

**ACADEMIC REGULATIONS
COURSE STRUCTURE
AND
DETAILED SYLLABUS**

CHEMICAL ENGINEERING

For

B.TECH FOUR YEAR DEGREE COURSE
(Applicable for the batches admitted from 2002-2003)



**JAWAHARLAL NEHRU
TECHNOLOGICAL UNIVERSITY**
KUKATPALLY, HYDERABAD - 500 072.

8. Electrical and Electronics Engineering
9. Electronics and Communication Engineering
10. Electronics and Computer Engineering
11. Electronics and Control Engineering
12. Electronics and Instrumentation Engineering
13. Electronics and Telematics Engineering
14. Information Technology
15. Instrumentation and Control Engineering
16. Mechanical (Mechatronics) Engineering
17. Mechanical (Production) Engineering
18. Mechanical Engineering
19. Metallurgical Engineering
20. Metallurgy and Material Technology

and any other course as approved by the authorities of the University from time to time.

4. Credits:

	Semester Pattern	Yearly Pattern		
	Periods / Week	Credits	Periods / Week	Credits
Theory	04	04	03	06
Practicals	03	02	03	04
Practicals	06	04	06	08
Project	08	08	—	—

5. Distribution and Weightage of Marks:

- i. The performance of a student in each semester / I year shall be evaluated subject-wise with a maximum of 100 marks for theory and 75 marks for practical subject. In addition, project shall be evaluated for 200 marks.
- ii. For theory subjects the distribution shall be 20 marks for Internal Evaluation and 80 marks for the End-Examination.

- iii. For theory subjects, there shall be 5 objective type tests for a duration of 20 minutes each during the semester. Each test shall contain 20 objective type questions for 20 marks. The best 4 tests will be considered for awarding 20 sessionals marks. For the I year class which shall be on yearly basis, there shall be 6 tests of the same duration and weightage as mentioned above. However, the performance in the best 4 tests will be considered for awarding 20 sessional marks.
- iv. For practical subjects there shall be a continuous evaluation during the semester for 25 sessional marks and 50 End Examination marks. Of the 25 marks for internal, 15 marks shall be awarded for day-to-day work and 10 marks to be awarded by conducting Internal Lab Test(s). The End Examination shall be conducted by the teacher concerned and another member of the staff of the same department of the same institution.
- v. For the subject having design and / or drawing, and estimation, the distribution shall be 20 marks for internal evaluation (10 marks for day-to-day work and 10 marks for internal tests). There shall be two internal tests in a Semester and the better of the two will be taken into consideration. However in the I year class, there shall be three tests and the best two will be taken into consideration for a maximum of 20 marks. The End Examination shall be for a total of 80 marks.
- vi. The Engineering Drawing Practice Course wherever offered is to be treated as a practical course. Evaluation method adopted for practicals shall be followed here also.
- vii. Out of a total of 200 marks for the project work, 40 marks shall be for Internal Evaluation and 160 marks for the End Semester Examination. The End Semester Examination (viva-voce) shall be conducted by a board of examiners consisting of Guide, Head of the Department and an external examiner. The evaluation of project work shall be conducted at the end of the IV year. The Internal Evaluation shall be on the basis of two seminars given by each student on the topic of his project.
- viii. Laboratory marks and the sessional marks awarded by the College are not final. They are subject to scrutiny and scaling by the University wherever felt desirable. The uniform distribution of awarding of Sessional marks and Laboratory marks will be referred to a Committee. The Committee will arrive at a scaling factor and

the marks will be scaled as per the scaling factor. The recommendations of the Committee are final and binding. The laboratory records and internal test papers shall be preserved in the respective departments as per the University norms and shall be produced to the Committees of the University as and when they visit the College.

6. Attendance:

- i. A student has to put in a minimum of 75% of attendance in aggregate of all the subjects for acquiring credits in the I year and / or each semester thereafter.
- ii. Condonation of shortage of attendance in aggregate upto 10% (65% and above and below 75%) in each semester or I year may be granted by the College Academic Committee.
- iii. A student will not be promoted to the next semester unless he satisfies the attendance requirement of the present semester / I year.
- iv. Shortage of Attendance below 65% in aggregate shall in no case be condoned.
- v. Students whose shortage of attendance is not condoned in any semester / I year are not eligible to take their end examination of that class and their registration shall stand cancelled. They may seek re-admission for that semester / I year when offered next.
- vi. Condonation of shortage of attendance as stipulated in 6 (ii) above shall be granted on genuine and valid grounds with supporting evidence.
- vii. A stipulated fee shall be payable towards condonation of shortage of attendance.

7. Minimum Academic Requirements:

The following academic requirements have to be satisfied in addition to the attendance requirements mentioned in item no. 6.

- i. A student shall be deemed to have satisfied the minimum academic requirements and earned the credits allotted to each theory or practical design or drawing subject or project if he secures not less than 35% of marks in the end examination and a minimum of 40% of marks in the sum total of the internal evaluation and end examination taken together.

- ii. A student shall successfully complete all the I year subjects from 3 regular consecutive examinations and 3 supplementary consecutive examinations of I year from the date of admission. If he has failed to do so he shall forfeit the seat in course and his seat shall stand cancelled.
- iii. A student shall be promoted from II to III year only if he fulfils the academic requirement of 56 credits from the consecutive regular and supplementary examinations of I year and from the regular examination of II year I semester irrespective of whether the candidate takes the examination or not.
- iv. A student shall be promoted from third year to fourth year only if he passes all the subjects of I year and fulfils the academic requirements of total 100 credits (including 56 credits of I year) from the examinations.
 - a. Two regular and Two supplementary examinations of I year.
 - b. Two regular and one supplementary examinations of II Year I Semester
 - c. One regular and one supplementary examinations of II Year II Semester
 - d. One regular III year I Semester examination.
- v. A student shall earn all the 212 credits offered as indicated in the course structure.
- vi. Students who fail to earn all the 212 credits offered as indicated in the course structure within eight academic years from the year of their admission shall forfeit their seat in the course and their seat shall stand cancelled.

8. Withholding of Results:

The result of a student shall be withheld if:

- i. He has not cleared any dues to the Institution / Hostel;
- ii. A case of disciplinary action against him is pending disposal;

9. Course pattern:

- i. The entire course of study is of four academic years. The first year shall be on yearly pattern and the second, third and fourth years on semester pattern.

- ii. A student eligible to appear for the end examination in a subject, but absent at it or has failed in the end examination may appear for that subject at the supplementary examination.

10. Award of Class:

After a student has satisfied the requirements prescribed for the completion of the programme and is eligible for the award of B. Tech. Degree he shall be placed in one of the following four classes:

First Class with Distinction	70% and above	From the aggregate marks secured for 212 Credits.
First Class	Below 70% but not less than 60%	
Second Class	Below 60% but not less than 50%	
Pass Class	Below 50% but not less than 40%	

(The marks in internal evaluation and end examination shall be shown separately in the marks memorandum)

11. Minimum Instruction Days:

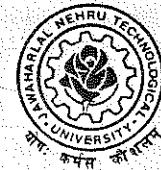
The minimum instruction for each semester / I year shall be 90/180 working days excluding examination days.

12. There shall be no branch transfers after the completion of admission process.
13. There shall be no place transfer within the Constituent Colleges of Jawaharlal Nehru Technological University for B.Tech. Regular / FDH / CCC and P. G. Programmes.

General:

14. Where the words "he", "him", "his", occur in the regulations, they include "she", "her", "hers".
15. The academic regulation should be read as a whole for the purpose of any interpretation.
16. In the case of any doubt or ambiguity in the interpretation of the above rules, the decision of the Vice-Chancellor is final.
17. The University may change or amend the academic regulations or syllabi at any time and the changes or amendments made shall be applicable to all the students with effect from the dates notified by the University.

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**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY,
HYDERABAD**

**Academic Regulations for
B.Tech. (Lateral Entry Scheme)**

(Effective for the students getting admitted into II year from the Academic Year 2003-2004 and onwards)

1. The Students have to acquire 156 credits from II to IV year of B.Tech. Programme (Regular) for the award of the degree.
2. Students, who fail to fulfill the requirement for the award of the degree in 6 consecutive academic years from the year of admission, shall forfeit their seat.
3. The same attendance regulations are to be adopted as that of B. Tech. (Regular).
4. Promotion Rule:

A student shall be promoted from third year to fourth year only if he fulfills the academic requirements of 44 credits from the examinations following

- a. Two regular and one supplementary examinations of II Year I Semester
 - b. One regular and one supplementary examinations of II Year II Semester
 - c. One regular III year I Semester examination
5. Award of Class:

After a student has satisfied the requirements prescribed for the completion of the programme and is eligible for the award of B. Tech. Degree he shall be placed in one of the following four classes:

First Class with Distinction	70% and above	From the aggregate marks secured for 156 Credits. (i.e II year to IV year)
First Class	Below 70% but not less than 60%	
Second Class	Below 60% but not less than 50%	
Pass Class	Below 50% but not less than 40%	

(The marks in internal evaluation and end examination shall be shown separately in the marks memorandum)

6. All other regulations as applicable for B. Tech. Four-year degree course (Regular) will hold good for B. Tech. (LES)

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY,
HYDERABAD

I-B.Tech. (CHE)

CHEMICAL ENGINEERING

COURSE STRUCTURE

CODE NO.	SUBJECT	Th	Pr	C
CH1021	English	3	0	6
CH1022	Mathematics-I	3+1*	0	6
CH1023	Engineering Physics	2+1*	0	4
CH1024	Inorganic and analytical chemistry	3	0	6
CH1025	Introduction to Computers	3	0	6
CH1026	Strength of Materials	2	0	4
CH1027	Introduction to chemical Engineering	2	0	4
CH1028	Computer lab and Engineering	0	6	8
CH1029	Analytical chemistry lab	0	3	4
CH1030	Engineering Physics lab	0	3/2	2
CH1031	Engineering Drawing Practice	0	3	4
CH1032	Chemical Engineering Workshop practice	0	3/2	2
Total		18+2*	15	56

*Tutorial

2002 – 2003
JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY,
HYDERABAD

II-B.Tech. (CHE) - I Semester

CHEMICAL ENGINEERING

COURSE STRUCTURE

CODE NO.	SUBJECT	Th	Pr	C
CH2121	Mathematics-II	4	0	4
CH2122	Electrical Engineering	4	0	4
CH2123	Fluid Mechanics	4	0	4
CH2124	Organic Chemistry	4	0	4
CH2125	Material & Energy Balance	4	0	4
CH2126	Inorganic Chemical technology	4	0	4
CH2127	Fluid Mechanics Lab	0	3	2
CH2128	Organic chemistry lab	0	3	2
<hr/>		Total	24	6 28

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY,
HYDERABAD

II-B.Tech. (CHE) - II Semester

CHEMICAL ENGINEERING

COURSE STRUCTURE

CODE NO.	SUBJECT	Th	Pr	C
CH2221	Probability & Statistics	4	0	4
CH2222	Mechanical Engineering	4	0	4
CH2223	Chemical Engineering Thermodynamics-I	4	0	4
CH2224	Physical Chemistry	4	0	4
CH2225	Organic chemical Technology	4	0	4
CH2226	Material science for chemical engineering	4	0	4
CH2227	Chemical technology lab	0	3	2
CH2228	Physical Chemistry lab	0	3	2
<hr/>		Total	24	6 28

2002 – 2003

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY,
HYDERABAD

III-B.Tech. (CHE) - I Semester

CHEMICAL ENGINEERING

COURSE STRUCTURE

CODE NO.	SUBJECT	Th	Pr	C
CH3121	Energy Engineering	4	0	4
CH3122	Mechanical Unit Operations	4	0	4
CH3123	Chemical Engineering Thermodynamics-II	4	0	4
CH3124	Heat Transfer	4	0	4
CH3125	Mass Transfer	4	0	4
CH3126	Process Instrumentation	4	0	4
CH3127	Heat Transfer lab	0	3	2
CH3128	Mechanical Unit Operation Lab	0	3	2
Total		24	6	28

2002 – 2003

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY,
HYDERABAD

III-B.Tech. (CHE) - II Semester

CHEMICAL ENGINEERING

COURSE STRUCTURE

CODE NO.	SUBJECT	Th	Pr	C
CH3221	Management Science	4	0	4
CH3222	Mass Transfer operation-II	4	0	4
CH3223	Chemical Reaction Engineering-I	4	0	4
CH3224	Process Dynamics and Control	4	0	4
CH3225	Mathematical methods for Chemical Engineers	4	0	4
Elective –I		4	0	4
CH3226	Petrochemical Engineering			
CH3227	Polymer Engineering			
CH3228	Fertilizer Technology			
CH3229	Mass Transfer operations lab	0	3	2
CH3230	Process dynamics &control Lab	0	3	2
Total		24	6	28

2002 – 2003

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY,
HYDERABAD

IV-B.Tech. (CHE) - I Semester

CHEMICAL ENGINEERING

COURSE STRUCTURE

CODE NO.	SUBJECT	Th	Pr	C
CH4121	Transport phenomenon	4	0	4
CH4122	Chemical Reaction Engineering-II	4	0	4
CH4123	Chemical Engineering Plant Design and Economics	4	0	4
CH4124	Environmental Engineering	4	0	4
CH4125	Process Modelling and simulation	4	0	4
	Elective –II	4	0	4
CH4126	Corrosion Engineering			
CH4127	Bio Chemical Engineering			
CH4128	Technology of Pharmaceuticals & Fine chemicals			
CH4129	Chemical reaction Engineering lab	0	3	2
CH4130	Process Equipment Design & Drawing	0	3	2
Total		24	6	28

2002 – 2003

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY,
HYDERABAD

IV-B.Tech. (CHE) - II Semester

CHEMICAL ENGINEERING

COURSE STRUCTURE

CODE NO.	SUBJECT	Th	Pr	C
	Elective –III	4	0	4
CH4221	Safety & Hazard Analysis			
CH4222	Membrane Technology			
	Elective –IV	4	0	4
CH4223	Computer applications in Chemical Engineering	-	-	-
CH4224	Operations Research (same as Mech. Engg)	-	-	-
CH4225	Optimization of chemical processes	-	-	-
CH4226	Industrial Entrepreneurship & Management	-	-	-
CH4227	Project	0	-	8
Total		8	-	16

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY,
HYDERABAD**

I Year B.Tech (CHE)

3-0-6 CH1021

ENGLISH

(Common for all branches)

The following textbooks of English are prescribed for I B.Tech.Class of all Branches in the Colleges of Engineering and Technology affiliated to Jawaharlal Nehru Technological University, HYDERABAD. The exercises given are expected to be covered by the teacher in the classroom, the objective of the course being the development of linguistic skills of the learners.

