HINDUSTAN UNIVERSITY

HINDUSTAN INSTITUTE OF TECHNOLOGY & SCIENCE

(Estd. u/s 3 of the UGC Act, 1956)

Padur, Kancheepuram District - 603 103.

DEPARTMENT OF CHEMICAL ENGINEERING

CURRICULUM
&
SYLLABUS 2013-14

B.Tech.
(CHEMICAL ENGINEERING)

ACADEMIC REGULATIONS (B.Tech)

(Full /Part Time) (Effective 2013-14)

1. Vision, Mission and Objectives

1.1 The Vision of the Institute is "To make every man a success and no man a failure".

In order to progress towards the vision, the Institute has identified itself with a mission to provide every individual with a conducive environment suitable to achieve his / her career goals, with a strong emphasis on personality development, and to offer quality education in all spheres of engineering, technology, applied sciences and management, without compromising on the quality and code of ethics.

1.2 Further, the Institute always strives

- To train our students with the latest and the best in the rapidly changing fields of Engineering, Technology, Management, Science & Humanities.
- To develop the students with a global outlook possessing, state of the art skills, capable of taking up challenging responsibilities in the respective fields.
- To mould our students as citizens with moral, ethical and social values so as to fulfill their obligations to the nation and the society.
- To promote research in the field of Science, Humanities, Engineering, Technology and allied branches.

1.3 Aims and Objectives of the Institute are focused on

- Providing world class education in engineering, technology, applied sciences and management.
- Keeping pace with the ever changing technological scenario to help the students to gain proper direction to emerge as competent professionals fully aware of their commitment to the society and nation.
- To inculcate a flair for research, development and entrepreneurship.

2. Admission

2.1 The admission policy and procedure shall be decided from time to time by the Board of Management (BOM) of the Institute, following guidelines issued by Ministry of Human Resource Development (MHRD), Government of India. The number of seats in each branch of the B.Tech programme will be decided by BOM as per the directives from MHRD, Government of India and taking into account the market demands. Some seats for Non Resident Indians and a few seats for foreign nationals shall be made available.

2.2 (i) Full-Time :

At the time of applying for admission, the candidates should have passed / appeared and be awaiting results of the final examination of the 10+2 system or its equivalent with Mathematics, Physics and Chemistry as subjects of study.

(ii) Part -Time:

At the time of applying for admission, the candidates should have a Diploma in Engineering/Technology in the relevant branch of specialization awarded by the State Board of Technical Education, Tamil Nadu or any other authority accepted by the Board of Management of the University as equivalent thereto

and a minimum of one year practical experience.

2.3 The selected candidates will be admitted to the B.Tech. programme after he/she fulfills all the admission requirements set by the Institute and after the payment of the prescribed fees.

2.4 In all matters relating to admission to the B.E. / B.Tech. programme, the decision of the Institute and its interpretation given by the Chancellor of the Institute shall be final.

2.5 If at any time after admission, it is found that a candidate has not fulfilled any of the requirements stipulated by the Institute, the Institute may revoke the admission of the candidate with information to the Academic Council.

3. Structure of the programme

3.1 The programme of instruction will have the following structure:

i) A general (common) core programme comprising basic sciences, engineering sciences, humanities, technical arts and mathematics.

ii) An engineering core programme introducing the student to the foundations of engineering in the respective branch.

iii) An elective programme enabling the student to opt and undergo a set of courses of interest to him/ her.

iv) Professional practice including project, seminar and industrial training.

v) General elective courses, such as, Environmental Studies, Physical Education, Professional ethics, and National Service Scheme.

The distribution of total credits required for the degree programme into the above five categories will nominally be 20%, 50%, 15%, 5%, and 10% respectively.

3.2 (i) Full-Time:

The duration of the programme will be a minimum of 8 semesters. Every branch of the B.E. / B.Tech. programme will have a curriculum and syllabi for the courses approved by the Academic Council.

ii) Part - Time:

The duration of the programme will be a minimum of 7 semesters. Every branch of the B.Tech. programme will have a curriculum and syllabi for the courses approved by the Academic Council

3.3 The academic programmes of the Institute follow the credit system. The general pattern is:

- One credit for each lecture hour per week per semester;
- One credit for each tutorial hour per week per semester;
- Two credits for each laboratory practical/ drawing of three hours per week per semester.
- One credit for 4 weeks of industrial training and
- One credit for 4 hours of project per week per semester

3.4 (i) Full-Time:

For the award of degree, a student has to earn certain minimum total number of credits specified in the curriculum of the relevant branch of study. The curriculum of the different programs shall be so designed that the minimum prescribed credits required for the award of the degree shall be within the limits of 190-200.

(ii) Part-Time:

For the award of degree, a student has to earn certain minimum total number of credits specified in the curriculum of the relevant branch of study. The curriculum of the different programs shall be so designed that the minimum prescribed credits required for the award of the degree shall be within the limits of 110-120.

3.5 The medium of instruction, examination and the language of the project reports will be English.

4. Faculty Advisor

4.1 To help the students in planning their courses of study and for getting general advice on the academic programme, the concerned Department will assign a certain number of students to a Faculty member who will be called their Faculty Advisor.

5. Class Committee

5.1 A Class Committee consisting of the following will be constituted by the Head of the Department for each class:

(i) A Chairman, who is not teaching the class.

(ii) All subject teachers of the class.

(iii) Two students nominated by the department in consultation with the class.

The Class Committee will meet as often as necessary, but not less than three times during a semester.

The functions of the Class Committee will include:

(i) Addressing problems experienced by students in the classroom and the laboratories.

(ii) Analyzing the performance of the students of the class after each test and finding ways and means of addressing problems, if any.

(iii) During the meetings, the student members shall express the opinions and suggestions of the class students to improve the teaching / learning process.

6. Grading

6.1 A grading system as below will be adhered to.

Range of Marks	Letter Grade	Grade points
95 -100	S	10
85 - 94	A	09
75 - 84	B	08
65 -74	C	07
55 - 64	D	06
50 - 54	E	05
< 50	U	00
	I (Incomplete)	–

6.2 GPA and CGPA

GPA is the ratio of the sum of the product of the number of credits Ci of course "i " and the grade points Pi earned for that course taken over all courses "i" registered by the student to the sum of Ci for all "i ". That is,

$$GPA = \frac{\sum_i C_i P_i}{\sum_i C_i}$$

CGPA will be calculated in a similar manner, at any semester, considering all the courses enrolled from the first semester onwards.

6.3 For the students with letter grade I in certain subjects, the same will not be included in the computation of GPA and CGPA until after those grades are converted to the regular grades.

6.4 Raw marks will be moderated by a moderation board appointed by the Vice-Chancellor of the University. The final marks will be graded using an absolute grading system. The Constitution and composition of the moderation board will be dealt with separately.

7. Registration and Enrolment

7.1 Except for the first semester, registration and enrollment will be done in the beginning of the semester as per the schedule announced by the University.

7.2 A student will be eligible for enrollment only if he/she satisfies regulation 10 (maximum duration of the programme) and will be permitted to enroll if (i) he/she has cleared all dues in the Institute, Hostel and Library up to the end of the previous semester and (ii) he/she is not debarred from enrollment by a disciplinary action of the University.

7.3 Students are required to submit registration form duly filled in.

8. Registration requirement

8.1 (i) Full -Time:

A full time student shall not register for less than 16 credits or more than 30 credits in any given semester.

(ii) Part -Time:

A part time student shall not register for less than 10 credits or more than 20 credits in any given semester

8.2 If a student finds his/her load heavy in any semester, or for any other valid reason, he/she may withdraw from the courses within three weeks of the commencement of the semester with the written approval of his/her Faculty Advisor and HOD. However the student should ensure that the total number of credits registered for in any semester should enable him/her to earn the minimum number of credits per semester for the completed semesters.

9. Continuation of the programme

9.1 For those students who have not earned the minimum required credit prescribed for that particular semester examination, a warning letter to the concerned student and also to his/her parents regarding the shortage of his/her credit will be sent by the HOD after the announcement of the results of the university examinations.

10. Maximum duration of the programme

10.1 (i) Full - Time

The normal duration of the programme is eight semesters. However a student may complete the programme at a slower pace by taking more time, but in any case not more than 14 semesters excluding the semesters withdrawn on medical grounds or other valid reasons.

(ii) Part - Time

The normal duration of the programme is seven semesters. However a student may complete the programme at a slower pace by taking more time, but in any case not more than 12 semesters excluding the semesters withdrawn on medical grounds or other valid reasons

11. Temporary discontinuation

11.1 A student may be permitted by the Director (Academic) to discontinue temporarily from the programme for a semester or a longer period for reasons

of ill health or other valid reasons. Normally a student will be permitted to discontinue from the programme only for a maximum duration of two semesters.

12. Discipline

12.1 Every student is required to observe discipline and decorum both inside and outside the campus and not to indulge in any activity which will tend to bring down the prestige of the University.

12.2 Any act of indiscipline of a student reported to the Director (Academic) will be referred to a Discipline Committee so constituted. The Committee will enquire into the charges and decide on a suitable punishment if the charges are substantiated. The committee will also authorize the Director (Academic) to recommend to the Vice-Chancellor the implementation of the decision. The student concerned may appeal to the Vice-Chancellor whose decision will be final. The Director (Academic) will report the action taken at the next meeting of the Council.

12.3 Ragging and harassment of women are strictly prohibited in the University campus and hostels.

13. Attendance

13.1 A student whose attendance is less than 75% in a semester is not eligible to appear for the end-semester examination for that semester. The details of all students who have less than 75% attendance in a course will be announced by the teacher in the class. These details will be sent to the concerned HODs and Director (Academic).

13.2 Those who have less than 75% attendance will be considered for condonation of shortage of attendance. However, a condonation of 10% in attendance will be given on medical reasons. Application for condonation recommended by the Faculty Advisor, concerned faculty member and the HOD is to be submitted to the Director (Academic) who, depending on the merits of the case, may permit the student to appear for the end semester examination. A student will be eligible for this concession at most in two semesters during the entire degree programme. Application for medical leave, supported by medical certificate with endorsement by a Registered Medical Officer, should reach the HOD within seven days after returning from leave or, on or before the last instructional day of the semester, whichever is earlier.

13.3 As an incentive to those students who are involved in extra curricular activities such as representing the University in Sports and Games, Cultural Festivals, and Technical Festivals, NCC/ NSS events, a relaxation of up to 10% attendance will be given subject to the condition that these students take prior approval from the officer - in-charge. All such applications should be recommended by the concerned HOD and forwarded to Director (Academic) within seven instructional days after the programme / activity.

14. Assessment Procedure

14.1 The Academic Council will decide from time to time the system of tests and examinations in each subject in each semester.

14.2 For each theory course, the assessment will be done on a continuous basis as follows:

Test / Exam	Weightage	Duration of Test / Exam
First Periodical Test *	10%	2 Periods
Second Periodical Test *	10%	2 Periods
Model Exam	20%	3 hours
Seminar/Assignments/Quiz	10%	-
Attendance	10%	
End - semester examination	50%	3 Hours

*Best out of the two tests will be considered.

14.3 For practical courses, the assessment will be done by the subject teachers as below:

(i) Weekly assignment/Observation note book / lab records - weightage 60%.

(ii) End semester examination of 3 hours duration including viva - weightage 40%.

14.4 For courses on Physical Education, NSS, etc the assessment will be as satisfactory/not satisfactory only.

15. Make up Examination/Model Exam

15.1 Students who miss the end-semester examinations / model examination for valid reasons are eligible for make-up examination /model examination. Those who miss the end-semester examination / model examination should apply to the Head of the Department concerned within five days after he / she missed examination, giving reasons for absence.

15.2 Permission to appear for make-up examination / model examination will be given under exceptional circumstances such as admission to a hospital due to illness. Students should produce a medical certificate issued by a Registered Medical Practitioner certifying that he/she was admitted to hospital during the period of examination / model exam and the same should be duly endorsed by parent / guardian and also by a medical officer of the University within 5 days.

16. Project evaluation

16.1 For Project work, the assessment will be done on a continuous basis as follows:

Review / Examination	Weightage
First Review	10%
Second Review	20%
Third Review	20%
End-semester Examination	50%

For end-semester examination, the student will submit a Project Report in a format specified by the Director (Academic). The first three reviews will be conducted by a Committee constituted by the Head of the Department. The end-semester examination will be conducted by a Committee constituted by the Registrar / Controller of examination. This will include an external expert.

17. Declaration of results

17.1 A candidate who secures not less than 50% of total marks prescribed for a course with a minimum of 50% of the marks prescribed for the end semester examination shall be declared to have passed the course and earned the specified credits for the course.

(ii) To be Eligible to appear for the end semester examinations for a particular course, a candidate will have to secure a minimum of 40% marks in the sessional for that course.

(iii) Candidates are required to obtain all credits assigned to the first two semesters of the programme within the first four semesters of the programme.

Candidates failing to satisfy this requirement will not be allowed to proceed to the fifth semester until the condition is satisfied. Further, candidates will not be allowed to proceed to seventh semester if they have not cleared all the courses assigned during third & fourth semesters.

17.2 After the valuation of the answer scripts, the tabulated results are to be scrutinized by the Result Passing Boards of UG programmes constituted by the Vice-Chancellor. The recommendations of the Result Passing Boards will be placed before the Standing Sub Committee of the Academic Council constituted by the Chancellor for scrutiny. The minutes of the Standing Sub Committee along with the results are to be placed before the Vice-Chancellor for approval. After getting the approval of the Vice-Chancellor, the results will be published by the Controller of Examination/ Registrar.

17.3 If a candidate fails to secure a pass in a course due to not satisfying the minimum requirement in the end-semester examination, he/she shall register and re-appear for the end-semester examination during the following semester. However, the sessional marks secured by the candidate will be retained for all such attempts.

17.4 If a candidate fails to secure a pass in a course due to insufficient sessional marks though meeting the minimum requirements of the end-semester examination, and wishes to improve on his/her sessional marks, he/she will have to register for the particular course and attend the course with permission of the HOD concerned and Director(Academic) with a copy marked to the Registrar. The sessional and external marks obtained by the candidate in this case will replace the earlier result.

17.5 A candidate can apply for the revaluation of his/her end-semester examination answer paper in a theory course within 2 weeks from the declaration of the results, on payment of a prescribed fee through proper application to the Registrar/ Controller of Examinations through the Head of the Department. The Registrar/ Controller of Examination will arrange for the revaluation and the results will be intimated to the candidate concerned through the Head of the Department. Revaluation is not permitted for practical courses and for project work.

17.6 After ten semesters, the sessional marks of the candidate will not be considered for a pass in a course. A candidate who secures 50% in the end semester examination shall be declared to have passed the course and earned the specified credits for the course.

18. Grade Card

18.1 After results are declared, grade sheet will be issued to each student which will contain the following details:

(i) Program and branch for which the student has enrolled.

(ii) Semester of registration.

(iii) List of courses registered during the semester and the grade scored.

(iv) Semester Grade Point Average (GPA)

(v) Cumulative Grade Point Average (CGPA).

19. Class/Division

19.1 Classification is based on CGPA and is as follows:

CGPA $\geq$ 8.0: **First Class with distinction**

6.5 $\leq$ CGPA < 8.0 : **First Class**

5.0 $\leq$ CGPA < 6.5 : **Second Class.**

19.2 (i) Further, the award of 'First class with distinction' is subject to the candidate becoming eligible for the award of the degree having passed the examination in all the courses in his/her first appearance within the minimum duration of the programme.

(ii) The award of 'First Class' is further subject to the candidate becoming eligible for the award of the degree having passed the examination in all the courses **within 10 semesters.**

(iii) The period of authorized discontinuation of the programme (vide clause 11.1) will not be counted for the purpose of the above classification.

20. Transfer of credits

20.1. Within the broad framework of these regulations, the Academic Council, based on the recommendation of the transfer of credits committee so consulted by the Chancellor may permit students to earn part of the credit requirement in other approved institutions of repute and status in the country or abroad.

20.2 The Academic Council may also approve admission of lateral entry (who hold a diploma in Engineering/ technology) candidates with advance credit based on the recommendation of the transfer of credits committee on a case to case basis.

21. Eligibility for the award of B.Tech. Degree

21.1. A student will be declared to be eligible for the award of the B.Tech. Degree if he/she has

i) registered and successfully acquired the credits for the core courses;

ii) successfully acquired the credits in the different categories as specified in the curriculum corresponding to the discipline (branch) of his/her study within the stipulated time;

iii) has no dues to all sections of the Institute including Hostels, and

iv) has no disciplinary action pending against him/her.

The award of the degree must be recommended by the Academic Council and approved by the Board of Management of the University.

22. Change of Branch

22.1 If the number of students in any branch of B.Tech. class as on the last instructional day of the First Semester is less than the sanctioned strength, then the vacancies in the said branches can be filled by transferring students from other branches. All such transfers will be allowed on the basis of merit of the students. The decision of the Chancellor shall be final while considering such requests.

22.2 All students who have successfully completed the first semester of the course will be eligible for consideration for change of branch subject to the availability of vacancies.

23. Power to modify

23.1. Notwithstanding all that has been stated above, the Academic Council shall modify any of the above regulations from time to time subject to approval by the Board of Management.

HINDUSTAN UNIVERSITY

HINDUSTAN INSTITUTE OF TECHNOLOGY AND SCIENCE

CHEMICAL ENGINEERING

SEMESTER I

Sl. No.	Course Code	Course Title	L	T	P	C	TCH
THEORY							
1.	EL 2101	Technical English	3	0	0	3	3
2.	MA 2101	Engineering Mathematics-I	3	1	0	4	4
3.	PH 2001/ CY 2001	Engineering Physics / Engineering Chemistry *	3	0	0	3	3
4.	ME 2101	Engineering Graphics	1	0	3	3	4
5.	CS 2101	Computer Programming	3	0	0	3	3
Practical							
6.	CS 2131	Computer Programming Laboratory	0	0	3	2	3
7.	GE 2131	Engineering Practices Laboratory-I	0	0	3	2	3
8.	EL 2131	Communication Skills Laboratory I	0	0	3	2	3
9.	PH 2031/ CY 2031	Physics Laboratory / Chemistry Laboratory *	1	0	3	3	4
		Total				25	30

SEMESTER II

Sl. No.	Course Code	Course Title	L	T	P	C	TCH
THEORY							
1.	MA2201	Engineering Mathematics-II	3	1	0	4	4
2.	PH 2001/ CY 2001	Engineering Physics / Engineering Chemistry *	3	0	0	3	3
3.	CH2202	Instrumental Analysis for Engineers	3	0	0	3	3
4.	CH2201	Introduction to Chemical Engineering	3	1	0	4	3
5.	PH2201	Materials Science and Engineering	3	0	0	3	3

Sl. No.	Course Code	Course Title	L	T	P	C	TCH
Practical							
6.	PH 2031/ CY 2031	Physics Laboratory / Chemistry Laboratory *	1	0	3	3	4
7.	GE2231	Engineering Practices Laboratory-II	0	0	3	2	3
8	CH2333	Technical Analysis Lab	0	0	3	2	3
9	EL 2231	Communication Skills Laboratory II	2	0	2	3	4
		Total				**27**	**30**

SEMESTER III

Sl. No.	Course Code	Course Title	L	T	P	C	TCH
THEORY							
1.	MA2301	Engineering Mathematics III	3	1	0	4	4
2.	CH2301	Unit Operations	3	1	0	4	4
3.	ME2312	Manufacturing Technology	3	0	0	3	3
4.	EE2314	Basic Electrical Technology	3	1	0	4	4
5.	CH2302	Chemical Process Calculation	3	1	0	4	4
Practical							
6.	CH2331	Organic Technology Lab	0	0	3	2	3
7.	EE2235	Electrical Engg Lab	0	0	3	2	3
8.	CH2332	Unit Operations Lab	0	0	3	2	3
9.	ME2332	Manufacturing Technology Lab	0	0	3	2	3
		Total				**27**	**31**

SEMESTER IV

Sl. No.	Course Code	Course Title	L	T	P	C	TCH
Theory							
1.	CH2401	Fluid Mechanics	3	1	0	4	4
2.	CY2002	Environmental Science and Engineering	3	0	0	3	3
3.	CH2402	Chemical Engg Thermodynamics	3	1	0	4	4
4.	CH2403	Chemical Process Industry - Inorganic Materials	3	0	0	3	3
5.	CH2404	Chemical Reaction Engg	3	1	0	4	4

Sl. No.	Course Code	Course Title	L	T	P	C	TCH
Practical							
6.	CH2431	Chemical Reaction Engg lab	0	0	3	2	3
7.	CH2432	Fluid Mechanics lab	0	0	3	2	3
8.	CH2433	Computer programming lab in Chemical Engg	0	0	3	2	3
9.	CH2434	Project	0	0	6	2	6
		Total				**28**	**33**

Total Credits after four semesters: 107

SEMESTER V

Sl. No.	Course Code	Course Title	L	T	P	C	TCH
THEORY							
1.	MA2501	Numerical Methods in Chemical Engineering	3	1	0	4	4
2.	CH2501	Heat Transfer	3	1	0	4	4
3.	CH2502	Chemical Process Industry-Organic Materials	3	0	0	3	3
4.	CH2503	Heterogeneous reaction Engineering	3	1	0	4	4
5.	CH2504	Petrochemical Engineering	3	1	0	4	4
Practical							
6.	CH2531	Heat Transfer Lab	0	0	3	2	3
7.	CH2532	Numerical Computation Lab	0	0	3	2	3
8.	EL2431	Communication skills and Personality Development	2	0	2	3	3
		Total				**26**	**28**

SEMESTER VI

Sl. No.	Course Code	Course Title	L	T	P	C	TCH
THEORY							
1.	CH2601	Chemical Process Equipment Design	3	1	0	4	4
2.	CH2602	Mass Transfer - 1	3	1	0	4	4
3.	CH2603	Safety and Hazard Management in the Chemical Process Industries	3	0	0	3	3
4.	MA2601	Probability and Statistics	3	1	0	4	4
5.	EI2611	Instrumentation & Process Control	3	1	0	4	4
6.	CH2604	Process design using CAD	3	0	0	3	3
Practical							
7.	CH2631	Mass Transfer Lab	0	0	3	2	3
8.	CH2632	Design Practices Lab	0	0	3	2	3
9.	CH2634	Industrial Training	0	0	0	2	0
		Total				**28**	**28**

SEMESTER VII

Sl. No.	Course Code	Course Title	L	T	P	C	TCH
THEORY							
1	CH2701	Modeling, Computer simulation & Optimization	3	1	0	4	4
2	CH2702	Biotechnology & Biochemical Engineering	3	1	0	4	4
3	CH2703	Mass Transfer - 2	3	1	0	4	4
4	CH2704	Polymer and Elastomer Technology	3	0	0	3	3
5	CH2705	Process Economics and Industrial Management	3	0	0	3	3
6.		Elective - I	3	0	0	3	3
Practical							
7.	CH2731	Chemical Engg software Lab	0	0	3	2	3
8.	CH2732	Process Control Lab	0	0	3	2	3
		Total				**25**	**27**

SEMESTER VIII

Sl. No.	Course Code	Course Title	L	T	P	C	TCH
THEORY							
1.	MG2002	Total Quality Management	3	0	0	3	3
2.	EI2811	Process Dynamics and Control	3	1	0	4	4
3.		Elective-II	3	0	0	3	3
Practical							
4.	CH2831	Project Work & Viva-voce			24	6	24
		Total				**16**	**34**

TOTAL CREDITS = 202

LIST OF ELECTIVES

Sl. No.	Course Code	Course Title	L	T	P	C	TCH
THEORY							
Elective - I							
1.	CH2751	Electrochemical Reaction Engineering	3	0	0	3	3
2.	CH2752	Pulp and Paper Technology	3	0	0	3	3
3.	CH2753	Industrial Catalysis	3	0	0	3	3
4.	CH2754	Food Processing	3	0	0	3	3
5	CH2755	Energy Engineering	3	0	0	3	3
Elective - II							
1	CH2851	Genetic Engineering	3	0	0	3	3
2	CH2852	Enzyme Engineering	3	0	0	3	3
3	CH2853	Corrosion Engineering	3	0	0	3	3
4	CH2854	Neural Networks and Artificial Intelligence	3	0	0	3	3
5	CH2855	Transport Processes	3	0	0	3	3

SEMESTER - I

EL 2101 TECHNICAL ENGLISH

L	T	P	C
3	0	0	3

Goal

The goal of the programme is to provide a theoretical input towards nurturing accomplished learners who can function effectively in the English language skills; to cultivate in them the ability to indulge in rational thinking, independent decision-making and lifelong learning; to help them become responsible members or leaders of the society in and around their workplace or living space; to communicate successfully at the individual or group level on engineering activities with the engineering community in particular, and on multi-disciplinary activities in general, with the world at large.

Objectives

The course should enable the students to:

1. Widen the capacity of the learners to listen to English language at the basic level and understand its meaning.
2. Enable learners to communicate in an intelligible English accent and pronunciation.
3. Assist the learners in reading and grasping a passage in English.
4. Learn the art of writing simple English with correct spelling, grammar and punctuation.
5. Cultivate the ability of the learners to think and indulge in divergent and lateral thoughts.

