UNIVERSITY OF MUMBAI
No.UG /358 of 2008

CIRCULAR :-

A reference is invited to the Ordinances, Regulations and syllabi relating to the Bachelor of Engineering degree course **vide** this office Circular No. UG/347 of 2002 dated 17th August, 2002 and the Principals of the affiliated collages in Engineering are hereby informed that the recommendation made by the Dean, Faculty of Technology at its meeting held on 26th March, 2008 has been accepted by the Academic Council at its meeting held on 13th June, 2008 **vide** item No.4.3 and that, in accordance therewith, the scheme and syllabus prescribed for S.E. (Chemical Engineering) (Sem.III and IV) of the B.E. degree course is revised as per **Appendix** and that the same has been brought into force with effect from the academic year 2008 – 2009.

MUMBAI-400 032
4th August, 2008

PRIN.K.VENKATARAMANI
REGISTRAR

To,

The Principals of the affiliated colleges in Engineering.

A.C./4. 3/13.06.2008

No.UG/358 - A of 2008, MUMBAI-400 032 4th August, 2008

Copy forwarded with compliments for information to :-

1) The Dean, Faculty of Technology
2) The Chairman,Board of Studies in Chemical Engineering .
3) The Controller of Examinations,
4) The Co-Ordinator, University Computerization Centre,

(D. H. KATE)
DEPUTY REGISTRAR
(U.G.7.3.Section.)

Copy to :-

The Director, Board of College and University Development, , the Deputy Registrar (Eligibility and Migration Section), the Director of Students Welfare, the Executive Secretary to the Vice-Chancellor, the Pro-Vice-Chancellor, the Registrar and the Assistant Registrar, Administrative sub-center, Ratnagiri for information .

The Controller of Examinations (10 copies), the Finance and Accounts Officer (2 copies), Record Section (5 copies), Publications Section (5 copies), the Deputy Registrar, Enrolment, Eligibility and Migration Section (3 copies), the Deputy Registrar, Statistical Unit (2 copies), the Deputy Registrar (Accounts Section), Vidyanagari (2 copies), the Deputy Registrar, Affiliation Section (2 copies), the Director, Institute of Distance Education, (10 copies) the Director University Computer Center (IDE Building), Vidyanagari, (2 copies) the Deputy Registrar (Special Cell), the Deputy Registrar,(PRO) . the Assistant Registrar, Academic Authorities Unit (2 copies)and the Assistant Registrar, Executive Authorities Unit (2 copies) . They are requested to treat this as action taken report on the concerned resolution adopted by the Academic Council referred to in the above Circular and that, no separate Action Taken Report will be sent in this connection. the Assistant Registrar Constituent Colleges Unit (2 copies), BUCT(1 copy), the Deputy Account, Unit V(1 copy). the In-charge Director, Centralize Computing Facility (1 copy), the Receptionist (1 copy), the Telephone Operator (1 copy), the Secretary MUASA (1 copy), the Superintendent, Post-Graduate Section (2 copies), the Superintendent, Thesis Section (2 copies)

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Enclosure to Item No. 4.3
13/6/08

UNIVERSITY OF MUMBAI

Revised Syllabus

and Scheme of Examinations

For

The Second Year

.(Semester III and IV)

Of the

B.E. Degree Course

in Chemical Engineering

(With effect from the academic year 2008-2009)

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SCHEME OF INSTRUCTIONS AND EXAMINATIONS

UNIVERSITY OF MUMBAI

COURSE: BE (CHEMICAL ENGINEERING) (R-07) **SEMESTER: III**

YEAR:SE

S. No.	Subject	Scheme of Instructions 1 Hr. Periods			Duration of Papers Hrs	Scheme of Examination				
		Lecture	Practical	Tutorial		Theory Paper	Term Work/ Assignment	Practical	Oral	Total
3.1	Applied Mathematics-III	4	-	1*	3	100	25	-	-	125
3.2	Advanced Chemistry-I	4	3	-	3	100	25	25	-	150
3.3	Electronics & Electrical Engineering	4	3	-	3	100	25	25	25	175
3.4	Computer Application	4	3	-	3	100	25	25	-	150
3.5	Process Calculations	4	-	2	3	100	25	-	25	150
3.6	Presentation & Communication Techniques	2	2	-	—	-	50	-	—	50
	TOTAL	22	11	3	-	500	175	75	50	800

