ProgrammeOrdinance, POs,PSOs& CourseOutcomes(COs)

DEPARTMENT OF CHEMICAL ENGINEERING
SIR CHHOTU RAM INSTITUTE OF ENGINEERING AND TECHNOLOGY
CHAUDHARY CHARAN SINGH UNIVERSITY MEERUT
(Session 2020-21)

PROGRAMME ORDINANCE

1. ADMISSION

1.1 Admission to B.Tech. First year in 1st semester and lateral admission in B.Tech. Second year in 3rd semester (for diploma holder/B.Sc. candidates only) will be made as per the rules prescribed by the Academic Council of CCSU Meerut.

1.2 Admission on migration of a candidate from any other University to the University is not permitted.

2. ELIGIBILITY FOR ADMISSIONS

2.1 Admission to B. Tech. First Year through Entrance Examination:

(a) Eligibility for admission to under graduate courses in First year shall be as per guidelines of All India Council for Technical Education (AICTE) / Related Council and according to the latest U.P. Government notifications/rules.

2.2 Admission to B.Tech. Second Year through Lateral Entry Scheme:

(a) Candidates who have passed 3/4-year Diploma (with minimum 60% marks) from institutions recognized by the U.P. Board of Technical Education in any branch of Engineering/Technology except Agriculture Engineering are eligible for admission to Second year in any branch of Engineering. /Technology except Agriculture Engineering

(b) Candidates who have passed 3/4-year Diploma (with minimum 60% marks) from institutions recognized by the U.P. Board of Technical Education in Agriculture Engineering are only eligible for admission to Second year of Agriculture Engineering.

2.3 Direct admission on vacant seats at institution/college level: The eligibility criteria for direct admission on seats remaining vacant in first year after entrance examination counseling shall be such as may be notified from time to time.

2.4 The Academic Council shall have power to amend or repeal the eligibility criteria laid down at clause 2.1. & 2.2, as per the guidelines of AICTE.

3. ATTENDANCE

3.1 Every student is required to attend all the lectures, tutorials, practical's and other prescribed curricular and co-curricular activities. The attendance can be condoned up to 25% on medical grounds or for other genuine reasons beyond the control of students.

3.2 A further relaxation of attendance up to 15% for a student can be given by Head of Institution/college provided that he/she has been absent with prior permission of the Head of the institution/college for the reasons acceptable to him.

3.3 No student will be allowed to appear in the end semester examination if he / she do not satisfy the overall average attendance requirements of Clause Nos. 3.1, and 3.2. and such candidate(s) shall be treated as having failed due to detained and will be further governed by clause no. 4.2 & 4.3 and annexure I.

3.4 In each semester, the attendance shall be counted from the date of admission in the college or start of academic session whichever is later.

4. DURATION OF COURSES

4.1 Total duration of the B.Tech. Course shall be 4 years, each year comprising of two semesters. Each semester shall normally have teaching for the 90 working days or as prescribed by A.I.C.T.E. from time to time.

4.2 The student admitted to 1st year B.Tech shall complete the course within a period of seven academic years from the date of first admission, failing which he/she has to discontinue the course. The students admitted under lateral entry scheme (2nd Year B.Tech) shall complete the course within a period of six academic years from the date of first admission, failing which he/she has to discontinue the course.

4.3 A candidate, who has failed twice in first year due to any reason (either due to his/her non-appearance or he/she being not permitted to appear in semester examinations) shall not be allowed to continue his/her studies further. Provided further that if a student wishes to continue third time in first year he/she may be allowed on the terms and conditions laid down by the University for such permission but the maximum time allowed for completing the course will remain the same as in clause 4.2.

4.4 The minimum credit requirement for B.Tech degree is 160 credits.

5. CURRICULUM

5.1 The 4 year curriculum has been divided into 8 semesters and shall include lectures, tutorials, practicals, seminars and projects etc. in addition to industrial training and educational tour etc. as defined in the scheme and executive instructions issued by the University from time to time.

5.2 The curriculum will also include such other curricular, co-curricular and extracurricular activities as may be prescribed by the University from time to time.

6. CHANGE OF BRANCH

6.1 Change of branch may be allowed against the vacant seats in the following two stages, provided criteria at following sub clauses is satisfied:

(a) In first year, after the last date of admission to the B.Tech. Ist semester, on the basis of merit of entrance examination on vacant seat subject to clause 6.2.

(b) In the second year, on the basis of merit at the B.Tech. first year examination for those who are pass without any carry over paper subject to clause 6.2.

6.2 After change of branch, number of students in branch(s) shall neither increase over the intake approved by A.I.C.T.E. nor it will decrease below 75% of intake approved by A.I.C.T.E.

6.3 Change of branch facility is not applicable to following: -

(a) Candidates admitted in B.Tech. Agricultural Engineering/Biotechnology courses.
(b) Candidates admitted in second year of B.Tech. courses as per clauses 2.2

6.4 The change of branch if allowed will become effective from B.Tech. IIIrd semester.

6.5 The Branch change process must be completed by 30th August of each academic session. Further change of branch shall not be permitted.

7. CHANGE OF COLLEGE

7.1 Change of College shall not be permitted.
7.2 Change of study center shall not be permitted.

8. EXAMINATION

8.1 The performance of a student in a semester shall be evaluated through continuous class assessment and end semester examination. The continuous assessment shall be based on class tests, assignments/tutorials, quizzes/viva-voce and attendance. The marks for continuous assessment (Sessional marks) shall be awarded at the end of the semester. The end semester examination shall be comprised of written papers, practicals and viva-voce, inspection of certified course work in classes and laboratories, project work, design reports or by means of any combination of these methods.

8.2 The distribution of marks for sessional, end semester theory papers, practicals and other examinations, seminar, project and industrial training shall be as prescribed. The practicals, viva-voce, projects and reports shall be examined/evaluated through internal and external examiners as and when required.

8.3 The marks obtained in a subject shall consist of marks allotted in end semester theory paper and sessional work.

9. ELIGIBILITY OF PASSING

9.1 A student who obtained Grades A^{+} to E shall be considered as passed. If a student secured "F" grade, he /she has to reappear for the examination. It is mandatory for a student to earn therequired credits as mentioned in each semester.

(a) For a pass in a Theory Subject, a student shall secure minimum of 30% of the maximum marks prescribed by the University in the end semester examination and 40% of aggregate marks in the subject including sessional marks. i.e. Minimum Passing Grade is "E".
(b) For a pass in a Practical/Internship/Project/Viva-voce examination, a student shall secure a minimum of 50% of the maximum marks prescribed by the University in the relevant Practical/Internship/Project/Viva-voce examination and 40% of marks in the aggregate in

the Practical/Internship/Project/Viva-voce including sessional marks. i.e. Minimum Passing Grade in a course is "E".

(c) For a pass in the subject which has only sessional component and No End semester exam component, such as Seminar, a student shall secure a minimum of 40% of the maximum marks prescribed. i.e. Minimum Passing Grade is "E".

(d) For a pass in a subject having Theory and Practical component, a student shall secure minimum of 30% of the maximum marks prescribed by the University in theory examination and 50% of marks in practical examination; in addition the student must secure 40% of marks in the aggregate in the subject including theory, practical, theory sessional and practical sessional marks. i.e. Minimum Passing Grade in a course is "E"..

9.2 The students who do not satisfy the condition 9.1 or the student who remains absent shall be deemed to have failed in that subject and may reappear for the University examination in the subsequent examinations. However, the Sessional marks awarded to the student/s at previous attempt in the concerned subject will be carried forward.

9.3 A student may, at his/her desire, opt to abandon his/her performance of a semester in following manner.

(a) A student may opt to abandon his/her performance only in end semester examination of university for a given semester.
(b) A student may opt to abandon his/her Total Performance of a Semester which includes performance in university end semester examination and sessional marks of all theory and practical subjects.
(c) A student may opt to abandon his/her performance in University Examination of any or both semesters of the same academic year only.
(d) A student shall be allowed to abandon the performance maximum twice during the entire course of study.
(e) Performance of a semester, once abandoned, cannot be claimed again.

9.4 The student, who opts to abandon the performance of a semester as per clause 9.3, shall abandon performance in all the courses of that semester, irrespective of the fact whether the student has passed or failed in any subject of that semester.

9.5 A student, who opts to abandon the total performance of the semester including sessional marks as per 9.3(b) and 9.3(c), has to take readmission for the relevant semester(s). Readmission to the First semester in such cases shall not be considered as fresh admission i.e., the student will continue to have the same University Roll Number, which was allotted earlier.

9.6 The student, who opted to abandon his / her performance only in the university end semesterexamination of a semester and does not desire readmission, shall be permitted to re-appear for examinations of all the subjects of the semester in the subsequent examinations as an Ex-

Student. However, the sessional marks obtained by the student in the abandoned semester shall be retained.

9.7 Such students who opted to abandon the performance at any stage of his/her study and has clearedany paper in more than one attempt are eligible for the award of *DIVISION* at the B.Tech. degree level but are not eligible for the award of RANKS and HONOURS degree.

9.8 The student who passes a course of a semester as per 9.1 shall not be allowed to appear for the same again, unless he/she opts for *abandoning of results* as per 9.3-9.7.

9.9 A student shall be declared to have completed the program of B.Tech. degree, provided the student has undergone the stipulated course work as per the regulations and has earned at least 160 Credits.

10. ELIGIBILITY FOR PROMOTION

10.1 There shall not be any restriction for promotion from an odd semester to the next evensemester.

10.2 For promotion from even semester to the next odd semester (i.e. of the next academicyear) the student has secured either of the semester of an academic year is fully cleared or earned the credit greater than or equal to minimum credit of either of the semester for example.

Example 1

1. **A Student of 1st year earned 10 credits in I semester and 8 credit in II semester. The total credit of I semester is 17.5 and II semestersare 20.5.**

Minimum Credit Threshold for Promotion Check Point	Credit* Threshold
First Year to Second Year	**17.5 credits in** First Year (I&II sem.)

Total credit earned by student is 18(10+8) therefore he / she is eligible for promotion from 1st to 2nd year.

Example 2

A Student of 1st year earned17.5 credit in I semester and 18 credit in II semester. The total credit of I semester is 17.5 and II semester is 20.5.

Minimum Credit Threshold for Promotion Check Point	Credit* Threshold
First Year to Second Year	**17.5 credits in First** Year (I&II sem.)

His / Her I semester is fully cleared therefore he / she is eligible for promotion to 2nd year.

10.3 In yearly result, a student shall be declared PASS only if he/ she secures"E" or above gradesin all the subjects and minimum Semester Grade Point Average (SGPA) of 5.0, in each semester of an academic year.

10.4 Student himself can decide to abandon the performance of any or both the semestersofsame academic year as per clause 9.3 and reappear in abandoned semester examination as per clauses 9.4, 9.5 & 9.6.

11. Carry over System

11.1 Following rules shall be followed for carry over papers:

(a) A candidate who satisfies the requirements of clause 9.1 appear in those theory papers / practical during respective end failed.

(a) and 9.1 (b) will be required to semester exams in which he/she

(b) A candidate satisfying clause 9.3 (a) shall be required to appear in theory papers / practical examination to fulfil the requirements of clause 9.1(a) and 9.1 (b).

(c) A candidate shall be required to exercise his/her choice of minimum theory papers in which he/she desires to appear in the examination for improvement of SGPA to fulfil the requirements of clause 10.3.

(d) Candidate appearing for carry over paper in any semester shall be examined with the examination paper of that subject running in that semester.

11.2 All carryover examinations shall be held only with end semester examination.

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12. **RE-ADMISSION IN THE INSTITUTION/ COLLEGE**

A candidate may be allowed for re-admission provided he/she satisfies one of the following conditions:

(a) A candidate is declared fail.
(b) A candidate did not appear in a semester examination / or he/she was not granted permission to appear in the examination.
(c) A candidate has been detained by the institute and subsequently has been permitted to take re-admission.
(d) A candidate has own desire to abandon the performance of semester(s) as stated in clause 9.3 (b) and 9.3 (c).

13. COURSES

13.1There will be four types of courses.

(i) Foundation Courses: The Foundation Courses are of two kinds: *Compulsory Foundation* and *Elective foundation*.

"Compulsory Foundation": These courses are the courses based upon the content that leads to Knowledge enhancement. They are mandatory for all disciplines.

"Foundation Electives": These are value-based courses aimed at man making education.

(ii) Core Courses: This is the course which is to be compulsorily studied by a student as a core requirement to complete the requirements of a program in a said discipline of study.

(iii) Elective Courses: This is course, which can be chosen from the pool of papers. It may be supportive to the discipline/ providing extended scope/enabling an exposure to some other discipline / domain / nurturing student proficiency skills.

(iv) Mandatory Courses: These courses are mandatory for students joining B.Tech. Program and students have to successfully complete these courses before the completion of degree.

13.2 The minimum number of students to be registered for an Elective to be offered shall be not less than twenty.

13.3 A student shall exercise his option in respect of the electives and register for the same at the beginning of the concerned semester. The student may be permitted to opt for change of elective subject within 15 days from the date of commencement of the semester as per the calendar of the University.

14. COMPUTATION OF SGPA, YGPA AND CGPA

14.1 The Dr. A.P.J.AbdulKalam Technical University (APJAKTU) Lucknow adopts absolutegrading system wherein the marks are converted to grades and every semester results will be declared with semester grade point average (SGPA). Yearly Grade Point Average (YGPA) shall be calculated at each year by calculating from the formula given in section 14.4 (b) of an academic year. The Cumulative Grade Point Average (CGPA) shall be calculated at the end of last semester of the program. The grading system is with the following letter grades and grade points scale as given below:

Level	Outstanding	Excellent	Very Good	Good	Above Average	Average	Poor	Fail
Letter Grade	A+	A	B+	B	C	D	E	F
Grade Points	10	9	8	7	6	5	4	00
Score (Marks) Range (%)	≥ 90 (90-100)	<90 (80-89)	<80, ≥70 (70-79)	<70, ≥60 (60-69)	<60 ,≥50 (50-59)	<50, ≥45 (45-49)	<45, ≥40 (40-44)	< 40 (0-39)

14. 2

(a) A student obtaining Grade 'F' in a subject shall be considered failed in that subject and will be required to reappear in the examination. Such students after passing the failed subject in subsequent examination(s) will be awarded with grade according to marks he/she scores in the subsequent examination(s).

(b) If a student's SGPA in a semester is less than 5 to be declared pass in that semester as laid down by clause 10.3 of the ordinance, he/she shall be allowed to appear in the improvement examination of the theory subjects of that semester. Such student after passing the said subjects in subsequent examination(s) will be awarded with grade according to marks he/she scores in the subsequent examination(s).