Outcome

The students should be able to:

1. Have the self-confidence to improve upon their informative listening skills by an enhanced acquisition of the English language.
2. Speak English at the formal and informal levels and use it for daily conversation, presentation, group discussion and debate.
3. Read, comprehend and answer questions based on literary, scientific and technological texts.
4. Write instructions, recommendations, checklists, process-description, letter-writing and report writing.
5. Have the confidence to develop thinking skills and participate in brainstorming, mind-mapping, audiovisual activities, creative thinking and also answer tests in the job-selection processes.

Unit I: Listening Skill **9**

Topics: Listening to the sounds, silent letters & stress in English words & sentences - Listening to conversation & telephonic conversation -- Listening for general meaning & specific information -- Listening for positive & negative comments - Listening to technical topics - Listening to prose & poetry reading -- Listening exercises.

Embedded language learning: Sentence definition -- Spelling & punctuation -- Imperative form - Sequencing of sentences -- Gerunds -- Infinitives -- 'Wh-'questions.

Unit II: Speaking Skill **9**

Topics: Self-introduction - Expressing personal opinion - Dialogue - Conversation - Simple oral interaction -- Speaking on a topic -- Expressing views for & against -- Speaking on personal topics like hobbies, topics of interest, present & past experiences, future plans - Participating in group discussions, role plays, debates, presentations, power-point presentations & job-interviews.

Embedded language learning: Adverbs -Adjectives - Comparative and Numerical adjectives -- Nouns & compound nouns -- Prefixes and suffixes.

Unit III: Reading Skill **9**

Topics: Reading anecdotes, short stories, poems, parts of a novel, notices, message, time tables, advertisements, leaflets, itinerary, content page - Reading pie chart & bar chart -- Skimming and scanning -- Reading for contextual meaning - Scanning for specific information -- Reading newspaper & magazine articles - Critical reading -- Reading-comprehension exercises.

Embedded language learning: Tenses - Active and passive voice -- Impersonal passive -- Words and their function -- Different grammatical forms of the same word.

Unit IV: Writing Skill **9**

Topics: Writing emails, notes, messages, memos, notices, agendas, advertisements, leaflets, brochures, instructions, recommendations & checklists -- Writing paragraphs -- Comparisons & contrasts - Process description of Flow charts - Interpretation of Bar charts & Pie charts - Writing the minutes of a meeting -- Report writing -- Industrial accident reports -- Letter-writing -- Letter to the editors - Letter inviting & accepting or declining the invitation - Placing orders - Complaints -- Letter requesting permission for industrial visits or implant training, enclosing an introduction to the educational institution -- Letters of application for a job, enclosing a CV or Resume - Covering letter.

Embedded language learning: Correction of errors - Subject-verb Concord -- Articles - Prepositions - - Direct and indirect speech.

Unit V: Thinking Skill **9**

Topics: Eliciting & imparting the knowledge of English using thinking blocks - Developing thinking skills along with critical interpretation side by side with the acquisition of English -- Decoding diagrams & pictorial representations into English words, expressions, idioms and proverbs.

Embedded language learning: General vocabulary -- Using expressions of cause and effect -- Comparison & contrast -- If-conditionals -- Expressions of purpose and means.

Reference Books

1. Norman Whitby. Business Benchmark: Pre-Intermediate to Intermediate - BEC Preliminary. New Delhi: Cambridge University Press, 2008 (Latest South Asian edition).
2. Norman Whitby. Business Benchmark: Pre-Intermediate to Intermediate - Preliminary-Personal Study Book. New Delhi: Cambridge University Press, 2008 (Latest South Asian edition).

3. Cambridge BEC Preliminary: Self-study Edition - Practice Tests. New Delhi: Cambridge University Press, 2008 or latest South Asian edition.

4. Devaki Reddy & Shreesh Chaudhary. Technical English. New Delhi: Macmillan, 2009.

5. Rutherford, Andrea J. Basic Communication Skills for Technology. 2nd edition. New Delhi: Pearson Education, 2006.

MA 2101 ENGINEERING MATHEMATICS I

L	T	P	C
3	1	0	4

Goal

To create the awareness and comprehensive knowledge in engineering mathematics.

Objectives

The course should enable the students to:

1. Find the inverse of the matrix by using Cayley Hamilton Theorem and Diagonalisation of matrix using transformation.
2. Understand the Evolutes and Envelope of the curve.
3. Learn the solutions of second order linear differential equations of standard types and Legendre's linear differential equation.
4. Learn partial differentiations involving two and three variables and expansions of functions using Taylor series.
5. Learn the expansions of trigonometric, hyperbolic functions and their relations..

Outcome

The students should be able to:

1. Identify Eigen value problems from practical areas and obtain its solutions and using transformation diagonalising the matrix which would render Eigen values.
2. Find out effectively the geometrical aspects of curvature and appreciates mathematical skills in constructing evolutes and envelopes in mechanics and engineering drawing.
3. Recognize and to model mathematically and solving, the differential equations arising in science and engineering.
4. Understand and model the practical problems and solve it using maxima and minima as elegant applications of partial differentiation.
5. Acquire skills in using trigonometric and hyperbolic and inverse hyperbolic functions.

UNIT I MATRICES **12**

Review: Basic concepts of matrices-addition, subtraction, multiplication of matrices - adjoint -inverse - solving cubic equations.

Characteristic equation - Properties of Eigen values - Eigen values and Eigen vectors - Cayley

Hamilton theorem (without proof) - Verification and inverse using Cayley Hamilton theorem. Diagonalisation of matrices - Orthogonal matrices - Quadratic form - Reduction of symmetric matrices to a Canonical form using orthogonal transformation - Nature of quadratic form.

UNIT II DIFFERENTIAL CALCULUS 12

Review: Basic concepts of differentiation - function of function, product and quotient rules.

Methods of differentiation of functions - Cartesian form - Parametric form - Curvature - Radius of curvature - Centre of curvature - Circle of curvature. Evolutes of parabola, circle, ellipse, hyperbola and cycloid - Envelope.

III ORDINARY DIFFERENTIAL EQUATIONS 12

Review: Definition, formation and solutions of differential equations.

Second order differential equations with constant coefficients - Particular integrals - , eaxCosbx, eaxSinbx. Euler's homogeneous linear differential equations - Legendre's linear differential equation - Variation of parameters.

UNIT IV PARTIAL DIFFERENTIATION 12

Partial differentiation - differentiation involving two and three variables - Total differentiation -Simple problems. Jacobian - verification of properties of Jacobians - Simple problems. Taylor's series - Maxima and minima of functions of two and three variables.

UNIT V TRIGONOMETRY 12

Review: Basic results in trigonometry and complex numbers - De Moivre's theorem.

Expansions of sinn , cosn , tann where n is a positive integer. Expansions of in terms of sines and cosines of multiples of where m and n are positive integers. Hyperbolic and inverse hyperbolic functions - Logarithms of complex numbers - Separation of complex functions into real and imaginary parts - Simple problems.

Note: Questions need not be asked from review part.

TOTAL: 60

TEXT BOOKS

1. Erwin Kreyzig, A Text book of Engineering Mathematics, John Wiley, 1999.
2. Grewal B.S, Higher Engineering Mathematics, Thirty Eighth Editions, Khanna Publisher, Delhi, 2004.
3. Chandrasekaran A, A Text book of Engineering Mathematics I, Dhanam Publications, Chennai, 2010.

REFERENCES

1. Venkataraman M.K, Engineering Mathematics, Volume I, The National Publishing Company, Chennai, 1985.
2. Kandaswamy P, Thilagavathy K and Gunavath K, Engineering Mathematics, Volume I & II, S.Chand and Company, New Delhi, 2005.

3. Bali N.P, Narayana Iyengar. N.Ch., Engineering Mathematics, Laxmi Publications Pvt. Ltd, New Delhi, 2003

4. Veerarajan T, Engineering Mathematics (for first year), Fourth Edition,Tata McGraw - Hill Publishing Company Limited, New Delhi, 2005.

PH2001 ENGINEERING PHYSICS

L	T	P	C
3	0	0	3

Goal

To impart fundamental knowledge in various fields of Physics and its applications.

OBJECTIVES

The course should enable the students to:

1. Develop strong fundamentals of properties and behaviour of the materials
2. enhance theoretical and modern technological aspects in acoustics and ultrasonics.
3. enable the students to correlate the theoretical principles with application oriented study of optics.
4. provide a strong foundation in the understanding of solids and materials testing.
5. Enrich the knowledge of students in modern engineering materials.

OUTCOME

The students should be able to:

1. Understand the properties and behaviour of materials.
2. Have a fundamental knowledge of acoustics which would facilitate in acoustical design of buildings and on ultrasonics and be able to employ it as an engineering tool.
3. Understand the concept, working and application of lasers and fiber optics.
4. Know the fundamentals of crystal physics and non destructive testing methods.
5. Have an understanding of the production, characteristics and application of the new engineering materials. This would aid them in the material selection stage.

UNIT I PROPERTIES OF MATTER **9**

Elasticity - types of moduli of elasticity - Stress-Strain diagram - Young's modulus of elasticity - Rigidity modulus - Bulk modulus - Factors affecting elasticity - twisting couple on a wire - Torsional pendulum - determination of rigidity modulus of a wire - depression of a cantilever - Young's modulus by cantilever - uniform and non-uniform bending - viscosity - Ostwald's viscometer - comparison of viscosities.

UNIT II ACOUSTICS AND ULTRASONICS **9**

Classification of sound - characteristics of musical sound - intensity - loudness - Weber Fechner law - Decibel - Reverberation - Reverberation time, derivation of Sabine's formula for reverberation

time(Jaeger's method) - absorption coefficient and its determination - factors affecting acoustics of building (Optimum reverberation time, loudness, focusing, echo, echelon effect, resonance and noise) and their remedies. Ultrasonics - production - Magnetostriction and Piezoelectric methods - properties - applications of ultrasonics with particular reference to detection of flaws in metal (Non - Destructive testing NDT) - SONAR.

UNIT III LASER AND FIBRE OPTICS 9

Principle of lasers - Stimulated absorption - Spontaneous emission, stimulated emission - population inversion - pumping action - active medium - laser characteristics - Nd-Yag laser - CO2 laser - Semiconductor laser - applications - optical fiber - principle and propagation of light in optical fibers - Numerical aperture and acceptance angle - types of optical fibers - single and multimode, step index and graded index fibers - applications - fiber optic communication system.

UNIT IV CRYSTAL PHYSICS AND NON- DESTRUCTIVE TESTING 9

Crystal Physics: Lattice - Unit cell - Bravais lattice - Lattice planes - Miller indices - 'd' spacing in cubic lattice - Calculation of number of atoms per unit cell - Atomic radius - coordination number - Packing factor for SC, BCC, FCC and HCP structures.

Non Destructive Testing: Liquid penetrate method - Ultrasonic flaw detection - ultrasonic flaw detector (block diagram) - X-ray Radiography - Merits and Demerits of each method.

UNIT V MODERN ENGINEERING MATERIALS AND SUPERCONDUCTING MATERIALS 9

Modern Engineering Materials: Metallic glasses: Preparation properties and applications. Shape memory alloys (SMA): Characteristics, applications, advantages and disadvantages of SMA. Nano Materials: Synthesis -Properties and applications.

Superconducting Materials: Superconducting phenomena - Properties of superconductors - Meissner effect - Type I and Type II superconductors - High Tc superconductors (qualitative) - uses of superconductors.

TOTAL : 45

TEXT BOOKS:

1. Gaur R.K. and Gupta S.L., "Engineering Physics ", 8th edition, Dhanpat rai publications (P) Ltd., New Delhi 2010.
2. P.Mani, "Engineering Physics", Vol-I, Dhanam Publications, Chennai 2011.
3. Rajendran V. an Marikani A., "Applied Physics for engineers" , 3rd edition, Tata Mc Graw -Hill publishing company Ltd., New Delhi,2003.

REFERENCES:

1. Uma Mukherji, Engineering Physics , Narosa publishing house, New Delhi, 2003.
2. Arumugam M., Engineering Physics , Anuradha agencies, 2007.
3. Palanisamy P.K., Engineering Physics, SciTech Publications, Chennai 2007.
4. Arthur Beiser, Concepts of Modern Physics, Tata Mc Graw -Hill Publications, 2007.
5. P.Charles, Poople and Frank J. Owens, Introduction to Nanotechnology, Wiley India, 2007.

CY 2001 Chemistry

L	T	P	C
3	0	0	3

Goal

To impart basic principles of chemistry for engineers.

Objectives

The course should enable the students to

1. Make the students conversant with the basics of

   (a) Water technology and (b) Polymer science
2. Provide knowledge on the requirements and properties of a few important engineering materials.
3. Educate the students on the fundamentals of corrosion and its control.
4. Give a sound knowledge on the basics of a few significant terminologies and concepts in thermodynamics.

- Create an awareness among the present generation about the various conventional energy sources.

Outcome

The students should be able to

1. Gain basic knowledge in water analysis and suitable water treatment method.
2. Get an idea on the type of polymers to be used in engineering applications.
3. Get awareness about new materials
4. Get knowledge on the effects of corrosion and protection methods will help the young minds to choose proper metal / alloys and also to create a design that has good corrosion control.
5. Get exposure on the important aspects of basic thermodynamics will be able to understand the advanced level thermodynamics in engineering applications.
6. Get a good background on the various aspects of energy sources will create awareness on the need to utilize the fuel sources effectively and also for exploring new alternate energy resources.

UNIT I: WATER TECHNOLOGY AND POLYMER CHEMISTRY 9

Hardness (Definition, Types, Units) - problems - Estimation of Hardness (EDTA Method) - Water softening - Carbonate conditioning and Calgon conditioning - Demineralization (Ion-Exchange Method) - Water Quality Parameters - Municipal Water Treatment- Desalination - Reverse Osmosis.

Classification of Polymers - PVC, Bakelite - preparation, properties and applications - Effect of Polymer Structure on Properties - Compounding of Plastics- Polymer Blends and Polymer Alloys - Definition, Examples.

UNIT II: ENGINEERING MATERIALS 9

Properties of Alloys - Heat Treatment of Steel - Polymer Composites - types and applications.-

Lubricants - Classification, properties and applications - Mechanism of Lubrication - MoS2 And Graphite - Adhesives - classification and properties - Epoxy resin (Preparation, properties and applications) - Refractories - Classification, Properties and General Manufacture - Abrasives - Classification , Properties and Uses - Carbon nano tubes - preparation, properties and applications.

UNIT III: ELECTROCHEMISTRY AND CORROSION **9**

Conductometric Titration - HCl vs NaOH and mixture of acids vs NaOH - Electrochemical Series and its applications - Nernst Equation - problems - Polarization, Decomposition Potential, Over-voltage (definitions only) - Galvanic series - Corrosion (Definition, Examples, effects) - Mechanism of Dry Corrosion and Wet Corrosion - Differential aeration Corrosion , examples - Factors Influencing Corrosion - Metal and Environment - Corrosion Control - Design -Cathodic Protection methods - Protective Coatings - Galvanising - Anodising - Electroplating (Cu and Ni) and Electroless plating (Cu and Ni) - Constituents of Paints and varnish.

UNIT IV: CHEMICAL THERMODYNAMICS **9**

Thermodynamic terminology- First Law of Thermodynamics-Internal energy- enthalpy - heat capacity - work done in isothermal expansion of an ideal gas -problems - second law of thermodynamics - entropy change - phase transformations and entropy change - problems - Work Function & Free Energy Function- Maxwell's Relations-Gibbs Helmholtz equation- van't Hoff Isotherm- van't Hoff Isochore - Problems.

UNIT V: FUELS AND ENERGY SOURCES **9**

Fuels - classification - Calorific Value - Dulong's Formula - Problems - Determination of Calorific Value by Bomb Calorimeter - Coal - Proximate Analysis - problems - Octane Number - Cetane Number - Diesel Index (Definitions only) - Bio Gas - Producer Gas -Water Gas - Preparation, Properties and Uses - Batteries - Primary Cells - Leclanche Cell -Secondary Cell - Nickel Cadmium Battery - Fuel Cells - Hydrogen -Oxygen Fuel Cell - Solar Battery - Lead Acid Storage Cell - Nuclear Energy - Light water nuclear power plant.

Total : 45

Text Books

1. S. S. Dara, Text Book of Engineering Chemistry, S. Chand & Company Ltd., New Delhi, 2003
2. Murthy, Agarwal & Naidu, Text Book of Engineering Chemistry, BSP, 2003.
3. S.Sumathi, Engineering Chemistry, Dhanam Publications, 2008.
4. S.Sumathi and P.S.Raghavan, Engineering Chemistry II, Dhanam Publications, 2008.

References

1. B. K. Sharma, Engineering chemistry, Krishna Prakasam Media (P) Ltd., 2003
2. A 1. Vogel, A text book of Qualitative Inorganic Analysis, ELBS, London, 2004
3. A. Gowarikar, Text Book of Polymer Science, 2002
4. Kuriacose & Rajaram, Vols. 1 & 2, Chemistry in Engineering and Technology, 2004
5. Puri, Sharma and Pathania, Principles of Physical Chemistry, Vishal Publishing Co. Jalandar, 2004.

ME 2101 ENGINEERING GRAPHICS

L	T	P	C
1	0	3	3

Goal

To develop graphical skills for communicating concepts, ideas and designs of engineering products and to give exposure to national standards relating to technical drawings.

Objectives

The course should enable the students to

1. Introduce drawing standards and use of drawing instruments.
2. Introduce first angle projection.
3. Practice of engineering hand sketching and introduce to computer aided drafting
4. Familiarize the students with different type of projections.
5. Introduce the process of design from sketching to parametric 3D CAD and 2D orthographic drawings to BIS

Outcome

The students should be able to

1. Develop Parametric design and the conventions of formal engineering drawing
2. Produce and interpret 2D & 3D drawings
3. Communicate a design idea/concept graphically
4. Examine a design critically and with understanding of CAD - The student learn to interpret drawings, and to produce designs using a combination of 2D and 3D software.
5. Get a Detailed study of an engineering artifact

Note: Only first angle projection is to be followed

BASICS OF ENGINEERING GRAPHICS **2**

Importance of graphics Use of drawing instruments - BIS conventions and specifications - drawing sheet sizes, layout and folding - lettering - Dimensioning-Geometrical constructions - Scales. Construction of curves like ellipse, parabola, cycloids and involutes.

UNIT I PROJECTION OF POINTS, LINES AND SURFACES **15**

General principles of presentation of technical drawings as per BIS - Introduction to Orthographic projection - Naming views as per BIS - First angle projection. Projection of points. Projection of straight lines located in first quadrant using rotating line(using method only). Projection of plane surfaces like polygonal lamina and circular lamina. Drawing views when the surface of the lamina is inclined to one reference plane.

UNIT II PROJECTION OF SOLIDS **10**

Projections of simple solids like prism, pyramid, cylinder and cone - Drawing views when the axis of the solid is inclined to one reference plane. Introduction to 'section of solids'.

UNIT III DEVELOPMENT OF SURFACES **10**

Development of lateral surfaces of truncated prisms, pyramids, cylinders and cones.

UNIT IV ORTHOGRAPHIC PROJECTIONS **10**

Orthographic projections - Conversion to orthographic views from given pictorial views of objects, including dimensioning. Free hand sketching of Orthographic views from Pictorial views.

UNIT V PICTORIAL PROJECTIONS **10**

Isometric projection - Isometric scale - Isometric views of simple solids like prisms, pyramids, cylinders and cones. Introduction to perspective Projections.

COMPUTER AIDED DRAFTING (Demonstration Only) **3**

Introduction to computer aided drafting and dimensioning using appropriate software.

2D drawing commands: Zoom, Picture editing commands, Dimensioning, Isometric drawing, Iso-Planes and 3D drafting. Plotting of drawing. Practice includes drawing the projection of lines and solids. Prepare isometric view of simple solids like prisms, pyramids, cylinders and cones.

TOTAL : 60

TEXT BOOKS:

1. Jeyapoovan T, Engineering Drawing and Graphics Using AutoCAD, Vikas Publishing House Pvt Ltd.,New Delhi, 2010.
2. Warren J. Luzadder and Jon. M.Duff, Fundamentals of Engineering Drawing, Prentice Hall of India Pvt. Ltd., Eleventh Edition, 2003.

REFERENCES

1. Bhatt N.D and Panchal V.M, Engineering Drawing: Plane and Solid Geometry, Charotar Publishing House, Anand-3001, 2007.
2. Thomas E. French, Charles J.Vierck and Robert J.Foster, Engineering Drawing and Graphic Technology, McGraw-Hill Book company 13th Edition.1987.
3. IS 9609 - 1983 Lettering on Technical Drawings.
4. IS 10714 - 1983 General Principles of Presentation of Technical Drawings.
5. IS 11669 - 1986 General Principles of Dimensioning of Technical Drawings.

CS2101 COMPUTER PROGRAMMING

L	T	P	C
3	0	0	3

Goal

To introduce computers and programming and to produce an awareness of the power of computational techniques that are currently used by engineers and scientists and to develop programming skills to a level such that problems of reasonable complexity can be tackled successfully.

OBJECTIVES

The course should enable the students to:

1. Learn the major components of a Computer system.
2. Learn the problem solving techniques.
3. Develop skills in programming using C language.

OUTCOMES

The student should be able to:

1. Understand the interaction between different components of Computer system and number system.
2. Devise computational strategies for developing applications.
3. Develop applications (Simple to Complex) using C programming language.

UNIT - I COMPUTER FUNDAMENTALS **9**

Introduction - Evolution of Computers - Generations of Computer - Classification of Computers - Application of Computers - Components of a Computer System - Hardware - Software - Starting a Computer (Booting) - Number Systems.

UNIT- II COMPUTER PROGRMMING AND LANGUAGES **9**

Introduction - Problem-Solving Techniques: Algorithms, Flowchart, Pseudocode - Program Control Structures - Programming Paradigms - Programming languages - Generations of Programming Languages - Language Translators - Features of a Good ProgrammingLanguages.

UNIT - III PROGRAMMING WITH C **9**

Introduction to C - The C Declaration - Operators and Expressions - Input and Output in C - Decision Statements - Loop Control Statements.

UNIT- IV FUNCTIONS, ARRAYS AND STRINGS **9**

Functions - Storage Class - Arrays - Working with strings and standard functions.

UNIT - V POINTERS, STRUCTURES AND UNION **9**

Pointers - Dynamic Memory allocation - Structure and Union - Files.

TEXT BOOK:

1. ITL Education Solution Limited, Ashok Kamthane, "Computer Programming", Pearson Education Inc 2007 (Unit: I to V).

REFERNCES:

1. Byron S. Gottfried, "Programming with C", Second Edition, Tata McGraw Hill 2006.
2. Yashvant Kanetkar, "Let us C", Eighth edition, BPP publication 2007.
3. Stephen G.Kochan, "Programming in C - A Complete introduction to the C programming language" , Pearson Education, 2008.
4. T.JeyaPoovan, "Computer Programming Theory and Practice", Vikas Pub, New Delhi.

CS2131 COMPUTER PROGRAMMING LABORATORY (Common to all branches)

L	T	P	C
0	0	3	2

Goal

To provide an awareness to develop the programming skills using computer languages.

OBJECTIVES

The course should enable the students to:

1. To gain knowledge about Microsoft office, Spread Sheet.
2. To learn a programming concept in C.

OUTCOME

The students should be able to

1. Use MS Word to create document, table, text formatting and Mail merge options.
2. Use Excel for small calculations using formula editor, creating different types of charts and including pictures etc,
3. Write and execute the C programs for small applications.

LIST OF EXPERIMENTS:

a) Word Processing 15

1. Document creation, Text manipulation with Scientific notations.
2. Table creation, Table formatting and Conversion.
3. Mail merge and Letter preparation.
4. Drawing - flow Chart

b) Spread Sheet 15

5. Chart - Line, XY, Bar and Pie.
6. Formula - formula editor.

7. Spread sheet - inclusion of object, Picture and graphics, protecting the document

c) Programming in C :

8. To write a C program to prepare the electricity bill.
9. Functions:

   (a) Call by value (b) Call by reference.
10. To write a C program to print the Fibonacci series for the given number.
11. To write a C program to find the factorial of number using recursion.
12. To write a C program to implement the basic arithmetic operations using Switch Case statement.
13. To write a C program to check whether the given number is an Armstrong number.
14. To write a C program to check whether the given string is a Palindrome.
15. To write a C program to create students details using Structures.
16. To write a C program to demonstrate the Command Line Arguments.
17. To write a C program to implement the Random Access in Files.
18. To write C programs to solve some of the Engineering applications

GE 2131 ENGINEERING PRACTICE LABORATORY - I
(Common to all branches)

L	T	P	C
0	0	3	2

Goal

To provide the students with hands on experience on various basic engineering practices in Civil and Mechanical Engineering.

Objectives

The course should enable the students to

1. Relate theory and practice of basic Civil and Mechanical Engineering
2. Learn concepts of welding and machining practice
3. Learn concepts of plumbing and carpentry practice

Outcomes

The students should be able to

1. Indentify and use of tools, Types of joints used in welding, carpentry and plumbing operations.
2. Have hands on experience on basic fabrication techniques such as carpentry and plumbing practices.
3. Have hands on experience on basic fabrication techniques of different types of welding and basic machining practices.

LIST OF EXPERIMENTS

I. MECHANICAL ENGINEERING PRACTICE 15

1. Welding

   Arc welding: Butt joints, Tee and lap joints.

1. Basic Machining

   Facing, turning, threading and drilling practices using lathe and drilling operation with vertical drilling machine.

