ACADEMIC REGULATIONS & CURRICULUM

(Applicable to the Students Admitted from the Academic Year 2015-16)

CHEMICAL ENGINEERING

(B.Tech. Programme)

Maharaj Vijayaram Gajapathi Raj College of Engineering (Autonomous)

Approved by AICTE, New Delhi, and Permanently Affiliated to JNTUK, Kakinada
Listed u/s 2(f) & 12(B) of UGC Act 1956.
Vijayaram Nagar Campus, Chintalavalasa, Vizianagaram - 535005, Andhra Pradesh

Vision

MaharajVijayaramGajapathi Raj College of Engineering strives to become a centre par excellence for technical education where aspiring students can be transformed into skilled and well-rounded professionals with strong understanding of fundamentals, a flair for responsible innovation in engineering practical solutions applying the fundamentals, and confidence and poise to meet the challenges in their chosen professional spheres.

Mission

The management believes imparting quality education in an atmosphere that motivates learning as a social obligation which we owe to the students, their parents/guardians and society at large and hence the effort is to leave no stone unturned in providing the same with all sincerity. Towards that end, the management believes special focus has to be on the following areas:

- Have on-board staff with high quality experience and continuously updating themselves with latest research developments and sharing that knowledge with students.
- Having a well stream-lined teaching learning process that is continuously assessed for effectiveness and fine-tuned for improvement.
- Having state-of-the-art lab and general infrastructure that gives students the necessary tools and means to enhance their knowledge and understanding.
- Having a centralized department focused on improving placement opportunities for our students directly on campus and coordinating the training programs for students to complement the curriculum and enhance their career opportunities.
- Having advanced research facilities and more importantly atmosphere to encourage students to pursue self-learning on advanced topics and conduct research.

ABOUT THE INSTITUTION:

Maharaja Alak Narayan Society of Arts and Science (MANSAS) is an Educational Trust founded by Dr. (late) P.V.G Raju, Raja Saheb of Vizianagaram in the hallowed memory of his father Maharaja Alak Narayan Gajapati with a view to confound socio-economic inequalities in the Vizianagaram principality executing a trust deed on 12-11-1958 duly established Maharajah's College and other Educational Institutions in and around Vizianagaram. The Trust is a charitable one published under Section 6 a (1) of A.P Charitable and Hindu Religious Institutions and Endowment Act 30 of 1987.

The object of the Trust is to manage the properties of educational Institutions under it and to promote and advance the cause of education in general, besides awarding scholarships to deserving students enabling them to undergo special training in science and industries in and out of India. The Trust has made an uncompromising contribution to the nation by presenting the stalwarts.

Trust offers KG to PhD level education in Arts, Sciences, Law, Pharmacy, Humanities Education, Engineering and Management and presently houses 12 Educational Institutions. MVGR College of Engineering is one of the 12 institutes.

MaharajVijayaramGajapathi Raj (MVGR) College of Engineering was established in the year 1997 by MaharajAlak Narayan Society for Arts and Sciences (MANSAS) to impart quality technical education. The Institution is located in lush green, serene and pollution free environment spread over 60 acres of land in Chintalavalasa village situated in the outskirts of Vizianagaram, a fort city in the north coastal region of Andhra Pradesh.

MVGR College of Engineering

- Established in the year 1997
- Reaccredited for all B.Tech Programs (CHEMICAL, CSE, ECE, EEE, IT, CIVIL& MECHANICAL) by National Board of Accreditation
- Departments of MECHANICAL, CHEMICAL, ECE and CSE are recognized as RESEARCH CENTERS by JNTUK
- MBA program was accredited by NBA and presently in the progress of reaccreditation
- Reaccredited with 'A' grade by National Assessment and Accreditation Council up to 2020
- Conferred "Autonomous Status" up to 2020-21 by UGC
- Permanently affiliated to JN Technological University-Kakinada
- Listed under sections of 2(f) & 12(b) of UGC act 1956.
- Approved by AICTE-New Delhi
- MSME identified "Business Incubation Centre"
- Government of AP identified the institution as "Skill Development Centre"
- MVGR College of Engineering is rated as one among the best EngineeringInstitutions in the state of Andhra Pradesh.
- Identified as Technical Skill Development Institute by SIEMENS

MVGR College of Engineering is rated as one among the best engineering colleges in the state of Andhra Pradesh as it set up highest standards in all areas of curricular, co-curricular and extra-curricular activities and in students' placements. Based on industry and expert's feedback, the college is updating the curriculum from time to time. The college offers many value added add-on courses for students and conducts training programs to meet the industries' requirements.

Academic Regulations for B.Tech. Program

Applicable to the students admitted from the Academic year 2015-2016 onwards.

1. COURSE PATTERN:

B.Tech. : The program is 8 Semesters over 4 academic years.

B.Tech. (Lateral Entry): The program is 6 Semesters over 3 academic years.

2. AWARD OF DEGREE:

A student will be declared eligible for the award of degree on fulfilling the following academic regulations:

a) Shall complete program course work within 8 years (6 years in case of lateral entry admission) from the year of admission else shall forfeit admission.

b) Shall register for 180 credits (138 in case of lateral entry admission)and secure all.

c) Shall also register and successfully complete audit programs (Non-credit) offered by the Program Department.

d) On completing one year of class work, mayopt for a break of 1 year which shall be deemed as GAP year, as recommended by APSCHE, for undertaking successful entrepreneurial ventures.

3. CERTIFICATION PROGRAMME:

The following certification programs are being offered:

S.No.	Department	Name of the Program
1	MECH	Windchill 10.2 PDM by Adroitec Engineering Solutions Pvt. Ltd., Hyderabad
2	MECH	Creo 2.0 by PTC
3	MECH	Edgecam by Verosoft, UK
4	CHEM	Chemical Process Design and Simulation by Simtech Simulations, Hyderabad
5	ECE	Embedded Systems by ThinkLABS, Mumbai
6	ECE	Labview by National Instruments Systems India Pvt. Ltd.
7	ECE	Unified Technology Learning Program (UTLP) by Wipro Mission 10X
8	CSE, IT	PEGA by Virtusa Corporation
9	CSE, IT	Microsoft technologies by Microsoft Corp.
10	CSE, IT	Ethical Hacking by EC-Council Academia
11	CSE, IT	Java and C by Talent Sprint
12	CSE, IT	Network Analyst (CCNA) by Cisco Systems Inc
13	CSE, IT	Java Programming (OCJP) and DBMS by Oracle
14	EEE	PLC, Drives and Automation by Siemens
15	EEE	PLC by New Dawn Automation
16	Civil	Remote Sensing and GIS by Indian Institute of Remote Sensing

a) Certification Programs other than mentioned may also be offered with advance notice from time to time.

b) The Institution shall offer the certification programs by itself or in collaboration with industry/such other Institutions deemed to have specialized expertise in the proposed area of training.

c) Only students of the Institution shall be eligible to register on payment of prescribed fee.However, subject to availability of resources and the demand the Institution may offer the program to external candidates meeting the pre-qualification requirements and in the order of the merit.

d) The duration of the course and design of the content shall be done by the respective departments of the Institution by themselves or in collaboration with industry/such other Institutions deemed to have specialized expertise in the proposed area of training.

e) The duration under normal condition shall not exceed 50 hours per semester else it can suitably be distributed over a number of semesters.

f) Mere enrolment/registration for the program shall not entitle any claim for award of certificate.

g) A candidate shall be deemed eligible for the award of the certificate subject to:

- Attending at least 75% of scheduled training sessions
- Compliance to all the requirements of submission of the assignments, presentations, seminars, projects, etc., and also appears for periodic tests
- Attaining minimum levels of performance as prescribed by the departments successfully
- Payment of such fee as deemed fit for the certification

h) A candidate registered and failed to meet the requirements shall be permitted to repeat the said training one another time after remitting 25% of the fee fixed for the program as re-registration fee

4. COURSES OFFERED:

Name of the Program	Degree
B.Tech. UG Programs (Engineering & Technology)	• Civil Engineering • Electrical and Electronics Engineering • Mechanical Engineering • Electronics and Communication Engineering • Computer Science and Engineering • Chemical Engineering • Information Technology
M.Tech. PG Programs (Engineering & Technology)	• Structural Engineering • Power Systems • Product Design and Manufacturing • VLSI • Communication Systems • Computer Networks and Information Security • Data Sciences
Other PGPrograms	MBA
Ph. D.(Research Programs)	CIVIL ,EEE,MECH, ECE, CSE, CHEM , IT,MBA,Maths.

5. DISTRIBUTION AND WEIGHTAGE OF MARKS:

B.TECH:

a). Theory courses are assessed for 100 marks with a split of 40 marks for internal assessment and 60 marks for semester end external examination.

- Two internal assessments tests (90 min each), for each theory course are conducted over the period of the semester, one in the middle and the other at the end and the performances are averaged for 30 marks.
- Internal assessment test shall have 3 questions each for 10 marks, all questions to be answered.
- Shall also be assessed for two assignments/surprise test/quiz or a combination each for 5 marks and for a total of 10 marks.
- External examination is for 60 marks (180 min). Question paper contains 7 questions at least 1 question from each unit. Each question carries 12 marks. A student is expected to answer any 5 questions.

b). **Laboratory/Practice:**

Laboratory/Practice courses are assessed for 100 marks with a split of 40 marks for internal assessment and 60 marks for semester end external examination.

- Continuous assessment for 20 marks for each experimental session finally averaged to 20 marks.
- Internal assessment test (180 min) conducted at the end of the semester shall be assessed for another 20 marks where a student is expected to perform at least one laboratory test/experiment. Appropriate weightage shall be given to the performance in viva-voce.
- External examination is for 60 marks (180 min) - conducted and assessed by an external and internal examiners.
- Both internal and external examination shall include assessment of the student on
    a) Knowledge of principles/concepts involved
    b) Experimental design
    c) Result interpretation and analysis
    d) Experimental report

c). **Drawing/Design/Estimation:**

These courses are assessed for 100 marks with a split of 40 marks for internal assessment and 60 marks for semester end external examination.

- Continuous assessment is for 20 marks for each session / unit finally averaged to 20 marks.
- Two internal assessment tests are conducted during the semester and assessed for the remaining 20 marks by taking the average.

d) **Project Evaluation**:

- A student shall take a project during the eighth semester.
- Project is evaluated for 200 marks.
- A student shall report to the guide/external supervisor and work under his supervision at least 10 hours per week.
- Also, a student shall engage a minimum of 10 hours per week in the directed study/learning a modern tool/self-learning (referencing etc.,)/periodic report writing/conduct of experiments/tests/fabrication together.
- Evaluation shall comprise of internal and external assessment.

  Internal: 80

  External: 120

- A project committee comprising of HoD, department Academic Coordinator, R&D member of the department, one senior faculty and guide shall review the progress once in four weeks.
- Vice-Principal (Academic) / one of the ADMN team members shall be an invitee for the review.
- Internal evaluation shall be done by HoD, department Academic Coordinator, R&D member of the department, one senior faculty and guide for 80 marks.
- External evaluation shall be done by HoD, Guide/Internal Examiner and External Examiner for 120 marks.
- Assessment shall be on:

  a) Problem definition

  b) Literature review

  c) Review on fundamental knowledge involved

  d) Inter disciplinary aspect

  e) Experimental/methodology design

  f) Result analysis and interpretations

  g) Report writing

  h) Team work

  i) Presentation

  j) Viva-voce

6. ATTENDANCE REGULATIONS:

I. A student shall be eligible to appear for end semester examinations, if aminimum of 75% of attendance in aggregate of all the subjects (Theory & Lab.) for the semester is secured.

II. A Student shall be promoted to the next semester on fulfillment of a minimum of 75% attendance in the current semester.

III. A student detained may seek re- admission for that semester when offered.

IV. To appear for end laboratory examination a candidate shall put up a minimum of 75% attendance for regular lab sessions and should have completed all the laboratory experiments/tests along with submission of record complete in all respects.

7. MINIMUM ACADEMIC REQUIREMENTS:

i. A student is deemed to have satisfied the minimum academic requirements if he has earned the credits allotted and secures at least 24 marks out of 60 marks at semester end examination and overall 40 marks out of 100 marks both internal and semester end examinationsput together.

ii. A student shall be promoted from IV semester to V semester if he fulfills the academic requirement of 50% of credits up to IV semester from the following examinations irrespective of whether the candidate takes the examination or not.

a) Two regular and Two supplementary examinations of I semester
b) Two regular and One supplementary examinations of II semester
c) One regular examination and One supplementary examination of III semester
d) One regular examination of IV semester.

iii. A student shall be promoted from VI semester to VII semester subject to fulfillment of the academic requirement of 50% of credits up to VI semester from the following examinations irrespective of whether the candidate takes the examination or not.

a) Three regular and Three supplementary examinations of I semester
b) Three regular and Two supplementary examinations of II semester
c) Two regular and Two supplementary examinations of III semester
d) Two regular and One supplementary examinations of IV semester
e) One regular and One supplementary examination of V semester
f) One regular examination of VI semester.

B.TECH (Lateral Entry):

i) A student is deemed to have satisfied the minimum academic requirements if he has earned the credits allotted and secures at least 24 marks out of 60 marks at semester end examination and overall 40 marks out of 100 marks both internal and semester end examinations put together.

ii) A student shall be promoted from VI semester to VII semester if he fulfills the academicrequirement of 50% of credits up to VI semester from the following examinations irrespective of whether the candidate takes the examination or not replace with:

a) Two regular and Two supplementary examinations of III semester
b) Two regular and one supplementary examinations of IV semester
c) One regular and One supplementary examinations of V semester
d) One regular examination of VI semester.

8. PROGRAM STRUCTURE:

The total program will consist of the following components.

a) Foundation Mandatory	FM	39-45 credits

- Basic Science Core(BSC)
- Engineering Science Core(ESC)
- Mandatory Learning Core(MLC)
- English & Humanities Core(EHC)

b) Foundation Elective	FE	06-09 credits
c) Core Mandatory(Theory)	CM	68-76 credits
d) Core Mandatory(Lab)	CM(L)	18-22 credits
e) Core Elective (Theory)	CE(T)	21-27 credits
f) Open Elective	OE	06-09 credits
g) Directed Study	DS	02-04 credits
h) Project	PR	08-12 credits
i) Audit Courses	AC	S/N

- Open electives offered by the parent department are listed in the course structure and are offered to students of other programs also.
- For audit course a student is expected to meet minimum contact hours, as prescribed by the department and shall also comply with the requirements of submission of assignments/projects.

List of Foundation Electives:

1. Professional Communication
2. Business Communication
3. Material Science
4. Engineering Mathematics-II
5. Electro Magnetic Theory
6. Instrumental Methods of Analysis
7. Thermodynamics
8. Applied Analysis
9. Probability & Statistics
10. Complex variables & Statistical Methods

List of Audit Courses:

1. Professional Ethics & IPR
2. Soft Skills-I
3. Soft Skills-II
4. General Aptitude
5. NSS/NCC/Sports/Cultural/Yoga
6. Health and Nutrition
7. Entrepreneurship Development
8. Foreign Language (Chinese/Japanese/Korean/German/French)

*For all the programs offered, in the list of courses for electives one of the choices would be "MOOCs". Each department shall short list MOOCs course/(s) meeting the requirements of course duration, credits, etc., from time to time. The same shall be placed in the immediate BoS meeting for ratification.

9. GRADING SYSTEM:

The UGC recommends the following procedure to compute the Semester Grade Point Average (SGPA) and Cumulative Grade Point Average (CGPA):

Semester Grade Point Average (SGPA) is calculated on the basis of grade points obtained in all courses, except audit courses and courses in which satisfactory or course continuation has been awarded.

The **SGPA** is the ratio of sum of the product of the number of credits with the grade points scored by a 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

$$\mathbf{SGPA\ (Si) = \Sigma(Ci \times Gi) / \Sigma Ci}$$

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.

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.

$$\mathbf{CGPA = \Sigma(Ci \times Si) / \Sigma\ Ci}$$

Where Si is the SGPA of the i^{th} semester and Ci is the total number of credits in that semester.

The UGC recommends a 10-point grading system with the following letter grades as given below:

O	(Outstanding)	10
A+	(Excellent)	9
A	(Very Good)	8
B+	(Good)	7
B	(Above Average)	6
C	(Average)	5
P	(Pass)	4
F	(Fail)	0
Ab	(Absent)	0

- A student with Grade F is required to reappear for the examination.

Illustration for Computation of SGPA

Course	Credit	Grade Letter	Grade point	Credit Point (Credit x Grade)
Course 1	3	A	8	3 X 8 = 24
Course 2	4	B+	7	4 X 7 = 28
Course 3	3	B	6	3 X 6 = 18
Course 4	3	O	10	3 X 10= 30
Course 5	3	C	5	3 X 5 = 15
Course 6	4	B	6	4 X 6 = 24
20				**139**

Thus, **SGPA** =139/20 = 6.95

Illustration for Computation of CGPA

Semester 1	**Semester 2**	**Semester 3**	**Semester 4**	**Semester 5**	**Semester 6**
Credit : 20	Credit : 22	Credit : 25	Credit : 26	Credit : 26	Credit : 25
SGPA:6.9	SGPA: 7.8	SGPA: 5.6	SGPA: 6.0	SGPA: 6.3	SGPA: 8.0

Semester 7	**Semester 8**
Credits: 23	Credits:13
SGPA: 8.2	SGPA: 8.5

Thus, **CGPA** = 20 x 6.9 + 22 x 7.8 + 25 x 5.6 + 26 x 6.0 + 26 x 6.3 + 25 x 8.0+23x8.2+13x8.5

_____ **= 7.05**

180

10. ELIGIBILITY FOR AWARD OF DEGREE:

A student shall be eligible for award of the degree if he/she fulfillsthe following conditions:

1) Successfully completes all the courses prescribed for the Program.
2) CGPA greater than or equal to 4.0(Minimum requirementfor Pass),
3) Should have cleared all dues.
4) Complied with all the rules and regulations during the period of study governing satisfactory conduct.

11. AWARD OF CLASS:

Candidates who are eligible for the award of B.Tech. Degree shall be placed in one of the following Classes based on CGPA.

Class	**CGPA**
Distinction	≥ 7.5
First Class	≥ 6.5
Second Class	≥ 5.5
Pass class	≥ 4.0

12. INSTRUCTION DAYS: A semester shall have a minimum of 90 clear instruction days.

13. There shall be no **branch transfer** after completion of the admission process.

14. SUPPLEMENTARY EXAMINATIONS:

Supplementary examinations shall be conducted in addition to regular examinations for every semester.

15. WITHHOLDING OF RESULTS: The result of the student will be withheld

- If any pending case of disciplinary action against him,
- Involving in any sort of malpractices etc.

16. TRANSITORY REGULATIONS:

- A candidate joining the Institution on transfer from other Institutions shall submit a record/history of courses of semesters already completed elsewhere prior to seeking such transfer.
- Board of Studies of the department may accept/reject such request for transfer depending on compatibility of the program.
- For accepted cases, the Board of Studies shall recommend equivalency of courses and also additional equivalent (substitute) courses if any to be taken up for the award of degree for all prospective courses leading to the completion of the program.
- Only candidates who have fulfilled the academic/course work requirements up to the previous semester shall be considered for admission on transfer.
- Student seeking admission on transfer should have cleared backlogsubjects of previous semestersat the parent college.
- Admission on transfer may be taken only on the payment of prescribed fee prevailing at the time.

17. AMENDMENTS TO REGULATIONS:

The Academic Council of MVGR College of Engineering (Autonomous) reserves the right to revise, amend, change or nullify the Regulations, Schemes of Examinations, and/ or Syllabi or any other such matter relating to the requirements of the program which are compatible to the contemporary/emerging trends effectively meeting the needs ofsociety/industry/stake holding groups.

18. List of MALPRACTICES and corresponding punishments

	Nature of Malpractices/Improper conduct	Punishment
1 (a)	If the candidate possesses or keeps accessible in examination hall, any paper, note book, programmable calculators, Cell phones, pager, palm computers or any other form of material concerned with or related to the subject of the examination (theory or practical) in which he is appearing but has not made use of (material shall include any marks on the body of the candidate which can be used as an aid in the subject of the examination)	Expulsion from the examination hall and cancellation of the performance in that subject only.

(b)	If the candidate gives assistance or guidance or receives it from any other candidate orally or by any other body language methods or communicates through cell phones with any candidate or persons in or outside the exam hall in respect of any matter.	Expulsion from the examination hall and cancellation of the performance in that subject only of all the candidates involved. In case of an outsider, he will be handed over to the police and a case is registered against him.
2	If the candidate has copied in the examination hall from any paper, book, programmable calculators, palm computers or any other form of material relevant to the subject of the examination (theory or practical) in which the candidate is appearing.	Expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted to appear for the remaining examinations of the subjects of that Semester/year. The Hall Ticket of the candidate is to be cancelled.
3	If the candidate impersonates any other candidate in connection with the examination.	The candidate who has impersonated shall be expelled from examination hall. The candidate is also debarred and forfeits the seat. The performance of the original candidate, who has been impersonated, shall be cancelled in all the subjects of the examination (including practicals and project work) already appeared and shall not be allowed to appear for examinations of the remaining subjects of that semester/year. The candidate is also debarred for two consecutive semesters from class work and all University examinations. The continuation of the course by the candidate is subject to the academic regulations in connection with forfeiture of seat. If the imposter is an outsider/candidate not on rolls, he will be handed over to the police and a case is registered against him.
4	If the candidate mishandles the Answer book or additional sheet or takes out or arranges to send out the question paper during the examination or answer book or additional sheet, during or after the examination. Also if the answer script is mutilated / damaged disturbing the shape, of the script, answers, the bar code intentionally.	Expulsion from the examination hall and cancellation of performance in that subject and all the other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester. He shall be

		debarred from class work and all examinations and be allowed to reregistered for the next subsequent odd or even semester only. The continuation of the course by the candidate is subject to the academic regulations in connection with forfeiture of seat.
5.	Uses objectionable, abusive or offensive language in the answer paper or in letters to the examiners or writes to the examiner requesting him to award pass marks.	The same should be brought to the notice of CE who in turn in consultation with malpractice committee makes decision for cancellation of the performance in that subject.
6.	Refuses to obey the orders of the Chief Superintendent/Assistant – Superintendent / any officer on duty or misbehaves or creates disturbance of any kind in and around the examination hall or organizes a walk out or instigates others to walk out, or threatens the officer-in charge or any person on duty in or outside the examination hall of any injury to his person or to any of his relations whether by words, either spoken or written or by signs or by visible representation, assaults the officer-in-charge, or any person on duty in or outside the examination hall or any of his relations, or indulges in any other act of misconduct or mischief which result in damage to or destruction of property in the examination hall or any part of the College campus or engages in any other act which in the opinion of the officer on duty amounts to use of unfair means or misconduct or has the tendency to disrupt the orderly conduct of the examination.	In case of students of the college, they shall be expelled from examination halls and cancellation of their performance in that subject and all other subjects the candidate(s) has (have) already appeared and shall not be permitted to appear for the remaining examinations of the subjects of that semester. The candidates also are debarred and forfeit their seats. In case of outsiders, they will be handed over to the police and a police case is registered against them.
7.	Leaves the exam hall taking away answer script or intentionally tears of the script or any part thereof inside or outside the examination hall.	Expulsion from the examination hall and cancellation of performance in that subject and all the other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year. The candidate is also debarred for two consecutive semesters from class work and all University examinations. The continuation of the course by the candidate is

		subject to the academic regulations in connection with forfeiture of seat.
8.	Possess any lethal weapon or firearm in the examination hall.	Expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year. The candidate is also debarred and forfeits the seat.
9.	If student of the college, who is not a candidate for the particular examination or any person not connected with the college indulges in any malpractice or improper conduct mentioned in clause 6 to 8.	Student of the colleges expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester. The candidate is also debarred and forfeits the seat. Person(s) who do not belong to the College will be handed over to police and, a police case will be registered against them.
10	Comes in a drunken condition to the examination hall.	Expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester.
11	Copying detected on the basis of internal evidence, such as, during valuation or during special scrutiny.	Cancellation of the performance in that subject and all other subjects the candidate has appeared including practical examinations and project work of that semester/year examinations.

Ragging

Prohibition of ragging in Educational Institutions Act 26 of 1997

Salient Features

- Ragging within or outside any Educational Institution is prohibited.
- Ragging means doing an act which causes or is likely to cause Insult or Annoyance of Fear or Apprehension or Threat or Intimidation or outrage of modesty or Injury to a student

	Imprisonment upto		Find Upto
Teasing, Embarrassing and Humiliation	6 Months	+	Rs. 1,000/-
Assaulting or Using Criminal force or Criminal intimidation	 1 Year	+	Rs. 2,000/-
Wrongfully restraining or confining or causing hurt	 2 Years	+	Rs. 5,000/-
Causing grievous hurt, kidnapping or Abducts or rape or committing unnatural offence	 5 Years	+	Rs. 10,000/-
Causing death or abetting suicide	 10 Months	+	Rs. 50,000/-

In Case of Emergency CALL TOLL FREE NO. : 1800 - 425 - 1288

LET US MAKE MVGR A RAGGING FREE CAMPUS

ABSOLUTELY NO TO RAGGING

1. Ragging is prohibited as per Act 26 of A.P. Legislative Assembly, 1997.
2. Ragging entails heavy fines and/or imprisonment.
3. Ragging invokes suspension and dismissal from the College.
4. Outsiders are prohibited from entering the College and Hostel without permission.
5. Girl students must be in their hostel rooms by 7.00 p.m.
6. All the students must carry their Identity Cards and show them when demanded
7. The Principal and the Wardens may visit the Hostels and inspect the rooms any time.

DEPARTMENT OF CHEMICAL ENGINEERING

COURSE STRUCTURE

I SEMESTER						
S. No	Course code	Subject	L	T	P	C
1	A1MAT001	Engineering Mathematics-I	3	0	0	3
2	A1CYT002	Chemistry for Chemical Engineers - I	3	0	0	3
3	A1CIT001	Computer Programming	3	0	0	3
4	A1CET001	Basics of Civil & Mechanical Engineering	3	0	0	3
5	A1CHT002	Introduction to Chemical Engineering	3	0	0	3
6	A1EHL001	English Language Practice-I	1	0	2	2
7	A1CYL001	Engineering Chemistry lab	0	0	3	2
8	A1CIL001	Computer Programming Lab	0	0	3	2
		Total				**21**

II SEMESTER						
S. No	Course code	Subject	L	T	P	C
1	A1MAT002	Mathematical Methods	3	0	0	3
2	A1CHT001	Environmental Studies	3	0	0	3
3	A1PYT001	Engineering Physics	3	0	0	3
4	A1EET001	Basic Electrical and Electronics Engineering	3	0	0	3
5	A1MED001	Engineering Drawing	3	0	0	3
6	A1EHL002	English Language Practice-II	1	0	2	2
7	A1PYL001	Engineering Physics Lab	0	0	3	2
8	A1MEW001	Basic Engineering Workshop	0	0	3	2
		Total				**21**

III SEMESTER						
S. No	Course code	Subject	L	T	P	C
1	A1CHT201	Material Science for Chemical Engineers	4	0	0	4
2	A1CHT202	Chemical Process Calculations	3	1	0	4
3	A1CHT203	Fluid Mechanics for Chemical Engineers	3	1	0	4
4	A1CHT204	Chemical Technology	4	0	0	4
5	A1CYT205	Organic Chemistry	4	0	0	4
6	A1XXT1XX	**Foundation Elective-I**	3	0	0	3
7	A1CHL201	Fluid Mechanics Lab for Chemical Engineers	0	0	3	2
8	A1CHL202	Chemical Technology Lab	0	0	3	2
9	A1ACA5XX	**Audit Course-1**	-	-	-	-
		Total				**27**

IV SEMESTER						
S. No	Course code	Subject	L	T	P	C
1	A1CHT206	Process Heat Transfer	3	1	0	4
2	A1CHT207	Chemical Engineering Thermodynamics-I	3	1	0	4
3	A1CHT208	Mechanical Unit Operations	3	1	0	4
4	A1CHT3XX	**Core Elective-I**	3	0	0	3
5	A1XXT1XX	**Foundation Elective-II**	3	0	0	3
6	A1CHL203	Process Heat Transfer Lab	0	0	3	2
7	A1CHL204	Mechanical Unit Operations Lab	0	0	3	2
8	A1ACA5XX	**Audit Course-2**	-	-	-	
		Total				**22**

V SEMESTER						
S. No	Course code	Subject	L	T	P	C
1	A1CHT209	Process Instrumentation	3	0	0	3
2	A1CHT210	Chemical Engineering Thermodynamics-II	3	1	0	4
3	A1CHT211	Chemical Reaction Engineering-I	3	1	0	4
4	A1CHT212	Mass Transfer Operations-I	3	1	0	4
5	A1CHT3XX	**Core Elective-II**	3	0	0	3
6	A1CHT3XX	**Core Elective-III**	3	0	0	3
7	A1CHL205	Chemical Reaction Engineering Lab	0	0	3	2
8	A1CHL206	Mass Transfer Operations Lab	0	0	3	2
9	A1ACA5XX	**Audit Course-3**	-	-	-	-
10	A1ACA5XX	**Audit Course-4**	-	-	-	-
		Total				**25**

VI SEMESTER						
S. No	Course code	Subject	L	T	P	C
1	A1CHT213	Mass Transfer Operations-II	3	1	0	4
2	A1CHT214	Process Dynamics and Control	3	1	0	4
3	A1CHT215	Chemical Reaction Engineering-II	3	1	0	4
4	A1CHT216	Process Modeling and Simulation	3	1	0	4
5	A1CHT3XX	**Core Elective-IV**	3	0	0	3
6	A1CHL207	Process Dynamics and Control Lab	0	0	3	2
7	A1CHL208	Process Modeling and Simulation Lab using MATLAB	0	0	3	2
8	A1XXT4XX	**Open Elective-I**	3	0	0	3
9	A1ACA5XX	**Audit Course-5**	-	-	-	-
		Total				**26**

VII SEMESTER						
S. No	Course code	Subject	L	T	P	C
1	A1MST001	Managerial Economics & Financial Analysis	3	0	0	3
2	A1CHT217	Transport Phenomena	3	1	0	4
3	A1CHT218	Plant Design & Economics for Chemical Engineers	3	1	0	4
4	A1CHT3XX	**Core Elective-V**	3	0	0	3
5	A1CHT3XX	**Core Elective-VI**	3	0	0	3
6	A1CHT3XX	**Core Elective-VII**	3	0	0	3
7	A1XXT4XX	**Open Elective-II**	3	0	0	3
8	A1CHD201	Process Equipment Design & Drawing using AutoCAD	0	0	3	2
9	A1ACA5XX	**Audit Course-6**	-	-	-	-
		Total				**25**

VIII SEMESTER						
S. No	Course code	Subject	L	T	P	C
1	A1CHT3XX	**Core Elective-VIII (Self-Study)**	3	0	0	3
2	A1CHP601	Directed Study	0	0	0	2
3	A1CHP602	Project Work	0	0	0	8
		Total				**13**

Foundation Electives		
S. No	Subject Code	Subject Name
1	A1EHT101	Professional Communication
2	A1EHT102	Business Communication
3	A1PYT103	Material Science
4	A1MAT104	Engineering Mathematics-II
5	A1PYT105	Electromagnetic Theory
6	A1CYT106	Instrumental Methods of Analysis
7	A1MET107	Thermodynamics
8	A1CYT108	Applied Analysis
9	A1MAT109	Probability & Statistics
10	A1MAT110	Complex Variables & Statistical Methods

S. No	Subject Code	Subject Name
Core Elective-I		
1	A1CHT301	Fertilizer Technology
2	A1CHT302	Petroleum Refining
3	A1CHT303	Polymer Technology
Core Elective-II		
1	A1CHT304	Paper Technology
2	A1CHT305	Fuel Cell Technology
3	A1CHT306	Industrial Pollution Control & Engineering
Core Elective-III		
1	A1CHT307	Ceramic Technology
2	A1CHT308	Petro Chemical Technology
3	A1CHT309	Nano Technology
Core Elective-IV		
1	A1CHT310	Food Technology
2	A1CHT311	Mineral Process Engineering
3	A1CHT312	Technology of Pharmaceuticals & Fine Chemicals
Core Elective-V		
1	A1CHT313	Bio Chemical Engineering
2	A1CHT314	Project Management
3	A1CHT315	Process Intensification
Core Elective-VI		
1	A1CHT316	Industrial Bio Technology
2	A1CHT317	Corrosion & Control
3	A1CHT318	Optimization of Chemical Processes
Core Elective-VII		
1	A1CHT319	Fermentation Engineering
2	A1CHT320	Nuclear Reactor Engineering
3	A1CHT321	Industrial Safety & Hazard Management
Core Elective-VIII		
1	A1CHT322	Statistical Molecular Thermodynamics
2	A1CHT323	Organic Solar Cells
3	A1CHT324	Bio Electricity

OPEN ELECTIVE-I OFFERED BY CHEMICAL ENGINEERING DEPARTMENT TO OTHER DEPARTMENTS		
S. No	Subject Code	Subject Name
1	A1CHT401	Non-Conventional Sources of Energy
2	A1CHT402	Design & Analysis of Experiments
3	A1CHT403	Industrial Pollution Control & Engineering
OPEN ELECTIVE-II OFFERED BY CHEMICAL ENGINEERING DEPARTMENT TO OTHER DEPARTMENTS		
S. No	Subject Code	Subject Name
1	A1CHT404	Energy Engineering
2	A1CHT405	Green Chemistry & Technology
3	A1CHT406	Environmental Impact Assessment

AUDIT COURSE ELECTIVES		
S. No	Subject Code	Subject Name
1	A1ACA501	NSS
2	A1ACA502	NCC
3	A1ACA503	Sports
4	A1ACA504	Cultural
5	A1ACA505	Yoga
6	A1ACA506	Health & Nutrition
7	A1ACA507	Entrepreneurship Development
8	A1ACA508	Foreign Language (Chinese/Japanese/Korean/German)
9	A1ACA509	Professional Ethics & IPR
10	A1ACA510	Soft Skills-I
11	A1ACA511	Soft Skills-II
12	A1ACA512	General Aptitude
13	A1ACA513	MOOC

I – SEMESTER

A1MAT001	I – SEMESTER	L	T	P	C
	ENGINEERING MATHEMATICS-I	**3**	**0**	**0**	**3**
	Total Contact Hours – 45				
COURSE OBJECTIVES					
COBJ1	To develop the proficiency in solving 1st order & 1st degree differential equations and linear differential equations of second and higher order with constant coefficients.				
COBJ2.	To learn the definition and scope of Laplace Transforms and to learn the method of solving initial value problems.				
COBJ3.	To learn the concept of Maxima and Minima of functions of several variables.				
COBJ4.	To learn the method of formation and solving of PDE's of particular types of linear and non-linear.				

SYLLABUS

UNIT – I: DIFFERENTIAL EQUATIONS OF FIRST ORDER
Linear equations – Bernoulli equations – Exact equations

APPLICATIONS OF DIFFERENTIAL EQUATIONS OF FIRST ORDER:
Newton's Law of cooling – rate of decay of radioactive materials - orthogonal trajectories.

UNIT – II: HIGHER ORDER LINEAR DIFFERENTIAL EQUATIONS:
Linear differential equations-definition-operator form-rules for finding complimentary function - rules for finding particular integral-working procedure to solve the equations.

UNIT-III: LAPLACE TRANSFORMS:
Introduction-definition-transforms of elementary functions- properties of laplace transforms-transforms of derivatives-transforms of integrals-multiplication by t^n-division by t .(statements only)

INVERSE TRANSFORMS–method of partial fractions- Convolution theorem (without proof)-applications to differential equations.

UNIT-IV: PARTIAL DIFFERENTIATION AND ITS APPLICATIONS:
Functions of two or more variables-total derivative-differentiation of implicit function-change of variables-Jacobians.Maxima and Minima of functions of two variables-Lagrange's method of undetermined multipliers.

UNIT – V: PARTIAL DIFFERENTIAL EQUATIONS:
Introduction-Formation of partial differential equations-linear equations of first order-non linear equations of first order (standard types).

UNIT – VI: HIGHER ORDER PARTIAL DIFFERENTIAL EQUATIONS:
Homogeneous linear partial differential equations with constant coefficients- rules for finding complimentary function – rules for finding particular integral-working procedure to solve the equations.

APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATIONS: Method of separation of variables- vibrations of stretched string – wave equation-One-dimensional heat flow equation, solution of Laplace equation (problems only)

TEXT BOOK:

1. B.S.GREWAL, Higher Engineering Mathematics, 42nd Edition, Khanna publishers

REFERENCES:

1. ERWIN KRESZIG, Advanced Engineering Mathematics, 9th Edition, Wiley-India
2. GREENBERG, Advanced Engineering Mathematics, 2nd edition, Pearson education

COURSE OUTCOMES:

CO1. Students will be able to apply the knowledge of solving 1st order & 1st degree differential equations in finding orthogonal trajectories of families of curves, Growth & Decay problems

CO2. Student will be able to find the solution of initial value problems and be able to evaluate improper integrals of particular kind by using Laplace Transforms

CO3. Students will be able to apply the concepts of Maxima and Minima for finding extreme values

CO4. Student will be able to formulate and solve P.D.E and be able to apply the knowledge in finding the solutions of one dimensional wave equation and one dimensional heat equation.

A1MAT001- ENGINEERING MATHEMATICS-I											
Course designed by	DEPARTMENT OFMATHEMATICS										
CO / PO mapping	a	b	c	d	e	f	g	h	i	j	k
	X				X						X

A1MAT001- ENGINEERING MATHEMATICS-I

Course designed by	DEPARTMENT OFMATHEMATICS
Approval	Approved by: Meeting of Board of Studies held on 23.06.15
	Ratified by: 1st Meeting of Academic Council, June, 2015

A1CYT002	I – SEMESTER	L	T	P	C
	CHEMISTRY FOR CHEMICAL ENGINEERS - I	3	-	-	3
	Total Contact Hours – 45				
COURSE OBJECTIVES					
1.	For prospective engineers, knowledge about water used in industries (boilers etc.) and for drinking purposes is necessary; hence chemistry of hard water, boiler troubles and modern methods of softening hard water are introduced.				
2.	Knowledge of galvanic cells, concentration cells is necessary for engineers to understand corrosion and its control; also this knowledge helps in understanding bio-sensors and fuel cells.				
3.	A broad understanding of the fuels which are employed on a large scale is necessary for all engineers to understand energy – related problems and solving them. The mechanism of lubrication is needed in machinery.				
4.	Knowledge of Distribution law and colloids helps the student to know the importance of separation of solids and liquids and nature and properties of colloids imparts useful knowledge for applications.				
5.	Knowledge on kinetics and catalysis makes the student understand the factors which influence reaction rates and catalysis ranging from the theoretical basis to the industrial level.				
6.	Students will gain knowledge on the different instrumental methods and their use in chemical analysis in lab and industry.				

SYLLABUS:

UNIT-1: WATER TECHNOLOGY: Hard& soft water – Estimation of hardness by EDTA method – Potable water- Sterilization and disinfection – Boiler feed water – Boiler troubles – scale formation, corrosion, caustic embrittlement, -Priming and foaming , – Softening of water – Lime soda process (cold & hot), Numerical problems on Lime Soda requirements for softening – Zeolite method- Ion exchange process - Reverse osmosis – Electro Dialysis.

UNIT-2 : ELECTROCHEMISTRY: Concept of ionic mobilities – Applications of Kohlrausch law – Conductometric titrations – Galvanic cells — glass electrode, ion selective electrode (Fluoride and enzyme based) -Potentiometric titrations – Concentration cells – Batteries(Alkaline battery, Nickel-Cadmium battery, Lead acid battery, solid state battery, Li ion battery (with reactions) and Fuel cells(H2-O2 and methanol- oxygen).

UNIT-3: FUELS& LUBRICANTS: Coal – Proximate and ultimate analysis – Numerical problems based on coal analysis – Calorific value – HCV and LCV – determination of calorific value by bomb calorimeter – numerical problems based on calorific value; Petroleum – Refining – Cracking, Petrol & Diesel knocking; Combustion – numerical problems on air requirements for combustion.

Lubricants – purpose of lubrication, mechanism of lubrication

UNIT – 4: DISTRIBUTION LAW AND COLLOIDS: Nernst Distribution Law – Distribution Coefficient – Limitations of Distribution Law and Modifications– Determination of Equilibrium Constant from Distribution Coefficient – Applications of Distribution Law. Colloids and Classification, Solids in liquids (sols) – Properties (kinetics, optical and Electrical properties) –Stability of Colloids- Protective Action, Hardy – Schultz Law, Gold Number - General applications of colloids.

UNIT – 5: CHEMICAL KINETICS AND CATALYSIS: Order, molecularity – significance with examples – differences – theories of reaction rates – collision theory – Absolute reaction rate theory (Transition state theory) – definition and expressions for zero, first and second order reactions (with two examples) – pseudo unimolecular reactions.

Catalysis – Homogeneous and Heterogeneous – Characteristics – Theories of catalysis – Intermediate compound formation theory – Adsorption theory – Autocatalysis –Promoter – Moderator – Catalytic Poisons - Enzyme catalysis – Mechanism – Influence of concentration -Michaelis - Menton equation .

UNIT – 6: FUNDAMENTALS OF SPECTROPHOTOMETRY AND CHROMOTOGRAPHY: Photochemical Reactions – Differences between photochemical and thermochemical reactions - Lambert's law- Beer – Lambert's law - limitations of Beer Lambert's law- spectrophotometry – applications.