14.3

(a) The University has right to scale/moderate the theory exam/practical exam/sessional marks of any subject whenever required for converting of marks in to letter grades on the basis of the result statistics of university as in usual practice.

(b) The modality for moderation of marks before the declaration of result shall be decided by a committee of Pro-Vice Chancellor, Dean UG, Assoc. Dean UG and Controller of Examination.

(c) The modality for moderation of marks if needed after the declaration of result shall be decided by a committee of Pro-Vice Chancellor, Dean UG, Assoc. Dean UG, Controller of Examination and an external member not below the rank of Professor nominated by the Vice Chancellor.

(d) If the candidate(s) appeared in the examination but theory marks are not available due to missing of copy by any reason, the average marks may be awarded as decided by the

committee mentioned in 14.3(a). In case of missing/unavailable of sessional marks, Controller of Examination can take decision as per the provision laid down by the Examination Committee.

(d) The Committee defined in14.3 (a) shall also fix up the responsibility and recommend the punishment for occurrence of such case(s) in14.3(c).

(e) All the matters defined under 14.3(a) to 14.3 (d) shall be executed subject to the approval of Academic Council of the APJAKTU.

14.4 **Computation of SGPA, YGPA and CGPA**

The following procedure to compute the Semester Grade Point Average (SGPA), Yearly Grade Point Average (YGPA) and Cumulative Grade Point Average (CGPA):

(a) The SGPA is the ratio of sum of the product of the number of credits with the grade points scored by student in all the courses taken by a student and the sum of the number of credits of all the courses undergone by a student, i.e SGPA (Si) = Σ (Ci x Gi) / ΣCi where Ci is the number of credits of the ith course and Gi is the grade point scored by the student in the ith course.

(b) The YGPA(Yearly Grade Point Average) is calculated at end of each year as:

$$YGPA= (SGPA_{(odd)} * \sum C_{i(odd)} + SGPA_{(even)} * \sum C_{i(even)} / (\sum C_{i(odd)} + \sum C_{i(even)})$$

(c) The CGPA is also calculated in the same manner taking into account all the courses undergone by a student over all the semesters of a programme, i.e., CGPA = Σ (Ci x Si) / Σ Ci where Si is the SGPA of the ith semester and Ci is the total number of credits in that semester.

(d) The SGPA shall be calculated at end of each semester and YGPA shall be calculated at the end of each academic year. CGPA shall be calculated at the end of last semester of the Program and shall be rounded off to 2 decimal places and reported in the transcripts / grade Sheet.

Illustration for Computation of SGPA, YGPA and CGPA

Computation of SGPA of odd semester Illustration No.1

Course	Credit	Grade letter	Grade point	Credit Point (Credit x Grade)
Course 1	5.5	B^+	8	5.5x8 = 44
Course 2	4	C	6	4x6 = 24
Course 3	5	B	7	5x7 = 35
Course 4	3	A^+	10	3x10= 30
Total	17.5			**133**

Thus, SGPA= 133/17.5 =7.6

Computation of SGPA of even semester Illustration No.2

Course	Credit	Grade letter	Grade point	Credit Point (Credit x Grade)
Course 1	5.5	B^+	8	5.5x8 = 44
Course 2	4	C	6	4x6 = 24
Course 3	5	B	7	5x7 = 35
Course 4	3	A^+	10	3x10= 30
Course 5	3	F	0	3x0= 00
Total	20.5			**133**

Thus, SGPA= 133/20.5 =6.48

$$YGPA= (SGPA_{(odd)} * \sum C_{i(odd)} + SGPA_{(even)} * \sum C_{i(even)} / (\sum C_{i(odd)} + \sum C_{i(even)})$$

Thus, YGPA = 7.6 * 17.5+6.48 *20.5 / (17.5 +20.5) = 6.99

Illustration No.2a

Course	Credit	Grade letter	Grade point	Credit Point (Credit x Grade)
Course 5	3.0	E	4	3.0 x 4 = 12

C_i (First Attempt) + C_i (Subsiquent Attempt) = 133 + 12 = 145

Thus SGPA= 145/20.5 = 7.07

CGPA after Final Semester

Semester	I	II	III	IV	V	VI	VII	VIII
Credit	17.5	20.5	21.0	21.0	21.0	21.0	20	18.0
SGPA	7	8.5	9.2	6.86	8.18	7.73	8.68	9.4

Thus, CGPA= (17.5*x*7 + 20.5*x*8.5 + 21*x*9.2 + 21*x*6.86 + 21*x*8.18 + 21*x*7.73 + 20*x*8.68 + 18*x*9.4)/160 =8.66

14.5 Grade sheet: Based on the above recommendations on Letter grades, grade points, SGPA of each semester and YGPA of an academic year, a consolidated grade sheet indicating performance in a particular academic year.

14.6 CGPA (calculated at the end of the last semester of the program) shall be issued.

15. **CONVERSION OF CGPA INTO PERCENTAGE**

Conversion formula for the conversion of CGPA into Percentage is (CGPA-0.75) x 10 = Percentage of marks scored.

Illustration: (8.66-0.75) x 10 =79.1%

16. **AWARD OF DIVISION, RANK AND MEDALS**

16.1 Division and CGPA shall be awarded only afterthe eighth and final semester examination based on integrated performance of the candidate for all the eight semesters (six semesters for lateral entry) as per following details.

(a) After successful completion of 160 credits, a student shall be eligible to get under graduate degree in engineering/technology. A student will be eligible to get undergraduate degree with honours only, if he/ she voluntary completes additional University recommended courses only (equivalent to 20 credits offered by NPTEL of 4 weeks, 8 weeks and 12 weeks shall be of 2, 3 and 4 credits respectively) through MOOCs. For registration to MOOCs courses, the students shall follow NPTEL site http://nptel.ac.in/as per the NPTEL policy and norms. These students can register for their courses through NPTEL directly as per the course offering in odd/even semesters at NPTEL. The registration fees will be borned by the student. These NPTEL courses (recommended by the university) may be cleared during the B.Tech degree program (not necessary one course in each semester). After successful completion of these MOOCs courses the students, shall, provide their successful completion NPTEL status/ certificates to the university (COE) through their college of study only. The student shall

be awarded **First division with Honours** Degree only if he/she secures 7.50 or above CGPA and passed each subject of that degree program in single attempt without any grace marks, without any gap along with successful completion of MOOCS based course of 20 credits.

(b) The student shall be awarded **First division with Distinction** Degree only if he/she secures 7.50 or above CGPA and passed each subject of that degree program in single attempt without any grace marks and without any gap.

(c) A candidate who qualifies for the award of the degree by securing E or above grades in all subjects of all the semesters (eight semesters/six semesters) as applicable, and secures CGPA less than 7.5 and greater than or equal to 6.5 shall be declared to have passed the examination in FIRST DIVISION.

(d) All other candidates who qualify for the award of degree by securing E or above grades in all subjects of all semesters (eight semesters/six semesters as applicable) and secures CGPA below6.5 and greater than or equal to 5.0 shall be declared to have passed the examination in
SECOND DIVISION.

16.2 For award of ranks in a branch, a minimum of 10 students should have appeared in the 8th semester examination. The total number of ranks awarded shall be 10% of total number of students appeared in 8th semester or 10 students, whichever is less in that branch.

Illustration:

1. If 1028 students appeared for the 8th semester in Electronics and Communication Engineering Branch, the number of ranks to be awarded for Electronics and Communication Engineering will

10.

2. If 90 students appeared for the 8th semester in Biomedical Engineering Branch, the number of ranks to be awarded for Biomedical Engineering will be 09.

For award of rank in a branch of Engineering / Technology, the CGPA secured by the student from

(a) 1st to 8th semester for the students admitted to B.E./B.Tech. Program from 1st year, and

(b) 3rd to 8th semester for the students admitted to B.E./B.Tech. Program from 2nd year (Lateral Entry)

shall be considered.

A student shall be eligible for a rank at the time of award of degree in each branch of Engineering / Technology, provided the student

(a) Has passed 1st to 8th (students joining from 1st semester) or 3rd to 8th (in case of lateral entry) semester in all the subjects in first attempt only

(b) Has not repeated/rejected any of the lower semesters.

If two students get the same *CGPA*, the tie should be resolved by considering the number of times a student has obtained higher *SGPA;* but, if it is not resolved even at this stage, the number of times a student has obtained higher grades like A^+, A, B^+, B etc shall be taken into account in rank ordering of the students in a program.

16.3 The Gold, Silver and any other Medals as decided by the university shall be awarded to students falls in the top ranks of various courses as per university rules.

17. SCRUTINY AND RE-EVALUATION

17.1 Scrutiny and re-evaluation shall be allowed in only theory papers.

17.2 Revaluation of theory/practical papers is permitted only with certain conditions as laid down by university.

18. UNFAIR MEANS

Cases of unfair means shall be dealt as per the rules and regulations of the University (**ANNEXURE-II**).

19. AWARD OF SESSIONAL MARKS

Sessional marks for theory subjects, practicals and project shall be awarded as prescribed and at present the break-up of sessional marks shall be as follows:

(a) Theory Subjects:

(i) Class test which will comprise 30 % of total theory marks with two mid-term tests of equal weightage.

(ii) Teacher Assessment Tutorial/Assignment/ Quizzes/ Attendance comprises 20% of total theory marks.

(b) Practicals,

(i) Two mid-term viva-voce/tests of equal weightage 30% of total Practical marks.

(ii) Teacher Assessment: Lab, Record/ Attendance 20% of total Practical marks.

(c) Make-up test may be held only for those students who could not appear in any one of mid-term class tests due to genuine reasons for which the prior permission from the Head of Institution/College was taken. Make up test shall ordinarily be held about two weeks before the semester examination. The syllabus for the make-up test shall be the whole syllabus covered by the subject teacher upto that time.

20. AWARD OF SEMINAR INDUSTRIAL TRAINING, EDUCATIONAL TOUR MARKS AT INSTITUTION/COLLEGE LEVEL

20.1 The marks of Seminar, Industrial Training, Educational tour marks shall be awarded on the following basis:

(i) Write-up / Report 50%

(ii) Presentation 50%

20.2 The marks in Seminar, Industrial Training and Educational Tour shall be awarded by a committee consisting of following members:

(i) Head of the Department or his/her nominee.

(ii) Concerned Officer – Incharge.

(iii) Senior Faculty Member of the department nominated by the Head of Department.

21. CANCELLATION OF ADMISSION

The admission of a student at any stage of study shall be cancelled if :

(a) He / She is not found qualified as per AICTE / State Government norms and guidelines or the eligibility criteria prescribed by the University. or

(b) He / She is found unable to complete the course within the stipulated time as prescribed in clause 4.2 or

(c) He / She is found involved in creating indiscipline in the Institution / College or in the University.

(a) The Academic Council shall have the power to relax any provision provided in the ordinance in any specific matter/situation subject to the approval of Executive Council of the University.

PROGRAMME OUTCOMES (POs)

Chemical Engineering graduates will be able to:

PO1: Engineering knowledge

Graduates will be able to apply mathematical, scientific, and engineering knowledge to solve domain-specific engineering problems.

PO2: Problem analysis

Graduates will have the ability to design and conduct experiments, also have the ability to analyze and interpret experimental results

PO3: Design/development of solutions

Graduates will have the ability to design systems, processes to meet specified objectives within realistic constraints such as economic, environmental, social, ethical, health, safety and sustainability

PO4: Conduct investigations of complex problems

Graduates will have the ability to conduct investigations to solve the complex problem based on the realistic situation

PO5: Modern tool usage

Graduates will have the ability to explore and apply the techniques, skills and modern engineering tools necessary to solve Chemical Engineering problems

PO6: The engineer and society

Graduates will have the knowledge about Engineer's responsibility for the up-liftment of the society

PO7: Environment and sustainability

Graduates will have an idea about the impact of process on the environment and resource management

PO8: Ethics

Graduates will have the knowledge of professional and ethical responsibilities

PO9: Individual and team work

Function effectively as an individual and as a member or leader in diverse teams and in multidisciplinary settings

PO10: Communication

Graduates will have the communication skills in English language in verbal and written and also graphical form to convey their innovative ideas in an effective way at various forums

PO11: Project management and finance Demonstrate

knowledge and understanding of the principles of engineering and management and apply these principles to their own work, as a member and leader of a team, to manage projects in a multidisciplinary environment.

PO12: Life-long learning

Recognize the need to prepare for and have the ability to engage in independent and lifelong learning in the broadest sense of technological change

PROGRAMME SPECIFIC OUTCOMES (PSOs)

PSO1: Apply the principles and practices of Chemical Engineering discipline along with the basic sciences and humanities to solve the complex engineering problems concerning the issues of environment, safety, economics, culture and society etc.

POS2: Will be to able to develop mathematical models of real world industrial problems and compute solutions to dynamic processes.

PSO3: Acquire and apply the new knowledge with professional responsibility and ethics towards the advancement of academic and research pursuits in chemical and allied disciplines in the societal contexts

PSO4: Design, develop and modify the chemical processes and to analyze these by applying the different techniques.

PSO5: Able to expose their skills using latest tools to arrive cost effective and appropriate solutions.