3. Machine assembly practice

   Study of centrifugal pump

4. Study on

a. Smithy operations - Productions of hexagonal headed bolt.

b. Foundry operations - Mould preparation for gear and step cone pulley.

II. CIVIL ENGINEERING 12

1. Basic pipe connection using valves, couplings, unions, reducers, elbows in household fitting.
2. Practice in mixed pipe connections: Metal, plastic and flexible pipes used in household appliances.
3. Wood work: Sawing, Planning and making common joints.
4. Study of joints in door panels, wooden furniture.

EL2131 COMMUNICATION SKILLS LABORATORY 1

L	T	P	C
0	0	3	2

Goal

The goal of the programme is to provide a practical input towards nurturing accomplished learners who can function effectively in the English language skills.

Objectives

The course should enable the students to

1. Extend the ability of the learners to be able to listen to English and comprehend its message.
2. Enable the learners to have a functional knowledge of spoken English.
3. Assist the learners to read and grasp the meaning of technical and non-technical passages in English.
4. Help the learners develop the art of writing without mistakes.
5. Expand the thinking capability of the learners so that they would learn how to view things from a different angle.

Outcome

The students should be able to

1. Listen to and evaluate English without difficulty and comprehend its message.
2. Develope a functional knowledge of spoken English so as to use it in the institution and at job interviews.
3. Read and comprehend the meaning of technical and non-technical passages in English.
4. Develope the art of writing so as to put down their thoughts and feelings in words.
5. Think independently and contribute creative ideas.

UNIT I: LISTENING SKILL

Topics: Listening to conversations and interviews of famous personalities in various fields -- Listening practice related to the TV-- Talk shows - News - Educative programmes -- Watching films for critical comments - Listening for specific information - Listening for summarizing information - Listening to monologues for taking notes - Listening to answer multiple-choice questions.

UNIT II: SPEAKING SKILL

Topics: Self-introduction -- Group discussion - Persuading and negotiating strategies - Practice in dialogues -- Presentations based on short stories / poems -- Speaking on personal thoughts and feelings -- academic topics - News reading - Acting as a compere -- Speaking about case studies on problems and solutions - Extempore speeches.

UNIT III: READING SKILL

Topics: Reading anecdotes to predict the content - Reading for interpretation -- Suggested reading - - Short stories and poems -- Critical reading - Reading for information transfer - Reading newspaper and magazine articles for critical commentary - Reading brochures, advertisements, pamphlets for improved presentation.

UNIT IV: WRITING SKILL

Topics: At the beginning of the semester, the students will be informed of a mini dissertation of 1000 words they need to submit individually on any non-technical topic of their choice. The parts of the dissertation will be the assignments carried out during the semester and submitted towards the end of the semester on a date specified by the department. This can be judged as part of the internal assessment.

UNIT V: THINKING SKILL

Topics: Practice in preparing thinking blocks to decode diagrammatical representations into English words, expressions, idioms and proverbs - Inculcating interest in English using thinking blocks. Making pictures and improvising diagrams to form English words, phrases and proverbs -- Picture reading

Reference Books

1. Raman, Meenakshi, and Sangeetha Sharma. Technical Communication: English Skills for Engineers. 2nd edition. New Delhi: Oxford University Press, 2010.

2. Riordian, Daniel. Technical Communication. New Delhi. Cengage Learning, 2009

Websites for learning English

1. British: Learn English - British Council (Listen & Watch) - <http://learnenglish. british council. org/>

2. American: Randall's ESL Cyber Listening Lab - <http://www.esl-lab.com/>

3. Intercultural: English Listening Lesson Library Online http://www.elllo.org/

PH 2031 PHYSICS LABORATORY

L	T	P	C
1	0	3	3

OBJECTIVE

To expose the students for practical training through experiments to understand and appreciate the concepts learnt in Physics

OUTCOME

Performing the experiments related to the subject will help the students to apply the practical knowledge in industrial applications and for developing or modifying methods

S.No.	List of Experiments	Batch 2 (30)			Batch 1 (30)		
		Week	Periods allotted		Week	Periods allotted	
			L	P		L	P
1	Torsional Pendulum - Determination of rigidity modulus of the material of a wire.	1	1	3	2	1	3
2	Non Uniform Bending - Determination of Young's Modulus.	3	1	3	4	1	3
3	Viscosity -Determination of co-efficient of Viscosity of a liquid by Poiseuille's flow.	5	1	3	6	1	3
4	Lee's Disc - Determination of thermal conductivity of a bad conductor.	7	1	3	8	1	3
5	Air Wedge - Determination of thickness of a thin wire.	9	1	3	10	1	3
6	Spectrometer - Refractive index of a prism.	11	1	3	12	1	3
7	Semiconductor laser - Determination of wavelength of Laser using Grating.	13	1	3	14	1	3
	TOTAL	**7**	**2**	**1**	**7**	**2**	**1**
							56 Periods

LIST OF EQUIPMENTS REQUIRED FOR A BATCH OF 30 STUDENTS

1	Torsional Pendulum	(500 gm, wt, 60 cm wire Al-Ni Alloy)	5 nos.
2	Travelling Microscope	(X10)	15 nos.
3	Capillary tube	(length 10cm, dia 0.05mm)	5 nos.
4	Magnifying lens	(X 10)	15 nos.
5	Lee's disc apparatus	(std form)	5 nos.
6	Stop watch	(+/- 1 s)	5 nos.
7	Meter scale	1m length	5 nos.
8	Spectrometer	(main scale 360 deg, ver 30")	5 nos.
9	Grating	(2500 LPI)	5 nos.
10	Laser	(632.8 nm)	5 nos.
11	Semi transparent glass plate Al coating, 65 nm thickness,	50% visibility	5 nos.
12	Equilateral prism	(n = 1.54)	5 nos.
13	Thermometer	+/- 1 deg	8 nos.
14	Screw gauge	(+/- 0.001cm)	12 nos.
15	Vernier caliper	(+/- 0.01 cm)	8 nos.
16	Steam Boiler	1 L	5 nos.
17	Scale	50 cms	5 nos.
18	Cylindrical mass	100 gms	10 sets
19	Slotted wt	300 gms	5 sets
20	Heater	1.5 KW	5 nos.
21	Transformer sodium vapour lamp1 KW	10 nos.	
22	Sodium vapour lamp	700 W	5 nos
23	Burette	50 mL	5 nos
24	Beaker	250 mL	5 nos
25	Spirit level		10 nos

REFERENCES

1. P.Mani, Engineering PhysicsPracticals, Dhanam Publications, 2011.

CY 2031 CHEMISTRY LABORATORY

L	T	P	C
1	0	3	3

OBJECTIVE

To expose the students for practical training through experiments to understand and appreciate the concepts learnt in Chemistry.

OUTCOME

Performing the experiments related to the subject will help the students to apply the practical knowledge in industrial applications and for developing or modifying methods

S.No.	List of Experiments (Any Five)	Batch 2 (30)			Batch 1 (30)		
		Week	Periods allotted		Week	Periods allotted	
			L	P		L	P
1	Estimation of Commercial soda by acid-base titration	1	1	3	2	1	3
2	Determination of Percentage of nickel in an alloy	3		3	4		3
3	Determination of Temporary, permanent and total hardness of water by EDTA method	5	1	3	6	1	3
4	Determination of Chloride content in a water sample	7		3	8		3
5	Potentiometric Estimation of iron	9	1	3	10	1	3
6	Conductometric Titration of a strong acid with a strong base	11	1	3	12	1	3
7	Conductometric Titration of mixture of acids.	13	1	3	14	1	3
8	Determination of Degree of polymerization of a polymer by Viscometry	15	1	3	16	1	3
	TOTAL		**6**	**24**		**6**	**24**
							60 Periods

List of Glassware and Equipments required for a batch of 30 students

1	Burette	(50 mL)	30 nos.
2	Pipette	(20 mL)	30 nos.
3	Conical Flask	(250 mL)	30 nos.
4	Distilled water bottle	(1 L)	30 nos.
5	Standard flask	(100 mL)	30 nos.
6	Funnel	(small)	30 nos.
7	Glass rod	20 cm length	30 nos.
8	Reagent Bottle	(250 mL)	30 nos.
9	Reagent Bottle	(60 mL)	30 nos.
10	Beaker	(100 mL)	30 nos.
11	Oswald Viscometer	Glass	30 nos.
12	Measuring Cylinder	(25 mL)	30 nos.
13	Digital Conductivity Meter	PICO make	8 nos.
14	Conductivity cell	(K=1)	12 nos.
15	Digital Potentiometer	PICO make	8 nos.
16	Calomel Electrode	Glass	12 nos.
17	Platinum Electrode	Polypropylene	12 nos.
18	Burette Stands	Wooden	30 nos.
19	Pipette stands	Wooden	30 nos.
20	Retard stands	Metal	30 nos.
21	Porcelain Tiles	White	30 nos.
22	Clamps with Boss heads	Metal	30 nos.

REFERENCES

1. J.Mendham, R.C. Denney, J.D. Barnes and N.J.K. Thomas, Vogel's Textbook of Quantative Chemical Analysis, 6th Edition, Pearson Education, 2004.
2. C. W. Garland, J. W. Nibler, D. P. Shoemaker, ;"Experiments in Physical Chemistry, 8th ed.," McGraw-Hill, New York, 2009.
3. S. Sumathi, Engineering Chemistry Practicals, Dhanam Publications, 2011.

SEMESTER-II

MA2201 ENGINEERING MATHEMATICS II

L	T	P	C
3	1	0	4

Goal

To create the awareness and comprehensive knowledge in engineering mathematics.

Objectives

The course should enable the students to:

1) Understand the evaluation of the double and triple integrals in Cartesian and polar forms.
2) Know the basics of Vector calculus.
3) Know Cauchy - Riemann equations, Milne - Thomson method and Conformal mapping
4) Grasp the concept of Cauchy's integral formula, Cauchy's residue theorem and contour integration.
5) Know Laplace transform and inverse Laplace transform and their properties.

Outcome

The students should be able to:

1) Find area as double integrals and volume as triple integrals in engineering applications.
2) Evaluate the gradient, divergence, curl, line, surface and volume integrals along with the verification of classical theorems involving them.
3) Applies analytic functions and their interesting properties in science and engineering.
4) Evaluate the basics of complex integration and the concept of contour integration which is important for evaluation of certain integrals encountered in practice.
5) Have a sound knowledge of Laplace transform and its properties and their applications in solving initial and boundary value problems.

UNIT I MULTIPLE INTEGRALS 12

Review: Basic concepts of integration - Standard results - Substitution methods - Integration by parts - Simple problems.

Double integrals: Cartesian and polar co-ordinates - Change of variables - simple problems - Area as a double integral. Triple integrals: Cartesian co ordinates - Volume as a triple integral - simple problems.

UNIT II VECTOR CALCULUS 12

Review: Definition - vector, scalar - basic concepts of vector algebra - dot and cross products-properties. Gradient, Divergence and Curl - Unit normal vector, Directional derivative - angle between surfaces-

Irrotational and solenoidal vector fields. Verification and evaluation of Green's theorem - Gauss divergence theorem and Stoke's theorem. Simple applications to regions such as square, rectangle, triangle, cuboids and rectangular parallelopipeds.

UNIT III ANALYTIC FUNCTIONS **12**

Review: Basic results in complex numbers - Cartesian and polar forms - Demoivre's theorem.

Functions of a complex variable - Analytic function - Necessary and sufficient conditions (without proof) - Cauchy - Riemann equations - Properties of analytic function - Harmonic function - Harmonic conjugate - Construction of Analytic functions by Milne - Thomson method. Conformal mapping: w = z + a, az, 1/z and bilinear transformation.

UNIT IV COMPLEX INTEGRATION **12**

Statement and application of Cauchy's integral theorem and Integral formula - Evaluation of integrals using the above theorems - Taylor and Laurent series expansions -Singularities - Classification. Residues - Cauchy's residue theorem (without proof) - Contour integration over unit circle and semicircular contours (excluding poles on boundaries).

UNIT V LAPLACE TRANSFORM **12**

Laplace transform - Conditions of existence - Transform of elementary functions - properties - Transforms of derivatives and integrals - Derivatives and integrals of transforms - Initial and final value theorems - Transforms of unit step function and impulse function - Transform of periodic functions. Inverse Laplace transform - Convolution theorem - Solution of linear ODE of second order with constant coefficients.

TOTAL: 60

Note: Questions need not be asked from review part.

TEXT BOOKS

1. Venkatraman M.K, Mathematics, Volume - II, National Publishing Company, Chennai, 1985.
2. Grewal B.S, Higher Engineering Mathematics, Thirty Eighth Editions, Khanna Publisher, Delhi, 2004.
3. Chandrasekaran A, Engineering Mathematics, Volume - II, Dhanam Publication, 2008.

REFERENCE:

1. Kandasamy P, Engineering Mathematics Volume II, S. Chand & Co., New Delhi, 1987.
2. Grewal B.S, Engineering Maths - II, Sultan Chand, New Delhi, 1993.
3. Bali N.P, Manish Goyal, Text book of Engineering Mathematics, 3rd Edition, Lakshmi Publications, 2003.

CH2201 INTRODUCTION TO CHEMICAL ENGINEERING

4 Credits

Goal

Provide an overview of chemical engineering and its role in the chemical process industry

Objectives

The course should enable the students to

- Understand the difference between chemistry and chemical engineering and the role of chemical engineering in the process industry.
- Understand the various aspects of chemical engineering such as unit operations and unit processes.
- Learn the basic laws such as conservation of mass and energy and understand its importance in the basic material and energy balance calculations.
- Know the dimensional analysis along with various methods of performing dimensional analysis..
- Learn the importance and aspects of safety and various methods of systematic analysis of safety aspects.

Outcomes

The students should be able to

- Identify the role of chemical engineer in a process industry.
- Appreciate the scope of engineering in a chemical industry in comparison with that of other engineering disciplines.
- Carry out mass and energy balances for a given chemical process.
- Perform the dimensional analysis and empirical calculations for simple physical systems.
- Carry out the preliminary analysis of the various aspects of safety of any chemical process.

UNIT I: ROLE OF CHEMICAL ENGINEERS IN EVERY DAY LIFE 8

Chemistry, Chemical engineering and Chemical technology, Role of Chemical Engineers in Petroleum Refining, Coal gasification, Electronics, Bio-chemical and Environmental engineering.

UNIT II: HISTORY OF CHEMICAL ENGINEERING AND UNIT OPERATIONS 8

History of Chemical Engineering and Chemical Technology, Scope of Chemical Engineering, Concept of different Unit processes and Unit operations.

UNIT III: CONSERVATION LAWS AND APPLICATION 9

Laws of Conservation of mass and energy, steady and Unsteady process, General conservation equation for open systems, Conservation of mass in waste water treatment.

UNIT IV: SCALE UP AND DIMENSIONAL ANALYSIS 10

Principle of Dimensional Analysis, pi-theorem, Dimensionless groups, Use of dimensional analysis for Scale-up studies, Geometric, Dynamic and Kinematic Similarity.

UNIT V: SAFETY AND EMPIRICAL CORRELATIONS **10**

Engineering aspects of Industrial Safety, Storage of Chemicals - Pool fire, BLEVE, VCE, MSDS of a compound, Need for semi empirical approach in Chemical Engineering- Case Studies.

Total No. of Periods: 45

TEXT BOOK:

1. Introduction to Chemical Engineering by S.K.Ghosal, S.K.Sanyal, S.Datta.

REFERENCE BOOKS:

1. McCabe, W.L., Smith, J. C. and Harriot, P. "Unit operations in Chemical Engineering", McGraw Hill.
2. Badger W.L. and Banchero J.T., "Introduction to Chemical Engineering", Tata McGraw Hill.
3. Safety in Chemical process industries,O.P.Kharbanda.

PH2201 MATERIALS SCIENCE AND ENGINEERING

3 Credits

Goal

To make the students understand the subject materials science and its importance in the engineering industry

Objectives

The course should enable the students to

- Learn the structure and behavior, and various characteristics of materials
- Learn the response characteristics of materials subjected to load, and the basics of phase diagrams of binary alloys
- Learn various processes related to extraction of iron and the manufacture of various grades of steel, such as metal extraction, purification of iron and the making of steel
- Understand the concept of multi-phase flow, physicochemical principles that are involved in continuous casting of metal into various shapes
- Learn the metallurgical processes of Aluminum, Copper, Zinc and Lead.

Outcomes

The students should be able to

- Identify the correct material based on the characteristics of the material
- Interpret the phase diagrams of binary alloys
- Design the processes for the steel industry and appreciate the metallurgical principles
- Analyze the engineering aspects of metal casting processes
- Design and analyze the extraction processes for of Aluminum, Copper, Zinc and Lead

UNIT I : STRUCTURE OF MATERIALS **10**

Structure of materials-Various types of bonds. Crystalline Structure of Solids- concepts of unit cell and space lattice, packing factor. X-ray diffraction for determining crystal structure. Mechanical properties-Elastic, anelastic and viscoelastic behaviour of material. Strength, hardness toughness, ductility, brittleness in engineering materials. Optical fibers.

UNIT II : PLASTIC DEFORMATION / PHASE DIAGRAMS **12**

Mechanism of plastic deformation, slip and dislocations, stain hardening and recrystallization. Elementary aspects of creep, fatigue, fracture. Phase Diagrams- Solidification and structure of metals. Grain boundaries. Phase equilibrium and phase diagrams of binary alloys. Phase diagram of ternary systems. Iron-Carbon diagram. Heat Treatment -Introduction and purposes of heat treatment. T-T-T Curve. Corrosion-Concepts and forms of corrosion. Corrosion Mechanism and prevention. Protective materials and coating.

UNIT III : METAL EXTRACTION **9**

Basic principles of metal extraction: Pyrometallurgy: calcinations, roasting-oxidizing, predominance area diagrams, multiple hearth, flash and fluo-solid, sintering, smelting, slag and its classification. Steelmaking process flow diagram: Iron making (Operation involved in Blast furnace)- Steel making (oxygen blown converter - LD) - Secondary steel making / refining (ladle processing, vacuum degassing, ladle furnace processing)

UNIT IV : CONTINUOUS CASTING **4**

Continuous casting - with emphasis on application of the concepts of physicochemical principles involved, moving/packed bed reactor, gas-liquid two-phase flow, heat transfer with phase change (solidification).

UNIT V : METALLURGY **10**

Principles of Hydrometallurgy and Electrometallurgy, Extraction of Aluminum: Hall-Heroult process, Electrolytic refining; Sources of Zinc & Copper: Pyro & Hydro metallurgical extraction of copper & Zinc; Extraction of Lead, Recent development in Lead smelting.

TOTAL: 45 hrs

TEXT BOOKS

1. Lawrence, H. Vanvlack, Elements of Material Science and Engineering, Pearson Education.
2. Raghavan, V. Material Science and Engineering, Prentice Hall of India.

REFERENCES

1. L. Von Bogdandy and H.J Engell, The Reduction of Iron Ores, Springer-Verlag, NY.
2. R.I.L Guthrie: Engineering in Process Metallurgy, Oxford University Press (Paperback edition 1992)

CH2202 INSTRUMENTAL ANALYSIS FOR ENGINEERS

3 Credits

Goal

To introduce important instruments used in Analytical Chemistry and their working principle and applications

Objectives

The course should enable the students to

- Understand the basic concepts of electromagnetic radiation and classification of various instrumental methods
- Learn molecular spectroscopy
- Understand the concept of atomic spectroscopy and chromatography
- Learn Moseley's law understand the concept of X-Ray Detectors
- Learn thermogravimetry, thermograms, and related instruments

Outcomes

The students should be able to

- Identify the suitable instrumental method of analysis based on the physical properties and bond structure
- Interpret and analyze the data from vibrational, rotational characteristics of molecules
- Apply the atomic spectroscopy to detect metal ions and chromatography tools to separate molecules
- Interpret the data obtained from X-Ray analysis
- Analyze thermograms of various compounds and predict melting points

UNIT I INTRODUCTION TO SPECTROSCOPICAL METHODS OF ANALYSIS 9

ELECTROMAGNETIC RADIATION: Various ranges, Dual properties, Various energy levels, Interaction of photons with matter, absorbance and transmittance and their relationship, Permitted energy levels for the electrons of an atom and simple molecules, Classification of instrumental methods based on physical properties.

QUANTITATIVE SPECTROSCOPY: Beer-Lambert's Law, Limitations, Deviations (Real, Chemical, Instrumental). Nesslerimetry, Duboscq colourimetry, Estimation of inorganic ions such as Fe, Ni and estimation of Nitrite using Beer-Lambert's Law.

UNIT II MOLECULAR SPECTROSCOPY 9

Various electronic transitions in organic and inorganic compounds effected by UV, Visible and infra red radiations, Various energy level diagrams of saturated, unsaturated and carbonyl compounds, excitation by UV and Visible radiations, Woodward-Fischer rules for the calculation of absorption maxima (dienes and carbonyl compounds), Effects of auxochromes and effects of conjugation on the absorption maxima, Instrumentation for UV, VISIBLE and IR spectroscopies (Source, Optical parts

and Detectors), Multicomponent analysis, Photometric titration (Experimental setup and various types of titrations), Applications of UV, VISIBLE AND IR spectroscopies.

UNIT III ATOMIC SPECTROSCOPY AND CHROMATOGRAPHIC METHODS 9

Atomic absorption spectrophotometry: Principle, Instrumentation and Applications, Various interferences observed in AAS (Chemical radiation and excitation).

Classification of chromatographic methods, Column, Thin layer, Paper, Gas, High Performance Liquid Chromatographical methods (Principle, mode of separation and Technique). Separation of organic compounds by column and Thin layer, mixture of Cu, Co and Ni by Paper, separation of amino acids by paper, estimation of organic compounds by GC and HPLC.

UNIT IV ELECTROMETRIC METHODS OF ANALYSIS 9

Introduction to electrometric methods, difference between redox and acid-base reactions, types of cells,schematic representation of cells, single electrode potential, laboratory reference electrodes (Standard hydrogen, saturated calomel, Ag - AgCI and inert electrodes), ion-selective electrodes. Potentiometry: Nernst equation, experimental set-up and measurement of pH; Conductometry - Measurement of conductance, experimental set-up and various titrations (strong and weak acid/ base).

UNIT V XRD ANALYSIS AND THERMAL METHODS 9

Introduction, Mosley's law, Different emission and diffraction methods, various X-ray detectors

Thermogravimetry: Instrumentation, factors affecting the shapes of thermograms, applications, thermograms of some important compounds (CuSO4, 5H2O, CaC2O4.2H2O etc). Differential thermal analysis : Principle, Instrumentation and applications, differences between DSC and DTA. Applications of DSC (Inorganic and Polymer samples)

Total No of periods: 45

TextBook

1. Willard, H.H., Merritt. I.I., Dean J.a., and Settle, F.A., " Instrumental methods of analysis ", Sixth edition, CBS publishers, 1986.

References:

1. Parikh V.M., " Absorption spectroscopy of organic molecules ", Addison - Wesley Publishing Company, 1974.
2. Skoog D.A. and West D.M., " Fundamentals of Analytical Chemistry ", Saunders-college Publishing, 1982.
3. Banwell, G.C., " Fundamentals of molecular spectroscopy ", TMH, 1992.
4. Vogel A.I., " Quantitative Inorganic analysis ", V.Edition.
5 Day R.A., Underwood A.L., " Qualitative Inorganic analysis ", (A.I.Vogel), V.Edition, Prentice-Hall of India (P) Ltd., New Delhi, 1991.
6. Sharma, B.K., " Instrumental Methods of Analysis ", Goel publishing House, 1995.

7. Robert de Levie, " Principles of Quantitative Chemical Analysis ", I Edition, Tata McGraw Hill, 1998.

8. Rouessac, F., " Chemical Analysis-Modern instrumental methods and techniques ", Wiley-Publishers 1999.

GE 2231 - ENGINEERING PRACTICES LABORATORY II

L	T	P	C
0	0	3	2

LIST OF EXPERIMENTS

1. Electrical Engineering

1. Wiring for a tube light.
2. Wiring for a lamp and fan.
3. Staircase wiring.
4. Study of (i) Iron box and (ii) Fan with Regulator.

2. Electronics Engineering

1. Study of Electronic components and Equipments.
2. Characteristics of PN junction diode & measurement of Ripple factor or half wave and full wave rectifier.
3. Applications of OP-AMP - Inverter, Adder and Subtractor.
4. Study and verification of Logic Gates.

Total = 30

Text Book:

1. T. Jeyapoovan, M.Saravanapandian and S. Pranitha, "Engineering Practices Lab Manual", 3rd Edition 2006, Vikas Publishing house (P) Ltd., New Delhi.