1. A Textbook of English for Engineers and Technologists, OL.
2. Masterminds, OL.

UNIT – I:

1. Energy, Unit 3: Alternative Sources (from A Textbook of English for Engineers and Technologists, OL).
2. Jagadish Chandra Bose, (a profile from The Trailblazers in Masterminds, OL).

UNIT – II:

1. Computers, Unit 2: New Frontiers (from A Textbook of English for Engineers and Technologists, OL).
2. Chandrasekhara Venkata Raman (a profile from The World of Figures and Physics in Masterminds, OL).

UNIT – III:

1. Technology, Unit 3: Evaluating Technology (from A Textbook of English for Engineers and Technologists, OL).
2. S.S. Bhatnagar (a profile from The Institution Builders in Masterminds, OL).

UNIT – IV:

1. Environment, Unit 1: Pollution (from A Textbook of English for engineers and Technologists, OL).
2. Homi Jehangir Bhabha (a profile from The New Age in Masterminds, OL).

UNIT – V:

1. Industry, Unit 2: Safety and Training (from A Textbook of English for Engineers and Technologists, OL).
2. Salim Ali (a profile from The Living World in Masterminds, OL).

UNIT – VI:

- Common Errors
- Sentence Completion
- Synonyms and Antonyms
- Analogy
- Report Writing
- Comprehension
- General Essay
- Situational Dialogues

NOTE:

The establishment of an English Language Laboratory in each Affiliated College of Engineering and Technology is recommended with effect from the academic year 2002-03 for the following reasons:

1. to expose the students to TOEFL and GRE model of training and practice.
 2. to help the students learn correct pronunciation, accent and intonation.
 3. to enable the students to improve and strengthen their communicative skills.
 4. to expose the students to different variations in English expression.
- It is also recommended that the English Language Laboratory training and practice be treated as a non-examination item of the curriculum.

BOOKS RECOMMENDED:

1. Strengthen Your Writing, by V.R.Narayana Swami (OL).
2. Success with Grammar and Composition, by K.R.Narayanaswamy (OL).
3. Examine Your English, by Margaret Maison (OL).
4. English for Professional Students, by S.S.Prabhakara Rao.
5. TOEFL (ARCO & BARRONS, USA) and Cliff's TOEFL.
6. GRE (ARCO & BARRONS, USA) and Cliff's GRE.
7. Communication Skills for Technical Students, by T.M.Farhathulla (OL).
8. Strategies for Engineering Communication – by Susan Stevenson and Steve Whitemore, John Wiley and Sons.
9. Basic Communication Skills for Technology – by Andrea J. Rutherford, 2/e, Pearson Education Asia.

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY,
HYDERABAD**

I year B.Tech (CHE)

3-0-6 CH1022

MATHEMATICS - I

(Common to all Branches)

Effective for the batches admitted in the year 2002 and onwards.

UNIT – I

Sequences – Series – Convergence and divergence – Ratio test – Comparison test – Integral test – Cauchy's root test – Raabe's test – Absolute and conditional convergence.

Rolle's theorem – Lagrange's Mean Value theorem – Cauchy's Mean value Theorem – Generalized Mean Value theorem (Taylor's Theorem)

UNIT – II :

Functions of several variables – limit and continuity – partial differentiation – Chain rule – Total derivative – Euler's theorem, Jacobian – Functional dependence. Maxima and Minima of functions of two variables with and without constraints, Radius, Centre and Circle of Curvature – Evolutes and Envelopes.

UNIT – III

Curve tracing – Cartesian, polar and Parametric curves. Applications of integration to lengths, volumes and surface areas in Cartesian and Polar coordinates.

UNIT – IV

Differential equations of first order and first degree – formation. Exact, linear and Bernoulli.

Applications to Newton's Law of cooling, Law of natural growth and decay, Orthogonal trajectories, Non-homogeneous linear differential equations of second and higher order with constant coefficients with RHS term of the type e^{ax} , $\sin ax$, $\cos ax$, polynomial in x , $e^{ax} V(x), xV(x)$. method of variation of parameters.

UNIT – V :

Laplace transform of standard functions – Inverse transform – Linearity – first shifting

Theorem. Transforms of derivatives and integrals – Unit step function – second shifting theorem – Dirac's delta function – Differentiation and

integration of transforms – Multiple integrals : Double and triple integrals – change of variables – Change of order of integration.

UNIT – VI :

Vector Differential Calculus :

Gradient, Divergence, Curl and their related properties of sums, Products, Laplacian and second order operators.

Vector integral Calculus : Vector integration – Line integral – work done – Potential function – area, surface and volume integrals, Green's theorem, Stoke's and Gauss' Divergence Theorem. Verification of Green's stoke's and Gauss' Theorem. Curvilinear Coordinates – Cylindrical, Spherical Coordinates – Expressions of Grad, div, curl in Spherical, Cylindrical and Curvilinear Coordinates.

TEXT BOOKS :

1. A Text Book of Engineering Mathematics Volume – I
T.K.V. Iyengar, B.Krishna Gandhi, and others S. Chand and Company
2. Engineering Mathematics
B.V.Ramana, Tata McGraw_Hill 2002 (In press)
3. Engineering Mathematics – I
C. Sanakraiah, Vijaya Publications (In press)
4. Engineering Mathematics – I
P. Nageswara Rao, Y. Narsimhulu, Prabhakara Rao ((In press)

SUGGESTED REFERENCES :

1. Engineering Mathematics
S.K.V.S. Sri Rama Chary, M.Bhujanga Rao, Shankar, B.S. Publications 2000
2. Advanced Engineering Mathematics (Eighth edition)
Erwin Kreyszig John Wiley & Sons (ASIA) Pte. Ltd.
3. Advanced Engineering Mathematics (Second edition)
Michael D. Greenberg, Prentice Hall
4. Sarveswara Rao Koneru
Engineering Mathematics Orient Longman Pvt. Ltd. 2002 (Inpress)
5. Engineering Mathematics – I
N.P. Bali, Laxmi Publications (P) Ltd., New Delhi

ENGINEERING PHYSICS**UNIT – I:**

(A): Interference of light : Introduction – Superposition of waves-Young's double slit experiment – Coherence – Types of interference-Interference in thin films – Colour of thin films – Newton's rings.

(B): Diffraction of light : Introduction – Fraunhofer diffraction at a single slit Fraunhofer diffraction due to two parallel slits-Fraunhofer diffraction due to n-parallel slits – Diffraction-a qualitative description – diffraction grating – Grating Spectrum – Fraunhofer diffraction at a circular aperture – Rayleigh's criterion for resolving power – electron microscope.

UNIT – 2

(A): Polarization of light : Introduction – Representation of polarized and unpolarized light- Production of polarized light – Circular and elliptical polarization – calculation of the phase difference when a linearly polarized light passes through a double refracting crystal.

(B) : Non-destructive Testing : Introduction – Theory and practice of ultrasonic testing – Ultrasonic testing systems – Ultrasonic testing methods – Applications of ultrasonics.

UNIT – 3

(A) : Laser : Introduction – Characteristics of laser light – basic concepts of laser – Types of lasers : Ruby laser, He-Ne laser – Applications of lasers.

(B) : Fibre Optics : Introduction – Basic principles – Light wave communication using optical fibres – numerical aperture – Acceptance angle – Fibre optics in medicine & industry.

UNIT 4

(A) : Thermal properties: Specific heat of solids – Einstein model, Phonons – Thermal conductivity – Thermal expansion – thermoelectric effect-thermo-analyzes –thermo-gravimetry –Thermo-mechanical analysis.

4(B) : Dielectric materials : Introduction – Dielectric constant or relative permittivity – Loss tangent or dielectric loss- Polarization – Dielectric strength – Classification of dielectrics – Porcelain – Glass.

UNIT 5

(A) : Magnetic materials : Introduction – Magnetic moment of electrons and atoms – basic definitions – Classification of Magnetic materials – Diamagnetic materials – Paramagnetic materials – Ferromagnetic materials-Anti-ferromagnetic and Ferri-magnetic materials – Soft and Hard magnetic materials

5 (B) : Superconductivity : Introduction – Properties of superconductors – BCS theory of superconductivity – Applications of superconductors.

UNIT 6

(A): Deformation & Creep in materials : Plastic deformation – Stress strain curve – deformation by slip – Strength of crystals – dislocations – multiplication of dislocations – mechanism of creep – creep resistant materials.

6(B) : Materials for Space Applications : Space programme – Structural materials and their properties – High temperature materials – materials for thermal protection.

TEXT BOOK PRESCRIBED:

1. Physics for engineers by M.R. Srinivasan, (New Age International, New Delhi)
2. Material Science & engineering, V Raghavan, (Prentice Hall India) New Delhi.

INORGANIC & ANALYTICAL CHEMISTRY**UNIT – I**

Principles of analytical methods : Gravimetric analysis – Co-precipitation – post precipitation – Optimum conditions for precipitation – Nickel DMG Complex – cupferron Neocupferron.

Volumetric analysis : precipitation – methods, Neutralization reactions, Redox reactions, complexometric titration's with examples.

Instrumental methods of analysis :

Uv-Visible – Lambert- Beers law – Limitations and applications – estimation of iron in cement, chromium n water, manganese in steel.

UNIT – II

Principles of electro analytical methods : 1. Potentiometric method – Determination of PH – Redox titrations – conductometric method-acid-base titrations – Polarography-Factors affecting the limiting current – Half-wave potential polarographic maxima – applications and Amperometry.

UNIT – III

Metallurgy : General Principles of metallurgy, manufacturing of steel (open hearth) bessemer converter, L-D-Process) heat treatment of steels

UNIT – IV

Fuels :

Introduction – Heat units –definition – HCV and LCV- classification of fuels – characteristics of good fuels

Solid fuels : Primary fuels – wood –coal –origin of coal – classification of coal-AnalYSIS of coal proximate and ultimate analysis – Metallurgical coke – carbonization-types-Manufacture of coke. Behive oven – Otto-Hoffmann's byproduct oven and recovery of byproduct. Liquid fuels : Petroleum – classification of petroleum –refining of crude oil-cracking – fixed and moving bed catalytic cracking/

Synthetic petro-polymerisation-Fischer-Tropsch and Bergius Process – knocking – octane number-centane number.

Gaseous fuels : Natural gas – coal gas –Biogas. Determination of calorific value by bomb and boys calorimeter and theoretical calculations of calorific values problems – Analysis of flue gas – combustion – problems.

UNIT – V**Water Technology**

Introduction sources of water – impurities in water hardness of water-equivalent of calcium carbonate units+ estimation of hardness by EDTA method –disadvantage of hard water – Boiler troubles-scales and sludges-caustic embrittlement –boiler corrosion – carry over-softening methods – lime soda process and problems –zeolite process-ion-exchange process-internal treatment of water-drinking water-filtration-disinfection and methods- Analysis of water : Alkalinity – chloride – dissolved oxygen.

UNIT – VI

Refractories Introduction – Objectives – characteristics – classification-properties-failures Insulators Definitions – classification- properties- applications.

BOOK RECOMMENDED :

1. Quantitative inorganic chemistry by vogel
2. Engineering chemistry by Jain and Jain
3. Engineering chemistry by B.K. Sharma
4. Fundamentals of analytical chemistry by D.A. Skoog and west D.M

INTRODUCTION TO COMPUTERS

UNIT I: (COMPUTER AWARENESS – QUALITATIVE TREATMENT ONLY)

Computers, capabilities, types of computers, application areas, computer anatomy, functional block diagram central processing unit, functions of ALU and Control unit in CPU purpose of Registers in CPU, micro-processors CIRC / RISC processors, memory functions, address, word, RAM, ROM, Cache memory, associate memory, magnetic disk, tape, floppy, optical disk, address bus, data bus, control bus, functions of I-O devices, key board, mouse, light pen, dot-matrix printer, line printer, laser printer, ink jet printer, CRT monitor, Colour monitor, CGA, Screen resolution, Flat panel display unit, machine language instruction, stored program concept, assembly language, assembler, high level language, compiler, Operating System, Types of operating systems, Number Systems, Binary, Hex, Octal, BCD Code, Character Codes, 3 methods of binary representation, of integers, floating point numbers.

UNIT – II: COMPUTER PROGRAMMING I:

Algorithm, flow chart program development steps, Basic Structures of C language, C tokens, Data types, declaration of variables, assigning values, arithmetic, relational and logical operators, increment and decrement operators, control operator, bit-wise operators, expressions, evaluation, input – output operations, IF and SWITCH statements, WHILE, DO-WHILE, and FOR Statements, C programs covering all the above aspects.

UNIT – III: COMPUTER PROGRAMMING II:

String Variables in C, declaration, reading, writing, string handling functions, user – defined functions, variables and storage classes, structures, unions, pointers, file management in C, opening, closing and I-O operations on files, C programs covering the above aspects.