Course Structure and Evaluation Scheme for B.Tech (Chemical Engineering)

SEMESTER-I

S. No.	Course Code	CourseTitle	Periods			EvaluationScheme				End Semester		Total	Credits
			L	T	P	CT	TA	Total	PS	TE	PE		
1	BT-104/103	EngineeringPhysics/ EngineeringChemistry	3	1	0	30	20	50		100		150	4
2	BT-105	EngineeringMathematics-I	3	1	0	30	20	50		100		150	4
3	BT-101/107	Basic Electrical Engineering/Emerging DomaininElectronicsEngineering	3	0	0	30	20	50		100		150	3
4	BT-102/106	ProgrammingforProblemSolving/Fundamentals of MechanicalEngineering&Mechatronics	3	0	0	30	20	50		100		150	3
5	BT-154/153	Engineering Physics Lab/EngineeringChemistryLab	0	0	2				25		25	50	1
6	BT-151/157	Basic Electrical EngineeringLab/ElectronicsEngineeringLab	0	0	2				25		25	50	1
7	BT-152/158	ProgrammingforProblemSolving/ EnglishLanguageLab	0	1	2				25		25	50	1
8	BT-155/156	EngineeringGraphics&DesignLab/ MechanicalWorkshopLab	0	1	2				50		50	100	1
9	BT-108/109	AI For Engineering/EmergingTechnologyforEngineering	2	0	0	15	10	25		25		50	2
10	**BT-110**	**SoftSkillI**	2	0	0	15	10	25		25			NC
11	MOOCs	(ForB.Tech.Hons.Degree)*											
		Total										900	20

SEMESTER-II

S. No.	Course Code	Course Title	Periods			Evaluation Scheme				End Semester		Total	Credits
			L	T	P	CT	TA	Total	PS	TE	PE		
1	BT-204/ BT-203	Engineering Physics/ Engineering Chemistry	3	1	0	30	20	50		100		150	4
2	BT-205	Engineering Mathematics-II	3	1	0	30	20	50		100		150	4
3	BT-201/ BT-207	Basic Electrical Engineering/ Emerging Domain in Electronics Engineering	3	0	0	30	20	50		100		150	3
4	BT-202/ BT-206	Programming for Problem Solving / Fundamentals of Mechanical Engineering & Mechatronics	3	0	0	30	20	50		100		150	3
5	BT-254/ BT-253	Engineering Physics Lab/ Engineering Chemistry Lab	0	0	2				25		25	50	1
6	BT-251/ BT-257	Basic Electrical Engineering Lab/ Electronics Engineering Lab	0	0	2				25		25	50	1
7	BT-252/ BT-258	Programming for Problem Solving / English Language Lab	0	1	2				25		25	50	1
8	BT-255/ BT-256	Engineering Graphics & Design Lab/ Mechanical Workshop Lab	0	1	2				50		50	100	1
9	BT-209/ BT-208	AI For Engineering/ Emerging Technology for Engineering	2	0	0	15	10	25		25		50	2
10	**BT-210**	**Soft Skill II**	2	0	0	15	10	25		25			NC
	MOOCs	(For B.Tech. Hons. Degree)*											
		Total										900	20

Mini Project or Internship (3-4 weeks) shall be conducted during summer break after IIsemester and will be assessed during III semester

SEMESTERIII

Sl. No.	Subject Name	Subject Code	Periods			Evaluation Scheme				End Semester		Total	Credit
			L	T	P	CT	TA	Total	PS	TE	PE		
1.	Material and Energy Balance	BT – 315	3	1	0	30	20	50	-	100	-	150	4
2.	Chemical Engineering Fluid Mechanics	BT – 316	3	1	0	30	20	50	-	100	-	150	4
3.	Heat Transfer Operations	BT – 317	3	0	0	30	20	50	-	100	-	150	3
4.	Computer System Security/ Python Programming	BT – 309 / BT – 310	2	0	0	15	10	25	-	50	-	-	0
5.	Engineering Science Course/ Mathematics – IV	BT - 322 / BT – 305	3	1	0	30	20	50	-	100	-	150	4
6.	Universal Human Values / Technical Communication	BT – 314 / BT – 304	3 2	0 1	0 0	30	20	50	-	100	-	150	3
7.	Chemical Engineering Fluid Mechanics Lab	BT – 366	0	0	2	-	-	-	25	-	25	50	1
8.	Heat Transfer Operations Lab	BT – 367	0	0	2	-	-	-	25	-	25	50	1
9.	Soft Computing Lab	BT – 368	0	0	2	-	-	-	25	-	25	50	1
10.	Mini Project or Internship Assessment*	BT – 369	0	0	2	-	-	50	-	-	-	50	1
11.	MOOCs (Essential for Hons. Degree												
	Total											**950**	**22**

* The Mini Project or internship (3-4 weeks) conducted during summer break after II Semester and will be assessed during III Semester.

SEMESTER-IV

Sl. No.	Subject Name	Subject Code	Periods			Evaluation Scheme				End Semester		Total	Credit
			L	T	P	CT	TA	Total	PS	TE	PE		
1.	Chemical Reaction Engineering – I	BT – 415	3	1	0	30	20	50	-	100	-	150	4
2.	Chemical Engineering Thermodynamics	BT – 416	3	1	0	30	20	50	-	100	-	150	4
3.	Mechanical Operations	BT – 417	3	0	0	30	20	50	-	100	-	150	3
4.	Computer System Security/ Python Programming	BT – 409 / BT – 410	2	0	0	15	10	25	-	50	-	-	0
5.	Mathematics – IV	BT – 405	3	1	0	30	20	50	-	100	-	150	4
6.	Universal Human Values / Technical Communication	BT – 414 / BT – 404	3 2	0 1	0 0	30	20	50	-	100	-	150	3
7.	Chemical Reaction Engineering Lab	BT – 465	0	0	2	-	-	-	25	-	25	50	1
8.	Mechanical Operations Lab	BT – 467	0	0	2	-	-	-	25	-	25	50	1
9.	Numerical Methods of Analysis Lab	BT – 466	0	0	2	-	-	-	25	-	25	50	1
10.	MOOCs (Essential for Hons. Degree												
	Total											**900**	**21**

SEMESTER–V

Sl.No.	Subject Codes	Subject	Periods			Evaluation Scheme				End Semester		Total	Credit
			L	T	P	CT	TA	Total	PS	TE	PE		
1	BT-523	Process Dynamics andControl	3	1	0	30	20	50		100		150	4
2	BT-524	MassTransfer-I	3	1	0	30	20	50		100		150	4
3	BT-525	Chemical ReactionEngineering–II	3	1	0	30	20	50		100		150	4
4	BT-526	OptimizationTechniques	3	0	0	30	20	50		100		150	3
5	BT-527	IntellectualPropertyRights&Standardization	3	0	0	30	20	50		100		150	3
6	BT-573	Process Modelling andSimulationLab	0	0	2				25		25	50	1
7	BT-574	MassTransfer-ILab	0	0	2				25		25	50	1
8	BT-576	PDCLab	0	0	2				25		25	50	1
9	BT-575	Mini Project or InternshipAssessment*	0	0	2				50			50	1
10	BT-510	Constitution of India	2	0	0	15	10	25		50			
11		MOOCs (Essential forHons.Degree)											
		Total	**17**	**3**	**8**							**950**	**22**

*TheMiniProjectorinternship(4weeks)conductedduringsummerbreakafterIVsemesterandwillbeassessedduringVsemester.

SEMESTER–VI

Sl. No.	Subject Codes	Subject	Periods			Evaluation Scheme				End Semester		Total	Credit
			L	T	P	CT	TA	Total	PS	TE	PE		
1	BT-625	MassTransfer-II	3	1	0	30	20	50		100		150	4
2	BT-627	TransportPhenomenon	3	1	0	30	20	50		100		150	4
3	BT-626	ChemicalTechnology	3	1	0	30	20	50		100		150	4
4	BT-628	SustainabilityofEnvironment	3	0	0	30	20	50		100		150	3
5	BT-624	Understanding the human being comprehensively	3	0	0	30	20	50		100		150	3
6	BT-676	ChemicalTechnologyLab	0	0	2				25		25	50	1
7	BT-675	MassTransfer-IILab	0	0	2				25		25	50	1
8	BT-677	TechnicalPresentation	0	0	2				25		25	50	1
9	BT-609	Essence of IndianTraditionalKnowledge	2	0	0	15	10	25		50			
10		MOOCs(Essential for Hons.Degree)											
		Total	0	3	6							900	21

SEMESTER–VII

Sl No.	Subject Code	Subject Name	L-T-P	Th/Lab Marks	Sessional		Total	Credit
					Test	Assig/ Att.		
1	BT – 701	Human Value	3---0---0	70	20	10	100	3
2	BT – 726	IPA & Waste Management	3---0---0	70	20	10	100	3
3	BT – 727	Energy Engg. & Management	3---1---0	70	20	10	100	4
4	BT – 728	Process Modeling & Simulation	3---0---0	70	20	10	100	3
5	BT – 729	Process Design & Economics	3---1---0	70	20	10	100	4
6	BT – 776	CAD Lab	0---0---2	50		50	100	1
7	BT – 777	Energy Lab	0---0---2	50		50	100	1
8	BT – 778	Industrial Training	0---0---3			100	100	2
9	BT – 779	PROJECT-1	0---0---6			200	100	3
	TOTAL						**1000**	**24**

SEMESTER–VIII

Sl No.	Subject Code	Subject Name	L-T-P	Th/Lab Marks	Sessional		Total	Credit
					Test	Assig/ Att.		
1	BT - 806	Renewable Energy Resources	3---0---0	70	20	10	100	3
2	BT - 826	Fertilizer Technology	3---1---0	70	20	10	100	4
3	BT - 827	Petrochemical Technology	3---0---0	70	20	10	100	3
4	BT - 876	Seminar	0---0---3			100	100	2
5	BT - 877	Project-2	0---12---0	350		250	600	12
	TOTAL						**1000**	**24**

BT-315
Material and Energy Balance

L T P
3 1 0

Course Outcomes:

After completion this course students will be able to understand :-

- CO1.Ability to make material balances on unit operations and processes
- CO2.Ability to perform simultaneous material and energy balances
- CO3.Understanding of the degrees of freedom analysis and its significance
- CO4.Understanding of the concept of humidity and usage of psychrometric chart

Syllabus

Unit-1

Introduction: Units and dimension in chemical engineering, units conversion of dimensional equations, stoichiometric and composition relations, concept of degrees of freedom and linear independence of a set of equations.Material Balance: Concept of material balance, open and closed systems, steady state and unsteady state, multiple component system, selection of a basis, problem solving strategy.

Unit-2

Material Balance without Chemical Reaction for Single and Multiple Units: Conservation of mass/atom, material balance for Systems without chemical reactions involving single unit and multiple units. Material Balance with Chemical Reaction for Single and Multiple Units: Concept of excess reactant, extent of reaction, Material balance for systems with chemical reactions involving single unit and multiple units.

Unit-3

Recycle, Bypass, Purge and Industrial Applications: Calculations for a cyclic processes involving recycle/ purge/ bypass, material balances involving gases, vapors, liquids and solids and use of real gas relationships, material balance involving gases, vapors, liquids & solids and uses of real gas relationships, vapor-liquid equilibrium and concepts of humidity & saturation, analysis of systems with bypass, recycle and purge, analysis of processes involving condensation, crystallization and vaporization.

Unit-4

Energy Balance: Conservation of energy with reference to general energy balance with and without chemical reactions, chemical engineering problems involving reversible processes and mechanical energy balance. Applications of Energy Balance: Calculations of heat of change of phase (solid – liquid &liqid – vapor), heat of reaction, heat of combustion, heat of solutions and mixing, determination of temperatures for adiabatic and nonadiabatic reactions, use of psychometric and enthalpy concentration diagrams.

Unit-5

Simultaneous Material and Energy Balances: Degrees of freedom analysis for multicomponent systems, combined steady state material and energy balances for units with multiple sub-systems.

Unsteady State Material and Energy Balances:Transient materials and energy balances involving with and without chemical reactions.

Text Book:

1 Himmelblau P.M. and Rigggif, B. " Principles, and Salculations in Chemical Engineering Ed., Prentice Hall o India.
2 Felder R.M. and Rousseau R. W., "Elementary Principles of Chemical Processes' Ed. John Wiley.
3 Bhatt B.L and Vora S.M. "Stoichiometrv" S"Ed. Tata McGraw-Hill
4.Narayanan K. V. and Lakshmikutty B."Stoichiometry and Process Calculations". Prentice Hall of India.
5.Hougen D.A. Process Principles" Watson K. M.and RagaysR. A. bisfibe" Chemical Part-I.

BT-316
Chemical Engineering Fluid Mechanics

Course Outcome:

After completion of this course, the students will be able to

- CO1.Understand the properties and flow of fluid.
- CO2.Analyses the model and prototype.
- CO3.Explain the factors influencing velocity profiles for laminar and turbulent flow.
- CO4.Design the pumps and compressors for optimum operation.

Syllabus

Unit-1

Introduction: Fundamental concepts of fluids; Fluid statics, kinematics and dynamics; Properties of fluids, Fluid Statics: The basic equation of fluid statics; Pressure – depth relationship; Pressure forces on plane and curved surfaces; Buoyancy and stability; Forces on immersed and submerged bodies; Pressure measurements; Pressure in accelerated rigid body motions.

Unit-2

Elementary Fluid Kinematics: Lagrangian and Eulerian descriptions; Flow visualization – streamline, pathline, streakline and timeline, profile plots; Description and classification of fluid motions; Rotational, irrotational, inviscid and potential flows; Deformation of fluids; System and control volume representation; Reynolds transport theorem.

Unit-3

Dynamic Analysis of Flow: Conservation of mass, linear and angular momentum, and energy; Eulers equation of motion, Bernoulli theorem; Navier-Stokes equations. Dimensional Analysis, Similitude and Modeling: Dimensional homogeneity and analysis; Methods of finding dimensionless numbers; Selection of variables, Rayleigh and Buckingham's π method; Common dimensionless numbers and their physical significance; Model and Prototypes; Complete and incomplete similarity.

Unit -4

Internal Incompressible Viscous Flow: General characteristics of pipe flow – laminar, turbulent, entrance region, fully developed; Fully developed laminar/turbulent flow in pipe – shear stress distribution and velocity profiles; Energy correction factors; Energy and hydraulic grade lines; Major and minor losses in pipes, fittings, pipe network; Friction factor. Flow Measurements: Flow rate and velocity measurements – Pitot tube, orifice meter, venturimeter, rotameter, notches and weirs.

Unit-5

Fluid Handling Machinery: Classification; Positivedisplacement pumps and compressors, centrifugal pumps and compressors, Axial flow pumps and compressors, compressor efficiency. Characteristics of centrifugal pumps; NPSH; Selection of pumps. Agitation and Mixing: Agitated vessels; Blending and mixing; Suspension of solid particles; Dispersion operations; Agitator selection and scale up.

REFERENCE BOOKS:

1	Never N.D. "Fluid Mechanics For Chemical Engineers", 3" Ed. McGraw Hill Higher Education.	2005
2	Cengel Y.A. AND Climba J.M. Fluid meachincs Fundamental and Applications , 2 Ed. McGraw hill	2010
3	Balachandran P. Engineering Fluid Mechanics; PHI Learning Pvt Ltd. Nnnnew Delhi	2012
4	Munson B.R., Young D.F, Oklishi T.H and Huebsch W.W "Fundamentals of Fluid Mechanics" Ed.. Willey	2010
5	White FM. "Fluid Mechanies", 7' Ed. Tata McGraw-Hill Rajput, R. K., "Textbook of Fluid Mechanics", S. Chand and Co. New Del	1998

BT-317
Heat Transfer Operation

Course Outcome:

After completion of this course, student will be able to:

- CO1.Ability to understand and solve conduction, convection and radiation problems
- CO2.Ability to design and analyze the performance of heat exchangers and evaporators
- CO3.Ability to design and analyze reactor heating and cooling systems.
- CO4.Students will able to correlate the all possible mode of heat transfer and application the same on industrial scales.