COURSE: BE (CHEMICAL ENGINEERING) (R-07) **SEMESTER: IV**

YEAR:SE

S. No.	Subject	Scheme of Instructions 1 Hr. Periods			Duration of Papers Hrs	Scheme of Examination			
		Lecture	Practical	Tutorial		Theory Paper	Term Work/ Assignment	Practical with Oral	Total
4.1	Applied Mathematics-IV	4	-	1*	3	100	25	-	125
4.2	Advanced Chemistry-II	4	3	-	3	100	25	25	150
4.3	Fluid Flow	4	3	-	3	100	25	25	150
4.4	Strength of Material & Fabrication Technology	4	3	-	3	100	25	-	125
4.5	Material Science & Technology	3	-	2	3	100	25	-	125
4.6	Plant Utilities	3	-	1	3	100	25	-	125
	TOTAL	22	9	4	-	600	150	50	800

* The TUTORIAL for Mathematics should be conducted classwise and NOT batch wise.

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CLASS: S.E. CHEMICAL ENGINEERING

SUBJECT: Applied Mathematics- III — Semester – III

Periods Per Week (Each of 60 min.)	Lectures	04	
	Practical	---------	
	Tutorial	01	
		Hours	Marks
Evaluation System	Theory Examination	03	100
	Practical and Oral Examination	-----	----
	Oral Examination	-----	
	Term Work		25
	Total		125

Detailed Syilabus		Lectures
3.1.1	Module 1 **Laplace Transform** 3.1.1.1 Definition, properties of linearity, Laplace transform of elementary function, Properties of Laplace transform (First and Second Shifting property). 3.1.1.2 Theorem on Laplace Transform L[t^n f(t)], L[f(t)/t], L[∫f(u)du], L[f(at)], L[d/dt(f)] (With proof)	10
3.1.2	Module 2 **Inverse Laplace Transform** 3.1.2.1 Definition, Inverse Laplace Transform by using partial fraction method, Convolution Theorem (without proof) 3.1.2.2 Applications to solve boundary value problem involving ordinary differential equations with one independent variable, Applications to chemical engineering	08
3.1.3	Module 3 **Laplace Transform and Matrices** 3.1.3.1 Laplace Transform of periodic functions Heaviside unit step functions, Dirac delta function 3.1.3.2 Types of Matrices Adjoint of Matrices, Inverse of Matrix	08
3.1.4	Module 4 **Matrices** 3.1.4.1 Rank of Matrix Elementary transformation of matrix, Linear dependent and independent of	

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	rows and columns of a matrix over a real field. 3.1.4.2 Reduction of normal form, Homogeneous linear equations and non-homogenous equations, their consistency	08
3.1.5	Module 5 **Complex Variable** 3.1.5.1 Functions of complex variable, Continuity (only statement), Derivability of a function, Analytic functions, C-R equations in Cartesian and polar (with proof), Harmonic functions. 3.1.5.2 Orthogonal trajectories, Analytical and Milne-Thomson method to find f(z) 3.1.5.3 Mapping, Conformal mapping, Bilinear transformation, Cross ratio preservation property (with proof)	14
3.1.6	Module 6 **Bessels Equation** 3.1.6.1 Bessels Equation and functions (without proof), Equations reducible to Bessel form, Method of solving the equations and conditions for the four types of Bessels and modified Bessels equations and functions. 3.1.6.2 Recurrence Relations for Bessels functions. Applications to Chemical engineering e.g. heat transfer for an extended surface.	12

Theory Examination:

1. Question paper will comprise of 7 questions, each of 20 marks.
2. Only 5 questions need to be solved.
3. Question 1 will be compulsory and it will be based on entire syllabus.
4. Remaining questions will be mixed in nature. (for example if Q2 has part (a) from module 3 then part (b) will be from any module other than module 3.)
5. In question paper, weightage of each module will be proportional to number of respective lecture hours as mentioned in the syllabus.

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Term Work:

Term Work will be in the form of Journal which will consist of minimum six tutorial assignments covering the entire portion and a written test paper. The distribution of marks for term work shall be as follows:-

Journal	: 10 marks
Test	: 10 marks
Attendance (Practical & Theory)	: 05 marks

The final certification and acceptance of the term work ensure the satisfactory performance of practical work and minimum passing of the term work.