UNIT – IV: NUMERICAL METHODS – I:

Iterative methods, bisection, false position, Newton-Raphson, Successive approximation methods, algorithms, comparison of iterative methods, solution of linear simultaneous algebraic equations, Gauss Jordan and Gauss Siedel's methods, algorithms.

UNIT V: NUMERICAL METHODS – II:

Interpolation, Language interpretation, forward difference, Backward difference and central difference interpolation methods, algorithms, errors in interpolation, least square approximation of functions, linear regression, polynomial regression, algorithms.

UNIT – VI: NUMERICAL METHODS – III:

Numerical integration by Trapezoidal and Simpson's rules, algorithms. Numerical solution of differential equations, Euler Method, Runge-Kutta fourth order method, Milne predictor corrector method, algorithms, comparison of Runge-Kutta and predictor – corrector methods.

BOOKS:

1. "Computers and Commonsense" Shelly and Hunt, 4th Edn., PHI.
2. "Programming in ANSI C" E Balaguruswamy.
3. "Computer Oriented Numerical Methods" V Rajaraman.
4. "Numerical Methods" E Balaguruswamy.

**JAWAHARALAL NEHRU TECHNOLOGICAL UNIVERSITY,
HYDERABAD**

2002 – 2003

CHEMICAL ENGINEERING

I year B.Tech (CHE)

2-0-4 CH1026

STRENGTH OF MATERIALS

UNIT – I

Simple stresses and strains : Elasticity, plasticity, ductility, malleability, hardness and brittleness of materials, Definition of stress – types of stresses compressive tensile and shear – definition of strain, types of strains – factor of safety.

Elastic limit, Hooke's law, Young's Modulus and shear modulus, Tensile test on mild steel specimen, bars of varying section- Extension of a tapering rod- stresses in bars of composite section – Temperature stresses lateral strain poisson's ratio and volumetric strain, element in a state of simple shear- stresses on oblique sections. Definition of Bulk modulus, relation between three elastic constants, bars of uniform strength.

UNIT – II

Shear forces and bending moments : Definitions of a beam, types of beams – cantiliver, freely supported, overhanging, fixed and continuous beam – concepts of shear force and bending moments – shear force and bending moment diagrams for cantilevers, freely supported and overhanging beams due to point loads, uniformly distributed load, uniformly varying load and combination of the above loads – point of contra – flexure, relation between shear force and bending moment.

UNIT – III

Flexural stresses : Theory of simple bending – Derivation of the equation $M/I = F/Y = E/R = \text{Neutral axis}$ – Assumptions in the theory of pure bending – determination of bending stresses – Section modulus of solid and hollow rectangular and circular sections. I.T. Channel and angle sections, design of simple beam sections.

Shear Stresses : Derivation of governing equation – shear stress distribution over a cross section – rectangular, circular and structural sections.

UNIT- IV

Thin and thick cylinder : Thin seamless cylindrical stress – derivation of the formula for hoop stress and longitudinal stress – Hoop strain and longitudinal strain – volumetric strain. Wire wound thin cylinders, thick cylinders – Lame's equations – Hoop stress and radial pressure distribution.

UNIT – V

Principles stresses and strains : introduction – stress components on inclined plains – two perpendicular normal stresses accompanied with state of simple shear – Mohr's circle – determination of principles stresses and principles planes analytically and graphically – principles strains.

UNIT – VI

Torsion : Theory of pure torsion – Torsional moment of resistance – Assumptions in theory of pure torsion- polar modulus –power transmitted by shaft keys and couplings – shear and torsional resistance – shafts of circular cross sections – combined bending and torsion and end thrust – Design of shafts based on theories of failure.

TEXT BOOKS:

1. Solid mechanics by Papov
2. Elementary strength of materials by Timoshenko and Young
3. Strength of materials and mechanics of solids – vol. I by B.C. Punmia
4. Strength of materials by S. Ramamurtham.

INTRODUCTION TO CHEMICAL ENGINEERING

Note : Qualitative Treatment Only

UNIT I

Unit operations – basic laws- units and dimensions, energy, equivalent mass, electro chemical processes humidity and saturation.

UNIT II

Material balances, energy balances, nature of fluid, fluid flow, viscosity, conservation of mass and energy, frictional losses, laminar flow and turbulent flow, fluidization, pumping of fluids.

UNIT III

Heat transfer : conduction, convection and radiation. Flow arrangement in heat exchangers, heat transfer equipment, evaporators, crystallizers.

UNIT IV

Mass transfer : diffusion, mass transfer operations, boiling point diagram vle, absorption, distillation, reflux, mccabe-thiele method, plate efficiency.

UNIT V

Gas fluid operators : equipment for gas fluid operations, selection and use, liquid- liquid extraction, distribution coefficient, triangular diagram. Single stage equilibrium extraction, multistage extraction, industrial liquid-liquid extraction.

UNIT VI

Humidification, dehumidification, drying, drying equipment, classification and uses, absorption equipment, isotherms and its uses.

TEXTBOOK :

Introduction to chemical engineering by S.K.Ghosal, S.K Sanyal and S. Dutta, TMH Publications, 1998.

COMPUTER LAB

1. Write a C program the evaluates the following algebraic expressions after reading necessary values from the user:
 a) $ax+b/ax-b$
 b) $2.5 \log x + \cos 32^0 + 1/x^2 - y^2 / 1 + \sqrt{2xy}$
 c) $1/av2? e- (x-m/v2s)^2$
2. Write a C program for the following
 a) Printing three given integers in ascending order
 b) Sum of $1 + 2 + 3 + \dots + n$
 c) $1 + x^2/2! + x^4/4! + \dots$ upto ten terms
 d) $x + x^3/3! + x^5/5! + \dots$ upto 7th digit accuracy
 e) Read x and compute $Y = 1$ for $x > 0$
 $Y=0$ for $x = 0$
 $Y= -1$ for $x < 0$
3. Write C program using FOR statement to find the following from a given set of 20 integers.
 i) Total number of even integers. ii) Total number of odd integers.
 iii) Sum of all even integers. iv) Sum of all odd integers.
4. Write a C program to obtain the product of two matrices A of size (3X3) and B of size (3X2). The resultant matrix C is to be printed out along with A and B. Assume suitable values for A & B.
5. Using switch-case statement, write a C program that takes two operands and one operator from the user, performs the operation and then prints the answer.
 (consider operators +,-,/,* and %).
6. Write C procedures to add, subtract, multiply and divide two complex numbers ($x+iy$) and ($a+ib$). Also write the main program that uses these procedures.
7. The total distance traveled by vehicle in 't' seconds is given by distance = $ut + 1/2at^2$ where 'u' and 'a' are the initial velocity (m/sec.) and acceleration (m/sec²). Write C program to find the distance traveled a

regular intervals of time given the values of 'u' and 'a'. The program should provide the flexibility to the user to select his own time intervals and repeat the calculations for different values of 'u' and 'a'.

8. A cloth show room has announced the following seasonal discounts on purchase of items.

Purchase Amount	Discount (Percentage)	
	Mill Cloth	Handloom items
1-100	-	5.0
101-200	5.0	7.5
201-300	7.5	10.0
Above 300	10.0	15.0

- Write a C program using switch and If statements to complete the net amount to be paid by a customer.

9. Given a number, write C program using while loop to reverse the digits of the number. Example 1234 to be written as 4321.
 10. The Fibonacci sequence of numbers is 1,1,2,3,5,8... based on the recurrence relation $f(n) = f(n-1) + f(n-2)$ for $n \geq 2$.

Write C program using do-while to calculate and print the first m fibonacci numbers.

11. Write C programs to print the following outputs using for loop.

12. Write a C program to extract a portion of a character string and print the extracted string. Assume that m characters are extracted starting with the nth character.

A Maruthi Car dealer maintains a record of sales of various vehicles in the following form:

Vehicle type	Month of sales	Price (Rs)
Maruthi - 800	02 / 87	75,000
Maruthi - DX	07 / 87	95,000
Gypsy	04 / 88	1,10,000
Maruthi Van	08 / 88	85,000

Write a C program to read this data into a table of strings and output the details of a particular vehicle sold during a specified period. The program should request the user to input the vehicle type and the period (Starting month & ending month).

14. Write a function that will scan a character string passed as an argument and convert all lower case characters into their upper case equivalents.
 15. Implement the following data structures using Arrays
 - i) Stacks
 - ii) Linear Queues
 - iii) Circular queues
 - iv) Dequeue.
 16. Implement polynomial addition and multiplication with linked list sparse matrix.
 17. Implement binary search tree using linked list and perform the following operations.
 - i) Insertion
 - ii) Deletion
 - iii) Inorder Traversal
 - iv) Preorder Traversal
 - v) Post Order Traversal.
 18. Singly linked list and doubly linked lists
 - i) Insertion
 - ii) Deletion
 - iii) Lookup
 19. i) Implement stack using singly linked list.
ii) Implement queue using singly linked list.
 20. Implement the following sorting techniques.
 - i) Bubble sort
 - ii) Insertion Sort
 - iii) Quick Sort
 - iv) Heap Sort.
 21. Implement the following searching method.
 - i) Sequential Search
 - ii) Binary Search
 - iii) Fibonacci

22. i) Conversion of Infix expression to Postfix notation.
ii) Simple expression evaluator, that can handle +,-,/ and *.
23. Implement the algorithms for the following iterative methods using C to find one root of the equation $f(x)=x \sin x + \cos x=0$.
 - a) Bisection
 - b) False Position
 - c) Newton-Raphson
 - d) Successive approximation.
24. Write programs for implementing Gauss-Jordan and Gauss-Seidal methods for solving simultaneous algebraic equations given below.

$$\begin{aligned} 9x_1 + 2x_2 + 4x_3 &= 20 \\ x_1 + 10x_2 + 4x_3 &= 6 \\ 2x_1 - 4x_2 + 10x_3 &= -15. \end{aligned}$$
25. Write Computer programs to implement the Lagrange interpolation and Newton-Gregory forward interpolation.
26. Implement in 'C' the linear regression and polynomial regression algorithms.
27. Implement Trapezoidal and Simpson methods.
28. Practice of exercises (in text book 2 of theory) related to:
 - a) Word 2000 Chapter 7, 8, 9.
 - b) Excel 2000 Chapter 12, 13.
 - c) Powerpoint- 2000 Chapter 15, 16.
 - d) Access 2000 Chapter 18, 19.
 - e) Outlook 2000 Chapter 21, 22, 23.
 - g) FrontPage 2000 Chapter 25

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY
HYDERABAD**

0-3-4 CH1029

I year B.Tech (CHE)

ANALYTICAL AND ENGINEERING CHEMISTRY LAB
List of experiments

Redox Titration :

1. Estimation of Iron by potassium dichromate
2. Estimation of Ferric Iron by dichromate

Iodometry :

3. Estimation hypo using standard potassium dichromate
4. Estimation of copper by sodium thiosulphate

Complexometric titrations :

5. Estimation of hardness of water using EDTA
6. Estimation of copper by EDTA

Colorimetry :

7. Estimation of chromium in water
8. Estimation of Iron in cement

Analysis of minerals :

9. Percentage purity of pyrolusite
10. Percentage purity of limestone

Precipitation titration

11. Estimation of Zinc using potassium Ferro Cyanide

Analysis of water :

12. Estimation of dissolved oxygen in water sample

Gravimetry :

13. Estimation of sulphate

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY,
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I year B.Tech (CHE)

0-3/2-2 CH1030

ENGG.PHYSICS LAB

Any TEN of the following experiments are to be performed during the academic year.

1. Determination of Rigidity Modulus of the material of a wire (Torsional Pendulum).
2. Study of the normal modes in a string using forced vibrations in rods (Meldes experiment).
3. Study of Resonance – Using audio generator.
4. Coupled Oscillator.
5. Diffraction grating.
6. Dispersion of Light – (Prism – Spectrometer method).
7. Determination of thickness of a thin object by optical method – Parallel fringes.
8. Newton's Rings.
9. Lasers – Single slit and double slit experiments.
10. Study of electrical resonance – LCR circuit.
11. Time constant of an R-C circuit.
12. Sonometer – Verification of laws of stretched strings.
13. Frequency of A.C. Supply.
14. Magnetic field along the axis of a current carrying coil – Stewart and Gee's Method.
15. Optical Fibres – Numerical aperture measurement.
16. Optical Fibres – Study of losses

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY,
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I year B.Tech (CHE)

0-3-4 CH1031

ENGINEERING DRAWING PRACTICE

(Common for EEE, ECE, EIE, EConE, ICE, CSE, IT, CSSE, ETM, ECM, BME)

UNIT – I:

Introduction to Engineering Graphics – Construction of Ellipse, Parabola and Hyperbola, Cycloidal Curves.

UNIT – II:

Orthographic Projections of Points, Lines and Planes – Axis inclined to one plane and inclined to both the planes.

UNIT – III:

Orthographic Projections of Solids: Cylinder, Cone, Prism, Pyramid and Sphere in simple positions and Axis inclined to both the Planes.

UNIT – IV:

Development of Surfaces: Prisms, Cylinder, Pyramid and Cone.

UNIT – V:

Isometric Projections of Lines, Planes and Simple Solids.

UNIT – VI:

Conversion of Orthographic Views into Isometric Views and Vice-Versa.

TEXT BOOKS:

1. Engineering Graphics – by K.L. Narayana & P. Kannayya, SciTech Publishers.
2. Engineering Drawing – by N.D. Bhatt, Charotar Publishers.
3. Engineering Drawing and Graphics – by Venugopal, New Age International Limited.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY
HYDERABAD

I year B.Tech (CHE)

0-3/2-2 CH1032

CHEMICAL ENGINEERING WORKSHOP PRACTICE

I Trades for Exercises (Minimum of three exercises in each trade)

1. Carpentry and Pattern Making
2. Fitting
3. Tin smithy

II Trades for demonstration & exposure.