Syllabus

Unit-1

Introduction: Importance of heat transfer in Chemical Engineering operations - Modes of heat transfer.

Conduction: Fourier's law of heat conduction; One dimensional steady state heat conduction equation for flat plate; Hollow cylinder - Heat conduction through a series of resistances; Thermal conductivity measurement; Effect of temperature on thermal conductivity; Heat transfer in extended surfaces; Numerical Methods for solving conduction heat transfer problem (Explicit and Implicit methods); Stability criteria.

Unit-2

Convection: Concepts of heat transfer by convection; Natural and forced convection; Analogies between transfer of momentum and heat; Reynold's analogy; Prandtl and Coulburn analogy. Dimensional analysis; Correlations for the calculation of heat transfer coefficients; Heat transfer coefficient for flow through a pipe; Flow through non circular conduit; Flow past flat plate; Extended surface. Lumped system analysis; Heat transfer augmentations.

Unit-3

Radiation: Heat transfer by radiation; Emissive power; Black body radiation; Emissivity, Kirchhoff's law; Stefan - Boltzmann law; Plank's law; Radiation between surfaces.

Evaporator: Classification and use of evaporators in process industries, effect of boiling point rise on evaporator performance, Single effect and multiple effect evaporation - Design calculation for single and multiple effect evaporation.

Unit-4

Boiling: Characteristics, nucleate pool- and forced convection- boiling, boiling mechanism and curve, heat transfer correlations, heat pipes.

Condensation: Mechanism and types of condensation of vapor; Drop wise and film wise condensation; Nusselt equation for vertical and horizontal tubes; Condensation of superheated vapours; Effect of non-condensable gasses on rate of condensation.

Unit-5

Heat Exchangers: Parallel and counter flow heat exchangers; Log mean temperature difference; Single passand multi pass heat exchangers; Double pipe; Shell and tube; Plate and frame heat exchangers; use of correction factor charts; Heatexchangers effectiveness; Number of transfer unit; Chart for different configurations;Fouling factors; Design of heat exchangers; Selection criteria and application of Heat exchanger; Introduction to TEMA type heat transfer and applications.

REFERENCE BOOKS:

1. Holman, J. P., Heat Transfer, 10th Edition., Tata McGraw-Hill Education Private ltd. 2011
2. Kern, D.Q., Process Heat Transfer, 1st Edition, Tata McGrawHill Education Private ltd. 2001
3. Cengel Y.A. and Ghajar A.J., "Heat and Mass Transfer: Fundamentals and Applications", 4th Ed., McGraw Hill 2010
4. McCabe, W.L, Smith J.C, and Harriot, P, Unit Operations in Chemical Engineering, 7th Edition, McGraw-Hill, Inc. 2004
5. Coulson, J.M. and Richardson, J.F, Chemical Engineering, Vol. I, 6th Edition, Elsevier India. 1999

BT-322

Energy Science and Engineering

Course Outcome:

After students will be able studying this subject to:

- CO1.Have basic understanding of the energy sources and scientific concepts/principles behind them CO2.Understand effect of using these sources on the environment and climate
- CO3.Describe the challenges and problems associated with the use of various energy sources, including fossil fuels, with regard to future supply and the impact on the environment.
- CO4.List and describe the primary renewable energy resources and technologies.
- CO5.To quantify energy demands and make comparisons among energy uses, resources, and technologies.
- CO6. Collect and organize information on renewable energy technologies as a basis for further analysis and evaluation.
- CO7. Understand the Engineering involved in projects utilizing these sources

Syllabus

Unit-I

Energy and its Usage: Units and scales of energy use, Mechanical energy and transport, Heat energy: Conversion between heat and mechanical energy, Electromagnetic energy: Storage, conversion, transmission and radiation, Introduction to the quantum, energy quantization, Energy in chemical systems and processes, flow of CO2, Entropy and temperature, carnot and Stirling heat engines, Phase change energy conversion, refrigeration and heat pumps, Internal combustion engines, Steam and gas power cycles, the physics of power plants. Solid-state phenomena including photo, thermal and electrical aspects

Unit-II

Nuclear Energy: Fundamental forces in the universe, Quantum mechanics relevant for nuclear physics, Nuclear forces, energy scales and structure, Nuclear binding energy systematics, reactions and decays, Nuclear fusion, Nuclear fission and fission reactor physics, Nuclear fission reactor design, safety, operation and fuel cycles

Unit-III

Solar Energy: Introduction to solar energy, fundamentals of solar radiation and its measurement aspects, Basic physics of semiconductors, Carrier transport, generation and recombination in semiconductors, Semiconductor junctions: metal-semiconductor junction & p-n junction, Essential characteristics of solar photovoltaic devices, First Generation Solar Cells, Second Generation Solar Cells, Third Generation Solar Cells

Unit-IV

Conventional & non-conventional energy source: Biological energy sources and fossil fuels, Fluid dynamics and power in the wind, available resources, fluids, viscosity, types of fluid flow, lift, Wind turbine dynamics and design, wind farms, Geothermal power and ocean thermal energy conversion, Tidal/wave/hydro power

Unit-V

Systems and Synthesis: Overview of World Energy Scenario, Nuclear radiation, fuel cycles, waste and proliferation, Climate change, Energy storage, Energy conservation. Engineering for Energy conservation: Concept of Green Building and Green Architecture; Green building concepts, LEED ratings; Identification of energy related enterprises that represent the breath of the industry and prioritizing these as candidates;
Embodied energy analysis and use as a tool for measuring sustainability. Energy Audit of Facilities and optimization of energy consumption

Reference/Text Books

1. Energy and the Challenge of Sustainability, World Energy Assessment, UNDP, New York, (2000).
2. Perspective of Modern Physics, A. Beiser, McGraw-Hill International Editions (1968).
3. Introduction to Modern Physics, H.S. Mani and G.K.Mehta, East-West Press (1988). 4. Introduction to Electrodynamics, D. J. Griffiths, Fourth Edition, Prentice Hall (2013). 5. Introductory Nuclear Physics, R. K. Puri and V.K. Babbar, Narosa Publishing House (1996).
6. Physics of Solar Cells: From Basic Principles to Advanced Concepts by Peter Wurfel, John Wiley & Sons, 2016
7. Principles of Solar Engineering, D.Y. Goswami, F.Kreith and J.F. Kreider, Taylor and Francis, Philadelphia, 2000

BT-314
Universal Human Value

Course Outcome:

- CO1: Understand and analyse the essentials of human values and skills, self exploration, happiness and prosperity.
- CO2: Evaluate coexistence of the "I" with the body.
- CO3: Identify and evaluate the role of harmony in family, society and universal order.
- CO4: Understand and associate the holistic perception of harmony at all levels of existence.
- CO5: Develop appropriate technologies and management patterns to create harmony in professional and personal lives.

Syllabus

Unit-1

Course Introduction - Need, Basic Guidelines, Content and Process for Value Education Understanding the need, basic guidelines, content and process for Value Education, Self-Exploration–what is it? - its content and process; 'Natural Acceptance' and Experiential Validation- as the mechanism for self exploration, Continuous Happiness and Prosperity- A look at basic Human Aspirations, Right understanding, Relationship and Physical Facilities- the basic requirements for fulfillment of aspirations of every human being with their correct priority, Understanding Happiness and Prosperity correctly- A critical appraisal of the current scenario, Method to fulfill the above human aspirations: understanding and living in harmony at various levels.

Unit-2

Understanding Harmony in the Human Being - Harmony in Myself Understanding human being as a co-existence of the sentient 'I' and the material 'Body', Understanding the needs of Self ('I') and 'Body' - Sukh and Suvidha, Understanding the Body as an instrument of 'I' (I being the doer, seer and enjoyer), Understanding the characteristics and activities of 'I' and harmony in 'I', Understanding the harmony of I with the Body: Sanyam and Swasthya; correct appraisal of Physical needs, meaning of Prosperity in detail, Programs to ensure Sanyam and Swasthya

Unit-3

Understanding Harmony in the Family and Society- Harmony in Human-Human Relationship Understanding harmony in the Family- the basic unit of human interaction , Understanding values in human-human relationship; meaning of Nyaya and program for its fulfillment to ensure Ubhay-tripti; Trust (Vishwas) and Respect (Samman) as the foundational values of relationship, Understanding the meaning of Vishwas; Difference between intention and competence, Understanding the meaning of Samman, Difference between respect and differentiation; the other salient values in relationship, Understanding the harmony in the society (society being an extension of family): Samadhan, Samridhi, Abhay, Sah-astitva as comprehensive Human Goals, Visualizing a universal harmonious order in societyUndivided Society (AkhandSamaj), Universal Order (SarvabhaumVyawastha)- from family to world family!.

Unit-4

Understanding Harmony in the Nature and Existence - Whole existence as Co-existence Understanding the harmony in the Nature, Interconnectedness and mutual fulfillment among the four orders of nature-recyclability and self-regulation in nature, Understanding Existence as Co-existence (Sah-astitva) of mutually interacting units in all-pervasive space, Holistic perception of harmony at all levels of existence.

Unit-5

Implications of the above Holistic Understanding of Harmony on Professional Ethics Natural acceptance of human values, Definitiveness of Ethical Human Conduct, Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order, Competence in Professional Ethics: a) Ability to utilize the professional competence for augmenting universal human order, b) Ability to identify the scope and characteristics of people-friendly and eco-friendly production systems, technologies and management models, Case studies of typical holistic technologies, management models and production systems,

Strategy for transition from the present state to Universal Human Order: a) At the level of individual: as socially and ecologically responsible engineers, technologists and managers, b) At the level of society: as mutually enriching institutions and organizations.

Reference/Text Books

Text Books: 1. R R Gaur, R Sangal, G P Bagaria, 2009, A Foundation Course in Human Values and Professional Ethics

References: 1. Ivan Illich, 1974, Energy & Equity, The Trinity Press, Worcester, and Harper Collins, USA
2. E.F. Schumacher, 1973, Small is Beautiful: a study of economics as if people mattered, Blond & Briggs, Britain.
3. Sussan George, 1976, How the Other Half Dies, Penguin Press. Reprinted 1986, 1991

BT-416
Chemical Engineering Thermodynamics

Course Outcome:

After completion of this course, student will be able to:

- CO1.Ability to apply fundamental concepts of thermodynamics to engineering applications .
- CO2.Ability to estimate thermodynamic properties of substances in gas and liquid states.
- CO3.Capability to determine thermodynamic efficiency of various energy related processes.

Syllabus

Unit-1

Thermodynamic Laws and Property Relations: Laws of thermodynamics and their applications; PVT behaviour of pure substances; PVT behaviour of mixtures; Generalized equations of state;Joule's experiment; Carnot cycle and Carnot theorems; Thermodynamic property relations; Maxwell relations; Partial derivatives and Jacobian method; Residual properties; Partial molar properties; Excess properties of mixtures; Thermodynamic property tables and diagrams,

Unit-2

Properties of Solutions and Phase Equilibria: 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.

Unit-3

Correlation and Prediction of Phase Equilibria: Activity coefficient; Composition models; thermodynamic consistency of phase equilibria; Application of the correlation and prediction of phase equilibria in systems of engineering interest particularly to distillation and liquid extraction processes.

Unit-4

Chemical Reaction Equilibria: Definition of standard state; standard free energy change and reaction equilibrium constant; evaluation of reaction equilibrium constant; prediction of free energy data; equilibria in chemical reactors, calculation of equilibrium compositions for homogeneous chemical reactors; thermodynamic analysis of simultaneous reactions.

Unit-5

Refrigeration: Principles of refrigeration; methods of producing refrigeration; liquefaction process; coefficient of performance; evaluation of the performance of vapour compression and gas refrigeration cycles.

Reference/Text Books

S. No. Name of Authors / Books / Publishers Year of Publication/ Reprint

1. Smith, J.M., VanNess, H.C., & Abbot M.C, Introduction to Chemical Engineering Thermodynamics, 7th Edition, Tata Mcgraw Hill Education Private Limited. 2009

2. Narayanan K.V, Text Book of Chemical Engineering Thermodynamics, Phi Learning Pvt. Ltd-New Delhi. 2013

3. Hougen, O.A., Watson, K.M., and Ragatz, R.A., Chemical Process Principles Part II", Thermodynamics, John Wiley. 1970

4. Dodge, B.F., Chemical Engineering Thermodynamics,1st Edition, 6th im edition McGraw-Hill,. 1944

5. Sandler, S.I., Chemical,Biochemical and Engineering Thermodynamics, 4th Edition, Wiley. 2006

BT-415
Chemical Reaction Engineering I

Course Outcome:

After completion of this course, student will be able to:

- CO1.Identify the reaction type and their kinetics.
- CO2.Design the reactor for the batch and continuous chemical process.
- CO3.Understand the Ideal and Non – Ideal Reactors.
- CO4.Understand the concept of different arrangements of chemical reactors for optimum conversion.
- CO5.Industrial use of chemical reaction engineering for production and economic growth.

Syllabus

Unit-1

Rate Equations: Rate equation – elementary - non-elementary reactions - theories of reaction rate and temperature dependency - Design equation for constant and variable volume batch reactors - analysis of experimental kinetics data - integral and differential analysis.

Unit-2

Design of Reactors: Design of continuous reactors - stirred tank and tubular flow reactor, recycle reactors - combination of reactors - size comparison of reactors.

Unit-3

Design of Multiple Reactors: Design of reactors for multiple reactions – consecutive - parallel and mixed reactions – factors affecting choice - optimum yield and conversion - selectivity, reactivity and yield.

Unit-4

Non – isothermal Reactors: Non-isothermal homogeneous reactor systems - adiabatic reactors - rates of heat exchanges for different reactors - design for constant rate input and constant heat transfer coefficient - operation of batch and continuous reactors - optimum temperature progression.

Unit-5

Non Ideal Reactors: The residence time distribution as a factor of performance; residence time functions and relationship between them in reactor; basic models for nonideal flow; conversion in non ideal reactors.

REFERENCE BOOKS:

S. No. Name of Authors / Books / Publishers Year of Publication/ Reprint

1. Levenspiel O, Chemical Reaction Engineering, 3rd Edition, Wiley India Pvt Ltd. 2010 2. Smith, J.M, Chemical Engineering Kinetics, 3rd Edition McGraw. 2014

3. Fogler.H.S., Elements of Chemical Reaction Engineering, 4th Edition, Phi Learning Pvt Ltd (RS). 2009

4. Froment. G.F. &K.B.Bischoff,Chemical Reactor Analysis and Design, 3rd Edition, Wiley. 2010

5. Butt, J.B., " Reaction Kinetics and Reactor Design" 2nd Ed., CRC Press 2000

Mechanical Operation
BT-417

Course Outcome:

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

- CO1.Measure the particle size,
- CO2.Estimate the crushing efficiency of different type's crushers.
- CO3.Explain the particle sedimentation.
- CO4.Design the storage area for the different types of solids

Syllabus

Unit-1

Particles Size Analysis: General characteristics of solids; Different techniques of size analysis; Shape factor; Surface area determination; Estimation of particle size; Screening methods and equipment; Screen efficiency; Ideal and actual screens.