Books for Reference

1. Mathematical Methods in Chemical Engineering by Jenson V.G. & Jeffrey G.V. – Academic Press 1970
2. Mathematical Methods in Chemical Engineering by Pushpacanam S.. Prentice Hall of India 1998.
3. A Text Book of Applied Mathematics by P.N. & J.N. Wartikar (Volume 1 & 2)
4. Laplace Transforms by Lipschutz S. – Schaum's Outline Series.
5. Higher Engineering Mathematics bY Dr. B.S. Grewal.

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CLASS: S.E. CHEMICAL ENGINEERING			Semester -- III
SUBJECT: Advanced Chemistry - I			
Periods Per Week (Each of 60 min.)	Lectures	04	
	Practical	03	
	Tutorial	----------	
		Hours	Marks
Evaluation System	Theory Examination	03	100
	Practical Examination	03	25
	Oral Examination	-----	
	Term Work		25
	Total		150

Detailed Syllabus		Lectures
3.2.1	Module 1 **Chemical Bonding and Molecular Structures** 3.2.1.1 Ionic and convalent bonds, Exceptions to Octet rule, Resonance, Variable Valency, Hydrogen band, Valence band-Theory, Crystal field theory, Ligand field theory, Structures of molecules with lone pair electrons, H_2O, MH_3, BR F_3, SF_4, PCl_3, PCl_5, Molecular orbital theory, Non-bonding and antibonding orbitals, LCAO method, VSEPR theory, Molecular orbital structures of homonuclear and heteronuclear molecules H2, HC2, BC2, B2, C2, N2, O2, F2, CO, HF, NO2. Metallic band, Bloch's theory, Pauling theory.	10
3.2.2	Module 2 **Co-ordination Chemistry** 3.2.2.1 Co-ordination dative band, complexions, co-ordinations number or ligancy, Werner's co-ordination theory, Effective Atomic number. No menclatures and isomerism in co-ordination compounds with respect to co-ordination number 4 and 6. Application of CFT to tetrahedral and octahedral complexes, Drawbacks of CFT, MOT as applied to the octahedral complexes of Fe and Ni, Measurement of CFSE (10 D2) Numericals based on EAN and 10 D2 measurement.	10
3.2.3	Module 3 Organometallic Compounds 3.2.3.1 Chemistry of Fe-carbonyls with respect to	

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	preparation, properties, structure and bonding 3.2.3.2 **Bi-inorganic Chemistry of iron** Classification of biomolecules containing metalions, Bio-Chemistry of proteins containg Cu, Fe and Zm. Chemistry of cytochromes and their applications. O2 atom transfer reactions of biomo'ecular reaction containing Fe.	10
3.2.4	Module 4 **Dyes and Drugs** 3.2.4.1 **Dyes** – Sensation of colour, colour and constitution, nomenclature, classification based on chemical composition and mode of application. Synthetic and uses of (1) Fast Printing Green (2) Methyl Orange (3) Methyl red (4) congored (5) Alizarin 3.2.4.2 **Drugs** – Synthesis and uses of (1) Ibuprofen (2) Aspirin (3) Vitamin – C (4) P-nitro aniline (5) O-Chlorobenzoic acid	08
3.2.5	Module 5 **Electrochemistry** 3.2.5.1 Introduction –conductance, Effect of temperature on conductivity, mobility of ions, transport number and it's determination, theories of electrolytic conductance, Debye Huckel theory of strong electrolytes, concentration cells with and without transference, standard cells, standard electrode potential, reference electrode. Use of EMF measurements and other techniques for determination of dissociation constancies of acids and bases, solubility product, hydrolysis constand, hydrogenion concentration, theory of acid base indicators, Electrometric titrations.	12
3.2.6	Module 6 3.2.6.1 Reactions, mechanisms and Industrial applications of Pinacol-Pinacolone rearrangement, Michel reaction, Deckmann Condensation, Benzil-Benzilic acid rearrangement, Beckmann, Darzan reactions, Fischer-Indole synthesis, Mecrmin pondroff reaction and Oppenauer oxidation.	10

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Theory Examination:

1. Question paper will comprise of 7 questions, each of 20 marks.
2. Only 5 questions need to be solved.
3. Question 1 will be compulsory and it will be based on entire syllabus.
4. (One Question will based on one modules) in this way there will be remaining six questions of 20 marks each out of Four will have to solve.