Introduction to chromatography, classification and simple applications of chromatographic techniques

PRESCRIBED TEXT BOOK

1. Engineering Chemistry, Jain and Jain (Latest Edition), DhanpatRai Publishing company Ltd,
2. Essentials of Physical Chemistry, ArunBahl, B. S. Bahl, S. Chand Publications, New Delhi
3. Principles of Instrumental Analysis, Skoog, Neimann and Holler, Cengage Learning

STANDARD BOOKS

4. Text book of Physical Chemistry, Thomas Engel and Reid, Pearson Education
5. Text Book of Engineering Chemistry, S.S. Dara (2013), S. Chand Technical Series
6. Text Book of Physical Chemistry, Puri and Sharma

REFERENCE BOOKS

1. Chemistry for Engineers, Teh Fu Yen, Imperial College Press, London
2. Physical Chemistry, P.W. Atkins, Oxford Publications
3. Electrochemistry, Samuel Glasstone
4. Chemical Kinetics, K. J. Laidler,
5. Instrumental methods of analysis, Willard, Meritt and Dean, CBS publications
6. Principles of instrumental analysis, Douglas A. Skoog, F. James Holler, Stanley R. Crouch, Cengage Learning; VI edition 2014.

COURSE OUTCOMES

1. Students gain the knowledge about water used in industries, difference between hard and soft water, estimation of hardness of water and specification of potable water and purification of sea water through reverse osmosis.
2. Students gain the knowledge of galvanic cells, concentration cells, selected ion selective electrodes, Conductometry and Potentiometry, to understand the principle and applications of electrochemistry with alternate sources of energy and also help them to tackle problems of corrosion control.
3. Student gain the knowledge on the determination of calorific value, analysis of coal and sufficient knowledge of petroleum fuels, lubricants with mechanism of lubrication of machines.
4. Student gains the knowledge on the separation methods in industry using Nernst distribution law and also the uses and application of colloids in various fields.
5. Students gain the knowledge for the control of a chemical reaction with the aid of external factors if necessary in laboratory as well as in industry.
6. Students gain the knowledge on trace analysis and separation techniques.

A1CYT002 – CHEMISTRY FOR CHEMICAL ENGINEERS - I											
Course designed by	Department of Chemistry										
CO / PO mapping	a	b	c	d	e	f	g	h	i	j	k
	✓			✓	✓			✓	✓	✓	

A1CYT002 – CHEMISTRY FOR CHEMICAL ENGINEERS - I	
Course designed by	Department of Chemistry
Approval	Approved by: Meeting of Board of Studies held on 23-06-2015
	Ratified by: 1st Meeting of Academic Council, June, 2015

A1CIT001	I – SEMESTER	L	T	P	C
	COMPUTER PROGRAMMING	**3**	**0**	**0**	**3**
	Total Contact Hours – 42				
	Prerequisite : None				
COURSE OBJECTIVES					
COBJ1.	Students will study systematic approach to problem solution specification using finite number of unambiguous steps.				
COBJ2.	Students will gain understanding of procedural language features using C as the template.				
COBJ3.	Students will read and analyze alternative construct choices in procedural language C.				
COBJ4.	Students will get exposure to `systematic approach of automated solution design, implementation and testing using a procedural language.				

SYLLABUS

UNIT – I

Introduction: Computer System, Hardware and Software concepts.

Problem Solving: Algorithm, Pseudo-code, flow-chart, program development steps, high-level, Assembly and machine languages, Creating and running programs.

Basics of C: Structure of C program, identifier, basic data types and sizes, constants, variables, arithmetic operators, relational operators, logical operators, increment and decrement operators, assignment operator, conditional operator, expressions, type conversions, conditional expressions, precedence and order of evaluation.

UNIT – II

Selection: Two way selection:if-else, null else, nested if, examples, multi-way selection: switch, else-f, examples.

Iterative: loops: while, do-while and for statements, break continue, event and counter controlled loops.

Looping Applications: Summation, powers, smallest, and largest

Arrays: Concepts, declaration, definition, accessing elements, storing elements, String and String manipulations, 1-D arrays, 2-D arrays and character arrays, string manipulations, Multi-dimensional arrays, Matrix operations, checking the symmetries of a Matrix examples.

Strings: concept, c strings.

UNIT – III

FUNCTIONS- MODULAR PROGRAMMING: functions, basics, parameter passing, storage classes extern, auto, register, static, scope rules, block structure, user defined functions, standard library functions, recursive functions, Recursive solutions for Fibonacci series, towers of Hanoi, header files, C Preprocessor, example c programs, Passing 1-D arrays, 2-D arrays to functions.

UNIT – IV

POINTERS: pointers- concepts, initialization of pointer variables, pointers and function arguments, passing by address- dangling memory, address arithmetic, character pointers and functions, pointers to pointers, pointers and multi-dimensional arrays, dynamic memory management functions, command line arguments

UNIT – V

ENUMERATED, STRUCTURE AND UNION TYPES: Derived types- structures- declaration, definition and initialization of structures, accessing structures, nested structures, arrays of structures, structures and functions, pointers to structures, self referential structures, unions, type definition, bit-fields, program applications

BIT-WISE OPERATORS: logical, shift, rotation, masks.

UNIT – VI

FILEHANDLING: Input and output- concept of a file, text files and binary files, Formatted I/O, File I/O operations, example programs

Text Books:

1. Introduction to C Programming, ReemaThareja, OXFORD
2. C Programming, A Problem Solving Approach, Forouzan, Gilberg, Prasad, CENGAGE

Reference Books:

1. The C programming Language by Dennis Richie and Brian Kernighan
2. Programming in C, PradipDey, ManasGhosh, Oxford Higher Education.

COURSE OUTCOMES

CO1	Have the ability to write a formal algorithmic solution for the given problem & explain the features of C like types including scalar & vector types, operators, expressions, expression evaluation, operator precedence, sequential, conditional & iterative constructs.
CO2	Have the ability to use modular programming constructs of C while appreciating different ways of exchanging inputs and outputs among modules and different memory allocation strategies in C.
CO3	Have the ability to define & use user defined data types using C constructs and write C programs that handles files.
CO4	Grasp the significance of primary constructs & methodology of procedural language C and appreciate the orthoganality of the same in writing reasonably complicated programs.
CO5	Grasp the significance of type extendibility in C, need for address as a data type and library functions for dealing with files in writing more complicated programs.
CO6	Fully appreciate the art of procedural programming in C and develop programs optimally using the full feature set of C language.

< A1CIT001><COMPUTER PROGRAMMING>													
Course designed by		< COMPUTER SCIENCE & ENGINEERING>											
1	Course/Program outcomes mapping	a	b	c	d	e	f	g	h	i	j	k	l
		S	S		W			W		W			W
2	Approval	Approved by: Meeting of Board of Studies held on 17th June, 2015											
		Ratified by: 1st Meeting of Academic Council, 27th June, 2015											

A1CET001	I – SEMESTER	L	T	P	C
	BASICS OF CIVIL & MECHANICAL ENGINEERING	3	0	0	3
	Total Contact Hours – 48				
	Prerequisite : Basic Physics and Mathematics				

	COURSE OBJECTIVES
1.	understand the fundamental concepts of Civil Engineering
2.	expose the students to surveying concepts and various Civil Engineering structures such as buildings, roads, bridges, dams etc.,
3.	To enable the student understand a wide range of mechanical systems and their practical applications.

SYLLABUS

UNITI **Total=09hrs**

BUILDING MATERIALS

Introduction to Civil Engineering, Construction Materials- Bricks, Stones, Cement, Wood, Cement Concrete, Steel Sections, Plastics; Physical and Mechanical Properties of building materials; Plinth area, Floor area, carpet area, floor space index

UNIT II **Total=09hrs**

SUB STRUCTURE AND SUPERSTRUCTURE:

Objectives of foundations, soils, load on foundation, essential requirements of good foundation, Types of foundation, failure of foundations and remedial measures, foundation for special structures. Introduction to superstructure, Brick masonry, stone masonry, Reinforced Concrete Structures, Beams, Columns, Lintels, Roofs, Flooring and plastering.

UNIT III **Total=09hrs**

BASICS OF SURVEYING & INFRASTRUCTURE

Introduction to surveying, principles of surveying; Objectives of surveying-classification of surveys – Measurement of distances and angles- area determination; Leveling-contours; Dams-Purpose-classification of dams-selection of site for reservoir; Bridges-components and types of bridges-Necessity and uses of bridges; Roads-types, Water bound macadam road, cement concrete road, bituminous road. Water supply- sources and quality requirements for drinking- Rainwater harvesting.

UNITIV **Total=09hrs**

Internal combustion engines: classification of IC engines, basic engine components and nomenclature, working principle of engines, comparison of CI and SI engines, comparison of four stroke and two stroke engines, Cooling system, lubrication system, injection system, ignition system.

UNITV **Total=07hrs**

Rankine cycle, Layout of steam power plant, Types of boilers, boiler mountings, Steam turbines working principle, Introduction to hydraulic turbines, classification, Pelton& Francis turbines, working, Pumps, classification, construction and working. Centrifugal, rotary and reciprocating types and performance.

UNIT VI **Total=10hrs**

Welding, Brazing, Soldering methods. Casting and forming methods. Belts-Ropes and chain drives: Gear Trains

Refrigeration and air conditioning, units of refrigeration, types of refrigerants, methods of refrigeration, Vapour compression &vapour absorption systems, Air conditioning systems, Window & split air conditioner, Central air conditioning.

TEXT BOOK:

1. Basic Civil andMechanical Engineering, G. Shanmugam, M S Palanichamy, Tata McGraw Hill
2. Elements of Mechanical Engineering, A.R. Asrani, S.M.Bhatt and P.K.Shah, B.S. Publishers

REFERENCE BOOKS:

1. Basic Civil and Mechanical Engineering, S. Shanmugasundaram, K. Mylsamy, 2nd edition,Cengage Learning India
2. Elements of Mechanical Engineering,R.K.Rajput,laxmipublications,New Delhi

OUTCOMES:

i. Student will be able to understand floor area, plinth area, and building materials such as brick, cement, concrete, steel.

ii. Student will be able to understand the concepts of surveying, infrastructure such as buildings, roads, bridges, dams.

iii. Student will be able to understand the working and function of various components of systems and subsystems of I.C. Engines, turbines, pumps and refrigerating systems.

iv. Student will be able to identify various types of mechanical components suitable for power transmission

v. Student will be able to understand Casting, forming and different metal joining processes like Welding, Brazing, Soldering

Course Objectives	Course outcomes				
	i	ii	iii	iv	v
1					
2					
3					

A1CET001 BASICS OF CIVIL & MECHANICAL ENGINEERING											
Course designed by	Department of Mechanical and Civil Engineering										
CO / PO mapping	a	b	c	d	e	f	g	h	i	j	k
CO	√			√	√	√					

A1CET001 BASICS OF CIVIL & MECHANICAL ENGINEERING	
Course designed by	Department of Mechanical and Civil Engineering
Approval	Approved by: Meeting of Board of Studies held on 17th June, 2015
	Ratified by: 1st Meeting of Academic Council, 27thJune, 2015

A1CHT002	I – SEMESTER	L	T	P	C
	INTRODUCTION TO CHEMICAL ENGINEERING (Qualitative treatment only)	3	0	0	3
	Total Contact Hours – 45				
COURSE OBJECTIVES					
1.	To understand the role of chemical engineers in process industries and understanding material and energy balances				
2.	To understand the basic concepts of momentum, heat and mass transfer				
3.	To understand the use of various equipments for of momentum, heat and mass transfer				

SYLLABUS

Unit-1:
Role of Chemical Engineers in Process Industries, Unit operations, Unit processes, units and dimensions, material and energy balance.

Unit-2:
Flow of Fluids, Nature of Fluids, Newton's law of viscosity, Laminar and turbulent flow, Types of pumps, Introduction to size reduction equipments, Transportation of solids.

Unit-3:
Heat transfer by conduction, convection (natural and forced) and radiation, heat transfer equipments (Double pipe and shell and tube heat exchangers), evaporation, evaporation equipments.

Unit-4:
Introduction to reaction engineering, stoichiometry, kinetics of elementary reactions, ideal reactors: (CSTR, PFR and Batch Reactor).

Unit-5:
Introduction to mass transfer operations, Fick's first law, Diffusion (Analogy between heat and momentum transfer), Roult's law, VLE, Relative Volatility, Distillation, Absorption, Extraction, Drying, Leaching, Adsorption, Humidification.

Unit-6:
Mass transfer equipments for Distillation, Absorption, Extraction, Drying, Leaching, Adsorption, Humidification.

TEXT BOOKS:

1.Introduction to Chemical Engineering by Ghosal

2.Elementary Chemical Engineering by Max.Peters, Tata McGraw hill -2nd edition

REFERENCE BOOKS:

1. Unit Operations by McCabe& Smith, Mc. Graw Hill, 7th ed.
2. Mass Transfer Operations by R.E.Treybal, Mc. Graw Hill, 7th ed.

Course Outcomes

1. Student will be able to understand the role of chemical engineers in process industries and to carry out material and energy balances.
2. Student will be able to understand the basic concepts of momentum, heat and mass transfer.
3. Student will be able to understand the use of equipment required for momentum, heat and mass transfer.

A1CHT002INTRODUCTION TO CHEMICAL ENGINEERING (Qualitative treatment only)											
Course designed by	CHEMICAL ENGINEERING										
CO / PO mapping	a	b	c	d	e	f	g	h	i	j	k
	✓							✓	✓		

A1CHT002 INTRODUCTION TO CHEMICAL ENGINEERING
(Qualitative treatment only)

Course designed by	CHEMICAL ENGINEERING
Approval	Approved by: Meeting of Board of Studies held on_13/06/2015
	Ratified by: 1st Meeting of Academic Council, June, 2015

A1EHL001	I – SEMESTER	L	T	P	C
	ENGLISH LANGUAGE PRACTICE -I	1		2	2
	Total Contact Hours – 45				

COURSE OBJECTIVES	
COBJ1	Student will get exposure to important concepts of English Language.
COBJ2	Student will gain an understanding of Syntactical and Grammatical Components of English Language and their correct use
COBJ3	Student will get proficiency in all four skills of Language – Listening, Reading, Speaking and Writing
COBJ4	Student shall be able to comprehend and analyze the core concepts well

Orientation – 3 hrs

UNIT I – 8 hrs

- Etymology – Word Study and Formation
- Kernel Structures
  - Refresher on Parts of Speech
  - Basic Types of Sentences
  - Subject Verb Concord
  - Tense, Time, Aspect
  - Error Detection
- Greetings and Introducing

UNIT II – 8 hrs

- Transformation of Sentences
  - Speech
  - Voice
- Paragraph Writing
  - Scrambled Sentence
  - Use of Connectives
  - Cohesiveness and Coherence
- Situational Conversations
- JAMS

UNIT III **-8 hrs**

- Transformation of Sentences
  - Degrees of Comparison
  - Simple, Compound, Complex
- Participatory Roles for Conduction Events
  - Preparing Welcome Speeches
  - Proposing Vote of Thanks
  - Introducing Guests
- Basic Listening Skills

UNIT IV **-6 hrs**

- Letter Writing
  - Leave Application
  - Invitations
  - Greetings
- Mentoring a Discussion
- Add making

UNIT V **– 6 hrs**

- Writing for Specific Purposes
  - Circulars
  - Notices
  - Banners/Advertisements
  - Captions/Slogans
- Reading Techniques
  - Skimming
  - Scanning
  - Referral Reading
  - Reading for Specific Purpose

UNIT VI **– 6 hrs**

- Note Making
- Note Taking
- Translation
- Reading for Comprehension

TEXT BOOKS: Institute's Compilation from the Sources:

1. Language Through Literature -1&2 of OUP
2. Composition Models and Exercises by John E. Warriner of Harcourt Brace Jovanovich
3. Pan Piper Series of Good, Better, Best English of G H Vallins
4. Pitman Series of Words are Important Books 1-3
5. Living English Structures by Stannard Allen of Pearson Publication
6. Developing English Skills, Edited by PK Thaker et al of OUP

REFERENCE BOOKS

1.	Fundamentals of Technical Communication by Meenakshiraman, Sangeta Sharma of OUP
2	Basics of Communication in English by Francis Soundararaj of Trinity Publications
3	English for Engineers and Technologists by Orient Blackswan
4	Basic Communication Skills for Technology by Andrea J. Rutherfoord of Pearson Publications
5	Personality Development and Soft Skills by Barun K. Mitra of OUP
6	Practical English Grammar by Thomson and Martinet of OUP
7	Covey Sean "Seven habits of highly Effective Teens" Newyork Fireside Publishers, 1998
8	Dhanavel, S.P. English and Communication Skills for Students of Science and Engineering,. Orient Blackswan Ltd. 2009
9	Enriching Speaking and Writing Skills , Orient Blackswan
10	John Seely The Oxford Guide to Writing and Speaking, OUP

Course Outcomes:

CO1	Student shall have the ability understand the syntactical and grammatical intricacy
CO2	Student shall be able to use right structure for right context and meaning.
CO3	Student shall be able to read and comprehend the content in English well
CO4	Student shall be able to write well for his/her professional requirement
CO5	Student shall be able to Speak in English well
CO6	Student shall be able to understand and analyze the core components of his study well

A1EHL001 – ENGLISH LANGUAGE PRACTICE -I											
Course designed by	English and Humanities										
CO / PO mapping (SIZE:12)	a	b	c	d	e	f	g	h	i	j	k

A1EHL001 – ENGLISH LANGUAGE PRACTICE -I

Course designed by	English and Humanities
Approval	Approved by: Meeting of Board of Studies held on 18th June, 2015
	Ratified by: 1st Meeting of Academic Council, 27th June, 2015

A1CYL001	I – SEMESTER	L	T	P	C
	ENGINEERING CHEMISTRY LAB	-	-	3	2
	Total Contact Hours – 45				
COURSE OBJECTIVES					
1.	To understand the method of determination of concentrations acid/base, total hardness, iron and zinc contents in the sample solution.				
2.	To understand the principles of conductometric, potentiometric pH metric and colorimetric methods of determination.				
3.	To understand the construction of galvanic cell, determination of calorific value and preparation of biodiesel.				

SYLLABUS

1. Introduction to chemistry laboratory – Molarity, Normality, Primary, Secondary Standard Solutions, Volumetric titrations, Quantitative and Qualitative analysis etc.
2. Determination of Concentration of a strong acid HCI using standard Na2CO3
3. Determination of KMnO4 using standard Sodium Oxalate.
4. Determination of Ferrous iron using standard K2Cr2O7
5. Determination of Zinc using standard potassium Ferro cyanide solution
6. Determination of Total Hardness of water using standard EDTA solution.
7. Determination of iron III with KSCN by spectrophotometry.
8. Determination of Copper using EDTA solution.
9. pH metric titration between strong acid and strong base.
10. Conductometric Titration of a strong acid with strong base & weak acid with strong base.
11. Determination of Ferrous iron with standard K2Cr2O7 by Potentiometric Titration method.
12. Ore analysis: a. Determination of percentage purity of MnO2 in Pyrolusite
    (or)
    b. Determination of percentage purity of Dolomite.
13. Determination of rate constant of acid catalyzed hydrolysis of an ester.
14. Determination of distribution coefficient of benzoic acid between benzene and water
15. Advanced Design Experiment (01): Production of Biodiesel
16. Advanced Design Experiment (02): Construction of a Galvanic cell
17. AdvancedDesign Experiment – Demo- Working on UV-VIS Spectrophotometer, Fluoride Ion Selective electrode for detection of fluoride.
18. Determination calorific value by using bomb calorimeter and Junker's (Demo)
19. Measurement of acid concentration used in lead storage cell using Hydrometer
20. Fuels Experiments: a. Determination of Viscosity, Flash Point and Fire point (or)
    b. Determination of calorific Value by Bomb Calorimeter (or)
    c. Determination of calorific Value by Junker's Calorimeter
21. Construction and Working Principle of a Fuel Cell (demo experiment)

Note. A candidate is required to carry out a minimum of TEN experiments in a semester.

STANDARD BOOKS

1. Text of Quantitative Chemical analysis, A I Vogel, 6th Edition, Cengage Learning.
2. Quantitative Chemical Analysis, Day and Underwood, Prentice Hall Publications.
3. Practical Engineering Chemistry, K. Mukkanti (2009), B.S. Publication.

REFERENCE BOOKS:

4. Dr. JyotsnaCherukui (2012) Laboratory Manual of Engineering Chemistry-II, VGS Techno Series
5. Laboratory manual developed by Department of chemistry, MVGR College of Engineering.

COURSE OUTCOMES:

1. Students will gain knowledge on the method of determination of acid/base, total hardness, iron and zinc contents in the sample solution.
2. Students will gain knowledge on the principles of conductometric, potentiometric, pH metric and colorimetric methods of determination.
3. Students will understand in construction of galvanic cell, determination of calorific value, and preparation of biodiesel.

A1CYL001- ENGINEERING CHEMISTRY LAB											
Course designed by	Department of Chemistry										
CO / PO mapping	a	b	c	d	e	f	g	h	i	j	k
	✓	✓		✓							

A1CYL001- ENGINEERING CHEMISTRY LAB	
Course designed by	Department of Chemistry
Approval	Approved by: Meeting of Board of Studies held on 23-06-2015
	Ratified by: 1st Meeting of Academic Council, June, 2015

A1CIL001	I – SEMESTER	L	T	P	C
	COMPUTER PROGRAMMING LAB	-	-	3	2
	Total Contact Hours – 39 Hours (13 Weeks)				
COURSE OBJECTIVES					
COBJ1.	Students will experiment with basic data types, operators, expressions and expression evaluation mechanisms using C Programming Language.				
COBJ2.	Students will experiment with different control flow constructs in C Programming Language and will understand the syntax, semantics and usability contexts of these different constructs.				
COBJ3.	Students will experiment with composite data types in C and constructs available to develop their own data-types, utilize them to model things and dealing with data from and to external files.				
COBJ4.	Students will experiment with different variations of the constructs available for practicing modular programming and understand the pros and cons of using different variants.				

SYLLABUS

WEEK-1: [Basics of creating a C Program on Windows & LINUX platforms, scanf&printf]

1. Introduction to Linux based gcc Compiler. Basic commands of Linux, Editing (Vi or Vim Editor), Creating a file, creating a folder, ls, mkdir, man,cd, rmdir, mv etc. Practice on LINUX commands.
2. "Hello World" Program on Turbo C and gcc.
3. To read two numbers and display their sum.

WEEK-2: [Variables, Data-Types, Operators, Expression Evaluation]

4. Swapping of two numbers, with and without using third variable.
5. To find largest of three numbers, with and without ternary operator.
6. To find area of a triangle, using Heron's formula

WEEK-3: [Operators, Data-Types, decision-making constructs, For Loops]

7. To calculate Simple Interest and Compound Interest, given Principle, rate of interest per annum, and period.
8. To convert a given temperature from degrees Celsius to degrees Fahrenheit, vice-versa.
9. To print first *n* natural numbers.

WEEK-4: [Loops]

10. To find Sum and Mean of *n* numbers, read *n* from user.
11. Read 10 numbers from the user, count number of odd and even numbers.
12. Read *n* numbers and to count number of prime numbers.

WEEK-5: [Loops]

13. To accept an integer and to find sum of individual digits of that number and also print and save it in reverse order.
14. To display Fibonacci series up-to *n*.
15. To find the n^{th} Fibonacci number.

WEEK-6: [Switch, One-Dimensional Arrays]

16. To implement a calculator program using switch case. Create a calculator program which can perform +, -, *, / and % using switch case. Accept operand1, operand2 and the operator from the user. Continuously run the calculator until the user presses '#' symbol. '#' means the user wants to come out of the program.
17. To read an alphabet from the user and convert lower to upper and upper to lower case using switch case.
18. To declare, initialize and display a one dimensional array of integers of size 5.
19. To declare, initialize and display a one dimensional array of characters of size 5.
20. To read marks of 5 subjects, store them in an array. Find the lowest and highest marks.

WEEK-7: [Two-Dimensional Arrays]

21. Declare, initialize, and display a 2-D array of (3x4) matrix.
22. Declare, initialize and display names of 5 students (Array of Strings).
23. To read two matrices, check the necessary condition and to find the sum and display the result in matrix format.

WEEK-8: [Matrices]

24. To read to matrices, check the necessary condition, and to display the product of the matrices.
25. To find transpose of a matrix.
26. To find the sum of squares of the diagonal elements of a matrix.

WEEK-9: [Functions and Recursion]

27. Write a function to calculate factorial of a number, a) Norma Function b) Recursive Function.
28. To find GCD of two numbers, with and without recursion.
29. To generate prime numbers between 1 to n, user a function to check if a number is prime or not.

WEEK-10: [Pointers, Functions, Arrays]

30. To understand the difference between pass by value and pass by reference, write a c program to find sum of two numbers using functions.
31. To demonstrate the difference between pointer to an array and array of pointers.
    a) Store your name, address and phone number in a 2-D character array, and display the same using pointer notations.
    b) Use pointer to an array and array of pointers.
32. Use pointer to notations to read and display a 3x4 matrix.

WEEK-11: [Structures, Unions, Bit-Fields]

33. To read two complex numbers and display the sum and product using structures.
34. To read the data of four students, each student has a name (string), roll number (string), age (integer), use an array of structure. Later find the average age of the students.
35. A program to demonstrate the difference between structure and union.
36. To declare a structure using bit fields, to save a DATE, use 5-bits for DD, 4 bits for MM, remaining for YY. Read and display a date from the user.

WEEK-12: [Pointers, Strings]

37. To copy contents of one string to another, with and without using string functions.
38. To concatenate string1 with string2, with and without using string functions.
39. To compare two string with and without using string functions.
40. Write a program to add 2 matrices, with the dimension of the matrix specified by the user at the time of executing the problem.

WEEK-13: [Files]

41. To count number of characters and lines of a File.
42. To display the contents of a file and also to copy the contents of one file to another.

COURSE OUTCOMES

CO1	Have the ability to pick and choose the required built-in data-types for the specific problem and utilize the full power of operators and expression evaluation of C Language while writing programs for any given problem.
CO2	Have the ability to use choose and utilize different control constructs in C Language depending on the context of the need while developing a C program for any specific problem.
CO3	Have the ability to divide the parts of a program solution into functions and write a program in C as an inter-play of functions using each other in what is called modular programming.
CO4	Have the ability to fully appreciate the concept and utilization of single and multi-dimensional arrays of different data-types in C.
CO5	Have the ability to appreciate the concept of address variables and understand the benefits and utilization of the same along with under the flexibility provided by dynamic memory allocation and its comparison to static memory allocation.
CO6	Have the ability to appreciate the concept of user defined data types and utilize these concepts to define new composite data types as required for implementing

	solutions to a problem in a C program.												
CO7	Have the ability to appreciate the library support available in standard C for dealing with external files both for read and write purposes and use them as required while developing C Programs.												
<A1CIL001><COMPUTER PROGRAMMING LABORATORY>													
Course designed by		< COMPUTER SCIENCE & ENGINEERING>											
1	Course/Program outcomes mapping	a	b	c	d	e	f	g	h	i	j	k	l
		S	S		W			W		W			W
2	Approval	Approved by: Meeting of Board of Studies held in the month of June, 2015											
		Ratified by: 1st Meeting of Academic Council, 27th June, 2015											

II Semester

A1MAT002	II – SEMESTER	L	T	P	C
	MATHEMATICAL METHODS	3			3
	Total Contact Hours – 45				
	Prerequisite : None				
COURSE OBJECTIVES					
COBJ1	To understand the concept of consistency of linear system of equations				
COBJ2.	To learn the method of finding Eigen values and Eigen vectors for a given matrix, and also the knowledge of converting quadratic form to canonical form				
COBJ3.	To learn the methods of solving transcendental equations and to obtain the Knowledge in applying techniques of interpolation for equally and unequally spaced points.				
COBJ4.	To obtain the knowledge of solving of first order first degree differential equations through various numerical methods.				
COBJ5	To understand the definition and scope of Z-transforms.				

SYLLABUS

UNIT I: LINEAR ALGEBRA
Rank of a matrix- Normal form of a matrix – Solution of Linear System of equations - Gauss Elimination method - Gauss Seidel Method.

UNIT – II: EIGEN VALUES AND EIGEN VECTORS:
Eigen values - Eigen vectors – Properties of Eigen values (statements only) – Cayley Hamilton Theorem (without proof)- reduction to diagonal form- Reduction of quadratic form to canonical form-Nature of quadratic form .

UNIT-III: NUMERICAL SOLUTION OF EQUATIONS:
Solution of Algebraic and transcendental equations- Bisection Method – Method of False Position – Iteration Method – Newton Raphson Method.

UNIT – IV: FINITE DIFFERENCES AND INTERPOLATION:
Finite differences – Newton's interpolation formulae – Central difference interpolation-Gauss forward, Gauss backward interpolation (only statements) - Lagrange's Interpolation.

UNIT – V: NUMERICAL SOLUTION OF ORDINARY DIFFERENTIAL EQUATIONS:
Picard's Method - Taylor's series method -Euler's Method - Fourth order Runge-Kutta Methods (all without proofs).

UNIT – VI: Z-TRANSFORMS:

Introduction – definition-some standard Z-transforms- properties :Linearity property, Damping rule , Shifting rule ,Multiplication by 'n' - Initial and final value theorems-
Some useful inverse z-transforms - Convolution theorem (statement without proof)-Evaluation of Inverse Z-transforms-power series method-partial fraction method-Application to difference equations.

Text Book :

B.S.GREWAL, Higher Engineering Mathematics, 42nd Edition, Khanna publishers

Reference Books:

Introductory Methods of Numerical Analysis by S.S.Sastry, PHI publications
Numerical Methods For Scientific And Engineering Computation by M. K. Jain,
S. R. K. Iyengar and R. K. Jain, Publisher: New Age publication

COURSE OUTCOMES:

CO1. Student will be able to obtain the solution of linear system of equations which frequently occur in engineering problems
CO2. Student will gain the proficiency in finding the Eigen values and Eigen vectors and reduction of quadratic forms to canonical forms
CO3. Student will be able to estimate the missing terms of given data using interpolation.
CO4. Student will be able to solve Initial value problems through numerical methods.
CO5. Student will be able to find the solution of Difference equations which arise in discrete time systems.

A1MAT002- MATHEMATICAL METHODS											
Course designed by	DEPARTMENT OFMATHEMATICS										
CO / PO mapping	a	b	c	d	e	f	g	h	i	j	k
	X				X						X

A1MAT002- MATHEMATICAL METHODS

Course designed by	DEPARTMENT OF MATHEMATICS
Approval	Approved by: Meeting of Board of Studies held on 23.06.15
	Ratified by: 1st Meeting of Academic Council, June, 2015

A1CHT001	II – SEMESTER	L	T	P	C
	ENVIRONMENTAL STUDIES	3	0	0	3
	Total Contact Hours – 45				
	Prerequisite : Nil				
COURSE OBJECTIVES					
1.	To impartoverall understanding of natural resources				
2.	To impartbasic understanding of the ecosystem and its diversity				
3.	To impartacquaintance on various environmental challenges induces due to unplanned anthropogenic activities				
4.	To impartan understanding of the environmental impact of developmental activities				
5.	To impartawareness on the social issues, environmental legislation and global treaties				

SYLLABUS

UNIT – I:

Multidisciplinary nature of Environmental Studies:

Definition, Scope and Importance and of Multidisciplinary nature ofEnvironmental Studies, Stockholm and Rio-Summit, Climate change: Global warming, Acid rains, Ozone layer depletion, Population growth and explosion, Role of information technology in environment and human health

UNIT – II:

Natural resources:

Natural resources and associated problems, Forest resources – Use and over utilization – exploitation, deforestation, case studies – Timber extraction – Mining, dams and other effects on forest and tribal people

Water resources – Use and over utilization of surface and ground water –Floods, drought, conflicts over water, dams – benefits and problems

Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources

Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity

Land resources: Land as a resource, land degradation, Wasteland reclamation, man induced landslides, soil erosion and desertification

Energy resources: Growing energy needs, renewable and non-renewable energy sources use of alternate energy sources

Role of an individual in conservation of natural resources. Equitable use of resources for sustainable lifestyles

UNIT – III:

Ecosystem

Concept of an ecosystem**, Definition**, Classification, structure of an Ecosystem: Producers, consumers and decomposers, Function of an ecosystem: Food chains, food webs and ecological pyramids, Energy flow in the ecosystem, Nutrient cycles, Ecological succession, Introduction, types, characteristic features, structure and function of the following ecosystems: a. Forest ecosystem b. Grassland ecosystem c. Desert ecosystem d. Aquatic ecosystems

Biodiversity and its conservation:
Definition and types: genetic, species and ecosystem diversity, Values of biodiversity
Bio-geographical classification of India, Biodiversity at global, National and local levels, India as a mega-diversity nation
Hot-spots of biodiversity and threats to biodiversity
Endangered and endemic species of India
Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity

UNIT – IV:
Environmental Pollution
Definition, Cause, effets and control masures of Air pollution, Water pollution, Soil pollution, Marine pollution, Noise pollution, Nuclear hazards.Role of an individual in prevention of pollution.

Solid waste Management: Causes, effects and control measures of urban and industrial wastes, Consumerism and waste products.

UNIT – V:
Social Issues and Environment
Urban problems related to energy, Water conservation, rain water harvesting and watershed management. Resettlement and rehabilitation of people; its problems and concerns, Environmental ethics: Issues and possible solutions
Environment Protection Acts: Air (Prevention and Control of Pollution) Act, Water (Prevention and control of Pollution) Act, Wildlife Protection Act -Forest Conservation Act, Issues involved in enforcement of environmental legislation. Public awareness.

UNIT – VI:
Environmental Management
Impact Assessment and its significance, various stages of EIA
Preparation of EMP and EIS, Environmental audit and Ecotourism

Student reports and PPT presentations individually on any issues related to Environmental Studies course

TEXT BOOKS
1. Environmental Studies by AnubhaKaushik, 4th Edition
2. A Textbook of Environmental Studies by ShaashiChawla, TMH, New Delhi

REFERENCE BOOKS
1. Environmental Studies by P.N. Palanisamy, P. Manikandan, A. Geetha, and K. Manjula Rani; Pearson Education, Chennai
2. Text Book of Environmental Studies by Deeshita Dave & P. UdayaBhaskar, Cengage Learning.

Course Outcomes

Student will have knowledge on the natural resources and their importance for the sustenance of the life and recognize the need to conserve the natural resources

Student will have knowledge on the concepts of the ecosystem and its function in the environment, biodiversity of India and the threats to biodiversity, and conservation practices to protect the biodiversity

Student will have knowledge on various attributes of the pollution and their impact and measures to reduce or control the pollution along with waste management practices

Student will have knowledge on social issues both rural and urban environment and the possible means to combat the challenges

Student will have knowledge on the environmental legislations of India and the first global initiatives towards sustainable development, environmental assessment and the stages involved in EIA and the environmental audit

A1CHT001ENVIRONMENTAL STUDIES											
Course designed by	CHEMICAL ENGINEERING										
CO / PO mapping	a	b	c	d	e	f	g	h	i	j	k
	✓			✓	✓			✓	✓	✓	

A1CHT001ENVIRONMENTAL STUDIES

Course designed by	CHEMICAL ENGINEERING
Approval	Approved by: Meeting of Board of Studies held on_13/06/2015
	Ratified by: 1st Meeting of Academic Council,27thJune, 2015

A1PYT001	II – SEMESTER	L	T	P	C
	ENGINEERING PHYSICS	**3**	**0**	**0**	**3**
	Total Contact Hours – 44				
	Prerequisite : None				
COURSE OBJECTIVES					
COBJ 1.	To learn different optical phenomena shown by light waves related to interference and diffraction and characteristics of coherent radiations with an example and their application in specific to optic fiber.				
COBJ 2.	To gain knowledge on the foundation principles of crystallography in specific to crystal systems, unit cell and related parameters and to understand about concept of X-ray diffraction.				
COBJ 3.	To gain knowledge on the magnetic and dielectric properties of materials.				
COBJ 4.	To gain knowledge on the fundamental laws of thermodynamics and entropy and its physical significance				
COBJ 5.	To gain knowledge on the different forced systems and their resultant and the concepts of friction.				

SYLLABUS

UNIT-1 WAVE OPTICS [08hrs]

Introduction- Coherent sources- Interference in thin parallel film by reflection- Newton's rings- Fraunhofer diffraction due to single slit – Diffraction grating (Qualitative)- Resolving power of grating- Rayleigh criterion for resolving power- Polarization- Double refraction- Half wave plate –Quarter wave plate.

UNIT-2 LASER AND FIBER OPTICS [06hrs]

LASER: Introduction- Characteristics of lasers- Absorption, Spontaneous and stimulated emission of radiation - Population inversion- Semiconductor laser.

Fiber Optics: Introduction- Principle of optical fiber- Acceptance angle- Acceptance cone- Numerical Aperture.

UNIT-3 CRYSTALLOGRAPHY [06hrs]

Introduction- space lattice- basis- unit cell- lattice parameters- Crystal systems- Bravais lattices- Packing fractions of simple, body centered, face centered cubic structures - Directions and Planes in crystals- Miller indices- Interplanar spacing- Bragg's Law of X-Ray diffraction.

UNIT-4 MAGNETIC AND DIELECTRIC PROPERTIES OF MATERIALS [08hrs]

Magnetic Properties: Introduction- Origin of magnetic moment and Bohr magneton- Classification of magnetic materials- Hysteresis- Soft and hard magnetic materials.

Dielectrics: Introduction- Dielectric constant- Electronic, ionic and orientation polarization mechanisms (qualitative) - Internal field- Clausius-Mossotti relation.

UNIT-5 THERMODYNAMICS [06hrs]

Introduction- Zeroth law of thermodynamics- Internal energy- Work done in Isothermal and Adiabatic process- First law of thermodynamics- Reversible and Irreversible process- Second law of thermodynamics- Thermodynamical scale of temperature- Entropy- Physical significance- Temperature entropy diagram.

UNIT-6 PRINCIPLES OF MECHANICS [10hrs]

Introduction- System of forces- Resultant of coplanar concurrent & coplanar non-concurrent forces- Force system in space- Friction- Basic definition- Limiting friction & Impending motion- Coulomb's laws of dry friction- Coefficient of friction- Cone of friction- Types of friction (qualitative).

TEXT BOOKS

Engineering Physics by Gaur and Gupta, DhanpathraiPublications

REFERENCES

University Physics by Sear's and Zemansky, Pearson Edition.

Fundamentals of Physics by Resnick, Halliday&Walker

S.NO.	COURSE OUTCOMES
CO 1.	Student will be able to understand the phenomena of interference, diffraction and polarization exhibited by light waves and the characteristics of lasers with an example and its application in specific to optic fiber.
CO 2.	The student shall understand about different crystal systems, space lattices, and parameters of unit cell and the Bragg's law of X-ray diffraction.
CO 3.	Student shall understand about response of the materials in presence of electric and magnetic fields.
CO 4.	Student will gain knowledge on the basic laws of thermodynamics, work done, thermodynamic processes and entropy.
CO 5.	Student will be able to understand thesystem of forces(non-equilibrium)and different types frictions.

A1PYT001- ENGINEERING PHYSICS											
Course designed by	DEPARTMENT OF PHYSICS										
CO / PO mapping	a	b	c	d	e	f	g	h	i	j	k
	√	√		√							

A1PYT001- ENGINEERING PHYSICS	
Course designed by	DEPARTMENT OF PHYSICS
Approval	Approved by: Meeting of Board of Studies held on 23rd June, 2015
	Ratified by: 1st Meeting of Academic Council, June, 2015

A1EET001	II – SEMESTER	L	T	P	C
	BASIC ELECTRICAL & ELECTRONICS ENGINEERING	**3**	**1**	**-**	**3**
	Total Contact Hours – 48				
	Prerequisite: Basic Engineering Mathematics				
COURSE OBJECTIVES					
1.	Understand the fundamental concepts of circuits				
2.	Understand the basic operational characteristics of different electrical machines				
3.	Understand the working principle of different types of semiconductor devices and transducers.				
4.	Learn the concepts of Communication Systems				

SYLLABUS

UNIT I

FUNDAMENTAL CONCEPTS OF ELECTRICAL CIRCUITS:

Ohm's Law-Statement - Illustration and Limitation - Unit – Work, Power and energy (Electrical, Thermal and Mechanical) - Circuits – Identifying the Elements and the Connected Terminology - Kirchoff's Laws – Statement and Illustration - Resistance in Series and Voltage Division Technique - Resistance in Parallel and Current Division Technique - Method of solving a Circuit by Kirchoff's Laws - Star to Delta and to Star Transformations - Concept of 3-phase EMF Generation - Root Mean Square (RMS) or Effective Value - Average Value of AC - Phasor Representation of Alternating Quantities - Analysis of AC Circuit - Representation of Alternating Quantities in Rectangular and Polar Forms - Simple Method of Solving Parallel AC circuits - Three-phase AC circuits

UNIT – II

ELECTRICAL MACHINES:

DC Generator – principle of operation – characteristics - DC Motor - principle of operation – characteristics – Transformers - principle of operation - regulation – efficiency- Three-phase Induction Motor - principle of operation – characteristics - Single-phase Induction Motors - principle of operation – characteristics - 3-phase AC generator or Alternator – regulation - Synchronous Motor principle of operation – characteristics.

UNIT – III

Measuring Instruments and Fundamentals of Electrical wiring:

Classification of Instruments - Basic Principles of Indicating Instruments - Induction Type Energy Meter – Megger - Writing Materials and Accessories - Types of Wiring - Basic Principles of Earthing - Wiring Layout for a Residential Building - Power Generation - Transmission System - Comparison of Overhead (OH) and Underground (UG) Systems.