Unit-2

Size Reduction: Methods of size reduction; Classification of equipments; Crushers; Grinders; Disintegrators for coarse, Intermediate and fine grinding; Laws of size reduction; Energy relationships in size reduction; power requirement; Work index.

Size Enlargement: Principle of granulation; Briquetting; Pelletisation; Flocculation.

Unit-3

Particle Separation: Gravity settling; Sedimentation; Thickening; Elutriation; Double cone classifier; Rake classifier; Bowl classifier; Centrifugal separation; Continuous centrifuges; Design of basket centrifuges; Industrial dust removing equipment; Cyclones; Hydro cyclones; Electrostatic - Magnetic separators; Heavy media separations; Floatation; Jigging.

Unit-4

Flow through Porous media (Filtration): Theory of filtration,Batch and continuous filters, Filtration equipments; Rotary drum filter; Plate and frame filter; Leaf filter; Notch filter; Sand filter; Bag filter; Selection; Operation; Filter aids. Flow through filter cake and Filter media; Compressible and incompressible filter cakes; Design of filters and optimum cycle of operation.

Fluidization: Fluidization characteristics, aggregative and particulate fluidization, voidage and minimum fluidization velocity,terminal velocity of particles; entrainment; pressure drop in fluidization.

Unit-5

Mixing and agitation: Mixing of liquids (with or without solids); Mixing of powders; Ribbon blender; Screw blender; Double cone blender; High viscous mixer; Banbury mixer; Selection of suitable mixers; Power requirement for mixing.

Storage and conveying of solids: Bunkers; Silos; Bins; Hoppers; Transportation of solids in bulk; Conveyer selection; Types of conveyers; Belt Conveyor; Bucket conveyor; Screw conveyor; Pneumatic conveyor; Their performance and characteristics.

REFERENCE BOOKS: S. No. Name of Authors / Books / Publishers Year of Publication/ Reprint

1. Backhurst, J. R. and Harker J. H.,"Coulson and Richardson Chemical Engineering", Vol. II",5th Ed., ButterworthHeinemann. 2004

2. McCabe W.L., Smith J.C and Harriott P., "Unit Operations of Chemical Engineering", 7th Ed. , McGraw Hill. 2005

3. Foust, A. S., Wenzel, L.A., Clump, C.W., Naus, L., and Anderson, L.B., Principles of Unit Operations, 2nd Edition., John Wiley & Sons 1980

4. Brown G.G., Unit Operations, CBS Publishers & Distributors 2005

5. Hiramath R.S., Kulkarni A.P., Unit Operations of Chemical Engineering, 9th Edition, Everest Publications 2004

6. Narayanan C.M. & Bhattacharya B.C., "Mechanical Operation for Chemical Engineers –Incorporating Computer Aided Analysis", Khanna Publishers. 1992

BT-410
Python Programming

Course Outcome:

After completion of this course, student will be able to:

- CO1. Interpret the fundamental Python syntax and semantics and be fluent in the use of Python control flow statements.
- CO2. Express proficiency in the handling of strings and functions.
- CO3. Determine the methods to create and manipulate Python programs by utilizing the data structures like lists, dictionaries, tuples and sets.
- CO4. Identify the commonly used operations involving file systems and regular expressions.
- CO5. Articulate the Object-Oriented Programming concepts such as encapsulation, inheritance and polymorphism as used in Python.

Syllabus

Unit-1

Introduction: The Programming Cycle for Python , Python IDE, Interacting with Python Programs , Elements of Python, Type Conversion. Basics: Expressions, Assignment Statement, Arithmetic Operators, Operator Precedence, Boolean Expression.

Unit-2

Conditionals: Conditional statement in Python (if-else statement, its working and execution), Nested-if statement and Elif statement in Python, Expression Evaluation & Float Representation. Loops: Purpose and working of loops , While loop including its working, For Loop , Nested Loops , Break and Continue

Unit-3

Function: Parts of A Function , Execution of A Function , Keyword and Default Arguments ,Scope Rules.
Strings: Length of the string and perform Concatenation and Repeat operations in it. Indexing and Slicing of Strings.
Python Data Structure : Tuples , Unpacking Sequences , Lists , Mutable Sequences , List Comprehension , Sets , Dictionaries
Higher Order Functions: Treat functions as first class Objects , Lambda Expressions

Unit-4

Sieve of Eratosthenes: generate prime numbers with the help of an algorithm given by the Greek Mathematician named Eratosthenes, whose algorithm is known as Sieve of Eratosthenes.
File I/O : File input and output operations in Python Programming Exceptions and Assertions
Modules : Introduction , Importing Modules ,
Abstract Data Types : Abstract data types and ADT interface in Python Programming. Classes: Class definition and other operations in the classes , Special Methods (such as _init_, _str_, comparison methods and Arithmetic methods etc.) , Class Example , Inheritance , Inheritance and OOP.

Unit-5

Iterators & Recursion: Recursive Fibonacci , Tower Of Hanoi
Search : Simple Search and Estimating Search Time , Binary Search and Estimating Binary Search Time
Sorting & Merging: Selection Sort , Merge List , Merge Sort , Higher Order Sort

Text books:

1. Allen B. Downey, ``Think Python: How to Think Like a Computer Scientist‘‘, 2nd edition, Updated for Python 3, Shroff/O‘Reilly Publishers, 2016 (http://greenteapress.com/wp/thinkpython/)

2. Guido van Rossum and Fred L. Drake Jr, ―An Introduction to Python – Revised and updated for Python 3.2, Network Theory Ltd., 2011.

3.John V Guttag, ―Introduction to Computation and Programming Using Python‘‘, Revised and expanded Edition, MIT Press , 2013

4.Robert Sedgewick, Kevin Wayne, Robert Dondero, ―Introduction to Programming in Python: An Inter-disciplinary Approach, Pearson India Education Services Pvt. Ltd., 2016

5.Timothy A. Budd, ―Exploring Python‖, Mc-Graw Hill Education (India) Private Ltd.,, 2015.

6.Kenneth A. Lambert, ―Fundamentals of Python: First Programs‖, CENGAGE Learning, 2012.

7.Charles Dierbach, ―Introduction to Computer Science using Python: A Computational ProblemSolving Focus, Wiley India Edition, 2013.

8.Paul Gries, Jennifer Campbell and Jason Montojo, ―Practical Programming: An Introduction to Computer Science using Python 3‖, Second edition, Pragmatic Programmers, LLC, 2013.

BT-524

Mass Transfer -I

L	T	P
3	1	0

Course Outcomes (Cos):

After completion this course students will be able to understand:

- Understand the principles of molecular diffusion and basic laws of mass transfer.
- Utilize mass transfer concepts to design gas absorption systems.
- Discuss the basics of humidification process and its application.
- Explain the concept and mechanism of drying operations.
- Analyze the concept of crystallization process and identification of suitable crystallizer.

Unit 1Diffusion:
Molecular and turbulent diffusion, diffusion coefficient, Fick's Law of diffusion, Dependence of diffusion coefficient on temperature, pressure and composition; measurement and estimation of diffusivity. Diffusion in multi -component gas mixtures. Diffusion in Solids: Molecular, Knudsen & surface diffusion; Inter- phase mass transfer: Mass transfer coefficients, Diffusion between phases, Equilibrium solubility of gases in liquids, Mass transfer theories, Mass transfer in fluidized beds, Flow past solids and boundary layers, Simultaneous heat and mass transfer.

Unit 2Absorption and Stripping:
Equipments, Gas-liquid equilibrium, Henry's law, Selection of solvent, Absorption in tray column, Graphical and analytical methods, Absorption in packed columns, simultaneous heat and mass transfer studies in packed columns, HTU, NTU &HETP concepts, Design equations for packed column, Absorption with chemical reaction and mass transfer.

Unit 3Humidification and Dehumidification:
Vapour liquid equilibrium and enthalpy for a pure substance, vapour pressure temperature curve, Vapour gas mixtures, Definition and derivations of relationships related with humidity Fundamental concept of humidification, Dehumidification and water cooling, Wet bulb temperature, Adiabatic and non-adiabatic operations, Evaporative cooling, Classification and design of cooling towers.

Unit 4Drying:
Solid-gas equilibrium, Different modes of drying operations, Definitions of moisture contents, Types of batch and continuous dryers, Rate of batch drying, Time of drying, Mechanism of batch drying, Continuous drying, Design of continuous dryers.

Unit 5Crystallisation:
Equilibrium yield of crystallization, Heat and mass transfer rates in crystallization, Theories of crystallization, Factors governing nucleation and crystal growth rates, Controlled growth of crystal, Classification and design of crystallizers.

Text Books:

1. Treybal, R "Mass Transfer Operations"
2. , 3rd Editon, New York: McGraw-Hill, (1980).
3. . Sherwood T. K., Pigford R. L. and Wilke P. "Mass Transfer" McGraw Hill (1975)
4.

Reference Books: 1. Foust A. S. et.al., "Principles of Unit Operations" John Wiley (1980).
2. Geankoplis, C.J.. "Transport Processes and Unit Operations", 3rd Editon, Prentice Hall. (1993)
3. Coulson, J. M. and Richardson J. F., "Chemical Engineering" Vol. I, II, IV & V: Pergamon Press.
4. Phillip C. Wankat, "Separation Process Engineering Includes Mass

BT-525
Chemical ReactionEngineering–II

L	T	P
3	1	0

Course Outcomes (Cos):

After completion this course students will be able to understand:

- Classify catalysts and predict physical properties of catalyst, surface area, void volume, solid density pore volume distribution.
- Understand the nature and mechanism of catalytic reactions and predict the rate controlling step reactions.
- Analyze the various contacting pattern for two phase system.
- Predict the rate equation for heterogeneous reactions and understand the effect of velocity, particle size and fluid properties on rate of reactions controlled by mass transfer.
- Analyze the best kinetic regimes for mass transfer and reaction and predict the rate equation.
- Understand the nature and mechanism of Biochemical reactions.
- Understand the working of Biochemical and polymerization reactors.

Syllabus

Unit 1

Introduction to Homogeneous and Heterogeneous reactions, catalysts and Nature of catalysis, Physical properties of catalysts, determination of surface area, void volume and solid density, pore volume distribution; Classification, preparation, testing and characterization of solid catalysts, catalyst selection, catalyst promoters and inhibitors, catalyst poisoning and catalyst deactivation (no kinetics). Adsorption, physical adsorption and chemisorption, adsorption isotherms, mechanisms of catalytic reactions, Shifting of equilibrium in chemical reactions.

Unit 2

Solid catalysed reactions, the rate equations for surface kinetics, Reaction and diffusion within porous catalysts, Pore diffusion resistance combined with surface kinetics, effectiveness factor and Thiele modulus, various resistances to transfer of reactants to the catalyst site, intrinsic and global rate of reaction, kinetic regimes, heat effects during reaction, Performance equations for reactors containing porous catalyst particles, design of solid catalytic reactors.

Unit 3

Fluid-solid reactions, experimental methods for finding rates, selection of a model, shrinking core model for spherical particles of unchanging size, rate of reaction for shrinking spherical particles, determination of rate controlling step, kinetics and design, Design of packed bed and fluidized bed reactors.

Unit 4

Fluid-Fluid Reactions, Rate equation, rate equation for straight mass transfer, kinetic regimes of mass transfer and chemical reaction, rate equation for mass transfer and chemical reactions, fluid-fluid reactor design, deciding the contactor type and contacting pattern.

Unit 5

Introduction to Biochemical reactions: Kinetics of Enzyme Fermentation and Microbial Fermentation, understanding of Biochemical Reactors and study of polymerization reactors, Bioprocessing of edible oils.

REFERENCE BOOKS:

1. Levenspiel O, Chemical Reaction Engineering, 3rd Edition, Wiley India Pvt Ltd. 2010 2. Smith, J.M, Chemical Engineering Kinetics, 3rd Edition McGraw. 2014
3. Fogler.H.S., Elements of Chemical Reaction Engineering, 4th Edition, Phi Learning Pvt Ltd (RS). 2009
4. Froment. G.F. &K.B.Bischoff,Chemical Reactor Analysis and Design, 3rd Edition, Wiley. 2010
5. Butt, J.B., " Reaction Kinetics and Reactor Design" 2nd Ed., CRC Press 2000

BT-523
Process Dynamics andControl

L	T	P
3	1	0

Course Outcomes (Cos):

After completion this course students will be able to understand:

- Demonstrate fundamental understanding of process control.
- Develop transfer function (input-output) and models for linear dynamical process.
- Characterize the dynamics and stability of processes based on mathematical analysis.
- Develop the mathematical models for various chemical processes.
- Explain different control modes and their application in controlling various processes.
- Explain the working of different controllers and valves.

Syllabus

Unit 1

Dynamic modeling of first and second-order process; Interacting and noninteracting processes; Nonlinear and integrating processes; introduction to nonminimum phase processes; Distributed parameter processes and MIMO processes; Response of first and second order processes with respect to different types of forcing functions.

Unit 2

Experimental estimation of dynamic process parameters and identification. Modes of control action: Classification of controllers and control strategy.

Unit 3

Closed loop feedback control: Servo and regulator problems; Offset; Selection of mode of control action; Closed loop response.

Unit 4

Routh stability criterion; Controller tuning and design: Online tuning- closed loop and open loop methods. Frequency response technique: Phase margin and gain margin; Bode stability criterion; Nyquist stability criterion; Controller design. Root locus plot and stability analysis.

Unit 5

Cascade and feed forward control: Design of controller and analysis of control system. Ratio, Adaptive, Model-based, Multivariable, Selective and Split range control. Computer process control using SCADA and DCS.

