th edition, McGraw-Hill Publications.
3. Outlines of Chemical Technology by Dryden

UNIT OPERATIONS-III LAB

Subject Title	: Unit operations-III Lab
Subject Code	: CH-PC-706
Periods per week	: 3
Periods / Semester	: 45

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.

INSTRUMENTATION, PROCESS CONTROL AND REACTION ENGINEERING LAB

Subject Title : Instrumentation, Process Control and Reaction Engineering Lab
Subject Code : CH-PC-707
Periods / week : 03
Periods / Semester : 45

List of experiments for Instrumentation, Process Control:

1. Determine the response of a bare thermometer and plot the response curve.
2. Determine the response of a thermometer with thermal well and plot the response curve.
3. 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.
4. Obtain the resistance and temperature data for a given resistance thermometer.
5. 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 C_v for a linear type control valve and plot the control valve characteristics.
11. Determine the valve coefficient C_v 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.

PETROLEUM REFINING – II LAB

Subject Title : Petroleum Refining-II Lab
Subject Code : CH-PC-708
Periods / week : 03
Periods / Semester : 45

List of experiments:

1. Determine the flash and fire point of a given sample of fuel using Pensky-Martens open 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.

PROJECT WORK/ CAD IN CHEMICAL ENGINEERING LAB

Subject Title : PROJECT WORK/ CAD IN CHEMICAL ENGINEERING LAB

Subject Code : CH-PC-709

Periods / Week : 06

Periods / Semester : 90

PROJECT WORK

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) Extracter
 - f) Water purification system
 - g) Crystalliser
 - 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 equipments 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
5. To know the softwares connected with Chemical Engineering and prepare a project work by using MATLAB, ASPEN PLUS, HYSIS, COMSOL etc

CAD IN CHEMICAL ENGINEERING LAB

OBJECTIVES:

On completion of the course the student may be able to

1.0 Introduction to AUTOCAD and its applications

Features of AUTOCAD, Starting, exiting AUTOCAD; AUTOCAD drawing screen, creating, saving and opening a drawing; Using pull down menu, side screen menu, key board input; Setting of units and limits of a drawing

2.0 Drawing and Modifying commands

Understanding the co-ordinate systems, absolute co-ordinates, relative co-ordinates, polar co-ordinates; creation of lines, arcs, rectangle, polygon, ellipse, donut, poly lines, text; selecting objects, erase, undo, redo, oops, copy, mirror, offset, array, move, rotate, scale, stretch, lengthen, trim, extend, break, chamfer, fillet, explode, editing text, hatching

3.0 Dimensioning

Dimensioning commands, setting dimensioning style, linear dimensions, aligned, ordinate, radius, diameter, angular; editing a dimension, align text

4.0 Draw the equipment symbols, flow sheet symbols using AUTOCAD

Equipment symbols:

Water cooler, reboiler, condensers(water and air), Cooling coils(water and air), Jet condenser, heater coil, boiler, wax sweater, filters(kelly, rotary, wax press, centrifuge, agitator, jacketed kettle,

Flow sheet symbols:

Venturi meter, rota meter, pitot tube, separator, ejector, gate valve, globe valve, check valve, stop check, plug valve, needle valve, angle valve, 4-way valve, 3-way valve

5.0 Know about plant location and layout, draw the plant layout using AUTOCAD

Plant layout and location, draw the plant layouts of a petroleum refinery, Oil and fat industry, HDPE plant, Urea plant in a fertilizer Industry, sugar Industry, pulp & paper industry, .

REFERENCE BOOKS:

1. Working with AUTOCAD 2000 with ajeet singh, Tata Mc. Graw Hill Publications
2. Chemical Engineering drawing by KA Gavane, Nirali publications
3. Chemical Engineering drawing by R.S.Hiremath. Nirali Publications.
4. Introduction to Chemical Engineering by Badger & Bencherro, Mc Graw Hill Publications
1. Unit operation of Chemical Engineering by Mc Cabe and smith –Mc Graw Hill publications
2. Plant design drawing by vibrant & Dryden, Mc Graw Hill publications