UNIT – IV

PN JUNCTION DIODE AND TRANSISTOR: Review of Semi Conductor Physics, Open circuited P N Junction, Forward and Reverse Bias, Diode Resistance (Static and Dynamic), Zener Diode, Break Down mechanisms, Zener diode applications, Half wave rectifier, Full wave rectifier, Bipolar Junction transistor, Transistor current components, operation of NPN and PNP Transistor, Transistor CB, CE and CC configurations, Transistor as an amplifier and CE amplifier.

UNIT – V

TRANSDUCERS: Capacitive Transducer, Inductive Transducer, Linear Variable Differential Transformer (LVDT), Oscillation Transducer, Potentiometric Transducer, Electrical Strain Gauges, Resistance Thermometer, Thermistor, Thermocouple, Hall Effect, Piezoelectric Transducer, Photoelectric Transducer.

UNIT – VI

COMMUNICATION SYSTEMS: Communication System, Telecommunication Services, Analog and Digital Signals, Need for Modulation, Analog Modulation, Pulse Modulation, Pulse Digital Modulation-Pulse Code Modulation (PCM), Digital Modulation Techniques, Data Transmission, Radio transmitter(AM&FM), Radio receiver.

TEXT BOOKS:

R Muthusubramanian and S Salivahanan, "Basic Electrical and Electronics Engineering" Mc-Graw Hill, August 2009.

REFERENCES BOOKS:

Electronic Devices and Circuits by J. Millman, C.C. Halkias and Satyabrata Jit, Tata Mc-Graw Hill 2nd Edition Kothari D. P and Nagrath IJ, Basic Electrical Engineering, Tata McGraw-Hill, 1991.

Course Outcomes:

Able to analyze various types of electrical circuits
Ability to identify suitable machine for a particular application
Have the ability to explain the working principle of different types of semiconductor devices.
Have the ability to explain the concepts of Communication Systems.

A1EET001- BASIC ELECTRICAL & ELECTRONICS ENGINEERING											
Course designed by	Electrical & Electronics Engineering Department										
CO / PO mapping	a	b	c	d	e	f	g	h	i	j	k
Able to analyze various types of electrical circuits	H	M			H			M			
Ability to identify suitable machine for a particular application	H	M	L					M			L
Have the ability to explain the working principle of different types of semiconductor devices.	H	M						M			
Have the ability to explain the concepts of Communication Systems.	H							M			L

A1EET001- BASIC ELECTRICAL & ELECTRONICS ENGINEERING	
Course designed by	Electrical & Electronics Engineering
Approval	Approved by: Meeting of Board of Studies held on June 13, 2015
	Ratified by: 1st Meeting of Academic Council, June, 2015

A1MED001	II – SEMESTER	L	T	P	C
	ENGINEERING DRAWING	3	0	0	3
	Total Contact Hours – 52				
	Prerequisite : NA				
COURSE OBJECTIVES					
1.	To enable the student acquire graphical presentational skills to present a design				
2.	To enable the student acquire required skills to produce standard drawings related to a field of engineering				
3.	To enable the student develop geometrical models required for computer aided engineering				

Syllabus

UnitI **Total=12 hrs**

Polygons-Construction of Regular Polygons using given length of a side; Conic Curves (Ellipse, Parabola and Hyperbola) and Plain Scale.

Unit II **Total=08 hrs**

Introduction to Orthographic Projections; Projections of Points; Projections of Straight Lines parallel to both planes; Projections of Straight Lines-Parallel to one and inclined to other plane.

Unit III **Total=08 hrs**

Projections of Straight Lines inclined to both planes, determination of true lengths, angle of inclinations and traces.

UnitIV **Total=08 hrs**

Projections of Planes; Regular Planes Perpendicular / Parallel to one Reference Plane and inclined to other Reference Plane; inclined to both the Reference Planes.

UnitV **Total=08 hrs**

Projections of Solids-Prisms and Cylinders with the axis inclined to one Plane.
Projections of Solids- Pyramids and Cones with the axis inclined to one plane.

Unit VI **Total=08 hrs**

Conversion of Isometric Views to Orthographic Views.
Conversion of Orthographic Views to Isometric Projections and Views.

TEXT BOOK:

Engineering Drawing by N.D. Bhat, Chariot Publications

REFERENCE BOOKS:

Engineering Drawing by M.B. Shah and B.C. Rana, Pearson Publishers
Engineering Drawing by Dhananjay A. Jolhe, Tata McGraw Hill Publishers
Engineering Graphics for Degree by K.C. John, PHI Publishers

OUTCOMES:

Student will be able to construct regular polygons, conic curves and simple scales

Student will be able to draw orthographic projections of points, lines, planes and solids

Student will be able to produce isometric projection from orthographic projections and vice-versa

A1MED001ENGINEERING DRAWING												
Course designed by	Department of Mechanical Engineering											
CO / PO mapping	a	b	c	d	e	f	g	h	i	j	k	l

A1MED001ENGINEERING DRAWING	
Course designed by	Department of Mechanical Engineering
Approval	Approved by: Meeting of Board of Studies held on 17th June, 2015
	Ratified by: 1st Meeting of Academic Council, 27thJune, 2015

A1EHL002	II – SEMESTER	L	T	P	C
	ENGLISH LANGUAGE PRACTICE -II	1	0	2	2
	Total Contact Hours – 45				
	Prerequisite: English Language Practice -I				

COURSE OBJECTIVES	
COBJ1	Student will get exposure to advanced concepts of English Language.
COBJ2	Student will gain an understanding of sounds of English Language and their correct use
COBJ3	Student will get exposure in articulatory and argumentative skills
COBJ4	Student shall be able to acquire specific skills of speaking and writing for professional requirement

Orientation **3 hrs**

Unit -1 **6 hrs**

Phrasal Verbs
Prepositional Verbs
Idiomatic Expressions
Foreign Expressions
Pronunciation Practice- distinct sounds

Unit -2 **6 hrs**

Pronunciation Practice- Word Accent
Telephonic Conversation
Listening Comprehension
Video Profiles

Unit -3 **6 hrs**

Elocution
Debates
Group Discussion

Unit -4 **8 hrts**

Resume` writing
Interviews
Professional Etiquette
Pronunciation Practice – Accent in Connected Speech

Unit -5 **8 hrs**

Sentence Completion
Cloze Passages
Verbal Analogy
Reading Comprehension
Pronunciation Practice- Tone

Unit -6 **8 hrs**

Memos
E-mails
Technical Reports
Presentations
Pronunciation Practice – Rhythm

TEXT BOOKS: Institute's Compilation from the Sources:
Language Through Literature -1&2 of OUP
Fluency in English part I & II of OUP
The Students' Companion by Terry O'Brien of Rupa Publication
Living English Speech by Stannard Allen of Pearson Publication
Common Errors in English by F.G. French, CBE of OUP
English at the Workplace II of OUP

REFERENCE BOOKS

1.	English Idioms by Jennifer Seidl, W. McMordie of OUP
2	Effective Business Communication by Francis Soundararaj of Trinity Publication
3	English for Effective Communication by Sanjay Kumar, Pushp Lata of OUP
4	Word Origins and Their Romantic Stories by Wilfred Funk of Goyl SaaB Publications
5	How to Do Well in GDs and Interviews by Pearson Publications
6	Spoken English by Bansal and Harrison of Orient Longman
7	Covey Sean "Seven habits of highly Effective Teens" Newyork Fireside Publishers, 1998
8	The Leader in You by Dale Carnegie & Associates, INC
9	Objective English for Competitive Examinations by hari Mohan Prasad and Uma Rani Sinha of McGraw Hill
10	Exploring Strategy: Text and Cases by Gerry Johnson of Viva Books Pvt. Ltd.

Course Outcomes:

CO1	Student shall have the ability to speak intelligibly
CO2	Student shall be able to use phrases, foreign expressions and idioms correctly
CO3	Student shall be able to participate well in debates and discussions
CO4	Student shall be able to write both Technical and General reports well
CO5	Student shall be able prepare resume well and face the interviews confidently
CO6	Student shall communicate confidently and effectively

A1EHL002 – ENGLISH LANGUAGE PRACTICE -II											
Course designed by	English and Humanities										
CO / PO mapping (SIZE:12)	a	b	c	d	e	f	g	h	i	j	k

A1EHL002 – ENGLISH LANGUAGE PRACTICE -II

Course designed by	English and Humanities
Approval	Approved by: Meeting of Board of Studies held on 18th June, 2015
	Ratified by: 1st Meeting of Academic Council, June, 2015

A1PYL001	II – SEMESTER	L	T	P	C
	ENGINEERING PHYSICS LAB	**0**	**0**	**3**	**2**
	Total Contact Hours - 42				
	Prerequisite : None				

COURSE OBJECTIVES	
COBJ 1.	To experimentally demonstrate the phenomena of interference and diffraction of light waves by suitable arrangement of various optical devices and to determine the numerical aperture and bending loss of the optic fiber.
COBJ 2.	To experimentally demonstrate the response of a magnetic material in external magnetic field and magnetic field due to currents.
COBJ 3.	To experimentally determine the specific heat and coefficient of thermal conductivity for the given material's.
COBJ 4.	To experimentally determine the resultant of the system of forces and coefficient of friction.

LIST OF EXPERIMENTS

Newton's Rings method- Determination of the radius of curvature of the plano-convex lens.
Wedge method- Determination of the thickness of the given very thin object (hair/paper)
Diffraction grating- Determination of the wavelength of the most prominent lines in the mercury spectrum using spectrometer and a plane transmission grating.
LASER- Determination of wavelength of the laser beam due to diffraction at single slit.
LASER- Determination of the angle of divergence.
Optic Fiber – Determination of Numerical aperture and bending loss.
B-H curve – Determination of coercively and retentively of a ferromagnetic material.
Stewart & Gees apparatus- Study of the variation of the magnetic field along the axis of a current carrying circular coil.
Determination of coefficient of resistance of the given material
Determination of dielectric constant of given ferroelectric material.
Determination of specific heat of material.
Determination of coefficient of thermal conductivity of a bad conductor by Lee's disc method.
Determination of coefficient of friction of a given material.

TEXT BOOKS

A textbook of practical physics by M.N. Srinivasan, S. Chand & Co. Publishers

S.NO.	COURSE OUTCOMES
CO 1.	Student will be able to experimentally observe interference and diffraction patterns of light waves due to different optical devices and to determine the numerical aperture and bending loss of the optic fiber
CO 2.	Student shall experimentally study the magnetic hysteresis and determine related parameters and study the variation of magnetic fields due to currents using tangent law.
CO 3.	Student will be able to detrmine the specific heat and coeffecient of thermal conductivity for the given materials.
CO 4.	Student will be able to detrmine the resultatnt of the system of foces and coeffecient of friction.

A1PYL001- ENGINEERING PHYSICS LAB											
Course designed by	DEPARTMENT OF PHYSICS										
CO / PO mapping	a	b	c	d	e	f	g	h	i	j	k
	√	√		√							

A1PYL001- ENGINEERING PHYSICS LAB	
Course designed by	DEPARTMENT OF PHYSICS
Approval	Approved by: Meeting of Board of Studies held on 23rd June, 2015
	Ratified by: 1st Meeting of Academic Council, 27thJune, 2015

A1MEW001	II – SEMESTER	L	T	P	C
	BASIC ENGINEERING WORKSHOP	0	0	3	2
	Total Contact Hours – 42				
COURSE OBJECTIVES					
1.	The student will be able to trouble shoot various infrastructural support systems like plumbing, electical, networking etc				
2.	The student will be able to design various infrastructural support systems				
3.	The student will be able to estimate various infrastructural support systems				

List of Experiments
Note: At least two exercises to be done from each engineering field
Mechanical Engineering:
Development of plumbing layout system for domestic applications and address trouble shootings in basic plumbing emergencies.(water leakage of a tap, toilet cistern)
Development of surface profile for given object using G I sheet.
Assembly and disassembly of mechanical units using power driven hand tools (cutting, grinding, drilling, riveting)
Civil Engineering
Building planning and estimation
Masonry related work – estimation and hands-on
Carpentry related work – estimation and hands-on
Computer Engineering:
Week 1: Introduction to PC Hardware
Demonstration of Inside Components of a PC
I/O ports
Week 2: Installation of Operating System
Partitions Creation
Device Driver Installation
Assigning IP Address
Week 3: Internet Connectivity
Getting Internet using
Wired/Wireless Broad band
Data Card
Through Proxy
Installation of Tomcat/Apache

Electrical Engineering
Selection of wires and identification of electrical parts
Identification of wiring requirements for a given building
Load calculation given connected utilities and cost estimation

Electronics Engineering:
Parts identification and selection
Soldering electronic components onto PCB
Testing and use of electronic measurement equipment (meters, CRO etc.)

OUTCOMES:

Will be aware of the basic engineering trades and be able to execute related work at a rudimentary level

Will be able to select and use proper tools for the different tasks

Will be able to apply knowledge and skills developed to handle real-life situations in these areas

A1MEW001BASIC ENGINEERING WORKSHOP												
Course designed by	Department of Mechanical Engineering											
CO / PO mapping	a	b	c	d	e	f	g	h	i	j	k	l

A1MEW001BASIC ENGINEERING WORKSHOP	
Course designed by	Department of Mechanical Engineering
Approval	Approved by: Meeting of Board of Studies held on 17th June, 2015
	Ratified by: 1st Meeting of Academic Council, 27th June, 2015

III Semester

A1CHT201	III – SEMESTER	L	T	P	C
	MATERIAL SCIENCE FOR CHEMICAL ENGINEERS	4	0	0	4
	Total Contact Hours – 60				

COURSE OBJECTIVES	
1	To know the basic concepts of bonds in metals and alloys and to understand the basic requirements for the formation of solid solutions and other compounds. To understand the regions of stability of the phases that can occur in an alloy system in order to solve the problems in practical metallurgy.
2	To understand the various heat treatment and strengthening processes used in practical applications.
3	To study the properties and applications of widely used non-ferrous metals and alloys so as to use the suitable material for practical applications.
4	To study the properties and applications of ceramic and other advanced materials so as to use the suitable material for practical applications.

SYLLABUS

MATERIAL SCIENCE FOR CHEMICAL ENGINEERS

UNIT-I

Introduction: Introduction and classification of engineering materials. Crystal geometry and structure determination. Geometry of crystals -the Bravais lattices, Crystal directions and planes- the miller indices. Structure determination-X-Ray diffraction-Bragg law, the powder method.

UNIT II

Crystal imperfections: Point imperfections, Line imperfections-edge and screw dislocations, Surface imperfections.

UNIT-III

Phase Diagram & Phase Transformations: Phase rule, Single component systems, Binary phase diagrams, Lever rule, Typical phase diagrams for Copper-Zinc, Iron – Carbon systems, Nucleation & growth, solidification, Allotropic transformation, Cooling curve for pure iron, Iron carbon equilibrium diagram, Isothermal transformations (TTT Curves).

UNIT-IV

Heat Treatment: Annealing, Normalizing, Hardening, Martempering, Austempering, Hardenability, Quenching, Tempering, Carburising, Cyaniding, Nitriding, Flame hardening.

UNIT-V

Typical Engineering Materials: Ferrous metals, Non ferrous metals and alloys – Aluminium and its alloys, Copper and its alloys, Lead and its alloys, Tin, Zinc and its alloys, Alloys for high temperature service. Ceramic materials – Structure of ceramics, Polymorphism, Mechanical, electrical and thermal properties of ceramic phase.

UNIT-VI

Biomaterials: Introduction; Polymers as a biomaterial, microstructure, mechanical properties, biocompatibility of polymers. Applications in medicine and surgery, biodegradable polymers in drug delivery and drug carriers systems.Functional requirements of biomaterials, tissue and organ replacements.Orthopedic biomaterials, dental biomaterials, cardiovascular biomaterials.

- Scanning Electron Microscopy, Energy Dispersion Spectra systems and Fourier Transformations (FTIR) need to be introduced to students

TEXT BOOK:

1. Materials Science and Engineering – A First Course, Raghavan V, 3rd Edn., Prentice Hall of India Pvt. Ltd., New Delhi, 1996.
2. Material Science and Processes, Hajra Choudhury S.K., 2nd Edition, Indian Book Distributing Co., 1982.

REFERENCES:

1. Science of Engineering Materials Vol. 1 &2; Manas chanda; McMillan Company of India Ltd.
2. Elements of Material Science, Van Valck H.L., 2nd Edn., Addision – Wesly Publishing Company, New York, 1964.
3. Material Science by Smith, Mc graw Hill
4. Biomaterials science: An introduction to materials in medicine by Buddy dratner. Academic press {1996}

Course Outcomes:

By the end of the course, students will be able to:

CO 1. Interpret the structure of materials using crystal structure and should know the basic concepts of bonds in metals and alloys. Analyze the physical and chemical behaviour of various materials through phase equilibria.

CO 2. An understanding of various heat treatment and strengthening processes which are used in practical applications is achieved.

CO 3. An integrated understanding of the scientific and engineering principles underlying the four major elements of the field of Metallurgical and Materials Engineering, namely structure, properties, processing and performance related to materials systems appropriate to the field.

CO 4. Interpret various properties and applications of widely used non-ferrous metals and alloys and should be able to analyze the applications of ceramic and other advanced materials for practical applications.

Course objectives	Course outcomes			
	i	ii	iii	iv
1				
2				
3				
4				

A1CHT201 MATERIAL SCIENCE FOR CHEMICAL ENGINEERS												
Course designed by	Department of Chemical Engineering											
CO / PO mapping	a	b	C	d	e	f	g	h	i	j	k	l

A1CHT201MATERIAL SCIENCE FOR CHEMICAL ENGINEERS	
Course designed by	Department of Chemical Engineering
Approval	Approved by: Meeting of Board of Studies held on 4th Jan, 2016
	Ratified by: 2nd Meeting of Academic Council, 17th Feb, 2016

A1CHT202	III – SEMESTER	L	T	P	C
	CHEMICAL PROCESS CALCULATIONS	3	1	0	4
	Total Contact Hours – 60				

COURSE OBJECTIVES	
1	To introduce students to the major types of calculation which need to be performed in the design or analysis of chemical processing operations.
2	To provide practice in carrying out these calculations by hand or using the computer, in each case to an appropriate degree of accuracy.
3	To develop an understanding of the place of both hand and computer based calculations.
4	To indroduce students to the use of data sources for physical and chemical properties and to estimation of such data.
5	To develop skills in group and collaborative working, especially in the communication of technical information

SYLLABUS

UNIT-I

Stoichiometric relation: basis of calculations, methods of expressing compositions of mixtures and solutions, density and specific gravity, Baume and API gravity scales.

Behavior of Ideal gases: Kinetic theory of gases, application of ideal gas law, gaseous mixtures, gases in chemical reactions.

UNIT-II

Vapor pressure: Liquefaction and liquid state, vaporization, boiling point, effect of temperature on vapor pressure, Antoine equation, vapor pressure plots, estimation of critical properties, vapor pressure of immiscible liquids and ideal solutions, Raoult's law. Non-volatile solutes.

UNIT-III

Humidity and Saturation: Relative and percentage saturation or dew point, wet bulb and dry bulb temperature, use of humidity charts for engineering calculations.

UNIT-IV

Material balances: Tie substance, Yield, conversion, processes involving chemical reactions.

Material balance calculation involving drying, dissolution and crystallization. Processes involving recycles, bypass and purge

UNIT-V

Thermophysics: Energy, energy balances, heat capacity of gases, liquid and mixture solutions. Kopp's rule, latent heats, heat of fusion and heat of vaporization, Trouton's rule, Kistyakowsky equation for non polar liquids enthalpy and its evaluation.

Thermochemistry: Calculation and applications of heat of reaction, combustion, formation and neutralization, Kirchoff's equation, enthalpy concentration change, calculation of theoretical and actual flame temperatures.

UNIT-VI

Combustion Calculations: Introduction, fuels, calorific value of fuels, coal, liquid fuels, gaseous fuels, air requirement and flue gases, combustion calculations, incomplete combustion, material and energy balances, thermal efficiency calculations.

- Calculations should also be taught using Excel (macros)

Text Book:

1. Chemical Process Principles, Part -I, Material and Energy Balances by Hougen O A, Watson K.M. and Ragatz R.A. 2nd Ed., Cbs Publishers & Distributors, New Delhi (2010)

Reference:

1. Basic Principles and Calculations in Chemical Engineering by D.H. Himmelblau, 7th Ed. PHI, New Delhi (2009)
2. Stoichiometry by Bhat and Vora, Tata Mcgraw hill 4th Edition

COURSE OUTCOMES:

1. Find or estimate key physical properties of typical chemicals.
2. Perform phase equilibrium calculations graphically, numerically by hand or using a computer package, and to cross check different calculation methods and data.
3. Carry out design calculations for processes involving separation operations.
4. Carry out material and energy balance calculations for reaction and separation processes by hand or using a computer package as appropriate.
5. Analyze the behavior of recycle processes, performing approximate material balances by hand. and contribute to industry/academia.

Course objectives	Course outcomes				
	i	Ii	iii	iv	v
1					
2					
3					
4					
5					

A1CHT202CHEMICAL PROCESS CALCULATIONS												
Course designed by	Department of Chemical Engineering											
CO / PO mapping	a	b	C	d	e	f	g	h	i	j	k	l

A1CHT202 CHEMICAL PROCESS CALCULATIONS	
Course designed by	Department of Chemical Engineering
Approval	Approved by: Meeting of Board of Studies held on 4th Jan, 2016
	Ratified by: 2nd Meeting of Academic Council, 17th Feb, 2016

A1CHT203	III – SEMESTER	L	T	P	C
	FLUID MECHANICS FOR CHEMICAL ENGINEERS	3	1	0	4
	Total Contact Hours – 60				

COURSE OBJECTIVES	
1	Understand the basic fluid flow properties and rheological properties of fluid flow.
2	Learn and apply Bernoulli's equation for various simple and complex cases of fluid flow
3	Estimate the energy losses (major and minor) that occurs during fluid flow through pipes for various fluids to determine the size of the pumps and blowers required for a particular operation
4	Understand the basic differences between compressible and incompressible fluid flow and suitably adapt, modify and apply suitable correlations for compressible fluid flow.
5	Estimate the pressure drop that occurs during fluid flow through packed bed and fluidized bed
6	Have knowledge on various types of pumps, compressor, and blower and also understand the knowledge related to various fluid flow measuring devises

SYLLABUS

UNIT-I:

Basics on dimensional Analysis, Nature of fluids, hydrostatic equilibrium, applications of fluid statics: U-Tube and Inclined Manometers, Fluid flow phenomena-Laminar flow, Shear rate, Shear stress, Rheological properties of fluids, Turbulence, Boundary layers

UNIT-II:

Basic equation of fluid flow –Mass balance in a flowing fluid; continuity, Differential momentum balance; equations of motion, macroscopic momentum balances, Mechanical energy equations

UNIT-III:

Incompressible Newtonian /Non Newtonian Flow in pipes and channels- shear stress and skin friction in pipes, laminar flow in pipes and channels, turbulent flow in pipes and channels
Friction from changes in velocity or direction (frictional losses in contractions, expansions and fittings, Velocity profiles)

UNIT-IV:

Flow of compressible fluids- Definitions and basic equations, Processes of compressible flow Isentropic flow through nozzles, adiabatic frictional flow, isothermal frictional flow

UNIT-V:

Flow past immersed bodies, Drag and Drag coefficient, flow through beds of solids, Motion of particles through fluids, Fluidization, Conditions for fluidization, Minimum fluidization velocity
Types of fluidization, Expansion of fluidized bed, Applications of fluidization. Continuous fluidization; slurry and pneumatic transport

UNIT-VI:
Transportation and Metering of fluids- Pipes, fittings and valves, Pumps: positive displacement pumps, and centrifugal pumps, Fans, blowers, and compressors, Measurement of flowing fluids- full bore meters, insertion meters

- CFD should also be introduced to students

TEXT BOOK:
1. Unit Operations of Chemical Engineering by W.L.McCabe, J.C.Smith& Peter Harriot, McGraw-Hill, 6thed, 2001

REFERENCE BOOKS:
1. Transport processes and unit operations by Christie J. Geankoplis, PHI.
2. Introduction to Fluid mechanics by R.W. Fox, A.T.McDonald, P.J.Pritchard, JohnWiley and sons-6th edition

COURSE OUTCOMES:
By mastering the momentum transfer course, student will be able to
I. Analyze fluid flow in circular and non-circular conduits.
II. Do calculations involving Bernoulli's equation for transport of fluids in pipelines.
III. Calculate pressure drops and energy requirements associated to fluid flow in pipes.
IV. Calculate the pressure drops and energy requirements associated to compressible fluid flow in circular and rectangular ducts.
V. Estimate pressure drop in packed bed and fluidized bed
VI. Carry out various calculations associated to fluid flow in various types of pumps calculate, analyze and calibrate various flow measuring devices

Course objectives	Course outcomes					
	I	II	III	IV	V	VI
1						
2						
3						
4						
5						
6						

A1CHT203 FLUID MECHANICS FOR CHEMICAL ENGINEERS												
Course designed by	Department of Chemical Engineering											
CO / PO mapping	a	b	C	d	e	f	g	h	i	j	k	l

A1CHT203FLUID MECHANICS FOR CHEMICAL ENGINEERS	
Course designed by	Department of Chemical Engineering
Approval	Approved by: Meeting of Board of Studies held on 4th Jan, 2016
	Ratified by: 2nd Meeting of Academic Council, 17th Feb, 2016

A1CHT204	III – SEMESTER	L	T	P	C
	CHEMICAL TECHNOLOGY	4	0	0	4
	Total Contact Hours – 60				

COURSE OBJECTIVES This course is designed to make the students	
1	The basic functionalities of chemical processes with specific emphasis of unit processes and unit operations in chemical enginepering.
2	The Process Technologies and developments associated with Soda ash, caustic soda , chlorine gas , and glass manufacturing industries
3	The process technologies associated with production of industrially important gases like carbon dioxide, hydrogen, oxygen and production of valuable chemicals from nitrogen industries
4	The process technologies involved in manufacturing of sulfur, sulfuric acid, hydrochloric acid, aluminium sulphate, alum, barium salts, rare earth compounds, cements, and some miscellaneous chemicals from calcium and magnesium.
5	The process technologies in manufacturing of organic chemicals like phenols, formaldehehydes, vinyl chloride and vinyl acetate, phenol formaldehyde resin, PVC monomer, and SB rubber
6	The industrial process technologies involved in extraction , refining of vegitable oils, manufacturing of soap and detergents and pulp and paper

SYLLABUS

UNIT I

Soda ash, caustic soda and chlorine, Glass: manufacture of special glasses

Unit – II

Industrial gases: carbon dioxide, hydrogen and oxygen – products of water gas, producer gas. Nitrogen industries: synthetic ammonia, urea, nitric acid (ammonium nitrate), ammonium chloride, ammonium phosphate and complex fertilizers

Unit – III

Sulphur and sulphuric acid, manufacture of sulphuric acids, hydrochloric acid and some other chemicals –Aluminum sulphate and alum, barium salts rare earth compounds.

Cement manufacture, special cements, miscellaneous calcium compounds, magnesium compounds.

Unit – IV:

Manufacture of phenols, formaldehyde, vinyl chloride and vinyl acetate, manufacture of phenol- formaldehyde resin and polyvinyl chloride polymer, SBR.

Unit – V:

Oils: Definition, constitution, extraction and expression of vegetable oils, refining and hydrogenation of oils.

UNIT-VI:

Soaps and detergents: Definitions, continuous process for the production of fatty acids, glycerin and soap, production of detergents.

Pulp and paper industry: methods of pulping, production of sulphate and sulphite Pulp, production of paper –wet process

- Production of different chemicals using Green technology should also be taught.

TEXT BOOKS:

1. Shreve's Chemical Process Industries edited by Austin, McGraw-Hill.5th ed.1985.
2. Dryden's Outlines of Chemical Technology, edited by M.Gopal Rao and M.Sittig, 2nd ed. 1973.

REFERENCES:

1. Industrial Chemistry by B.K.Sharma
2. Hand book of industrial chemistry Vol 1&II K.H.Davis& F.S. Berner Edited by S.C. Bhatia, CBS publishers
3. Austin, G. T., Shreve's Chemical Process Industries, Tata – McGraw Hill Publishers, 2012.

COURSE OUTCOMES:

A student adept in Chemical Technology course must

1. Have technological knowledge of various process equipment and their respective functionalities in Process flow sheet.
2. Be able to relate the physical and chemical properties of various chemical compounds towards the working principles of various established technologies in industrial flow sheets
3. Understand complexity of various process equipments such as heat and mass transfer units, etc.
4. Have conceptual knowledge towards the application of principles of energy efficient, pollution abatement and raw material recovery and reuse in process flow sheets
5. Have an overall idea towards various alternate processes for the manufacture of important inorganic and organic products.
6. Have a working knowledge towards various important issues (safety issues, economics etc.) associated to both inorganic and organic chemical technologies

Course objectives	**Course outcomes**					
	i	ii	iii	iv	v	vi
1	√					
2	√	√	√	√	√	√
3	√	√	√	√	√	√
4	√	√	√	√	√	√
5	√	√	√	√	√	√
6	√	√	√	√	√	√

A1CHT204CHEMICAL TECHNOLOGY												
Course designed by	Department of chemical Engineering											
CO / PO mapping	a	b	C	d	e	f	g	h	i	j	k	l
1.Have technological knowledge of various process equipment and their respective functionalities in Process flow sheet.			√									
2.Ability to relate the physical and chemical properties of various chemical compounds towards the working principles of various established technologies in industrial flow sheets												
3.Understand complexity of various process equipments such as heat and mass transfer units, etc.			√									
4.Have conceptual knowledge towards the application of principles of energy efficient, pollution abatement and raw material recovery and reuse in process flow sheets									√			
5.Have an overall idea towards various alternate processes for the manufacture of important inorganic and organic products.			√						√			
6.Have a working knowledge towards various important issues (safety issues, economics etc.) associated to both inorganic and organic chemical technologies									√			

A1CHT204CHEMICAL TECHNOLOGY	
Course designed by	Department of Chemical Engineering
Approval	Approved by: Meeting of Board of Studies held on 4th Jan, 2016
	Ratified by: 2nd Meeting of Academic Council, 17th Feb, 2016

A1CYT205	III – SEMESTER	L	T	P	C
	ORGANIC CHEMISTRY	4	0	0	4
	Total Contact Hours – 60				

COURSE OBJECTIVES	
1	To develop an understanding and appreciation of both structure and chemical transformations of organic molecules from the Polar effects: Inductive effect, Electrometric effect, Resonance and Hyper conjugation.
2	To develop the ability to impart a better knowledge on different types of organic reactions which were very use full in the laboratory and industry. These reactions and to know the spatial orientation of constituent atoms or groups in a molecule.
3	To acquire fundamental chemical and physical information on the synthesis and characterization of polymer materials and dyes.
4	To give an insight into heterocyclic chemistry and the use of different classes of these compounds

SYLLABUS

UNIT I:

Polar effects – Inductive effect, electromeric effect, resonance, Hyper conjugation, steric inhibition of resonance – examples.

Electrophilic reactions: a) Friedel-Craft reaction b) Riemer- Teimenn Reaction c) Backmann rearrangement.

Nucleophillic reaction : a) Aldol condensation b) Perkin Reaction c) Benzoin condensation.

UNIT – II:

1. Free radical reaction a) Halogenation of Alkane b) Addition of HBr to Alkene in the presence of peroxide.
2. Allylic halogenation Using N-Bromo succinamide (NBS) 3) Thermal halogenation of Alkanes.

UNIT – III

Stereo isomerism; Optical isomerism; Symmetry and chirality; Optical isomerism in lactic acid and tartaric acid; Sequence rules; Enantiomers, diastereomers; Geometrical Isomerism; E-Z system of nomenclature, conformational analysis of ethane and Cyclohexane.

UNIT – IV:

Polymerization Reactions – Basic concepts. Types of Polymerization – Addtion and Condensation Polymerizations. Plastics-

UNIT – V Thermosetting and Thermoplastics - Differences.Compounding, Moulding of Plastics- Compression, injection, transfer, and Extrusion molding methods. Preparation, Properties and Engineering use of the Following: Polyethylene, PVC, Teflon, Bekelite, Nylon, Polyster, Polyurethane and Silicone Resins, Rubber - Procesing of Natural Rubber, Vulcanization and Compunding. Elastomers-Buna S, Buna N, Thiokol, Polyurethane Rubber.

UNIT – VI

Heterocyclic compounds and Nomenclature: Preparation, Properties and uses of (1) Pyrrole (2) Furan (3) Thiophene (4) Pyridine (5) Quinoline (6) Iso-quinoline.

Dyes - Colour and Constituion ; Classification of Dyes, Preparation and uses of (1) Malachite green (2) Rosaniline (3) Congored (4) Bismark brown (5) Flroroscien.

TEXTBOOKS:

1. Text book of Organic chemistry – Ferguson, LN East–West Press.
2. Text book of Organic Chemistry – Morrison and Boyd.

REFERENCES:

1. Polymer Science – Gaurikar.
2. Reaction mechanism – Peter Skyes.
3. Text book of Organic Chemistry – R.K. Bansal.
4. Text book of Organic Chemistry – P.L. Soni.
5. Organic Chemistry Vol- I-IL. Finar.
6. Reactions and Reagents – O.P. Agrawal.
7. Intermediates of Organic Synthesis by V.K. Ahulwalia, Pooja Bhagat, Renu Aggrwal, Ramesh Chandra, I.K. International Publishing House Pvt. Ltd.

COURSE OUTCOMES:

i. Students will acquire basic concepts of Organic reactions and the mechanism involved in it and the type of organic reaction and the mechanism involved in it.

ii. Students will be able to recognize the configuration and conformation of the molecule. The basic concept in polymers strengthens the student's knowledge in the polymer chemistry which helps him in the future.

iii. The students will be able to define terms related to heterocyclic compounds, to recognize their basic structures and to discuss the important chemical, and commercial aspects of compounds..

iv. Students will know the chemistry of heterocyclic compounds and their synthesis, reactions and their importance in Pharma industry.On exposer to dye stuff chemistry, the students will acquire knowledge in the synthesis, classification and industrial applications of dyes.

Course objectives	**Course Outcomes**			
	i	ii	iii	iv
1				
2				
3				
4				

A1CYT205 ORGANIC CHEMISTRY												
Course designed by	Department of Mechanical Engineering											
CO / PO mapping	a	b	C	d	e	f	g	h	i	j	k	l

A1CYT205 ORGANIC CHEMISTRY	
Course designed by	Department of Chemistry and Chemical Engineering
Approval	Approved by: Meeting of Board of Studies held on 4th Jan, 2016
	Ratified by: 2nd Meeting of Academic Council, 17th Feb, 2016

A1CHL201	III – SEMESTER	L	T	P	C
	FLUID MECHANICS LAB FOR CHEMICAL ENGINEERS	0	0	3	2
	Total Contact Hours – 45				

COURSE OBJECTIVES	
1	To determine discharge coefficient of orifice meter, venture meter, notches
2	To determine friction factors and friction losses in pipes and fittings, pressure drop in packed, fluidized beds and helical coils, fluid viscosity
3	To determine characteristics of centrifugal pump and efficiency of an air compressor
4	To characterize fluid flow, verify Bernoulli's theorem and to measure point velocities
	To Calibrate Rota meter

LIST OF EXPERIMENTS:

1. Determination of discharge coefficient for orifice meter and venturi meter and their variation with Reynolds number
2. a) Determination of weir meter constant K for V-Notch and rectangular notch
   b) Calibration of Rota meter and study of variation of flow rate with tube to float diameter.
3. Determination of Glycerol- water solution at different temperatures.
4. Determination of friction factor for flow of water through annulus using Fanning's and Darcy's equations.
5. Determination of friction factor for flow through straight pipes of different diameters and study of variation of friction factor with Reynolds number
6. Determination friction losses in pipe fittings
7. Determination of clearance volume and efficiency of an air compressor
8. Determination of characteristic curves for centrifugal pumps.
9. A) Determination of friction factor for packed beds.
   B) Determination of minimum fluidization velocity
10. Determination of pressure drop through helical coils
11. Determination of velocity profile of air in pipe by pitot tube
12. Determination of critical velocity by Reynolds experiments

COURSE OUTCOMES:

After completion of the course, students will be able to do the following:

1. Operate fluid flow equipment and instrumentation.
2. Collect and analyze data using momentum transfer principles and experimentation methods.
3. Calculate various types of energy losses in pipes and pipe fittings.
4. Determine viscosity of various liquids using Stokes law.
5. Demonstrate principles discussed in momentum transfer lecture course.

A1CHL201 FLUID MECHANICS LAB FOR CHEMICAL ENGINEERS												
Course designed by	Department of Chemical Engineering											
CO / PO mapping	a	b	C	d	e	f	g	h	i	j	k	l
	√	√	√									

A1CHL201 FLUID MECHANICS LAB FOR CHEMICAL ENGINEERS	
Course designed by	Department of Chemical Engineering
Approval	Approved by: Meeting of Board of Studies held on 4th Jan, 2016
	Ratified by: 2nd Meeting of Academic Council, 17th Feb, 2016

A1CHL202	III – SEMESTER	L	T	P	C
	CHEMICAL TECHNOLOGY LAB	0	0	3	2
	Total Contact Hours – 45				

COURSE OBJECTIVES

This course helps the student to

1	Prepare industrial chemicals, analyze essentially used organic compounds using chemical methods
2	Remove oil using solvent extraction, analyze oils and fats
3	Estimate hydroxyl groups in alcohols and phenols, understand manufacture of soap
4	Prepare copper pigment, chrome yellow pigment and analyze coal

LIST OF EXPERIMENTS

Experiment 1
Preparation of Industrial Chemicals (Nitrobenzene, Acetanilide, Methyl Orange)
Experiment 2
Estimation of Organic Compounds, using chemical methods (Formaldehyde and Urea)
Experiment 3
Estimation of Organic Compounds, using chemical methods (Glucose and Sucrose)
Experiment 4
Solvent Extraction of Oil
Experiment 5
Analysis of oils and fats (Acid Value, Saponification Value, Iodine Value)
Experiment 6
Estimation of Hydroxyl groups in alcohols and phenols
Experiment 7
Analysis of raw material/finished products (Lime stone, Soda ash and Fertilizers)
Experiment 8
Soap Manufacture
Experiment 9
Analysis of water (Total solids, Dissolved solids, pH, Chlorides and sulphates, temporary, permanent and total hardness)
Experiment 10
Preparation of copper pigment
Experiment 11
Preparation of chrome yellow pigment
Experiment 12
Analysis of coal (Proximate Analysis)

COURSE OUTCOMES:

After completion of the course, students will be able to do the following:

1. Handle different analytical apparatus
2. Conduct experimental procedure for manufacture of soap, Organic chemicals: nitrobenzene, acetanilide, methyl orange, aspirin.
3. Learn the desirable limits of various constituents in water analysis and its importance.
4. Prepare various essential organic compounds

CH 202P **CHEMICAL TECHNOLOGY LAB**												
Course designed by	Department of Chemical Engineering											
CO / PO mapping	a	b	C	d	e	f	G	h	i	j	k	l
	√	√	√									

CH 202P **CHEMICAL TECHNOLOGY LAB**	
Course designed by	Department of Chemical Engineering
Approval	Approved by: Meeting of Board of Studies held on 4th Jan, 2016
	Ratified by: 2nd Meeting of Academic Council, 17th Feb, 2016

IV Semester

A1CHT206	IV – SEMESTER	L	T	P	C
	PROCESS HEAT TRANSFER	3	1	0	4
	Total Contact Hours – 60				

COURSE OBJECTIVES	
1	To enable the student to basic study of the phenomena of heat transfer process.
2	To enable the student to learn the principles of Heat Transfer by Conduction, Convection and Radiation.
3	To enable the student to principles involve the estimation of overall heat transfer coefficients in natural and forced convection
4	To enable the student to learn the design principles of Heat exchanger equipment

SYLLABUS

UNIT - I

Introduction: Nature of heat flow, conduction, convection, natural and forced convection, radiation.

Heat transfer by conduction in Solids: Fourier's law , thermal conductivity, steady state conduction in plane wall & composite walls, compound resistances in series, heat flow through a cylinder, conduction in spheres, thermal contact resistance, plane wall: variable conductivity

Unsteady state heat conduction: Equation for one-dimensional conduction, Semi-infinite solid, finite solid.

Unit - II:

Principles of heat flow in fluids: Typical heat exchange equipment, countercurrent and parallel current flows, energy balances, rate of heat transfer, overall heat transfer coefficient, electrical analogy, critical radius of insulation, logarithmic mean temperature difference, variable overall coefficient, multi-pass exchangers, individual heat transfer coefficients, resistance form of overall coefficient, fouling factors, classification of individual heat transfer coefficients, magnitudes of heat transfer coefficients, effective coefficients for unsteady-state heat transfer.

Unit - III:

Heat Transfer to Fluids without Phase change: Regimes of heat transfer in fluids, thermal boundary layer, heat transfer by forced convection in laminar flow, heat transfer by forced convection in turbulent flow, the transfer of heat by turbulent eddies and analogy between transfer of momentum and heat, heat transfer to liquid metals, heating and cooling of fluids in forced convection outside tubes.

Unit - IV:

Natural convection: Natural convection to air from vertical shapes and horizontal planes, effect of natural convection in laminar flow heat transfer, free convection in enclosed spaces, mixed free & forced convection.

Heat transfer to fluids with phase change: Heat transfer from condensing vapors, heat transfer to boiling liquids.

Unit - V:

Heat exchange equipment: General design of heat exchange equipment, heat exchangers, condensers, boilers and calendrias, extended surface equipment, heat transfer in agitated vessels, scraped surface heat exchangers, heat transfer in packed beds, heat exchanger effectiveness (NTU method)

Evaporators: Evaporators, performance of tubular evaporators, capacity and economy, multiple effect evaporators, vapor recompression.