1. Plumbing
2. Welding
3. Black Smithy

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY
HYDERABAD

II year B.Tech (CHE) I Semester

4-0-4 CH2121

MATHEMATICS – II
(Common to all Branches)

Effective for the batches admitted in the year 2002 and onwards.

UNIT – I

Matrices – brief review – Inverse of a matrix by adjoint, elementary row transformations – Rank - Normal form – echelon form. Augmented matrix – Consistency – solution of system of simultaneous linear homogeneous and non-homogeneous equations.

UNIT – II

Eigen values, eigen vectors – properties – Cayley – Hamilton Theorem (Inverse and powers of a matrix by Cayley – Hamilton theorem). Quadratic forms – positive, negative definite – Diagnolization of matrix. Calculation of powers of matrix – Modal and spectral matrices Real matrices – Symmetric, skew-symmetric, orthogonal, Linear Transformation – Orthogonal Transformation. Quadratic forms – Reduction of quadratic form to canonical form – index – signature.
Complex matrices : Hermitian, Skew-Hermitian and Unitary – Eigen values and eigen vectors of complex matrices and their properties.

UNIT – III : FOURIER SERIES

Determination of Fourier coefficients – Fourier series – even and odd functions – Fourier series in an arbitrary interval – even and odd periodic continuation – Half – range Fourier sine and cosine expansions.

UNIT – IV :

Formation of Partial differential equations by elimination of arbitrary constants and arbitrary functions – solutions of first order linear (Lagrange) equation and nonlinear (standard type) equations. Method of separation of variables – Classification of second order linear Partial Differential Equations, solutions of one dimensional heat equation wave equation and two-dimensional Laplace's equation under initial and boundary conditions.

UNIT – V

Fourier integral theorem – Fourier sine and cosine integrals. Fourier transform – Fourier sine and cosine transforms. – properties – Inverse

transforms – Finite Fourier transforms. Solution of one dimensional wave, heat equations and two dimensional Laplace's equation by Fourier transforms. Z-transform – Inverse z – transform – properties – Damping rule – shifting rule – Initial and final value theorems.

Convolution theorem – Solution of difference equations equations by Z – transforms.

TEXT BOOKS :

1. A Text Book of Engineering Mathematics Volume – II
T.K.V.Iyengar, B. Krishna Gandhi and others, S. Chand and Company
2. Engineering Mathematics
B.V. Ramana, Tata McGraw-Hill 2002
3. Engineering Mathematics – II
C.Sankaraiah, Vijaya Publications
4. Engineering Mathematics – II
P.Nageswara Rao, Y. Narsimulu, Prabhakar Rao

SUGGESTED REFERENCES :

1. Engineering Mathematics
S.K.V.S.Sri Rama Chary, N. Bhujanga Rao, P.Bhaskara Rao, B.S.Publications 2000
2. Advanced Engineering Mathematics (Eighth edition)
Erwin Kreyszig John Wiley & Sons (ASIA) Pvt Ltd.
3. Advanced Engineering Mathematics (Second edition)
Michael D. Greenberg, Prentice Hall
4. Sarveswara Rao Koneru
Engineering Mathematics Orient Longman (Pvt.) Ltd. 2002 (in press)
5. Engineering Mathematics - II
N.P.Bali, Laxmi Publications (P) Ltd., New Delhi.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY

HYDERABAD

II year B.Tech (CHE) I Semester

4-0-4 CH2122

ELECTRICAL ENGINEERING

(Common with Mech.Engg – Mechatronics and Mech. Engg. – Production)

UNIT – I

SI Unit's law, series, and parallel circuits, Kirchhoff's laws, Mechanical, Star-delta transformation – magnetic circuits – force on a current carrying conductor – electromagnetic induction, Faraday's law, Lenz's law – effects of hysteresis & eddy currents – Self and mutual inductances.

UNIT – II

Generation of an alternating emf – average and rms values of alternating quantity – representation of alternating quantities by phasors – single phase circuits – resonance – three phase balanced systems – single and three phase power calculations.

UNIT – III

Principle of operation of DC machines – emf equation – types of generators – Magnetization and Load characteristics of DC generators – types and characteristics of DC motors – torque equation – DC motor starters (three point) – Efficiency calculation and Swinburne's test O Speed control.

UNIT – IV

Construction and principle of operation of single phase transformer – emf equation O.C. & S.C. tests – efficiency and regulation - 3F Transformers, Transmission and Distribution - principle and operation of three phase induction motors – types – slip torque characteristics – principle and operation of alternators – O.C. & S.C. tests – regulations by synchronous impedance method.

UNIT – V

Basic principles of indicating instruments – moving coil and moving iron instruments – dynamometer type wattmeters – induction types energy meter-measurement of single and three phase power.

TEXT BOOKS :

1. Electrical Engineering Fundamentals /Del Toro, 2nd edition / Prentice Hall Publishers
2. Fundamental of Electrical Engineering / Ashfaq Husain. 2nd edition / Dhanpat Rai & Co.
3. Theory and Problems of Basic Electrical Engineering / D.P.Kothari & I.J. Nagrath, PHI Publishers, 1998.
4. Basic Electrical Engineering / V.N.Mittle / TMH 1998.

REFERENCES :

1. Electrical technology - Edward Hughes.
2. Introduction to electrical engg. - Naidu & Kamakshaiah
3. Electrical technology - Vincent Del toro.

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY
HYDERABAD**

II year B.Tech (CHE) I Semester

4-0-4 CH2123

FLUID MECHANICS**UNIT – I**

Units and dimensions, dimension analysis, similarity, types of fluids, hydrostatic pressure, pressure distribution in a static fluids, pressure measuring devices.

Introduction to fluids in motion, concept of stream lines, stream tubes, viscosity, types of fluids, flow in boundary layers, its formation and growth in tubes and on plates, basic equations of fluid flow continuity, momentum and bernoulli's equation.

UNIT – II

Flow of incompressible fluids in pipes, relation between skin friction- wall shear, laminar flow in pipes, hagen- poiseille equation, turbulent flow in pipes, velocity distribution equation, friction factor, friction from changes in velocity or direction, flow of compressible fluids, basic equations, flow through variable area conduits, adiabatic and isothermal frictional flow.

UNIT – III

Flow of compressible fluids : processes of compressible flow, flow through variable area conduits, adiabatic frictional flow, isothermal frictional flow. Flow of compressible fluids, basic equations, flow through variable area conduits, adiabatic and isothermal frictional flow.

UNIT – IV

Flow past immersed bodies, drag, drag coefficient, friction in flow through beds of solids, motion of particles through fluids, its mechanics, terminal velocity, fluidization, mechanism of fluidization, pressure drop in fluidization, applications of fluidization.

UNIT – V

Transportation and metering of fluids : pipe fittings and valves, fluid moving machinery – pumps, positive displacement pumps, centrifugal pumps, fans, blowers and compressors, measurement of flowing fluids – full bore meter, insertion meters.

TEXT BOOK :

Unit operations in chemical engineering by w.l. McCabe and t.c.smith and peter harriot, McGraw hill inc. 5th ed. 1993.

REFERENCE :

1. Fluid and unit operations – Brown et al., Asian publishing house.
2. Engineering fluid mechanics by K.L. Kumar, Eurasia publishing house, New Delhi 1990.

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY
HYDERABAD**
II year B.Tech (CHE) I Semester
4-0-4 CH2124
ORGANIC CHEMISTRY**Unit – I**

Polar effects – Inductive effect, electromeric effect, Resonance, Hyper conjugation.

Mechanism of following Organic Reactions.

1. Electrophilic reaction
 - a) Friedel craft reaction
 - b) Riemer Timenn Reaction
 - c) Backmann rearrangements
2. Nucleophilic reactions
 - a) Aldol condensation
 - b) Perkin reaction
 - c) Benzoin condensation
3. Free radical reaction
 - a) Halogenation of Alkane
 - b) Addition HBR on Alkene in presence of peroxide
4. Alylic halogination
 - a) Using N-Bromo succinamide (NBS)
 - b) Thermal halogination of Alkane ($\text{CH}_3 - \text{CH} = \text{CH}$)

UNIT – II

Stereo isomerism optical isomerism symmetry and chirality, optical isomerism, lactic acid, Tartaric acid, sequence rule, enantiomers, diastereoisomers, geometrical isomerism, E,z-system of nomenclature, confirmation cyclohexane.

UNIT – III

Polymer (Synthetic & Natural)

- A) Synthetic: Classification of polymerization (Addition & Condensation)
 - a) Preparation, properties and uses of following polymers
 - (1) Polyethelene (2) PVC (3)Tefflon (4) Nylon (5) Bakelite (6) Polyester

- B) Natural : Source, Structure and uses of the following
 (1) Rubber (2) Cellulose (3) Silk (4) Wool.

UNIT – IV

Heterocyclic compounds and Nomenclature, preparation of properties and uses of

- (1) Pyrrole (2) Furan (3) Thiophene (4) Pyridine (5) Quinoline
 (6) Iso -quinoline.

UNIT – V

Dyes –colour and constitution:

Classification of Dyes, preparation and uses of
 (1) Malachite green (2) Rosaniline (3) Congored (4) Bismark brown
 (5) Fluoroscien.

REFERENCES:

1. Polymer science by Gaurikar and others.
2. Reaction mechanism by peter skyes.
3. Text book of organic chemistry – Gergussion, LN East, Westpress.
4. Text book of organic chemistry – Robbetmarrison and Robert bond.
5. Text book of organic chemistry – P.L.Soni.
6. Organic chemistry vol- I – I.L .Finar.
7. Reaction and reagent 8 – by O.P. Agrawal

MATERIAL AND ENERGY BALANCE

UNIT – I

Stoichiometric relations : 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, applications of ideal gas law, gaseous mixtures, gases in chemical reactions.

UNIT – II

Vapour 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 percent saturation, or dew point, wet 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, kistyakowski equation for non polar liquids enthalpy and its evaluation.

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

TEXT BOOK :

Chemical process principles, part i, material and energy balance by Hougan o.a, Watson K.M. And ragatz r.a. John Wiley and Sons, New York, 195, 2nd ed.

REFERENCE:

Basic principles and calculations in chemical engineering by D.H. Himmelblau, 5th ed. Prentice Hall.

Stoichiometry by B.I. Bhati and S.M. Vora (third ed.) Tata McGraw Hill Publishing Company Ltd, New Delhi (1996).

Stoichiometry for chemical engineering, by Williams and Johnson, McGraw Hill.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY
HYDERABAD

II year B.Tech (CHE) I Semester

4-0-4 CH2126

INORGANIC CHEMICAL TECHNOLOGY

UNIT – I

Objective, unit processes and unit operations General fundamentals, water conditioning and water treatment, outlines of industrial waste water treatment.

UNIT – II

Ceramic industries : basic raw materials, white waxes, heavy clay products, refractories, enamels and enameled metals.

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

UNIT - III

Soda ash, caustic soda and chlorine, Glass : manufacture of special glasses, rock or minerals.

UNIT – IV:

Industrial gases : carbon dioxide, hydrogen and oxygen – products of water gas, producer gas.

Nitrogen industries : synthetic ammonia, urea, nitric acid, (ammonium nitrate) ammonia chloride, ammonia phosphate, and complex fertilizers.

Unit – V : sulfur and sulfuric acid, manufacturer of sulfuric acids, hydrochloric acid and some other chemicals – hcl, aluminum sulfate and alum, barium salts, rare earth compounds.

TEXT BOOKS :

- Shreve's chemical process industries ed. By Austin, McGraw – Hill, 5th ed. 1985.
- Dryden's outlines of chemical technology ed. By M. Gopal Rao and M. Siting, 2nd ed., 1973.

REFERENCE:

Industrial chemistry by B.K.Sharma

2002 – 2003

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY
HYDERABAD

II year B.Tech (CHE) I Semester

0-3-2 CH2127

FLUID MECHANICS LAB

1. Identification of laminar and turbulent flows (reynolds apparatus)
2. Measurement of point velocities (pitot tube)
3. Verification of bernoullis equation
4. Calibration of rotameter
5. Variation of orifice coefficient with reynolds number
6. Determination of venturi coefficient
7. Friction losses in fluid flow in pipes
8. Pressure drop in a packed bed for different fluid velocities
9. Pressure drop and void fraction in a fluidised bed
10. Studying the coefficient of contraction for a given open orifice
11. Studying the coefficient of discharge in a v – notch
12. Study of the characteristics of a centrifugal pump
13. Viscosity determination using stokes law.

2002 – 2003

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY
HYDERABAD

II year B.Tech (CHE) I Semester

0-3-2 CH2128

ORGANIC CHEMISTRY LAB

1. Criteria of purity of solid and liquid compounds, determination of melting point, mixed melting point and boiling point. Crystallization and filtration. Detecting Nitrogen Sulphur and Halogens in Organic Compounds.
2. Identification of an unknown substance from the following classes of organic compounds, alcohols, phenols, aldehydes, ketones, carbohydrates, acids, anhydrides, ester, amides, nitro compounds, amines and hydrocarbons and their biogen derivatives.

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY
HYDERABAD**

II year B.Tech (CHE) II Semester

4-0-4 CH2221

PROBABILITY AND STATISTICS

UNIT - I

Probability :

Sample space and events – probability – The axioms of probability – Some elementary theorems – conditional probability – Baye's theorem.

UNIT - II

Probability Distributions

Random variables – Discrete and continuous – Distribution – Distribution function – Distribution – Binomial, poisson and normal distribution – related properties.