Reference Books:

1. Seborg, D. E., Edgar, T., and Mellichamp, D. A., “Process Dynamics and Control”, John Wiley and Sons. 2. Bequette, B. W., “Process Control: Modeling, Design, and Simulation”, Prentice-Hall, Inc. 3. Chidambaram, M., “Computer Control of Processes” Narosa Publishing House Pvt. Ltd., Ind. 4. D.C. Sikdar, " Instrumentation and Process Control", Khanna Book Publishing

BT-526
OptimizationTechniques

L	T	P
3	1	0

Course Outcomes (Cos): After completion this course understand:

- Identify different types of optimization problems.
- Understanding of different optimization technique.
- Ability to solve various multivariable optimization problems.
- Ability to solve optimization using software tools.
- Identify different types of test of Hypotheses.
- Ability to solve problems by using least square analysis.
- Understand Correlation and Regression

Syllabus

Unit 1

Optimization Optimization, Degree of freedom, Optimization formulation of the Problem, Analytical Method, Necessary and sufficient conditions for optimum in single and multi-variable unconstrained and constrained problems.

Unit 2

Constrained and unconstrained variables Unconstrained one dimensional search, Newton, Quasi-Newton and Secant method for uni-dimensional search, Region climnation methods (Golden Section Fibonacci, Dichotomous etc), Unconstrained multivariable optimization with special focus to Powell's conjugate direction method.

Unit 3

Optimization Techniques Linear Programming, graphical simplex method, revised simplex method, duality and transportation problems, unconstrained multi variable search, Direct methods, Indirect method.

Unit 4

Finite Difference method Forward, Backward and Divided Differences Table, Central Differences, Newton's Forward, Backward and Divided Differences Interpolation Formula, Interpolation Polynomials, Lagrange Interpolation Formula, Sensitivity analysis.

Unit 5

Optimality Principle of optimality, discrete and continuous dynamic programming. Algorithms & Computer Programming: Newton-Raphson Method, Gauss Elimination, Trapezoidal Rule, Simpson's 1/3rd, 3/8th Rule, Runge-Kutta 2nd Order, and R-K 4th Order Methods in reference to the Applications in Chemical Engineering.

Books:

1. T. F. Edgar and D. M. Himmelblau Optimization of Chemical Processes - McGraw Hill (1989)

2. K. Urbanier and C. McDermott - Optimal Design of Process Equipment - John Wiley (1986)

BT-527
IntellectualPropertyRights &Standardization

L	T	P
3	1	0

Course Outcomes (Cos):

After completion this course students will be able to understand:

- The students once they complete their academic projects, shall get an adequate knowledge on patent and copyright for their innovative research works.
- During their research career, information in patent documents provide useful insight on novelty of their idea from state-of-the art search. This provide further way for developing their idea or innovations.
- Proved the way for the students to catch up Intellectual Property(IP) as an career option.
- Gives awareness of international standards to students

Syllabus

Unit 1

Overview of Intellectual Property: Introduction to intellectual property right(IPR), intellectual property and its protection, Forms of Protection depending on product; Patent, copyright, trademark, design knowhow, trade secrets etc.

Unit 2

Patents: Concept of quality mark and standardization, development in quality mark, bureau of Indian standards (BIS)and its role, IS, Ag Mark, BIS Hallmark, ECO mark, FPO mark , geographical indication mark under WTO /TRIPS, Bharat stage emissions,Toxicity labels; and vegetarian and non-vegetarian mark

Unit 3

Copyrights: Quality council of India and its role, National accreditation body NABCB (National accreditation board for certification bodies),benefits of accreditation, Important legislations; National and International

Unit 4

Trademarks: Patenting systems in India, requirements of filing a patent application, patents in R&D, opposition to grant of patent under Indian Patent act 1970, protection of chemical pharmaceutical and biotechnological inventions

Unit 5

Other forms of IP Design: Management of intellectual property right (IPR's), quality management systems(QMS), ISO-9000 for manufacturing, ISO-14000 for environment, ISO -5000 for energy management systems, ISO - 22000 for Food safety management systems(FSMS), Information security management system(ISMS), Cyber Law and Digital Content Protection – Unfair Competition – Meaning and Relationship between Unfair Competition IP Laws.

REFERENCE BOOKS

1. P. Narayanan; Law of Copyright and Industrial Designs; Eastern law House, Delhi, 2010
2. Deborah. E. Bouchoux; Intellectual property right, Cengage learning.
3. AjitParulekar and Sarita D' Souza, Indian Patents Law – Legal & Business Implications; Macmillan India ltd , 2006

BT-510
Constitution of India

L	T	P
3	1	0

Course Outcomes (Cos):

After completion this course students will be able to understand:

- Meaning of the constitution law and constitutionalism, Historical Background of the Constituent Assembly
- Functions of Lok Sabha, Powers and Functions of the President, Comparison of powers of Indian President with the United States
- Sources of Law and the Court Structure: Enacted law -Acts of Parliament are of primary legislation
- Introduction, Legal Aspects of Patents, Filing of Patent Applications, Rights from Patents
- The Company's Act: Introduction, Formation of a Company, Memorandum of Association

Syllabus

Unit 1 Introduction and Basic Information about Indian Constitution:

Meaning of the constitution law and constitutionalism, Historical Background of the Constituent Assembly, Government of India Act of 1935 and Indian Independence Act of 1947,Enforcement of the Constitution, Indian Constitution and its Salient Features, The Preamble of the Constitution, Fundamental Rights, Fundamental Duties, Directive Principles of State Policy, Parliamentary System, Federal System, Centre-State Relations, Amendment of the Constitutional Powers and Procedure, The historical perspectives of the constitutional amendments in India, Emergency Provisions: National Emergency, President Rule, Financial Emergency, and Local Self Government – Constitutional Scheme in India.

Unit 2 Union Executive and State Executive:

Powers of Indian Parliament Functions of Rajya Sabha, Functions of Lok Sabha, Powers and Functions of the President, Comparison of powers of Indian President with the United States, Powers and Functions of the Prime Minister, Judiciary – The Independence of the Supreme Court, Appointment of Judges, Judicial Review, Public Interest Litigation, Judicial Activism, LokPal, Lok Ayukta, The Lokpal and Lok ayuktas Act 2013, State Executives – Powers and Functions of the Governor, Powers and Functions of the Chief Minister, Functions of State Cabinet, Functions of State Legislature, Functions of High Court and Subordinate Courts.

Unit 3 Introduction and Basic Information about Legal System:

The Legal System: Sources of Law and the Court Structure: Enacted law -Acts of Parliament are of primary legislation, Common Law or Case law, Principles taken from decisions of judges constitute binding legal rules. The Court System in India and Foreign Courtiers (District Court, District Consumer Forum, Tribunals, High Courts, Supreme Court). Arbitration: As an alternative to resolving disputes in the normal courts, parties who are in dispute can agree that this will instead be referred to arbitration. Contract law, Tort, Law at workplace.

Unit 4 Intellectual Property Laws and Regulation to Information:

Intellectual Property Laws: Introduction, Legal Aspects of Patents, Filing of Patent Applications, Rights from Patents, Infringement of Patents, Copyright and its Ownership, Infringement of Copyright, Civil Remedies for Infringement, Regulation to InformationIntroduction, Right to Information Act, 2005, Information Technology Act, 2000, Electronic Governance, Secure Electronic Records and Digital Signatures, Digital Signature Certificates, Cyber Regulations Appellate Tribunal, Offences, Limitations of the Information Technology Act.

Unit 5 Business Organizations and E-Governance:

Sole Traders, Partnerships: Companies: The Company's Act: Introduction, Formation of a Company, Memorandum of Association, Articles of Association, Prospectus, Shares, Directors, General Meetings and Proceedings, Auditor, Winding up. E-Governance and role of engineers in E-Governance, Need for reformed engineering serving at the Union and State level, Role of I.T. professionals in Judiciary, Problem of Alienation and Secessionism in few states creating hurdles in Industrial development.

Referred Case Studies:

- Keshavanand Bharati V. State of Kerala, AIR 1973 SC 1461.
- Maneka Gandhi V. Union of India AIR, 1978 SC 597.
- S.R. Bammai V. Union of India, AIR 1994 SC 1918.
- Kuldip Nayyar V. Union of India, AIR 2006 SC312.
- A.D.M. Jabalpur V. ShivkantShakla, AIR 1976 SC1207.
- Remshwar Prasad V. Union of India, AIR 2006 SC980.
- Keshav Singh in re, AIR 1965 SC 745.
- Union of India V. Talsiram, AIR 1985 SC 1416.
- Atiabari Tea Estate Co.V. State of Assam, AIR 1961SC232.
- SBP & Co. Vs. Patel Engg. Ltd. 2005 (8) SCC 618.
- Krishna Bhagya Jala Nigam Ltd. Vs. G. Arischandra Reddy (2007) 2 SCC 720.
- Oil & Natural Gas Corporation Vs. Saw Pipes Ltd. 2003 (4) SCALE 92 – 185.

BT-625

Mass Transfer -2

L	T	P
3	1	0

Course Outcomes (Cos):After completion this course students will be able to understand:

- Understandthebasicsofdistillationprocessforseparation.
- Determine number of stages in distillation, absorption and extraction operations
- Determine the height of packed column in absorption, distillation and extraction
- Analyzethedistillationprocess for binaryandmulticomponent mixtures
- Determinethenumberofstagesrequiredforseparationofliquid-liquidandsolid-liquidextractionprocess.
- Solvent selection for absorption and extraction operations

Syllabus

Unit 1

Distillation Pressure-composition, Temperature-concentration, Enthalpy-concentration diagrams for ideal and non-ideal solutions, Raoults law and its application, Maximum and minimum boiling mixtures, concept of relative volatility, Single Stage Distillation, Differential distillation, Flash vaporization, Vacuum, molecular and steam distillation.

Unit 2Continuous Distillation of Binary Mixtures:

Multistage contact operations, Characteristics of multistage tower, McCabe Thiele method, PonchonSavarit method, Reflux, maximum, min. and optimum reflux, Use of open steam, Tray efficiency, Determination of height and column diameter, Multistage batch distillation; Principles of azeotropic and extractive distillation, Introduction to multi component distillation system.

Unit 3Liquid-Liquid Extraction:

Ternary liquid equilibrium, Triangular graphical representation concept of theoretical or ideal stage, Equipment used for single stage and multistage continuous operation; Analytical and graphical solution of single and multistage operation Super critical fluid extraction.

Unit 4Solid /Liquid Extraction:

Leaching, Solid liquid equilibrium, Equipment used in solid-liquid extraction, Single and multistage cross current contact and counter current operations. Concept of an ideal stage, Overall stage efficiency, Determination of number of stages.

Unit 5Adsorption:

Description of adsorption processes and their application, Types of adsorption, Nature of adsorbents adsorption equilibrium and adsorption hysteresis, Freundlich and Langmuir adsorption isotherm , Chemisorption Stage wise and continuous contact adsorption operations, Determination of number of stages, Equipments; Ion exchange, Equilibrium relationship, Principle of ion-exchange, techniques and applications, Principles and

application of dialysis, osmosis reverse osmosis, thermal diffusion, sweep diffusion.

Reference Books:

1. Foust A. S. et.al., “Principles of Unit Operations” John Wiley (1980).
2. Geankoplis, C.J.. “Transport Processes and Unit Operations”, 3rd Editon, Prentice Hall. (1993)
3. Coulson, J. M. and Richardson J. F., “Chemical Engineering” Vol. I, II, IV & V: Pergamon Press.
4. Phillip C. Wankat, “Separation Process Engineering Includes Mass

BT-627

Transport Phenomenon

L	T	P
3	1	0

Course Outcomes (Cos):

After completion this course students will be able to understand:

- Understand the chemical and physical transport processes and their mechanism.
- Do heat, mass and momentum transfer analysis samultaneously.
- Analyze industrial problems along with appropriate approximations and boundary conditions.
- Develop steady and time dependent solutions along with their limitation

Syllabus

Unit 1

Momentum Transport Viscosity - Temperature effect on viscosity of gases and liquids - Newton's law - Mechanism of momentum transport - Shell balance method - Pressure and velocity distributions in falling film - Circular tube - Annulus.

Unit 2

Equations of Change and Turbulent Flow: Equation of continuity- Motion - Use of equations of change to solve flow problems - Dimensional analysis of equations of change - Comparison of laminar and turbulent flows - Timesmoothed equation of change.

Unit 3

Energy Transport: Thermal conductivity - Temperature and pressure effect on thermal conductivity of gases and liquids - Fourier's law - Mechanism of energy transport - Shell energy balance - Temperature distribution in solids and laminar flow - with electrical - Nuclear - Viscous, Chemical heat source - Heat conduction through composite walls, cylinders – Spheres

Unit 4

Temperature Distribution in Turbulent Flows: Energy equations - Use of equations of change - Dimensional analysis of equations of change - Timesmoothed equations of change - Empirical expressions - Temperature distribution for turbulent flow in tubes

Unit 5

Mass Transport: Diffusivity - Temperature and pressure effect - Fick's law - Mechanism of mass transport - Theory of diffusion in gases and liquids - Shell mass balances - Concentration distribution in solids and in laminar flow: stagnant gas film - Heterogeneous and homogeneous chemical reaction systems- Falling film - Porous catalyst. The equation of continuity - Summary of equations of change and fluxes. Momentum, heat and mass transfer analogies: Chilton–Colburn analogy and Reynold's Analogy.

Text Book: 1. Byron, R. B., Stewart, W. E., Lightfoot, E. N., "Transport Phenomena", John Wiley & Sons,

BT-626

Chemical Technology

L	T	P
3	1	0

Course Outcomes (Cos): After completion this course students will be able to understand:

- Ability to understand the manufacturing of various inorganic and organic chemicals.
- Ability to understand the process flow diagram and various process parameters.
- Ability to identify and solve engineering problems during production.
- Students will understand the industrial application and utilization of chemical technology.

Syllabus

Unit 1 Introduction: Importance and Overview of Chemical Process Industries Starch, glucose and starch Fermentation products : Alcohol, Acetic acid, Citric acid and antibiotics 10 Cellulose -Derivatives of Cellulose- Carboxyl Methyl Cellulose and gun cotton, Structural aspects of cellulose. Oil, fats and waxes industry: properties of oils and fats, Saturated, mono-, di-, and polyunsaturated fatty acids, hydrogenation of edible oils, hydrogenolysis, esterification and randomization, refining, waxes, Fat Splitting, Soap, Surfactants, Emulsifiers, Glycerin.

Unit 2

Chlor-alkali industry: Common salt, Caustic soda and Chlorine, Soda Ash, Hydrochloric acid. Sulfur Industry: Sulfur and sulfuric acid, Oleum Phosphorus Industry: Phosphorus, Phosphoric acid and super phosphates, Nitrogen and Fertilizer Industry: Ammonia, Nitric acid, Urea and other nitrogen fertilizers, Mixed fertilizers (SSP, TSP, NPK, KAP, DAP, Nitro phosphate), Effect of changing feed raw material on fertilizer products, Bio-fertilizers, Agrochemical industries: Manufacturing process of some important pesticides, insecticides, fungicides, fumigants, herbicides and their uses.