Unit - VI: Radiation

Introduction, properties and definitions, black body radiation, real surfaces and the gray body, absorption of radiation by opaque solids, radiation between surfaces, radiation shielding, radiation to semi transparent materials, combined heat transfer by conduction, convection and radiation.

TEXT BOOKS

1. Unit Operations of Chemical Engg by McCabe, Smith and P Harriot, McGraw-Hill 5th Ed1993

REFERENCES

1. Process heat transfer D.Q.Kern, McGraw-Hill
2. Heat Transfer by J.P.Holman
3. Y.V.C.Rao, Heat Transfer, University Press.
4 Heat transfer-Schaum's series, McGraw-Hill publications
5. Chemical Engineering, Vol-I, Coulson and Richardson
6. Transport processes and Unit operations, Christie J. Geankoplis, PHI

COURSE OUTCOMES:

i. Students will be able to understand the basic laws of heat transfer
ii. Students will be able to analyze problems involving steady state heat conduction in simple geometries.
iii. Students will be able to evaluate heat transfer coefficients for natural convection and forced convection.
iv. Students will be able to analyze heat exchanger performance by using the method of LMTD and Effectiveness

Course objectives	**Course outcomes**			
	i	ii	iii	iv
1				
2				
3				
4				

A1CHT206 PROCESS HEAT TRANSFER												
Course designed by	Department of Chemical Engineering											
CO / PO mapping	a	b	c	d	e	f	g	h	i	j	k	l

A1CHT206 PROCESS HEAT TRANSFER	
Course designed by	Department of Chemical Engineering
Approval	Approved by: Meeting of Board of Studies held on June, 2015
	Ratified by: 1st Meeting of Academic Council, June, 2015

A1CHT207	IV – SEMESTER	L	T	P	C
	CHEMICAL ENGINEERING THERMODYNAMICS –I	3	1	0	4
	Total Contact Hours – 60				

COURSE OBJECTIVES	
1	First and Second thermodynamic laws and analyses of problems using these laws in open, close and isolated systems;
2	Thermodynamic relationships among thermodynamic properties and be able to calculate changes in U, H, and S for ideal gases, and also for non ideal gases through the use of residual properties. (Heat, work, enthalpy, entropy, free energy, temperature, pressure, volume, etc.);
3	Analyze the performance of typical thermodynamic devices and units (turbine, pump, nozzles, compressor, heat engines, Heat pump, Refrigerator, etc) using thermodynamic principles.

SYLLABUS

Unit-I :

The scope of thermodynamics : Temperature, Volume, Pressure, Work Energy, Heat, Joules Experiments. The first law and other basic concepts**:** The First law of thermodynamics, thermodynamic state and state functions Enthalpy, the steady-state steady-flow process, equilibrium, The phase rule, the reversible process, Constant-V and constant- P processes, heat capacity

Unit-II:

Volumetric properties of pure fluids :the PVT behavior of pure substances, Virial equations, The ideal gas, Applications of virial equations the ideal gas, the application of virial equation Cubic equation of state, generalized correlations for gases and liquids

Unit-III:

Statements of the second law:, heat engines, Thermodynamic temperatures scales, Entropy, Entropy changes of an ideal gas, mathematical statement of the second law, the third law of thermodynamics,

Thermodynamics properties of fluids including residual and generalized property correlations

Unit-IV:

Application of thermodynamics to flow processes: duct flow of compressible fluids, turbines and expanders

Unit-V :

Production of power from heat: Steam power plant, Production of power from heat. Vapor power cycle, Simple steam power cycle, Rankine Cycle Comparison of Rankin and Carnot Cycle, Regenerative cycle

Unit-VI:

Refrigeration and liquefaction: The Carnot refrigerator, the vapor compression cycle, The comparison of refrigeration cycles, the choice of refrigerant, Absorption refrigeration, the heat pump, Liquefaction processes.

TEXT BOOKS

1. J. M. Smith and HC Van Ness, Introduction to Chemical Engineering Thermodynamics, 5th ed, McGraw Hill,1996.
2. Rao, Y.V.C., Chemical Engineering Thermodynamics, Universities Press India Ltd., 1997.

REFERENCE

1. K. V. Narayanan, Chemical Engineering Thermodynamics, PHI, 2001
2. Sonntag, Fundamentals of thermodynamics

COURSE OUTCOMES:

By mastering the chemical engineering thermodynamics course, student will be able to

i. Understand the terminology associated with engineering thermodynamics, the concepts of heat, work and laws of thermodynamics.
ii. Will be able to calculate properties of ideal gases an well as real gases which facilitate calculation of heat and work requirements.
iii. Will analyze (calculate efficiencies) typical thermodynamic devices and units (turbine, pump, nozzles, compressor, heat pump, refrigerator, etc) using thermodynamic principles.
iv. Understand processes involving power production, refrigeration, and liquefaction, and be able to calculate relevant system efficiencies for these processes.

Course objectives		**Course outcomes**		
	i	ii	iii	iv
1				
2				
3				

A1CHT207 CHEMICAL ENGINEERING THERMODYNAMICS-I												
Course designed by	Department of Chemical Engineering											
CO / PO mapping	a	b	c	d	e	f	g	h	i	j	k	l

A1CHT207CHEMICAL ENGINEERING THERMODYNAMICS-I	
Course designed by	Department of Chemical Engineering
Approval	Approved by: Meeting of Board of Studies held on 4th Jan, 2016
	Ratified by: 2nd Meeting of Academic Council, 17th Feb, 2016

A1CHT208	IV – SEMESTER	L	T	P	C
	MECHANICAL UNIT OPERATIONS	3	1	0	4
	Total Contact Hours – 60				

COURSE OBJECTIVES	
1	To enable the student to gain basic knowledge in particle characterization namely particle size, shape and specific surface.
2	To enable the student to have working knowledge of particulate solids handling and mixing
3	To enable the student to learn the principles of size reduction and screening and concepts of filtration.
4	To enable the student to understand the functioning of various prominent solid fluid operations related equipment.

SYLLABUS

Unit-I:

Properties, handling and mixing of particulate solids: Characterization of solid particles, properties of particulate masses, storage of solids and mixing of solids. Types of mixers, mixers for non-cohesive solids and mixers for cohesive solids, Conveyors

Unit-II:

Agitation and mixing of liquids: Agitation of liquids, circulation velocities, power consumption in agitated vessels. Blending and mixing of liquids, suspension of solid particles, dispersion operations.

UNIT-III

Size reduction: Principles, criteria for comminution, characteristics of comminution, size reduction equipment-crushers, grinders, ultra fine grinders, cutting machines, Equipment operation.

Screening: Screening, Industrial screening equipments, general factors in selecting an screening equipment, comparison of ideal and actual screens, material balance over a screen and screening efficiency.

Unit–IV:

Filtration: Cake filters, centrifugal filters, filter aids, clarifying filters, liquid clarification, and gas cleaning, Principles of cake filtration, principles of clarification and principles of centrifugal filtration, types of membranes

Unit-V:

Separations based on motion of particles through fluids: Gravity sedimentation process: gravity classifiers, sorting classifiers, clarifiers and thickeners, Equipment for sedimentation, clarifier and thickener design.

Centrifugal settling process: Separations of solids from gases: Cyclones, Separations of solids from liquids: Hydroclones, principles of centrifugal sedimentation, centrifugal classifiers.

Unit -VI:

Electrostatic separation: Principle, charging by contact electrification, charging by conductive induction, charging by ion bombardment, types of equipment, effect of humidity, applications of process.

Flotation: General description, flotation reagents, applications, flotation machines, capacities, flotation economics.

Text book:

1. Unit Operations in Chemical Engg by W.L. McCabe and J.C. Smith and P Harriott, Mc Graw Hill 7th ed. 2005.
2. Brown G. G., "Unit Operations", CBS publishers.

References:

1. Narayanan C.M. and Bhattacharya B.C., "Mechanical Operations for Chemical Engineers", Khanna publishers.
2. Introduction to Chemical Engg by J.T.Banchero & W.L.
3. Badger.,TMH,1997.
4. Coulson J. H. and Richardson J.F., "Chemical Engg, Vol. II", 5th Ed., Butterworth-Heinemann.
5. Unit Operations by Foust et.al
6. M. Gaudin, Principles of Mineral Dressing, Tata McGraw-Hill Publishing Company Limited, New Delhi 2003.

COURSE OUTCOMES:

i. Students will be able to have knowledge on particle characterizations and solids handling and mixing
ii. Students will be able to learn size reduction of solids, Screening and filtration
iii. Students will be able to learn about equipments associated to solid fluid mechanical operations
iv. Students will be able to learn about Electrostatic precipitators and floatation equipment.

Course objectives	Course outcomes			
	i	ii	iii	iv
1				
2				
3				
4				

A1CHT208MECHANICAL UNIT OPERATIONS												
Course designed by	Department of Chemical Engineering											
CO / PO mapping	a	b	c	d	e	f	g	h	i	j	k	l

A1CHT208MECHANICAL UNIT OPERATIONS	
Course designed by	Department of Chemical Engineering
Approval	Approved by: Meeting of Board of Studies held on June, 2015
	Ratified by: 2nd Meeting of Academic Council, 17th Feb, 2016

A1CHT301	IV – SEMESTER(Core Elective – I)	L	T	P	C
	FERTILIZER TECHNOLOGY	3	0	0	3
	Total Contact Hours – 45				

COURSE OBJECTIVES

The student will be able to learn

1	About the sources available for Nitrogen, Phosphorous and Potassium.
2	Know different methods available for Production of nitrogenous, phosphoric and potash fertilizers
3	Know different methods available for production of complex and NPK fertilizers
4	Understand the process available for production of miscellaneous fertilizers.

SYLLABUS

UNIT I NITROGENOUS FERTILISERS

Methods of production of nitrogenous fertilizer-ammonium sulphate, nitrate, urea and calcium ammonium nitrate; ammonium chloride and their methods of production, characteristics and specifications, storage and handling.

UNIT II PHOSPHATIC FERTILISERS

Raw materials; phosphate rock, sulphur; pyrites etc., processes for the production of sulphuric and phosphoric acids; phosphates fertilizers - ground rock phosphate; bone meal

UNIT III PHOSPHATIC FERTILISERS

Single superphosphate, triple superphosphate, triple superphosphate, thermal phosphates and their methods of production, characteristics and specifications.

UNIT IV POTASSIC FERTILISERS

Methods of production of potassium chloride, potassium schoenite, their characteristics and specifications.

UNIT V COMPLEX AND NPK FERTILISERS

Methods of production of ammonium phosphate, sulphate diammonium phosphate, nitrophosphates, urea, ammonium phosphate, mono-ammonium phosphate and various grades of NPK fertilizers produced in the country.

UNIT VI MISCELLANEOUS FERTILISERS

Mixed fertilizers and granulated mixtures; biofertilisers, nutrients, secondary nutrients and micro nutrients; fluid fertilizers, controlled release fertilizers, controlled release fertilizers.

TEXTBOOKS

1. “Handbook of fertilizer technology”, Association of India, New Delhi, 1977.
2. Menno, M.G.; “Fertilizer Industry - An Introductory Survey”, Higginbothams Pvt. Ltd., 1973.72

REFERENCES

1. Sauchelli, V.; “The Chemistry and Technology of Fertilizers”, ACS MONOGRAPH No. 148, Reinhold Publishing Cor. New York, 1980.
2. Fertiliser Manual, “United Nations Industrial Development Organisation”, United Nations, New York, 1967.
3. Slack, A.V.; Chemistry and Technology of Fertilisers, Interscience, New York, 1966.

COURSE OUTCOMES:

After the completion of the course will be able to

i. Use reactions and unit operations steps in manufacturing of various fertilizers
ii. Characterize fertilizers on the basis of different properties.
iii. Identify engineering problems in fertilizer manufacturing.
iv. Handle the fertilizers.
v. Select appropriate mixed fertilizer.

Course objectives	**Course outcomes**				
	i	ii	iii	iv	v
1					
2					
3					
4					

A1CHT301 FERTILIZER TECHNOLOGY												
Course designed by	Department of Chemical Engineering											
CO / PO mapping	a	b	c	d	e	f	g	h	i	j	k	l

A1CHT301FERTILIZER TECHNOLOGY	
Course designed by	Department of Chemical Engineering
Approval	Approved by: Meeting of Board of Studies held on 4th June, 2016
	Ratified by: 2nd Meeting of Academic Council, 17th Feb, 2016

A1CHT302	IV – SEMESTER(Core Elective – I)	L	T	P	C
	PETROLEUM REFINING	3	0	0	3
	Total Contact Hours – 45				

COURSE OBJECTIVES	
1	Understand the origin and formation of petroleum and methods available for refining
2	Understanding the properties of petroleum products
3	Understanding various stages of refining
4	Environmental aspects of petroleum

SYLLABUS

UNIT I

Origin, formation and composition of petroleum: Origin and formation of petroleum, Reserves and deposits of world, Indian Petroleum Industry.

Unit-II: Past, present and future of petroleum refining, Characterization of petroleum & Petroleum products, Chemical Composition of Crude Petroleum.

Unit-III:

Petroleum processing data: Evaluation of petroleum, thermal properties of petroleum fractions, important products, properties and test methods.

Unit-IV:

Fractionation of petroleum: Dehydration and desalting of crudes, heating of crude pipe still heaters, distillation of petroleum, blending of gasoline.

Unit-V:

Treatment techniques: Fraction-impurities, treatment of gasoline, treatment of kerosene, treatment of lubes.

Unit-VI: Global economic scenario, Environmental aspects in general, Present Indian scenario of Petroleum industry.

Texts/ references:

1. Petroleum Refining, Dr B.K. Bhaskara Rao.
2. Petrochemicals, Dr B.K. Bhaskara Rao.
3. Nelson, W.L. “Petroleum Refinery engineering”, McGraw Hill, New York 1961.
4. Hengstebeck R.J., “Petroleum Refining”, McGraw Hill, New York 1959.
5. Steiner H, “Introduction to Petroleum Chemical Industry”, Pergamon, London, 1961.
6. V.Y.Sern, “Gas phase oxidation”, Pergamon, London, 1964.

Course Outcomes:

Understand the reforming process.
Understanding the various steps in refining
Understand the economic aspects of refining
Understand the economic aspects of refining

Course objectives	Course outcomes			
	i	ii	iii	iv
1				
2				
3				
4				

A1CHT302PETROLEUM REFINING												
Course designed by	Department of Chemical Engineering											
CO / PO mapping	a	b	c	d	e	f	g	h	i	j	k	l

A1CHT302PETROLEUM REFINING	
Course designed by	Department of Chemical Engineering
Approval	Approved by: Meeting of Board of Studies held on 4th Jan, 2016
	Ratified by: 2nd Meeting of Academic Council, 17th Feb, 2016

A1CHT303	IV – SEMESTER(Core Elective – I)	L	T	P	C
	POLYMER TECHNOLOGY	3	0	0	3
	Total Contact Hours – 45				

COURSE OBJECTIVES	
The student will be able to learn	
1	Basic fundamentals of polymer technology and classification of polymers.
2	Different methods of polymerization and comparison between among them.
3	Kinetics of addition polymerization.
4	Different methods to measure molecular weight and size of a polymer.
5	Crystallinity of polymers and determination of properties of polymers with deformation.
6	Thermodynamics of polymer mixtures like Flory Huggins theory, free volume theory, free volume theory with diffusion.
7	Role of additives like antioxidants, plasticizers, lubricants, stabilizers, inhibitors in polymers.
8	Description of manufacture of few typical polymers.
9	Polymer processing methods like Moulding, extrusion, calendaring

SYLLABUS

Unit-I Introduction; definitions: polymer& macro molecule, monomer, functionality, average functionality, co-polymer, polymer blend., plastic and resin. Classification of polymers: based on source, structure, applications, thermal behavior, Concept of average molecular weight of polymers, molecular weight distribution, poly disparity index. Determination of average molecular weights: End group analysis, osmometry, light scattering techniques, viscometer, Gel permeation chromatography.

Unit-II Natural polymers: brief study of i) Natural rubber ii) shellac iii) rosin iv) cellulose v) proteins. Mechanism and kinetics of : Addition or chain polymerization a) free radical addition polymerisation b) Ionic addition polymerizations c) Coordination polymerization. d) Coordination or step growth or condensation polymerization.

Unit-III Methods of polymeisation: mass or Bulk polymerization process, solution polymeisation process, suspension polymeisation process and emulsion polymerisation method comparison of merits and demerits of these methods.Properties of polymers: crystalline and amorphous status, melting and glass transition temperatures and their determination, effect of polymer structure on mechanical, physical, chemical and thermal properties.

Unit-IV Degradation of polymers, Role of the following additives in the polymers: i) Fillers and reinforcing fillers ii) Plasticizers iii) Lubricants iv)Antioxidants and UV stabilizers v) Blowing agents vi)Coupling agents vii)Flame retardents viii) Inhibitors

Unit-V Brief description of manufacture, properties and uses of : i) Polyethylene (HDPE&LDPE), ii) Poly propylene iii) Polyvinylchloride iv) Polystyrene v) Polytetra fluoroethylene vi) Polymethyl mehacrylate vii) Polyvinylacetate & Polyvinylalcohol.

Unit-VI Brief description of manufacture, properties and uses of : i) Polyesters(Polyethylene terephalate polycarbonate and unsaturated polyesters) ii) Nylon(Nylon 66) iii) Phenol-Formaldehyde resins iv) Epoxy resins v) Polyurethane vi) Silicones Compounding of polymer resins, brief description of : i) Compression and transfer moulding ii) Injection moulding iii) Extrusion iv) Blow moulding v) Calendaring vi) Laminating and pultrusion

TEXT BOOKS:

1. Plastic materials, J.A. Brydson, Newnes-Butterwarths (London) 1989.
2. Text book of polymer science, Bill meyer, F.W.Jr. (3rd ed.) John Wiely&sons 1984

REFERENCES:

1. Introduction to plastics, J.H. Brison and C.C. Gosselin, Newnes, London 1968.
2. Polymeric Materials, C.C.Winding and G.D.Hiatt Mc Graw Hill Book Co. 1961 3. Polymer Science by Gowarikar

COURSE OUTCOMES:

After the completion of the course will be able to

i. Classify the polymers.
ii. Know the different methods of polymerization
iii. Find kinetics of addition polymerization
iv. Determine the molecular size and weight of polymers.
v. Find glass transition temperature, phase diagrams and crystallinity of polymers.
vi. Find the effect of additives in polymers.
vii. Describe the manufacture of few typical polymers.
viii. Identify appropriate polymer processing methods.

Course objectives	**Course outcomes**							
	i	ii	iii	iv	v	vi	vii	viii
1								
2								
3								
4								
5								
6								
7								
8								
9								

A1CHT303 POLYMER TECHNOLOGY												
Course designed by	Department of Chemical Engineering											
CO / PO mapping	a	b	c	d	e	f	g	h	i	j	k	l

A1CHT303 POLYMER TECHNOLOGY	
Course designed by	Department of Chemical Engineering
Approval	Approved by: Meeting of Board of Studies held on 4th June, 2016
	Ratified by: 2nd Meeting of Academic Council, 17th Feb, 2016

A1CHL203	IV – SEMESTER	L	T	P	C
	PROCESS HEAT TRANSFER LAB	0	0	3	2
	Total Contact Hours – 45				

COURSE OBJECTIVES	
1	Fundamentals of process heat transfer by conduction will be demonstrated through experiments like determination of thermal conductivities of composite wall and metal rod.
2	Fundamentals of process heat transfer by convection will be demonstrated through experiments involving natural convective and forced convective heat transfer process
3	Fundamentals of process heat transfer by radiation will be demonstrated through experiments involving Stefen-Boltzman constant, emissivity of a metal plate etc
4	Students will achieve hands-on experience and acquire writing skills and communication skills while conducting experiments in a team.

LIST OF EXPERIMENTS

1. Determination of total thermal resistance and thermal conductivity of composite wall.
2. Determination of thermal conductivity of a metal rod.
3. Determination of natural convective heat transfer coefficient for a vertical tube.
4. Determination of critical heat flux point for pool boiling of water.
5. Determination of forced convective heat transfer coefficient for air flowing through a pipe
6. Determination of overall heat transfer coefficient in double pipe heat exchanger.
7. Study of the temperature distribution along the length of a pin-fin under natural and forced convection conditions
8. Estimation of un-steady state film heat transfer coefficient between the medium in which the body is cooled.
9. Determination of Stefan – Boltzmann constant.
10. Determination of emissivity of a given plate at various temperatures.

COURSE OUTCOMES:

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

i. Understand the basics of experimental techniques for heat transfer measurements.

ii. Analyze experimental data and obtain correlations to predict heat transfer coefficients for design of heat transfer systems.

iii. conduct the experiments at R & D level in the industry

iv. Produce a written laboratory report.

A1CHL203 PROCESS HEAT TRANSFER LAB												
Course designed by	Department of Chemical Engineering											
CO / PO mapping	a	b	c	d	e	f	g	h	i	j	k	l
	√	√	√		√		√		√			

A1CHL203 PROCESS HEAT TRANSFER LAB	
Course designed by	Department of Chemical Engineering
Approval	Approved by: Meeting of Board of Studies held on 4th Jan, 2016
	Ratified by: 2nd Meeting of Academic Council, 17th Feb, 2016

A1CHL204	IV – SEMESTER	L	T	P	C
	MECHANICAL UNIT OPERATIONS LAB	0	0	3	2
	Total Contact Hours – 45				

COURSE OBJECTIVES	
1	To develop a basic understanding on size reduction equipment
2	To understand the principle of operation and the concepts involved in size reduction equipment
3	To understand the performance of equipment with the effect of parameters on separation of solids and size reduction.
4	Performing various experiments on equipment & understanding the theoretical concepts in depth

LIST OF EXPERIMENTS

i. To calculate average particle diameter and specific surface area for a given sample
ii. To determine the reduction ratio and time of crushing to get 80% product
iii. To calculate the power required for crushing and work index for different materials using roll crusher
iv. To calculate the time of grinding in a ball mill for a product of 80% product passing through a screen
v. To calculate the reduction ratio for different materials
vi. To calculate the average particle diameters for a given sample.
vii. To calculate reduction ratio and time of grinding in attrition mill for a product of 80% product passing through a screen.
viii. To calculate the effectiveness of a 100 mesh screen.
ix. To calculate specific cake resistance and filter medium resistance using plate and frame filter press
x. To calculate the average particle diameter for different materials
xi. To study the effect of inlet gas velocity to overall efficiency for different materials
xii. To calculate the percentage recovery of coal as froth from coal-sand mixture

COURSE OUTCOMES:

After successful completion of this lab course, the students will be able to do the following:

- Operate and explain the function of size reduction equipment, filtration equipment, classifiers, solid particle separators, settlers, floatation equipment and particle screening equipment.
- Measure and explain the effect of design parameters on the dynamics of the above equipment and performance.
- Collect and analyze data with respect to theoretical principles learnt in mechanical operations theory.
- Work in teams to conduct experiments effectively and efficiently and to write lab reports to document experimental work

A1CHL204 MECHANICAL UNIT OPERATIONS LAB												
Course designed by	Department of Chemical Engineering											
CO / PO mapping	a	b	c	d	e	f	g	h	i	j	k	l

A1CHL204 MECHANICAL UNIT OPERATIONS LAB	
Course designed by	Department of Chemical Engineering
Approval	Approved by: Meeting of Board of Studies held on
	Ratified by: 2nd Meeting of Academic Council, 17th Feb, 2016

V - SEMESTER

A1CHT209	V - SEMESTER	L	T	P	C
	PROCESS INSTRUMENTATION	3			3
	Total Contact Hours – 48				

COURSE OBJECTIVES	
1	To learn thebasic elements of an instrument and its static and dynamic characteristics
2	To studythevarious types ofindustrial thermometers
3	To learn the various types of instruments for measurement of pressure, vacuum, head, density, leveland flow measurement
4	Togetanoverviewofvariousrecording,indicatingandsignalinginstruments,transmission of instrumentreadings,instrumentationdiagrams,controlcenter,process analysisanddigital instrumentation.
5	To learn thebasic concepts ofvarious types of composition analysis

SYLLABUS

Unit –I:

Elements of instruments, static and dynamic characteristics, basic concepts of response of first order type instruments, mercury in glass thermometer, bimetallic thermometer, pressure spring thermometer, static accuracy and response of thermometers.

Unit-II:

Thermo electricity: Industrial thermocouples, thermocouple wires, thermo couple wells and response of thermocouples.

Thermal coefficient of resistance, industrial resistance thermometer bulbs and circuits, radiation receiving elements, radiation, photoelectric and optical pyrometers.

Unit-III:

Composition analysis, spectroscopic analysis by absorption, emission, mass and color measurement spectrometers, gas analysis by thermal conductivity, analysis of moisture, gas chromatography, refractometer.

Pressure vacuum and head: liquid column manometers, measuring elements for gauge pressure and vacuum, indicating elements for pressure gauges, measurement of absolute pressure, measuring pressure in corrosive liquids, static accuracy and response of pressure gauges.

Unit -IV

Head, density and specific gravity, direct measurement of liquid level, pressure measurement in open vessels, level measurements in pressure vessels, measurement of interface level, density measurement, and level of dry materials.

Unit -V

Head flow meters, area flow meters, open channel meters, viscosity meters, quantity meters, flow of dry materials, viscosity measurements.

Unit -VI

Recording instruments, indicating and signaling instruments, transmission of instrument readings, control center, instrumentation diagram, process analysis. Telemetry & Transducers.

Text Book:
1. Industrial instrumentation by Donald P.Eckman, Wiley eastern, 1950.

Reference:
1. Principles of industrial instrumentation by Patra Nabis, TMH.
2. Instruments for measurements and control by Holbrock W.C. Van Nostrand East West.
3. Hand book Instrumentation, Considine, McGraw Hill,
4. Instrumentation for Process measurement and Control, Norman A. Anderson,3rd Edition, CRC press

Course Outcomes:
Thestudents will be ableto

- Understand thebasic elements of an instrument and its characteristics
- Becomefamiliarwith various types ofinstruments formeasurement ofvarious process variables liketemperature, pressure, vacuum, head, level, composition, flow and density
- Getaclearperspectiveofvariousrecording,indicating,signalinginstruments,transmission ofinstrument readings
- Get an understanding of instrumentation diagrams, control center, process analysis and digital instrumentation

Course objectives	**Course outcomes**			
	i	ii	iii	Iv
1				
2				
3				
4				
5				

A1CHT209PROCESS INSTRUMENTATION												
CO/PO mapping												
Course designed by	Department of Chemical Engineering											
CO / PO mapping	a	b	c	d	e	f	g	h	i	j	k	L
CO1												
CO2												
CO3												
CO4												

A1CHT209PROCESS INSTRUMENTATION	
Course designed by	Department of Chemical Engineering
Approval	Approved by: Meeting of Board of Studies held on 4th Jan, 2016
	Ratified by: 2nd Meeting of Academic Council, 17th Feb, 2016

A1CHT210	V - SEMESTER	L	T	P	C
	CHEMICAL ENGINEERING THERMODYNAMICS –II	3	1	0	4
	Total Contact Hours – 60				

COURSE OBJECTIVES	
1	Calculate heat and work requirements for industrial process
2	Compute thermodynamic properties of multi component systems undergoing composition changes.
3	Analyze experimental VLE data to calculate the activity coefficient and obtain simple models for excess Gibbs energy.
4	Have the knowledge to draw T-xy, P-xy, x-y equilibrium diagrams using Raoults law and modified Raoults law.
5	Have the knowledge of effect of Temperature, Pressure and concentrations on the rate of reaction which is of use in design of reactors.

SYLLABUS

UNIT –I: Heat effects: Sensible heat effects, Internal energy of ideal gases: Microscopic view, Latent heats of pure substances, heat effects of industrial reactions, heat effects of mixing processes. Standard heat of reaction, Standard heat of formation, Standard heat of combustion, temperature dependence of heat of reaction

UNIT-II: Solution thermodynamics: Theory: Fundamental property relation, chemical potential as a criterion for phase equilibrium, partial properties, ideal gas mixtures, fugacity and fugacity coefficient for pure species, fugacity and fugacity coefficient for species in solutions, generalized correlations for Fugacity coefficient, The ideal solutions, excess properties.

UNIT –III: Solution thermodynamics: applications: the liquid phase properties from VLE data, models for the excess Gibbs energy, property changes of mixing

UNIT –IV: VLE at low to moderate pressures: The nature of equilibrium, the phase rule, Duhems theorem, VLE: Qualitative behavior, the gamma /Phi formulation of VLE, Dew point and bubble point calculations, flash calculations, solute (1)/solvent (2) systems **Thermodynamic properties and VLE from equations of state:** properties of fluids from the virial equations of state, properties of fluids from cubic equations of state, fluid properties from correlations of the Pitzer type, VLE from cubic equations of state

UNIT –V: Topics in phase equilibria: Equilibrium and stability, liquid-liquid equilibrium (LLE), vapor- liquid–liquid equilibrium (VLLE), solid-liquid equilibrium (SLE), solid vapor equilibrium (SVE), equilibrium absorption of gases on solids

UNIT – VI: Chemical reaction equilibria: The reaction coordinate, application equilibrium criterion to chemical reactions, the standard Gibb's energy change and the equilibrium constant, effect of temperature on equilibrium constants, relation of equilibrium constants to composition, equilibrium conversion for single reactions, Phase rule and Duhem's theorem for reacting systems.

TEXT BOOKS:

1. Introduction to chemical engineering thermodynamics by J.M. Smith, H.C. Van Ness and M.M. Abbott, 7th ed. McGraw Hill, 2005.
2. Chemical Engineering Thermodynamics, Rao Y.V.C., Universities Press (India) Pvt. Ltd.,1997.

REFERENCE BOOKS:

1. Chemical and Process Thermodynamics, BG Kyle, 3rd Edition, Phi Learning, 2008.
2. Introductory Chemical Engineering Thermodynamics, J. Richard Elliott, Carl T. Lira, 2nd Edition, Prentice Hall, 2012.
3. Chemical, Biochemical and Engineering Thermodynamics, Stanley I Sandler, 4th Edition, Wiley India Pvt Ltd, 2006.
4. Molecular Thermodynamics in Fluid Phase Equilibria, J.M. Prausnitz, R.N. Lichtenthaler, E.G.de Azvedo, 3rd Edition, Prentice-Hall, 1998.
5. Engineering and Chemical Thermodynamics, Milo D. Koretsky, Wiley India Pvt Ltd, 2009
6. Thermodynamics: Applications in Chemical Engineering and The Petroleum Industry, J.Vidal, Editions Technip, 2003.

COURSE OUTCOMES:

By mastering the chemical engineering thermodynamics course, student will be able to

i. Estimate heat requirement for any physical change and chemical change.
ii. Find fugacity coefficient and activity coefficient for a component in a mixture.
iii. Identify the non-ideal solution model for vapour liquid equilibrium.
iv. Obtain VLE data using appropriate cubic equations of state.
v. Find reaction equilibrium constant and equilibrium conversion for single reactions and multiple reactions.

Course objectives		**Course outcomes**			
	i	Ii	Iii	iv	v
1					
2					
3					
4					
5					

A1CHT210 CHEMICAL ENGINEERING THERMODYNAMICS-II												
Course designed by	Department of Chemical Engineering											
CO / PO mapping	a	b	C	d	e	f	g	h	i	j	k	l

A1CHT210CHEM. ENGG. THERMODYNAMICS-II	
Course designed by	Department of Chemical Engineering
Approval	Approved by: Meeting of Board of Studies held on 4th Jan, 2016
	Ratified by: 2nd Meeting of Academic Council, 17th Feb, 2016

A1CHT211	V - SEMESTER	L	T	P	C
	CHEMICAL REACTION ENGINEERING-I	3	1	0	4
	Total Contact Hours – 60				

COURSE OBJECTIVES	
1	**DOMAIN KNOWLEDGE**: Graduates will be trained to demonstrate knowledge of mathematics, science, basic computing and engineering fundamentals, breadth and in-depth studies in mechanical engineering aimed at bringing them abreast with industrial and research domains
2	**EMPLOYMENT**: Graduates will be trained to succeed in securing engineering positions with Mechanical /Manufacturing firms as well as Software-based industries and also with government agencies
3	**HIGHER STUDIES & LIFELONG EDUCATION**: Graduates will beoriented towards success in the pursuit of advanced degrees in Mechanical engineering or other fields and will be imparted the spirit for continued, independent, life-long learning to become experts in their profession and to broaden their professional knowledge
4	**PROFESSIONAL CITIZENSHIP**: Graduates will be trained to organize and present information, to write and speak effective English, to work effectively on team-based engineering projects, to practice ethics at work and demonstrate a sense of social responsibility

SYLLABUS

UNIT- I:

Classification of reactions, Rate equations of elementary and non-elementary reactions, variables affecting the rate of reaction, reaction rate constant, reaction order and molecularity, reversible reactions, non elementary reactions; Concentration dependent term of rate equation, Temperature dependent term of rate equation, searching for a mechanism, predictability of reaction rate from theory.

Unit:II:

Constant and variable volume reaction systems, integral and differential methods of kinetic analysis, half□lives, fractional life method – general procedure, irreversible unimolecular type first order, bimolecular type second order, and trimolecular type third order reactions, empirical reactions of nth order, zero-order reactions, overall order of irreversible reactions, irreversible reactions in series and parallel, Analysis of total pressure data obtained in a constant-volume system,

Unit:III:

First and second order reversible reactions, reactions of shifting order, Ideal reactors for a single reaction - Ideal batch reactor, Steady-state mixed flow reactor, Steady-state plug flow reactors; Design for single reactions - Size comparison of single reactors, Multiple reactor systems, Recycle reactor, Autocatalytic reactions.

Unit-IV:

Design for parallel reactions, Introduction to multiple reactions, qualitative and quantative discussion about product distribution, sizing of reactor,

Unit-V:

Introduction to multiple reactions, qualitative discussion and quantitative treatment of product distribution and of reactor size, Irreversible first order reactions in series, quantitative discussion about product distribution, quantitative treatment - plug flow or batch reactor, mixed flow reactor, first-order followed by zero order reaction, zero order followed by first order reaction.

Unit-VI:

Non-isothermal operation of reactors: Optimum temperature progression; Adiabatic and non-adiabatic batch, mixed flow and plug flow reactors; exothermic reactions in mixed flow reactors; Multiple reactions: Yield and selectivity

Text Books:

1. O. Levenspiel, Chemical Reaction Engineering, 3rd ed. John Wiley & Sons, 2007.

Reference Books:

1. H. S. Fogler, Elements of Chemical Reaction Engineering, 4th ed., PHI, 2005.
2. K A Gavhane, Chemical Reaction Engineering – I, Nirali Prakashan, 2004.

Course Outcomes:

1. Analyze the experimental data obtained from ideal reactors and determine the kinetics of homogeneous reactions of various types for both constant volume and variable volume conditions.
2. Design ideal reactors for carrying out homogeneous reactions.
3. Compare the performance of various types of reactors including multiple reactor systems and recycle reactors.
4. Design suitable reactors for carrying out reactions in parallel and reactions in series.
5. Analyze the effects of temperature and pressure on equilibrium constants and equilibrium conversions

Course objectives	**Course outcomes**				
	i	Ii	iii	iv	v
1					
2					
3					
4					

A1CHT211CHEMICAL REACTION ENGINEERING-I												
Course designed by	Department of Chemical Engineering											
CO / PO mapping	a	b	C	d	e	f	g	h	i	j	k	l

A1CHT211CHEMICAL REACTION ENGINEERING-I	
Course designed by	Department of Chemical Engineering
Approval	Approved by: Meeting of Board of Studies held on 4th Jan, 2016
	Ratified by: 2nd Meeting of Academic Council, 17th Feb, 2016

A1CHT212	V - SEMESTER	L	T	P	C
	MASS TRANSFER OPERATIONS- 1	3	1	0	4
	Total Contact Hours – 60				

COURSE OBJECTIVES	
1	Give a basic understanding of engineering mathematics to solve mass transfer operation problems.
2	To understand the application of concepts of physical and chemical separation methodologies to solve mass transfer operation problems.
3	Develop the ability to know about the design specifications of distillation & absorption columns.
4	Ability to understand the thrust of engineering solutions & threshold limits of separation process.

SYLLABUS

Unit-1: Molecular diffusion

Introduction: Classification of Mass Transfer Operations, Methods of conducting the Mass Transfer Operations, Design Principles.

Molecular diffusion: Fick's law, Molecular diffusion in gases, Molecular diffusion in liquids, Diffusion in solids, Fick's law for solids, Unsteady state diffusion, Types of solid diffusion.

Unit-2: Mass Transfer Coefficients

Mass transfer coefficients, Theories of Mass Transfer: Film Theory, Penetration Theory, Surface Renewal Theory, Combination of film-surface renewal theory, Surface stretch theory.

Flow past solids: Boundary layers, Dimensionless groups in mass transfer, Mass and heat transfer analogies.

Unit-3:Interphase Mass Transfer

Equilibrium, Diffusion between phases, Raoult's law, Henry's law, Mass transfer between two phases, Overall mass transfer coefficient, Material balances: Steady state concurrent processes, Steady state countercurrent processes, Stages, Cascades: Cross flow cascades, Countercurrent cascades.

Unit-4:Equipment for Gas-Liquid Operations

Gas dispersed: Bubble columns, Mechanically Agitated vessels, Tray towers. Liquid dispersed: Venturi scrubbers, Wetted wall towers, Spray towers, Packed towers.

Unit-5: Gas absorption

Equilibrium solubility of gases in liquids, Ideal liquid solutions, Selection of solvent, Co-current flow, Counter-current flow, Determination of the number of stages in a tray tower, Height equivalent to a theoretical plate (HETP), Tray efficiency

Unit-6:Distillation

Vapor- liquid equilibria, Relative volatility, Flash distillation, Simple distillation, Continuous rectification of binary mixtures, Condenser, Re-boiler, Enriching section, Exhausting secting, McCabe-Thiele method, Ponchon Savarit method, Azeotropic distillation, Extractive distillation.

TEXT BOOKS:

1. Principles of Mass Transfer and separation processes by Binay K. Dutta
2. Mass transfer Operations, R.E. Treybal, 3rd Edition., Mc Graw Hill, 1980

REFERENCE BOOKS:

1. Unit Operations of Chemical Engineering, W.L.Mc Cabe, J.C.Smith & Peter Harriott, McGraw- Hill, 6th Edition, 2001.
2. Coulson and Richardson's Chemical engineering, Vol 1,Backhurst, J.R., Harker, Richardson, J.F., and Coulson, J.M., Butterworth-Heinemann, 1999
3. Coulson and Richardson's Chemical engineering, Vol 2, Richardson, J.F. & Harker, J.H. with Backhurst, J.R., Butterworth-Heinemann, 2002.

COURSE OUTCOMES:

Student will be able to

1. An ability to apply knowledge of mathematics, physical and chemical sciences in solving mass transfer operations problems.
2. An ability to understand an engineering system, component or process (diffusion, distillation and absorption).
3. To understand the thrust of engineering solutions & threshold limits of separation process.
4. To understand the mass transfer equipment operations and design parameters.

Course objectives	**Course outcomes**			
	i	ii	iii	iv
1				
2				
3				
4				

A1CHT212MASS TRANSFER OPERATIONS - 1												
Course designed by	Department of Chemical Engineering											
CO / PO mapping	a	b	C	d	e	f	g	h	i	j	k	l

A1CHT212MASS TRANSFER OPERATIONS - 1	
Course designed by	Department of Chemical Engineering
Approval	Approved by: Meeting of Board of Studies held on June, 2015
	Ratified by: 2nd Meeting of Academic Council, 17th Feb, 2016

A1CHT304	V - SEMESTER (Core Elective – II)	L	T	P	C
	PAPER TECHNOLOGY	3	0	0	3
	Total Contact Hours – 48				

COURSE OBJECTIVES	
1	Gaining a comprehensive overview of pulp & paper industry
2	Raw materials used for paper making
3	Types of pulping used
4	Testing methods used for pulp and paper

SYLLABUS

Unit 1

History:

Importance of paper industry, historical background of paper making, development of paper industry in India,

Different types and uses of paper: Different types and uses of papers and paper boards, composition, method of making different types of papers and boards,

Unit 2

Raw materials for paper making:

Classification of fibres, characteristics and composition of some important vegetable fibers (hard woods, softwoods, bagasse, straws, rags and paper stock)

Preparation of raw materials: Wood preparation – pulp wood measurement, barking, chipping, screening and conveying of chips)

Unit 3

Pulping processes:

Mechanical pulping, alkaline pulping (Soda and Kraft), sulfite pulping, semi-chemical pulping, recovery of cooking chemicals from spent cooking liquors,

Unit 4

Pulp bleaching:

Bleaching agents, bleaching methods – single stage and multi stage bleaching,

Stock preparation: Beating and refining, sizing and loading (filling)

Unit 5

Manufacture of paper: Paper machines (Fourdrinier and Cylinder), making of paper – forming section, press section, dryer section, calendaring section,

Unit 6

Testing of different properties of pulp and paper: Testing and evaluation of pulp, various properties of pulp and paper and their testing.

Text books:

1. 'Handbook of Pulp and Paper Technology' by Kenneth W.Britt, Vols.I&II
2. 'Modern Pulp and Paper Making' edited by John B.Calkin
3 `Pulp and Paper: Science and Technology – Vols .I&II' by E.Libby, McGraw HillBooks Co.
4. 'Pulp and Paper Manufacture- Vols. I & II' by R.C.McDonald & Others, McGraw Hill Books Company.