UNIT - III

Sampling Distribution

Populations and samples – Sampling distributions of mean (known and unknown) Proportions, sums and differences.

UNIT - IV

Inferences concerning means and proportions

Point estimation – Interval estimation – Bayesian estimation – Test of Hypothesis – Mean and Proportions – Hypothesis concerning one and two means – type – I and type – II errors. One tail, two-tail tests; Tests of significance, - Student t-test, F-test, X²-test estimation of proportions.

UNIT - V

Curve fitting

The method of least squares- inferences based on the least – squares estimations – curvilinear regression – Multiple regression – correlation for univariate and bivariate distributions.

RECOMMENDED TEXT BOOK :

1. Probability and Statistics for Engineers by Irwin Miller and John E Freund
Prentice – Hall of India Private Limited, 6th Edition
2. Engineering Mathematics – B.V.Ramana Tata Mcgraw Hill 2002.

REFERENCE BOOK :

1. Probability and Statistics for engineers
Walpole and meyer

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY
HYDERABAD**

II year B.Tech (CHE) II Semester

4-0-4 CH2222

MECHANICAL ENGINEERING

UNIT - I

Thermodynamics : definitions – systems – open- closed, - process cycle, first law of thermodynamic for closed system : flow processes – open systems with flow processes – first law of thermodynamics for cyclic processes.

UNIT - II

Second law of thermodynamics – carnot cycle – inequality of clausius – reverse – cornot cycle – entropy – air standard cycle – diesel cycle-ottodiesel – diesel cycles.

UNIT - III

Properties of steam and use of steam tables, boilers & steam generation, ranking, cycle, steam turbines, impulse and reaction turbines, velocity and pressure compounding governing i.c. Engines, cycles, performance of engines – brake power – indicated power – brake thermal efficiency, indicated thermal efficiency, mechanical efficiency, the gas turbine cycles, jet propulsion.

UNIT - IV

Reciprocating compressors : single stage, work done during cycle, effect of clearance – two stage compressors, condition for minimum work, effect of inter cooling, efficiency.

UNIT - V

Drives : belts, expression for the ratios of tensions on the slack and tight side, power transmitted, v-belts, chain drives.

Gears : spur, helical, bevel gear trains – simple and compound

Bearings : hydrodynamic theory of bearing, slipper bearing, thrust bearing- ball and roller bearings.

TEXT BOOKS SUGGESTED

1. Thermal engineering by Balani
2. Theory of machines by Balani

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY
HYDERABAD**

II year B.Tech (CHE) II Semester

4-0-4 CH2223

**CHEMICAL ENGINEERING
THERMODYNAMICS – I**

UNIT – I

Relevance and scope of chemical engineering thermodynamics, systems, state and state functions. Thermodynamic properties, equilibrium and its states. The phase rule, temperature and the zeroth law of thermodynamic processes, maxwell equations.

UNIT – 2

Internal energy. Energy content, conservation of mass, first law of thermodynamics for closed systems and cyclic processes. Work interactions, thermodynamic definition of heat, Enthalpy – a thermodynamic property, first law of thermodynamics for an open system, conservation of mass for an open system, steady state flow processes.

UNIT – 3

The ideal gas law, the constant volume, pressure and temperature processes, the adiabatic process, the polytropic process. P-v-t relations of fluids: the pvt behaviour of pure substances application of equations of state for gases, the principle of corresponding states, gas mixtures.

UNIT – 4

Statement of the second law, second law of thermodynamics for closed and open systems, heat transfer between two heat reservoirs, heat engine, efficiencies of heat engines, carnot cycle and deviations from it, example of irreversible process. The ideal gas temperature scale, the concept of entropy, entropy and quality of energy entropy change of work and heat reservoir. Mathematical statement of second law, third law of thermodynamics, entropy change and irreversibility, entropy, equilibrium and direction of change, entropy and probability.

UNIT – V

Refrigeration : the carnot and refrigeration cycle, the vapor compression cycle and their comparison, the choice of refrigerant, absorption refrigeration, heat pump, liquefaction processes, combined refrigeration, heat engine problems.

TEXT BOOK

1. J m smith and h c van ness, introduction to chemical engineering thermodynamics, 5th ed., Mc Graw hill 1996.
2. YVC Rao, chemical engineering thermodynamics, university publications.

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PHYSICAL CHEMISTRY

UNIT I: Distribution Law and Phase Rule:

Distribution Law – Nernst Distribution Law – Distribution Co-efficient – Explanation and Limitations of Distribution Law – Modification of Distribution Law – Determination of Equilibrium Constant From Distribution Co-Efficient – Applications of Distribution law.

Phase Rule – Terms Involved in Phase Rule – Types of Liquids – Derivation of Phase Rule – Phase Diagrams of One Component (Water and Sulphur System), Two Component System (Lead Silver System) and Three Component System. Applications of Phase Rule.

UNIT II: CHEMICAL KINETICS:

Introduction to Chemical Kinetics – Theories of Reaction Rates – Collision Theory – Modified Collision Theory – Absolute Reaction Rate Theory (Transition State Theory) – Reaction Between Ions – Influence of Solvent (Double Sphere Activated Complex and Single Sphere Activated Complex) – Influence of Ionic Strength on the Rate of the Reactions – Chain Reactions – Hydrogen and Bromine, Hydrogen and Oxygen (Steady State Treatment) – Explosion Limits.

UNIT III: COLLOIDAL STATE:

Definition of Colloids, Classification of Colloids.

Solids in Liquids (Sols) – Properties, Kinetics, Optical and Electrical, Stability of Colloids. Protective Action, Hardy – Schultze Law, Gold Number.

Liquids in Liquids (Emulsions) – Types of Emulsions, Preparation, Emulsifier.

Liquid in Solids (Gels) – Classification, Preparation and Properties, Inhibition, General applications of Colloids.

UNIT IV: ELECTRO CHEMISTRY:

Ohm's Law – Conductance – Specific Conductance – Equivalent Conductance – Molecular Conductance and its Determination – Transport Number and its Determination – Kohlrausch's Law, its Application – Conductometric Titrations – Applications of Conductivity Measurements.

UNIT V: CATALYSIS:

Homogeneous Catalysis – Catalysis by electron and group transfer in solution – Acid-Base Catalysis – Protolytic and Prototropic Mechanism.

Enzyme Catalysis – Specificity – Examples – Influence of Concentration (Michaelis Constant) – Influence of pH – Influence of Temperature.

BOOKS RECOMMENDED:

1. Chemical Kinetics by K. J. Laidler.
2. Electro Chemistry by Samuel Glastone.
3. Physical Chemistry by Puri, Sharma and Pathania.
4. Physical Chemistry by Castalin.
5. Atomic Structure and Chemical Bond by Manasa Chanda.

Essentials of Physical Chemistry by Bahl and Tuli.

ORGANIC CHEMICAL TECHNOLOGY

UNIT – I

Plastic industry : classification of plastics, outlines and manufacture of phenols, formaldehyde, vinyl chloride and vinyl acetate, manufacture of phenol-formaldehyde resin and polyvinyl resins.

Paints and varnishes : constituents of paints and varnishes and their manufacturing procedures.

UNIT – II

Rubbers : classification, natural rubber, monomers of synthetic rubber, manufacture of sbr.

Synthetic fibers : classification, manufacture of nylon66, polyester fiber, viscose rayon fiber.

UNIT – III

Sugar and starch industry : manufacture of cane sugar, production of starch from maize

Fermentation industry : manufacture of alcohol from molasses, manufacture of penicillin.

UNIT – IV

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

UNIT – V

Oils, soaps and detergents : definitions, constitution of oils, extraction and expression of vegetable oils, refining and hydrogenation of oils, continuous process for the production of fatty acids and soap, production of detergents.

TEXTBOOK :

Shreve's chemical process industries, 5th ed. McGraw Hill.

REFERENCE :

Outlines of chemical technology by C E. Dryden
Industrial chemistry by B.K. Sharma.

MATERIAL SCIENCE FOR CHEMICAL ENGINEERS

UNIT – I

A brief review on bonding, bond energy, Oh, Dh lattice Crystal structure – symmetry, elements of symmetry in cubic crystals – space lattices – two and three dimensional – unit cell., Crystal, bravais lattices, crystal systems with examples. Lattice coordinates, miller and miller – bravais indices for directions and planes. Linear density of atoms, planar density of atoms-close packed directions and planes – atomic and ionic packing fractions – densities of metals and ionic structures, covalent structures – close packed structures; crystal structure determination. X-ray diffraction, braggs method, derivation of braggs law of x-ray diffraction – powder method, ionic covalent and metallic structures – structure determination of cubic crystals – ligancy and limiting radii ratio.

UNIT – II :

Basic thermodynamic functions – impure phases, solid solutions, alloys, single phase and multi phase alloys – crystal defects, point imperfections, classification – application of configurational entropy to estimate vacancy concentration and other defect concentrations – defect structure, line imperfections, edge and screw – dislocations – their nature, burgers circuit and burgers vector. Dislocation reaction – dislocation motion, multiplication of dislocations during deformation. Role of dislocations in determining crystal properties. Twining – surface defects- grains and grain boundary – dislocation energy, stress required to move a dislocation, dislocation density.

UNIT – III

Elasticity, plasticity, stress, strain – true stress. True strain, poissons ratio. Elastic compliances- strain energy – stress – strain diagrams for ductile and brittle materials, proof stress, yield stress, plastic stress, modulus of elasticity, rigidity, bulk modulus – relationship between the three – plastic deformation. Uniform elongation and necking strainhardening., Work hardening as strengthening mechanisms - plastic deformation by slip-

slip systems and planes- critical resolved shear stress (crss) – cold working, hot working, dynamic recovery, recrystallisation, grain growth, grain size and yield stress. Hall-petch equation. Single crystal – polycrystalline material, comparison of stress – strain diagrams. Anelasticity – elastic after effect – damping, internal friction, energy loss, viscoelasticity, - viscoelastic models.

UNIT – IV

Composite materials – fibrous, particulate, their properties and young's moduli of composites when axially and transversely loaded – fraction of the load taken by fiber and matrix.

Fracture , ductile, brittle – griffith's criterio for brittle failure – ductile brittle transition temperature, creep, mechanisms of creep-creep resistance materials – creep rate and related equations to find creep rates. Fatigue-mechanism-factors to increase fatigue resistance.

UNIT – V

Transition between states of matter, energetics of transition, structure of solids, nucleation, mechanisms, nucleation rates, homogeneous and heterogeneous nucleation, phase rule, unary, binary phase diagrams, thermal equilibrium diagrams, eutectic, eutectic phase diagrams, cd-bl, pb-sn, cu-ni, ag-cu, fe-c or fe- Fe_3 , c-phase transformations – time temperature – transformation curves for eutectoid steels-plain carbon steels – effect to addition of alloying elements on the properties of steels, types of steels used in chemical industries.

TEXT BOOKS :

1. Material science & engineering by V. Raghavan, Printice Hall of India Ltd, New Delhi.
2. Elements of materials science & engineering, 5th edition, Lawrence H.Van Vlack, Addison-Weley Publishing Co.

REFERENCE BOOKS :

1. Science of engineering materials, vols 1,2,3 Manas Chanda, Mcmillan company of India Ltd, Delhi, Bombay, Madras and Calcutta,
2. Principles of materials science & engineering, William F.Smith, McGraw-Hill publishing co.
3. Essentials of materials science by A.G.Guy.

CHEMICAL TECHNOLOGY LAB

Estimation of formaldehyde, urea, glucose and sucrose using chemical methods.

Analysis of oils and fats: acid value, saponification value and iodine value

Estimation of hydroxyl groups in alcohols and phenols Physico-chemical methods of analysis – use of chromatographic units and spectrophotometers.

Preparation of following organic chemicals : introbenzene, acetanilide, methyl orange, aspirin.

Analysis of water, limestone, soda and typical fertilizers.

PHYSICAL CHEMISTRY LAB

1. Distribution of succinic acid between ether and water.
2. Distribution of acetic acid between n-butanol and water.
3. Distribution of benzoic acid between benzene and water.
4. Determination of specific rotation of substance by polarimeter.
5. Study of inversion of sucrose by polarimetry.
6. Study of hydrolysis of an ester.
7. Study of reaction between persulphate and iodide.
8. Conductiometric titration of strong acid versus strong base.
9. Conductiometric titration of weak acid versus strong base.
10. Potentiometric titration between potassium diachromate and ferrous iron.

ENERGY ENGINEERING**UNIT – I :**

Conventional energy sources – the present and scope for future development, - utilization of coal, formation, analysis, classification, storage and carbonization – by product recovery.

UNIT – II :

Petroleum : origin, classification, single and multi-stage fractionation, deforming, catalytic cracking, specification of kerosene, motor gasoline and fuel oils. Liquefied petroleum gas and nature gas, composition, properties and uses.

UNIT – III :

Non-conventional energy sources: solar radiation, principles of heating, cooling and photo-voltaic cells.

UNIT – IV :

Biogas production, biomass, wind energy, tidal and wave energy, geo-thermal energy, nuclear energy, ocean thermal energy, hydrogen energy.

UNIT – V :

Fuel cells, storage of energy – types – water storage, packed bed storage, solar pond, chemical storage, phase change storage, mechanical energy storage and windmill storage.

Solid waste management

TEXT BOOKS :

1. fuels and combustion by S.Sirkar, Orient Longmans, 2nd Ed.
2. Solar energy, thermal storage by S.P.Sukhatme - TMH
3. Non-conventional energy sources by G.D.Rai, Khanna Publications.

MECHANICAL UNIT OPERATIONS

UNIT – I

Properties, handling and mixing of particulate solids : characterization of solid particles, properties of particulate masses, storage and mixing of solids, types of mixers, mixers for cohesive solids, mixers for free flowing solids.