CH2333 TECHNICAL ANALYSIS LAB

2 Credits

Goal

To learn analytical techniques in determining contaminants/pollutants in water and various analysis methods

Objectives

The course should enable the students to

- Understand the basic concepts of determination of chemical constituents of a material
- Learn spectroscopy and simple characterization tools
- Understand the importance of contaminants and pollutants determination

Outcome

The students should be able to

- Identify the constituents and chemical composition of a given mixture
- Interpret and analyze the data from spectroscopy and simple characterization tools
- To identify and formulate approaches to any sample analysis in a lab or in an industry

List of Experiments

1. Analysis of water

A. Determination of temporary hardness

B. Determination of permanent hardness

2. Determination of chlorine demand in water - Estimation of residual chlorine in water by Volumetric method

3. Cement Analysis (3 experiments)

A. Estimation of silica content

B. Estimation of calcium oxide content

C. Estimation of mixed oxide content

4. Fertilizer Analysis - Estimation of Nitrogen in Urea by Kjeldals method

5. Determination of Sulfur in coal by Turbidity method

6. Preparation of standard curve(Absorbance vs. concentration) of a standard protein by folin's Method using visual Spectrophotometer

7. Determination of Ferrous/Copper ions by colorimeter method

8. Determination of CO in a combustion process by IR method

9. Analysis of gaseous mixture using TCD/FID

10. Separation of proteins by Paper Chromatography

11. Determination of molecular weight by UV spectrophotometer

12. Calibration and analysis of an organic mixture(benzene&toluene) by a refractometer

13. Determination of any optically active substance in the presence of non-active species by a polarimeter

List of Equipment

1. Polarimeter
2. Paper Chromatography Kit
3. UV Spectrophotometer
4. Colorimeter
5. Turbidimetry equipment
6. Visual Spectrophotometer

TOTAL: 45hrs

EL 2231 COMMUNICATION SKILLS LABORATORY 2

L	T	P	C
2	0	2	3

Goal

The goal of the programme is to provide an advanced practical input towards moulding student-achievers who can use the English language with ease.

Objectives

The course should enable the students to

1. Extend the power of the learners to listen to English at an advanced level and comment on it.
2. Guide the learners to speak English at the formal and informal levels.
3. Enable learners to read and grasp the in-depth meaning of technical and non-technical passages in English.
4. Help the learners develop the art of writing at the formal and informal levels.
5. To expand the thinking capability of the learners so that they would learn how to be original in their thoughts.

Outcome

The students should be able to

1. Listenand understand English at an advanced level and interpret its meaning.
2. Develop English at the formal and informal levels and thus gained the confidence to use it without fear.
3. Read and grasp the in-depth meaning of technical and non-technical passages in English.
4. Develope the art of formal and informal writing.
5. The learners will be able to think independently and creatively and also verbalize their thoughts fearlessly.

Unit I: Listening Skill

Topics: Listening to telephonic conversations -- Listening to native British speakers -- Listening to native American speakers -- Listening to intercultural communication -- Listening to answer questions as one-liners and paragraphs -- Listening practice to identify ideas, situations and people -- Listening to group discussions -- Listening to films of short duration.

Unit II: Speaking Skill

Topics: Interview skills - People skills - Job interview - Body language and communication -- How to develop fluency -- Public speaking -- Speaking exercises involving the use of stress and intonation - Speaking on academic topics - Brain storming & discussion - Speaking about case studies on problems and solutions - Extempore speeches - Debating for and against an issue - Mini presentations - Generating talks and discussions based on audiovisual aids.

Unit III: Reading Skill

Topics: Reading exercises for grammatical accuracy and correction of errors -- Reading comprehension exercises with critical and analytical questions based on context - Evaluation of contexts - Reading of memos, letters, notices and minutes for reading editing and proof reading -- Extensive reading of parts of relevant novels after giving the gist of the same.

Unit IV: Writing Skill

Topics: At the beginning of the semester, the students will be informed of a mini dissertation of 2000 words they need to submit individually on any non-technical topic of their choice. The parts of the dissertation will be the assignments carried out during the semester and submitted towards the end of the semester on a date specified by the department. This can be judged as part of the internal assessment.

Unit V: Thinking Skill

Topics: Practice in preparing thinking blocks to decode pictorial representations into English words, expressions, idioms and proverbs - Eliciting the knowledge of English using thinking blocks -- Picture rereading -- Finding meaning in the meaningless - Interpreting landscapes, simple modern art and verbal and non-verbal communication.

Reference Books

1. Ibbotson, Mark. Cambridge English for Engineering. New Delhi: Cambridge University Press, 2009.
2. Smith-Worthington Jefferson. Technical Writing for Success. New Delhi. Cengage Learning, 2007.

Websites for learning English

1. British: Learn English - British Council (Business English) -<http://learnenglish. british council.org/>
2. BBC Learning English (General and Business English) - <http://www.bbc.co.uk/worldservice/learningenglish/>
3. Intercultural: English Listening Lesson Library Online <http://www.elllo.org/>

SEMESTER III

MA 2301 ENGINEERING MATHEMATICS III
(Common to all branches)

L	T	P	C
3	1	0	4

Goal

To develop the skills of the students in the areas of boundary value problems and transform techniques

Objectives

The course should enable the students to

1. Develop the skills of the students in the areas of boundary value problems and transform techniques.
2. Gain a knowledge in a large number of engineering subjects like heat conduction, communication systems, electro-optics and electromagnetic theory.
3. Serve as a prerequisite for post graduate and specialized studies and research.

Outcome

The students should be able to

1. Formulate certain practical problems in terms of partial differential equations, solve them and physically interpret the results.
2. Have gained a well founded knowledge of Fourier series, their different possible forms and the frequently needed practical harmonic analysis that an engineer may have to make from discrete data.
3. Have obtained capacity to formulate and identify certain boundary value problems encountered in engineering practices, decide on applicability of the Fourier series method of solution, solve them and interpret the results
4. Have grasped the concept of expression of a function, under certain conditions, as a double integral leading to identification of transform pair, and specialization on Fourier transform pair, their properties, the possible special cases with attention to their applications.
5. Have learnt the basics of Z - transform in its applicability to discretely varying functions gained the skill to formulate certain problems in terms of difference equations and solve them using the Z - transform technique bringing out the elegance of the procedure involved.

UNIT I PARTIAL DIFFERENTIAL EQUATIONS 12

Formation of partial differential equations by elimination of arbitrary constants and arbitrary functions - Solution of standard types of first order partial differential equations - Lagrange's linear equation - Linear partial differential equations of second and higher order with constant coefficients.

UNIT II FOURIER SERIES 12

Dirichlet's conditions - General Fourier series - Odd and even functions - Half range sine series - Half range cosine series - Complex form of Fourier Series - Parseval's identify - Harmonic Analysis.

UNIT III BOUNDARY VALUE PROBLEMS **12**

Classification of second order linear partial differential equations - Solutions of one dimensional wave equation - One dimensional heat equation - Steady state solution of two-dimensional heat equation (Insulated edges excluded) - Fourier series solutions in Cartesian coordinates.

UNIT IV FOURIER TRANSFORM **12**

Fourier integral theorem (without proof) - Fourier transform pair - Sine and Cosine transforms - Properties - Transforms of simple functions - Convolution theorem.

UNIT V Z -TRANSFORM AND DIFFERENCE EQUATIONS **12**

Z-transform - Elementary properties - Inverse Z - transform - Convolution theorem -Formation of difference equations - Solution of difference equations using Z - transform.

TOTAL = 60

TEXT BOOK

1. Grewal, B.S., Higher Engineering Mathematics, 39th Edition , Khanna Publishers, Delhi, 2007.
2. Kandasamy, P., Thilagavathy, K., and Gunavathy, K., Engineering Mathematics Volume II", S. Chand & Company ltd., New Delhi, 4th edition 2009.
3. Wylie C. Ray and Barrett Louis, C., Advanced Engineering Mathematics, Sixth Edition, McGraw-Hill, Inc., New York, 1995.

REFERENCES

1. Andrews, L.A., and Shivamoggi B.K., Integral Transforms for Engineers and Applied Mathematicians, Macmillen, New York, 2007.
2. Narayanan, S., Manicavachagom Pillay, T.K. and Ramaniah, G., Advanced Mathematics for Engineering Students, Volumes II and III, S. Viswanathan (Printers and Publishers) Pvt. Ltd. Chennai, 2002.
3. Churchill, R.V. and Brown, J.W., Fourier Series and Boundary Value Problems, Fourth Edition, McGraw-Hill Book Co., Singapore, 1987.

CH2302 CHEMICAL PROCESS CALCULATION

4 Credits

Goal

To teach the students the material and energy balance calculations for various chemical processes

Objectives

The course should enable the students to

- Learn various units and dimensions relevant to chemical engineering
- Understand the ideal and non-ideal behavior of gases, gas laws
- Learn the basics of material balance in steady-state and unsteady state conditions for various processes
- Learn the basics of humidity and use the humidity charts
- Learn the basics of thermo physics and thermo chemistry calculations

Outcomes

The students should be able to

- Express various properties in different systems of units and convert them from one system of units to another system
- Apply gas law calculations to real life problems
- To carry out material balance calculations for various unit operations
- Perform drying and condensation calculations
- Perform energy balance calculations for various processes in chemical engineering

UNIT I UNITS AND DIMENSIONS 9

Basic and derived units, use of model units in calculations, Methods of expression, compositions of mixture and solutions.

UNIT II GAS CALCULATIONS 9

Ideal and real gas laws - Gas constant - calculations of pressure, volume and temperature using ideal gas law. Use of partial pressure and pure component volume in gas calculations, applications of real gas relationship in gas calculation

UNIT III MATERIAL BALANCE 9

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

UNIT IV HUMIDITY AND SATURATION 9

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

UNIT V THERMO PHYSICS & THERMOCHEMISTRY 9

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

TOTAL: 45 hrs

TEXT BOOKS:

1. Bhatt, B.L., VORA, S.M., "Stoichiomentry ", Tata McGraw-Hill, 2008.
2. Hougen, O.A., Watson, K.M and Ragatz, R.A., " Chemical Process Principles Part-I ", John Wiley and Asia Publishing, 1970.

REFERENCES:

1. Himmelblau, D.M., "Basic Principles and Calculations in Chemical Engineering ", Fourth Edition, Prentice Hall Inc.,1982.
2. Whitwell, J.C., Tone, R.K. "Conservation of Mass and Energy ", McGraw-Hill, 1973.
3. Process Calculation for Chemical Engineering, Second Revised Edition, Chemical Engineering Education Development Centre, I.I.T., Madras, 1981.

CH2301 UNIT OPERATIONS

4 Credits

Goal

To study various processing techniques in a process industry

Objectives

The course should enable the students to

- Study the characteristics of solids and their behavior under external forces, size analysis
- Learn size reduction and the laws related to energy calculations in size reduction, and different equipment for size reduction
- Understand the various methods of mechanical separation of mixtures such as screening, gravity settling, thickening
- Study the theory of filtration and types of filters
- Learn the working principle of mixing and agitation equipment and the design correlations
- Study various equipment used for storage and conveying of various types of solids

Outcomes

The students should be able to

- Carry out the stress analysis calculations for various forces on a body

- Select the right type of equipment for size reduction and calculate the energy requirements and the efficiency of equipment
- Carry out the design calculations for mechanical separation equipment
- Design the filtration equipment
- Perform design calculations for mixers, and agitators
- Identify the right type of storage facility, and conveyors for the given solid material

UNIT I PARTICLE CHARACTERISTICS AND SIZE ANALYSIS 9

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

UNIT II SIZE REDUCTION 9

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

UNIT III MECHANICAL SEPARATIONS 9

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

UNIT IV FILTRATION 9

Theory of filtration, Batch and continuous filters, centrifuges, membrane and ultra filtration

UNIT V MIXING AND AGITATION 9

Equipment for blending and kneading, dispersion, power for agitation, correlations

Total No of periods: 45

Text Book

1. McCabe,W.L, Smith J.C ., " Unit Operations in Chemical Engineering ", McGraw-Hill, Fourth Edition,1984.

References

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

EE 2314 BASIC ELECTRICAL TECHNOLOGY

L	T	P	C
3	1	0	4

Goal

To understand basic principles underlying the behaviour of electrical circuits, electric power apparatus and measurement techniques.

Objectives

The course should enable the students to

1. Expose the students to the fundamental of electrical circuits, principles of operation of D.C. & A.C. machines, measurements and measuring instruments.

Outcome

The students should be able to

1. Understand the basic principles of electric circuits.
2. Know the construction details of electric machines.
3. Know the technique of measurement using voltmeter and ammeter.

UNIT I FUNDAMENTALS OF D.C. AND A.C. CIRCUITS 12

D.C. voltage - current and power - ohm's law - Resistance in series and parallel circuits - current and voltage division - Kirchoff's laws - simple problems using mesh analysis - sinusoidal voltage - R.M.S, average and peak values - phase and phase difference - phasor representation - power factor - voltage and current relation in single phase RC, RL and RLC simple series and parallel circuits - complex power - real, reactive and apparent power - three phase circuits - line and phase values of voltage / current - power measurement in three phase circuits using two wattmeters - simple problems.

UNIT II D.C. AND A.C. MACHINES 12

Constructional details and operating principles of D.C. generators - e.m.f equation - type of generators - O.C.C. and load characteristics - principle and operation of D.C. motors - back e.m.f. - types of motors - speed and torque equation - load characteristics of D.C. motors - starting methods. Construction and operation of synchronous generators - types of synchronous machines - e.m.f equation - load characteristics - principle of operation of synchronous motors - starting methods - simple problems.

UNIT III TRANSFORMERS 12

Constructional details and operation of single phase transformers - types of transformers - e.m.f equation - transformation ratio - transformer on no load and load - parameters of transformers referred to primary and secondary - equivalent circuits - regulation - losses and efficiency - simple problems in single phase transformers - introduction to three phase transformers - types of three phase connections.

UNIT IV INDUCTION MACHINES **12**

Constructional details and principle of operation of three phase induction motor - types of three phase induction motors - e.m.f equation - rotor e.m.f and current at standstill and running conditions - slip - torque characteristics - starting of induction motors- rotor resistance, auto transformer and star - delta starters - losses and efficiency - simple problems. Construction and principle of operation of single-phase induction motors - starting methods - split phase and shaded pole types.

UNIT V MEASUREMENTS AND MEASURING INSTRUMENTS **12**

Deflecting torque, controlling torque and damping torque in indicating instruments - construction and operating principles of moving coil and moving iron instruments - voltmeters and ammeters - construction and operating principles of induction type energy meters and dynamo meter type wattmeters - types of errors.

TOTAL : 60

TEXT BOOKS

1. D.P.Kothari and I.J.Nagrath, 'Basic Electrical Engineering', Second Edition 2002, Tata McGraw-Hill Publishing Company Limited.
2. H. Cotton, Advanced Electrical technology, CBS Publishers, New Delhi,1999.
3. V.K. Metha and Rohit Metha, "Principles of Electrical Engineering", 2003, S.Chand and Company Ltd., New Delhi 110055.

REFERENCES

1. Stephen J.Chapman, Electric Machinery Fundamentals, Third Edition, 1999, McGraw-Hill.
2. S. Parkar Smith, Problems in Electrical Engineering, Asia Publications.
3. K.Murugesh Kumar, Basic Electrical Science & Technology, First Published 2002, Vikas Publishing House Private Limited.
4. T.Thyagarajan, K.P.Sendur Chelvi and T.R.Rangaswamy, Engineering Basics, Third Edition, 2002, New Age International (P) Limited, Publisher.

ME 2312 MANUFACTURING TECHNOLOGY

L	T	P	C
3	0	0	3

Goal

To introduce basic manufacturing processes and to develop theoretical skill of students.

Objectives

The course should enable the students to

1. Learn Metal joining processes
2. Learn Casting processes.

3. Learn Metal forming/high energy rate forming.

4. Learn the processing of plastics

Outcome

The students should be able to

1. Understand the various manufacturing methods employed in the Industry.

2. Get knowledge in Basic welding & finishing operations

3. Get knowledge in Hot & cold working of metals including High Energy Rate forming

4. Get knowledge in Plastic manufacturing.

UNIT I METAL CASTING PROCESSES 10

Sand casting - Sand moulds - Type of patterns - Pattern materials - Pattern allowances- Types of Moulding sand - Properties - Core making - Methods of Sand testing - Moulding machines - Types of moulding machines - Melting furnaces - Working principle of Special casting processes - Shell, investment casting - Ceramic mould - Lost Wax process - Pressure die casting - Centrifugal casting - CO_2 process - Sand Casting defects - Inspection methods.

UNIT II FABRICATION PROCESS 10

Fusion welding processes - Types of Gas welding - Equipments used - Flame characteristics - Filler and Flux materials - Arc welding equipments - Electrodes - Coating and specifications - Principles of Resistance welding - Spot/butt, seam welding - Percusion welding - Gas metal arc welding - Flux cored - Submerged arc welding - Electro slag welding - TIG welding - Principle and application of special welding processes - Plasma arc welding - Thermit welding - Electron beam welding - Friction welding - Diffusion welding - Flame cutting - Weld defects - Brazing and soldering process - Methods and process capabilities - Filler materials and fluxes - Types of Adhesive bonding

UNIT III BULK DEFORMATION PROCESSES 10

Hot working and cold working of metals - Forging processes - Open and close die forging - Characteristics of the process - Types of Forging Machines - Typical forging operations - Rolling of metals - Flat strip rolling - Types of Rolling mills - Shape rolling operations - Tube piercing - Defects in rolled parts - Principles of Extrusion - Types of Extrusion - Hot and Cold extrusion -Principle of rod and wire drawing - Equipments used.

UNIT IV SHEET METAL FORMING PROCESSES 8

Sheet metal characteristics - Typical shearing operations, bending and drawing operations - Stretch forming operations - Formability of sheet metal - Test methods - Working principle and application of special forming processes - Hydro forming - Rubber pad forming - Metal spinning - Explosive forming - Magnetic pulse forming - Peen forming - Super plastic forming - Process characteristics

UNIT V FORMING AND SHAPING OF PLASTICS 7

Types of plastics - Characteristics of forming and shaping processes - Moulding of Thermoplastics - Working principles and typical applications of - Injection moulding - Plunger and screw machines - Blow moulding - Rotational moulding - Film blowing - Extrusion - Typical industrial applications -

Thermoforming - Processing of Thermosets - Working principles and typical applications - Compression moulding - Transfer moulding - Bonding of Thermoplastics - Fusion and solvent methods - Induction and Ultrasonic methods.

TOTAL : 45

TEXT BOOKS :

1. Hajra Choudhury, Elements of Workshop Technology, Vol.I and II, Media Promotors Pvt Ltd., Mumbai, 2007
2. Serope Kalpak jain, Steven R.Schmid, Manufacturing Engineering and Technology, Pearson Education, Inc. 4th Edition, 2009.

REFERENCE BOOKS

1. Elements of Manufacturing Processes, B.S. Magendran Parashar & R.K. Mittal, Prentice Hall of India, 2008.
2. Manufacturing Technology, P.N. Rao, Tata McGraw-Hill Publishing Limited, 2010.
3. A text book of production technology, P.C. Sharma, S. Chand and Company, 2010.
4. Manufacturing Process - Begman, John Wilely & Sons, VIII Edition, 1999.

CH2331 ORGANIC TECHNOLOGY LAB

2 Credits

Goal

To analyze commonly used organic materials in everyday life

Objectives

The course should enable the students to

- Prepare simple organic compounds and characterize them
- Tools to be used to characterize organic compounds
- Understand simple techniques such as boiling point, melting point , etc., to identify compounds

Outcomes

The students should be able to

- Formulate thought process for organic compounds analysis
- Importance of simple approaches to characterize compounds before using sophisticated tools
- To identify protocols for purity analysis

List of Experiments

1. Oil Analysis: (3 experiments)
   a) Acid value
   b) Saponification value

c) Iodine value

2. Soap Analysis: (2 experiments)

   a) Alkali Content

   b) Fatty acid content of Soap

3. Estimation of purity of glycerol by Dichromatic method

4. Preparation of Benzoic Acid

5. Preparation of Phenol

List of Equipmet

1. Glassware (Conical flasks, measuring jar, test-tubes, etc.)

CH 2332 UNIT OPERATIONS LAB

2 CREDITS

Goal

To expose the students to the practical experience of handling various equipment that are used in process industry.

Objectives

The course should enable the students to

- Learn the operation of drying
- operate size reduction equipment such as Jaw Crusher and Ball Mill
- Carry out the mass separation operations such as Distillation, Extraction, Leaching, and absorption
- Understand the concept of pressure drop across the fixed bed, and the transition of fixed bed to fluidized bed

Outcome

The students should be able to

- Generate the drying curve for the given wet material
- Determine the energy requirement for size reduction of the solid material
- Determine the size of distillation, extraction leaching, and absorption equipment
- Determine the minimum fluid velocity to for the required to operate the bed

1. Drying
2. Simple Distillation
3. Size reduction (or) Screening

4. Leaching
5. Extraction
6. Packed Bed Absorber
7. Fluidized Bed
8. Jaw Crusher
9. Ball Mill
10. Heat Exchanger

List of Equipment

1. Dryer
2. Simple Distillation Set-up
3. Ball Mill
4. Leacing Equipm,ent
5. Extraction Equipment
6. Packed Bed
7. Jaw Crusher
8. Heat Exchanger

ME 2332 MANUFACTURING TECHNOLOGY LAB

L	T	P	C
0	0	3	2

Goal

To impart knowledge on Mechanics of metal cutting & Machining Operations

Objectives

The course should enable the students to

1. Learn the Applications of mechanics of metal cutting
2. Have knowledge on milling and drilling and grinding operations
3. Introduce the CNC Machine.

Outcome

The students should be able to

1. Select the right tool, machining condition and relevant measurement
2. Know the methods and applications of various machining operations
3. Understanding the CNC hardware and CNC Programming

EXERCISES

1. Two or More Metal Cutting Experiments (Example: Shear Angle Measurement, Cutting Force Measurement, Cutting Temperature Measurement, Tool Wear Measurement, Life Measurement etc.)
2. One or More Exercises in Milling Machines (Example: Milling Polygon Surfaces, Gear milling, Keyway milling, Helical Groove milling etc.)
3. Two or More Exercises in Grinding / Abrasive machining (Example: Surface Grinding, Cylindrical Grinding, Centreless Grinding, Lapping, Honing etc.)
4. Two or More Exercises in Machining Components for Assembly of different fits. (Example: Machining using Lathes, Shapers, Drilling, Milling, Grinding Machines etc.)
5. One or More Exercises in Capstan or Turret Lathes
6. One or More Exercises in Gear Machining (Example: Gear Cutting, Gear Shaping, Gear Hobbing etc.)
7. One or More Exercises in CNC Machines (Example: CNC Programming, CNC Tooling, CNC Machining etc.)

TOTAL : 45

LIST OF EQUIPMENTS
(for a batch of 30 students)

1. Centre Lathes - 15 No (5 Precision Type)
2. Turret and Capstan Lathe - 1 No each
3. Horizontal Milling Machine - 1 No
4. Vertical Milling Machine - 1 No
5. Surface Grinding Machine - 1 No
6. Tool Dynamometer - 1 No
7. Gear Hobbing Machine - 1 No
8. CNC Lathe (Trainer or Industrial Type) - 1No

EE 2235 ELECTRICAL ENGINEERING LAB

L	T	P	C
0	0	3	2

Goal

To Impart hands-on training to the students on various types of motors and controls

Objectives

The course should enable the students to

1. Impart knowledge on DC Motors and its load characteristics
2. Impart knowledge on Single phase transformers
3. Impart knowledge on AC Motors and its load characteristics
4. Impart knowledge on DC & AC Starters

Outcome

The students should be able to

1. Study the load and speed characteristics of DC motors
2. Do Load test on single phase transformers
3. Study the v-curves and inverted v-curves of synchronous motors
4. Study the load and speed characteristics of AC motors

LIST OF EXPERIMENTS

1. Load test on DC Shunt & DC Series motor
2. O.C.C & Load characteristics of DC Shunt and DC Series generator
3. Speed control of DC shunt motor (Armature, Field control)
4. Load test on single phase transformer
5. O.C & S.C Test on a single phase transformer
6. Regulation of an alternator by EMF & MMF methods.
7. V curves and inverted V curves of synchronous Motor
8. Load test on three phase squirrel cage Induction motor
9. Speed control of three phase slip ring Induction Motor
10. Load test on single phase Induction Motor.
11. Study of DC & AC Starters

TOTAL : 45

LIST OF EQUIPMENTS
(for batch of 30 students)

1. DC Shunt motor - 2 No
2. DC Series motor - 1 No
3. DC shunt motor-DC Shunt Generator set - 1 No
4. DC Shunt motor-DC Series Generator set - 1 No
5. Single phase transformer - 2 No
6. Three phase alternator - 2 No
7. Three phase synchronous motor - 1 No
8. Three phase Squirrel cage Induction motor - 1 No
9. Three phase Slip ring Induction motor - 1 No
10. Single phase Induction motor - 1 No

SEMESTER IV

CH2401 FLUID MECHANICS

4 Credits

Goal

To impart the basic knowledge of behavior of fluids

Objectives

The course should enable the students to

- Learn the characteristics of fluid under stress, and calculation of hydrostatic pressure
- Learn the concepts of control volume, and Bernoulli's theorem
- Understand the differential equations of momentum balance such as Euler's and Navier-Stoke's Equations
- Learn the dimensional analysis, and pressure drop calculations of fluid flow through ducts, pipes and packed beds
- Understand the flow measurements and study the characteristics of various fluid pumps

Outcome

The students should be able to

- Perform basic pressure calculations
- perform energy calculations for steady-state fluid flow
- Carry out momentum balance calculations and to calculate pressure drop for flows in various geometries
- Calculate the head loss, given the flow conditions and the geometry of the flow channel
- Perform design calculations related to flow measurements and pumping of fluids.