Course Outcomes:

1. Understand the importance of pulp and paper
2. Understanding the se of various materials used for paper making
3. Understanding the various methods of paper making
4. Understanding the methods for testing pulp and paper

Course objectives	**Course outcomes**			
	i	ii	iii	iv
1				
2				
3				
4				

A1CHT304PAPER TECHNOLOGY												
Course designed by	Department of Chemical Engineering											
CO / PO mapping	a	b	C	d	e	f	g	h	i	j	k	l

A1CHT304PAPER TECHNOLOGY	
Course designed by	Department of Chemical Engineering
Approval	Approved by: Meeting of Board of Studies held on 4th Jan, 2016
	Ratified by: 2nd Meeting of Academic Council, 17th Feb, 2016

A1CHT305	V - SEMESTER (Core Elective – II)	L	T	P	C
	FUEL CELL TECHNOLOGY	3	0	0	3
	Total Contact Hours – 48				

COURSE OBJECTIVES	
1	Understanding the importance of fuel cells
2	Reactions in fuel cells
3	Characterization of fuel cells
4	Understanding the life cycle of fuel cells

SYLLABUS

Unit 1: Overview of fuel cells: Low and high temperature fuel cells; Fuel cell thermodynamics - heat, work potentials, prediction of reversible voltage, fuel cell efficiency.

Unit 2: Fuel cell reaction kinetics - electrode kinetics, overvoltages, Tafel equation, charge transfer reaction, exchange currents

Unit 3: Electrocatalyses - design, activation kinetics, Fuel cell charge and mass transport - flow field, transport in electrode and electrolyte.

Unit 4: Fuel cell characterization: - in-situ and ex-situ characterization techniques, i-V curve, frequency response analyses

Unit 5: Fuel cell modeling and system integration: - 1D model - analytical solution and CFD models.

Unit 6: Balance of plant; Hydrogen production from renewable sources and storage; safety issues, cost expectation and life cycle analysis of fuel cells.

Prescribed Textbooks

1. O'Hayre, R. P., S. Cha, W. Colella, F. B. Prinz, Fuel Cell Fundamentals, Wiley, NY (2006).
2. Bard, A. J., L. R., Faulkner, Electrochemical Methods, Wiley, N.Y. (2004) Ref Book.
3. Basu, S. (Ed) Fuel Cell Science and Technology, Springer, N.Y. (2007).
4. Liu, H., Principles of fuel cells, Taylor & Francis, N.Y. (2006).

Course Outcomes:

The use of fuel cells and their thermodynamics
Able to characterize the fuel cells
Understand the safety aspects of fuel cells.
Able to model the fuel cells.

Course objectives	Course outcomes			
	i	ii	iii	iv
1				
2				
3				
4				

A1CHT305FUEL CELL TECHNOLOGY												
Course designed by	Department of Chemical Engineering											
CO / PO mapping	a	b	C	d	e	f	g	h	i	j	k	l

A1CHT305FUEL CELL TECHNOLOGY	
Course designed by	Department of Chemical Engineering
Approval	Approved by: Meeting of Board of Studies held on 4th Jan, 2016
	Ratified by: 2nd Meeting of Academic Council, 17th Feb, 2016

A1CHT306	V - SEMESTER (Core Elective – II)	L	T	P	C
	INDUSTRIAL POLLUTION CONTROL &ENGINEERING	3	0	0	3
	Total Contact Hours – 48				

COURSE OBJECTIVES	
1	Understand the types of pollution and dispersion of air pollutants
2	Understand the classification of air pollutants and methods of treatment
3	Understand the types of water pollution and treatment methods
4	Understand the types of solid waste management

SYLLABUS

INDUSTRIAL POLLUTION CONTROL ENGINEERING

Unit-I

Type of pollution, Environment legislation, Guidelines and standards, Types of emissions from chemical industries and effects of environment. Global warming, climate change and carbon capture

Unit-II

Meteorological aspects of air pollutant dispersion: Temperature lapse rates and stability, Wind velocity and turbulence, Plume behavior, Dispersion of air pollutants, Estimation of plume rise.

Sources and characteristics of pollutants in fertilizer, paper and pulp industry, petroleum and petroleum industry.

Unit-III

Air pollution sources & effects: Classification and properties of air pollutants, Emission sources, Behavior and fate of air pollutants, Effect of air pollution.

Air pollution sampling and measurement: Types of pollutant sampling and measurement, Ambient air sampling, Stack sampling, Analysis of air pollutants.

Unit-IV

Air pollution control methods & equipment: Control methods, Source correction methods, Cleaning of gaseous effluents, Particulate emission control, Selection of a particulate collector, Control of gaseous emissions, Design methods for control equipment.

Unit-V

Water pollution: Water resources, Origin of wastewater, types of water pollutants and there effects.

Waste water sampling, analysis and treatment: Sampling, Methods of analysis, Determination of organic matter, Determination of inorganic substances, Physical characteristics, Bacteriological measurement, Basic processes of water treatment, Primary treatment, Secondary treatment, Advanced wastewater treatment, Recovery of materials from process effluents.

Unit-VI

Solid waste management: Sources and classification, Public health aspects, Methods of collection, Disposal Methods, Potential methods of disposal.

Hazardous waste management: Definition and sources, Hazardous waste classification, Treatment methods, Disposal methods.

TEXT BOOKS:

1. Environmental pollution and control engineering, Rao C. S. – Wiley Eastern Limited, India, 1993.
2. Pollution control in process industries by S.P. Mahajan TMH.,1985.

REFERENCES:

1. Rao M.N. and Rao H.V.N - Air Pollution, Tata – McGraw Hill Publishing Ltd., 1993.
2. De A.K - Environmental Chemistry, Tata – McGraw Hill Publishing Ltd., 1999.
3. Waste water treatment by M.Narayana Rao and A.K.Datta,Oxford and IHB publ. New Delhi.
4. Air pollution control by P.Prathap mouli and N.Venkata subbayya. Divya Jyothi Prakashan, Jodhpur.
5. Glynn Henry J. and Gary W. Heinke, Environmental Science and Engineering, 2nd Edition, Prentice Hall of India, 2004.
6. "Industrial Pollution Control and Engineering." Swamy AVN, Galgotia publications, 2005

Course Outcomes:

1. Should be able to understand the importance of air pollution and dispersion of plumes
2. Should be able to understand the methods of treatment of air pollutants
3. Should be able to understand the methods of treatment of liquid wastes.
4. Should be able to the methods of solid waste management

Course objectives	**Course outcomes**			
	i	ii	iii	iv
1				
2				
3				
4				

A1CHT306 INDUSTRIAL POLLUTION CONTROL &ENGINEERING												
Course designed by	Department of Chemical Engineering											
CO / PO mapping	a	b	C	d	e	f	G	h	i	j	k	l

A1CHT306 INDUSTRIAL POLLUTION CONTROL &ENGINEERING	
Course designed by	Department of Chemical Engineering
Approval	Approved by: Meeting of Board of Studies held on 4th Jan, 2016
	Ratified by: 2nd Meeting of Academic Council, 17th Feb, 2016

A1CHT307	V - SEMESTER (Core Elective – III)	L	T	P	C
	CERAMIC TECHNOLOGY	3	0	0	3
	Total Contact Hours – 48				

COURSE OBJECTIVES	
1	Types of structures in ceramic materials
2	Understanding the various types of ceramic materials
3	Understanding the use of various coatings
4	Characterization of ceramic materials

SYLLABUS

UNIT 1: Rocks Types:

Various types of rocks; igneous, sedimentary and metamorphic.Textures, Strucutres and classification of above rocks.Origin of igneous, sedimentary and metamorphic rocks.Geology and its utility in ceramic industry.

UNIT 2: Ceramic Minerals:

Description and classification of various minerals based on their chemical compositions, Physical properties and occurrence. Brief idea on processing of synthetic raw materials:

Bayer process, Calcined Alumina, Tabular Alumina, Fused Alumina, Sea-water agnesia, Zircon and Zirconia, Titania, Magnesio-Aluminate Spinel, Fumed Silica etc.The application areas and limitations of synthetic raw materials.

UNIT 3: Ceramic Raw materials:

Importance, use and limitations of natural raw materials in refractories, whitewares, cement, potteries, and glass ceramic Industries; Bauxite, Limestone, Chromite, Magnesite, Dolomite, Fluorite, Graphite, Gypsum, Haematite, Kaolinite, Fireclay, Ball clay, Silica sand etc

UNIT 4: COATINGS:

Introduction, classification, opacity and opacifiers, glaze materials – selection, glaze maturing, preparation of glaze, application of glaze, glaze firing and glaze body interaction, glaze defects. Ceramic colors, enamels

UNIT 5: Characterization:

Chromatography: Introduction, Paper and thin layer chromatorgraphy, Liquid chromatography, Types of liquid chromatography, Column and detection systems. Effect of heat on different raw materials: Differential thermal analysis (DTA), thermo gravimetric analysis (TGA), thermal analysis, Differential Scanning Calorimetry (DSC), Factors affecting the phase transformations with suitable examples, Dilatometry–basic principles, instrumentations and case study in ceramic applications.

UNIT 6: Fabrication Method:

Packing of particles, Additives in forming processes, Selection of additives; Solvent, Binder, Plasticizers, deflocculants and lubricant, Dry and semidry pressing methods; Die compaction and isostatic compaction, Casting methods: slip casting, pressure casting and tape casting,Plastic forming method: extrusion and injection molding.

Text Books:

1. Engineering Geology by Dr. Praveen Singh.
2. Hand Book of Ceramic by S. Kumar.
3. Ceramic Raw Material by W. E. Worrall.
4. Norton F.H. Fine Ceramics: Technology and Applications; Mc-Graw Hill, Co; NY, 1978.
5. F. Singer and S. Singer, Industrial Ceramics, Oxford & IBH Publishing Co; 1991.
6. Paul Bormans, Ceramics are More Than Clay Alone, Cambridge International Science Publishing 2004

Course Outcomes:

1. Will be able to understand the various properties of ceramic materials
2. Should be able to understand various types of ceramic minerals and their applications
3. Should be able to understand the methods of fabrication
4. Understand various methods of characterization

Course objectives	**Course outcomes**			
	i	Ii	iii	iv
1				
2				
3				
4				

A1CHT307CERAMIC TECHNOLOGY												
Course designed by	Department of Chemical Engineering											
CO / PO mapping	a	b	C	D	e	f	g	h	i	j	k	l

A1CHT307CERAMIC TECHNOLOGY	
Course designed by	Department of Chemical Engineering
Approval	Approved by: Meeting of Board of Studies held on 4th Jan, 2016
	Ratified by: 2nd Meeting of Academic Council, 17th Feb, 2016

A1CHT308	V - SEMESTER (Core Elective – III)	L	T	P	C
	PETROCHEMICAL TECHNOLOGY	3	0	0	3
	Total Contact Hours – 48				

COURSE OBJECTIVES The student will	
1	Acquire knowledge about different feed stocks being used in the Petrochemical Industry
2	Get an understanding about production of wide range of widely used petrochemicals
3	Learn the recent trends in the production of LPPE and HDPE
4	Know the Global economic scenario and Environmental aspects in general

SYLLABUS

Unit-I:
Petrochemical Industry – Feed stocks: Petrochemical Industry in India, Feed stocks for Petrochemicals, Separation of gases, Separation of Aromatics.

Unit-II:
Chemicals from methane: Introduction, production of Methanol, Formaldehyde, Ethylene glycol, PTFE, Methylamines.

Unit-III:
Chemicals from Ethane-Ethylene-Acetylene: Oxidation of ethane, production of Ethylene, Manufacture of Vinyl Chloride monomer, Ethanol from Ethylene, Acetylene manufacture, Acetaldehyde from Acetylene.

Unit-IV:
Chemicals from C_3, C_4: Products from Propane, Chemical from Propylene: Isopropyl alcohol, Acetone, Phenol, Dehydrogenation of Butane, Butadiene.

Unit-V: Recent trends in the production of LDPE and HDPE, Details of thermal cracking to produce light olefins from various feed stocks.

Unit-VI: Global economic scenario, Environmental aspects in general, Present Indian scenario of Petrochemical industry.

TEXT BOOKS:
1. Petroleum Refining Engineering; WL Nelson, Mc Graw Hill Company IV addition.
2. Petrochemicals, 4th ed., B.K. Bhaskara Rao, Khanna Publishers, 2002.

REFERENCES:
1. The Petroleum chemicals industry by R.F.Goldstine, e &fn London, 1967
2. Chemical technology of petroleum by W.S.Gruese and D.R. Stevens, Mc graw‘ Hill, 1980
3. Fundamentals of petroleum chemical technology by P Below.
4. Petro Chemicals Volume 1 and 2; A Chauvel and Lefevrev ; Gulf Publishing company 1989

COURSE OUTCOMES:

After the completion of the course will be able to

- **i.** Describe about different feed stocks being used in the Petrochemical Industry
- **ii.** Describe about production of wide range of widely used petrochemicals
- **iii.** Explain the recent trends in the production of LPPE and HDPE
- **iv.** Explain the Global economic scenario and Environmental aspects in general

Course objectives	**Course outcomes**				
	i	ii	Iii	iv	
1					
2					
3					
4					

A1CHT308 PETROCHEMICAL TECHNOLOGY												
Course designed by	Department of Chemical Engineering											
CO / PO mapping	a	b	C	d	e	f	g	h	i	j	k	l

A1CHT308 PETROCHEMICAL TECHNOLOGY	
Course designed by	Department of Chemical Engineering
Approval	Approved by: Meeting of Board of Studies held on 4th June, 2016
	Ratified by: 2nd Meeting of Academic Council, 17th Feb, 2016

A1CHT309	V - SEMESTER (Core Elective – III)	L	T	P	C
	NANO TECHNOLOGY	3	0	0	3
	Total Contact Hours – 48				

COURSE OBJECTIVES The student will	
1	Acquire knowledge about basic fundamentals of nano technology
2	Get an understanding about Nano fabrication and Chemical self assembly
3	Learn the synthesis of Nano particles using different manufacturing methods
4	Know the application of nano technology and future prospects

SYLLABUS

UNIT-I:

The big world of Nano-materials: Introduction to Nano Technology: History and scope, Historical development of nanomaterials- Issues in fabrication and characterization of nanomaterials, Unique properties of nano-materials, effects of nano dimensions on materials behavior.

UNIT-II:

Classification of Nano-materials: Amorphous, Crystalline, microcrystalline, quasi-crystalline and nano-crystalline materials, Intermolecular forces, Aqueous, Biological, Van der-waal, Electro static, Double layer forces.

UNIT-III:

Synthesis Routes: Bottom-up approaches, Top-down approaches, Sol-Gel Synthesis, Inert Gas Condensation, High energy ball milling, Chemical vapor deposition, Arc discharge method.

UNIT-IV:

Applications of Nano-materials: Food and agriculture industry, cosmetics, consumers goods, structure and engineering automotive industry, water treatment, and environment, medicine, textiles, paints, energy, defenses and space applications, structure applications.

UNIT-V:

Tools to characterize Nano- materials: X-ray diffraction (XRD), Scanning Electron Microscopy (SEM), Transmission Electron Microscopy (TEM), Atomic Force Microscopy (AFM), Scanning Tunneling Microscopy (STM), Field Ion Microscopy (FIM).

UNIT-VI:

Depletion interactions, Hydro phobic forces, Thin films, micro structures and defects in nano crystalline materials, Nano-indentation.

Text Books:

1. Text book of Nano-Science and Nano-Technology, Murthy B.S., Shankar P., Baldev Raj, B. B. Rath and James Murday, Universities Press India Limited, Hyderabad, 2013.
2. Nano Materials & Introduction to synthesis, properties and application, Dieter Vollath, Wiley vch, 2006.

Reference Book:

1. Introduction to Nano-science and Nanotechnology, K.K. Chattopadhyay and A. N. Banerjee, PHI, 2009.

COURSE OUTCOMES:

After the completion of the course will be able to

- Demonstrate the key fundamentals of nano technology
- Describe nano fabrication and chemical self assembly
- Synthesize nano particles using different manufacturing methods
- Explain the applications of nano technology

Course objectives	**Course outcomes**				
	i	ii	Iii	iv	
1					
2					
3					
4					

A1CHT309 NANO TECHNOLOGY												
Course designed by	Department of Chemical Engineering											
CO / PO mapping	a	b	C	d	e	f	g	h	i	j	k	l

A1CHT309 NANO TECHNOLOGY	
Course designed by	Department of Chemical Engineering
Approval	Approved by: Meeting of Board of Studies
	Ratified by: 2nd Meeting of Academic Council

A1CHL205	V - SEMESTER	L	T	P	C
	CHEMICAL REACTION ENGINEERING LAB	0	0	3	2
	Total Contact Hours – 45				

COURSE OBJECTIVES	
1	Plan short series of experiments in lab reactors with the intent of satisfying preset goals
2	Analyze reactor models with experimental evidence
3	Characterize lab reactors through residence time distributions
4	Combine standard models for simple chemical reactors to a model for the behavior of non-ideal lab reactors
5	Calculate upper and lower limits for conversion based on knowledge of residence time distributions

LIST OF EXPERIMENTS

1. To study the effect of temperature on the reaction rate constant (isothermal batch reactor)
2. Kinetic studies in batch reactor with equimolar and equimolar feed (batch reactor)
3. Kinetic studies in a CSTR
4. To study the effect of temperature on the reaction rate constant (Isothermal CSTR)
5. Kinetic studies in a plug flow reactor (coil type)
6. Kinetic studies in a plug flow reactor (straight tube type)
7. Study the effect of temperature on the reaction rate constant (Isothermal PFR)
8. Study the decomposition of h_2o_2 with water in presence of iodide catalyst (adiabatic reactor)
9. Kinetic studies in combined reactor (CSTR + PFR)
10. Kinetic studies in packed bed reactor
11. RTD studies in packed bed reactor
12. RTD studies in a tubular reactor

COURSE OUTCOMES:

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

1. Analyze chemical reactors and reaction systems
2. Designing experiments involving chemical reactors, and analyzing and interpreting data
3. Solve problems of mass transfer with reaction in solid catalyzed reactions
4. Design and sizing of industrial scale reactor on the basis of kinetic data obtained at lab scale
5. **Mapping of PO's & CO's (PROGRAM OUTCOMES & COURSE OUTCOMES)**

Subject Name(CRE LAB)	***a***	***b***	***c***	***d***	***e***	***f***	***g***	***h***	***i***	***j***	***k***
Analyze chemical reactors and reaction systems		√	√		√						√
Designing experiments involving chemical reactors, and analyzing and interpreting data	√	√	√		√						√
Solve problems of mass transfer with reaction in solid catalyzed reactions		√	√		√						√
Design and sizing of industrial scale reactor on the basis of kinetic data obtained at lab scale	√	√	√		√						√

A1CHL205 CHEMICAL REACTION ENGINEERING LAB	
Course designed by	Department of Chemical Engineering
Approval	Approved by: Meeting of Board of Studies held on 4th Jan, 2016
	Ratified by: 2nd Meeting of Academic Council, 17th Feb, 2016

A1CHL206	V - SEMESTER	L	T	P	C
	MASS TRANSFER OPERATIONS LAB	0	0	3	2
	Total Contact Hours – 45				

COURSE OBJECTIVES	
1	To help the students in understanding the basic concepts of mass transfer process;
2	To make the students familiar with most of the separations in leaching, liquid-liquid extraction, humidification, drying and adsorption;
3	The students will also have hands on experience in handling and operation of different types of mass transfer equipments.

LIST OF EXPERIMENTS:

1. Determination of diffusivities of gas-gas system
2. Studies on Vapor liquid equilibria
3. Studies on Wetted wall tower
4. Verification of Rayleigh's equation using simple distillation apparatus
5. Distillation in packed tower
6. Studies of drying characteristics of wet solids
7. Studies on Batch Leaching
8. Studies on Batch Extraction
9. Studies on Batch Adsorption
10. Determination of Psychometric properties using DBT & WBT
11. Hydrodynamic Studies in Packed column
12. Studies on Continuous Adsorption
13. Studies on solubility characteristics of a ternary liquid system

COURSE OUTCOMES:

Students will be able to

- Design and conduct experiments; analyze and interpret data related to mass transfer in leaching, liquid-liquid extraction, humidification, drying and adsorption.
- Visualize and understand mass transfer operations.
- Work in teams accommodating the contributions of team members having a variety of skills and perspectives.
- Identify, formulate and solve mass transfer problems.
- Attain proficiency in written, graphical and communications.

A1CHL206 MASS TRANSFER OPERATIONS LAB												
Course designed by	Department of Chemical Engineering											
CO / PO mapping	a	b	C	d	e	f	g	h	i	j	k	l

A1CHL206MASS TRANSFER OPERATIONS LAB	
Course designed by	Department of Chemical Engineering
Approval	Approved by: Meeting of Board of Studies held on 4th Jan, 2016
	Ratified by: 2nd Meeting of Academic Council, 17th Feb, 2016

VI Semester

A1CHT213	VI - SEMESTER	L	T	P	C
	MASS TRANSFER OPERATIONS-II	3	1	0	4
	Total Contact Hours – 60				

COURSE OBJECTIVES	
1	Give an elaborative idea of separation techniques like extraction, leaching & adsorption. Make the students more efficiently in the separation of organic and inorganic chemical compounds or solutions as individual components. These are necessary for industry people to run the industry in smooth fashion.
2	To understand the various techniques like chromatography techniques, ion exchange etc.
3	Develop the ability to preliminary design of extractors; adsorption columns etc
4	To understand the concept of membrane separation technology.
5	To understand the thrust of mass transfer operations solutions & threshold limits of various process etc

SYLLABUS

UNIT-I

Extraction: Liquid-liquid operations, fields of usefulness, liquid – liquid equilibrium, Equilateral triangular co-ordinates, choice of solvent, stage wise contact, single stage extraction, multi stage cross current extraction, Multistage counter current without reflux, Differential (continuous contact) extractors: spray towers, packed towers, Mechanically agitated counter current extractors, centrifugal extractors.

UNIT-II

Leaching: Fields of applications, Preparation of solid for leaching, Unsteady state operation: In-situ leaching, Heap leaching, Percolation tanks, Shanks system, Agitated vessels, Steady state operation: Agitated vessels, Thickeners, Continuous countercurrent decantation, Bollman extractor, Single stage leaching, Multi stage cross current and countercurrent leaching.

UNIT-III

Drying: Equilibrium, definitions, Classification of drying operations, Batch drying: Direct driers, Indirect driers, Rate of batch drying, Mechanisms of batch drying, Continuous drying: Tunnel driers, Rotating shelf driers, Through circulation driers, Rotary driers, Drum driers, Spray driers, Fluidized bed driers, Flash driers, Material and energy balances of continuous driers.

UNIT-IV

Adsorption: Types of adsorption, nature of adsorbents, adsorption equilibria, Single gases and vapors, adsorption hysteresis, effect of temperature, heat of adsorption, Vapor and gas mixtures: effect of change of temperature or pressure. Liquids: Adsorption of solute from dilute solution Freundlich equation

UNIT-V

Adsorption operations, Single stage operation, Multistage operations, Fluidized and teeter beds, adsorption of vapor from gas fluidized beds, Continuous contact: Steady state moving bed adsorbers, Unsteady state fixed bed adsorbers, Adsorption wave, pressure swing adsorption, elution, chromatography, Ion–exchange: techniques and applications.

UNIT-VI

Membrane separation: Basic principles of membrane separation, Classification of membrane processes: Pressure driven, concentration driven, electric potential driven, Reverse osmosis, Nanofiltration, Ultrafiltration, Microfiltration, Pervaporation, Dialysis, Electro dialysis, Types of synthetic membranes-micro porous, asymmetric, thin film, composite, electrically charged and inorganic membranes, Membrane modules-industrial applications.

TEXT/REFERENCE BOOKS

1. Mass transfer operations by R.E. Treybal, 3rd ed. McGraw Hill, 1980.
2. Unit operations of Chemical Engg, WL McCabe TJC Smith & Peter Harriot, TMH, 6th Ed 2001.
3. Membrane separation processes, Kaushik Nath, PHI,2008.

COURSE OUTCOMES:

i. An ability to apply the separation techniques like extraction, leaching & adsorption for the separation of organic and inorganic chemical compounds or solutions as individual components

ii. An ability to understand the various techniques like chromatography techniques, ion exchange etc.

iii. An ability to preliminary design of extractors; adsorption columns etc

iv. An ability to apply the concept of membrane separation technology for industry.

v. An ability to understand the thrust of mass transfer operations solutions & threshold limits of various process etc

Course objectives	**Course outcomes**				
	i	Ii	iii	iv	v
1					
2					
3					
4					
5					

A1CHT213MASS TRANSFER OPERATIONS-II												
Course designed by	Department of Chemical Engineering											
CO / PO mapping	a	b	C	d	e	f	g	h	i	j	k	l

A1CHT213MASS TRANSFER OPERATIONS-II	
Course designed by	Department of Chemical Engineering
Approval	Approved by: Meeting of Board of Studies held on 4th January, 2016
	Ratified by: 2nd Meeting of Academic Council, 17th Feb, 2016

A1CHT214	VI - SEMESTER	L	T	P	C
	PROCESS DYNAMICS AND CONTROL	3	1	0	4
	Total Contact Hours – 60				

COURSE OBJECTIVES	
1	To understand and be able to describe quantitatively the dynamic behavior of process systems.
2	To learn the fundamental principles of control theory including different types of controllers and control strategies.
3	To learn how to estimate the stability limits for a system, with or without control.
4	To calculate and use the frequency response of a system.
5	To learn the different types of control valves and design of control valve.

SYLLABUS

UNIT I: Introduction to process dynamics and control. Response of First Order Systems. Physical examples of first order systems

Unit-II: Response of first order systems in series, Higher order systems: Second order and transportation lag

Unit-III: Control systems, Controllers and final control elements

Unit-IV: Closed loop transfer functions, Transient response of simple control systems

Unit-V: Stability, Routh criteria, Root locus. Introduction to frequency response, Control systems design by frequency response.

Unit-VI: Advanced control strategies: Cascade control, Feed forward control, Ratio control. Controller tuning and Process identification. Control valves.

TEXT BOOK

1. Process systems analysis and control by D.R. Coughanowr, 2nd ed. Mc Graw Hill 1991

REFERENCE

2. Chemical process control by G. Stephanopolous, PHI, 1998

COURSE OUTCOMES:

i. An ability to describe quantitatively the dynamic behavior of process systems..
ii. An ability to learn the fundamental principles of control theory including different types of controllers and control strategies
iii. An ability to estimate the stability limits for a system, with or without control.
iv. An ability to calculate and use the frequency response of a system.
v. An ability to learn the different types of control valves and design of control valve.

Course objectives	Course outcomes				
	i	Ii	iii	iv	v
1					
2					
3					
4					
5					

A1CHT214PROCESS DYNAMICS AND CONTROL												
Course designed by	Department of Chemical Engineering											
CO / PO mapping	a	b	C	d	e	f	g	h	i	j	k	l

A1CHT214PROCESS DYNAMICS AND CONTROL	
Course designed by	Department of Chemical Engineering
Approval	Approved by: Meeting of Board of Studies held on 4th January, 2016
	Ratified by: 2nd Meeting of Academic Council, 17th Feb, 2016

A1CHT215	VI - SEMESTER	L	T	P	C
	CHEMICAL REACTION ENGINEERING-II	3	1	0	4
	Total Contact Hours – 60				

COURSE OBJECTIVES	
1	To Understand the basic concepts of non ideal flow
2	To Design of real reactors
3	To Understand the concepts of Catalysis and Kinetics of heterogeneous catalytic reactions
4	To Understand the kinetics of fluid solid and fluid-fluid reactions

SYLLABUS

Unit 1:

Basics of non-ideal flow- E, the age distribution of fluid, the RTD, Conversion in Non-ideal flow reactors, Diagonizing reactors ills (qualitative discussion only), Earliness of mixing, segregation and RTD- self-mixing of a single fluid, mixing of two miscible fluids

Unit 2:

The dispersion model-axial dispersion, correlations for axial dispersion, chemical reaction and dispersion, The tanks in series model- pulse response experiments and the RTD, chemical conversion. The convection model for laminar flow- the convective model and its RTD, chemical conversion in laminar flow reactors

Unit 3:

Catalysis and Catalytic reactors- catalysts, steps in a catalytic reactions, synthesizing a rate law, mechanism and rate limiting step. (From chapter 6 Fogler)

Unit 4:

Heterogeneous reactions -Introduction. Solid catalyzed reactions- The rate equation for Surface Kinetics- Pore diffusion resistance combined with surface kinetics, Porous catalyst particles, Heat effects during reaction, Performance equations for reactors containing porous catalyst particles.

Unit 5:

Solid catalyzed reactions- Experimental methods for finding rates. Deactivating catalysts-mechanisms of catalyst deactivation, the rate and performance equations

Unit 6:

Fluid-fluid reactions: kinetics- the rate equation. Fluid-particle reactions: kinetics-selection of a model, shrinking core model for spherical particles often changing size, rate of reaction for shrinking spherical particles, extensions, determination of rate controlling step.

TEXT/REFERENCE BOOKS:

Chemical Reaction Engineering by Octave Levenspiel 3rd ed. Wiley Eastern Ltd.
Elements of chemical reaction engineering by H.S. Fogler, 3rd ed. PHI, 1999

COURSE OUTCOMES:

By mastering Chemical Reaction Engineering II course, student will be able to

i. Calculate the residence time distribution function
ii. Design real reactors using the Dispersion and Tank in series models
iii. Explain the effect of pore diffusion and surface kinetics on solid catalytic reactions
iv. Explain different types of deactivation of catalysis
v. Explain shrinking core model and progressive conversion model in fluid solid reactions

Course objectives	**Course outcomes**				
	i	ii	iii	iv	v
1					
2					
3					
4					

A1CHT215 CHEMICAL REACTION ENGINEERING II												
Course designed by	Department of Chemical Engineering											
CO / PO mapping	a	b	c	d	e	f	g	h	i	j	k	l

A1CHT215CHEMICAL REACTION ENGINEERING II	
Course designed by	Department of Chemical Engineering
Approval	Approved by: Meeting of Board of Studies held on 4th June, 2016
	Ratified by: 2nd Meeting of Academic Council, 17th Feb, 2016

A1CHT216	VI - SEMESTER	L	T	P	C
	PROCESS MODELING AND SIMULATION	3	1	0	4
	Total Contact Hours – 60				

COURSE OBJECTIVES	
1	Give a basic understanding of engineering mathematics to solve modeling equations for chemical process problems involving reaction kinetics, heat transfer, fluid mechanics and mass transfer.
2	To write component and energy balances for chemical engineering problems
3	To design Non isothermal CSTR and distillation column
4	Give an elaborative idea on modeling and simulation of chemical process equations on kinetics, heat transfer, fluid mechanics and mass transfer, and its equipment. Make the students more efficiently in solving the equations for individual components. These are necessary for industry people to run the industry in complex stage of process by DCS panels.
5	To use the Matlab tools for chemical engineering practice.

SYLLABUS

UNIT-1

Mathematical models for chemical engineering systems, fundamentals, introduction to fundamental laws.

UNIT-2

Examples of mathematical models of chemical engineering systems, constant volume CSTR, two heated tanks, gas phase pressurized CSTR, non-isothermal CSTR.

UNIT-3

Examples of single component vaporizer, batch reactor, reactor with mass transfer, ideal binary distillation column, batch distillation with holdup.

UNIT-4

Numerical methods: Iterative methods, bisection, false position, Newton –Raphson, successive approximation methods, comparison of iterative methods, solution of linear simultaneous algebraic equations, Eigenvalues and Eigen vectors, Gauss elimination method, Gauss-Jordan and Gauss-Seidel's method.

UNIT-5

Numerical methods for simulation: Numerical integration by Trapezoidal and Simpson's rules, numerical solution of differential equations, Euler method, Runge Kutta fourth order method, Milne predictor corrector method. Interpolation, Lagrange interpolation, forward difference, backward difference and central difference interpolation methods, least square approximation of functions, linear regression, polynomial regression.

UNIT-6

Computer simulation, examples, gravity flow tank, three CSTRs in series, binary distillation column, batch reactor, Simulation of Non-isothermal CSTR, VLE, dew point, bubble point calculations, countercurrent heat exchanger.

TEXT BOOKS

1. Process modeling simulation and control for chemical engineers by W. L. Luyben, McGraw Hill, 2nd Ed.,
2. Numerical methods in engineering, S.K. Gupta, New Age international, 1995.
3. Computational methods for process simulation, WF Ramirez, 2nd edition, Butterworth- Heinmann 1998

COURSE OUTCOMES:

i. An ability to apply the engineering mathematics to solve model equations for chemical process problems involving reaction kinetics, heat transfer and mass transfer etc.
ii. An ability to write component and energy balances for chemical engineering problems
iii. An ability to design Non isothermal CSTR and distillation column
iv. An ability to write modeling and simulation of chemical process equations on kinetics, heat transfer, fluid mechanics and mass transfer and its equipment
v. An ability to use the Matlab tools for chemical engineering practice.

Course objectives	**Course outcomes**				
	i	ii	iii	iv	v
1					
2					
3					
4					
5					

A1CHT216PROCESS MODELING AND SIMULATION												
Course designed by	Department of Chemical Engineering											
CO / PO mapping	a	b	c	d	e	f	g	h	i	j	k	l

A1CHT216PROCESS MODELING AND SIMULATION	
Course designed by	Department of Chemical Engineering
Approval	Approved by: Meeting of Board of Studies held on 4th January, 2016
	Ratified by: 2nd Meeting of Academic Council, 17th Feb, 2016

A1CHT310	VI - SEMESTER (Core Elective – IV)	L	T	P	C
	FOOD TECHNOLOGY	3	0	0	3
	Total Contact Hours – 48				

COURSE OBJECTIVES	
1	The importance of food processing
2	Various methods available for food handling and storage.
3	Understanding the biochemistry of Fermentation
4	Understanding the importance of large scale processing , waste management and maintenance of hygine

SYLLABUS

UNIT I: PROCESSING OF FOOD AND ITS IMPORTANCE

Source of food - Food from plants, animals and microbes.

Different foods as raw materials for processing: cereals, pulses, grains, vegetables, fruits, milk, sea weeds, algae, oil seeds, fats, sugars, cocoa, spices, condiments, additives.

Need and significance of processing these foods.

UNIT II: METHODS OF FOOD HANDLING AND STORAGE

Nature of harvested crop, storage of raw materials and products using low temperature, refrigerated storage of foods, packed refrigerated foods, sub atmospheric storage, Gas atmospheric storage of grains, seeds and flour, roots and tubers; freezing of raw and processed foods.

UNIT III: MICROBES IN FOOD FERMENTATIONS

Microbes of importance in food fermentations: Homo & hetero-fermentative bacteria, yeasts & fungi, Biochemistry of fermentations – pathways involved, Lactic acid bacteria, Alcoholic fermentations -Yeast fermentations, Fungal fermentations. Microbes associated with typical food fermentations: yoghurt, cheese, fermented milks, breads, idli, soy products, fermented vegetables.

UNIT IV: LARGE-SCALE FOOD PROCESSING

Milling of grains and pulses; edible oil extraction; Pasteurisation of milk and yoghurt, Canning and bottling of foods; Drying: Traditional and modern methods of drying, Dehydration of fruits, vegetables, milk, Preservation by use of acid, sugar and salt, Pickling and curing with microorganisms, frying, baking, extrusion, cooking, snack foods.

UNIT V: FOOD WASTES IN VARIOUS PROCESSES

Waste disposal: solid and liquid waste, rodent and insect control, use of pesticides, ETP, selecting and installing necessary equipment.

Training & Education for safe methods of handling and processing food; sterilization and disinfection of manufacturing plant, Cleaning of equipment and premises.

UNIT VI: FOOD HYGIENE

Food related hazards: Biological hazards, physical hazards, Food adulteration: definition, common food adulterants, contamination with toxic metals, pesticides and insecticides; Safety in food procurement, storage handling and preparation; Relationship of microbes to sanitation, Public health hazards due to contaminated water and food; use of sanitizers, detergents, heat, chemicals.

TEXT BOOKS

1. Karnal, Marcus and D.B. Lund "Physical Principles of Food Preservation". Rutledge, 2003.
2.VanGarde, S.J. and Woodburn. M "Food Preservation and Safety Principles and Practice"..Surbhi Publications, 2001.
3.Sivasankar, B. "Food Processing & Preservation", Prentice Hall of India, 2002.
4.Khetarpaul, Neelam, "Food Processing and Preservation", Daya Publications,

Course Outcomes:

1. Should be able to understand the various methods of food processing.
2. Should be able to understand the role of microbes in food processing.
3. The importance of hygiene in food processing.
4. The significance of large scale food processing.

Course objectives	**Course outcomes**			
	i	ii	iii	iv
1				
2				
3				
4				

A1CHT310FOOD TECHNOLOGY												
Course designed by	Department of Chemical Engineering											
CO / PO mapping	a	b	C	d	e	f	g	h	i	j	k	l

A1CHT310FOOD TECHNOLOGY	
Course designed by	Department of Chemical Engineering
Approval	Approved by: Meeting of Board of Studies held on 4th Jan, 2016
	Ratified by: 2nd Meeting of Academic Council, 17th Feb, 2016

A1CHT311	VI - SEMESTER (Core Elective – IV)	L	T	P	C
	MINERAL PROCESS ENGINEERING	3	0	0	3
	Total Contact Hours – 48				

COURSE OBJECTIVES	
1	Classification of minerals and their sources
2	Important properties of minerals
3	The origin of important fuels like coal and petroleum
4	Understanding the importance of mining legislation

UNIT-1 (Introduction)

Mineral processing introduction - Process overview, metals vs minerals, Economic minerals: their classification, origin, mode of occurrence, geographical and geological distribution, physical properties and industrial uses and distribution of major metallic and non-metallic mineral deposits of India.

UNIT-2 (Classification)

Classification of ore reserves: Economic classification of mineral resources

Exploration: Theory and application of various methods in mineral exploration, Seismic, Gravity and Magnetic methods. Exploration for oil and natural gas.

Particle transport and storage: Storage of solids: Hopper, Bins & Silos, Mechanical conveyers, Gas-solid: Pneumatic transport in horizontal and vertical pipelines, Liquid-solid: Hydraulic transport

Beneficiation circuits of Minerals: Chalcopyrites, Sphalerites, Galena and Bauxite.

UNIT-3 (Petrography)

Determinative properties and occurrence of common rock forming minerals in India, Petrology - Igneous, Sedimentary and Metamorphic rocks

Origin and distribution of natural fuels - Coal, Petroleum and natural gas, nuclear fuels

UNIT-4 (Coal)

Introduction: Processes of formation of coal, Theories of origin of coal, Eras of coal formation, Indian Coalfields and its subsidiaries: Occurrence and distribution, coal bearing formations, coal type and rank variation, Characteristics of major coalfields,

Coal petrography: Classification of coal - International and Indian classification, grading of Indian coals; Coal Washing

UNIT-5 (Beneficiation)

General Principle: Mineral Beneficiation and its role in mineral Exploitation. Comminution and Liberation : Theory and practice of crushing and grinding, Industrial screens, Froth Flotation.

Electrostatic and Electro-magnetic Separation - Principles, operations and fields of applications.;

Flow Sheets: Simplified flow sheets for the beneficiation of beach sand, coal and manganese with special reference to Indian deposits.

UNIT-6 (Mining & Mineral Legislation)

Commercial uses of minerals and ores, Mineral Industry of India,; National Mineral Policies

General: Environmental issues in Mineral Industry- National and Global, Environmental impacts of Mineral exploitation in underground and opencast mining.

Text Books:

1. C. M. Narayanan & B. C. Bhattacharyya, ***Mechanical Operation for Chemical Engineers (Incorporating Computer Aided Analysis)***, Khanna Publisher, Third Edition, 2005.
2. A. M. Gaudin, ***Principles of Mineral Dressing***, Tata McGraw & Hill, 1939

References:

1. W I McCabe & J C Smith, P. Harriot, ***Unit Operations of Chemical Engineering,*** McGraw-Hill publication, 2005
2. R. Marjoribanks, ***Geological methods in Mineral exploration and Mining***, Springer; 1st edition, 1997.
3. S. Krishnaswamy, ***India's Mineral Resources***, Oxford & IBH pub., 2nd ed, 1972
4. O. P. Gupta, ***Elements of Fuels, Furnaces and Refractories,*** Khanna Publication, 3rd Edition, 1996.
5. R. S. Rao, ***Law of Mines and Minerals***, S. N. Hussainy (Revised), Asia Law House, 8th Eds, 1996.

Course Outcomes:

1. Student should be able to understand the importance of minerals and their origin
2. Important methods of mineral beneficiation.
3. Should be able to classify the minerals
4. Should be able to understand the legislation in India.