UNIT – II

Size reduction : principles of comminution, computer simulation of milling operations, size reduction equipment – crushers, grinders, ultrafine grinders, cutting machines, equipment operation.

UNIT – III

Mechanical separations : screening, screening equipment, filtration cake, centrifugal filters, principles of cake filtration and clarifying filters, liquid clarification, gas cleaning, principles of clarification, cross flow filtration, types of membranes, permeate flux for ultrafiltration, concentration polarization, particle rejection of solutes, microfiltrations, separations based on motion of particles through fluids, gravity settling processes and centrifugal settling processes.

UNIT – IV

Agitation and mixing of liquids : agitation of liquids, circulation velocities, power consumption in agitated vessels, blending and mixing – suspension of solid particles, dispersion operation.

UNIT – V

Crystallization : crystal geometry, principles of crystallization equilibria and yields, nucleation, crystal growth, application of principles of design, msmpcr crystallizer, concentration of melts.

TEXT BOOK :

Unit operations in chemical engineering by W.L.Mccabe and J.C.Smith and Peter Harriott, McGraw Hill, 5th Ed. 1993.

REFERENCE :

Chemical engineers handbook, Jhperry, 7th Ed. McGraw Hill.
Unit operation by GB. Brown

CHEMICAL ENGINEERING THERMODYNAMICS – II

UNIT – I

Heat effects : heat capacities of gases as a function of temperature, specific heats of liquids ad gases, heat effects accompanying phase changes, the standard heat of reactions, formation and combustion, heat effects of industrial reactions and mixing processes.

UNIT II

Solution thermodynamics: fundamentals property relation, chemical potential as a criterion for phase equilibrium, partial properties, ideal gas mixtures, fugacity and fugacity coefficient for pure and species in solutions, ideal solutions, excess properties; behavior of excess properties of liquid mixtures.

Liquid phase properties from vle data. Models for excess gibb's energy property changes in mixing, heat effects of mixing processes.

UNIT III

VLE at low to moderate pressure: the nature of equilibrium, the phase rule-duhem's theorem, qualitative behavior, the gamma/phi formulations of vle, dewpoint and bubble point calculations, flash calculations,solute(1)/solvent(2) systems.

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 IV

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, vle by molecular simulation.

UNIT V

Chemical reaction equilibria: the reaction coordinate, application of 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, reacting systems.

TEXT BOOK:

Introduction to chemical engineering thermodynamics by J M Smith, C van ness and M M Abbott, 5th ed. Mc Graw Hill 1996..

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HEAT TRANSFER**UNIT I**

Heat by conduction: steady state and unsteady state conduction. Principles of heat flow in fluids: energy balances, rate of heat transfer, overall and individual heat transfer coefficients, effective coefficients, effective coefficients for unsteady state heat transfer.

UNIT II

Heat transfer to fluids without phase change: heat transfer by forced convection in laminar flow, forced convection in turbulent flow, eddies and analogies between heat and momentum transfer in transition regions to liquid metals, heating and cooling of fluids in forced convection outside tubes – natural convection.

UNIT III

Heat transfer to fluids with phase change: transfer from condensing vapors and boiling liquids, evaporator equipment, performance of tubular evaporators, evaporator capacity, economy and vapor recompression.

UNIT IV

Heat exchange equipment: heat exchangers, condensers, boilers and calandrias, extended surface equipment, heat transfer in agitated vessels, scraped surface heat exchangers, heat transfer in packed beds.

UNIT V

Radiation heat transfer: emission of radiation, absorption of radiation by opaque solids, radiation between surfaces, radiation to semitransparent materials, combined heat transfer by conduction, convection and radiation.

TEXT BOOK

Unit operations of chemical engineering by W I McCabe and J C Smith and Peter Harriott, McGraw Hill, 5th Ed. 1993.

REFERENCE :

1. Process heat transfer by D.Q.Kern, McGraw Hill, 1986.
2. Engineering heat transformer – Gupta, Prakash

MASS TRANSFER OPERATIONS – I**UNIT – I**

Introduction : mass transfer operations, molecular diffusion in fluids, binary solutions, fick's law, equation of continuity, steady state equimolar counter current diffusion, stefen's diffusion, estimation of diffusivity of gases and liquids application of molecular diffusion, mass transfer coefficients in turbulent flow, theories of mass transfer, analogy between momentum, heat and mass transfer in laminar and turbulent flow, correlation's for mass transfer coefficients in simple situations, diffusion in solids.

UNIT – II

Inter phase mass transfer : concept of equilibrium, diffusion between phases, material balances in steady state co-current and counter-current stage processes.

Equipment for gas – liquid operations : sparged vessels, mechanically agitated vessels for single phase liquids and gas – liquid mixtures. Tray towers, sieve tray design for absorption and distillation, design of batch distillation columns, venturi scrubbers, distillation, tray tower versus packed towers.

UNIT – III

Absorption and stripping : counter and co-current isothermal absorption and stripping of single component operating lines, minimum flow rates, determination of number of transfer units and height of a continuous absorber, determination of number of plates, absorption factor, kremser brown equation.

UNIT – IV

Vapor gas mixtures : humidity and relative saturation, dew point, adiabatic, saturation and wet bulb temperatures, psychrometric charts, en-

PROCESS INSTRUMENTATION**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 thermometry.

UNIT – II

Thermoelectricity industrial thermocouples, thermocouple wires, thermocouple wells and response of thermocouples, thermal coefficient of resistance, industrial resistance, thermometer bulbs and circuits, radiation receiving elements, radiation photoelectric and optional 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.

UNIT – IV

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 – V

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, level of dry materials.

Head flow meters, area flow meters, open channel meters, viscosity meters, quantity meters, flow of dry materials, viscosity measurements. Recording instruments, indicating and signaling instruments, transmission of instrument readings, controls center, instrumentation diagram, process analysis.

TEXT BOOK :

Industrial instruments by donal p eckman, wiley eastern, 1950.

REFERENCE :

1. Principles of industrial instrumentation by Patra Nabis, TMH.
2. Instruments for measurement and control by Holbrook W.C. Van Nostrand East West.

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HEAT TRANSFER LAB

1. Determination of total thermal resistance and thermal conductivity of composite wall.
2. Determination of the thermal conductivity of a metal rod.
3. Determination of the 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 over-all 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 unsteady 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.
11. Determination of radiation constant of a given surface.

MECHANICAL UNIT OPERATIONS LAB

1. To determine the time of grinding in a ball mill for producing a product with 80% passing a given screen.
2. To verify the laws of crushing using any size reduction equipment like crushing rolls, or vibrating mill and to find out the work index (w.i) of the material.
3. To find the effectiveness of hand screening of a given samples by a given screen.
4. To separate a mixture of coil into two fractions using froth flotation technique.
5. To obtain batch sedimentation data and to calculate the minimum thickner area under given conditions.
6. To determine the specific cake resistance and filter medium resistance of a slurry in plate and frame filter press.
7. To determine the specific cake resistance and filter medium resistance of a slurry in centrifugal filtration.
8. To separate a mixture of particles by jigging.

MANAGEMENT SCIENCE

(Common for all branches)

UNIT I:**INTRODUCTION TO MANAGEMENT**

Concepts of management and organisation – functions of management – evolution of management thought: taylor's scientific management, fayol's principles of management, douglas mc-gregor's theory x and theory y, mayo's hawthorne experiments, hertzberg's two factor theory of motivation, maslow's hierarchy of human needs – systematic approach to management - principles of organisation – types of organisation, types of organisation structure: line organisation, functional organisation and line and staff organisation, matrix organisation – managerial objectives –social responsibilities.

UNIT II:**INTRODUCTION TO OPERATIONS MANAGEMENT**

Types of plant layout – methods of production: job, batch and mass production.
 Work-study: basic procedure involved in method study and work measurement.
 Statistical quality control.
 Materials management-objectives of inventory control – eoq-abc analysis – purchase procedure – stores management and stores records.
 Marketing: marketing vs selling, marketing mix, stages in product life cycle, channels of distribution.

UNIT III:**INTRODUCTION TO HUMAN RESOURCE MANAGEMENT (HRM)**

The concepts of hrm, human resource development (hrd) and personnel management & industrial relations (pmir)-hrm vs pmir, basic functions of hr manager: manpower planning, recruitment, selection, training,

development, placement, wage and salary administration promotion, transfer, separation, performance appraisal, grievance handling and welfare administration, job evaluation and merit reading.

UNIT IV:

INTRODUCTION TO STRATEGIC MANAGEMENT

Corporate planning process: mission, goals, objectives, policy, strategy, programmes-elements of corporate planning process -environmental scanning: external environment analysis, internal environment analysis, swot analysis- stages in strategy formulation and implementation.

UNIT V:

INTRODUCTION TO PERT/CPM

Network analysis- project management - programme evaluation and review technique (pert) vs critical path method (cpm) - identifying critical path-probability of completing the project within given time under pert, project cost analysis, project crashing.

BOOKS FOR REFERENCE:

1. Koontz and O'donnel, *Principles of Management*, McGraw-Hill, 2001.
2. Phillip Kotler, *Marketing Management*, Pearson Education Asia, 2002.
3. Gary Dessler, *Human Resource Management*, Pearson Education Asia, 2002.
4. L.S.Srinath, pert / cpm, affiliated east-west press, New Delhi, 2000.
5. W.Glueck & L.R.Jauch, *Business Policy and Strategic Management*, McGraw-Hill, 1998.
6. A.R.Aryasri, *Management Science for JNTU (B. Tech.)*, Tata McGraw-Hill, 2002.
7. O.P.Khanna, *Industrial Engineering & Management*, Dhanpat Rai, 1999.
8. Chandra Bose, *Management and Administration*, Prentice Hall, 2002.

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MASS TRANSFER OPERATION – II

UNIT – I

Distillation : fields of application, vle for miscible liquid, immiscible liquids, steam distillation, vle phase diagrams, tie lines, mixture rules, flash vaporization and differential distillation for binary and multicomponent mixtures, batch distillation with reflux for binary mixtures.

UNIT – II

Continuous fractionation of binary mixtures, ponchon- savarit method, mccabe thiele methods of determination of ideal plate for binary mixtures, optimum reflux ratio, use of total and partial condensers and open system, plate efficiencies, condenser and reboiler duties, packed bed distillation, principles of azeotropic and extractive distillation.

UNIT – III

Liquid – liquid extraction : fields of applications of ternary liquid systems, triangular and solvent free coordinate systems, choice of solvent selectivity extraction with insoluble and partially soluble systems, single stage and multistage cross extraction with reflux fractional solvent extraction continuos contact extraction (packed beds), equipment for liquid – liquid extraction operation.

UNIT – IV

Leaching : fields of application, preparation of solid for leaching, types of leaching, leaching equilibria, single stage and multistage leaching calculations, constant underflow conditions, equipment for leaching operation.

UNIT – V

Absorption and ion exchange : principles and their applications, types of absorption, use absorbents, absorption equilibria, absorption isotherms for vapors ad dilute solutions, design of a steady state moving bed absorber for absorption of one component, unsteady state absorption, absorption wave and break through curve, fixed bed absorber, equipment for absorption operation, ion exchange.

TEXT BOOK :

Mass transfer operations by R.E.Treybal, 3rd ed. McGraw Hill, 1980.

REFERENCE:

Mass transfer operations by Alapati Suryanarayana

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CHEMICAL REACTION ENGINEERING – I**UNIT – I**

Thermodynamics, chemical kinetics, classification of reactions, variables affecting the rate of reaction, definition of reaction rate.

Kinetics of homogeneous reactions – concentration dependent term of rate equation, temperature dependent term for rate equation, searching for a mechanism, predictability of reaction rate from theory.

UNIT – II

Interpretation of batch reactor data – constant volume batch reactor, variable volume batch reactor, temperature and reaction rate, search for a rate equation.

UNIT – III**INTRODUCTION TO REACTOR DESIGN**

Single ideal reactor – ideal batch reactor, space-time and space-velocity, steady state mixed flow reactor, steady state plug flow reactor, holding time and space time for flow systems.

UNIT – IV

Heterogeneous catalysis: catalyst properties, physical adsorption and chemisorption, adsorption isotherm; derivation of rate equations for various mechanisms (adsorption, surface reactions and desorption controlling etc.,), Data analysis for heterogeneous laboratory catalytic reactors.

UNIT –V

Multiple reactions : design for multiple reactions, parallel reactions, series reactions (omit reversible and series-parallel reactions).

Isothermal packed bed (pfr) reactor design, effectiveness factor and internal pore diffusion, criteria for internal pore diffusion limitation

Non-isothermal design: energy balance equations for batch, pfr and cstr under non-isothermal conditions, equilibrium conversion under adiabatic conditions, design of the homogeneous reactors under adiabatic conditions.

TEX BOOK

Chemical reaction engineering by octave levenspiel, 2nd ed. Wiley Eastern Ltd.

REFERENCE:

1. Elements of chemical reaction engineering by H.S.Fogler, 2nd ed phi, 1992
2. Chemical engineering kinetics by J.M.Smith, 3rd Mcgraw Hill 1981.

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PROCESS DYNAMICS AND CONTROL**UNIT – I**

Response of first order systems
Physical examples of first order systems
Response of first order systems in series,

UNIT – II

Higher order systems and transportation lag
Control systems
Controllers and final control elements
Block diagram of a chemical reactor control systems

UNIT – III

Closed loop transfer functions
Transient response of simple control systems Stability

UNIT – IV

Root locus
Transient response from root locus
Application of root locus to control systems
Introduction to frequency response
Control systems design by frequency response

UNIT – V

Advance control strategies
Cascade control, feed forward control, ratio control, smith predictor, dead time compensation, internal model control Controller tuning and process identification Control valves.