UNIT I INTRODUCTION , PRESSURE DISTRIBUTION IN FLUID FLOW 9

The concept of fluid, the fluid as a continuum - laws of dimensional homogeneity - properties of velocity field - thermodynamic properties of a fluid - viscosity and other secondary properties - basic flow analysis techniques - flow patterns

Pressure and pressure gradient - equilibrium of fluid element - hydrostatic pressure distributions - applications to manometry.

UNIT II INTEGRAL RELATIONS FOR A CONTROL VOLUME 9

Basic laws of fluid mechanics, concept of system and control volume concept - The Reynold's transport theorem - continuity equation - the linear momentum equation - the angular momentum theorem - steady flow energy equation - friction less flow - Bernoulli equation - relation between the Bernoulli and steady flow energy equation.

UNIT III DIFFERENTIAL RELATIONS FOR A FLUID PARTICLE 9

The acceleration field of a fluid - the differential equation of conservation of mass - the differential equation of linear momentum - the Euler's and Navier -Stoke's equations - differential equation of energy - boundary conditions for the basic equations - the stream function, vorticity and irrotationality.

UNIT IV A DIMENSIONAL ANALYSIS AND SIMILITUDE 4

The principle of dimensional homogeneity - the Pi-theorem - non-dimensional action of the basic equations - similitude - relationship between dimensional analysis and similitude - use of dimensional analysis for scale up studies.

UNIT IV B VISCOUS FLOW IN DUCTS AND BOUNDARY LAYER FLOW 5

Reynold's number regimes, internal versus external viscous flow, flow in circular pipe - head loss, minor losses in pipe systems and multiple-pipe systems - boundary layer concepts, functions and pressure drag - flow through fixed and fluidised beds.

UNIT V FLOW MEASUREMENT AND TURBO MACHINERY 9

Constant and variable headmeters - classification of pumps - performance curves - matching pumps to system characteristics, compressors and its efficiency.

TOTAL PERIODS: 45

Text Books:

1. Noel de Nevers, " Fluid Mechanics for Chemical Engineers ", Second Edition, McGraw-Hill Inc, 1991.
2. Brar and Bansal,"A Textbook of Theory of Machines (In S.I. Units)",Laxmi Publications, 2009.

References:

1. Shames, I.H., "Mechanics of Fluids", Third Edition, McGraw-Hill Inc., 1992.
2. White, F.M., " Fluid Mechanics ", Third Edition, McGraw-Hill Inc., 1994.
3. Daughenty, R.L., Franzini, J.B and Finnemore, E.J., " Fluid Mechanics with Engineering Applications ", SI metric Edn., McGraw-Hill Book Company, 1989.
4. Streeter, V.L., Wylie, E.B., "Fluid Mechanics", First SI metric Edition, McGraw-Hill Book Company, 1989.5. Welty, J.R., Wicks, C.E and Wilson, R.E., " Fundamentals of Momentum, Heat and Mass Transfer ", third Edition, John Wiley & Sons, 1984.
5. Liggett, J.A., " Fluid Mechanics ", International Edition, McGraw-Hill, Inc., 1994.

CH2402 CHEMICAL ENGINEERING THERMODYNAMICS

4 Credits

Goal

Teach the thermodynamic concepts and emphasize the role of thermodynamics in various chemical engineering operations

Objectives

The course should enable the student to

- Understand the basic terminologies used in thermodynamics
- Learn various thermodynamic formulations such as Maxwell's equations in relating various properties of thermodynamic systems
- Study the equations of state for real gases to determine their PVT behavior
- Study thermodynamic aspects of compression in single-stage and multi-stage
- Study the equilibrium relationships between different phases under different circumstances.

Outcomes

The students should be able to

- Clearly identify the thermodynamic system and its interaction with its surroundings
- Calculate the energy requirements to carry out certain thermodynamic transformations
- Estimate the various properties of thermodynamic systems involving real gases
- Calculate the energy requirement for compression
- Carry out calculations related phase equilibrium

UNIT I BASIC CONCEPTS **9**

The terminologies of thermodynamics, the variables and quantities of thermodynamics, categorization of systems and processes. Energy classifications, point and path properties, energy in transition, heat and work, reversible and irreversible processes, phase rule. The first law and internal energy, statements of first law for the non-flow and flow systems, enthalpy and heat capacity limitations of the first law. Statements of the second law of thermodynamics, available and unavailable energies, the entropy function, applications of the second law.

UNIT II THERMODYNAMIC FORMULATIONS **9**

Measurable quantities, basic energy relations, maxwell relations, thermodynamic formulations to calculate enthalpy, internal energy and entropy as function of pressure and temperature, other formulations involving Cp and Cv, complex thermodynamic formulations, thermodynamic properties of an ideal gas, entropy change in reversible and irreversible process

UNIT III THERMODYNAMIC PROPERTIES OF REAL GASES **9**

The PVT behavior of fluids, laws of corresponding states and equation of states approaches to the PVT relationships of non ideal gas problems, compressiblity factors, generalized equations of state, property estimation via generalised equation of state , fugacity and fugacity coefficients of real gases.

UNIT IV COMPRESSION OF FLUIDS **8**

Thermodynamic aspects of compression process, classification of compression processes, basic equation for change of state of gases, the work expression for different situations, the effect of clearance volume, multistage compression, convergent divergent flow, Ejectors.

UNIT V PHASE EQUILIBRIA **10**

Criteria for equilibrium between phases in multi component non-reacting systems in terms of chemical potential and fugacity, application of phase rule, vapour-liquid equilibrium, phase diagrams for homogeneous systems and for systems with a miscibility gap, effect of temperature and pressure on azeotrope composition, liquid-liquid equilibrium, ternary liquid-liquid equilibrium.

TOTAL PERIODS : 45

Text Book

1. Smith, J.M., Van Ness, H.C., " Introduction to Chemical Engineering Thermodynamics ", Kogakushai 1976.

References:

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

CH2403 CHEMICAL PROCESS INDUSTRY-INORGANIC MATERIALS

3 Credits

Goal

Introduce manufacturing methods and the unit operations involved in the manufacture of important inorganic chemicals.

Objectives

The course should enable the students to

- Learn principles of various unit operations in chemical industry and the manufacturing method of chloro-alkali chemicals
- Understand the manufacturing processes for Sulphur, Copper, aluminum and their chemicals form the raw materials
- Study the manufacturing methods of Glass and Cement
- Learn the methods of manufacture of industrially important gases and various types of paints
- Understand the manufacturing methods of important fertilizers

Outcomes

The students should be able to

- Identify the unit operations involved in the manufacture of chemicals
- Analyze and improve the manufacturing methods for various heavy chemicals
- Determine the relevant unit processes and operations in the manufacture of glass and cement
- Analyze and improve the viability of manufacturing processes for gases and paints
- Contribute in the design of plants for fertilizer manufacture

UNIT I INTRODUCTION - CHLORO ALKALI INDUSTRIES 9

Introduction - Basic principles of unit operations and unit process to common devices used in manufacturing processes like Reactors, Steam jet ejectors, Pumps, Thickeners, Dryers, Electrostatic precipitators, Condenser, Vacuum evaporator in block diagram - Standard symbols used for such devices, Process flow sheet. Manufacturing of soda ash, caustic soda and chlorine - manufacture of bleaching powder, calcium hypochlorite, sodium hypochlorite and sodium chlorite.

UNIT II HEAVY CHEMICALS 9

Manufacture of Sulphur, Hydrochloric Acid and Miscellaneous Inorganic Chemical - Mining and production of Sulphur - Manufacture of Sulphur Trioxide and Sulphuric Acid - Manufacture of Hydrochloric acid - Manufacture of alum, Copper Sulphate, Sodium Dichromate, Hydrogen Peroxide, Aluminium Chloride.

UNIT III CEMENT AND GLASS 9

Manufacture of Cement, Glass & Products Used in Photography: Types and Manufacture of Portland Cement - Manufacture of Glasses and Special glasses.

UNIT IV INDUSTRIAL GASES AND PAINTS 9

Manufacture of Carbon dioxide - Hydrogen - Oxygen - Nitrogen - Acetylene - Water Gas - Producer Gas - Production of Natural Gas.

Introduction of Paints, Pigments, Emulsions and Varnishes -Manufacture of Paints -Manufacture of White and Coloured Pigments.

UNIT V FERTILIZER INDUSTRIES 9

Nitrogen Industries: Synthesis of Ammonia - Manufacture of Nitric Acid and Urea. Phosphorous Industries: Production and Manufacture of Phosphorous, phosphoric Acid, Super Phosphate and Triple super phosphate.

Potassium Industries: Potassium Chloride and Potassium Sulphate

REFERENCE BOOKS:

1. Dryden's Outlines of Chemical Technology, 3rd Edition, Affiliated East West Press, New Delhi. 2006
2. Shreve. N, Chemical Process Industries, 8th Edition, McGraw Hill, 2004.
3. Chemical vol. I, II, III & IV, Chemical Engineering Education Development Centre, IIT Madras, 1975-78.

CH2404 CHEMICAL REACTION ENGINEERING

4 Credits

Goal

To impart the basic understanding of Reaction engineering and the knowledge to choose the correct reactor system for the given reaction.

Objectives

The course should enable the student

- Learn the reaction kinetics and its calculation in the context of batch reaction.
- Study the design calculations for the flow reactors such as CSTR and PFR
- Learn the reaction kinetics involving multiple reactions in series and parallel
- Study the effects of temperature and pressure on the reaction kinetics
- Study the non-ideal conditions and the residence time distributions in flow reactions systems using various techniques such as E Curve, F Curve, and C Curve

Outcomes

The student should be able to

- Analyze the batch reactor systems
- Perform design calculations of CSTR and PFR
- Calculate the reaction conversions involving multiple reactions
- Determine the reaction conversions under non-isothermal conditions and the best reaction conditions to optimize the reaction
- Analyze the residence time distribution in a given flow reactor system.

UNIT I BATCH REACTORS **9**

Introduction and over view of the subject, kinetics of homogeneous reactions, non elementary reactions, Collision theory and Transition - state theory, volume Arrhenius relation, various methods of analysis of batch reactor data (including variable volume and variable pressure data). Isothermal batch reactor design.

UNIT II HOMOGENEOUS FLOW REACTORS **9**

Design equation for plug flow reactor (PFR) and continuous stirred tank reactor (CSTR), data analysis in flow reactors, Design of PFR, CSTR, cascade of CSTR's and combination for PFR and CSTR.

UNIT III MULTIPLE REACTIONS **9**

Design for multiple reactions, parallel reactions, series reactions (Omit reversible and series - parallel reaction).

UNIT IV TEMPERATURE AND PRESSURE EFFECTS **9**

Non - Isothermal design: Energy balance equations for batch, PFR and CSTR under non-isothermal

conditions, Equilibrium conversion under adiabatic conditions, Design of the homogeneous reactors under adiabatic conditions.

UNIT V NON-IDEAL FLOW **9**

Residence time distribution curves E, F and C; Interpretation of the response data for the "Dispersion" and "Tanks - in series" Models (omit multi parameter models).

TOTAL:45

TextBook

1. Scott Fogler," Elements of Chemical Reaction Engineering" 2nd Edition Eastern Economy Edition

REFERENCES:

1. S. D. Dawande, Principles of Reaction Engineering,Central Techno Publications
2. Smith J. M., Chemical Engineering Kinetics, MGH, 2nd Edition
3. Levenspiel. O., Chemical Engineering, Wiley Eastern Ltd., 3rd Edition
4. Froment and Bischoff, Chemical Reactor Analysis and Design, Wiley

CY2002 ENVIRONMENTAL SCIENCE AND ENGINEERING

3 Credits

Goal

To make the students aware of the impact of development on the environment and ways to mitigate the ill effects.

Objectives

The course should enable the students to

Give an overview of exploitation of various natural resources and its impact on the environment

- Understand the ecosystem and biodiversity
- Understand the pollution of air, water, soil and its effect on environment, and study the methods to reduce the pollution
- Study the impact of population growth on environment, and the human health

Outcomes

The students should be able to

- Identify the various human activities adversely affecting the natural resources and the balance ecosystem
- Analyze the various aspects of ecosystems and suggest ways to protect them
- Carry out detailed study of pollution of given locality and suggest steps to mitigate pollution
- Analyze and manage human healthcare problems due to population growth

UNIT I INTRODUCTION TO ENVIRONMENTAL STUDIES AND NATURAL RESOURCES **10**

Definition, scope and importance - need for public awareness - forest resources: use and over-exploitation, deforestation, case studies. Timber extraction, mining, dams and their ground water, floods, drought, conflicts over water, dams-benefits and problems - mineral resources: use effects on forests and tribal people - water resources: use and over-utilization of surface and exploitation, environmental effects of extracting and using mineral resources, case studies - food resources: world food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies - energy resources: growing energy needs, renewable and non renewable energy sources, use of alternate energy sources. Case studies - land resources: land as a resource, land degradation, man induced landslides, soil erosion and desertification - role of an individual in conservation of natural resources - equitable use of resources for sustainable lifestyles.

Field study of local area to document environmental assets - river / forest / grassland / hill / mountain.

UNIT II ECOSYSTEMS AND BIODIVERSITY **14**

Concept of an ecosystem - structure and function of an ecosystem - producers, consumers and decomposers - energy flow in the ecosystem - ecological succession - food chains, food webs and ecological pyramids - introduction, types, characteristic features, structure and function of the (a) forest ecosystem (b) grassland ecosystem (c) desert ecosystem (d) aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries) - introduction to biodiversity - definition: genetic, species and ecosystem diversity - biogeographical classification of India - value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values - biodiversity at global, national and local levels - India as a mega-diversity nation - hot-spots of biodiversity - threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts - endangered and endemic species of India - conservation of biodiversity: in-situ and ex-situ conservation of biodiversity.

Field study of common plants, insects, birds

Field study of simple ecosystems - pond, river, hill slopes, etc.

UNIT III ENVIRONMENTAL POLLUTION **8**

Definition - causes, effects and control measures of: (a) air pollution (b) water pollution (c) soil pollution (d) marine pollution (e) noise pollution (f) thermal pollution (g) nuclear hazards - solid waste management: causes, effects and control measures of urban and industrial wastes - role of an individual in prevention of pollution - pollution case studies - disaster management: floods, earthquake, cyclone and landslides.

Field study of local polluted site - urban / rural / industrial / agricultural

UNIT IV SOCIAL ISSUES AND THE ENVIRONMENT **7**

From unsustainable to sustainable development - urban problems related to energy - water conservation, rain water harvesting, watershed management - resettlement and rehabilitation of people; its problems and concerns, case studies - environmental ethics: issues and possible solutions - climate change,

global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust, case studies. - wasteland reclamation - consumerism and waste products - environment production act - air (prevention and control of pollution) act - water (prevention and control of pollution) act - wildlife protection act - forest conservation act - issues involved in enforcement of environmental legislation - public awareness.

UNIT V HUMAN POPULATION AND THE ENVIRONMENT 6

Population growth, variation among nations - population explosion - family welfare programme - environment and human health - human rights - value education - HIV / AIDS - women and child welfare - role of information technology in environment and human health - case studies.

TOTAL : 45hrs

TEXT BOOKS

1. Gilbert M.Masters, "Introduction to Environmental Engineering and Science", Pearson Education Pvt., Ltd., Second Edition, ISBN 81-297-0277-0, 2004.
2. Miller T.G. Jr., "Environmental Science", Wadsworth Publishing Co.

REFERENCES

1. Bharucha Erach, "The Biodiversity of India", Mapin Publishing Pvt. Ltd., Ahmedabad India.
2. Townsend C., Harper J and Michael Begon, "Essentials of Ecology", Blackwell Science.
3. Trivedi R.K. and P.K. Goel, "Introduction to Air Pollution", Techno-Science Publications.
4. Trivedi R.K., "Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standards", Vol. I and II, Enviro Media.
5. Cunningham, W.P.Cooper, T.H.Gorhani, "Environmental Encyclopedia", Jaico Publ., House, Mumbai, 2001.
6. Wager K.D. "Environmental Management", W.B. Saunders Co., Philadelphia, USA, 1998.

CH2431 CHEMICAL REACTION ENGINEERING LAB

2 Credits

Goal

Lab session to complement the theory portion of Chemical Reaction Engineering course

Objectives

The course should enable the students to

- Understand various reactor systems
- Importance of residence time and holding time
- Monitoring the rate of reactions in series/parallel arrangement of reactors

Outcomes

The students should be able to

- Determine the rate coefficients for multitude of reactor systems

- Interpret and analyze the data from reaction systems
- Identify the best possible arrangement of reactors vis-à-vis series/parallel/ or mixed types reactor systems

List of Experiments

1. Kinetic studies in a batch reactor

a) To determine the reaction conversion in saponification reaction

b) To determine the time taken for a specific conversion percentage for 2nd order kinetics

2. Kinetics a plug flow reactor
3. Kinetics in a PFR followed by a CSTR
4. RTD in a PFR
5. RTD in a packed bed
6. RTD in CSTRs in series

List of Equipment

1. Batch Reactor with stirrer
2. Plug Flow Reactor (PFR)
3. CSTR
4. CSTRs in series
5. Combined PFR and CSTR

CH2432 FLUID MECHANICS LAB

2 Credits

Goal

To determine pressure, energy loss and other parameters involved in flow of liquid system.

Objectives

The course should enable the students to

- Learn the calibration constant/variable head meters, and weirs
- Study the pressure drop through straight pipe, and packed beds
- Understand the working of centrifugal pump

Outcomes

The students should be able to

- Prepare and modify the calibration curves

- Do the sizing of pipe-lines for various velocities
- Prepare the technical specifications of the pump required for the transportation of fluids

List of Experiments

1. Calibration of constant and variable Head meters
2. Calibration of Weirs
3. Flow through straight pipe a) Pressure drop studies b)
4. Pressure drop studies in packed column
5. Fluidisation
6. Characteristic curves of centrifugal pump

List of equipment

1. Manometer
2. Weirs
3. Pressure Drop equipment
4. Packed Bed/Fluidized Bed
5. Centrifugal Pump

CH2433 COMPUTER PROGRAMMING LAB IN CHEMICAL ENGINEERING

2 Credits

Goal

To understand and write programs using commonly available software packages to do elementary calculations in Chemical Engineering

Objectives

The course should enable the students to

- Learn the basics of spreadsheet program (MS-EXCEL), and formulae to carry out various calculations
- Study the statistical functions available in MS-EXCEL
- Solve the interpolation, integration and differentiation problems

Outcomes

The students should be able to

- Perform various chemical process calculations using MS-EXCEL
- Set-up the statistical analysis in EXCEL to handle large amount of data
- Solve chemical engineering problems using mathematical solvers available in MS-EXCEL

List of Experiments

The following calculations need to be carried out using a spreadsheet program such as MS-EXCEL

1. Calculations of Density, Molecular weight, Mole and Percentage Composition of mixtures
2. Data Fitting and Regression Analysis
3. Statistical Analysis of Data
4. Numerical Interpolation
5. Numerical Integration
6. Numerical Differentiation

List of Equipment

1. Computers with Windows OS and MS-Office Programs

CH2434 PROJECT WORK

2 Credits

Goal

To do mini project to appreciate the concepts learned upto fourth semester

SEMESTER - V

MA 2501 NUMERICAL METHODS IN CHEMICAL ENGINEERING

L	T	P	C
3	1	0	4

Goal

GoalTo expose students to Numerical methods, and various topics in computing relevant to Mechanical engineering.

Objectives

The course should enable the students to:

1. Learn the Linear and non-linear equations
2. Do Ordinary differential equations
3. Understand the variety of numerical and computational methods.

Outcome

The students should be able to:

1. Solve linear and non-linear equations.
2. Formulate physical systems into mathematical models
3. Employ numerical methods to find solutions for mathematical models
4. Model physical systems using analytical and numerical methods.

UNIT I SOLUTION OF EQUATIONS AND EIGEN VALUE PROBLEMS 12

Iterative method, Newton - Raphson method for single variable and for simultaneous equations with two variables. Solutions of a linear system by Gaussian, Gauss - Jordon, Jacobi and Gauss - Seidel methods. Inverse of a matrix by Gauss - Jordan method. Eigen value of a matrix by Power by Jacobi methods.

UNIT II INTERPOLATION 12

Newton's divided difference formulae, Lagrange's and Spline interpolation - cubic spline. Newton forward and backward difference formulae.

UNIT III NUMERICAL DIFFERENTIATION AND INTEGRATION 12

Numerical differentiation with interpolation polynomials, Numerical Integration by Trapezoidal and Simpson's (both 1/3rd and 3/8th) rules. Two and three point Gaussian quadrature formula. Double integrals using Trapezoidal and Simpson's.

UNIT IV INITIAL VALUE PROBLEM FOR ORDINARY DIFFERENTIAL EQUATIONS 12

Single step method - Taylor's Series, Euler and Modified Euler, Runge - Kutta method of order four for first and second order differential equations. Multi step methods - Milne and Adam's Bash forth predictor and corrector methods.

UNIT V BOUNDARY VALUE PROBLEMS **12**

Finite difference solutions for the second order ordinary differential equations. Finite difference solutions for one dimensional heat equation (both implicit and explicit), One dimensional wave equations and two dimensional Laplace and Poisson equations

Total : 60

Text Books

1. Numerical Recipes in C. Cambridge Press, 1995, ISBN 0-521-43108-5
2. A first course in Computational Physics, Paul DeVries, John Wiley and Sons, 1993, ISBN 0-471-54869-3
3. Numerical Analysis, David Kincaid and Ward Cheney, 2nd edition, Brooks/Cole, 1996, ISBN 0-534-33892-5

CH2501 HEAT TRANSFER

4 Credits

Goal

To equip students to design the various heat transfer equipment used in the chemical industry

Objectives

The course should enable the student to

- Learn the different modes of heat transfer, and the concept of conductive heat transfer
- Understand the concept of heat transfer by convection and overall combined heat transfer coefficient for conduction-convection in process heat exchangers
- Learn heat transfers involving phase changes such as condensation and boiling
- Study the various heat exchange equipment used in process industry such as Pipe-in-Pipe Exchanger, Shell-and-Tube Exchangers
- Study concept of radiation energy and the radiation between surfaces including various theories related to heat radiation

Outcomes

The student should be able to

- Identify the different modes of heat transfer and carry out the conduction calculations in various geometries.
- Calculate the design requirements of heat transfer in co-current and counter-current heat exchanger operations.
- Design condensers and evaporators for carrying physical transformations
- Carry out design calculations and piping diagrams
- Analyze the systems involving radiation and to solve problems pertaining to them

UNIT I CONDUCTION **12**

Importance of heat transfer in Chemical Engineering operations - Modes of heat transfer

Concept of heat conduction - Fourier's law of heat conduction - one dimensional steady state heat conduction equation for flat plate, hollow cylinder, hollow sphere - Heat conduction through a series of resistances - Analogy between flow of heat and flow of electricity - Thermal Conductivity measurement; Effect of temperature on thermal conductivity; conduction through liquids

Two dimensional steady state conduction - Analytical and graphical methods - Transient heat conduction. Conduction with heat source.

UNIT II CONVECTION **12**

Concept of heat transfer by convection - Natural and forced convection - Application of dimensional analysis for convection - Equations for forced convection under laminar, transition and turbulent conditions - Equations for natural convection

Individual and overall heat transfer coefficients and the relationship between them

UNIT III HEAT TRANSFER WITH PHASE CHANGE **8**

Heat transfer from condensing vapours, heat transfer to boiling liquids - Influence of boundary layer on heat transfer - Heat transfer to molten metals - Heat transfer in packed and fluidized beds

UNIT IV HEAT EXCHANGERS **8**

Parallel and counter flow heat exchangers - Log mean temperature difference - Single pass and multi-pass heat exchangers; plate heat exchangers; use of correction factor charts; heat exchangers effectiveness; number of transfer unit - Chart for different configurations - Fouling factors and wilson's plot - Design of various types of heat exchangers & Evaporators- Design of furnaces - Design of condensers, - Design of tubular reactors

UNIT V RADIATION **5**

Concept of thermal radiations - Black body concept - Stefan Boltzmann's law -concept of grey body - radiation between surfaces

Total No of periods: 45

Text Book:

1. Mccabe, W.L., Smith, J.C., "Unit Operations in Chemical Engineering", McGraw-Hill, Higher Education, Seventh Edition 2005.

References:

1. Coulson, J.M., Richardson, J.F., " Chemical Engineering ", Vol.I., Pergamon and ECBS, 1970.
2. Binay K.Dutta "Heat Transfer Principles and Applications", Prentice Hall of India, 2001.
3. Kenn, D.Q., " Process Heat Transfer ", McGraw-Hill - Revised adition - 1999.

CH2502 CHEMICAL PROCESS INDUSTRY - ORGANIC MATERIALS

3 Credits

Goal

Introduce manufacturing methods and the unit operations involved in the manufacture of important organic chemicals such as plastics, soaps, dyes and paper

Objectives

The course should enable the students to

- Learn the manufacturing methods of paper and sugar, and their downstream processes
- Understand the manufacture of alcohol, acid and antibiotics, refined oils, soaps and detergents
- Learn the important unit operations in Pharmaceutical Industry
- Study the methods of manufacture and refining processes for plastics, rubber compounds, and leather
- Understand the manufacture of synthetic fibres such as Nylon, Polyesters and dyes

Outcomes

The Students should be able to

- Analyze the manufacturing methods of paper and sugar
- Identify the major unit operations involved in the manufacture of products of fermentation, soaps and detergents
- Determine the best possible process conditions and the suitable unit operations for the manufacture of generic drugs
- Determine the sequence of unit operations to produce plastics, rubber compounds and refined leather
- Assess the process flow sheets for the manufacture of commercially important synthetic fibres

UNIT I PULP, PAPER AND SUGAR **9**

Introduction to Organic Chemical Processes. Manufacture of Chemical, Semi-chemical and NSSC pulp. Manufacture of Newsprint paper and Writing paper. Manufacture of Sugar, Starch and Starch derivatives.