Course objectives	**Course outcomes**			
	i	ii	iii	iv
1				
2				
3				
4				

A1CHT311 MINERAL PROCESS ENGINEERING												
Course designed by	Department of Chemical Engineering											
CO / PO mapping	a	b	C	d	e	f	g	h	i	j	k	l

A1CHT311 MINERAL PROCESS ENGINEERING	
Course designed by	Department of Chemical Engineering
Approval	Approved by: Meeting of Board of Studies held on 4th Jan, 2016
	Ratified by: 2nd Meeting of Academic Council, 17th Feb, 2016

A1CHT312	VI - SEMESTER (Core Elective – IV)	L	T	P	C
	TECHNOLOGY OF PHARMACEUTICALS & FINE CHEMICALS	3	0	0	3
	Total Contact Hours – 48				

COURSE OBJECTIVES	
1	Introduce the preparation and properties of important pharmaceuticals and fine chemicals
2	Importance of tablet making
3	Understand the tests used for determining the impurities
4	The importance of sterilization

SYLLABUS

Unit I: A brief outline of grades of chemicals, sources of impurities in chemicals, principles) of limit test for arsenic, lead, iron, chloride and sulfate in Pharmaceuticals.
Unit II: Outlines of Preparation, properties, uses and testing of the following Pharmaceuticals - sulfacetamide, paracetamol, , riboflavin, nicotinamide,
Unit III: Outlines of Preparation, properties, uses and testing of the following fine chemicals - Methyl orange, fluorescence, procaine hydrochloride, paramino salicylic acid, isonicatinic acid hydrazide. Manufacture with flowsheets, properties uses and testing of the following Pharmaceuticals – aspirin, penicillin, calcium gluconate
Unit IV: Properties uses and testing of the following ferric ammonium citrate, pthallic anhydride and phenol flourobenzene process and benzene sulfate process, other processes in outline only. Tablet making and coating, granulation equipments
Unit V: Preparation of capsules, extraction of crude drugs.
Unit VI: Sterilization: introduction, risk factor, methods of sterilization, heat (dry and moist), heating with bactericide, filtration, gaseous sterilization and radiation sterilization.

TEXT BOOKS :

1. Remington's Pharmaceutical Science, Mac publishing company, 13th ed. 1965.
2. TEXT BOOK of Pharmaceutical Chemistry by Blently and driver. Oxford University press, London, 8th ed. 1960.

REFERENCES :

1. Blently's TEXT BOOK of Pharmaceutical Chemistry by H A Rawlins, B Tindell and Box, 8th ed. OU Press, London, 1977.
2. Industrial Chemicals by Faith, Kayes and Clark, John Wiley & Sons, 3rd Ed. 1965.

Course Outcomes:

1. Should be able to understand the preparation and properties of important pharmaceuticals and fine chemicals.
2. The methods of tablet making and its importance
3. The possible impurities in pharmaceutical products
4. The various methods of sterilization

Course objectives	Course outcomes			
	i	ii	iii	iv
1				
2				
3				
4				

A1CHT312TECHNOLOGY OF PHARMACEUTICALS & FINE CHEMICALS												
Course designed by	Department of Chemical Engineering											
CO / PO mapping	a	b	C	d	e	f	g	h	i	j	k	l

A1CHT312TECHNOLOGY OF PHARMACEUTICALS & FINE CHEMICALS	
Course designed by	Department of Chemical Engineering
Approval	Approved by: Meeting of Board of Studies held on 4th Jan, 2016
	Ratified by: 2nd Meeting of Academic Council, 17th Feb, 2016

A1CHL207	VI - SEMESTER	L	T	P	C
	PROCESS DYNAMICS & CONTROL LAB	0	0	3	2
	Total Contact Hours – 45				

COURSE OBJECTIVES	
1	To calibrate and determine the time lag of various first and second order instruments.
2	To determine the response in single and two capacity systems with and with-outInteraction.
3	To understand the advanced control methods used for complex processes in theIndustries. Different experiments like Flow, level and cascade control can be configured and studied.
4	To study the open loop (Manual control) and the on/off controller, ProportionalController, PI controller, PD controller, PID controller, Tuning of controller (Open loop and close loop methods), and to study the stability of the system (Bode plot).
5	To understand the control valve operation and its flow characteristics.
6	To determine the damping coefficient and response of U-tube manometer.

LIST OF EXPERIMENTS

1. Calibration and determination of time lag of various first and second order instruments.
   Major equipment - First order instrument like Mercury-in-Glass thermometer and overall Second order instrument like Mercury-in-Glass thermometer in a thermal well.
2. Experiments with single and two capacity systems with and without interaction.
   Major equipment- Single tank system, Two-tank systems (Interacting and Non-Interacting).
3. Level control trainer
   Major equipment - Level control trainer set up with computer.
4. Temperature control trainer
   Major equipment -Temperature control trainer with computer.
5. Cascade control
   Major equipment -Cascade control apparatus with computer.
6. Experiments on proportional, reset, rate mode of control etc.
   Major equipment – PID control apparatus
7. Control valve characteristics
   Major equipment – Control valve set up.
8. Estimation of damping coefficient for U-tube manometer
   Major equipment - U-tube manometer.

COURSE OUTCOMES:

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

i. Estimate the dynamic characteristics of first and second order systems.
ii. Apply the advanced control methods used for complex processes in the industries.
iii. Screen and suggest controllers like On/off, P, PI, PD and PID for process systems.
iv. Understand the behavior of the pneumatic control valves.

A1CHL207 PROCESS DYNAMICS & CONTROL LAB												
Course designed by	Department of Chemical Engineering											
CO / PO mapping	a	b	c	d	e	f	g	h	i	j	k	l
	√	√	√		√		√		√		√	

A1CHL207 PROCESS DYNAMICS AND CONTROL LAB	
Course designed by	Department of Chemical Engineering
Approval	Approved by: Meeting of Board of Studies held on 4th Jan, 2016

	Ratified by: 2nd Meeting of Academic Council, 17th Feb, 2016				
A1CHL208	**VI - SEMESTER**	**L**	**T**	**P**	**C**
	PROCESS MODELING AND SIMULATION LAB USING MATLAB	0	0	3	2
	Total Contact Hours – 45				

COURSE OBJECTIVES	
1	To train the students on latest computational techniques in order to face global era.
2	To train the students in art of computer application in chemical engineering design.
3	To Evaluation of thermodynamic & transport properties
4	To Steady state design of conventional processes & equipments.
5	To train on optimization & control

The following experiments will be conducted using MATLAB

1. Gravity flow tank
2. Three CSTRs in series- open loop
3. Three CSTRs in series- closed loop
4. Non isothermal CSTR
5. Bubble point calculation
6. Dew point calculation
7. Non isothermal CSTR
8. Binary distillation column
9. Interacting and non-interacting systems
10. Binary distillation column
11. Heat exchanger

COURSE OUTCOMES:

i. An ability to understand the concept of computational techniques.
ii. An ability to understand the computer application in chemical engineering design.
iii. An ability to get the concept of the thermodynamic & transport properties.
iv. An ability to get the concept of steady state design of conventional process& equipments.
v. An ability to understand the concept of optimization & control.

A1CHL208 PROCESS MODELING AND SIMULATION LAB USING MATLAB												
Course designed by	Department of Chemical Engineering											
CO / PO mapping	a	b	c	d	e	f	g	h	i	j	k	l

A1CHL208 PROCESS MODELING AND SIMULATION LAB USING MATLAB	
Course designed by	Department of Chemical Engineering
Approval	Approved by: Meeting of Board of Studies held on 4th January, 2016
	Ratified by: 2nd Meeting of Academic Council, 17th Feb, 2016

VII SEMESTER

A1MST001	VII - SEMESTER	L	T	P	C
	MANAGERIAL ECONOMICS AND FINANCIAL ANALYSIS	3	0	0	3
	Total Contact Hours – 48				

COURSE OBJECTIVES	
1	Understand the difference between demand and supply
2	Understand the importance of cost analysis
3	Understand the forms of business organizations
4	Understand financial analysis and accounting

SYLLABUS

Unit I *:*
Definition, Nature and Scope of Managerial Economics–Demand Analysis: Demand Determinants, Law of Demand and its exceptions.
Definition, Types, Measurement and Significance of Elasticity of Demand. Demand Forecasting, Factors governing demand forecasting, methods of demand forecasting (survey methods, statistical methods, expert opinion method, test marketing, controlled experiments, judgmental approach to demand forecasting)

Unit II Theory of Production and Cost Analysis:
Production Function – Isoquants and Isocosts, MRTS, Least Cost Combination of Inputs, Cobb-Douglas Production function, Laws of Returns, Internal and External Economies of Scale.
Cost concepts, Opportunity cost, Fixed vs. Variable costs, Explicit costs Vs. Implicit costs, Out of pocket costs vs. Imputed costs. Break-even Analysis (BEA)-Determination of Break-Even Point (simple problems)- Managerial Significance and limitations of BEA.

Unit III :
Market structures: Types of competition, Features of Perfect competition, Monopoly and Monopolistic Competition. Price-Output Determination in case of Perfect Competition and Monopoly.
Objectives and Policies of Pricing- Methods of Pricing: Cost Plus Pricing, Marginal Cost Pricing, Sealed Bid Pricing, Going Rate Pricing, Limit Pricing, Market Skimming Pricing, Penetration Pricing, Two-Part Pricing, Block Pricing, Bundling Pricing, Peak Load Pricing, Cross Subsidization.

Unit IV:
Characteristic features of Business, Features and evaluation of Sole Proprietorship, Partnership, Joint Stock Company, Public Enterprises and their types, Changing Business Environment in Post-liberalization scenario.
Capital and its significance, Types of Capital, Estimation of Fixed and Working capital requirements, Methods and sources of raising finance.
Nature and scope of capital budgeting, features of capital budgeting proposals, Methods of Capital Budgeting: Payback Method, Accounting Rate of Return (ARR) and Net Present Value Method (simple problems)

Unit V:
Double-Entry Book Keeping, Journal, Ledger, Trial Balance- Final Accounts (Trading Account, Profit and Loss Account and Balance Sheet with simple adjustments).

Unit VI:
Computation, Analysis and Interpretation of Liquidity Ratios (Current Ratio and quick ratio), Activity Ratios (Inventory turnover ratio and Debtor Turnover ratio), Capital structure Ratios (Debt- Equity ratio, Interest Coverage ratio), and Profitability ratios (Gross Profit Ratio, Net Profit ratio, Operating Ratio, P/E Ratio and EPS).

TEXT BOOKS:
1. Aryasri: Managerial Economics and Financial Analysis, 2/e, TMH, 2005.
2. Varshney & Maheswari: Managerial Economics, Sultan Chand, 2003.

REFERENCES:
1. Ambrish Gupta, Financial Accounting for Management, Pearson Education, New Delhi.
2. H. Craig Peterson & W. Cris Lewis, Managerial Economics, PHI, 4th Ed.
3. Suma Damodaran, Managerial Economics, Oxford University Press.
4. Lipsey & Chrystel, Economics, Oxford University Press.
5. S. A. Siddiqui & A. S. Siddiqui, Managerial Economics & Financial Analysis, New age International Space Publications.
6. Domnick Salvatore: Managerial Economics In a Global Economy, 4th Edition, Thomson.
7. Narayanaswamy: Financial Accounting—A Managerial Perspective, PHI.

Course Outcomes:
1. Understand the market dynamics namely, demand and supply, demand forecasting, elasticity of demand and supply, pricing methods and pricing in different market structures.
2. Analyse how capital budgeting decisions are carried out.
3. Understanding the framework for both manual and computerised accounting process
4. Know how to analyse and interpret the financial statements through ratio analysis.

Course objectives	**Course outcomes**			
	i	ii	iii	iv
1				
2				
3				
4				

A1MST001 MANAGERIAL ECONOMICS AND FINANCIAL ANALYSIS												
Course designed by	Department of Chemical Engineering											
CO / PO mapping	a	b	C	d	e	f	g	h	i	j	k	l

A1MST001 MANAGERIAL ECONOMICS AND FINANCIAL ANALYSIS	
Course designed by	Department of Chemical Engineering
Approval	Approved by: Meeting of Board of Studies held on 4th Jan, 2016
	Ratified by: 2nd Meeting of Academic Council, 17th Feb, 2016

A1CHT217	VII - SEMESTER	L	T	P	C
	TRANSPORT PHENOMENA	3	1	0	4
	Total Contact Hours – 60				

COURSE OBJECTIVES	
1	To learn the estimation of transport properties like mass diffusivity, thermal conductivity and viscosity.
2	Identify and solve various momentum transport problems based on shell momentum balance approach
3	Identify and solve various heat transport problems based on shell energy balance approach.
4	Learn the concepts of concentration distribution in solids and in laminar flow based on shell mass balance approach.
5	Learn the derivation of the equation of continuity & equation of motion in Cartesian coordinates and curvilinear coordinates.
6	Learn to derive the unsteady state velocity profile, temperature profile and concentration profiles for laminar flow conditions.
7	Learn the basic concepts of turbulent flow transport.

SYLLABUS

UNIT 1

Introduction to Transport Phenomena

Viscosity and the mechanisms of momentum transfer: Newton's law of viscosity (molecular momentum transport), Generalization of Newton's law of viscosity, Pressure and temperature dependence of viscosity, Molecular theory of the viscosity of gases at low density, molecular theory of the viscosity of liquids.

Thermal conductivity and the mechanisms of energy transport: Fourier's law of heat conduction (molecular energy transport), temperature and pressure dependence of thermal conductivity, and theory of thermal conductivity of gases at low density.

Diffusivity and the mechanisms of mass transport: Fick's law of binary diffusion (molecular mass transport), temperature and pressure dependence of diffusivities, theory of diffusion in gases at low density.

UNIT 2

Shell momentum balances and velocity distributions in laminar flow: shell momentum balances and boundary conditions, Flow of a falling film, Flow through a circular tube, Flow through annulus, Flow of two adjacent immiscible fluids

UNIT 3

Shell energy balances and temperature distributions in solids and laminar flow: shell energy balances; boundary conditions, Heat conduction with an electrical heat source, Heat conduction with a nuclear heat source, Heat conduction with a viscous heat source, Heat conduction with a chemical heat source, Heat conduction through composite walls, Heat conduction in a cooling fin, forced convection, free convection

UNIT 4

Concentration distributions in solids and laminar flow: shell mass balances; boundary conditions, Diffusion through a stagnant gas film, Diffusion with a heterogeneous chemical reaction, Diffusion with a homogeneous chemical reaction, Diffusion into a falling liquid film (gas absorption), Diffusion into a falling liquid film (solid dissolution), Diffusion and chemical reaction inside a porous catalyst

UNIT 5

The equations of change: Derivation of the equation of continuity in Rectangular Coordinates, Derivation of the equation of continuity in Polar Coordinates, the equation of motion, the equation of energy, the equation of continuity of a component in multi-component mixture (in rectangular coordinates only), The equations of change in terms of the substantial derivative.

UNIT 6

Use of the equations of change to solve one dimensional steady state problems of momentum transfer, heat transfer and component transfer

Unsteady state one dimensional transport of momentum transfer, heat transfer and component transfer.

Introduction to Turbulent transport: Momentum Transfer, Heat Transfer, Component Transfer, Time smoothing of equation change.

TEXT BOOKS:

Transport phenomena by Bird R.B., Stewart W.C., Lightfoot F.N., 2nd ed. John Wiley & Sons Inc,U.S.A,1960

REFERENCE BOOKS:

1.Transport Processes: Momentum, Heat and Mass, C. J. Geankoplis, PHI, Allyn and Bacon Inc., 2ndRevised Edition, 1983.

2. Transport Phenomena for Engineers by L. Theodore, International text Book Company, 1971.

3. Transport Phenomena- A Unified Approach, Robert S. Brodkey, Harry C. Hershay, McGraw-Hill International Edition, 1988.

4. Transport Phenomena and Unit Operations-A combined Approach, Richard G. Griskey, John Wiley, 2002.

5. Mass Transport Phenomena, Christie J. Geankoplis, Ohio State Univ Bookstore, 1984.

6. Modeling in Transport Phenomena: A Conceptual Approach, Ismail Tosun, Elsevier, 2002.

COURSE OUTCOMES:

After completion the course, the student will be able to

i. Determine diffusivity, thermal conductivity and viscosity at low and high pressure.
ii. Derive momentum flux and velocity distribution for typical geometries.
iii. Derive heat flux and temperature distribution for typical geometries.
iv. Derive mass flux and concentration distribution for typical geometries.
v. Derive unsteady state velocity profile, temperature profile and concentration profile.
vi. Derive equation of change for turbulent transport.
vii. Analyze the momentum, heat and transport problems involved in process equipment.

Course objectives	**Course outcomes**						
	i	ii	iii	iv	v	vi	vii
1							
2							
3							
4							
5							
6							
7							

A1CHT217TRANSPORT PHENOMENA												
Course designed by	Department of Chemical Engineering											
CO / PO mapping	a	b	C	d	e	f	g	h	i	j	k	l

A1CHT217TRANSPORT PHENOMENA	
Course designed by	Department of Chemical Engineering
Approval	Approved by: Meeting of Board of Studies held on 4th June, 2016
	Ratified by: 2nd Meeting of Academic Council, 17th Feb, 2016

A1CHT218	VII - SEMESTER	L	T	P	C
	PLANT DESIGN & ECONOMICS FOR CHEMICAL ENGINEERS	3	1	0	4
	Total Contact Hours – 60				

COURSE OBJECTIVES	
1	**DOMAIN KNOWLEDGE**: Graduates will be trained to demonstrate knowledge of mathematics, science, basic computing and engineering fundamentals, breadth and in-depth studies in mechanical engineering aimed at bringing them abreast with industrial and research domains
2	**EMPLOYMENT**: Graduates will be trained to succeed in securing engineering positions with Mechanical /Manufacturing firms as well as Software-based industries and also with government agencies
3	**HIGHER STUDIES & LIFELONG EDUCATION**: Graduates will beoriented towards success in the pursuit of advanced degrees in Mechanical engineering or other fields and will be imparted the spirit for continued, independent, life-long learning to become experts in their profession and to broaden their professional knowledge
4	**PROFESSIONAL CITIZENSHIP**: Graduates will be trained to organize and present information, to write and speak effective English, to work effectively on team-based engineering projects, to practice ethics at work and demonstrate a sense of social responsibility

SYLLABUS

Unit-I: Product design development, General design considerations, cost and asset accounting

Unit-II: Cash flow for industrial operations, factors affecting investment and production cost, capital investment, estimation of capital investments, cost indices, cost factors in capital investment, organization for presenting capital investments, estimates by compartmentalization, estimation of total production costs , fixed charges, plant overhead cost, financing

Unit-III: Taxes and insurance, types of taxes :federal income taxes,insurance-types of insurance, self insurance

Unit-IV: Depreciation, types of depreciation, salvage value, present value, methods for determination of depreciation

Unit:V : Profitability, alternative investments and replacements, profitability standards, discounted cash flow, capitalized cost, payout period, alternative investments, analysis with similar investments

Unit:VI : Optimum design and design strategy, incremental costs, general procedure for determining optimum conditions, comparison of graphical and analytical methods, optimum production rates.

Text Book :

Plant design and Economics for Chemical Engineering by M.S.Peters and K.D. Timmerhaus, Mcgraw hill 3r edition, 1981.

Course Outcomes:

1. Selection of various process equipment for heat transfer, mass transfer and momentum transfer.
2. Ability to understand the use software for development of process flow sheet
3. Evaluate the safety and environment aspects
4. Develop correlations for process equipment

Course objectives	**Course outcomes**			
	i	ii	iii	iv
1				
2				
3				
4				

A1CHT218PLANT DESIGN & ECONOMICS FOR CHEMICAL ENGINEERS												
Course designed by	Department of Chemical Engineering											
CO / PO mapping	a	b	C	d	e	f	g	h	i	j	k	l

A1CHT218PLANT DESIGN & ECONOMICS FOR CHEMICAL ENGINEERS	
Course designed by	Department of Chemical Engineering
Approval	Approved by: Meeting of Board of Studies held on 4th Jan, 2016
	Ratified by: 2nd Meeting of Academic Council, 17th Feb, 2016

A1CHT313	VII - SEMESTER (Core Elective – V)	L	T	P	C
	BIOCHEMICAL ENGINEERING	3	0	0	3
	Total Contact Hours – 48				

COURSE OBJECTIVES	
1	To have an overview of the basic structure and function of important cell types, RNA andDNA, amino acids and proteins
2	To learn about enzyme structure, function and kinetics of enzyme catalyzed reactions
3	To learn about immobilization of enzymes, industrial applications and understand immobilized enzyme kinetics
4	To learn about the kinetics of cellular growth, models for cellular growth, and thermal death kinetics of cells and spores
5	To understand the various metabolic pathways, biosynthesis, transport across cell membranes, end products of metabolism and stoichiometry of cell growth and product formation
6	To get acquainted with design and analysis of various bioreactors and also to have an Overview about fermentation technology

SYLLABUS

UNIT 1: Introductionto biochemical engineering – Comparison of chemical and biochemical processes, industrially important microbial strains used for different bio products.

Chemicals of life –Carbohydrates, proteins, lipids, nucleic acids, their classification and functions.

UNIT2: Biology of microbes – Protist kingdom, classification and structure of different cells.

UNIT 3: Introduction to enzymes – Classification, kinetics of enzyme catalyzed reactions, factors affecting E.S complex, derivation of Michaelis Menten equation for single substrate, determination of M.M parameters, enzyme inhibition – types, immobilization of enzymes, methods, immobilized enzyme kinetics, applications of immobilized enzymes.

UNIT 4:

Kinetics of cell growth – Growth phases, yield coefficient, Monod growth kinetics, ideal bioreactors – batch –mixed flow and plug flow reactors, their analyses.

UNIT 5: Transport phenomenon across the cell – Active, passive and facilitated diffusion, gas liquid mass transfer in cellular systems, determination of k_La values,
Sterilization - Media and air, methods.

UNIT 6: Down stream processing - Strategies to recover and purify products, **separation of insoluble products**-Filtration and centrifugation, Cell disruption-mechanical and non-mechanical methods, **Separation of soluble products --**Liquid-liquid extractions, membrane separation (dialysis, ultra filtration and reverse osmosis),Chromatographic separation-Gel permeation chromatography, electrophoresis, Final steps in purification – crystallization and drying.

TEXT BOOK:

1. Biochemical Engineering fundamentals by J.E.Bailey and D.F.Ollis, 2nd ed, 1986, McGraw Hill.
2. Bioprocess Engineering by Michael L. Shuler and Fikret Kargi, 2nd edition, Pearson education.

REFERENCE:

1. Biochemical Engineering by James M.Lee – Prentice-Hall-1992.
2. Biochemical Engineering by Aiba, Humphrey and Mells, academic press.

Course Outcomes:

The expectedoutcomes are that the student

I. Will become familiar with basic cell structure and biomolecules.
II. Develop a clear picture of what enzymes are, what their functions are and analyses the kinetics of enzyme catalyzed reactions.
III. Demonstrate a clear understanding of immobilized enzyme technology and the kinetics involved.
IV. Understand the concept of growth curve & Monod kinetics
V. Grasp the mechanisms and energetics of biomolecule and cell conformation and differentiation, ionic transport and cell communication
VI. Apply the above knowledge to the basic analysis and design of bioreactors.

Course objectives	**Course outcomes**					
	I	II	III	IV	V	VI
1						
2						
3						
4						
5						
6						

A1CHT313 BIOCHEMICAL ENGINEERING												
Course designed by	Department of Chemical Engineering											
CO / PO mapping	a	b	C	d	e	f	g	h	i	j	k	l

A1CHT313 BIOCHEMICAL ENGINEERING	
Course designed by	Department of Chemical Engineering
Approval	Approved by: Meeting of Board of Studies held on 4th Jan, 2016
	Ratified by: 2nd Meeting of Academic Council, 17th Feb, 2016

A1CHT314	VII - SEMESTER (Core Elective – V)	L	T	P	C
	PROJECT MANAGEMENT	3	0	0	3
	Total Contact Hours – 48				

COURSE OBJECTIVES	
1	Explain the objectives of project management
2	The methods for cost estimation and budgeting
3	Various tool for project scheduling and planning
4	Role of computers in project management

SYLLABUS

Unit 1: Introduction to Project management: Characteristics of projects, Definition and objectives of Project Management, Stages of Project Management, Project Planning Process, Establishing Project organization.

Unit 2: Work definition: Defining work content, Time Estimation Method, Project Cost Estimation and budgeting

Unit 3: Project Risk Management, Project scheduling and Planning Tools: Work Breakdown structure, LRC, Gantt charts, CPM/PERT Networks.

Unit 4: Developing Project Plan (Baseline), Project cash flow analysis, Project scheduling with resource constraints: Resource Levelling and Resource Allocation. Time Cost Trade off: Crashing Heuristic.

Unit 5: Project Implementation: Project Monitoring and Control with PERT/Cost, Computers applications in Project Management, Contract Management, Project Procurement Management.

Module 6: Post-Project Analysis.

Text/Reference Books:

1.Shtub, Bard and Globerson, Project Management: Engineering, Technology, and Implementation, Prentice Hall, India

2. Lock, Gower, Project Management Handbook.

3. Cleland and King, VNR Project Management Handbook.

4. Wiest and Levy, Management guide to PERT/CPM, Prentice Hall. Ibdia

References:

1. John M Nicholas, Project Management for Business and Technology: Principles and Practice, Prentice Hall, India, 2002.

2. N. J. Smith (Ed), Project Management, Blackwell Publishing, 2002.

3. Robert K. Wysocki, Robert Back Jr. and David B. Crane, Effective Project Management, John Wiley, 2002.

Course Outcomes:

1. Understanding the objectives of project management
2. Use of different methods for cost estimation
3. Use and importance of PERT/CPM.
4. Understanding the role of computers in project management

Course objectives	**Course outcomes**			
	i	ii	iii	iv
1				
2				
3				
4				

A1CHT314PROJECT MANAGEMENT												
Course designed by	Department of Chemical Engineering											
CO / PO mapping	a	b	C	d	e	f	g	h	i	j	k	l

A1CHT314PROJECT MANAGEMENT	
Course designed by	Department of Chemical Engineering
Approval	Approved by: Meeting of Board of Studies held on 4th Jan, 2016
	Ratified by: 2nd Meeting of Academic Council, 17th Feb, 2016

A1CHT315	VII - SEMESTER (Core Elective – V)	L	T	P	C
	PROCESS INTENSIFICATION	3	0	0	3
	Total Contact Hours – 48				

COURSE OBJECTIVES	
1	Types and benefits of PI
2	Working principles of spinning and rotary packed bed reactors
3	The working of Compact heat exchangers
4	The importance of micro reactors

SYLLABUS

Unit-1:
Definition of Process Intensification (PI).Benefits of PI. Techniques for PI application:active and passive techniques.

Unit-II
Spinning disc reactor (SDR): Operating principle and development of models for thin film flow on rotating disc.Examples of application of SDR to a range of processes.

Unit-III
Rotary packed bed (RPBs): Operating principle of rotating contactors. Development of models for counter-current multiphase flow in rotating systems.Examples of the application of multiphase contactors.

Unit-IV
Oscillatory baffled reactor (OBR): Description & operating principles. History.Explanation of niche applications.Design.Case studies.

Unit-V
Compact heat exchangers (CHE): Definition of CHEs. Construction and main properties.Applications.Basic design procedures.Examples.

Unit-VI
Micro-reactors: Description and operating principles. Heat transfer, mass transfer and mixing applications.

Text book :
David Reay, Colin Ramshaw and Adam Harvey Process Intensification (Second Edition) Engineering for Efficiency, Sustainability and Flexibility, Elsevier publishers

Course Outcomes:

1. The difference between active and passive PIs.
2. Use of spinning bed reactor and rotating contactors
3. The application of baffled reactor
4. Use and application of micro reactors

Course objectives	**Course outcomes**			
	i	ii	iii	iv
1				
2				
3				
4				

A1CHT315PROCESS INTENSIFICATION												
Course designed by	Department of Chemical Engineering											
CO / PO mapping	a	b	C	d	e	f	g	h	i	j	k	l

A1CHT315PROCESS INTENSIFICATION	
Course designed by	Department of Chemical Engineering
Approval	Approved by: Meeting of Board of Studies held on 4th Jan, 2016
	Ratified by: 2nd Meeting of Academic Council, 17th Feb, 2016

A1CHT316	VII - SEMESTER (Core Elective – VI)	L	T	P	C
	INDUSTRIAL BIOTECHNOLOGY	3	0	0	3
	Total Contact Hours – 48				

COURSE OBJECTIVES	
1	To understand the fundamentals of biochemical engineering sciences and history of biotechnology
2	To understand conventional and modern techniques in biotechnology and to know various applications of biotechnology
3	To understand the engineering perspectives of animal and plant biotechnology
4	To identify the various commercially important microorganisms and to understand the overall fermentation economics

SYLLABUS

Unit-I: Fundamentals of biochemical engineering sciences; Biotechnology – ancient and modern.

Unit-II: Exploitation of microbes – Large scale process, commercial exploitation, microgravity biotechnology (space biotechnology);

Unit-III: Animal biotechnology – application of animal cell culture, monoclonal antibodies, transgenic animal and gene therapy;

Unit-IV: Plant biotechnology – plant cell, tissue and organ culture processes – engineering perspectives;

Unit-V: Large scale separation processes- ATPS, gradient elution and affinity interaction;

Unit-VI: Technoeconomics of biotechnology industries; Legal, social and ethical aspects of biotechnology

TEXT BOOK :

1. Text book of Biotechnology ; HK Das, Wiely Dremtechs Publications
2. Concepts in Biotechnology by Balasubramayam, 2nd ed., University Press,2004.

REFERENCES :

1. Molecular biotechnology; Glick and Pasternack,
2. Fundamentals of biochemical engineering ; Baily Ollis
3. Introduction to Biotechnology ; Ray V.Herran, Thomsam publications-2005

Course Outcomes:

By the end of the course, the student will be able to:

I. Identify biologically relevant problems in biotechnology, biomedical, and agricultural research.

II. Understand the impact of bioengineering solutions in a global, economic, environmental, and societal context

III. Apply the domain knowledge of biochemical engineering and acquire basic knowledge of Techno-economic feasibility studies

IV. Ability to develop comprehensive knowledge on contemporary issues related to biotechnology

A1CHT316 INDUSTRIAL BIOTECHNOLOGY												
Course designed by	Department of Chemical Engineering											
CO / PO mapping	a	b	C	d	e	f	g	h	i	j	k	l

A1CHT316 INDUSTRIAL BIOTECHNOLOGY	
Course designed by	Department of Chemical Engineering
Approval	Approved by: Meeting of Board of Studies held on 4th Jan, 2016
	Ratified by: 2nd Meeting of Academic Council, 17th Feb, 2016

A1CHT317	VII - SEMESTER (Core Elective – VI)	L	T	P	C
	CORROSION AND ITS CONTROL	3	0	0	3
	Total Contact Hours – 48				

COURSE OBJECTIVES	
1	To introduce the principles of corrosion, common corrosion forms, corrosion Control methods, and material selection to reduce corrosion cost
2	Discuss the problem of stress corrosion cracking of stainless steels in a chloride environment and how stress corrosion cracking can be controlled in an amine environment.
3	Describe the impressed current cathodic protection system and the importance of correctly connecting and maintaining it.
4	Discuss the methods of preventing caustic gouging, hydrogen damage, and pitting in boilers.

SYLLABUS

CORROSION AND ITS CONTROL

UNIT-1

Introduction: Corrosion principles, electro chemical aspects, environmental effects, metallurgical and other aspects.

UNIT-2

Forms of corrosion 1: Uniform attack, galvanic Forms of corrosion 1:crevice, pitting.

UNIT-3

Forms of corrosion 2: Inter granular, selective,Forms of corrosion 2: leaching, erosion and stress corrosion

UNIT-4

Corrosion testing procedures: Corrosion prevention: Material, alteration of environment.

UNIT-5

Design: Cathodic coating: anodic protection

UNIT-6

Modern Theory, principles;Thermodynamics and electrode kinetics, Predicting corrosion behaviour,corrosion prevention and rate measurement

TEXT/REFERENCE BOOKS:

Corrosion Engineering, MG Fontana, McGraw Hill, 3rd edition, 1985
Corrosion Engineering principles and practice, Pierre Roberge, McGraw Hill, 2008
Corrosion and protection, E Bardal, Springer, 2004

COURSE OUTCOMES:

1. understand electrochemical fundamentals
2. understand corrosion preventing methods
3. understand environmental induced corrosion
4. Describe the more common methods used by industry to control corrosion.

Mapping of PO's & Co's (PROGRAM OUTCOMES & COURSE OUTCOMES)

		a	b	c	d	e	f	g	h	i	j	k	l
CO1	Understand electrochemical fundamentals	√		√		√		√				√	
CO2	Understand corrosion preventing methods	√		√		√		√				√	
CO3	Understand environmental induced corrosion	√		√		√		√				√	
CO4	Describe the more common methods used by industry to control corrosion.	√		√		√		√				√	

A1CHT317CORROSION AND ITS CONTROL	
Course designed by	Department of Chemical Engineering
Approval	Approved by: Meeting of Board of Studies held on 4th Jan, 2016
	Ratified by: 2nd Meeting of Academic Council, 17th Feb, 2016

A1CHT318	VII - SEMESTER (Core Elective – VI)	L	T	P	C
	OPTIMIZATION OF CHEMICAL PROCESSES	3	0	0	3
	Total Contact Hours – 48				

COURSE OBJECTIVES	
1	Enable the significance of optimization
2	Understand the difference between constrained and unconstrained optimization
3	Understand the principles of linear programming
4	Understand the method to optimization of chemical processes

SYLLABUS

Unit-I: Nature and organization of optimization problems: what optimization is all about, Why optimize, scope and hierarchy of optimization, examples of applications of optimization, the essential features of optimization problems, general procedure for solving optimization problems, obstacles to optimization. Classification of models, how to build a model, fitting functions to empirical data, the method of least squares, factorial experimental designs, fitting a model to data subject to constraints.

Unit-II: Basic concepts of optimization: Continuity of functions, unimodal versus Multimodel functions. Convex and Concave functions, Convex region, Necessary and sufficient conditions for an extremum of an unconstrained function, interpretation of the objective function in terms of its quadratic approximation.

Unit-III: optimization of unconstrained functions: one-dimensional search: Numerical methods for optimizing a function of one variable, scanning and bracketing procedures, Newton's, Quasi-Newton's and Secant methods of uni-dimensional search, region elimination methods, polynomial approximation methods, how the one- dimensional search is applied in a multi-dimensional problem, evaluation of uni-dimensional search methods.

Unit-IV: unconstrained multivariable optimization: Direct methods, random search, grid search, uni-variate search, simplex method, conjugate search directions, Powell's method, indirect methods- first order, gradient method, conjugate method, indirect method- second order: Newton's method forcing the Hessain matrix to be positive definite, movement in the search direction, termination, summary of Newton's method, relation between conjugate gradient methods and Quasi-Newton method.

Unit – V: Linear programming and applications: Basic concepts in linear programming, Degenerate LP's – graphical solution, natural occurrence of linear constraints, the simplex method of solving linear programming problems, standard LP form, obtaining a first feasible solution, the revised simplex method, sensitivity analysis, duality in linear programming, the Karmarkar algorithm, LP applications.

Unit-VI: Optimization of Unit operations-1 recovery of waste heat, shell & tube heat exchangers, evaporator design, liquid liquid extraction process, optimal design of staged distillation column, Optimal pipe diameter, optimal residence time for maximum yield in an ideal isothermal batch reactor, chemostat, optimization of thermal cracker using liner programming.

TEXT BOOK:

1. Optimization of chemical processes by T.F.Edgar and Himmelblau DM.Mc- Graw. Hill.2001.

Course Outcomes:

1. Understand the importance and limitations of optimization
2. Solve problems on constrained and uncontained optimization
3. Application of linear programming to chemical engineering problems
4. Use of optimization in various processes

Course objectives	**Course outcomes**			
	i	ii	iii	iv
1				
2				
3				
4				

A1CHT318OPTIMIZATION OF CHEMICAL PROCESSES												
Course designed by	Department of Chemical Engineering											
CO / PO mapping	a	b	C	d	e	f	g	h	i	j	k	l

A1CHT318OPTIMIZATION OF CHEMICAL PROCESSES	
Course designed by	Department of Chemical Engineering
Approval	Approved by: Meeting of Board of Studies held on 4th Jan, 2016
	Ratified by: 2nd Meeting of Academic Council, 17th Feb, 2016

A1CHT319	VII - SEMESTER (Core Elective – VII)	L	T	P	C
	FERMENTATION ENGINEERING	3	0	0	3
	Total Contact Hours – 48				

COURSE OBJECTIVES	
1	Understand the importance of fermentation and its design
2	Understand various aspects of microbial processes
3	Understand the principles of upstream and downstream processing
4	Understand the principles of fermentation in production of antibiotics and acids

SYLLABUS

UNIT 1: History and development of fermentation industry: Introduction to submerged and solid state fermentation, Primary and secondary metabolite. General requirements of fermentation processes; Isolation,preservation and improvement of industrially important micro- organisms, development of innocula for industrial fermentations.

UNIT 2: Design of fermentor and ancillaries, An overview of aerobic and anaerobic fermentation processes and their application in the biotechnology industry so solid-substrate fermentation and its applications.

UNIT 3: Industrial product formation through different microbial processes. General aspects, raw materials: Availability, processes and pretreatment, medium preparation.

UNIT 4: Principles of upstream and down stream processing: small scale, medium scale and large scale processes, methods of inoculation and medium preparation, slurry processing and product isolation.

UNIT 5: Fermentative production of organic acids: Lactic acid, Citric acid and Acetic acid. Fermentative production of enzymes: Proteases, Lipases and Amylases.Fermentative production of biofertilizers i.e. rhizobium, BGA; Biopesticide i.e. Bacillu thuringienesis, Single Cell Protein and oil (SCP, SCO) and Baker's yeast.

UNIT 6: Fermentative production of Antibiotics: penicillin streptomycin, tetracycline and cephalosporin. Production of vitamins like Vitamin B12; amino acids i.e. L-glutami acid, phenylalanine and L-lysine. Biotransformation: Steriod transformation. Important products through r-DNA technology: hepatitis B vaccines, interferon, insulin, somatotrophic hormone. Production of biosurfactants, biopolymers like xanthan gum and dextran.

References:

1. A Lei and Kotlers riehard J. Mickey, Microbes & Fermentation, Oriffin Publication.
2. Prescott and Dun's – Industrial Microbiology, 4th Ed.
3. Rehm, Reed & Weinheim, Biotechnology Series, Verlag-Cheiie Publication.
4. Wang & Humphrey, Fermentations & Enzyme technology Wiley & Inter series.
5. A.Lel and R.J.Mickey- N.Y. Industrial Fermentation – Chemical Publishers.
6. A. Len and Richard J.Mickey, Microorganisms & Fermentation, Oriffm Publications.
7. Frazier, Food Microbiology, TMH publishers.
8. Robert P. Onellette & Paul N, 'Application of Biotech – Cherin Siroff Lancaster'.
9. Prescott and Donn, Industrial Microbiology.
10. Kashav Trehan, Biotechnology, New Age International (P) Ltd, 2002

Course Outcomes:

1. Able to understand the design of Fermetor
2. Able to device various microbial processes
3. Able to understand the difference between upstream and downstream processing.
4. Application of fermentation techniques for various processes

Course objectives	**Course outcomes**			
	i	ii	iii	iv
1				
2				
3				
4				

A1CHT319FERMENTATION ENGINEERING												
Course designed by	Department of Chemical Engineering											
CO / PO mapping	a	b	C	d	e	f	g	h	i	j	k	l

A1CHT319FERMENTATION ENGINEERING	
Course designed by	Department of Chemical Engineering
Approval	Approved by: Meeting of Board of Studies held on 4th Jan, 2016
	Ratified by: 2nd Meeting of Academic Council, 17th Feb, 2016

A1CHT320	VII - SEMESTER (Core Elective – VII)	L	T	P	C
	NUCLEAR REACTOR ENGINEERING	3	0	0	3
	Total Contact Hours – 48				

COURSE OBJECTIVES	
1	Graduates will be trained to demonstrate knowledge of mathematics, science, basic computing and engineering fundamentals, breadth and in-depth studies in mechanical engineering aimed at bringing them abreast with industrial and research domains
2	Graduates will be trained to succeed in securing engineering positions with Mechanical /Manufacturing firms as well as Software-based industries and also with government agencies
3	Graduates will beoriented towards success in the pursuit of advanced degrees in Mechanical engineering or other fields and will be imparted the spirit for continued, independent, life-long learning to become experts in their profession and to broaden their professional knowledge
4	Graduates will be trained to organize and present information, to write and speak effective English, to work effectively on team-based engineering projects, to practice ethics at work and demonstrate a sense of social responsibility

SYLLABUS

Unit-1

Nuclear Energy fundamentals, Nuclear fission, Nuclear fission reactors, Radioactivity : interaction of alpha and beta particles and gamma rays with matter, Cross sections for neutron, Variation of cross sections with neutron energy –Fission reactions-Fission process

Unit-2:

Neutron transport concepts: Neutron diffusion theory diffusion in multiplying systems, The slowing down of neutrons-Slowing down in infinite media, Spatial distribution of slowed down neutrons, Critical equations based on diffusion theory-criticality measurement

Unit-3

Multi group theory- fuel depletion calculation, Multi group theory- fuel depletion calculation, The neutron transport equation and its application

Unit-4

Reactor kinetics-Fission product poisoning, Effect of temperature on reactivity, Reactor stability analysis

Unit-5

Radiation units- biological effects of radiation, Radiation protection and standards-Radiation shielding principles,

Unit-6

Environmental effects of nuclear power and waste management, Nuclear reactor safety and regulations

Text books :

Nuclear reactor engineering – Reactor design basics, Samuel Glassstone, Alaxender Senonske, Volume 1 and 2 4th edition, CBS publishers, 2004.

Course Outcomes:

1. Able to understand the relative merits of nuclear reactions compared to conventional fuels
2. Able to explain the interaction of alpha, beta and gamma particles with matter.
3. Understand the importance of critical conditions for reactor design and control methods.