TEXT BOOK

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

REFERENCE :

Chemical process control by G.Stephapoulos, phi, 1998.

MATHEMATICAL METHODS FOR CHEMICAL ENGINEERS**UNIT – I**

Mathematical formulations of the physical problem, formulation of differential equations, application of the laws of conservation of mass and energy summary of stages, rate equations for homogeneous chemical reactions. Flow systems general problem.

UNIT – II

Formulation of partial differential equations, partial derivatives, differentiation of composite function, differentiation formulae, change from cartesian to cylindrical coordinates and spherical coordinates, differentiation of implicit functions, directional derivatives, maxima and minima, formulation of pdes, one dimensional heat conduction problems.

UNIT – III

Vectors, scalar or dot product products, scalar and vector fields, vector differential operators, line integrals, surface integrals, coordinate transformation, mass transfer in binary gas mixtures, equations of motion of perfect fluid.

UNIT – IV

Solutions of pdes heat transfer in a flowing fluid, heat conduction in a slab, unsteady state heat transfer in a sphere, temperature distribution in a rectangular parallel piped, heat condition in a slab of infinite thickness, flow around a sphere.

UNIT – V

Solutions of pdes by laplace transforms, one dimensional unsteady state head conduction, catalytic reaction in a flow system, unsteady state operations of a packed bed.

TEXT BOOK :

Applied mathematics in chemical engineering by H.S.Mickley, T.S.Sherwood and C.Reed, 2nd ed. TMH, 1998.

Mathematical methods in chemical engineering by Jenson. G.G., And G.V.Jeffreys, 2nd ed. Aad. Press, London and New York.

REFERENCE:

Numerical methods for engineering by Steve Chopra McGraw Hill.

**PETROCHEMICAL ENGINEERING
ELECTIVE – I****UNIT – I**

Origin of petroleum : natural gas, composition and application as fuel, petroleum refining, refining of crude petroleum, production of gasoline, kerosene, heating oils an dresidual oils, lubricants, asphalt and solvents.

UNIT – II

History of petrochemical industry and alternative sources, characteristics of pert chemical manufacture, techniques involved, naphtha cracking, alkylation, isomerization and polymerization to produce petrochemicals, and their applications.

UNIT – III

Classification of petrochemicals according to source :

1. Ethylene derivatives
2. Derivatives of higher paraffins

UNIT – IV

3. Propylene derivatives
4. Derivatives of c4 hydrocarbons

UNIT – V

5. Derivatives of higher olefins
6. Derivatives of aromatics

Economic aspects of petro-chemical industry in India.

BOOKS RECOMMENDED :

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, McGraw Hill, 1980.
3. Fundamentals of petroleum chemical technology by P Below
4. Chemicals from petroleum by A.L.Waddams
5. Petroleum processing handbook by William F Bland an Drobot I. Davidson
6. Petroleum technology by List H.I.
7. Petroleum processing part 2 by a. Chauvee and Lefebvre, Gulf publishing company, 1986.
8. Petroleum refining engineering by W.L. Nelson, McGraw Hill, 1987.

**POLYMER ENGINEERING
ELECTIVE – I**

UNIT – I**INTRODUCTORY CONCEPTS AND FUNDAMENTALS :**

- a) Definitions and concepts of plastics and polymers, comers, co-monomer, mesomer, co-polymer, functionality, visco-elasticity
- b) Classification of polymers
- c) Methods of determining molecular weights of polymers (i) methods based on colligative properties (ii) sedimentation velocity method (iii) sedimentation equilibrium method (iv) gel-chromatography method (v) light scattering analysis method (vi) end-group analysis method
- d) Natural polymers : brief study of the following : (i) rubber (ii) shellac (iii) rosin (iv) cellulose (v) proteins (vi) lignins

UNIT – II**CHEMISTRY OF POLYMERIZATION :**

- a) Elementary concepts of addition polymerization, condensation polymerization and co-polymerization.
- b) Glass transition temperature of polymers, methods of determining tg.
- c) Degradation of polymers of the following type
(i) mechanical (ii) hydrolytic (iii) thermal (iv) backbone effects
- d) Relation of the following properties with the structure of the polymer
(i) mechanical (ii) thermal (iii) electrical (iv) physical (v) chemical

UNIT – III

- a) The following methods of polymerization
(i) mass (ii) solution (iii) emulsion (iv) suspension

- b) Roles of the following additives for polymers : (i) initiators (ii) catalysts (iii) inhibitors (iv) solvents (v) fillers (vi) reinforcing agents (vii) stabilisers (viii) plasticisers (ix) lubricants (x) blowing agents (xi) coupling agents (xii) flame retardants (xiii) photo-degradants (xiv) biodegradables.

UNIT – IV

Methods of manufacture, properties and use of the following addition products :

- I) polyethylene (ldpe and hdpe) (ii) polypropylene (iii) pvc and its copolymers (iv) polystyrene and its copolymers (v) acetals (vi) ptfe (polytetra fluorethylene)

Methods of manufacture, properties and uses of the following condensation products : (i) polyesters – pmma, pet and alkyl (ii) pf-, uf- and mf- resins (iii) epoxy resins (iv) polyurethanes (v) silicones

UNIT – V

Description of the following processing methods : (with the principles involved and the equipment used) (i) mixing and compounding (ii) extrusion (iii) calendering (iv) laminating (v) moulding – compression, transfer, injection and blow moulding.

TEXT BOOK :

1. Plastic materials, J.A.Brydson, Newnes – Butterwarths (London) 1989.
2. Text book of polymer science, tillmeyer, f.w.jr. (3rd ed.) John wiley & sons. 1984.

REFERENCE :

1. Introduction to plastics, J.H.Brison and c.c. Gosselin, Newnes, London 1968.
2. Polymeric materials, c.c.winding and g.d.hiatt, McGraw-Hill book co., 1961.

UNIT I

Source of nitrogen and hydrogen, system reformation of hydrocarbons, coal gasification process, partial oxidation of flex oils, gas purification, high and low temperature shift conversion, CO removal processes, methanation.

UNIT II

Manufacture of ammonia, ammonia synthesis by various processes, byproduct ammonia recovery by direct and indirect methods, manufacture of nitric acid.

UNIT III

Production of urea, urea processes, manufacture of other nitrogenous fertilizer such as ammonium sulfate, calcium ammonium nitrate, ammonium chloride etc.

UNIT IV

Phosphatic fertilizers, single and triple super phosphate, manufacture and production of ammonium phosphate and nitrophosphates, manufacture of phosphoric acid.

UNIT V

Potassium fertilizers, mixed and compound fertilizers, liquid fertilizers, Indian fertilizer industry, production economics and future plans, fertilizer application techniques for different soils, controlled release fertilizers.

TEXTBOOKS

1. Chemistry and technology of fertilizers by V.Seucheli, Reinhold 1960.
2. Ammonia by Slack AV. Marcel Dekker, 1973.
3. Manual of fertilizer processing by F T Nielsson, Dekker 1987.

MASS TRANSFER –OPERATIONS LAB

1. Establishment of diffusivities
2. Distillation, a) steam distillation b) Differential distillation.
3. Packed Towers, HETP evaluation
4. Vapor Liquid Equilibria,
5. Hydrodynamics of spray column.
6. Continuous and batch drying
7. Evaluation of mass transfer coefficients
 - a) Surface evaporation
 - b) Wetted wall column
8.
 - a) Liquid – Liquid equilibria
 - b) Ternary Liquid Equilibria (Binodal Curve)

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JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY

HYDERABAD

III year B.Tech (CHE) II Semester

0-3-2 CH3230

PROCESS DYNAMICS AND CONTROL LAB

1. Calibration and determination of time lag of various first and second order instruments
2. Experiments with single and two capacity systems with or without interaction
3. Self and non-self regulation of processes.
4. Surface temperature measurements self and non-self regulations
5. Measurement of gas temperature
6. Experiments on proportional reset, rate mode of control etc.
7. Telemeter, pneumatic electric and hydraulic control sections.
8. Estimation of damping coefficient for u tube manometer.

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JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY

HYDERABAD

IV year B.Tech (CHE) I Semester

4-0-4 CH4121

TRANSPORT PHENOMENON

UNIT – I

Transport properties, estimation of transport properties, pressure, temperature and concentration dependence.

Unit – II

One dimensional transport in solids and laminar flow, formulation of differential equations and shell balance, boundary conditions- velocity, temperature and concentration distributions from shell momentum, energy and mass balances.

UNIT – III

Problems with and without heat generation, problems with and without chemical reaction.

UNIT – IV

Equations of changes, development of differential momentum, energy and mass balances equations.
Solutions for steady state velocity, temperature and concentration distributions using equations of change.

UNIT – V

Equations of change for turbulent flow, time smoothing of equations of change, turbulent fluxes and eddy transport properties.

TEXT BOOK :

Transport Phenomena by Bird R.B., Sterart, W.E. Lighfoot E.N. John Wiley and Sons Inc, USA. 1960.

REFERENCE :

Transport phenomenon for engineers by L. Theodore, International textbook company, USA 1971.

2002 – 2003

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY
HYDERABAD

IV year B.Tech (CHE) I Semester

4-0-4 CH4122

CHEMICAL REACTION ENGINEERING – II

UNIT – I

Non-ideal flow – Residence time distribution of fluid in vessel; conversions directly from tracer information, models for nonideal flow, dispersion (plug flow) model, tanks in series model.

UNIT – II

Mixing of fluids – self mixing of a single fluid mixing of two miscible fluids.

UNIT – III

Introduction to design for heterogeneous reacting systems. Rate equations for heterogeneous reactions, contacting patterns for two phase systems.

Fluid particle reactions – selection of a model, unreacted core model for spherical particles, rate of reaction for shrinking spherical particles, determination of rate controlling steps.

UNIT – IV

Fluid fluid Reactions – The rate equation

UNIT V :

Solid catalyzed reactions – The rate equation, experimental methods, for finding rates, deactivating catalysts – mechanisms of catalyst deactivation, the rate equation.

TEXT BOOK :

Chemical Reaction Engineering by Octave Levenspiel 2nd Ed., Wiley Eastern Ltd.

Chemical Engineering Kinetics by JM Smith, 3rd McGraw Hill.

REFERENCE :

Elements of chemical reaction engineering by H.S.Fogler, 2nd Ed. PHI, 1992.

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JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY
HYDERABAD

IV year B.Tech (CHE) I Semester

4-0-4 CH4123

CHEMICAL ENGINEERING PLANT DESIGN AND ECONOMICS

UNIT I

INTRODUCTION

Process Design Development

UNIT – II

General Design Considerations

Cost and asset accounting

UNIT – III

Cash flow for industrial operations, factors affecting investment and production cost, capital investments, estimation of capital investments, cost indices, cost factors in capital investment, organization for presenting capital investments, estimates by compartmentalization, estimation of total product of cost direction, production costs, fixed charges, plant overhead cost, financing.

Interest and investment cost, type of interest, nominal and effective interest rates, continuous interest, present worth and discount annuities, cost due to interest on investment, source of capital.

UNIT – IV

Taxes and insurance, type of taxes : federal income taxes, insurance – types of insurance, self insurance.

Depreciation : types of depreciation, services life, salvage value, present value, methods for determining depreciation, single and unit and group depreciation.

UNIT – V

Profitability : alternative investments and replacements, profitability standards, discounted cash flow, capitalized cost, payout period, alternative investments, analysis with small investments, increments and replacements.

Optimum design and design strategy, incremental costs, general procedure for determining optimum condition, comparison of graphical and analytical methods, optimum production rates, semi-continuous cyclic operations, fluid dynamics, mass exploration of response surfaces by group experiments.

TEXT BOOK :

Plant design and economics for chemical engineering by M.S.peters and K.D.Timmerhaus, McGraw Hill, 3rd Ed. 1981.

ENVIRONMENTAL ENGINEERING

UNIT – I

Types of emissions from chemical industries and effects of environment, environment legislation, type of pollution, sources of wastewater, effluent guidelines and standards, characterization of effluent streams, oxygen demands and their determination (BOD, COD and TOC), oxygen sag curve, BOD curve mathematical, controlling of BOD curve, self purification of running streams, sources and characteristics of pollutants in fertilizer, paper and pulp industry, petroleum and petroleum industry.

UNIT – II

Meteorological factors in pollution disposal (ALP and ELP), plume behavior and characteristics, chill index and equivalent ambient temperature, chimney design considerations, plume rise, effective stack height, removal of particulate matters, principles and design of settling chambers, solid traps, cyclone separators, fabric and fiber filters, scrubbers and electrostatic precipitators.

UNIT – III

General methods of control and removal of sulfur dioxide, oxides of nitrogen and organic vapors from gaseous effluent, treatment of liquid and gaseous effluent in fertilizer industry.

UNIT – IV

Introduction to wastewater treatment, biological treatment of wastewater, bacterial and bacterial growth curve, aerobic processes, suspended growth processes, activated aerated lagoons and stabilization ponds, attached growth processes, trickling filters, rotary drum filters, anaerobic processes.

UNIT V

Methods of primary treatments : screening, sedimentation, flotation, neutralization, methods of tertiary treatment.

A brief study of carbon absorption, ion exchange reverse osmosis, ultra-filtration, chlorination, ozonation, treatment and disposal

BOOKS RECOMMENDED :

1. Pollution control in process industries by S.P. Mahajan TMH
2. Wastewater Treatment by M.Narayana Rao and A.K.Datta, Oxford and IHB Publ. New Delhi
3. Air pollution control by P.Pratap Mouli and N.Venkata Subbayya. Divya Jyothi Prakashan, Jodhpur
4. Introduction to wastewater treatment by R.S.Ramalho, Academic press, N.Y.
5. Fundamentals of Air Pollution Control by Storn. Academic Press.