UNIT II FERMENTATION, OILS AND FATS **9**

Fermentation processes for the manufacture of ethyl alcohol, citric acid and antibiotics. Refining of Edible oils and Fats. Manufacture of Soaps and Detergents.

UNIT III PHARMACEUTICAL INDUSTRY **9**

Introduction to Drugs and pharmaceutical industry, Good Manufacturing practices, Generic Drugs, Manufacture of paracetamol, disposal of effluent and pollution control.

UNIT IV PLASTICS, RUBBER AND LEATHER 9

Raw materials, Classification of polymers, synthetic polymers - Polyethylene, polypropylene, PVC, Polystyrene, ABS, Teflon, formaldehyde and epoxy resins. Rubber - Natural rubber, synthetic rubber, SBR, polybutadiene, Poly isoprene, poly chloroprene, acrylic and silicone rubber, compounding of rubber. Leather tanning and finishing.

UNIT V SYNTHETIC FIBRE, DYES AND INTERMEDIATES 9

Viscose rayon, cuprammonium and cellulose acetate, nylons, polyesters, acrylics, mono acrylic polypropylene, Dyes and intermediates.

TEXT / REFERENCE BOOKS:

1. George T. Austin, Shreve's Chemical Process Industries, 5th Edition., McGraw-Hill International Editions, Singapore, 1984.
2. Gopala Rao M. and Marshall Sittig, Dryden's Outlines of Chemical Technology, 3rd Edition., East-West Press, New Delhi, 1997.
3. Kent, J.A. (ed), Riggel's Hand book of Industrial Chemistry, Van Nostrant Reinhold, 1974.
4. Chemical Vol. I, II, III & IV, Chemical Engineering Education Development Centre, IIT Madras, 1975-78.

CH2503 HETEROGENEOUS REACTION ENGINEERING

4 Credits

Goal

To impart the knowledge of advanced multi-phase reaction kinetics

Objectives

The course should enable the students to

- Learn the heterogeneous catalysis by studying the various mass transfer phenomena and their effect on catalysis
- Study the characteristics of catalysis for porous and non-porous surfaces, catalyst preparation
- Understand the phenomenon of heat and mass transfer in the solid-gas catalysis and their influence on the progress of reaction
- Models of gas-solid non catalytic reactions
- Study the methods to determine the mass transfer coefficients and kinetic constants for solid-liquid reactions

Outcomes

The student should be able to

- Design the reactors for heterogeneous catalysis
- Carry out the calculations related to catalyst preparation and catalyst deactivation
- Design the gas-solid catalytic reactors
- Design the gas-solid non catalytic reactor
- Perform the design calculations for solid-liquid reactors

UNIT I HETEROGENEOUS CATALYSIS 9

Catalyst - properties, physical-adsorption - & - chemisorptions, adsorption isotherm, Derivation of rate equations for various mechanisms (Adsorption, surface reaction and desorption controlling etc.,) Data analysis for heterogeneous laboratory catalytic reactors, Isothermal packed bed (PFR) reactor design, effectiveness factor and internal pore diffusion, Criteria for internal pore diffusion limitation

UNIT II HETEROGENEOUS PROCESS AND SOLID CATALYSIS 9

Porous and Non-porous catalysis, Catalysts Characterization, surface area and pore-volume distribution, catalyst preparation. De-activation of catalysts.

UNIT III GAS-SOLID CATALYTIC REACTORS 9

Diffusion within catalyst particle effective thermal conductivity mass and heat transfer within catalyst pellets; effective factors, Thiele Modulus, fixed bed reactors

UNIT IV GAS-SOLID NON-CATALYTIC REACTORS 9

Models for explaining the kinetics; volume and surface models; controlling resistances and rate controlling steps;time for complete conversion for single and mixed sizes, fluidised and static reactors.

UNIT V GAS-LIQUID REACTIONS 9

Absorption combined with chemical reactions; mass transfer coefficients and kinetic constants; application of film penetration and surface renewal theories; Hatta number and enhancement factor for first order reaction, tower reactor design.

Total No of periods: 45

Text Books

1. Levenspiel , O; " Chemical Reaction Engineering ", 2nd Edition, John Wiley, 1972.
2. Smith J.M., " Chemical Engineering Kinetics ", 3rd edition, McGraw-Hill, New York, 1981.

CH2504 PETROCHEMICAL ENGINEERING

4 Credits

Goal

Introduce the various unit processes and operations involved in the refining of petroleum and manufacture of different petrochemicals

Objectives

The course should enable the students to

- Learn the processes of petroleum refining by various types of distillation, cracking and reforming
- Study the various sources of feed stocks for petrochemical industry and their purification processes such as fractionation and crystallization
- Learn various processes involved in the manufacture of petrochemicals of industrial importance from Methane, Ethylene, Acetylene, and Propylene
- Understand the processes involved in the separation of aromatics, and the manufacture of various products such as detergents, dyes, and perfumes
- Understand the mechanism of polymerization and manufacturing methods for important polymers

Outcomes

The students should be able to

- Understanding how various product streams are derived from petroleum by refining
- Identify and select the suitable feedstock to produce various petrochemicals
- Sketch the flow-sheets for the manufacture of various industrially important petrochemicals
- Design the processes for the manufacture of detergents, dyes and perfumes
- Identify the raw materials, and select the unit operations to produce various polymers from their monomers.

UNIT I PETROLEUM REFINING **5**

Atmospheric Distillation, Vacuum Distillation, Catalytic Cracking, Reforming, Hydro desulfurization.

UNIT II PETROCHEMICAL INDUSTRIES & THEIR FEED STOCKS **10**

Survey of petrochemical industry - Resources and generation of different feedstocks-their purification, separation of individual components of adsorption, low temperature fractionation and crystallization. Production and utilization of synthesis gas- generation of synthesis gas by steam reforming of naphtha & Natural gas fuel oil partial oxidation.

UNIT III PETROCHEMICALS BASED ON METHANE, ETHYLENE, ACETYLENE PROPYLENE **12**

Acetylene and methanol from methane, VCM, VAM, ethylene oxide and ethylene glycol, ethanol amines from ethylene. Acrylonitrile form acetylene. Isopropanol, propylene oxided, glycerine, acrylonitrile, acrylic acid, acrolein from propylene.

UNIT IV SEPARATION AND UTILIZATION OF AROMATICS 8

Alkylation of benzene. Production of styrene, cumene and phenol, isomerization of O- and m- xylene into pxylene. Production of phthalic anhydride.

Synthetic detergents-classification-production of Keryl benzene sulphonate. filter, binders, dyes, perfumes. for detergents. Hard and soft detergents

UNIT V SYNTHETIC FIBRES, RUBBERS, PLASTICS, RESINS 10

Method, mechanism and types of polymerization, production of HDPE, LDPE, PP,PVC, Polystyrene, Polybutadiene. manufacture of Polyesters , nylons, acrylic fibres. Production of phenol, formaldehyde resin, Epoxy resin. Production principle of ABS plastic, polycarbonates. Manufacturing techniques of Butyl rubber, SBR, Isoprene, rubber.

TOTAL : 45

Text Books/References

1. A text on Petrochemicals:B. K. B. Rao, Khanna Publishers, 2008
2. Petrochemical processes: Chauvel:Gulf publishing
3. The Petroleum chemicals industry: R.F. Goldstein and A. L. Waddams
4. Advanced Petrochemicals: Dr.G. N. Sarkar, Khanna Publishers

CH2531 HEAT TRANSFER LAB

2 Credits

Goal

To determine heat transfer coefficients, thermal conductivity and other parameters using heat transfer equipment

Objectives

The course should enable the students to

- Carry out the different modes of heat transfer in different arrangements
- Perform the operation of boiling heat transfer in a kettle

Outcomes

The students should be able to

- Determine the rate of heat transfer within a system, and between a system and its surroundings.
- Determine the design parameters for the boiling

List of Experiments

1. Transient State heat conduction
2. Surface Evaporation

3. Jacketed kettle
4. Temperature profile of a rod
5. Natural Convection
6. Thermal Conductivity of composite wall
7. Emissivity measurement

List of Equipment

1. Transient Heat Conduction Device
2. Surface Evaporation set-up
3. Jacketed Kettle
4. Conduction rod with measuring devices
5. Natural Convection set-up
6. Composite wall set-up for conduction experiment
7. Emissivity measurement device

CH2532 NUMERICAL COMPUTATION LAB

2 Credits

Goal

To teach C program to do numerical calculations

Objectives

The course should enable the students to

- Develop mathematical C/FORTRAN program to implement various numercal methods such as Gauss Seidel method, Newton-Raphson method, Newton Method, Taylor Series, and Runge-Kutta method
- Learn to solve linear/non-linear systems of equations using MATLAB/POLYMATH

Outcomes

The students should be able to

- Solve different types of mathematical models using C/FORTRAN
- Study and understand the dynamics of the processes using FORTRAN
- Utilize the efficiency and productivity of commercial software such as MATLAB/POLYMATH to solve complex mathematical models of processes involving various types of linear/nonlinear equations

Programming Language:C/FORTRAN

1. Solution of Linear system by Gauss Elimination method and Gauss Seidel iterative method
2. Solution of non-linear equation by Newton-Raphson method
3. Solution of a set of non-linear equations by Newton method
4. Solution of one dimensional unsteady state heat conduction problem using Taylor series based Finite Difference Method
5. Numerical solution of ODEs by Runge-Kutta method

Use of MATLAB/POLYMATH software to solve following problems:

1. Solution of linear system: steady state solution of isothermal SCTR in series in which a first order reaction is taking place.
2. Solution of a set of non-linear equations: steady state solution of a non-isothermal SCTR in which a first order reaction is taking place.

List of Equipment

1. Computers with FORTRAN and C Compilers, and MATLAB/POLYMATH

EL 2431 COMMUNICATION SKILLS & PERSONALITY DEVELOPMENT

L	T	P	C
2	0	2	3

Goal

The goal of the programme is to provide the learners with the methods and materials required for becoming accomplished personalities through the medium of English.

Objectives

The course is expected to enable students to:

1. Be aware of self-knowledge by exposure to soft skills, values, behaviour, attitudes, temperamental changes, and a positive attitude to life.
2. Learn personality traits and undergo personality tests to determine their own personality characteristics and the scope for improvement.
3. Cultivate the art of speaking fluently making use of proper gestures, tone and voice modulation, adding humour to the speech.
4. Figure out the need to work in teams, adorn or accept team leadership, and make use of body language to enhance team spirit.
5. Be familiar with the art of managing self, people, work and time, keeping in mind problems like time-wasters and stress-builders.

Outcome

On completion of the course, the students will be able to:

1. Apply the knowledge gained to improve upon their values, behaviour, attitude, and develop the soft skills required for home, workplace and the society.
2. Employ the concept of personality traits and build up an accomplished personality that would be pleasing to people around so as to influence them positively.
3. Develop a personal style and communicate fearlessly and effectively in a convincing manner so as to impress listeners or the audience.
4. Participate in presentations, group discussions, debates and mock interviews making good use of language skills and interpersonal relationships.
5. Comprehend stress-management tips to overcome stress-prone habits and develop a career plan with personal, familial and societal goals for success.

UNIT I **12**

Values and attitudes - Value-formation - Values & education - Terminal & Instrumental values - Civic responsibilities - The power of Personal/ Cultural/ Social valves -- Behaviour and attitudes -- Features of attitudes - Developing positive attitude - Overcoming negative attitude -- People skills - Soft skills as per the Work Force Profile - The four temperaments - Sanguine - Choleric - Melancholic - Phlegmatic -- Tests for Personal Chemistry.

UNIT II **12**

What is personality development? - Types of personalities as per (i) Heredity (ii) Environment (iii) Situation - the 16 personality factors - MBTI Tests - Personality types - Increasing self awareness: Assessing one's locus of control, Machiavellianism, self-esteem, self-monitoring, risk-taking, Type A, Type B personality elements - Intellectual and physical abilities for jobs -- Personality tests.

UNIT III **12**

Developing the art of speaking - How to get rid of stage fright? - Enhancing fluency - Modulating voice - Enunciation - Positive and negative gestures - Preparation - How to begin? - How to convince the listeners? - How to wind up the speech? - Adding humour and illustration - Developing one's own style - Types of style - How to influence the audience? - How to become an effective speaker? -- Tests for effective speaking.

UNIT IV **12**

Team work - Team building - Team leadership -- How to face an interview? -- How to participate in a group discussion? - How to argue for or against in a debate? - Body language - Non-verbal communication - Personal appearance - Facial expression - Posture - Gestures - eye contact - Etiquette - Voluntary and involuntary body language - Gender implications -- Tests.

UNIT V **12**

Managing self, people, work, situations - Time-management - Secrets of time-management - Time-wasters - Stress -- Kinds of stress - Spotting stress - Stress-builders - Stress -management tips -

Stress-prone habits -- Goals - Career planning - Interpersonal interaction - Interpersonal relationships -- Tests.

References:

1. Burlington, V.T. Group Interaction in High Risk Environments. Ashgate Publication, 2004.
2. Fisher, Kimball. Leading Self-directed Work Terms: A Guide to Developing New Team Leadership Skills. New York, NY: McGraw Hill, 2000.
3. Ted W. Engstrom and R. Alec Mackenzie. Managing Your Time: Practical Guidelines on the Effective Use of Time. 2008.
4. Burnard, Philip. Training Games for Interpersonal Skills. McGraw Hill, Inc., New York, 1992.
5. Greenwich, Carolyn. The Fun Factor, McGraw Hill, Inc., New York, 1997.

- **Study material will be prepared by the Department of Languages.**
- **Tests suggested will be prepared by a senior faculty of the department.**
- **Movies will be screened to discuss and debate on the topics introduced in each unit.**

SEMESTER VI

CH2601 CHEMICAL PROCESS EQUIPMENT DESIGN

4 Credits

Goal

To enable the students to design chemical process equipment taking into consideration the mechanical aspect of the design

Objectives

The course should enable the students to

- Learn the stress-strain relationship of elastic materials subjected to various types of forces, and the design considerations.
- Understand the basis for selection of correct type of support for the vessel
- Learn the design equations for the design of vessels subjected to internal and external pressure
- Understand the design requirements of heat exchangers
- Learn the design equations related to crystallizers and packed columns

Outcomes

The students should be able to

- Design joints, screws, and bolt, and nut
- To appreciate process parameters in storage tanks and supports design
- Calculate forces and pressure parameters in pressure vessels
- Perform calculations for the design of heat exchangers, and evaporators
- Design mass transfer equipment

UNIT-I STRESS-STRAIN RELATIONSHIPS 9

Stress-strain relationships of elastic materials subjected to tensile, compressive and shear forces, general design codes, design considerations of bolt, nut and screws, welded and riveted joints, flanged joints, nozzles and reinforcements.

UNIT-II VESSELS AND TANKS 9

Vessel supports, design of bracket, saddle and skirt supports, storage tanks, pipe fittings.

UNIT-III PRESSURE VESSEL DESIGN 9

Fundamental principles, equations, general design considerations of vessels subjected to internal pressure, vessel subjected to external pressure. High pressure vessels.

UNIT-IV DESIGN OF HEAT TRANSFER EQUIPMENTS 9

Fundamental equations, general design considerations of Shell and tube heat exchangers, Condensers, Evaporators and Re-boilers.

UNIT-V MASS TRANSFER EQUIPMENT DESIGN **9**

Fundamental equations, general design considerations of Crystallizers, Plate and Packed Distillation and Absorption columns.

TEXT BOOK:

1. M.V. Joshi and V.V. Mahajan, "Process Equipment Design", MacMillan India Ltd.

REFERENCE BOOKS:

1. R.H. Perry, "Chemical Engineers' Handbook", McGraw Hill.
2. J.M. Coulson and J. Richardson, "Chemical Engineering", Vol. 6, Asian Books Printers Ltd.
3. S.D. Dawande, "Process Design of Equipments", Central Techno Publications, Nagpur, 2000.
4. Indian Standard Specifications IS-803, 1962; IS-4072, 1967; IS-2825, 1969. Indian Standards Institution, New Delhi.

CH2602 MASS TRANSFER - 1

4 Credits

Goal

To make the students understand the mechanisms of Mass Transfer in unit operations

Objectives

The course should enable the students to

- Importance of separation process
- Apply the concepts of mass transfer operations introduced in the theory component
- Identify the best tools for separating mixtures

Outcomes

The students should be able to

- Determine the Diffusion coefficients of simple gases and liquids
- Appreciate the importance of separating mixtures in an economical way
- Identify the Best possible separating method with the given parameters

UNIT-I DIFFUSION **9**

Molecular and Eddy diffusion, Fick's Law, Measurement and calculation of diffusivity, Diffusion in Multi-component gaseous mixtures, Diffusion in solids and its applications, Steady state diffusion under stagnant and laminar flow conditions.

UNIT-II MASS TRANSFER CO-EFFICIENT **9**

Concept of mass transfer co-efficient, Mass transfer under laminar and turbulent flow, Theories of mass transfer and their applications, Boundary layer, Correlation of mass transfer co-efficient, Analogies

between momentum, heat and mass transfer, Interphase and overall mass transfer co-efficient in binary and Multi-component systems, jd factor.

UNIT-III HUMIDIFICATION **9**

Basic concepts, psychrometric charts, Methods of humidification and de-humidification, Design calculation, Cooling Towers principle and operation, equipments.

UNIT-IV DRYING **9**

Theory and mechanism of drying, Drying characteristics, Design and performance of Batch and Continuous Drying, Estimation of Drying rates, equipments.

UNIT-V CRYSTALLIZATION **9**

Theory of Crystallization, Factors governing nucleation and crystal growth, Growth coefficient, Applications, Batch and Continuous crystallizers, Industrial Crystallizer.

TEXT BOOK:

1. Treybal, R.E, Mass Transfer Operations - McGraw Hill.

REFERENCE BOOKS:

1. McCabe and Smith, Unit Operations of Chemical Engineering, McGraw Hill.
2. J.M. Coulson and J.F. Richardson, Chemical Engineering Vol - II, Pergamon Press.
3. T.K. Sherwood, R.L. Pigford and C.R. Wilke, Mass Transfer, McGraw Hill.

CH2603 SAFETY AND HAZARD MANAGEMENT IN THE CHEMCIAL PROCESS INDUSTRIES

3 Credits

Goal

To make the students understand the importance of safety and risk management in chemical industries

Objectives

The course should enable the students to

- Understand the importance of operational safety in the context direct and indirect economic costs of potential accidents
- Learn the various hazard identification tools such as HAZOP, Fault Trees, Event Trees, FMEA to
- Learn the quantitative risk analysis methods
- Learn the various methods that can be incorporated to avoid the potential hazards and learn to manage the hazards to reduce the losses.

Outcomes

The students should be able to

- Identify the types of potential accidents in a process operation

- Carry out a systematic procedure to identify the potential accidents and prioritize them in the order of importance and criticality
- Prepare the list of potential hazards according to Risk Priority Number using quantitative analysis
- Include various safety aspects starting from the design of any process to achieve improves safety and operability of the processes.

UNIT I SCIENTIFIC PRINCIPLES 10

Engineering aspects of industrial safety in relation to economic and operational aspects-safety regulations-wild roses-hazards due to fire , explosions and toxic chemicals, fire triangle, BLEVE, runaway reaction etc.

UNIT II TOOLS FOR HAZARD IDENTIFICATION 10

HAZOP, fault tree, event tree, Failure mode and Analysis (FMEA), Dow fire and explosion index, Mond index, Safety Audits,etc

UNIT III RISK ANALYSIS 12

Concept and methodology-risk concept and measure of risk, risk acceptance criteria, quantitative risk analysis, Proit number

UNIT IV ENGINEERING CONTROL OF CHEMICAL PLANT HAZARDS 13

Intensification and attenuation of hazardous materials, Industrial plant layout, Ventilation and lighting, electrical system, instrumentation etc. fire prevention, personnel protection devices, Laboratory safety, emergency safety, safety systems and disaster management

Text books:

1. Chemical Process Safety : Fundamentals with application: Daniel a Crowl and J. F. Louvar
2. Safety in Chemical Process Industries:O.P. Kharbanda
3. Hazardous Waste management:Wentz.C. A. MGH
4. Environmental risks & hazards, Cutter, PHI

EI2611 INSTRUMENTATION & PROCESS CONTROL

4 Credits

Goal

Teach the working of various instruments and control system in the process industry

Objectives

The course should enable the students to

- Learn the concept of measurement, and working principle of the transducers
- Understand how various types of temperature measuring devices work
- Learn the working principle behind the flow and level measurement devices

- Understand the basics of control systems and learn the notations and terminologies used in block diagrams
- Learn the functions of control system using examples from various industry

Outcomes

The students should be able to

- Chose the appropriate instruments for measuring various parameters
- Select the correct temperature measuring device for different temperatures and process conditions
- Develop the design specifications for level and flow measuring devices
- Develop and analyze block diagram for any control system.
- Develop the complete control system for a given process/operation

UNIT I GENERAL CONCEPTS OF MEASUREMENTS 9

Variables and their measurements signals, the three stages of generalized measurement system, some common terms used in the measurement systems, mechanical loading, impedance matching, frequency response. Factors considered in selection of instruments - error analysis and classification, source of error. Transducer: classification, displacement & velocity transducers, potentiometer, LVDT, variable reluctance transducers, capacitive transducers, tachometer. Types of electric strain gauges - strain gauge bridges. Calibration of strain gauges.

UNIT II TEMPERATURE MEASUREMENT 9

Platinum resistance thermometers, thermistors, thermocouple, total radiation pyrometers, optical pyrometer, temperature measuring problems in flowing fluids.

Pressure measurement: Manometers, Elastic transducers, elastic diaphragm transducers, McLeod gauge, thermal conductivity gauges, calibration of pressure gauge using dead weight tester, dynamic characteristics of pressure measuring systems.

UNIT III FLOW & MISCELLANEOUS MEASUREMENTS 9

Venturi, Orifice & nozzle meters, Pitot tube, turbine type meters, hot wire anemometer, magnetic flow meters. Level measurement: float level meters & electrical conductivity meters.

UNIT IV CONTROL SYSTEMS 9

Open loop and closed loop controls, elements of closed loop control systems. Mathematical models for mechanical & electrical systems, transfer function, block diagram representation, signal flow graphs, control system components.

UNIT V PROCESS CONTROL 9

Automatic speed control of drives - process control, closed loop control systems - pneumatic two step controller, control of chain grate boilers, feed water control - machine tool control, hydraulic

operation, automatic positioning profile generation by coordinate setting and copying - inductosyn measuring systems - electro optical displacement measuring systems.

TOTAL : 45hrs

TEXTBOOKS

1. T.G. Beckwith and N.L. Buck, Mechanical measurements, Addition Wesley Publishing company ltd. 1995.
2. Ernest O Doebelin, Measurements systems Application & design, McGraw-Hill Publishing, 1990.

REFERENCES

1. Rangan, Mani & Sharma, Instrumentation, Tata McGraw-Hill, New Delhi, 1997.
2. I.J. Nagarath and M. Gopal, Control systems engineering, 2nd Ed. New Age International Pvt. Ltd., 1982.
4. R. K. Jain, Mechanical & Industrial measurements, Khanna Publishing.

CH2604 PROCESS DESIGN USING CAD

3 Credits

Goal

To equip the students with knowledge in process design and synthesis using CAD

Objectives

The course should enable the students to

- Understand the general concepts of product/process synthesis, and learn different methods of developing optimum reactor networks
- Learn synthesis of separation trains to perform important separation processes encountered in the design of chemical processes
- Understand the importance of heat integration between hot streams and cold streams to reduce the reliance on utilities
- Learn the various methods of heat and power integration in process industry
- Learn the concept of optimal scheduling of batch processes

UNIT I THE DESIGN PROCESS **9**

Design Opportunities, Steps in Product Process Design, Environmental Protection, Safety Considerations, Engineering Ethics, Role of Computers. Reactor Design and Reactor Network Synthesis- Objectives, Reactor Models, Reactor Design for Complex Configurations, Reactor Network Design Using the Attainable Region.

UNIT II SYNTHESIS OF SEPARATION TRAINS **9**

Objectives, Criteria for Selection of Separation Methods, Selection of Equipment, Sequencing of

Ordinary Distillation for the Separation of Nearly Ideal Fluid Mixtures, Sequencing of Operations for the Separation of Nonideal Fluid Mixtures, Separation Systems for Gas Mixtures, Separation Sequencing for Solid-Fluid Systems.

UNIT III HEAT AND POWER INTEGRATION - I **9**

Objectives, Minimum Utility Targets, Networks for Maximum Energy Recovery, Minimum Number of Heat Exchangers, Threshold Approach Temperature.

UNIT IV HEAT AND POWER INTEGRATION - II **9**

Optimum Approach Temperature, Superstructures for Minimization of Annual Costs, Multiple Utilities, Heat-integrated Distillation Trains, Heat Engines and Heat Pumps.