Term Work:-

Students are expected to perform at least 09 experiments from the followings. One test examination and five assignments are necessary for the complete term work.

Journal	10 marks
Test	10 marks
Attendance	5 marks

Practicals:-

a. Inorganic Qualitative Analysis (four radicals) at least – 5
b. Analysis of Compounds
   i) Analysis of talcum powder for Mg content by EDTA method.
   ii) Analysis of Aspirin as per I.P. or USP
   iii) Determination of Fluoride content in the toothpaste Spectrophotometrically.
   iv) Estimation of CaO in cement.
c. Organic Estimation
   i) Estimation of Aniline
   ii) Estimation of Phenol
   iii) Estimation of Acetamide
d. Gravimetric Estimation
   i) Ba as $BaSO_4$
   ii) Sa as SnO_2
e. Synthesis of Compound
   i) Tetramine copper (II) complex $[Cu(NH_3)_4]$
   ii) Acetyl Salicylic acid (Aspirin)
   iii) M-dinitrobenzene
   iv) Sodium thio sulphate
   v) Methyl Salicylate

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Reference Books for Advanced Chemistry I & II

vi) Industrial Chemistry, B.K. Sharma, Goel Publishing House (2006)

vii) Vogel's Textbook of Quantitative Chemical Analysis, Gogel A-I, ELS Longman (1991)

viii) Vogel's Text book of Practical Organic Chemistry

ix) A Textbook of physical chemistry, kapoor (Vol 1,2 &3), Macmillan India Ltd (1991)

x) A Textbook of Physical Chemistry, Glasston Samuel, Macmillan India Ltd (1991)

xi) Physical Chemistry, Castellan G.W., Addison Heslay-Haroda Students Edition (1994)

xii) Basic Physical Chemistry, Mooro, PHI

xiii) Principals of Physical chemistry –Puri and Sharma

xiv) Advanced Chemistry – Skoog and West

xv) Advanced Chemistry – Mathews

xvi) Organic Chemistry, Finar I.C. Vol- 1 & 2- ELBS Longman (1994)

xvii) Organic Chemistry, Morrison & Boyd PHI Ltd.

xviii) Instrumental methods of Analysis, B.K. Sharma, Go... ublishing house

xix) A Guide book to mechanism in organic chemistry, Skyobpotor, Longman

xx) A primer to mechanism inorganic chemistry, Skyobpotor Longman

xxi) Organic Reactions and Reagents – O.P. Agrawal, Goel Publishing house

xxii) Organic Reactions and Reagents – Chatwaal

xxiii) Instrumental methods of Analysis, Willard, Merritt, CBS publishers and distributors.

xxiv)

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CLASS: S.E. CHEMICAL ENGINEERING

SUBJECT: Electrical and Electronics Engineering — Semester – III

Periods Per Week (Each of 60 min.)		
	Lectures	04
	Practical	03
	Tutorial	----------

Evaluation System	Theory Examination	Hours	Marks
	Practical Examination	03	100
	Oral Examination	02	25
	Term Work	-----	25
	Total		25
			175

	Detailed Syllabus	
3.3	**Module 1** **D.C.Machines** **3.3.1.1 D.C.Generator** Constructional details, types (shunt, series & compound), principle of working, emf equation, characteristics. **3.3.1.2 D.C.Motor** Motoring action, significance of back emf, torque and speed equations, torque-armature current, speed-armature current and torque-speed characteristics of different types of motors, speed control, starter, applications.	12
3.3.2	**Module 2** **3.2.2.1 Induction Motor** Rotating magnetic field, construction and principle of operation, slip, rotor frequency, torque-slip characteristic, relationship between slip and rotor copper loss, speed control, starting methods, motor ratings.	10
3.3.3	**Module 3** **3.3.3.1 Fractional Horse Power Motors** Construction and principle of operation of single phase induction motor, types of single phase induction motor (resistance split phase, capacitance split phase) and their applications. Shaded pole induction motor.	08