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY
HYDERABAD**

IV year B.Tech (CHE) I Semester

4-0-4 CH4125

PROCESS MODELLING AND SIMULATION**UNIT – I**

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

UNIT – II

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

UNIT – III

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

UNIT – IV

Computer simulation, numerical methods, computer programming, iterative convergence methods, numerical integration of ODEs.

UNIT – V

Computer simulation, examples, gravity flow tank, three CSTRs in series, binary distillation column, batch reactor, VLE, dewpoint, bubble point calculations, countercurrent heat exchanger.

TEXTBOOK :

Process modeling simulation and control for chemical engineers by W.L.Luyben, 2nd Ed. McGraw Hill

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JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY
HYDERABAD

IV year B.Tech (CHE) I Semester

4-0-4 CH4126

CORROSION ENGINEERING
ELECTIVE - II

UNIT-I

Introduction: Corrosion Principles, Electro-chemical aspects, environmental effects, metallurgical and other aspects.

UNIT – II

Forms of corrosion : Uniform attack, galvanic, crevice, pitting, intergranular, selective, leaching, erosion and stress corrosion.

UNIT – III

Corrosion Testing procedures

UNIT – IV

Corrosion Prevention : Material selection, alteration of environment, design, cathodic and anodic protection, coating.

Unit – V

Modern Theory : Principles, thermodynamics and electrode kinetics, predicting corrosion behavior, corrosion prevention, rate measurement.

TEXTBOOK :

Corrosion Engineering by M.G Fontana, 3rd Ed. McGraw Hill.

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HYDERABAD

IV year B.Tech (CHE) I Semester

4-0-4 CH4127

BIOCHEMICAL ENGINEERING
ELECTIVE – II

UNIT – I

Introduction to microbiology : biophysics and cell doctrine, the structure of cells, important cell types, RNA and DNA building blocks, proteins from amino acids,

UNIT – II

Kinetics of enzyme catalyzed reactions : The enzymes substrate complex and enzyme action simple enzyme kinetics with one and two substrates. Michaelis – Menture equation, estimation of M-M Parameters – Line waves block plot, enzyme inhibitions – MM- form of equation for enzyme inhibitions.

UNIT – III

Immobilized enzyme technology: enzyme immobilization, immobilization of enzyme in industrial processes, utilization and regeneration of cofactors, biosynthesis, transport across cell membranes, passive and facilitated diffusion, active transport, introduction of metabolic pathways and end products of metabolism.

UNIT – IV

Microbial growth – Monod growth kinetics, substrate and product inhibitions yield coefficients for biomass and products – Growth kinetics in batch fermenter continuos culture of micro organisms in stirred tank fermenters

UNIT – V

Design and analysis of biological reactors : batch reactors, enzyme catalyzed reactions in CSTR, CSTR reactors with recycle and cell growth. The ideal plug flow reactors.

Fermentation technology and industrial fermentation production of antibiotics penicillin, citric acid, bakers yeast and ethanol – Anaerobic fermentation production of biogas continuous sterilization of air and media, aeration and agitation in bio-reactors, scale up concepts.

TEXT BOOK :

Biochemical engineering fundamentals by J.E.Bailey and D.F. Ollis, 2nd edition. 1986 McGraw Hill.

REFERENCE :

Biochemical Engineering by Artsa, Humphrey and Mells, Academic press.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY

HYDERABAD

IV Year B.Tech (CHE) I Semester

4-0-4 CH4128

TECHNOLOGY OF PHARMACEUTICALS AND FINE CHEMICALS**ELECTIVE – II****UNIT I**

A brief outline of grades of chemicals, sources of impurities in chemicals, principles (without going into details of individual chemicals) 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 and fine chemicals- sulfacetamide, paracetamol, methyl orange, riboflavin, nicotinamide, fluorescence, procaine hydrochloride, para amino salicylic acid, isonicotinic acid hydrazide.

UNIT III

Manufacture with flowsheets, properties uses and testing of the following Pharmaceuticals – aspirin, penicillin, calcium gluconate, ferric ammonium citrate, phthalic anhydride and phenol flourobenzene process and benzene sulfate process, other processes in outline only.

UNIT IV

Tablet making and coating-preparation of capsules, extraction of crude drugs.

UNIT V

Sterilization: introduction, risk factor, methods of sterilization, heat (dry and moist), heating with bactericide, filtration, gaseous sterilization and radiation sterilization, suitable example to be discussed.

BOOKS RECOMMENDED

1. Remington's Pharmaceutical science, Mac publishing company, 13th ed. 1965.
2. Textbook of Pharmaceutical chemistry by Blently and driver. Oxford University press, London, 8th ed. 1960.
3. Blently's Textbook of Pharmaceutical Chemistry by H A Rawlins, B Tindell and Box, 8th ed. OU Press, London, 1977.
4. Industrial chemicals by faith, Kayes and Clark, John Wiley & Sons, 3rd Ed. 1965.

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY
HYDERABAD**

IV Year B.Tech (CHE) I Semester

0-3-2 CH4129

CHEMICAL REACTION ENGINEERING LAB

1. Determination of the order of the reaction using a batch reactor and analysing the data by (a) differential method (b) integral method.
2. Determination of the activation energy of a reaction using a batch reactor.
3. To determine the effect of residence time on conversion and to determine the rate constant using a CSTR.
4. To determine the specific reaction rate constant of a reaction of a known order using a batch reactor.
5. To determine the order of the reaction and the rate constant using a Tubular reactor.
6. Determination of RTD and Dispersion number in a Tubular reactor using a tracer.
7. Mass transfer with chemical reaction (solid-liquid system) – Determination of Mass Transfer Co-efficient.
8. Axial mixing in a packed bed. Determination of RTD and the dispersion number for a packed-bed using tracer.

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JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY
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IV year B.Tech (CHE) I Semester

0-3-2 CH4130

PROCESS EQUIPMENT DESIGN AND DRAWING

1. Drawing of flow sheet symbols
2. Drawing of instrumentation symbols
3. Drawing of instrumentation diagrams
4. Process, Design and drawing of following equipment.
 - a) Double pipe Heat ex.
 - b) Shell and tube Heat ex
 - c) Evaporator
 - d) Distillation colour
 - e) Absorption packed colour
 - f) Batch reactor

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IV year B.Tech (CHE) II Semester

4-0-4 CH4221

SAFETY AND HAZARD ANALYSIS
ELECTIVE – III

UNIT I

Why safety? What makes safety? Chemical Hazards and worker safety, safty aspect of the site selection, plant layout and unit plot.

UNIT II

Hazards of commercial chemical reactions and operations

UNIT III

Process design, instrumentation for safe operations, safety education and training.

UNIT IV

Effect of toxic agents, flammable materials, respiratory hazards and protection (only brief introduction)

UNIT V

Other personnel protective equipment, fire extinguishing agents and their applications, measuring safety effectiveness.

TEXTBOOKS:

Safety and accident prevention in chemical operations by Feweett H.H. and W.S Wood, John Wiley and Sons, Inc. 1965.

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HYDERABAD**

IV year B.Tech (CHE) II Semester

4-0-4 CH4222

**MEMBRANE TECHNOLOGY
ELECTIVE – III**

UNIT I

Introduction to barrier separation processes, principles of dialysis, electrodialysis, reverse osmosis, ultrafiltration, and gas permeation, comparison with conventional separation processes.

UNIT II

Membranes : synthetic membranes for various processes, classification and methods of preparation, structural properties, liquid membrane.

UNIT III

Dialysis : Solute transport, augmentation with chemical reaction, industrial dialyzers, applications

Electrodialysis . Electrodialysis with neutral and ion exchange membranes, ion transport, cells for electrodialysis, applications.

UNIT IV

Reverse Osmosis : Osmosis and reverse osmosis, concentration polarization, exsolvent and solute transport applications.

UNIT V

Transport of gases through membranes, permeability, potential applications.

TEXTBOOKS:

1. Progress in separation and purification vol. 1, E.S. Perry, Interscience publ. 1968.
2. Progress in separation and purification vol. 3, E.S. Perry and C.J. Van Ness, Interscience publ. 1970.
3. Synthetic polymeric membranes by R.E. Kesting, McGraw Hill 1971.
4. Diffusion and Membrane technology by S.B. Tuwiner, Reinhold publ. 1962.

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IV year B.Tech (CHE) II Semester

4-0-4 CH4223

COMPUTER APPLICATIONS IN CHEMICAL ENGINEERING
ELECTIVE – IV

Note : Application of the following techniques for problems of interest in chemical engineering, writing and testing of programs written in C languages.

UNIT I

Numerical solution of first order differential equations with initial condition, Euler's method, Runge-Kutta method.

UNIT II

Systems of liner equations, solution by the method of determinants, matrix inversion for the solution of linear equations, Guass elimination method.

UNIT III

Roots of algebraic and transcendental equation, iteration methods, regula-falsi method, newton-raphson method, roots of simultaneous and solution set of transcendental and algebraic equations. Development of equations for heat transfer, fluid mechanics and reaction engineering problems.

2002 – 2003

UNIT IV

Regression Analysis-least square, error approach, approximation by chebychev orthogonal plynomical.

UNIT V

Elements of optimization techniques, single variable function optimization-direct search, with and without acceleration, method of regular intervals and fibonacci search méthod, gradient methods.

TEXT BOOK

Digital Computation for Chemical Engineers by Leon Lapidas, McGraw Hill, 1962.

OPERATIONS RESEARCH
ELECTIVE –IV

UNIT – I

Development – Definition – Characteristics and phases – Scientific method – Types of models – General methods for solving operations research models.

Allocation : Linear programming problem formulation – Graphical solution – Simplex method – Artificial Variables technique – Quality principle.

UNIT – II

Transportation problem – Formulation – Optimal solution, unbalanced transportation problem – degeneracy assignment problem – Formulation – Optimal solution – variations i.e. non-square ($m \times n$) Matrix.

Sequencing : Introduction – Optimal solution for processing 'n' jobs through two machines and 'n' jobs through machines – Processing two jobs through 'm' machines – travelling salesman problem i.e. shortest acyclic.

UNIT – III

Replacement : Introduction – Replacement of items that deteriorate with time – when money value is not counted and counted – replacement of items that fail completely, group replacement.

Theory of games. Introduction – Minimax (maximin) – Criterion and optimal strategy – Solution of games with saddle points – Rectangular games without saddle points.

UNIT – IV :

Waiting Lines : Introduction – Single channel – Poisson arrivals, exponential services times, unrestricted queue, with infinite population and with finite population models – Single channel, Poisson arrivals, exponential services times with infinite population and restricted queue – Multi-channel, poisson arrivals, exponential service times with infinite population and unrestricted queue.

UNIT – V:

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Inventory : Introduction – Single item – Determine models, Production is instantaneous or at a constant rate, shortage and allowed or not allowed or not allowed and withdrawals from stock is continuous – Purchase inventory models with one price break, and multiple price breaks, shortages are not allowed – Stochastic models, demand may be discrete variable or continuous variable – Instantaneous production. Instantaneous demand and no set up cost.

Dynamic programming : Introduction – Bellman's Principle of optimality – Solution of problems with finite number of stages.

TEXT BOOKS :

1. Operation Research : Methods and Problems by Maurice. Casion, Arthur Yaspan and Lawrence Friedman.
2. Operations Research by Taha
3. Operations Research by Wagner,

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IV year B.Tech (CHE) II Semester

4-0-4 CH4225

**OPTIMIZATION OF CHEMICAL PROCESSES
ELECTIVE – IV**

UNIT I

Nature and organization of optimization problems, fitting models to data, formulation of objective functions.

UNIT II

Basic concepts of optimization, optimization of unconstrained function, one dimensional search.

UNIT III

Linear programming and applications

UNIT IV

Optimization recovery of waste heat, shell tube heat exchanger, evaporator design, liquid-liquid extraction process, optimal design of staged distillation column.

UNIT V

Optimal pipe diameter, optimal residence time for maximum yield in a ideal isothermal batch reactor, chemostat, optimization of a thermal cracker using linear programming.

TEXT BOOK

Optimization of Chemical Process by TF edgat and Himmelblau DM.
Mcgraw Hill 1988.

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HYDERABAD**

2002 – 2003

IV year B.Tech (CHE) II Semester

4-0-4 CH4226

**INDUSTRIAL ENTREPRENEURSHIP AND MANAGEMENT
Elective – IV**

UNIT - I

Entrepreneurship : concept, need its existence in India and abroad, traits of an entrepreneur, development of entrepreneurial talents, motivation, achievement, risk taking, goal setting, creativity obligation, pitfalls and steps for successful Entrepreneurship.

UNIT II

Entrepreneurship education and role of institutions, Entrepreneurship development through promotional organization, concept and growth of such organizations specially with respect to state.

UNIT – III

Product development and research preparation of project report, decision making, forms of ownership organization structure, production planning and control, marketing.

UNIT – IV

Working capital management, operation and control through budget, inventroy control, motion and time study, job evaluation.

UNIT – V

Industrial psychology, industrial safety, labor disputes, labor welfare and morale,leadership – development and training of managers.

TEXT BOOKS :

1. Industrial Engineering and management by OP Khanna, Reprinted.
1998.
2. Management of small scale industry by Vasant Desai, 3rd Ed,
1986, Himalaya Publishing House Bombay
3. Industrial organization and management by S.A.Sherlekar, July 1979.

REFERENCE :

1. Essential of Management by Kootz and Donnel, THM 1975.
2. Handbook of Industrial Eng. and management by Grant and Grant
Personnel Administration by C.A. Myers, 8th Ed. 1977.