UNIT V OPTIMAL DESIGN AND SCHEDULING OF BATCH PROCESSES **9**

Optimal Design and Scheduling of Batch Processes- Objectives, Introduction, Design of Batch Process Units, Design of Reactor-separator Processes, Design of Single Product Processing Sequences, Design of Multi-Product Processing Sequencing.

Total : 45 hrs

TEXT BOOKS

1. "Product and Process Design Principles: Synthesis, Analysis, and Evaluation" Warren D. Seider, J. D. Seader, Daniel R. Lewin, , 2nd Edition, Wiley(2003)
2. 'Chemical Process Design' Robin Smith, McGraw-Hill, 3rd Edn, 1995
3. Systematic Methods of Chemical Process Design by Lorens T Biegler, E. I. Gnacio Grossmann Arthur W Westerberg, PHI International. 2nd edn, 2005.

Reference Books

1. T.F. Edgar and D.M. Himmelblau, "Optimization of Chemical Processes", Chemical Engg. Series, McGraw Hill
2. Richard G. Brereton, "Chemometrics: Data Analysis for the Laboratory and Chemical Plant", April 2003 Wiley.

MA2601 PROBABILITY AND STATISTICS

4 credits

Goal

To equip the students to understands various probability distributions

Objectives

The course should enable the students to

- Understand the concept of probability and deterministic variables
- To analyze various probability distributions
- To test hypothesis

Outcomes

The students should be able to

- Appreciate the random in engineering processes
- To read t-table, F-table
- Arrive at probable conclusion with the significant data calculation

UNIT I PROBABILITY AND RANDOM VARIABLES 9

Axioms of Probability - Conditional Probability - Total Probability - Baye's Theorem - Random variable - Probability mass function - Probability Density functions - Properties - Moments - Moment generating functions and their properties.

UNIT II STANDARD DISTRIBUTIONS 9

Binomial, Poisson , Geometric, Negative binomial, Uniform, Exponential, Gamma, Weibull and normal distributions and their properties - Functions of Random Variables.

UNIT III TWO-DIMENSIONAL RANDOM VARIABLES 9

Joint distribution - Marginal and conditional distribution - Co-variance - Correlation and Regression - Transformation of Random Variables - Central Limit Theorem.

UNIT IV TESTING OF HYPOTHESIS 9

Sampling distributions - Testing of Hypothesis for mean, Variance, Proportions and differences using normal, t, Chi-square and F distribution - Tests for Independence of attributes and goodness of fit.

UNIT V DESIGNS OF EXPERIMENTS 9

Analysis of variance one way classification CRD - Two way classification RBD - Latin square.

Total:45

Text Books:

1. Kandasamy, "Probability and Statistics", S. Chand & Co, Latest Edition
2. Sivaramakrishna Dass, "Probability and Statistics, Viji Academy, Latest Edition.

Reference Books:

1. M.B.K. Murthy, "Probability and Statistics", V.R.B., Publishers, Latest Edition.
2. T. Veerarajan "Probability and Statistics", Tata McGraw Hill, New Delhi, Latest Edition.

CH2631 MASS TRANSFER LAB

2 Credits

Goal

To carry out experiments in determining various mass transfer parameters

Objectives

The course should enable the students to

- Importance of separation process
- Apply the concepts of mass transfer operations introduced in the theory component
- Identify the best tools for separating mixtures

Outcomes

The students should be able to

- To determine the Diffusion coefficients of simple gases and liquids
- Appreciate the importance of separating mixtures in an economical way
- Identify the Best possible separating method with the given parameters

List of Experiments

1. Measurement of Diffusion coefficient
2. Simple distillation
3. Steam distillation
4. Leaching
5. Packed bed distillation column
6. Determination of thermal conductivity of metal bar using Fourier's equation

List of Equipment

1. Diffusion Experiment Set-up
2. Simple Distillation Set-up
3. Steam Distillation Device
4. Leaching Equipment
5. Packed Bed Distillation Column Set-up
6. Thermal conductivity metal bar with measuring devices

CH2632 DESIGN PRACTICES LAB

2 Credits

Goal

To use free hand flow sheeting tools in designing chemical Engg processes

Objectives

The course should enable the students to

- Importance of flowsheet and piping diagram for a chemical plant
- Learn simple design strategies
- Introduce process flow diagram and design methods for simple unit operations processes such as filtration, distillation, etc.,

Outcomes

The students should be able to

- Draw flow sheet diagrams with all the nodes/details mentioned
- Design piping diagrams for a mixture of processes
- Appreciate the importance of valves, fittings and flow monitoring devices in a chemical plant

List of Experiments

1. Flow sheeting: Plan and space layout of Chemical Processes
2. Design of Orificemeter, Venturimeter, Rotameter
3. Pipeline Design, Valve and Fittings
4. Absorption / Stripping column
5. Rectification Column
6. Induced Draft Cooling Towers
7. PRESSURE VESSELS: Constructional details and supporting structure.
8. HEAT EXCHANGERS: Single and multi-pass heat exchangers, Double pipe, floating head exchangers, constructional details and assembly.
9. EVAPORATORS: Constructional details and assembly drawings.
10. DISTILLATION TOWER: Constructional details and assembly drawings of packed and plate towers.
11. FILTERS AND CENTRIFUGES: Constructional details and assembly drawings of filters and Centrifuges

List of equipment

1. Drawing Boards

SEMESTER VII

CH2701 MODELING, COMPUTER SIMULATION & OPTIMIZATION

4 Credits

Goal

Equip the students with the knowledge of using computer to design and analyze the chemical processes

Objectives

The course should enable the students to

- Understand the concept of mathematical model and formulate the models with necessary equations
- Learn the formulation of mathematical equations involving batch and continuous processes
- Learn the equations related to heat transfer and mass transfer in the context of modeling of distillation column and heat exchangers
- Simulation of batch/semi-batch, and isothermal and non-isothermal processes
- Learn the basics of flow sheeting and the various methods of optimization involving single variable.

Outcomes

The student should be able to

- Identify the various equations necessary to model a process
- Model both batch and continuous processes
- Design distillation columns and heat exchangers
- Simulate any type of chemical process model represented by different types mathematical equations
- Carry out the optimization of the process with the tools taught in the class

UNIT I INTRODUCTION TO MATHEMATICAL MODEL & SIMULATION 9

Concept of mathematical model, simulation and process analysis-Lumped and distributed parameters models-hydraulic tank, mixing vessel, simultaneous mass and energy balance

UNIT II MODELING OF BATCH & CONTINUOUS PROCESS 9

Batch heating of multi-component flash drum, steady state flow processes involving non-reactive systems-extraction column (plate type)-continuous heating in a stirred tank using jacket and using coil-mixing in flow processes

UNIT III MODELING OF HEAT& MASS TRANSFER 9

Concentration gradient across a bubble plate-simultaneous hat and mass transfer in packed bed-startup of double pipe heat exchangers-shell and tube heat exchanger-simulation of multi-component

distillation column- Wang-Henke bubble method- sum-rate method and simultaneous correction method

UNIT IV CHEMICAL REACTOR SIMULATION 9

Modelling and simulation of isothermal and non-isothermal operation of batch reactor-CSTR and Semi-batch reactor-steady -state multiplicities in CSTR-thermal stability analysis of CSTR-non-isothermal operation of a single homogenous gas phase reaction in PFR-Diffusion and chemical reaction -catalytic reaction in packed bed reactor.

UNIT V PROCESS OPTIMIZATION 9

Concept and utility of process optimization one variable operation -Newtons's method, secant methods, Fibonacci, golden search- optimization-direct technique and gradient search techniques

Text Books/ References:

1. Luyben , W. L Process modeling simulation and control , MGH
2. Edger, AT. F. and Himmelblau, D. M. Optimization of chemical process, MGH
3. Systematic method of Chemical Process Design-L. T. Biegler, I. E. Grossmann and Westerberg, prentice hall international, Inc.

CH2702 BIOTECHNOLOGY & BIOCHEMICAL ENGINEERING

4 Credits

Goal

To introduce the subject of biotechnology in the context of chemical engineering

Objectives

The course should enable the students to

- Know the relevance of chemical engineering principles in understanding the biological processes in the living systems
- Study the catalytic activity of enzymes, and enzyme immobilization to optimally use the catalyst
- Learn fermentation kinetics, types of fermenters, importance of mass transfer in fermentation processes
- Learn various down-stream processes such as filtration, membrane processes, chromatographic separation used to separate and purify the products from fermenter.

Outcome

The students should be able to

- Identify the chemical processes that are happening in the living systems
- Determine the catalytic activity of the given enzyme in the given reaction conditions

- Design the various types of reactors for fermentation
- Identify the correct downstream processes that are required for a certain fermentation process

UNIT I INTRODUCTION TO BIOCHEMICAL PROCESS INDUSTRIES 10

Interaction of chemical engineering principles with biological systems; Microbiology; Fermentation pathways; Reactions in living systems.

UNIT II BIOCATALYSTS 10

Enzymes and enzymatic reactions; Michaelis-Menten equation and its various forms; enzymatic immobilization and Kinetics of immobilized systems with diffusion.

UNIT III FERMENTATION 15

Mechanism and kinetics (Monod model); types of fermenters; chemostat; chemostat, PFR, fluidized bed reactor, Bubble column and air lift fermenter; Mass transfer in microbial reactors; mixing phenomenon in bioreactors (RTD); sterilization of air and media; design of sterilizers.

UNIT IV DOWNSTREAM PROCESSING 10

Separation process for cell mass and product, filtration, Centrifuging, membrane processes (Reverse osmosis, ultrafiltration, chromatographic separation.

TOTAL PERIODS: 45

Reference Books:

1. Schule & Kargi: Bioprocess Engineering, Pearson, 2002.
2. J. E. Bailey and D.F. Ollis, Biochemical Engineering Fundamentals, 2nd Edition, 1986, McGraw Hill Book Co.
3. S.Siba and A.E. Humphrey and N.F. Mills- Biochemical Engineering, 2nd edition, 1973, Prentice Hall; Reynolds, prandtl, Von Karman and Colburn analogies.

CH2703 MASS TRANSFER - 2

4 Credits

Goal

Enable the students to apply the concept of mass transfer to various mass transfer equipment used in the chemical process industry

Objectives

The course should enable the students to

- Understand the concept of vapor-liquid equilibrium and its application in the design of distillation column
- Learn the process of absorption, and stage-wise characteristics of absorption process
- Study the concept of liquid-liquid extraction and leaching operations

- Understand the adsorption and its characteristics
- Study the modern separation techniques which are of importance in chemical engineering

Outcomes

The students should be able to

- Determine the number of theoretical plates required to carry out the given distillation
- Design the absorber
- Design the equipment for leaching and extraction
- Design the adsorption equipment
- Design the separation equipment such as reverse osmosis and dialysis

UNIT I DISTILLATION 9

Vapor - liquid equilibria, Raoults law and deviations from ideality, Methods of distillation - Batch, Continuous, Flash, steam, vacuum, McCabe Thiele method, Ponchon Savorit method, Azeotropic, Extractive and Molecular distillation.

UNIT-II ABSORPTION 9

Equilibrium and operating line concept in absorption calculations, Calculation of NTU, HTU, Number of stages - Packed and plate type absorbers, Absorption with chemical reaction, HETP, Operating characteristics of stage wise and differential contactors.

UNIT-III LIQUID-LIQUID EXTRACTION AND LEACHING 9

Liquid - liquid extraction, Stage wise contact equipments, Calculations for batch and continuous extractors, Calculation of number of stages, Equipments.

Solid - Liquid equilibrium, Equipment, Batch and Continuous type, Calculation of number of stages.

UNIT IV ADSORPTION 9

Types of adsorption, Nature of adsorption, Theories of adsorption, Adsorption isotherms, Operation of adsorption columns, Batch and continuous operations, Equipments.

UNIT-V MISCELLANEOUS SEPARATION PROCESSES 9

Concept of Osmosis, Reverse Osmosis, Dialysis, Foam Separation ,Thermal and Sweep diffusion process, Ion Exchange, Zone Refining.

TEXT BOOK:

1. Treybal, R.E, Mass Transfer Operations, McGraw Hill,3rd edition

REFERENCE BOOKS:

1. McCabe and Smith, Unit Operations of Chemical Engineering, McGraw Hill.
2. J.M. Coulson and J.F. Richardson, Chemical Engineering, Vol. II, Pergamon Press.

CH2704 POLYMER AND ELASTOMER TECHNOLOGY

3 Credits

Goal

Introduce the structure and manufacturing methods of important polymers and elastomers

Objectives

The course should enable the students to

- Know the concept of polymerization and its mechanism and kinetics
- Study the various types of polymerization, and their reaction mechanisms and kinetics
- Learn structures, properties and manufacture of synthetic elastomers such as SBR, EPDM and others
- Learn structures, properties and manufacture of thermoplastic elastomers such as polyester, polyurethane

Outcomes

The students should be able to

- Identify the polymer type and its monomer
- To choose the correct type of polymerization process to produce certain polymer
- To design the production process for manufacture of various industrially important polymers
- To design the manufacture of various thermoplastic elastomers

UNIT I POLYMERIZATION **08**

Basic concepts of macromolecules - Monomers- Functionality - Classification and nomenclature of polymers. Step growth polymerization - Mechanism - Kinetics - Bi-functional systems - Poly functional systems

UNIT II TYPES OF POLYMERIZATION **12**

Addition polymerization Mechanism and kinetics of free radical- Cationic -Anionic polymerisation - Initiator systems -Chain length and degree of Polymerisation - Control of molecular weight -Chain transfer -Inhibition Coordination polymerisation -Ziegler Natta Polymerization- Mechanism - Kinetics- Ring opening polymerization - Diene polymerization.

UNIT III SYNTHETIC ELASTOMERS **13**

Manufacturing, structure, properties, compounding, curing and applications - Polyisoprene, Polybutadiene, SBR, EPDM, Butyl rubber, Neoprene, Nitrile rubber, Silicone rubber, Fluoro elastomer, Polysulphide rubber, polyurethane rubber, Acrylic rubber.

UNIT IV THERMOPLASTIC ELASTOMERS **12**

Basic structure, Manufacture, Morphology, Commercial grades and Applications - Thermoplastic styrene block copolymers, Polyester thermoplastic elastomers, polyamide thermoplastic elastomer, Polyurethane thermoplastic elastomers.

TOTAL:45

TEXT BOOKS

1. C.M.Blow and Hepburn, - Rubber Technology and Manufacture, 2nd edition, 1982.
2. Hoffman, Rubber Technology Handbook -, Hanser Pub. Munich - 1996.

References:

1. F.W. Billmeyer, Text Books: of Polymer Science, Wiley international publishers,1984.
2. Joel R. Fried, Polymer science and Technology, Prentice Hall , NJ, 1995
3. Premamoy Ghosh, Polymer Science and Technology of Plastics and Rubbers, Tata McGraw - Hill, New
4. Anil .K. Bhowmik, Howard L. Stephens (Edt), Handbook of Elastomers - New Developments & Technology, Marcel Decker Inc. New York 1988.
5. Maurice Morton, Rubber Technology.

CH2705 PROCESS ECONOMICS AND INDUSTRIAL MANAGEMENT

3 Credits

Goal

To equip the students with requisite skills to become an entrepreneur

Objectives

The course should enable the students to

- Learn the concept of an organization and various activities that need to be performed to achieve the goals of an organization
- Study the various methods used in the production and its control such as work study, motion study, inventory control
- Study the basics of quality and different quality control charts
- Learn the basics of economics
- Study the profitability of various processes, replacement policies for various equipment
- Understand the concepts of accounting, and read the balance sheet and the Profit & Loss accounts
- Understand how to economically balance the various process equipment to be used in a process

Outcomes

The students should be able to

- Decide the type and structure of organization and the activities that necessary to realize a business goal
- Control the production to achieve the optimum level of productivity using different techniques
- Analyze the quality of a process using various control charts for the given data
- Incorporate the economic viability as part of the process design and its optimization
- Choose the economically best process from the various process alternatives
- Analyze the financial strength of a company at any given point of time
- Design optimized unit operations from the various available choices

UNIT I PRINCIPLES OF MANAGEMENT AND ORGANISATION 9

Planning, organisation, staffing, coordination, directing, controlling, communicating, organisation as a process and a structure; types of organisations.

UNIT II PRODUCTION AND MANAGEMENT 9

Method study; work measurement techniques; basic procedure; motion study; motion economy; principles of time study; elements of production control; forecasting; planning , routing; scheduling; despatching; costs and costs control, inventory and inventory control.

UNIT III INTEREST, INVESTMENT COSTS AND COST ESTIMATION 9

Time Value of money; capital costs and depreciation, estimation of capital cost, manufacturing costs and working capital, invested capital and profitability.

UNIT IV PROFITABILITY, INVESTMENT ALTERNATIVE AND REPLACEMENT 9

Estimation of project profitability, sensitivity analysis; investment alternatives; replacement policy; forecasting sales; inflation and its impact.

UNIT V ANNUAL REPORTS AND ANALYSIS OF PERFORMANCE & ECONOMIC BALANCE 9

Principles of accounting; balance sheet; income statement; financial ratios; analysis of performance and growth.

Different unit operations with single and multiple variables.

Total No of periods: 45

References:

1. Davis, G.S, " Chemical Engineering Economics and Decision Analysis ", CENDC, I.I.T., Madras, 1981.
2. Holand, F.A., Watson, F.A and Wilkinson, J.K., " Introduction to process Economics ",John

Wiley, 1974.

3. Sumanth, D.T., " Production Engineering and Management ", McGraw-Hill, 1984.

4. Shukla, M.C., " Business Organisation and Management ", Sultan Chand and Sons, 1975.

CH2731 CHEMICAL ENGG SOFTWARE LAB
(Aspen Plus, ChemCAD, HYSYS)

2 Credits

Goal

To learn Chemical Engineering software tools to use it in chemical Engg process calculation

Objectives

The course should enable the students to

- Softwares available to simulate real time processes
- Importance of virtualization of chemical processes to cut cost and time
- Programming tools needed for effective implementation of Chemical Engg softwares

Outcomes

The students should be able to

- To determine kinetic,diffusion and constants using simulation tools
- To design the piping and flow sheets of processes using the software saving manual work
- To design systems for combination of unit operation processes

List of Experiments

1. Batch Reactor
2. CSTR
3. CSTRs in series
4. Plug Flow Reactor
5. Simple Distillation
6. Continuous Distillation
7. Shell-and-Tube Heat Exchanger
8. Evaporator
9. Pressure Drop in Packed Bed
10. Pressure drop in Fluidized Bed

Book

1. Tutorial books on Hysys, Aspen Plus

List of Equipment

1. Computers with Chemical Process Simulation Software Aspen Plus, ChemCAD, and HYSYS

CH2732 PROCESS CONTROL LAB

2 Credits

Goal

To study various control tools to optimize process conditions

Objectives

The course should enable the students to

- Study the concept of time-constant using simple experiments
- Experimentally study the control of various process parameters such as temperature, pH, level, and flow

Outcomes

The students should be able to

- Determine the time required to capture the changes in process parameters of a given system
- To design the control system for simple and complex processes

List of Experiments

1. Time constant in measuring instrument
2. Study in level control and pH control
3. Study in temperature control
4. Study in flow control
5. Study in interacting and non-interacting system
6. Study in valve characteristics

List of Equipment

1. Time Constant Measurement Set-up
2. Level Control Set-up
3. Temperature Control Set-up
4. Flow Control Set-up
5. Interacting System
6. Valve Characteristics Set-up

SEMESTER VIII

MG2002 TOTAL QUALITY MANAGEMENT

3 Credits

Goal

To teach the importance of quality in industry and various methods and tools of quality management

Objectives

The course should enable the students to

- Understand the basics of quality and its management
- Learn various principles aimed at maintaining TQM (Total Quality Management)
- Understand the concept of Statistics and its usefulness in different process control techniques
- Study and understand different tools used in quality control
- Understand the various aspects of ISO

Outcomes

The students should be able to

- Acquire basics of quality and various methods involved in it
- Achieve the quality targets using various Total Quality Management principles
- Use statistical process control techniques to achieve the set quality goals
- Use various Quality Control Tools aimed at improves quality
- Execute the implementation of ISO in the organization

UNIT I INTRODUCTION **9**

Definition of Quality, Dimensions of Quality, Quality Planning, Quality costs - Analysis Techniques for Quality Costs, Basic concepts of Total Quality Management, Historical Review, Principles of TQM, Leadership - Concepts, Role of Senior Management, Quality Council, Quality Statements, Strategic Planning, Deming Philosophy, Barriers to TQM Implementation.

UNIT II TQM PRINCIPLES **9**

Customer satisfaction - Customer Perception of Quality, Customer Complaints, Service Quality, Customer Retention, Employee Involvement - Motivation, Empowerment, Teams, Recognition and Reward, Performance Appraisal, Benefits, Continuous Process Improvement - Juran Trilogy, PDSA Cycle, 5S, Kaizen, Supplier Partnership - Partnering, sourcing, Supplier Selection, Supplier Rating, Relationship Development, Performance Measures - Basic Concepts, Strategy, Performance Measure.

UNIT III STATISTICAL PROCESS CONTROL (SPC) **9**

The seven tools of quality, Statistical Fundamentals - Measures of central Tendency and Dispersion, Population and Sample, Normal Curve, Control Charts for variables and attributes, Process capability, Concept of six sigma, New seven Management tools.

UNIT IV TQM TOOLS **9**

Benchmarking - Reasons to Benchmark, Benchmarking Process, Quality Function Deployment (QFD) - House of Quality, QFD Process, Benefits, Taguchi Quality Loss Function, Total Productive Maintenance (TPM) - Concept, Improvement Needs, FMEA - Stages of FMEA.

UNIT V QUALITY SYSTEMS **9**

Need for ISO 9000 and Other Quality Systems, ISO 9000:2000 Quality System - Elements, Implementation of Quality System, Documentation, Quality Auditing, QS 9000, ISO 14000 - Concept, Requirements and Benefits.

TOTAL : 45hrs

TEXT BOOK

1. James R.Evans & William M.Lidsay, The Management and Control of Quality, (5th Edition), South-Western (Thomson Learning), 2002 (ISBN 0-324-06680-5).
2. Dale H.Besterfiled, et at., "Total Quality Management", Pearson Education Asia, 1999. (Indian reprint 2002).

REFERENCES

1. Feigenbaum.A.V. "Total Quality Management, McGraw Hill, 1991.
2. Oakland.J.S. "Total Quality Management Butterworth - Hcinemann Ltd., Oxford. 1989.
3. Narayana V. and Sreenivasan, N.S. Quality Management - Concepts and Tasks, New Age International 1996.
4. Zeiri. "Total Quality Management for Engineers", Wood Head Publishers, 1991.

EI2811 PROCESS DYNAMICS AND CONTROL

4 Credits

Goal

To introduce control equipment used to control the production process of a chemical factory and to introduce the control mechanism through automation and computers.

Objectives

The course should enable the students to

- Learn mathematical formulation of time series.
- Understand the working of open and closed loop systems
- Analyze closed loop systems using various standard methods such as frequency response and Bode Diagram
- To learn types of controls systems and their complexities and benefits
- Learn various measurement instruments used in process industry

Outcomes

The students should be able to

- Appreciate and understand time series solution
- Figure out feedback mechanism and frequency response
- Analyze the stability of the control systems and suggest steps to improve their stability
- Design efficient control mechanisms for given process
- Understand and analyze data generated by various measurement devices

UNIT I LAPLACE TRANSFORMATION 9

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

UNIT II CONTROL SYSTEMS 9

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

UNIT III CLOSED LOOP SYSTEMS 9

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

UNIT IV TYPES OF CONTROL MECHANISMS 9

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

UNIT V PHYSICAL MEASUREMENT 9

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

TOTAL : 45

TEXT BOOKS

1. Coughnowr and Koppel, "Process Systems Analysis and Control", McGraw-Hill, New York, 1986.
2. George Stephanopolous, "Chemical Process Control", Prentice-Hall of India Pvt. Ltd., New Delhi, 1990.

3. Patranabis.D, Principles of Process control, II edition, Tata McGraw-Hill Publishing Co. Ltd., 1981.

4. Peter Harriott, Processcontrol, Tata McGraw-Hill Publishing Co., Reprint 2004.

REFERENCES

1. Thomas, E.Marlin, Process Control, 2nd Edn, McGraw-Hills International Edn. 2000.

2. George Stephanopoulos, Chemical Process Control, Prentice Hall of India 2003.

3. Norman H.CEAGLSKE, Automatic process control for chemical engineers, John Wiley & Sons, Japan.

4. Emenule, S.Savas, "Computer Control of Industrial Processes", McGraw-Hill, London, 1965.

5. Eckman, D.P., "Industrial Instrumentation", Wiley, 1978.

CH2831 PROJECT & VIVA-VOCE

6 Credits

Goal

To apply the concepts studied over four years and to do a project to improve critical thinking and to analyze industry problems

ELECTIVE -I LIST
CH2751 ELECTROCHEMICAL REACTION ENGINEERING

3 Credits

Goal

To provide basic understanding in electrochemical reaction engineering

Objectives

The course should enable the students to

- Learn about electrolytes, mass and energy transports in the electrolytic reaction
- Learn the working principles of Plug Flow Reactor and Continuous Stirred Tank Electrolytic Reactor
- Study the thermal behavior of electrochemical reactors
- Learn to build the concept mass transportation in the electrochemical reactions and build the models of electrochemical reactors
- Study the dispersion models of electrochemical reactors

Outcomes

The students should be able to

- Determine the efficiency of electrochemical reactors
- Carry out the design of electrolytic reactors

- Estimate the heat losses in the electrochemical reactors
- Simulate the electrochemical reactions, and analyze the results
- Perform optimization electrochemical reactors

UNIT I CURRENT - VOLTAGE RELATIONSHIPS 9

A general view of electrolytic processes; current-voltage relationship in electrolytic reactors; The limiting current plateau; convective diffusion theory and the mass transport coefficient; Mass & energy balance, and efficiency in electrochemical reactors. The estimation of mass transport coefficients at commonly occurring electrodes. The estimation of mass transport coefficients under enhanced convection conditions.