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3.3.4	**Module 4** **Synchronous Machines** **3.3.4.1 Alternator** Constructional features and principle of operation, synchronous speed, regulation. **3.3.4.2 Synchronous Motor** Principle of operation, method of starting and applications.	06
3.3.5	**Module 5** **3.3.5.1 Switchgear, Measuring Instruments and Utilization of Power.** Autotransformer, Construction and principle of current and potential transformer, Introduction to relays, contactors, isolators and HRC fuses. Principle and working of circuit breakers. Introduction of Induction and Dielectric Heating.	08
3.3.6	**Module 6** **3.3.6.1 Electronics** Diode rectifiers and filter, transistor characteristics and its three configurations (CE, CB, CC). Transistor as an amplifier. Opto-electronic devices(e LDR, Photo transistors, Photodiode). SCRs (Silicon controlled Rectifier) and its application to control speed of motors. Cathode Ray Oscilloscope. A preliminary level treatment for introduction to digital electronics (number system and basic gates).Basic architecture block diagram of microprocessor 8085.	16

Theory Examination:

1. Question paper will comprise of total 7 questions, each of 20 marks.
2. Only 5 questions need to be solved.
3. Q.1 will be compulsory and based on the entire syllabus.
4. Remaining questions will be mixed in nature.
5. In question paper weightage of each module will be proportional to the number of respective lecture hours as mentioned in the syllabus

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Books Recommended:

1. I. J. Nagrath, D. P. Kothari, *Electrical Machines*, 2nd ed., Tata McGraw Hill, New Delhi 1997.
2. Bobrow, Leonard S., *Fundamentals of Electrical Engineering*, 2nd ed.,Oxford University Press, New Delhi, 2003.
3. Dr. P. S. Bhimbra, *Electrical Machinery*, 5th ed., Khanna Publishers, New Delhi 1997.
4. M. G. Say, *The performance and Design of Alternating Current Machines*, 3rd ed., CBS Publisher and Distributor, Delhi, 1983.
5. Openshaw Taylor, *FHP Mototors*, Addison Wesley 1976.
6. J Millman and C.C. Halkias, *Electronics Devices and Circuits*, Tata McGrawHill, 1994.
7. Bhag S. Guru & Huseyin R. Hiziroglu, *Electric Machinery and Transformers*, 3rd ed.,Oxford University Press, New Delhi, 2000.
8. A. Malvershead, *Electronic Devices and Circuits and Introduction*, Prentice Hall of India Private Limited, 1993.
9. Sunil S.Rao, "*Switchgear and protection*," 9th ed., Khanna Publishers, Delhi 1988.
10. S. L. Uppal, "*Electrical Power*," 13th ed., Khanna Publishers. Delhi 1988.

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Practical and Oral Examination:

Practical examination will be based on one experiment performed from the list of experiments given in the syllabus based on 25 marks and the oral will be based on entire subject based on 25 marks.

Term work:

Term work consists of minimum eight experiments and a written test. The distribution of the term work shall be as follows.

Laboratory work (Experiments and Journal)	:10 marks
Test (at least one)	:10 marks
Attendance (Practical and Theory)	:05 marks

The final certification and acceptance of term-work ensures the satisfactory performance of laboratory work and minimum passing in the term-work.

List of Laboratory Experiments:

1. Speed control of DC shunt motor by armature voltage and flux control method.
2. Load test on DC shunt motor.
3. Load test on DC series motor
4. Speed control of 3 phase slip ring induction motor by adding the external resistance in the rotor circuit
5. Starting of Induction motor by D.O.L., autotransformer, star/delta and rotor resistance starter.
6. Study of different types of Fractional Horse Power Motors.
7. Study of D.C. machine starter
8. Study of various circuit breakers, contactors and relays
9. Half / full wave rectifiers (using diode) with filters.
10. Input and output characteristics of BJT.
11. Characteristics of SCR.
12. Study of CRO.
13. Study of Induction and Dielectric Heating

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LASS: S.E. CHEMICAL ENGINEERING		Semester – III	
UBJECT: Computer Application			
eriods Per Week (each of 60 min.)	Lectures	04	
	Practical	03	
	Tutorial	NIL	
		Hours	Marks
valuation System	Theory Examination	03	100
	Practical Examination		25
	Oral Examination	------	----
	Term Work	------	25
	Total		150