Unit 3

Paper industry: pulping; Recovery of chemicals from cooking liquors; Paper making. Wood Chemicals industry: Composite wood, plywood etc.; Manufacture of oleoresin, turpentine, menthol, Ethanol production; Essential oils, perfumes, flavors and cosmetics, Pharmaceutical industries: Classification and production of drugs Leather industry: Tanning processes; Leather making; Embossing; Leather chemicals.

Unit 4

Surface coating industries: Types of surface coating; Paints, varnishes, distempers and enamels. Dyes industry: Classification of dyes and dye intermediates; production of some important dyes, lacquers and toners. Synthetic and natural fibers: Nylon, Dacron, Terylyne, Polyester, Viscose rayon, acetate rayon , Natural and synthetic rubber, vulcanization and reclaiming of rubber, SBR, Nano fibers Plastics; Thermosetting and Thermo Plastics (PVC, Polyethylene, Polyurethane, Teflon).

Unit 5 Crude oil distillation, Thermal conversion processes (vis-breaking, coking), Catalytic conversion processes (fluid catalytic cracking, catalytic reforming, hydro cracking, alkylation, isomerization, polymerization),Finishing processes, Sulphur removal process, lube oil manufacture; Petrochemicals: ethylene, propylene, formaldehyde, methanol, ethylene oxide, ethanolamine, cumin, ethylene glycol, ethyl benzene, BTX; Separation of xylenes.

Text Books: 1. Dryden, C. E. “Outlines of Chemical Technology” (Edited andRevised by M. Gopala Rao and M. Sittig) East West Press. Pvt. Ltd, New Delhi, 3rd Edition (1997). 2. Austin G. T. Shreve’s Chemical Process Industries”, 5th Edition, McGraw Hill (1984). 3. O P Gupta, "Chemical Process Technology", Khanna Publishing House.

BT-628

Sustainability of Environment

L	T	P
3	1	0

Course Outcomes (Cos):

After completion this course students will be able to understand:

- Understand the impact of environmental pollution and concept of sustainable development
- Analyze various resource conservation methodologies.
- Design of various air pollution and water pollution control equipments.
- Apply the basic scientific and sustainability principles behind waste management for solving practical
- waste management challenges Discuss the ethical and moral issues involved in seeking the sustainable use of resources

Syllabus

Unit 1Introduction: Interaction of man and environment, Ecology & Environment, components of the biosphere, biodiversity, Food chain, Environmental pollution from chemical process industries, characterization of emission and effluents, environmental Laws and rules (CPCB ,UPPCB), standards for ambient air, noise emission and effluents, concept of sustainable development.

Unit 2Resource Conservation:

Process modification, alternative raw material, recovery of by co-product from industrial emission effluents, recycle and reuse of waste, energy recovery and waste utilization, Water use minimization.

Unit 3Air quality Control:

Particulate emission control by mechanical separation and electrostatic precipitation, wet gas scrubbing, gaseous emission control by adsorption and adsorption, Design of cyclones, ESP, fabric filters and absorbers. Water Pollution Control: Physical treatment, pre-treatment, solids removal by settling and sedimentation, filtration centrifugation, coagulation and flocculation. Anaerobic and aerobic treatment biochemical kinetics, trickling filter, activated sludge and lagoons, aeration systems, sludge separation and drying and design of CETP, use of low waste technology.

Unit 4Solid Waste management:

Industrial and Municipal, Characterization of wastes-hazardous and non-hazardous wastes. Waste disposal and management laws and guidelines. Non-hazardous industrial wastes-treatment, disposal, utilization and management. Value-extraction from the wastes. Handling, storage and disposal of hazardous wastes.

Unit 5Environment and Sustainable development:

Economic development and social welfare consideration in socio economic developmental policies and planning. Impact of energy sources on environment, Approaches to mitigate environmental emissions from energy sector. Cleaner development mechanisms and their applications, Case studies on techno-economics of 7 V energy conservation and renewable energy technologies for making non renewable energy sources available over longer periods.

Books:

Peter Auer."Advancesin Energy System and Technology".Vol 1 & II Edited byAcademic Press.

John Twideu and Tony Weir, "Renewal Energy Resources" BSP Publications, 2006

M.V.R KoteswaraRao,"EnergyResources:Conventionale.Non-Conventional" BSPPublications.2006.

D.S. Chauhan,

*Non-conventional Energy Resources" New Age International.

CSSolanki."RenewalEnergvTechnologies:A Practical Guide for Beginners" PHI Learning.

Peter Auer."Advancesin Energy System and Technology".Vol 1 & II Edited by Academic Press.

BT-624

Understanding the human being comprehensively

L	T	P
3	1	0

Course Outcomes (Cos):

After completion this course students will be able to understand:

- The basic human aspirations and their fulfillment through Right understanding and Resolution
- The domain of right understanding starts from understanding the human being
- Understanding the human being comprehensively is the first step and the core theme of this course
- The need and the process of inner evolution
- Understanding different aspects of All-encompassing Resolution

Syllabus

Unit 1Introduction:

The basic human aspirations and their fulfillment through Right understanding and Resolution; All-encompassing Resolution for a Human Being, its details and solution of problems in the light of Resolution.

Unit 2Understanding Human being and its expansion:

The domain of right understanding starts from understanding the human being (the knower, the experience and the doer); and extends up to understanding nature/existence – its interconnectedness and co-existence; and finally understanding the role of human being in existence (human conduct).

Unit 3Activities of the Self:

Understanding the human being comprehensively is the first step and the core theme of this course; human being as co-existence of the self and the body; the activities and potentialities of the self; Reasons for harmony/contradiction in the self.

Unit 4Understanding Co-existence with other orders:

The need and the process of inner evolution (through self-exploration, selfawareness and self-evaluation)-particularly awakening to activities of the Self: Realization, Understanding and Contemplation in the Self (Realization of Co-Existence, Understanding of Harmony in Nature and Contemplation of Participation of Human in this harmony/ order leading to comprehensive knowledge about the existence).

Unit 5Expansion of harmony from self to entire existence:

Understanding different aspects of All-encompassing Resolution (understanding, wisdom, science etc.), Holistic way of living for Human Being with All-encompassing Resolution covering all four dimensions of human endeavour viz., realization, thought, behavior and work (participation in the larger order) leading to harmony at all levels from self to Nature and entire Existence.

BT-609

Essence of IndianTraditionalKnowledge

L	T	P
3	1	0

Course Outcomes (Cos):

After completion this course students will be able to understand:

- Evolutionary Theory, Force Theory, Mystical Theory Contract Theory
- Harappan Script and Brahmi Script. The Vedas, the Upanishads, the Ramayana and the Mahabharata
- Indian Religion, Philosophy, and Practices Pre-Vedic and Vedic Religion
- Science, Management and Indian Knowledge System Astronomy in India
- Cultural Heritage and Performing Arts Indian Architect, Engineering and Architecture in Ancient India

Syllabus

Unit 1Society State and Polity in India State in Ancient India:

Evolutionary Theory, Force Theory, Mystical Theory Contract Theory, Stages of State Formation in Ancient India, Kingship , Council of Ministers Administration Political Ideals in Ancient India Conditions' of the Welfare of Societies, The Seven Limbs of the State, Society in Ancient India, Purusārtha, Varnāshrama System, Āshrama or the Stages of Life, Marriage, Understanding Gender as a social category, The representation of Women in Historical traditions, Challenges faced by Women. Four-class Classification, Slavery.

Unit 2 Indian Literature, Culture, Tradition, and Practices Evolution of script and languages in India:

Harappan Script and Brahmi Script. The Vedas, the Upanishads, the Ramayana and the Mahabharata, Puranas, Buddhist And Jain Literature in Pali,Prakrit And Sanskrit, Kautilya'sArthashastra, Famous Sanskrit Authors, Telugu Literature, Kannada Literature,Malayalam Literature ,Sangama Literature Northern Indian Languages & Literature, Persian And Urdu ,Hindi Literature

Unit 3

Indian Religion, Philosophy, and Practices Pre-Vedic and Vedic Religion, Buddhism, Jainism, Six System Indian Philosophy, Shankaracharya, Various Philosophical Doctrines , Other Heterodox Sects, Bhakti Movement, Sufi movement, Socio religious reform movement of 19th century, Modern religious practices.

Unit 4

Science, Management and Indian Knowledge System Astronomy in India, Chemistry in India, Mathematics in India, Physics in India, Agriculture in India, Medicine in India ,Metallurgy in India, Geography, Biology, Harappan Technologies, Water Management in India, Textile Technology in India ,Writing Technology in India Pyrotechnics in India Trade in Ancient India/,India's Dominance up to Pre-colonial Times

Unit 5

Cultural Heritage and Performing Arts Indian Architect, Engineering and Architecture in Ancient India, Sculptures, Seals, coins, Pottery, Puppetry, Dance, Music, Theatre, drama, Painting, Martial Arts Traditions, Fairs and Festivals, Current developments in Arts and Cultural, Indian's Cultural Contribution to the World. Indian Cinema

SuggestedText &ReferenceBooks

1. V.Sivaramakrishna(Ed.),*CulturalHeritageofIndia-CourseMaterial*,BharatiyaVidyaBhavan,Mumbai,5thEdition,2014
2. S.Baliyan, *IndianArtandCulture*, OxfordUniversityPress, India
3. SwamiJitatmanand,*ModernPhysicsandVedant*,BharatiyaVidyaBhavan
4. RomilaThapar,*ReadingsInEarlyIndianHistory*Oxford UniversityPress,India
5. FritzofCapra,Tao ofPhysics
6. FritzofCapra,Thewave ofLife
7. VNJha(EnglishTranslation),*TarkasangrahaofAnnamBhatta,*InternationalChinmayFoundation, Velliarnad,Amaku,am
8. YogaSutraofPatanjali,RamakrishnaMission,Kolkatta
9. GNJha(Eng.Trans.)Ed.RNJha,*Yoga-darshanamwithVyasaBhashya*,VidyanidhiPrakasham,Delhi,2016
10. RNJha,ScienceofConsciousnessPsychotherapyandYogaPractices,VidyanidhiPrakasham,Delhi,2016
11. PRSharma(Englishtranslation), ShodashangHridayam
12. Basham,A.L., *TheWonderthatwasIndia*(34thimpression), NewDelhi, Rupa&co
13. Sharma,R.S.,*AspectsofPoliticalIdeasandInstitutionsinAncientIndia*(fourthedition),Delhi,MotilalBanarsidass,

BT-701
Human Value

L	T	P
3	1	0

Course Outcomes (Cos):

After completion of this course, student will be able to:

- To help the students having the clarity about human aspirations, goal, activities and purpose oflife.
- To facilitate the competence to understand the harmony in nature/existence and participation of human being in thenature/existence.
- To help the students to develop the understanding of human tradition and its variouscomponents.

Syllabus

Unit 1Introduction:

The basic human aspirations and their fulfilment through Right understanding and Resolution; All-encompassing Resolution for a Human Being, its details and solution of problems in the light of Resolution

Unit 2 Understanding Human being and its expansion.

The domain of right understanding starts from understanding the human being (the knower, the experiencer and the doer); and extends up to understanding nature/existence – its interconnectedness and co-existence; and finally understanding the role of human being in existence (human conduct).

Unit 3Activities of the Self.

Understanding the human being comprehensively is the first step and the core theme of this course; human being as co-existence of the self and the body; the activities and potentialities of the self; Reasons for harmony/contradiction in the self

Unit 4 Understanding Co-existence with other orders.

The need and the process of inner evolution (through self-exploration, self- awareness and self-evaluation)-particularly awakening to activities of the Self: Realization, Understanding and Contemplation in the Self (Realization of Co-Existence, Understanding of Harmony in Nature and Contemplation of Participation of Human in this harmony/ order leading to comprehensive knowledge about the existence).

Unit 5 Expansion of harmony from self to entire existence.

Understanding different aspects of All-encompassing Resolution (understanding, wisdom, science etc.), Holistic way of living for Human Being with All-encompassing Resolution covering all four dimensions of human endeavour viz., realization, thought, behavior and work (participation in the larger order) leading to harmony at all levels from self to Nature and entire Existence

Reference Books:

1. A Foundation Course in Human Values and Profession Ethics (Text Book and Teachers' Manual), R. R. Gaur, R. Sangal, G. P. Bagaria (2010), Excel Books, New Delhi [ISBN 978-8-174-46781-2]
2. Avartansheel Arthshastra, A. Nagraj, Divya Path Sansthan, Amarkantak, India

3. Economy of Permanence – (a quest for social order based on non-violence), J.C. Kumarappa (2010), Sarva-Seva-Sangh-Prakashan, Varansi, India
4. Energy and Equity, Ivan Illich (1974), The Trinity Press, Worcester & Harper Collins, USA
5. IshandiNauUpnishad, Shankaracharya, Geeta press, Gorakhpur,
6. Manav Vyavahar Darshan, A. Nagraj, Divya Path Sansthan, Amarkantak, India
7. Manaviya Sanvidhan, A. Nagraj, Divya Path Sansthan, Amarkantak, India
8. MahasatipatthanSutta , S N Goenka, Vipassana Research Institute, First Edition, 1996
9. Small Is Beautiful: A Study of Economics as if People Mattered, E. F. Schumacher, 1973, Blond & Briggs, UK
10. Slow is Beautiful, Cecile Andrews http://www.newsociety.com/Books/S/Slow-is-Beautiful).Science & Humanism – towards a unified worldview, P. L. Dhar & R. R. Gaur (1990), Commonwealth Publishers, New Delhi.
11. Sanchian Sri Guru Granth Sahib Ji ,Shiromani GurdwaraParbhandhak Committee, 2001.
12. SamanSuttam, JinendraVarni ,1974.
13. Vyavaharvadi Samajshastra, A. Nagraj, Divya Path Sansthan, Amarkantak, India.
14. Vyavahatmak Janvad, A. Nagraj, Divya Path Sansthan, Amarkantak, India.

BT – 727

ENERGY ENGINEERING& MANAGEMENT

L	T	P
3	1	0

Course Outcomes (Cos):

After completion of this course, student will be able to:

- Provide an overview of renewable and non-renewable energy resources scenarios.
- Perform energy audits in various unit operations.
- Able to understand the principles and technologies involved in alternate sources ofEnergy.
- Explore the energy conservation opportunities in chemical process utilities.
- Study the case studies of energy conservation in chemical process industries.

Syllabus

UNIT IEnergy Scenario:

Indian and global, energy crisis, Classification of various energy sources, Renewable and non-renewable energy sources, Remedial measures to some energy crisis. Energy Conservation.