4. Understand Nuclear reactions and control
5. Selection of various materials for a given nuclear reaction systems and control strategy for a nuclear reactions
6. Environmental aspects of nuclear power plants

		a	b	c	d	e	f	g	h	i	j	k	l
CO1	Able to understand the relative merits of nuclear reactions compared to conventional fuels				√				√		√		√
CO2	Able to explain the interaction of alpha, beta and gamma particles with matter.				√				√		√		√
CO3	Understand the importance of critical conditions for reactor design and control methods.				√				√		√		√
CO4	Understand Nuclear reactions and control				√	√			√		√		√
CO5	Selection of various materials for a given nuclear reaction systems and control strategy for a nuclear reactions				√	√			√		√		√
CO6	nvironmental aspects of nuclear power plants				√	√			√		√		√

A1CHT320NUCLEAR REACTOR ENGINEERING												
Course designed by	Department of Chemical Engineering											
CO / PO mapping	a	b	C	d	e	f	g	h	i	j	k	l

A1CHT320NUCLEAR REACTOR ENGINEERING	
Course designed by	Department of Chemical Engineering
Approval	Approved by: Meeting of Board of Studies held on 4th Jan, 2016
	Ratified by: 2nd Meeting of Academic Council, 17th Feb, 2016

A1CHT321	VII - SEMESTER (Core Elective – VII)	L	T	P	C
	INDUSTRIAL SAFETY AND HAZARD MANAGEMENT	3	0	0	3
	Total Contact Hours – 48				

COURSE OBJECTIVES	
1	To know about the Safety Programs, Engineering Ethics, Accident and Loss Statistics, Acceptable Risk, Public Perceptions
2	To know the concept of Toxicology: How Toxicants Enter Biological Organisms and How Toxicants Are Eliminated from Biological Organisms
3	To understand the Industrial Hygiene. Discussion about Government Regulations, Industrial Hygiene: Identification, Industrial Hygiene: Evaluation, Industrial Hygiene: Control
4	To learn about the Relief Concepts, Definitions, Location of Reliefs, Relief Types, Relief Scenarios, Data for Sizing Reliefs, Relief Systems
5	To understand about Relief Sizing Conventional Spring-Operated Reliefs in Liquid Service, Conventional Spring-Operated Reliefs in Vapor or Gas Service, Rupture Disc Reliefs in Liquid Service, Rupture Disc Reliefs in Vapor or Gas Service

SYLLABUS

Unit I: Introduction: Safety program, Engineering ethics, Accident and loss statistics, Acceptable risk, Public perception.

Unit II: Toxicology & Industrial Hygiene:

How toxicants enter biological organisms, How toxicants are eliminated from biological organisms.

Government regulations, Identification, Evaluation, Control.

Unit III: Fires and Explosions:

The fire triangle, Distinction between fire and explosions; Definitions, Flammability characteristics of liquids and vapors, MOC and inerting, ignition energy, Auto ignition, Auto oxidation, Adiabatic compression, Explosions.

Unit IV: Designs to prevent fires and explosions:

Inerting, Explosion proof equipment and instruments, Ventilations, Sprinkler systems.

Unit V: Introduction to Reliefs:

Relief concepts, Definitions, Location of reliefs, Relief types, Data for sizing reliefs, Relief systems.

Unit VI: Hazards Identification:

Process hazards checklists, Hazard surveys, Hazop safety reviews.

TEXT BOOK:

1 D.A.Crowl & J.F.Louvar – Chemical Process Safety (Fundamentals with applications), Prentice Hall (1990).

2. Industrial Hygiene and Chemical safety

REFERENCES:

1. H.H.Fawcett and W.S.Wood –Safety and Accident Prevention in Chemical Operations, 2nd edition, John Wiley and sons, New York 1982

2. Coulson and Richardson's – Chemical engineering – R.K.Sinnot, Vol.6, Butterworth-Heinmann Limited 1996.

COURSE OUTCOMES:

i. An ability to understand about the Safety Programs, Engineering Ethics, Accident and Loss Statistics, Acceptable Risk, Public Perceptions

ii. An ability to understand about the concept of Toxicology: How Toxicants Enter Biological Organisms and How Toxicants Are Eliminated from Biological Organisms

iii. An ability to understand about Industrial Hygiene : Identification, Evaluation, Control

iv. An ability to understand about Reliefs Relief Concepts, Definitions, Location of Reliefs, Relief Types, Relief Scenarios, Data for Sizing Reliefs, Relief Systems

v. An ability to understand about Relief Sizing Conventional Spring-Operated Reliefs in Liquid Service, Conventional Spring-Operated Reliefs in Vapor or Gas Service, Rupture Disc Reliefs in Liquid Service, Rupture Disc Reliefs in Vapor or Gas Service.

Course objectives	**Course outcomes**				
	i	ii	iii	iv	v
1					
2					
3					
4					
5					

A1CHT321INDUSTRIAL SAFETY AND HAZARD MANAGEMENT												
Course designed by	Department of Chemical Engineering											
CO / PO mapping	a	b	c	d	e	f	g	h	i	j	k	l

A1CHT321INDUSTRIAL SAFETY AND HAZARD MANAGEMENT	
Course designed by	Department of Chemical Engineering
Approval	Approved by: Meeting of Board of Studies held on 4th January, 2016
	Ratified by: 2nd Meeting of Academic Council, 17th Feb, 2016

A1CHD201	VII - SEMESTER	L	T	P	C
	PROCESS EQUIPMENT DESIGN & DRAWING USING AUTOCAD	0	0	3	2
	Total Contact Hours – 45				

COURSE OBJECTIVES	
1	Understandingofstandardsymbologyusedtorepresentvariouspipes,valvesandfittings and theirusein development ofP&ID(Piping &Instrument Diagram)
2	Understandingofstandardsymbologyusedtorepresentvariousinstruments,sensing elements,impulselines,local& digital(DCS)instruments,pneumatic/electronicsignals, controllers, control valves, complexcontrol loopsetc.
3	Understandingofstandard symbologyused to represent process equipment.
4	PreparationofstandardProcessFlowDiagramsusingAUTOCADwithrequireddetails forProcess Design.
5	PreparationofstandardPiping&InstrumentDiagrams(P&IDS)usingAUTOCAD,with required details fordesign ofpiping, instrument systems.
6	Mechanical design &drawingofHeat&Mass Transfer&StorageEquipment.

LIST OF EXPERIMENTS:

1. Drawing of flow sheet symbols
2. Drawing of instrumentation symbols
3. Drawing of instrumentation diagrams
4. Mechanical aspects of chemical equipment design and drawing of double pipe heat exchanger
5. Mechanical aspects of chemical equipment design and drawing of shell and tube heat exchanger
6. Mechanical aspects of chemical equipment design and drawing of evaporator
7. Mechanical aspects of chemical equipment design and drawing of distillation column
8. Mechanical aspects of chemical equipment design and drawing of batch reactor

Prescribed Textbook:

Joshi's Process Equipment Design by V.V.Mahajani, S.B.Umarji, 4th Edition, Macmillan Publishers, 2009.

COURSE OUTCOMES:

Thestudent shall be ableto carryout the followingtasks independently:

- Create&use standardsymbolsforpipes,valves,fittingsalongwithauxiliarydetails suchasinsulation,heattracingandultimately createpipelinenumbering/specification systemwithdetailssuchaslinesize,metallurgy,rating,service,external(insulation/ heat tracing) condition etc., suitable forgivenapplication.
- Create&usestandard(ISA/ASME)symbolsforsensingelements,instruments,signals &control loops, controlvalves etc.
- Draw standard Process Flow Diagram (PFD) in AUTOCAD using the steady state Simulationoutput(flow diagramandHeat&Materialbalance)withflaggedstream numbers &basicstreamconditions such flow, phase, pressure&temperature conditions.
- DrawadetailedPiping&InstrumentationDiagram(P&ID)inAUTOCADasperthe standard /specified details with piping specifications, instrumentation starting from sensingelementto completecontrolloops,basicdetailsoftheequipmentincluding nozzles,designconditionsoftheequipment,standard symbology torepresentminor pipingsuch as drains, instrument lead-lines etc.

arryoutmechanicaldesign&drawof(a)Shell&tubeandDoublePipeExchangers(b) Distillationcolumns&absorberand(c)Sphericalstoragevesselusing theprocessdesign data.

A1CHD201 PROCESS EQUIPMENT DESIGN & DRAWING USING AUTOCAD												
Course designed by	Department of Chemical Engineering											
CO / PO mapping	a	b	C	d	e	f	g	h	i	j	k	l

A1CHD201PROCESS EQUIPMENT DESIGN & DRAWING USING AUTOCAD	
Course designed by	Department of Chemical Engineering
Approval	Approved by: Meeting of Board of Studies held on 4th Jan, 2016
	Ratified by: 2nd Meeting of Academic Council, 17th Feb, 2016

VIII - SEMESTER

MOOCS (Self Study Course)

A1CHT322	**VIII - SEMESTER (Core Elective – VIII)**	**L**	**T**	**P**	**C**
	STATISTICAL MOLECULAR THERMODYNAMICS	3	0	0	3
	Total Contact Hours – 45				

SYLLABUS

STATISTICAL MOLECULAR THERMODYNAMICS

Unit 1

Overview of thermodynamics and its importance and utility, Molecular energy levels from quantum mechanics,Ideal gases; Equations of state; PV diagrams,Gases and liquids; Corresponding states, Dispersion; Intermolecular interactions; Real gases.

Unit 2

Boltzmann probability and connection to energy; Ensemble properties, Heat capacity; Partition functions.

Atomic and molecular partition functions; Connections to quantum mechanics (statistical thermodynamics).

Electronic and translational partition function for gases; Rovibrational partition functions, Heat capacities.

Unit 3

First law of Thermodynamics; Energy; PV Work; State functions, Adiabaticity; Reversibility; Heat and work.

Enthalpy; Heat capacity redux; Heat of transition, Enthalpy of chemical reaction; Heat of formation; Standard-state enthalpy.

Unit 4

Second law; Order/disorder; Entropy, Spontaneity and entropy; Statistical thermodynamics and entropy; Reversibility.

Entropy and the interconversion of heat and work; Entropy and the partition function.

Unit 5

Third law; Temperature limits; Perfect crystals; Phase transitions, Experimental determination of third-law entropies; Standard-state entropy.

Unit 6

Helmholtz and Gibbs free energies; Ensemble conditions, Maxwell relations; Ideal gas state functions; Independent variables, Gaseous standard state; Gibbs-Helmholtz equation; Fugacity.

Recommended Background

One year of college-level physics. One year of college-level general chemistry. Differential calculus of multiple variables.

Suggested Readings

There are many textbooks available for introductory thermodynamics. While students will *not* need to have such a textbook in order to follow this course, one with a development that is closely aligned with the material covered is *Molecular Thermodynamics* by McQuarrie and Simon, ISBN 1-891389-05-X.

A1CHT322STATISTICAL MOLECULAR THERMODYNAMICS	
Course designed by	Department of Chemical Engineering
Approval	Approved by: Meeting of Board of Studies held on 4th Jan, 2016
	Ratified by: 1st Meeting of Academic Council, 27th June, 2015

A1CHT323	VIII - SEMESTER (Core Elective – VIII)	L	T	P	C
	ORGANIC SOLAR CELLS	3	0	0	3
	Total Contact Hours – 45				

SYLLABUS

Unit 1: Introduction to solar energy and the three generations of solar cells combined with an introduction to life cycle analysis for solar cells.

Unit 2: Working principles of organic photovoltaics, how to measure and characterize organic solar cells and finally the application of organic solar cells.

Unit 3: Materials for organic solar cells with focus on the active layer including common polymer materials, fullerenes, and low bandgap polymers.

Unit 4: Stability and lifetime of organic and polymer solar cells.

Unit 5: Production of organic solar cells with focus on roll to roll processes, coating, printing, and up-scaling.

Unit 6: The future of organic solar cells.

A1CHT323ORGANIC SOLAR CELLS	
Course designed by	Department of Chemical Engineering
Approval	Approved by: Meeting of Board of Studies held on 4th Jan, 2016
	Ratified by: 1st Meeting of Academic Council, 27th June, 2015

A1CHT324	VIII - SEMESTER (Core Elective – VIII)	L	T	P	C
	BIO ELECTRICITY	3	0	0	3
	Total Contact Hours – 45				

SYLLABUS

Unit 1

Foundations: including electricity in solutions, Energy: pumps and channels that allow membranes to "charge their batteries" and thereby have a nonzero voltage across their membranes at rest.

Unit 2

Channels: remarkable experimental findings on how membranes allow ions to pass through specialized pores in the membrane wall.

Unit 3

Hodgkin-Huxley model: The Nobel-prize winning set of ideas describing how membranes generate action potentials by sequentially allowing ions of sodium and potassium to flow.

Unit 4

Axial and transmembrane currents within and around the tissue structure: including how these currents are determined by transmembrane voltages from site to site within the tissue, at each moment.

Unit 5

Propagation: How action potentials in one region normally produce action potentials in adjacent regions, so that there is a sequence of action potentials, an excitation wave

Unit 6

Extracellular observations: The basic principles that allow electrically active tissue to produce timevarying voltages between electrodes located far away from the electrical sources, including a little discussion of the sources of the electrocardiogram.

Transmembrane and Field Stimulation to initiate or control excitation: A brief glimpse into the huge world of electrical stimulation and how it works, especially with the stimulus electrodes are both outside the tissue to be stimulated.

A1CHT324BIO ELECTRICITY	
Course designed by	Department of Chemical Engineering
Approval	Approved by: Meeting of Board of Studies held on 4th Jan, 2016
	Ratified by: 1st Meeting of Academic Council, 27th June, 2015

A1CHT401	Open Elective	L	T	P	C
	NON-CONVENTIONAL SOURCES OF ENERGY	3	0	0	3
	Total Contact Hours – 45				

COURSE OBJECTIVES	
1	Understand the origin and usage of solar energy its radiation, collection, storage and applications.
2	Understand wind, biomass energy and exploring its utilization.
3	Understand geothermal, ocean energy and exploring its utilization.
4	Understand the need for direct energy conversion and the practical aspects of energy conversion.

SYLLABUS

UNIT – I

PRINCIPLES OF SOLAR RADIATION: Role and potential of new and renewable source, the solar energy option, Environmental impact of solar power, physics of the sun, the solar constant, extraterrestrial and terrestrial solar radiation, instruments for measuring solar radiation and sun shine.

UNIT-II

SOLAR ENERGY COLLECTION, STORAGE AND APPLICATIONS: Flat plate and concentrating collectors, classification of concentrating Collectors, Storage methods: Sensible, latent heat and stratified storage, solar ponds. Solar Applications- solar heating/cooling technique, solar distillation, drying, photovoltaic energy conversion.

UNIT-III

WIND ENERGY: Sources and potentials, horizontal and vertical axis windmills, Betz criteria.

UNIT-IV

BIO-MASS: Principles of Bio-Conversion, Bio-Fuels, Anaerobic/aerobic digestion, types of Bio-gas digesters, gas yield, combustion characteristics of bio-gas, utilization for cooking.

UNIT-V

GEOTHERMAL ENERGY & OCEAN ENERGY: Resources, types of wells, methods of harnessing the energy, potential in India, OTEC, Tidal and wave energy.

UNIT-VI

DIRECT ENERGY CONVERSION: Need for DEC, limitations, principles of DEC. Thermo-electric generators, seebeck, peltier and Joule-Thomson effects, MHD generators, principles, hall effect, Fuel cells.

TEXT BOOKS:

1. Renewable energy resources/ Tiwari and Ghosal/ Narosa.
2. Non-Conventional Energy Sources /G.D. Rai

REFERENCES:

1. Renewable Energy Sources /Twidell & Weir
2. Solar Energy /Sukhame
3. Splar Power Engineering / B.S Magal Frank Kreith & J.F Kreith.
4. Principles of Solar Energy / Frank Krieth & John F Kreider.
5. Non-Conventional Energy / Ashok V Desai /Wiley Eastern.
6. Non-Conventional Energy Systems / K Mittal /Wheeler
7. Renewable Energy Technologies /Ramesh & Kumar /Narosa

COURSE OUTCOMES:

1. Ability to explain the working of solar collectors and various applications.
2. Ability to explain different types of wind mills for power generation and the biomass sources.
3. Ability to explain the generating of power from geothermal energy and ocean energy.
4. Ability to explain about different direct energy conversion devices.

		a	b	c	d	e	f	g	h	i	j	k	l
CO1	ility to explain the working of solar collectors and various applications.				√		√		√		√		√
CO2	ility to explain different types of wind mills for power generation and the biomass sources.				√		√		√		√		√
CO3	ility to explain the generating of power from geothermal energy and ocean energy.				√		√		√		√		√
CO4	ility to explain about different direct energy conversion devices.				√	√	√		√		√		√

A1CHT401 NON-CONVENTIONAL SOURCES OF ENERGY												
Course designed by	Department of Chemical Engineering											
CO / PO mapping	a	b	c	d	e	f	g	h	i	j	k	l

A1CHT401NON-CONVENTIONAL SOURCES OF ENERGY	
Course designed by	Department of Chemical Engineering
Approval	Approved by: Meeting of Board of Studies held on 4th Jan, 2016
	Ratified by: 2nd Meeting of Academic Council, 17th Feb, 2016

A1CHT402	Open Elective	L	T	P	C
	DESIGN AND ANALYSIS OF EXPERIMENTS	3	0	0	3
	Total Contact Hours – 48				

COURSE OBJECTIVES	
1	To impart knowledge on the basic principles and guidelines for designing of experiments
2	Factors influencing experimental analysis
3	Use of Statistical and Mathematical methods for design of experiments

SYLLABUS

Unit I :
Introduction to the role of experimental design; basic statistical concepts; sampling and sampling distribution;Testing of hypotheses about differences in means- randomized designs and paired comparison designs; testing of hypotheses about variances

Unit II :
Analysis of variance (ANOVA) –one-way classification ANOVA; analysis of fixed effects model; comparison of individual treatment means; the random effects model; the randomized complete block design

Unit III:
Factorial design of experiments; two-factor factorial design-fixed effects and random effects model; General factorial design; analysis of 2k and 3k factorial designs

Unit IV:
Conforming in the 2k factorial design in 2p block; confounding in the 3k factorial design in 3p block

Unit V:
Fractional replication of the 2k factorial design and the 3k factorial design

Unit VI:
Regression analysis- Simple and multiple linear regression and hypothesis testing; response surface methodology-the method of steepness ascent : response surface designs for first-order and second-order models. Evolutionary operation(EVOP)

TEXT BOOK: Design and analysis of experiments by D.C. Montgomery, 2nd edition John Wiley and sons, NewYork (1984).

REFERENCE BOOKS:
1. Statistics for Experimenters, G.E.P. Box, William G. Hunter and J.S. Hunter, John Wiley & Sons. 1978.
2. Design of Experiments in Chemical Engineering: A Practical Guide, Zivorad R. Lazic, Wiley – VCH, 2005.

Course Outcomes:
1. Understand of experimental design by various principles and testing of hypothesis.
2. Use of factorial and block designs in chemical engineering experimentation
3. Comparison of various methods of analysis.

Course objectives			
	i	ii	iii
1			
2			
3			

A1CHT402 DESIGN AND ANALYSIS OF EXPERIMENTS												
Course designed by	Department of Chemical Engineering											
CO / PO mapping	a	b	C	d	e	f	g	h	i	j	k	l

A1CHT402 DESIGN AND ANALYSIS OF EXPERIMENTS	
Course designed by	Department of Chemical Engineering
Approval	Approved by: Meeting of Board of Studies held on 4th Jan, 2016
	Ratified by: 2nd Meeting of Academic Council, 17th Feb, 2016

A1CHT403	Open Elective	L	T	P	C
	INDUSTRIAL POLLUTION CONTROL ENGINEERING	3	0	0	3
	Total Contact Hours – 45				

COURSE OBJECTIVES	
1	Understand the types of pollution and dispersion of air pollutants
2	Understand the classification of air pollutants and methods of treatment
3	Understand the types of water pollution and treatment methods
4	Understand the types of solid waste management

SYLLABUS

Unit-I

Type of pollution, Environment legislation, Guidelines and standards, Types of emissions from chemical industries and effects of environment. Global warming, climate change and carbon capture

Unit-II

Meteorological aspects of air pollutant dispersion: Temperature lapse rates and stability, Wind velocity and turbulence, Plume behavior, Dispersion of air pollutants, Estimation of plume rise.

Sources and characteristics of pollutants in fertilizer, paper and pulp industry, petroleum and petroleum industry.

Unit-III

Air pollution sources & effects: Classification and properties of air pollutants, Emission sources, Behavior and fate of air pollutants, Effect of air pollution.

Air pollution sampling and measurement: Types of pollutant sampling and measurement, Ambient air sampling, Stack sampling, Analysis of air pollutants.

Unit-IV

Air pollution control methods & equipment: Control methods, Source correction methods, Cleaning of gaseous effluents, Particulate emission control, Selection of a particulate collector, Control of gaseous emissions, Design methods for control equipment.

Unit-V

Water pollution: Water resources, Origin of wastewater, types of water pollutants and there effects.

Waste water sampling, analysis and treatment: Sampling, Methods of analysis, Determination of organic matter, Determination of inorganic substances, Physical characteristics, Bacteriological measurement, Basic processes of water treatment, Primary treatment, Secondary treatment, Advanced wastewater treatment, Recovery of materials from process effluents.

Unit-VI

Solid waste management: Sources and classification, Public health aspects, Methods of collection, Disposal Methods, Potential methods of disposal.

Hazardous waste management: Definition and sources, Hazardous waste classification, Treatment methods, Disposal methods.

TEXT BOOKS:

1. Environmental pollution and control engineering, Rao C. S. – Wiley Eastern Limited, India, 1993.
2. Pollution control in process industries by S.P. Mahajan TMH.,1985.

REFERENCES:

1. Rao M.N. and Rao H.V.N - Air Pollution, Tata – McGraw Hill Publishing Ltd., 1993.
2. De A.K - Environmental Chemistry, Tata – McGraw Hill Publishing Ltd., 1999.
3. Waste water treatment by M.Narayana Rao and A.K.Datta,Oxford and IHB publ. New Delhi.
4. Air pollution control by P.Prathap mouli and N.Venkata subbayya. Divya Jyothi Prakashan, Jodhpur.
5. Glynn Henry J. and Gary W. Heinke, Environmental Science and Engineering, 2nd Edition, Prentice Hall of India, 2004.
6. "Industrial Pollution Control and Engineering." Swamy AVN, Galgotia publications, 2005

Course Outcomes:

1. Should be able to understand the importance of air pollution and dispersion of plumes
2. Should be able to understand the methods of treatment of air pollutants
3. Should be able to understand the methods of treatment of liquid wastes.
4. Should be able to the methods of solid waste management

Course objectives	Course outcomes			
	i	ii	iii	iv
1				
2				
3				
4				

A1CHT403 INDUSTRIAL POLLUTION CONTROL ENGINEERING												
Course designed by	Department of Chemical Engineering											
CO / PO mapping	a	b	c	d	e	f	g	h	i	j	k	l

A1CHT403 INDUSTRIAL POLLUTION CONTROL ENGINEERING	
Course designed by	Department of Chemical Engineering
Approval	Approved by: Meeting of Board of Studies held on 4th Jan, 2016
	Ratified by: 2nd Meeting of Academic Council, 17th Feb, 2016

A1CHT404	Open Elective	L	T	P	C
	ENERGY ENGINEERING	3	0	0	3
	Total Contact Hours – 48				

COURSE OBJECTIVES	
1	Understand the origin and usage of Coal, Petroleum & Natural gas.
2	Understand solar, wind, biomass energy and exploring its utilization
3	Understand the methods of waste heat recovery
4	Understand the concept of energy auditing and conservation.

UNIT – I

Sources of energy, Types of fuels, Energy and relative forms: Calorific value, Gross and net value, Calculation of calorific value from fuel analysis, Experimental determination of calorific value, Energy resources – Present and future demands with reference to India.

UNIT-II

Coal: Origin, Occurrence, reserves, Petrography, Classification, Ranking, Analysis, testing, storage, Coal carbonization and byproduct recovery, Liquefaction of coal, Gasification of coal. Burning of coal and firing mechanism, Burning of pulverized coal.

UNIT-III

Liquid Fuels: Petroleum, Origin, Occurrence, reserves, Composition, Classification, Characteristics, Fractionation, reforming, Cracking, Petroleum products, Specification of petroleum products, Burning of liquid fuels.

UNIT-IV

Gaseous Fuels: Natural gas, Coke oven gas, Producer gas, water gas, LPG, Burning of gaseous fuels.

UNIT-V

Renewable and Future Energy Sources: Energy from biomass and biogas, Solar energy, Wind energy, Hydrogen energy and Nuclear Energy.

Applications of Energy Sources: Boiler plant, Nuclear plants, Turbines, Gasifiers, Fuel cells, Solar cells.

UNIT-VI

Combined heat and power systems: Waste heat recovery, Source of waste heat and potential application, Various types of heat recovery systems: Regenerators, Recuperators, Waste heat boilers. **Energy auditing and Conservation:** Short term, Medium term, Long term schemes, Energy conversion, Energy index, Energy cost, Representation of energy consumption, Sanky diagram, Energy auditing. Conservation methods in process industries.

TEXT BOOKS:

1. Renewable energy resources/ Tiwari and Ghosal/ Narosa.
2. Non-Conventional Energy Sources /G.D. Rai
3. Elements of Fuel, Furnaces & Refractories / O.P.Gupta

REFERENCES:

1. Renewable Energy Sources /Twidell & Weir
2. Solar Energy /Sukhatme
3. Solar Power Engineering / B.S Magal Frank Kreith & J.F Kreith.
4. Principles of Solar Energy / Frank Krieth & John F Kreider.
5. Non-Conventional Energy / Ashok V Desai /Wiley Eastern.

Course Outcomes:

1. Ability to explain about the origin and usage of Coal, Petroleum & Natural gas.
2. Ability to explain the utilization of solar, wind, biomass energy for power generation.
3. Ability to explain the different methods of waste heat recovery.
4. Ability to explain and apply different energy auditing and conservation methods.

		a	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**
CO1	Ability to explain about the origin and usage of Coal, Petroleum & Natural gas.				√		√		√		√		√
CO2	Ability to explain the utilization of solar, wind, biomass energy for power generation.				√		√		√		√		√
CO3	Ability to explain the different methods of waste heat recovery.				√		√		√		√		√
CO4	Ability to explain and apply different energy auditing and conservation methods.				√	√	√		√		√		√

A1CHT404 ENERGY ENGINEERING												
Course designed by	Department of Chemical Engineering											
CO / PO mapping	a	b	C	d	e	f	g	h	i	j	k	l

A1CHT404 ENERGY ENGINEERING	
Course designed by	Department of Chemical Engineering
Approval	Approved by: Meeting of Board of Studies held on 4th Jan, 2016
	Ratified by: 2nd Meeting of Academic Council, 17th Feb, 2016

A1CHT405	OPEN ELECTIVE	L	T	P	C
	GREEN CHEMISTRY & TECHNOLOGY	3	0	0	3
	Total Contact Hours – 48				

COURSE OBJECTIVES	
1	To impart knowledge on the basic principles and guidelines for designing of experiments
2	Factors Influencing Experimental Analysis
3	Use of Statistical and Mathematical Methods for Design of Experiments

SYLLABUS

UNIT I

Overview of Major Environmental Issues, Global Environmental Issues.Air Quality Issues. Water Quality Issues, Ecology, Natural Resources, Description of Risk. Value of Risk Assessment in the Engineering Profession.Risk-Based Environmental Law. Risk Assessment Concepts. Hazard Assessment. Dose-
Response. Risk Characterization.

UNIT II

Pollution Prevention- Pollution Prevention Concepts and Terminology.Chemical Process Safety.Responsibilities for Environmental Protection.Environmental Persistence. Classifying Environmental Risks Based on Chemical Structure. Exposure Assessment for Chemicals in the Ambient Environment.

UNIT III

Green Chemistry.Green Chemistry Methodologies. Quantitative/Optimization- Based Frameworks for the Design of Green Chemical Synthesis Pathways. Green Chemistry Pollution Prevention in Material Selection for Unit Operations.Pollution Prevention for Chemical Reactors.Pollution Prevention for Separation Devices.Pollution Prevention Applications for Separative Reactors.Pollution Prevention in Storage Tanks and Fugitive Sources.

UNIT IV

Process Energy Integration.Process Mass Integration.Case Study of a Process Flow sheet-Estimation of Environmental Fates of Emissions and Wastes.

UNIT V

Magnitudes of Environmental Costs.A Framework for Evaluating Environmental Costs.Hidden Environmental Costs.Liability Costs. Internal Intangible Costs. External Intangible Costs.

UNIT VI

Introduction to Product Life Cycle Concepts.Life-Cycle Assessment.Life-Cycle Impact Assessments.Streamlined Life-Cycle Assessments.Uses of Life-Cycle Studies.

TEXTBOOKS:

1. Allen, D.T., Shonnard, D.R, Green Engineering: Environmentally Conscious Design of Chemical Processes. Prentice Hall PTR 2002.
2. MukeshDoble and Anil Kumar Kruthiventi, Green Chemistry and Engineering, Elsevier, Burlington, USA, 2007.

Course Outcome:

1. Understand the basic principles of green and sustainable chemistry
2. Understand stoichiometric calculations and relate them to green process metrics
3. Apply the principles of Green Chemistry to the principles of catalysis, photochemistry.

A1CHT405GREEN CHEMISTRY & TECHNOLOGY												
Course designed by	Department of Chemical Engineering											
CO / PO mapping	a	b	c	d	e	f	g	h	I	j	k	l

A1CHT405GREEN CHEMISTRY & TECHNOLOGY	
Course designed by	Department of Chemical Engineering
Approval	Approved by: Meeting of Board of Studies held on 4th Jan, 2016
	Ratified by: 2nd Meeting of Academic Council, 17th Feb, 2016

A1CHT406	Open Elective	L	T	P	C
	ENVIRONMENTAL IMPACT ASSESSMENT	3	0	0	3
	Total Contact Hours – 48				

COURSE OBJECTIVES	
1	To enable the students understand the development of EIA
2	To enable the students of EIA guidelines
3	To enable the students about the importance of sustainable development
4	To enable the students about the importance of GIS in EIA

SYLLABUS

Unit:I : Introduction to environmental impact analysis, origin and development of EIA Environmental Impact assessment and environmental management plan.

Unit-II: EIA guidelines 1994, Notification of Government of India. Impact assessment methodologies, generalized approach to impact analysis, procedure for reviewing environmental impact analysis and statement.

Unit-III: Guidelines for environmental audit. Introduction to environmental planning.Base line information and predictions (land, water, atmosphere, energy etc.).Restoration and rehabilitation technologies.Land-use policy for India and urban planning for India with special reference to NE India.

Unit-IV: Rural planning and land-use pattern. Concept and strategies of sustainable development. Cost –benefit analysis, Environmental priorities in India and sustainable development.

Unit-V: EIA process; Evaluation of proposed actions, scoping EIA methodologies. Role of GIS in EIA base line study, risk assessment and risk management.

Mitigation measures, Green belts. Review of procedures, practices and guidelines in India. Case Studies- River valley projects, Thermal power plants, Mining projects, Oil refineries and petrochemicals, with reference to fields of NE region.

Unit-VI: Current topics on Environmental Impact Assessment.

Text Books :

1. D. P. Lawrence Environmental Impact Assessment: Practical Solutions to Recurrent Problems, John Wiley and Sons, 2003
2. Glasson, Therivel and Chadwick An Introduction to Environmental Impact Assessment, UCL, 1999
3. P. Morris and R.Therivel Methods of Environmental Impact Assessment, Spoon Press, 2001
4. L. Carter Environmental Impact Assessment, McGraw Hill, 1996
5. Y. Anjaneyulu Environmental Impact Assessment Methodologies, B.S. Publications, 2002
6. Weston, Planning and EIA in Practice, Longman, 1997

Course Outcomes:

1. Students should be able to understand the importance of EIA
2. Students should be able to understand various EIA processes
3. Students should be able to understand the importance of sustainable development
4. Students should be able to understand the importance of GIS in EIA

Course objectives	Course outcomes			
	i	ii	Iii	iv
1				
2				
3				
4				

A1CHT406ENVIRONMENTAL IMPACT ASSESSMENT												
Course designed by	Department of Chemical Engineering											
CO / PO mapping	a	b	C	d	e	f	g	h	I	j	k	l

A1CHT406ENVIRONMENTAL IMPACT ASSESSMENT	
Course designed by	Department of Chemical Engineering
Approval	Approved by: Meeting of Board of Studies held on 4th Jan, 2016
	Ratified by: 2nd Meeting of Academic Council, 17th Feb, 2016

FOUNDATION ELECTIVES

A1EHT101	FOUNDATION ELECTIVE	L	T	P	C
	PROFESSIONAL COMMUNICATION	3			3
	Total Contact Hours – 45				
	Prerequisite: ENGLISH LANGUAGE PRACTICE –I & II.				

COURSE OBJECTIVES	
COBJ1	Students apply the principles and functions of corporate communication.
COBJ2	Students receive input on various business and professional genres that serve as a basis for completion of their letter, short business report, meeting simulation and minutes of a meeting.
COBJ3	Students analyze effective written and spoken communication in organizations.
COBJ4	Acquiring the skills required from linguistic perspective for preparing themselves for their prospective careers in business and management domain.

Unit – I **6 hrs**

- Process of communication
  - Channels & media of communication
  - Communication network
  - Facilitation & barriers to effective communication
  - Inter cultural Communication
  - Nonverbal Communication.
  - Ethics and Communication

Unit- II **5 hrs**

- Mechanics of Writing
  - Transitions
  - Spelling rules
  - Hyphenation
  - Transcribing numbers
  - Abbreviating technical and non-technical terms
  - Proof reading
- Vocabulary for Specific Purposes

Unit-III **7 hrs**

- Developing written & Analytical skills
  - Use of graphics
  - Business Communication
  - Report writing

Unit-IV **9 hrs**

- Oral Communication skills
  - Presentation skills Interviewing
  - Assertiveness training
  - Public Communication

Unit –V **8 hrs**

- Organizational Communication
  - Small Group Communication
  - Communicating with Employees
  - In Company Communication Barriers & facilitations,
  - Meeting and Committees
  - Discussion groups & briefing sessions
  - Public relations Social aspect of Communication
  - Press announcements

Unit-VI **7hrs**

- Communication Technology
  - Implications of new communication technology
  - Automated Office Impact of Computers in Business
  - Computer Crime
  - Data Protection Teleworking from home

Total Number of Hours per Course - 45

Books:

1. Argenti, P. A. (2013). *Corporate Communication 6th Edition*. New York: Irwin McGraw Hill, Inc.
2. Hill &Bovee, Business Communication (McGraw Hill).

REFERENCE BOOKS

1.	Lesikar&Pettet, Business Communication, (All India 'Travellers Book Sellers)
2	Korlahalli: Business Communication, Sultan Chand & Sons
3	Rai&Rai, *Business Communication*Himalays Publishing house
4	G. Danta, *Information in Enterprise* (Prentice Hall of India)
5	*All about Words* by Maxwell Nurnberg (Author), Morris Rosenblum (Author), GOYAL SAAB
6	*Technical Communication- A Practical Approach* by William Sanborn Pfeiffer and TVS Padmaja, Pearson Publications
7	*Interview Skills that **Win** the **Job*** **by** MICHAEL SPIROPOULOS, Allen and Unwin
8	*Art of Public Speaking* by Dale Carnegie,
9	*Teach Yourself Speed Reading* by Tina Konstant
10	Argenti, P. A. (2013). *Corporate Communication 6th Edition*. New York: Irwin McGraw Hill, Inc.
11	Cornelissen, J. (2011). Corporate Communication: A Guide to Theory and Practice (3rd ed.). Sage.
12	Ellet, W. (2007) *The Case Study Handbook: How to Read, Discuss, and Write Persuasively About Cases*. Harvard Business School Press.
13	Locker, K. O. &Kienzler, D. (2012). *Business and Administrative Communication with Connect Plus (10th ed.)*, New York: McGraw-Hill.
14	Maier, S. (2012). *The Diary: 100 Days and Lessons in Corporate Communications*. Marshall Cavendish Business.
15	Netzley, M., & Snow, C. (2001). *Guide to Report Writing*. Upper Saddle River, NJ: Prentice Hall.
16	Oliver, S. (1997). *Corporate Communication: Principles, Techniques and Strategies.* London: Kogan Page.
17	Tuck, A (ed.) (2000). *Oxford Dictionary of Business English for Learners of English.* UK: OUP.

Course Outcomes:

CO1	Student shall understand the significance of cultural front in communication and obtain the ability to communicate effectively at cross cultural fronts
CO2	The teaching and learning activities encompass three major aspects including foundations of business and organizational communication, and planning and composing business messages. Students shall apply this skill set when writing e-mails, memos, letters, minutes of a meeting and a short business report.
CO3	Student acquires effective public speaking skills
CO4	Students apply appropriate written and spoken skills in a variety
CO5	Student prepares himself for combating the future requirements of the employment
CO6	Student shall be able to understand and analyze the core components of his study well

A1EHT101 – PROFESSIONAL COMMUNICATION											
Course designed by	English and Humanities										
CO / PO mapping (SIZE:12)	a	b	c	d	e	f	g	h	i	j	k

A1EHT101 – PROFESSIONAL COMMUNICATION

Course designed by	English and Humanities
Approval	Approved by: Meeting of Board of Studies held on 18th June, 2015
	Ratified by: 1st Meeting of Academic Council, June, 2015

A1EHT102	FOUNDATION ELECTIVE	L	T	P	C
	BUSINESS COMMUNICATION	3			3
	Total Contact Hours – 45				
	Prerequisite: ENGLISH LANGUAGE PRACTICE –I & II.				

COURSE OBJECTIVES	
COBJ1	Understand the concepts of high context culture and low context culture, as well as their implications for business intercultural communication.
COBJ2	Acquire the necessary writing techniques for writing effective business documents based on communication functions, such as positive messages, negative messages, persuasive messages, and business report.
COBJ3	Communicate effectively by analyzing audience, organizing deliverances to the need and purpose, preparing clearly and precisely with no grammar errors and presenting them with skillful design.
COBJ4	Acquiring the skills required from linguistic perspective for preparing themselves for their prospective careers in business and management domain.

ORIENTATION -3 hrs

Unit – I

- The Seven Cs of Effective Communication -6 hrs
  Completeness
  - Conciseness
  - Consideration
  - Concreteness
  - Clarity
  - Courtesy
  - Correctness
- Mechanics of Writing
  - Transitions
  - Spelling rules
  - Hyphenation
  - Transcribing numbers
  - Abbreviating technical and non-technical terms
  - Proof reading
  - Vocabulary for Specific Purposes

Unit- II **5 hrs**

- Communication: Its interpretation
  - Basics
  - Nonverbal Communication
  - Barriers to Communication

Unit-III **7 hrs**

- Business Communication at Work Place:
  - Letter Components and Layout
  - Planning a letter Process of Letter writing
  - E-mail Communication, Memo and Memo reports
  - Employment Communication
    Cover letters
    Resumes
  - Notice agenda and Minutes of meeting
  - Brochures

Unit-IV **8 hrs**

- Report Writing
  - Effective writing
  - Types of business reports
  - Structure of reports
  - Gathering information
  - Organization of the material
  - Writing abstracts and summaries
  - Writing definitions
  - Visual aids
  - User instruction manual.

Unit –V **7 hrs**

- Required Skills
  - Reading skills
    - Speed Reading Techniques
    - Reading with Understanding
    - Critical/Analytical Reading
  - Listening skills
  - Note-making
  - Précis writing
  - Audiovisual aids

Unit-VI **9hrs**

- Oral Presentation
  - Public Speaking
  - Paper Presentations
  - Interview Skills

Total Number of Hours per Course - 45

Books:

1. Effective Business Communication by Herta A Murphy, Herbert W Hildebrandt, Jane P Thomas, McGraw Hill
2. Communication Skills by Sanjay Kumar, PushpLata, Oxford Publications

REFERENCE BOOKS

1.	Business Communication, Lesikar and Petit, McGraw Hill
2	**Communication Skills Handbook, Summers, Wiley, India**
3	**Business Communication (Revised Edition), Rai and Rai, Himalaya Publishing House**
4	**Business Correspondence and Report Writing by R. C. Sharma and Krishna Mohan, Tata McGraw Hill.**
5	All about Words by Maxwell Nurnberg (Author), Morris Rosenblum (Author), GOYAL SAAB
6	Technical Communication- A Practical Approach by William Sanborn Pfeiffer and TVS Padmaja, Pearson Publications
7	Interview Skills that **Win** the **Job by** MICHAEL SPIROPOULOS, Allen and Unwin
8	Art of Public Speaking by Dale Carnegie,
9	Teach Yourself Speed Reading by Tina Konstant

Course Outcomes:

CO1	Student shall understand the significance of cultural front in communication and obtain the ability to communicate effectively at cross cultural fronts
CO2	Student shall acquire the necessary writing techniques for writing effective business documents
CO3	Student acquires effective public speaking skills
CO4	Student enriches his linguistic knowledge from professional perspective
CO5	Student prepares himself for combating the future requirements of the employament
CO6	Student shall be able to understand and analyze the core components of his study well

A1EHT102 – BUSINESS COMMUNICATION											
Course designed by	English and Humanities										
CO / PO mapping (SIZE:12)	a	b	c	d	e	f	g	h	i	j	k

A1EHT102 – BUSINESS COMMUNICATION

Course designed by	English and Humanities
Approval	Approved by: Meeting of Board of Studies held on 18th June, 2015
	Ratified by: 1st Meeting of Academic Council, June, 2015

A1MET103	FOUNDATION ELECTIVE	L	T	P	C
	MATERIALS SCIENCE	3	0	0	3
	Total Contact Hours - 42				
	Prerequisite : None				
COURSE OBJECTIVES					
1.	To learn about various types of bonds in crystalline solids, crystal systems, crystalline planes and directions and basic defects in crystalline materials.				
2.	To gain knowledge on the differences between conducting solids and dielectrics and the behavior of dielectrics in presence of ac fields and temperature.				
3.	To gain knowledge on the characteristics of superconducting state, types of superconductors and their applications in specific to SQUID's.				
4.	To gain knowledge about the technologically useful dielectric, magnetic and nanomaterials, their properties and applications and the preparation of nanomaterials.				
5.	To gain knowledge on the modern characterization techniques like XRD, SEM, TEM, etc. used to analyze the materials for their useful properties.				