Detailed Syllabus		Lectures
3.4.1	Module 1 **Introduction:** 3.4.1.1 Software Evolution, Algorithm, Flowchart, Approaches to Modular Design, Software Development Life Cycle and Object Oriented Paradigm 3.4.1.2 Opening and Closing Data Files (File Access Options), Creating a Data File and Accessing a Data File.	10
3.4.2	Module 2 **Basic Concepts in Data Base Management Systems (DBMS).** 3.4.2.1 Database System Application, File Structure Versus DBMS, Database Languages, Database User and Administrator, E-R Diagrams and Reduction of E-R to the Relational Scheme. 3.4.2.2 **Introduction to Visual Programming:** Case study in Visual Basic: Form Designing by Active Data Object (ADO), Open Database Connectivity (ODBC) with Excel and Application to the Chemical Engineering Problem	10
3.4.3	Module 3 **Introduction to MATLAB:** 3.4.3.1 Introduction; Tutorial Lessons: A minimum MATLAB Session, Creating and working with Arrays of numbers, Creating and printing simple plots, Creating, saving and executing a script file, Creating and executing a function file, Working with files and directories, and Publishing reports;	

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	Interactive Computations: Matrices and Vectors, Matrix and Array Operations, Vectorization, Command line functions, Using built-in functions and on-line help, Saving and loading data and Plotting simple graphs; Programming in MATLAB: Scripts and Functions; Applications; Graphics: 2-D and 3-D plots.	14
3.4.4	**Module 4** **Introduction to Robotics:** 3.4.4.1 Automation, Specification of Robot NC and CNC Machine, Advantages, Disadvantages, Basic Concepts of Artificial Intelligence, Expert System and Its Applications to Chemical Engineering.	06
3.4.5	**Module 5** **Numerical Methods:** 3.4.5.1 Solution of Algebraic and Transcendental Equations, Bisection Method, Method of False Position, Iteration Method, Secant Method, Newton Raphson Method, Muller's Method, The Quotient Difference Method and Solution of Systems Nonlinear Method	10
3.4.6	**Module 6** **Interpolation:** 3.4.6.1 Errors in Polynomial Interpolation, Finite Differences, Detection of Errors by Use of Difference Tables, Newton's Formula for Interpolation, Central Difference Interpolation Formula, Practical Interpolation, Interpolation with Unevenly spaced points, Divided Differences and their properties, Inverse Interpolation and Double Interpolation. 3.4.6.2 **Curve Fitting, Cubic Splines and Approximation:** Least Squares Curve Fitting Procedures, Data Fitting with Cubic Splines, Approximation of Functions.	10

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Practicals:

1. Two programs based on Data Files
2. Two programs for Basic Concepts of Excel
3. Two programs based on Visual Basic and Excel Connectivity
4. Two programs based on MATLAB
5. Four programs of Numerical Methods using MATLAB

Theory Examinations:

1. Question paper will comprise of 7 questions, each of 20 marks.
2. Only 5 questions need to be solved.
3. Question 1 will be compulsory and it will be based on entire syllabus.
4. (One Question will based on one modules) in this way there will be remaining six questions of 20 marks each out of Four will have to solve.

Practical Examinations:

Practical examination will be based on one programme performed from the list of Programme given in the syllabus based on 25 marks

Term work:

Term work consists of minimum eight Programmes and a written test. The distribution of the term work shall be as follows.

Laboratory work (Experiments and Journal)	:10 marks
Test (at least one)	:10 marks
Attendance (Practical and Theory)	: 05 marks

The final certification and acceptance of term-work ensures the satisfactory performance of laboratory work and minimum passing in the term-work.