UNIT II PLUG FLOW & CSTER SYSTEMS MODEL 9

A general view of plug flow model electrolytic reactors; plug flow model electrochemical reactors employing parallel plate reactor; Plug flow model under constant mass flux conditions; PFM analysis with electrolytic recycling PFM and real electrochemical reactors. General view of simple CSTER systems; CSTER in cascades; CSTER analysis of batch electrochemical reactors, CSTER analysis of semi-continuous electrochemical reactors; CSTER analysis of electrolyte recycling; Batch reactor combined with electrolyte recycling.

UNIT III THERMAL BEHAVIOR OF REACTORS 9

General aspects of thermal behavior in electrochemical reactor. Thermal behavior under CSTER conditions. The estimation of heat losses; the thermal behavior under PFR conditions; Thermal behavior of batch electrochemical reactors.

UNIT IV CONVECTIVE DIFFUSION EQUATION & CURRENT DISTRIBUTION 9

Ionic transfer - the flux equation - derivation of general mass transfer equation - Migration - Migration during electrolysis - Effect of adding excess supporting electrolytic - diffusion boundary conditions in electrochemical problems - Theoretical treatment of convective systems - The convective diffusion equation - Determination of the velocity profile - the velocity of profile at the RDE, primary current distribution in electrochemical reactors - current distribution at the RDE, hydro dynamically modulated RDE - General digital simulation of electrochemical problems - simulations in convection systems.

UNIT V DISPERSION MODELS & OPTIMIZATION OF ELECTROCHEMICAL REACTOR 9

General aspects of dispersion models; tracer input signal/output signal; Axial dispersion in electrochemical reactors; Axial dispersion and reactor performance; General notions on optimization of electrochemical reactor.

TEXT BOOKS

1. D. Pletcher and F. C. Walsh, Industrial Electrochemistry, Chapman and Hall, London,1990
2. A. T. Kuhn, Industrial Electrochemistry, Elvesier Publishers, 1972
3. J.O.M Bockris & A.K. N. Reddy, Modern Electrochemistry, volume II, Plenum Press
4. A. J. Bard & L. R. Faulkner Electrochemical Methods fundamentals & Applications, John Wiley & Sons, 2nd Edition, 2001.

CH2752 PULP AND PAPER TECHNOLOGY

3 Credits

Goal

To make the students aware of latest technologies in use in the Pulp and Paper Industry

Objectives

The course should enable the students to

- Learn the advanced techniques in pulping process and the resultant improvements in the characteristics of pulp
- Study the innovative methods employed in bleaching and the effects of various chemicals used in bleaching
- Learn the advanced techniques in manufacture of paper to improve important characteristics of paper
- Understand the effect of temperature, residence time and other parameters on the recovery of various chemicals
- Learn the advanced techniques in the recycling process

Outcomes

The students should become aware of

- The latest trends in the pulping techniques and their benefits in the overall efficiency of pulping process
- The innovative bleaching techniques and their specific effects on the quality of bleaching
- The innovative methods of paper manufacture that lead to improved paper quality
- The various methods employed to improve the efficiency of recovery of chemicals
- The importance of recycling and the modern techniques in recyling.

UNIT - I FUNDAMENTAL ADVANCES AND INNOVATIONS IN PULPING

Compressibility and Flow Resistance of Chips Made With a New Chipping Technique - Kinetics and Space Modeling of Modified Kraft Pulping - Measurement of Delignification Diversity Within Kraft Pulping Processes - Modeling the Fate of metal Ions During Brown stock Washing with Bleaching Filtrate Recycle - Investigations into the Intrinsic Non-Process Element Binding Capacity of Kraft Black Liquor Lignin's.

UNIT - II FUNDAMENTAL ADVANCES AND INNOVATIONS IN BLEACHING

A Proposed Heterogeneous Kinetic Model for Oxygen Delignification of Kraft Pulps - Prediction of the Effect of Operating Variables on the Rates of Delignification and Cellulose Degradation during Ozone Bleaching - Effect of Borate and Boric Acid on Brightness Reversion of Lignin Containing Pulps.

UNIT - III FUNDAMENTAL ADVANCES AND INNOVATIONS IN PAPER MANUFACTURE

Optimization of Dilution in View of Grammage Control by Dilution With a Hydraulic Flown box - Diffusion of Water Vapour in Paper - Simultaneous Heat and Mass Transport in paper Sheets During

Moisture Sorption from Humid Air - Analysis of Convective Heat and mass Transfer in Through Air Drying of Paper - Lightweight, High Opacity paper: Process Costs and Enrgy Use Reduction.

UNIT IV FUNDAMENTAL ADVANCES AND INNOVATIONS IN CHEMICAL RECOVERY

Experimental and Modelling study on the Fume Formation at a Kraft Recovery Boiler - The Effect of Temperature and Residence Time on the Distribution of Carbon, Sulfur, and Nitrogen Between Gaseous and Condensed Phase Products from Low Temperature Pyrolysis of Kraft Black Liquor - Evaluation of Evaporator Scaling: A Preliminary comparison of Kraft and Kraft - AQ Liquors - Sintering of Calcined Lime Mud - The Influence of the Sodium Phosphate Content in the Lime.

UNIT V FUNDAMENTAL ADVANCES AND INNOVATIONS IN RECYCLING AND DEINKING

Relationship Between Thermal Properties of Hydrocarbon - Based Wax Coating and Their Behaviour in Papermaking Systems - Measurement of Long - Range Hydrophobic Attraction Forces and Their Relationship to Deinking Flotation: Recent Measurements and High - Speed Video - Compatibility of Pressure Sensitive Adhesives With Recycling Unit Operations.

Text Books / References:

1. Hand Book of Pulp and Paper Technology: K. W. Britt, Van Nostrand, Reinhold, N. V., 2nd Edn.
2. Pulp and paper, Vols I, II, III and IV: J. P. Casey, Wiley - Interscience, 3rd Edn.
3. Pulp Technology and Treatment for Paper: J. Clark, Miller, Freeman, S. F.

CH2753 INDUSTRIAL CATALYSIS

3 Credits

Goal

To teach the basics of synthesis and characterization of catalyst

Objectives

The course should enable the students to

- Study the various industrial catalytic processes, and their classification
- Understand the various methods of catalyst preparation, and the characteristics of catalytic surface
- Learn the synthesis of catalyst
- Understand the process catalyst activation, deactivation and regeneration
- Learn the basic concepts of electro catalysis and the working of fuel cell

Outcomes

The students should be able to

- Select a suitable type of catalytic process for the given catalytic process
- Choose the appropriate method of catalyst preparation

- Improve the catalyst activity by modifying the catalyst surface
- Estimate the duration of catalyst lifecycle, optimize the use of catalyst
- Carry out basic calculations related to fuel cell

UNIT I INTRODUCTION **9**

Survey of industrial catalytic processes-Theories of heterogeneous catalysis-classification of catalysts and supports

UNIT II CATALYST PREPARATION AND CHARACTERIZATION **9**

Impregnation-adsorption sol-gel-chemical vapour deposition- factors governing- catalytic activity- bulk characterization -physiosorption technique- surface area and pore size distribution - chemisorption-desorption-spectroscopy-thermal analysis-X-ray diffraction-electron microscopy-electron spectroscopy

UNIT III SYNTHESIS **9**

Synthesis, characterization and modification of microporous and mesoporous zeolites-Heteropoly compounds-pillared clays

UNIT IV MECHANISM AND KINETICS **9**

Mechanism and kinetics of activation -deactivation and regeneration of catalysts-sintering of supported metal catalysts

UNIT V ELECTROCATALYSIS AND FUEL CELL **9**

Electrocatalysis and fuel cell-photocatalysis for the removal of air and water pollutants and conversion of solar energy-Polyfunctional catalysts-synthesis , characterization and activity of nano-particles and nano-clusters

TEXT BOOKS

1. Thomas, J.M and Thomas W. J., Introduction to principles of heterogeneous catalysis", Academic Press
2. Butt, J. B. and Peterson, E. E.,"Activation , Deactivation and Poisoning of Catalysts", Academic Press
3. Anderson, R. B.(Ed.)"Experimental Methods in Catalytic Research" Volume I to III, Academic Press
4. Becker, E. R. and Pereira, C. J. (Eds.),"Computer Aided Design of catalysts", Marcel Dekker Inc.

CH2754 FOOD PROCESSING

3 Credits

Goal

To make the students aware of role of chemical engineering in the food processing industry

Objectives

The course should enable the students to

- Learn the characteristics and functions of constituents of food
- Understand the intentional and unintentional additives and their roles in the food processing
- Understand the use of various microorganisms in food processing and preservation
- Study various ways in which food can be spoiled and the diseases caused by spoiled food
- Learn the important techniques employed in food preservation

Outcomes

The students should be able to

- Figure out the relationship between the food constituents and their energy levels
- Determine the pros and cons of various food additives
- Analyze the process of food processing and preservation using appropriate microorganism
- Suggest steps to prevent food spoilage
- Employ the correct method of food preservation to improve the shelf life of food products

UNIT I FOOD AND ENERGY **9**

Constituents of food - carbohydrates, lipids, proteins, water, vitamins and minerals, dietary sources, role and functional properties in food, contribution to organoleptic and textural characteristics.

UNIT II FOOD ADDITIVES **9**

Classification, intentional and non-intentional additives, functional role in food processing and preservation; food colourants - natural and artificial; food flavours; enzymes as food processing aids.

UNIT III MICROORGANISMS ASSOCIATED WITH FOOD **9**

Bacteria, yeasts and molds - sources, types and species of importance in food processing and preservation; fermented foods and food chemicals, single cell protein.

UNIT IV FOOD BORNE DISEASES **9**

Classification - food infections - bacterial and other types; food intoxications and poisonings - bacterial and non-bacterial; food spoilage - factors responsible for spoilage, spoilage of vegetable, fruit, meat, poultry, beverage and other food products.

UNIT V FOOD PRESERVATION **9**

Principles involved in the use of sterilization, pasteurization and blanching, thermal death curves of

microorganisms, canning; frozen storage-freezing characteristics of foods, microbial activity at low temperatures, factors affecting quality of foods in frozen storage; irradiation preservation of foods.

TOTAL : 45

TEXT BOOKS

1. T.P. Coultate - Food - The Chemistry Of Its Components, 2nd Edn. Royal Society, London, 1992.
2. B. Sivasanker - Food Processing And Preservation, Prentice-Hall Of India Pvt. Ltd. New Delhi 2002.

REFERENCES

1. W.C. Frazier And D.C. Westhoff - Food Microbiology, 4th Ed., McGraw-Hill Book Co., New York 1988.
2. J.M. Jay - Modern Food Microbiology, CBS Pub. New Delhi, 1987

CH2755 ENERGY ENGINEERING

3 Credits

Goal

To teach the various energy sources- Renewable and Non-renewable

Objectives

The course should enable the students to

- Know importance of energy sources for survival of mankind
- Learn the biomass and generation of energy from disposed organic matter
- Understand various forms of energy sources
- Know the Green-House gas emission regulations governing
- Learn the ways to Nuclear and Thermal Energy

Outcomes

The students should be able to

- Appreciate the need for new sources and optimal use of existing energy sources
- Understand the process and practical issues in scaling up
- Augment his existing understanding with other forms of energy sources.
- Design the coal energy pants conforming to green-house gas emission regulations
- Examine the use of alternative energy sources for sustainable development

UNIT I ENERGY GENERATION - RENEWABLE AND NON RENEWABLE 9

Energy Sources- Renewable and Non-renewable, Sustainable energy sources, Need for Alternate Energy sources, Calorific value.

UNIT II BIO-ENERGY 9

Biomass, Energy from cane, biomass and oil seeds, Processing of Biofuels, Manufacture and scale-up

UNIT III SOLAR, TIDAL AND WIND ENERGY 9

Energy generation from renewable sources, Photo-voltaics, Tidal and ocean current phenomenon, wind energy and sustainability.

UNIT IV ENERGY FROM CLEAN COAL 9

Coal sources, clean energy from Coal, Various Green-house gas emission regulation protocols, Process Diagram and Sustainability.

UNIT V OTHER RESOURCES 9

Other sources-> Geothermal, Nuclear, Thermal, Hydroelectric and Gas based plants. Process Diagrams, Sustainability and Environmental Impact.

TOTAL : 45 hours

TEXT BOOKS

1) Renewable Energy Engineering and Technology, VVN Kishore, Teri Publishing House,2010.

2) Non-conventional energy sources, GD Roy, Khanna Publishers, 2004.

ELECTIVE-II LIST
CH2851 GENETIC ENGINEERING

3 Credits

Goal

To impart basic knowledge in Genetic Engineering

Objectives

The course should enable the students to

- Fundamental knowledge of Biotechnology related to genetics
- To learn recombinant technology
- To learn about various genetic libraries
- To study about sequencing tools in Genetic Engineering
- To study about Human Genome project

Outcomes

The students should be able to

- Have a thorough knowledge of the use of Genetic Engineering as a tool in Biotechnology
- Have a thorough know-how of recombination events and vectors used therein
- Evaluate the difference between a genomic library and cDNA library
- Employability of Genetic Engineering tools such as PCR, RT-PCR, Inverse PCR, Nested PCR, Genome sequencing
- Application of Recombinant DNA technology in the post Human Genome era

UNIT I BASICS OF RECOMBINANT DNA TECHNOLOGY 4

Role of genes within cells, genetic elements that control gene expression, restriction and modifying enzymes, safety guidelines of recombinant DNA research.

UNIT II CREATION OF RECOMBINANT MOLECULES 10

Restriction mapping, design of linkers and adaptors. Characteristics of plasmid and phage vectors, prokaryotic and eukaryotic expression vectors. Insect, Yeast and Mammalian vectors.

UNIT III CONSTRUCTION OF LIBRARIES 15

Construction of cDNA and genomic libraries. Screening of libraries with DNA probes and with antisera.

UNIT IV POLYMERASE CHAIN REACTION 10

Inverse PCR, Nested PCR, Taqman assay, Molecular beacons, RACE PCR, RAPD, site directed mutagenesis, methods of nucleic acid sequencing- Sangers method, (Kunkel's Method).

UNIT V APPLICATIONS OF RECOMBINANT DNA TECHNOLOGY 6

Cloning in plants, Ti plasmid, and transgenic and knockout animals.

TOTAL : 45

TEXT BOOK

1. Old RW, Primrose SB, "Principles of Gene Manipulation, An Introduction To Genetic Engineering", Blackwell Science Publications, 1993.
2. Ansubel FM, Brent R, Kingston RE, Moore DD, "Current Protocols In Molecular Biology", Greene Publishing Associates, NY, 1988.

REFERENCE

1. Berger Sl, Kimmer AR, "Methods In Enzymology", Vol. 152, Academic Press, 1987.

CH2852 ENZYME ENGINEERING

3 Credits

Goal

To introduce the basics of Enzyme Engineering

Objectives

The course should enable the students to

- Learn the mechanisms of enzyme activity, and related theories.
- Understand enzyme kinetics by studying various kinetic models such as M-M Kinetics and Monod Model
- Study the concept, methods, and benefits of enzyme immobilization
- Study the unit operations involved in extraction of enzymes from their sources and their purification
- Study the use of enzymes in the application of biosensors

Outcomes

The students should be able to

- Determine the required enzyme
- Analyze the enzymatic reaction data and determine the reaction constants
- Design the immobilized enzyme for the enzyme catalyzed reaction
- Develop the process flowchart for the production of enzyme and identify the major equipment required for the process
- Use enzymes in biosensors

UNIT I INTRODUCTION TO ENZYMES 9

Classification of enzymes. Mechanisms of enzyme action; concept of active site and energetics of enzyme substrate complex formation; specificity of enzyme action; principles of catalysis - collision theory, transition state theory; role of entropy in catalysis.

UNIT II KINETICS OF ENZYME ACTION 12

Kinetics of single substrate reactions; estimation of Michelis - Menten parameters, multi substrate reactions- mechanisms and kinetics; turnover number; types of inhibition & models -substrate, product. Allosteric regulation of enzymes, Monod changeux wyman model, ph and temperature effect on enzymes & deactivation kinetics.

UNIT III ENZYME IMMOBILIZATION 8

Physical and chemical techniques for enzyme immobilization - adsorption, matrix entrapment, encapsulation, cross-linking, covalent binding etc., - examples, advantages and disadvantages.

UNIT IV PURIFICATION AND CHARACTERIZATION OF ENZYMES FROM NATURAL SOURCES **8**

Production and purification of crude enzyme extracts from plant, animal and microbial sources; methods of characterization of enzymes; development of enzymatic assays.

UNIT V ENZYME BIOSENSORS **8**

Application of enzymes in analysis; design of enzyme electrodes and their application as biosensors in industry, healthcare and environment.

TOTAL : 45

TEXT BOOKS

1. Harvey W. Blanch, Douglas S. Clark, "Biochemical Engineering", Marcel Dekker, Inc.
2. James M. Lee, "Biochemical Engineering", PHI, USA.

REFERENCES

1. James. E. Bailey & David F. Ollis, "Biochemical Engineering Fundamentals", McGraw-Hill.
2. Wiseman, "Enzyme Biotechnology", Ellis Horwood Pub.

CH2853 CORROSION ENGINEERING

3 Credits

Goal To teach the basics of corrosion and the impact in environment and process industry

Objectives

The course should enable the students to

- Learn the concept and nature of corrosion
- Learn the kinetics and thermodynamics of electrochemical reaction
- To study different types of corrosion and techniques of corrosion measurement
- To learn the corrosion induced by environmental factors, and corrosion prevention techniques

Outcomes

The students should be able to

- Estimate the rate of corrosion
- Carry out the experimental study on electrochemical reaction
- To measure the rate of corrosion
- To device strategy to prevent and minimize corrosion

UNIT I BASIC CONCEPTS **10**

Definition and importance-electrochemical nature and forms of corrosion-corrosion rate and its determination

UNIT II ELECTRO-CHEMICAL THERMODYNAMICS AND KINETICS **10**

Electrode potentials-potential-pH(Pourbaix) diagrams-reference electrodes and experimental measurements-Faraday's laws-electrochemical polarization-experimental polarization curves-Instrumentation and experimental procedure

UNIT III CORROSION AND TYPES **15**

Galvanic-concentration cell-basic concepts-experimental measurements-determination of rates of galvanic corrosion-concentration cells-measurement through polarization techniques-Tafel extrapolation plots-polarization resistance method-Instrumental methods and errors in measurement of polarization resistance-commercial corrosion probes-Passivity-basic concepts-properties of passive films-applications of potentiostatic anodic polarization-anodic protection-pitting and crevice corrosion-basic concepts-mechanism of pitting and crevice corrosion-secondary forms of crevice corrosion-localized pitting

UNIT IV ENVIRONMENTAL INDUCED CRACKING **10**

Stress corrosion cracking - corrosion fatigue cracking-hydrogen induced cracking-environmental factors and corrosion-Atmospheric and elevated temperature corrosion-Prevention and control of corrosion-cathodic protection- coatings and inhibitors-material selection and design

BOOKS:

1. Fontana, M.G., Corrosion Engineering, Mc Graw-Hill
2. Jones, D. A., Principal and protection of Corrosion, Prentice-Hall

CH2854 NEURAL NETWORKS AND ARTIFICIAL INTELLIGENCE

3 Credits

Goal

To teach the basics of neural networks and artificial intelligence

Objectives

The course should enable the students to

Know the basics of neural networking and its application in software engineering

Learn models of Artificial Neural Networks and its characteristics

Outcomes

The students should be able to

Identify the application areas for neural networking

Develop models of Artificial Neural Networks

UNIT I NEURAL NETWORKS **9**

Introduction to neural computing- Neural computing in software engineering- Neural computing in cognitive Science

UNIT II ARTIFICIAL NEURAL NETWORKS **9**

Neural attributes-Modeling- Basic Model of a Neuron-Learning in Artificial Neural Networks-Delta Rule- Characteristics of ANNS- ANN Parameters- ANN Topologies

UNIT III NEURONAL DYNAMICS **9**

Neurons as functions-Neuron fields- Common Signal functions- Neuronal Dynamic Systems- Additive Neuronal Dynamics- Additive bivalent modules-BAM Connection Matrices

UNIT IV INTRODUCTION TO ARTIFICIAL INTELLIGENCE **8**

Intelligent Agents - Agents and environments - Good behavior - The nature of environments - structure of agents - Problem Solving - problem solving agents - example problems - searching for solutions - uniformed search strategies - avoiding repeated states - searching with partial information.

UNIT V SEARCHING TECHNIQUES **10**

Informed search and exploration - Informed search strategies - heuristic function - local search algorithms and optimistic problems - local search in continuous spaces - online search agents and unknown environments - Constraint satisfaction problems (CSP) - Backtracking search and Local search for CSP - Structure of problems - Adversarial Search - Games - Optimal decisions in games - Alpha - Beta Pruning - imperfect real-time decision - games that include an element of chance.

UNIT VI KNOWLEDGE REPRESENTATION **10**

First order logic - representation revisited - Syntax and semantics for first order logic - Using first order logic - Knowledge engineering in first order logic - Inference in First order logic - prepositional versus first order logic - unification and lifting - forward chaining - backward chaining - Resolution - Knowledge representation - Ontological Engineering - Categories and objects - Actions - Simulation and events - Mental events and mental objects.

TEXT BOOK

1. Stuart Russell, Peter Norvig, "Artificial Intelligence - A Modern Approach", 2nd Edition, Pearson Education / Prentice Hall of India, 2004.

REFERENCES

1. Nils J. Nilsson, "Artificial Intelligence: A new Synthesis", Harcourt Asia Pvt. Ltd., 2000.
2. Elaine Rich and Kevin Knight, "Artificial Intelligence", 2nd Edition, Tata McGraw-Hill, 2003.
3. George F. Luger, "Artificial Intelligence-Structures And Strategies For Complex Problem Solving", Pearson Education / PHI, 2002.

CH 2855 TRANSPORT PROCESSES

3 Credits

Goal

To appreciate coupled heat and flow systems in chemical Engineering

Objectives

The course should enable the students to

- Learn the basics of conservation laws, boundary conditions and methods of analysis
- Understand the transport properties of gases and liquids, effect of pressure and temperature
- To study the general method of shell balance approach

Outcomes

The students should be able to

- Identify the boundary conditions and the choose the right method of analysis for given problem
- Determine the transport models

UNIT I TRANSPORT PHENOMENA 3

Importance of transport phenomena; analogous nature of transfer process; basic concepts, conservation laws; continuous concept, field, reference frames, substantial derivative and boundary conditions; methods of analysis; differential, integral and experimental methods

UNIT II TRANSPORT BY MOLECULAR MOTION 5

Phenomenological laws of transport properties, Newtonian and non-Newtonian fluids; rheological models; theories of transport properties of gases and liquids; effect of pressure and temperature.

UNIT III ONE DIMENSIONAL TRANSPORT IN LAMINAR FLOW (SHELL BALANCE) 12

General method of shell balance approach to transfer problems; Choosing the shape of the shell; most common boundary conditions; momentum flux and velocity distribution for flow of Newtonian and non-Newtonian fluids in pipes, for flow of newtonian fluids in planes, slits and annulus heat flux and temperature distribution for heat sources such as electrical, nuclear, viscous and chemical; forced and free convection; mass flux and concentration profile for diffusion in stagnant gas, systems involving reaction and forced convection.

UNIT IV EQUATIONS OF CHANGE AND THEIR APPLICATIONS 14

Conservation laws and equations of change; Development of equations of continuity motion and energy in single multi-component systems in rectangular coordinates and the forms in curvilinear coordinates; simplified forms of equations for special cases, solutions of momentum, mass and heat transfer problems discussed under shell balance by applications of equation of change, scale factors; applications in scale-up.

UNIT V TRANSPORT IN TURBULENT AND BOUNDARY LAYER FLOW 7

Turbulents phenomena; phenomenological relations for transfer fluxes; time smoothed equations of change and their applications for turbulent flow in pipes; boundary layer theory; laminar and turbulent hydrodynamics thermal and concentration boundary layer and their thickness; analysis of flow overflat surface.

UNIT VI ANALOGIES BETWEEN TRANSPORT PROCESSES 4

Importance of analogy; development and applications of analogies between momentum and mass transfer; Reynolds, Prandtl, Von Karman and Colburn analogies.

TOTAL : 45

TEXT BOOKS

1. R. B. Bird, W. E. Stewart and E.W. Lightfoot, "Transport Phenomena: , John Wiley, 1978
2. Brodkey, R. S and Hershey, H. C., "Transport Phenomena", Mc.Graw-Hill
3. Welty, J. R., wicks, C. W. Wilson, R. E. and Rorrer, G., "fundamentals of Momentum Heat & Mass Transfer", John Wiley & sons