UNIT IIAlternative Sources of Energy:

Fuel cell,Solar Energy : Photo thermal and photovoltaic conversion and utilization methods , solar water heating , cooking , drying and its use for otherindustrial processes ,solar cells their material and mode of operation . direct and indirect methodssolar energystorage , sensible heat and latent heat storage materials Solar ponds .Bio energy,Biogas plants and their operation , Biomass and its conversion roots to gaseous and liquid fuels, Wind energy , its potential and generation by wind mills.

UNIT III

Hydroelectric potential, its utilization & production, Geothermal energy its potential status andproduction, Nuclear energy : Status, nuclear raw materials, nuclear reactors and otherclassification, Generation of Nuclear power, Nuclear installations in India and their capacity ofgeneration, Limitations of nuclear energy, Reprocessing of spent nuclear fuel, Cogeneration offuel and power, Energy from tidal and ocean thermal sources, MHD systems.

UNIT IV

Fossil and Processed Fuel: Coal its origin and formation, Coal analysis, Coal classification, Coal preparation, Coal washing and coal blending, Coal carbonization, Treatment of coal gas andrecovery of chemical from coal tar, Coal gasification, liquid fuel synthesis from coal, CBM.

UNIT V

Petroleum crude, Types of crude ,emergence of petroleum products as energy, GaseousFuels: Natural gas, Water gas, producer gas, L.P.G., bio- gas, coke oven gas, blast furnace gas, LNG,CNG,Gas hydrates ,GTL Technology (gas to liquid), Bio-diesel.

BOOKS:

1. Brame J.S.S. and King J.G., Edward Arnold “Fuel Solid, Liquid and Gases” Edward Arnold (1967).
2. Sukhatme S.P, "Solar Energy - Principles of Thermal Collection and Storage",2nd Ed., Tata McGraw-Hill.,(1996).

BT-729 N
Process Design & Economics

Course Outcomes (Cos):

After completion of this course, student will be able to:

- Able to process design of shell & tube heat exchanger.
- Able to process design of plate heat exchanger.
- Able to process design of sieve tray distillation column.
- Able to process design of packed bed distillation column

Syllabus

Unit-1

Introduction: Basic considerations in chemical engineering plant design, optimization and feasibility of plant design.

Plant location and layout: Factors affecting plant location, factors in planning layouts, principles of plant layout, use of scale models.

Unit-2

Process design aspects: Selection of process-factors affecting process selection. Types of project design, Importance of Laboratory development pilot plant, safety factors, types of flow diagrams. Selection of process equipment: Standard versus special equipment-material of construction for process equipment, selection criteria, and specification sheets.

Unit-3

Cost estimation: Cash flow and cumulative cash position for industrial operations, factors affecting estimation of investment and production cost, breakeven point and its significance, total capital investment, fixed and working capital investment & their estimations, type of estimates, cost indexes, method for estimating capital investment. Estimation of total product cost: Estimation of total product cost: manufacturing cost, general expenses, Manufacturing cost: direct production cost, fixed charges, plant overhead cost.

Unit-4

Depreciation: Types of depreciation, Method for determining depreciation: straight line method, decline balance method, sum of the year digit method, shrinking fund method etc, single unit and group depreciation, adjustment of depreciation account, evaluation of depreciation methods

Unit-5

Profitability, alternative investments and replacement: Methods for profitability evaluation, Evaluation of Break Even Point, % rate of return, Practical factors in alternative investment and replacement Studies.

Books:

Raj Singh: M.S. Peters and Timmerhaus,"Plant design and Economies forChemical Engineers" McGraw Hill, Inc. 4th Edition.

Raj Singh: F.C. Vibrandt and C.E. Dryden, "Chemical Engineering Plant Design'McGraw Hill, Fifth Edition

Raj Singh: R. K. Sinnott. Chemical Engineering Design, Volume 6. Elsevier/Butterworth-Heinemann. 4th Edition.

Raj Singh: V. V. Mahajani, S. M. Mokashi, Chemical Project Economics,Macmillan Publishers India Ltd.. 1* Edition, 2005.

Raj Singh: O. P. Khanna, Industrial Engineering and Management, Dhanpat RaiPublications, 17th Edition. 2010.

BT – 728

Process modelling and simulation

L	T	P
3	1	0

Course Outcomes (Cos):

- Identify the terms involved in inventory rate equation of mass, energy and momentum
- Recall the basic concepts involved in modeling and simulation
- Apply conservation of mass, momentum and energy equations to engineering problems.
- Develop model equations for chemical engineering systems
- Solve the model equations and chemical engineering problems using numerical techniques.

Syllabus

UNIT IIntroduction to mathematical modeling;

Advantages and limitations of models and applications of processmodelsofstand-aloneunitoperationsandunitprocesses;Classificationofmodels:Linearvs. Nonlinear,Lumpedparametervs.Distributedparameter;Staticvs.Dynamic,Continuousvs.Discrete;

Numerical Methods: Iterative convergence methods, Numerical integration of ODE- IVP and ODE- BVP.

UNIT IIConcept of degree of freedom analysis:

System and its subsystem, System interaction, Degree of freedom in a system e.g. Heat exchanger, Equilibrium still, Reversal of information flow, Design variable selection algorithm, Information flow through subsystems, Structural effects of design variable selection, Persistent Recycle.

UNIT IIISimple examples of process models;

Models giving rise to nonlinear algebraic equation (NAE) systems, - steady state models of flash vessels, equilibrium staged processes distillation columns, absorbers, strippers, CSTR, heat exchangers, etc.; Review of solution procedures and available numerical software libraries.

UNIT IV

Steady state models giving rise to differential algebraic equation (DAE) systems; Rate based approaches for staged processes; Modeling of differential contactors – distributed parameter models of packed beds; Packed bed reactors; Modeling of reactive separation processes; Review of solution strategies for Differential Algebraic Equations (DAEs), Partial Differential Equations (PDEs), and available numerical software libraries. Introduction to unsteady state models and their applications.

UNIT V

Simulationandtheirapproaches,Modular,Sequential,SimultaneousandEquationsolvingapproach,

Simulation softwares and their applications, Review of solution techniques and available numerical softwarelibraries.Reviewofthermodynamicproceduresandphysicalpropertydatabanks.

BOOKS:

1. LuybenW.L.,“ProcessModeling,Simulation,andControlforChemicalEngineering”,McGraw Hill.
2. D.F.RuddandC.C. Watson,“StrategyofProcessEngineering”,Wileyinternational.
3. M.M. Denn, “Process Modelling”, Wiley, New York,(1990).
4. K. Jana, “Chemical Process Modelling and Computer Simulation”,PHI,(2011)
5. C.D. Holland, “Fundamentals of Modelling Separation Processes”, Prentice Hall,(1975)
6. HussainAsghar,“ChemicalProcessSimulation”,WileyEasternLtd.,NewDelhi,(1986)

BT – 726
IPA & Waste Management

L	T	P
3	1	0

Course Outcomes (Cos):

After completion of this course, student will be able to:

- Identify improper practices of solid waste disposal and their environmental implications. Know the basic engineering principles of solid waste management.
- Describe the need for economics in collection and transportation of solid waste and clearly discuss various types of collection systems and analyse system dynamics.
- Understand the management concepts, define 4 R approach, apply PPP model and community involvement for effective management of solid waste.
- Develop a concise idea on various conventional and advanced treatment options for solid waste.
- Conceive the design aspects of engineered disposal options and apply the gained knowledge to solve numerical examples.

Syllabus

UNIT IIntroduction:

Industrial Pollution and types of pollution from chemical process industries, Characterization of emission and effluents, Global consideration of environmental pollution, Environmental legislation - Water Act 1974, Air Act 1981, Environmental Protection Act 1986;Standards for liquid effluents from chemical process industries, air quality, nuclear radiationemission, noise emission.

UNIT IIPollution Prevention:

Process modification, Alternative raw material, Recovery of by productfrom industrial emission/effluents, Recycle and reuse of waste, Energy recovery and wasteutilization, Material and energy balance for pollution minimization, Water minimization,Fugitive emission/effluents and leakages and their control-housekeeping and maintenance.

UNIT IIIAir Pollution Control:

Air pollutants classification, Equipments for controlling particulate andgaseous pollutants, lapse rate, atmospheric stability, Dispersion models, Plume behavior, Stackdesign, Design of gravity settling chamber, cyclones, electrostatic precipitator, fabric filters andabsorbers, Air pollution control for petroleum refineries and cement plants.

UNIT IVWater Pollution Control:

Waste water characteristics, Primary, secondary and tertiary treatments for wastewater, Anaerobic and aerobic treatment biochemical kinetics, Design of trickling filter, activated sludge systems, ponds and lagoons and aeration systems, Water pollution control for petroleum refineries, fertilizer industry, pulp and paper industry.

UNIT VSolid Waste Management:

Characterization of solid wastes-hazardous and non-hazardous wastes, Waste disposal and management laws and guidelines, Non-hazardous industrial wastestreatment,disposal, utilization and management, Value-extraction from the wastes, Handling,storage and disposal of hazardous wastes, Waste disposal for nuclear power plants.

BOOKS:

1. Metcalf & Eddy, "Wastewater Engineering - Treatment and Reuse", Revised by G. Tchobanoglous, F. L. Burton, and H. D. Stensel, 4th edition. Tata McGraw-Hill, 2003.
2. Mahajan S. P., Pollution control in process industries, Tata McGraw-Hill, 1985.
3. Peavy H.S., Rowe D.R. and Tchobanoglous G., Environmental Engineering, McGraw- Hill edition, 1985.
4. Kreith F. and Tchobanoglous G., "Handbook of Solid Waste Management", 2nd Ed., Mc Graw Hill, 2002.
5. Pichtel J., "Waste Management Practices: Municipal, Hazardous and Industrial", CRC, 2005

BT - 806
Renewable Energy Resources

L	T	P
3	1	0

Course Outcomes (Cos):

After completion of this course, student will be able to:

- To know the energy demand of world, nation and available resources to fulfill the demand
- To know about the conventional energy resources and their effective utilization To acquire the knowledge of modern energy conversion technologies
- To be able to understand and perform the various characterization techniques of fuels
- To be able to identify available nonconventional (renewable) energy resources and techniques to utilize them effectively.

Syllabus

UNIT-IIntroduction:

Various non-conventional energy resources- Introduction, availability, classification, relative merits and demerits. Solar Cells: Theory of solar cells. Solar cell materials, solar cell array, solar cell power plant, limitations.

UNIT-IISolar Thermal Energy:

Solar radiation, flat plate collectors and their materials, applications and performance, focussing of collectors and their materials, applications and performance; solar thermal power plants, thermal energy storage for solar heating and cooling, limitations.

UNIT-IIIGeothermal Energy:

Resources of geothermal energy, thermodynamics of geothermal energy conversion-electrical conversion, non-electrical conversion, environmental considerations. Magneto-hydrodynamics (MHD): Principle of working of MHD Power plant, performance and limitations.Fuel Cells: Principle of working of various types of fuel cells and their working, performance and limitations.

UNIT-IVThermo-electrical and thermionic Conversions:

Principle of working,performance and limitations. Wind Energy: Wind power and its sources, site selection, criterion, momentum theory, classification of rotors, concentrations and augments, wind characteristics. performance and limitations of energy conversion systems.

UNIT-VBio-mass:Availability of bio-mass and its conversion theory. Ocean Thermal Energy Conversion (OTEC):

Availability, theory and working principle, performance and limitations. Wave and Tidal Wave: Principle of working, performance and limitations. Waste Recycling Plants.

Text books:

1. Raja etal, “Introduction to Non-Conventional Energy Resources” Scitech Publications.

2. John Twideu and Tony Weir, “Renewal Energy Resources” BSP Publications, 2006.
3. M.V.R. Koteswara Rao, “Energy Resources: Conventional & Non-Conventional” BSP Publications,2006.
4. D.S. Chauhan,”Non-conventional Energy Resources” New Age International.
5. C.S. Solanki, “Renewal Energy Technologies: A Practical Guide for Beginners” PHI Learning.
6. Peter Auer, "Advances in Energy System and Technology". Vol. 1 & II Edited by Academic Press.
7. Godfrey Boyle,“ Renewable Energy Power For A Sustainable Future”, Oxford University Press.

BT – 827

Petrochemical Technology

L	T	P
3	1	0

Course Outcomes (Cos):

After completion of this course, student will be able to:

- Describe the process of crude oils production & refining and Characteristics of crude oils.
- Understand the various quality Control parameters of Petroleum Products
- Describe the physical properties of petroleum products and thermal conversion of petroleumProducts.
- Understand the process involved in catalytic conversion.
- Demonstrate the different methods available for lube oil manufacturing process.

Syllabus

Unit 1

Production and consumption pattern of petrochemicals in India, Feedstocks for petrochemicals-Natural gas, LPG, Refinery off-gases, Hydroforming of petroleum stocks, Naphtha and fuel oils, Petroleum coke.

Unit 2

Steam reforming and partial oxidation processes for syngas, Manufacture of Methanol, Formaldehyde, Chloromethanes, Trichloroethylene, Perchloroethylene, Acetic acid, adipic acid.

Unit 3

Ethylene and acetylene via steam cracking of hydrocarbons, Manufacture of Ethylene dichloride, Vinyl chloride, Ethylene oxide, Ethanolamine, Acetaldehyde, Vinyl acetate, Ethylene glycol.

Unit 4

Manufacture of Isopronol, Acetone, Methyl ethyl ketone, Methyl isobutyl ketone, Cumene, Acrylonitrile, Propylene oxide, Butadiene, Oxo process

Unit 5

Manufacture of Benzene, Toluene, Xylenes, Phenol, Styrene, Phthalic anhydride, Maleic anhydride, Nitrobenzene, Aniline, Bisphenol-A, Caprolactum.

BT-826
Fertilizer Technology

L	T	P
3	1	0

Course Outcomes (Cos):

After completion of this course, student will be able to:

- Use reactions and unit operations steps in manufacturing of various fertilizers.
- Identify engineering problems in fertilizer manufacturing.
- Select appropriate synthesis fertilizer

Syllabus

Unit 1

Introduction of Indian fertilizer industries, types of fertilizers process details.

Unit 2

Manufacture of Nitrogenous, Phosphatic, potassic, complex, NPK, mixed, Bio and other fertilizers.

Unit 3

Discussion of existing Indian plants pollution and its control, abetment and disposal of waste of fertilizer units.

Unit 4

Retrofits and modernization, computer control and Instrumentation, Energy conservation and diversification.

Unit 5

Design of ammonia converters and other reactors, colling water, expansion, capacity utilization and other problem of fertilizers industry.