SYLLABUS

Unit 1: Fundamentals of Materials Science & Engineering

Introduction- bonding in solids - crystal structure – crystallographic directions and planes. Defects in Crystals- Point defects- Dislocations- Burgers vectors.

Unit 2: Conducting & Dielectric Materials

Introduction- Types of conducting materials- Sources of Resistivity of Metals and Alloys- Electrical Conductivity at High Frequencies.

Dielectrics- Introduction- Polarization mechanisms in dielectris- Frequency and Temperature dependence of dielectric constant - Dielectric loss- Dielectric breakdown & strength.

Unit-3: Superconducting Materials

Introduction- General properties of superconducting state- Meissner effect- Type-I and Type-II superconductors- DC and AC Josephson effect- (Qualitative)- SQUID'S.

Unit-4: Advanced Materials

Introduction- Ferroelectric Materials- Spontaneous polarization- Piezoelectric materials Ferrites- Structure and properties- Applications- Multiferroic materials- Solar cells.

Unit-5: Nanomaterials

Introduction- Factors influencing at nanoscale- Types of nanomaterials- Preparation (Ball milling method, Physical Vapor deposition, Laser ablation method)- Properties (Physical- Optical- Electrical- Magnetic properties)- Applications of nanomaterials.

Unit-6: Modern Techniques for Material Studies

Introduction- X-Ray diffraction- Transmission Electron microscopy (TEM)- Scanning Electron microscopy (SEM)- EDAX (Energy Dispersive X-Ray Analysis)- Thermogravimetric Analysis (TGA) – Differential thermal analysis (DTA) – Electron spin resonance technique (ESR).

Text books:

1. W. D. Callister (Jr.), Material Science and Engineering - an Introduction, 6th Ed., John Wiley & Sons.

2. G. Cao, "Nanostructures and Nanomaterials: Synthesis, Properties and Applications", Imperial College Press, 2004

Reference Books:

1. Raghavan V., Material Science and Engineering Prentice Hall of India, New Delhi
2. James F. Shackelford (1996), Introduction to Materials Science for Engineers,Prentice Hall, India

S.NO.	COURSE OUTCOMES
CO 1.	Student shall understand about different crystal systems, planes and directions of planes in crystals, types of bonds in crystalline solids, defects and types of defects in crystals.
CO 2.	Student shall understand about the sources of electrical resistivity, dielectric polarization, dielectric constant, dielectric loss and breakdown strength.
CO 3.	Student shall understand about zero resistance, Meissner effect, soft and hard superconductors and applications of superconductors.
CO 4.	Student shall understand about properties and applications of ferroelectrics, piezoelectrics, ferrites and preparation, properties and applications of nanomaterials.
CO 5.	Student shall understand about modern characterization techniques useful to analyze the structural, microstructural, thermal and magnetic properties of materials.

MATERIALS SCIENCE											
Course designed by	DEPARTMENT OF PHYSICS										
CO / PO mapping	a	b	c	d	e	f	g	h	i	j	k
	√	√		√							

A1MAT104	FOUNDATION ELECTIVE	L	T	P	C
	ENGINEERING MATHEMATICS-II	3			3
	Total Contact Hours – 48				
	Prerequisite : None				
COURSE OBJECTIVES					
COBJ1	To learn the method of expressing functions of periodic nature of an infinite series of trigonometric functions (sine and cosine) and to learn about Fourier transforms				
COBJ2.	To learn the concept of curve tracing and the method of finding lengths, volumes and surface area of revolution of varies curves.				
COBJ3.	To learn about Gradient of Scalar point function, Divergence and Curl of a vector point function and their physical significance.				
COBJ4.	To learn the method of evaluating the line, surface and volume integrals and their relations using vector integral theorems which are useful in many fields like fluid mechanics, electromagnetic field theory .				

SYLLABUS

UNIT – I: FOURIER SERIES:

Introduction-Euler's formula-conditions for Fourier expansion-functions having points of discontinuity –change of interval– expansion of even and odd periodic functions-Half-range series

UNIT – II: FOURIER TRANSFORMS:

Introduction-definition-Fourier integral theorem (statement only) – Fourier sine and cosine integrals – Fourier transforms-Fourier sine and cosine transforms – properties of Fourier transforms (without proofs) – inverse transforms – Finite Fourier sine and cosine transforms.

UNIT-III: INTEGRAL CALCULUS AND ITS APPLICATIONS:

Curve tracing (Concepts only)- Lengths of plane curves- Volumes and Surface areas of revolution .

UNIT – IV: MULTIPLE INTEGRALS:

Double Integrals – Change of order of Integration–Triple integrals- change of variables.
Application: Moment of inertia.

UNIT – V: VECTOR CALCULUS AND APPLICATIONS:

Differentiation of vectors-scalar and vector point functions-del applied to scalar point functions -Gradient-del applied to vector point functions- Divergence and Curl- del applied twice to point functions (statements)-del applied to products of point functions (statements).

UNIT – VI: INTEGRATION OF VECTORS:

Introduction-Line integral –circulation- work done – surface integrals –flux-volume integral-Green's theorem in the plane - Stoke's and Gauss's Divergence Theorems (Without proof) and related problems.

Text Book :

1.B.S.GREWAL, Higher Engineering Mathematics, 42nd Edition, Khanna publishers

Reference Books :

2. ERWIN KREYSZIG, Advanced Engineering Mathematics, 9th Edition, Wiley-India
3. Schaum's Outline series of Integral calculus (schaum's Outline Series)

COURSE OUTCOMES:

CO1. Student will be able to solve boundary value problems using Fourier series and Fourier transforms.
CO2. Student will be able to find the lengths ,surface area of revolution and volume of revolution for various curves.
CO3. Student will be able to understand the physical significance of vector operators.
CO4. Student will be able to apply vector integral theorems to evaluate Line, Surface and Volume integrals with ease.

A1MAT104 - ENGINEERING MATHEMATICS-II											
Course designed by	DEPARTMENT OFMATHEMATICS										
CO / PO mapping	a	b	c	d	e	f	g	h	i	j	k
	X				X						X

A1MAT104 - ENGINEERING MATHEMATICS-II	
Course designed by	DEPARTMENT OFMATHEMATICS
Approval	Approved by: Meeting of Board of Studies held on 23.06.15
	Ratified by: 1st Meeting of Academic Council, June, 2015

	FOUNDATION ELECTIVE	L	T	P	C
	ELECTRO MAGNETICS THEORY	3			3
A1PYT105	Total Contact Hours – 48				
	Prerequisite: Basic Engineering Mathematics Fundamental Physics concepts				
COURSE OBJECTIVES					
1.	Perform some elementary vector analysis				
2.	Understand the field concepts as they arise in various engineering electromagnetic problems;				
3.	Recognize the relevance of Maxwell's equations in electromagnetic field theory.				
4.	Understand the fundamental nature of static electric fields, potential, flux, charge densities, static magnetic fields, steady current, resistance, capacitance, inductance, stored energy, materials, and boundary conditions.				
5.	Understand Faraday's law of induction, electromagnetic fields, Maxwell's equations, boundary conditions				

SYLLABUS

UNIT I
INTRODUCTION
Sources and effects of electromagnetic fields – Vector fields – Different co-ordinate systems-vector calculus – Gradient, Divergence and Curl - Divergence theorem – Stoke's theorem.

UNIT II
ELECTROSTATICS
Coulomb's Law – Electric field intensity – Field due to point and continuous charges – Gauss's law and application – Electric potential – Electric field and equipotential plots – Electric field in free space,

UNIT III
ELECTRIC FIELDS IN MATERIALS
Properties of materials-convection and conduction currents -conductors –polarization in dielectrics- dielectric constant and strength - continuity equation - Boundary conditions involving conductors, dielectric, and free space. Poisson and Laplace's equations-uniqueness theorem- Solution of Laplace's equation of single variable only

UNIT IV
MAGNETOSTATICS
Lorentz Law of force, magnetic field intensity – Biot–savart Law - Ampere's Law – Magnetic field due to straight conductors, circular loop, infinite sheet of current – Magnetic flux density (B) – B in free space, conductor, magnetic materials – Magnetization – Scalar and vector potential.

UNIT V:

MAGNETIC FORCE

Forces due to magnetic fields-magnetic torque and moment-Force and Torque on a closed circuit- Magnetic Materials- Boundary conditions at the interface of two different magnetic materials - Self and mutual inductance – determination of self inductance of a Solenoid and Toroid - Energy density in magnetic field

UNIT VI

ELECTRODYNAMIC FIELDS

Faraday's laws, induced emf – Transformer and motional EMF – Forces and Energy in quasi-stationary Electromagnetic Fields - Maxwell's equations (differential and integral forms) – Displacement current – Relation between field theory and circuit theory.

TEXT BOOKS

1. Engineering Electromagnetics –William H Hayt&Jhon A Buck, McGraw Hill Companies, 7th Edition.2006

REFERENCES BOOKS:

1. Principles of Electromagnetics – Sadiku, Oxford Publications, 4th Edition
2. Introduction to Electrodynamics – D.J Griffiths, Prentice Hall of India, 2nd Edition

Course Outcomes:

1. Identify the appropriate vector analysis concepts for a particular application. (Knowledge)
2. Differentiate between electrical field intensities due to various charge configurations. (Comprehension)
3. Identify the fundamental laws of electromagnetic theory and apply these laws in the development of the theory for power transmission lines and electrical machines.(Application).
4. Analyze the behavior of theses fields in different medias. (Analysis)
5. Design and develop various types of capacitances and inductances for all types of configurations. (Synthesis)

A1PYT105- ELECTRO MAGNETICS THEORY											
Course designed by	Electrical & Electronics Engineering Department										
CO/PO mapping	a	b	c	d	e	f	g	h	i	j	k
Identify the appropriate vector analysis concepts for a particular application. (Knowledge)	H			L	H			M			L
Differentiate between electrical field intensities due to various charge configurations. (Comprehension)	H							M			L
Identify the fundamental laws of electromagnetic theory and apply these laws in the development of the theory for power transmission lines and electrical machines.(Application).	H	M			M			M			L
Analyze the behavior of theses fields in different medias. (Analysis)	H							M			L
Design and develop various types of capacitances and inductances for all types of configurations. (Synthesis)	H		M		M			M			

A1CYT106	FOUNDATION ELECTIVE	L	T	P	C
	INSTRUMENTAL METHODS OF ANALYSIS	**3**	**-**	**-**	**3**
	Total Contact Hours – 45				
COURSE OBJECTIVES					
1.	To gain the knowledge on fundamentals of spectroscopy, working principles of instrumentation and applications of UV – Visible and IR Spectroscopic techniques.				
2.	To impart the basic knowledge on fundamental concepts and theory of separation techniques.				
3.	To gain the knowledge and understand the basic difference, instrumentation involved and applications of Planar chromatography, GC and HPLC.				

SYLLABUS:

UNIT-1: INTRODUCTION TO SPECTROCHEMICAL METHODS: Laws of absorption – general principles of electro – magnetic radiation – wave properties, particle properties – Electro – Magnetic spectrum – absorption of radiation. Absorption – transmittance- atomic absorption - comparison and differences between colorimeter and spectrophotometer- Lambert's law- Beer's law- derivation of Beer's law- limitations of Beer's law

UNIT-2 : UV – VISIBLE SPECTROSCOPY: Construction- working of single beam UV-VIS spectrophotometer and double beam spectrophotometer- sources of light- monochromators (prism, grating)- detectors (photo tubes, photo multiplier tubes)- diode array spectrophotometers- applications- determination of manganese- determination of chromium

UNIT-3 : INFRA RED SPECTROSCOPY: Theory of IR absorption spectrometry – types of molecular vibrations – finger print regions – instrumentation- sampling methods for solids, liquids and gases- Applications in determination of purity, presence of water in a sample, measurement of paints and varnishes, examination of old paintings and artifacts and in industry FTIR spectroscopy.

UNIT-4: CHROMATOGRAPHIC SEPARATION METHODS: Chromatography- introduction- principles of chromatography- classification- development methods (frontal analysis, displacement development, elution development)- Van Deemter equation- Resolution- Rf value

UNIT-5: PLANAR CHROMATOGRAPHY:

1.Paper chromatography – principle - R_f value – solvent systems – development techniques – applications

2. Thin layer chromatography – principle - R_f value- types of adsorbents – solvents – development techniques – applications.

UNIT-6: COULMN CHROMATOGRAPHY

1. Gas liquid chromatography- principle- instrumentation (carrier gas, columns, sample injection systems and detectors)- application of GLC in petroleum industry
2. High performance Liquid Chromatography- advantages (theoretical plate concept)- Instrumentation (pumps, columns, detectors)- application of HPLC in pharmaceutical industry.

PRESCRIBED TEXT BOOK

1. Fundamentals of analytical chemistry, Skoog, West and Holler, Cengage Learning
2. Instrumental methods of analysis, Gurdeep R Chatwaal&Anand, Himalaya Publishing house
3. Separation Methods, M.N Sastri, Himalaya Publishing house.

STANDARD BOOKS

1. Instrumental Methods of Analysis, H. Kaur, Himalaya Publishing house
2. Instrumental methods of chemical analysis, B. K. Sharma.

REFERENCES

1. Instrumental Methods of Analysis, Willard, Merrit, Dean and Settle, CBS Publications
2. Instrumental Methods of Analysis, H. Kaur, Himalaya Publishing house
3. Chemical Separation methods, John A Dean, Van Nostrandand Reinhold.

COURSE OUTCOMES:

i. Students gain the knowledge of the fundamental principles of spectrochemical techniques; understand the basic difference between them and their applications.
ii. Students gain the knowledge and fundamental concepts of various separation techniques used across the various industries.
iii. Students gain the knowledge on basic difference, instrumentation involved and applications of planar chromatography, GC and HPLC.

A1CYT106 - INSTRUMENTAL METHODS OF ANALYSIS											
Course designed by	Department of Chemistry										
CO / PO mapping	a	b	c	d	e	f	g	h	i	j	k
	✓							✓	✓	✓	✓

A1CYT106 - INSTRUMENTAL METHODS OF ANALYSIS	
Course designed by	Department of Chemistry
Approval	Approved by: Meeting of Board of Studies held on 23.06.15
	Ratified by: 1st Meeting of Academic Council, June, 2015

A1MET107	FOUNDATION ELECTIVE	L	T	P	C
	THERMODYNAMICS	3	0	0	3
	Total Contact Hours – 48				

COURSE OBJECTIVES	
1	To Prepare the students to apply basic conversion principles of mass and energy to open and closed systems
2	To enable the students to understand laws of thermodynamics and apply it to various systems.
3	To develop an intuitive understanding about pure substances and gas power cycles for evaluating the performance of power plants

SYLLABUS

UNIT I

Introduction: Basic Concepts : Types of systems, Surrounding, types of boundaries, Universe, Types of Systems, Macroscopic and Microscopic viewpoints, Concept of Continuum, Thermodynamic Equilibrium, State, Property, Process, Cycle – Reversibility – Quasi – static Process, Irreversible Process, Work transfer and Heat transfer, Point and Path function.

UNIT II

Zeroth Law of Thermodynamics – Joule's Experiments – First law of Thermodynamics First law applied to a Process – First law applied to a flow system – Steady Flow Energy Equation.

UNIT III

Limitations of the First Law –Second Law of Thermodynamics, Kelvin-Planck and Clausius Statements and their Equivalence, Carnot cycle and its specialties, Clausius Inequality, Entropy, Principle of Entropy Increase –Tds relations, Maxwell Relations Clausius – Clapeyron Equation –Third Law of Thermodynamics.

UNIT IV

Throttling and Free Expansion Processes – Flow processes –Ideal gas equation, Deviations from perfect Gas Model – Vander Waals Equation of State

Pure Substances, T-S and h-s diagrams, Phase Transformations – Triple point Dryness Fraction –Property tables. Mollier charts – Various Thermodynamic processes and energy Transfer

UNIT V

Mixtures of perfect Gases – Mole Fraction, Mass friction Gravimetric and volumetric Analysis – Dalton's Law of partial pressure, Avogadro's Laws of additive volumes, Enthalpy, sp. Heats and Entropy of Mixture of perfect Gases, Psychrometry- properties , chart.

UNIT VI

Thermodynamic Cycles: Otto, Diesel, Dual, Sterling,– Description and representation on P–V and T-S diagram, Thermal efficiency, Mean effective pressures on air standard basis – Comparison of Cycles – Bell Coleman cycle, Vapour compression refrigeration cycle. Thermodynamic analysis

TEXT BOOKS:

1. Engineering Thermodynamics, P.K. Nag, Tata Mcgraw Hill Education Private Limited
2. Fundamentals of Thermodynamics – Richard E. Sonntag, Claus Borgnakke and Gordon J. Van Wylen, John Wiley & Sons (ASIA).

REFERENCE BOOKS:

1. Engineering Thermodynamics – J.B. Jones & R.E. Dugan, Prentice Hall- Gale
2. Thermodynamics: An Engineering Approach – Yunus A. Cengel&Michael A. Boles, McGraw Hill College.
3. Thermodynamics – J.P. Holman , McGraw Hill Inc

COURSE OUTCOMES:

Student will be able to

i. Identify open and closed systems and analyze related problems.
ii. Explain the concepts such as work interaction, heat transfer and laws of thermodynamics.
iii. Demonstrate the importance of P-V, T-S and H-S diagrams.
iv. Analyze the performance of gas power cycles

A1MET107 THERMODYNAMICS												
Course designed by	Department of Mechanical Engineering											
CO / PO mapping	a	b	c	d	e	f	g	h	i	j	k	l

A1MET107 THERMODYNAMICS	
Course designed by	Department of Mechanical Engineering
Approval	Approved by: Meeting of Board of Studies held on 17th June, 2015
	Ratified by: 1st Meeting of Academic Council, 27th June, 2015

A1CYT108	FOUNDATION ELECTIVE	L	T	P	C
	APPLIED ANALYSIS	**3**	**-**	**-**	**3**
	Total Contact Hours – 45				
COURSE OBJECTIVES					
1.	A broad understanding and the comprehensive overview of the general principles of Metallurgy and the importance of constituents and analysis of Iron ores, ferrous alloys				
2.	To understand the composition, importance and analysis of finished products like cement, paint, oils, soaps.				
3.	To understand the composition of water and analysis of water for some parameters.				
4.	To provide the knowledge on basic principles of analysis of food and pharmaceutical drug samples.				

SYLLABUS:

UNIT-1: ANALYSIS OF ORES:

a. General techniques of analysis applied to complex materials - Scope of metallurgical analysis - General methods of dissolution of complex materials - Various chemical methods for the effective separation of the constituents in the complex materials.

b. Analysis of ores: Iron ore- Analysis of the Constituents – Moisture , loss of ignition, Total Iron, ferrous Iron ,Ferric Iron, alumina , silica, Titania, Lime, Magnesia, Sulphur, phosphrous, manganese, alkalis, combined water.

UNIT-2 : ANALYSIS OF FERROUS ALLOYS

a. Ferro manganese - Analysis of the constituents – Mn, S, C, P, Si

b. Ferro chromium - Analysis of the constituents – Cr, C, Si.

UNIT-3: ANALYSIS OF FINISHED PRODUCTS - I:

a. Chemical Analysis of cement-silica, NH_4OH group, ferric oxide, alumina, lime, magnesia, SulphideSulphur , K_2O,Na_2O, free CaO in Cement and Clinker,SO_3 and loss on ignition.

b. Analysis of paints-vehicle and pigment, $BaSO_4$, total lead and lead chromate.

UNIT-4: ANALYSIS OF FINISHED PRODUCTS - II:

a. Analysis of oils - saponification number, iodine number, and acid number.

b. Analysis of soaps - moisture, volatile matter, total alkali, total fatty matter, free caustic alkali or free fatty acids, sodium silicate, chloride.

UNIT-5: ANALYSIS OF WATER: Analysis of water for total hardness of water, calcium, magnesium, chloride, nitrite and fluoride

UNIT-6: ANALYSIS OF FOOD AND DRUGS

a. Analysis of Sugars, Fruits, Vegetables and Beverages

b. Analysis of anti-pyretic, analgesics and antibiotics.

PRESCRIBED TEXT BOOK

1. Text book of Metallurgical analysis, B.C. Aggrawal, S.P. Jain, Khanna Publishers
2. Technical methods of analysis, Griffin
3. Pharmaceutical analysis, T. Higuchi
4. Environmental chemistry, A. K. De, Wiley Eastern

STANDARD BOOKS

1. Chemical analysis – H.A Laitinan, McGraw Hill Book Co
2. Standard methods of Chemical Analysis, Welcher,
3. Analytical chemistry, R. M. Verma, CBS Publications.

REFERENCES

1. Practical pharmaceutical chemistry Vol – I & II, A. Beckett et.al., CBS publishers
2. Vogel's Text book of Quantitative chemical analysis, J Mendham, et. Al., Pearson Education.

COURSE OUTCOMES:

i. Students gain the knowledge about the various methods that are available for general metallurgical analysis and the analysis of iron ore and ferrous alloys.

ii. Students gain the knowledge of the constituents present, their importance and analysis of their constituents present in the finished products like cement, paints, oils, soaps.

iii. Students gain the knowledge on the composition of water, importance of their constituents and analysis of some of the parameters in water sample.

iv. Students gain the knowledge on the analysis of food samples like sugars, fruits, vegetables and beverages. He will also have comprehensive knowledge on analysis of some pharmaceutical drugs like analgesics, anti – pyretic and anti-biotics.

A1CYT108 - APPLIED ANALYSIS											
Course designed by	Department of Chemistry										
CO / PO mapping	a	b	c	d	e	f	g	h	i	j	k
	✓							✓	✓	✓	✓

A1CYT108 - APPLIED ANALYSIS	
Course designed by	Department of Chemistry
Approval	Approved by:
	Ratified by:

A1MAT109	FOUNDATION ELECTIVE	L	T	P	C
	PROBABILITY AND STATISTICS	3			3
	Total Contact Hours – 45				
	Prerequisite: Set theory and Calculus				
COURSE OBJECTIVES					
COBJ1	To provide basic knowledge to the students with an understanding of probability principles, techniques, and practices relevant to the applications and the random Variables and Distributions.				
COBJ2.	Students will be able to model situations using Statistical methods in order to solve problems.				
COBJ3.	To develop knowledge and skills related to investigate situations involving elements of chance by sampling, estimating the parameters and testing.				
COBJ4.	To provide knowledge to the students about Prediction and control by statistical methods Regression and SQC.				

SYLLABUS

UNIT – 1 : PROBABILITY&RANDOM VARIABLES

Random experiment, sample space, events, Axioms of probability, Random variable, Discrete and Continuous, Distribution, mathematical expectation and properties, Moment generating Function.

UNIT – 2: DISTRIBUTIONS

Binomial - Poisson distribution(mean and variance), Normal distribution, Normal approximation to Binomial distribution, Gamma distribution - properties.

UNIT – 3: CURVE FITTING

Least squares method: Introduction, fitting of straight line, second degree curves, exponential and power curves, simple correlation, regression, applications.

UNIT – 4: SAMPLING THEORY

Introduction, Population and samples, Sampling distribution of mean for large and small samples (with known and unknown variance), proportion - Sampling distribution of sums and differences of means and proportions, Point and interval estimators for means and proportions.

UNIT – 5: TESTS OF HYPOTHESIS

Introduction, Null and alternative hypothesis, Type I and Type II errors, One tail, two-tail tests. Tests concerning means, proportions and their differences using Z-test, Student's t-test, F-test and χ^2 - test of goodness of fit and independence of attributes.

UNIT – 6: STATISTICAL QUALITY CONTROL

Introduction, Methods for preparing control charts, variable charts – mean and range charts, Attribute charts- np, p and c charts.

Text Books

1. Probability & statistics for Engineers and Scientists ; R.E.Walpole, S. L. Mayeres&K.YePearsons
2. Probability and statistics-TKV Iyengar et al.,S.Chand publishers

References:

1. probability & statistics and Random Processes ; Murugesan -Anuradha publishers
2. Probability & Statistics for Engineers, Miller& John E. Freund, Prentice Hall of India.
3. Statistical Quality Control – Mahajan . M – danaparthiRai& co.
4. Higher Engineering Mathematics by B.S.Grewal, 42nd edition, Khanna publishers

COURSE OUTCOMES:

CO1	Students will able to apply probabilistic tools to study systems with random components in many areas of communication networks, electro physics and computers.
CO2	Students will be able to estimate the parameters of population in many socio- economic and industrial production related surveys and reducing sampling errors.
CO3	Students will able to get Prediction and control the numerical and time series data occurs in industry and scheduling
CO4	Student will able to evaluate the performance measures of the systems in Networks, transportation systems, process and production lines.

COURSE OBJECTIVES/ COURSE OUTCOMES MAPPING

Objectives/Outcomes	CO1	CO2	CO3	CO4
COBJ	X			
COBJ		X		
COBJ			X	
COBJ				X

A1MAT109 PROBABILITY AND STATISTICS											
Course designed by	DEPARTMENT OF MATHEMATICS										
CO / PO mapping	a	B	C	D	e	f	g	h	i	j	k
	X				X						X

A1MAT109 PROBABILITY AND STATISTICS

Course designed by	DEPARTMENT OF MATHEMATICS
Approval	Approved by: Meeting of Board of Studies.
	Ratified by: 2nd Meeting of Academic Council.

A1MAT110	FOUNDATION ELECTIVE	L	T	P	C
	Complex Variables & Statistical Methods	**3**			**3**
	Total Contact Hours – 45				
	Prerequisite : None				
COURSE OBJECTIVES					
COBJ1	To understand the concept of analyticity of complex functions				
COBJ2.	To learn the method of integration of complex functions in the given region by Cauchy's integral formula and by residue theorem				
COBJ3.	To learn the probability distributions of discrete and continuous random variables.				
COBJ4.	To learn the methods of sampling, estimation of parameters, testing of hypothesis.				

SYLLABUS

UNIT – I: Functions of Complex Variable:
Introduction – Limit and continuity of complex function f(z)-Derivative of f(z)- Cauchy & Riemann equations-Analytic functions- Harmonic functions –Construction of analytic function by Milne -Thomson method.

UNIT – II: Power Series:
Series of complex functions –Expansion of complex functions using Taylor's and Laurent's series – Zeros of analytic function- types of Singularities.

UNIT-III: Complex Integration:
Complex Integration – Line Integral – Cauchy Integral theorem- Cauchy Integral formula – Residues- Calculation of Residues- Evaluation of complex integrals using Cauchy's Residue theorem .

UNIT – IV:Statistical Distributions.
Random variables - Discrete probability distribution- Continuous probability distribution- Expectation – Normal distribution-Approximation to Binomial and Poisson distribution.

UNIT-V: Sampling Distribution
Sampling distribution-Sampling distribution of mean (known- unknown cases)- Sampling distribution of sums and differences of means and proportions-Estimation - Point estimation- Interval estimation- Bayesian estimation.

UNIT-VI: Testing of Hypothesis
Testing of hypothesis, type I and type II errors - Significance test –One tail test- Two tail test concerning one mean and two means(t- test and z- test)- χ^2 test-goodness of fit.

Text Books :

1. Higher Engineering Mathematics, B.S.Grewal , 42n^{d} Edition, Khanna publishers.
2. Engineering Mathematics, B.V.Ramana, Tata McGraw hill
3. Complex Variables and Statistical Methods, T.K.V.Iyengar et al., Schand.

COURSE OUTCOMES:

CO1	Student will be able to construct the conjugate harmonic functions and Orthogonal Trajectories.
CO2	Student will be able to evaluate integrals of complex functions in the given region
CO3	Student will be able to estimate the population parameters using sample data.
CO4	Student will be able to test the hypothesis for large samples and small samples.

COURSE OBJECTIVES/ COURSE OUTCOMES MAPPING

Objectives/Outcomes	CO1	CO2	CO3	CO4
COBJ1	X			
COBJ2		X		
COBJ3			X	
COBJ4				X

A1MAT110 – COMPLEX VARIABLES & STATISTICAL METHODS											
Course designed by	DEPARTMENT OF MATHEMATICS										
CO / PO mapping	a	B	C	d	e	f	G	H	i	j	k
	X				X						X

A1MAT110 – COMPLEX VARIABLES & STATISTICAL METHODS

Course designed by	DEPARTMENT OF MATHEMATICS
Approval	Approved by: Meeting of Board of Studies held on
	Ratified by: 2nd Meeting of Academic Council,

AUDIT COURSES

A1ACA507	AUDIT COURSE	L	T	P	C
	ENTREPRENEURSHIP DEVELOPMENT				
	Total Contact Hours – 30				
COURSE OBJECTIVES					
COBJ1	To inspire the students confident of entrepreneurial process and career development with their strengths of technical knowledge and skills.				
COBJ2.	To enable the students to understand the possible challenges in entrepreneurial career and how to overcome them.				
COBJ3.	To enable the students to learn about project formulation, appraisal. Financial and implementation issues.				

UNIT – 1: Introduction: Evolution of entrepreneurship, Characteristics, Types and Functions of Entrepreneur; Role of Entrepreneurship in Economic Development, Growth of Entrepreneurship in India; Women entrepreneurship.

UNIT – 2: Entrepreneurial Motivation and Promotion: Entrepreneurial behavior and qualities, Motivational programmes, Achievement motivation theories. Entrepreneurial promotion, Difference between entrepreneur and Manager.

UNIT – 3: Small Scale Industry: Introduction: Small and Medium enterprises–Definition, characteristics and their role in economic development, Growth of small-scale sector in India, Problems of small–scale industries, Micro, Small and Medium Enterprises Development Act **(MSMEDA) 2006**: Objectives and main provisions.

UNIT – 4: Starting the venture: Generating business idea – sources of new ideas, methods of generating ideas, opportunity recognition, creative problem solving; environmental scanning, competitor and industry analysis; Feasibility study and preparing DPR.

UNIT – 5: Government and Institutional support: Government support to SSI through priority sector,NSIC- National small industries corporation, DIC – District Industrial Center, SISI – Small Industries Services Institute, NIESBUD – National Institute of Entrepreneurship and Small Business Development, SIDBI – Small industries development bank of India, NEDB – National Entrepreneurship Development Board, EDII – Entrepreneurship Development Institute of India.

Reference books:

1. C.B. Gupta and S.S. Khanka, Entrepreneurship and Small Business Management, Sultan Chand and Sons, New Delhi.
2. M.B. Shukla, Entrepreneurship and Small Business Management, Kitab Mahal, Allahabad.
3. A. Sahay and V. Sharma, Entrepreneurship and New Venture Creation, Excel Books, New Delhi.
4. V. Desai, Dynamics of Entrepreneurial Development and Management, Himalaya Publishing House.
5. V. Desai, Small Scale Industries and Entrepreneurship, Himalaya Publishing House.

COURSE OUTCOMES:

CO1 Demonstrate the ability to provide a self-analysis in the context of an Entrepreneurial Career.
CO2 Demonstrate the ability to find an attractive market that can be reached Economically.
CO3 It helps the students in creating an Appropriate Business-Model for their innovations.

Course outcomes	CO/GA Mapping - Graduate Attributes											
	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
1	√					√	√					√
2						√	√					
3			√	√	√							

A1ACA509	AUDIT COURSE	L	T	P	C
	Professional Ethics & IPR				
	Total Contact Hours – 30				

Unit I : Human Values :

Moral, Values and Ethics – Integrity – Work Ethics – Service Learning – Civic Virtue – Respect for others – Living Peacefully – Caring – Sharing – Honesty – Courage – Value time - Co-operation – Commitment – Empathy – Self -confidence – Spirituality – Character .

Unit II : Engineering Ethics :

The History of Ethics- Purposes for Engineering Ethics – Engineering Ethics – Consensus and Controversy – Professional and Professionalism – Professional Roles to be played by an Engineer – Self Interest , Customs and Religion – Uses of Ethical Theories – Professional Ethics Types of Inquiry – Engineering and Ethics-Kohlberg's Theory Gilligan's Argument – Heinz's Dilemma.

Unit III

Introduction to Intellectual Property Law – Evolutionary past – Intellectual Property Law Basics - Types of Intellectual Property - Innovations and Inventions of Trade related Intellectual property Rights – Agencies Responsible for Intellectual Property Registration – Infringement -Regulatory – Over use or Misuse of Intellectual Property Rights .

Unit IV

Introduction to Copyrights – Principles of Copyright – Subject Matters of Copyright – Rights Afforded by Copyright Law –Copyright Ownership –Transfer and Duration –Copyright Formalities and Registration – Limitations – Infringement of Copyright – International Copyright Law-Semiconductor Chip Protection Act.

Unit V

Introduction to Patent Law – Rights and Limitations – Rights under Patent Law – Patent requirements – Ownership and Transfer – Patent Application Process and Granting of Patent – Patent Infringement and Litigation –International Patent Law – Double Patenting – Patent Searching – Patent Cooperation Treaty – New developments in Patent Law.

TEXT BOOKS

1. "Engineering Ethics and Human Values" by M.Govindarajan, S.Natarajan and V.S Senthilkumar-PHI Learning Pvt.Ltd-2009
2. Deborah E.Bouchox: "Intellectual Property" Cengage learning, New Delhi

REFERENCE BOOKS :

1. "Professional Ethics and Human Values" by A.Alavudeen, R.Kalil Rahman and M.Jayakumar –Laxmi Publications.
2. "Ethics in Engineering"by Mike W.Martin and Roland Schinzinger – Tata Mc Graw-Hill – 2003
3. Kompal Bansal & Parishit Bansal "Fundamentals of IPR for Engineers" BS Publications (Press)

A1ACA510	AUDIT COURSE	L	T	P	C
	SOFT SKILLS – I	1	0	2	0
	Total Contact Hours – 30				
	Prerequisite: NIL				

COURSE OBJECTIVES	
COBJ1	To develop inter-personal skills and be an effective goal oriented team player.
COBJ2	To develop professionals with idealistic, practical and moral values.
COBJ3	To develop communication and problem solving skills.
COBJ4	To re-engineer attitude and understand its influence on behavior.

Unit -1 **4 hrs**

- **SELF ANALYSIS**
  - SWOT/SWOC Analysis
  - Who am I? An Introspection
  - Attributes
  - Important of Self Confidence
  - Self Esteem

Unit -2 **4 hrs**

- **ATTITUDE**
  - Factors influencing Attitude
  - Challenges and lessons from Attitude
- **CHANGE MANAGEMENT**
  - Exploring Challenges
  - Risking Comfort Zone
  - Managing Change

Unit -3 **6 hrs**

- **MOTIVATION**
  - Factors of motivation
  - Self-talk
  - Intrinsic & Extrinsic Motivators

Unit -4 **6 hrs**

- GOAL SETTING
  - Wish List
  - SMART Goals
  - Blue print for success
  - Short Term
  - Long Term
  - Life Time Goals
- **Time management**
  - Value of time
  - Diagnosing Time Management
  - Weekly Planner -to do list
  - Prioritizing work

Unit -5 **10 hrs**

- **CREATIVITY**
  - Out of box thinking

ASSESSMENT

1. A Practical and activity oriented course which has continuous assessment for 75 marks based on class room interaction, activities etc.
2. Presentation – 25 marks.

TEXT BOOKS: Institute's Compilation

REFERENCE BOOKS

1	Covey Sean, "*Seven Habits of Highly Effective Teens*," New York, Fireside Publishers, 1998.
2	Carnegie Dale, "*How to win Friends and Influence People*," New York: Simon & Schuster, 1998.
3	Thomas A Harris, "*I am ok, you are ok*", New York-Harper and Row, 1972.
4	Daniel Coleman, "*Emotional Intelligence*", Bantam Book, 2006.

Course Outcomes:

CO1	Students shall develop their interpersonal skills and shall be an effective goal oriented team player
CO2	Students shall evolve as professional with idealistic, practical and moral values
CO3	Students shall develop communication and problem solving skills
CO4	Students develop improve their attitude towards life and understand its influence on their behavior.

Mapping of Course Objectives & Outcomes:

- Matrix with each outcome as one column and each objective as one row.

Outcome/ Objective	CO1	CO2	CO3	CO4	CO5	CO6
COBJ1						
COBJ2						
COBJ3						
COBJ4						

A1ACA510 – SOFT SKILLS -I											
Course designed by	English and Humanities										
CO / PO mapping (SIZE:12)	a	b	c	d	e	f	G	h	i	j	k

A1ACA510 – SOFT SKILLS -I

Course designed by	English and Humanities
Approval	Approved by: Meeting of Board of Studies held on 6th April,2016

A1ACA511	AUDIT COURSE	L	T	P	C
	SOFT SKILLS – II	1	0	2	0
	Total Contact Hours – 30				
	Prerequisite: NIL				

COURSE OBJECTIVES	
COBJ1	To develop inter personal skills and be an effective goal oriented team player.
COBJ2	To develop professionals with idealistic, practical and moral values.
COBJ3	To develop communication and problem solving skills.
COBJ4	To re-engineer attitude and understand its influence on behavior.

Unit -1 **6 hrs**

- **INTERPERSONAL SKILLS**
  - Understanding the relationship between Leadership Networking & Team work
  - Realizing Ones Skills in Leadership
  - Networking & Team Work
  - Assessing Interpersonal Skills Situation description of Interpersonal
- **Team work**
  - Necessity of Team Work Personally
  - Socially and Educationally

Unit -2 **4 hrs**

- **LEADERSHIP**
  - Skills for a good Leader
  - Assessment of Leadership Skills

Unit -3 **6 hrs**

- **STRESS MANAGEMENT**
  - Causes of Stress and its impact
  - How to manage & distress
  - Understanding the circle of control
  - Stress Busters

Emotional Intelligence

- What is Emotional Intelligence
- Emotional quotient why Emotional Intelligence matters
- Emotion Scales
- Managing Emotions

Unit -4 **4 hrs**

- **CONFLICT RESOLUTION**
  - Conflicts in Human Relations – Reasons Case Studies
  - Approaches to conflict resolution

Unit -5 **10 hrs**

Decision Making

- Importance and necessity of Decision Making
- Process of Decision Making
- Practical way of Decision Making
- Weighting positives & Negatives.

- **Presentation**

ASSESSMENT

1. A Practical and activity oriented course which has continuous assessment for 75 marks based on class room interaction, activities etc.
2. Presentation – 25 marks.

TEXT BOOKS: Institute's Compilation

REFERENCE BOOKS

1	Covey Goodman, "*Seven Habits of Highly Effective Teens*," New York, Fireside Publishers, 1998.
2	Carnegie Dale, "*How to win Friends and Influence People*," New York: Simon & Schuster, 1998.
3	Thomas A Harris, "*I am ok, you are ok*", New York-Harper and Row, 1972.
4	Daniel Coleman, "*Emotional Intelligence*", Bantam Book, 2006.

Course Outcomes:

CO1	Students shall develop their interpersonal skills and shall be an effective goal oriented team player
CO2	Students shall evolve as professional with idealistic, practical and moral values
CO3	Students shall develop communication and problem solving skills
CO4	Students develop improve their attitude towards life and understand its influence on their behavior.

Mapping of Course Objectives & Outcomes:

- Matrix with each outcome as one column and each objective as one row.

Outcome/ Objective	CO1	CO2	CO3	CO4	CO5	CO6
COBJ1						
COBJ2						
COBJ3						
COBJ4						

A1ACA511 – SOFT SKILLS -II											
Course designed by	English and Humanities										
CO / PO mapping	a	b	c	d	e	f	G	h	i	j	k

A1ACA511 – SOFT SKILLS -II

Course designed by	English and Humanities
Approval	Approved by: Meeting of Board of Studies held on 06th April, 2016

A1ACA512	AUDIT COURSE	L	T	P	C
	GENERAL APTITUDE	2	0	0	0
	Total Contact Hours – 32				
	Prerequisite : None				
COURSE OBJECTIVES					
COBJ1	To improve the quantitative aptitude skills				
COBJ2.	To improve the logical thinking				

SYLLABUS

UNIT I

Averages,
Ratios: Compound ratio, Inverse ratio
Proportion: Compound Proportion, Proportional division
Mixtures & Solutions

UNIT II

Percentages, profit & Loss, Simple Interest & Compound Interest

UNIT III

Time & Work, Time & Distance

UNIT IV

Types and Properties of Numbers, LCM, GCD, Partnership, Clocks & Calendars

UNIT V

Mensuration, -I (Area and perimeter of plane figures)
Mensuration-II (Volume and surface areas of solids)

UNIT VI

Permutations, Combinations, Probability

REFERENCES

1. Quicker Maths by M.Tyra
2. Agarwal.R.S – Quantitative Aptitude for Competitive Examinations, S Chand Limited 2011
3. AbhijitGuha, Quantitative Aptitude for Competitive Examinations, Tata Mcgraw Hill, 3rd Edition

COURSE OUTCOMES: CO1Students will be able to improve their employability skills

COURSE OBJECTIVES/ COURSE OUTCOMES MAPPING

Objectives/Outcome	CO'
COBJ1	X
COBJ	X

A1ACA512 - GENERAL APTITUDE											
Course designed by	DEPARTMENT OFMATHEMATICS										
CO / PO mapping	A	b	c	d	e	f	g	h	I	j	k
	X			X							

A1ACA512 - GENERAL APTITUDE

Course designed by	DEPARTMENT OF MATHEMATICS