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Books Recommended:

1. Balguruswamy, *Object Oriented Programming with C++*, 2nd Ed., Tata Mc-Graw Hill (2005).
2. Silberschatz; A., Korth, H. F. and Sudarshan, S., *Database System Concepts*, 5th Ed., Mc-Graw Hill (2004).
3. Gary Cornell, *Visual Basic 6.0*, Tata Mc-Graw Hill (1998).
4. Rudra Pratap, *Getting Started with MATLAB 7*, 1st Ed., Qxford University Press (2006).
5. Manjunath, *Robotics*, 2nd Ed., Tata Mc-Graw Hill (2005).
6. Sastry, S. S., *Introductory Methods of Numerical Analysis*, 3rd Ed., Prentice Hall of India (1998).
7. Rajaraman, V., *Computer Oriented Numerical Methods*, 2nd Ed., Prentice Hall of India (1991).
8. Kandasamy, P., Thilagavathy, K. and Gunavathy, K., *Numerical Methods*, 2nd Ed., S. Chand and Company Limited (2003).

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CLASS: S.E. CHEMICAL ENGINEERING — Semester – III

SUBJECT: Process Calculations

Periods Per Week (Each of 60 min.)	Lectures	04	
	Practical	----------	
	Tutorial	02	
		Hours	Marks
Evaluation System	Theory Examination	03	100
	Practical Examination	---------	
	Oral Examination		25
	Term Work		25
	Total		150

Detailed Syllabus		Lectures
3.5.1	Module 1 3.5.1.1 Introduction 3.5.1.2 Units And Dimensions Various systems of units, conversion of units from one system to other 3.5.1.3 Basic Chemical Calculations Density, specific volume, specific gravity, concentrations & composition of mixtures and solutions. Density of gases & vapors using Ideal Gas law & Van der Waals equation of state. Dalton's law, Amagat's law, concept of VLE, Raoult's law, Henry's law.	14
3.5.2	Module 2 3.5.2.1 Material Balance (For Unit Operations) General material balance equation, degree of freedom analysis for individual units, solving material balance problems for various unit operations using steady state equation	10
3.5.3	Module 3 3.5.3.1 Material Balance for Unsteady Processes.	04
3.5.4	Module 4 3.5.4.1 Material Balance (For Processes Involving Chemical Reactions)	08
3.5.5	Module 5 3.5.5.1 Recycle, Bypass and Purge Calculations (For topic 4 & 6) 3.5.5.2 Psychrometry Humidity and saturation	10

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	Psychrometric chart, basic calculations using psychrometric chart	
3.5.6	Module 6 3.5.6.1 Energy Balance Heat capacity, sensible heat, latent heat, calculation of enthalpy changes General energy balance equation Energy balance for processes involving chemical reaction including adiabatic reactions & combustion processes. 3.5.6.1 Material And Energy Balance for complete process/ flow sheet Formulation of equations and DOF analysis, use of spreadsheet software like MS Excel® for calculations	14

Tutorials

Minimum Number of Tutorials Conducted Must Be 10.

At least one Tutorial must be given on the each Topic.

Theory Examinations:

1. Question paper will comprise of 7 questions, each of 20 marks.
2. Only 5 questions need to be solved.
3. Question 1 will be compulsory and it will be based on entire syllabus.
4. (One Question will based on one modules) in this way there will be remaining six questions of 20 marks each out of Four will have to solve.

Term Work:

Term work consists of minimum eight assignments and a written test. The distribution of the term work shall be as follows,

Assignments and Journal	: 10 marks
Test (at least one)	: 10 marks
Attendance (Practical and Theory)	: 05 marks

The final certification and acceptance of term-work ensures the satisfactory performance of laboratory work and minimum passing in the term-work.

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Books for References

1. Basic Principles & Calculations in Chemical Engineering- D. M. Himmmelblau, Prentice Hall of India Pvt. Ltd.
2. Stoichiometry- Bhatt, B. I. U., Vora S. M.; Tata McGraw Hill
3. Process Calculation for Chemical Engineers – Edited By Ch. Durga Prasad Rao and D. V. S. Murthy: McMillan.
4. R. M. Felder, R. W. Rousseau, Elementary Principles of Chemical Processes; Jonn Wiley Sons, Inc, New York, 1978

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CLASS: S.E. CHEMICAL ENGINEERING		Semester – IV	
SUBJECT: Applied Mathematics – IV			
Periods Per Week (Each of 60 min.)	Lectures	04	
	Practical	----------	
	Tutorial	01	
		Hours	Marks
Evaluation System	Theory Examination	03	100
	Practical Examination and Oral Examination	---------	-------
	Oral Examination	-----	
	Term Work		25
	Total		125

Detailed Syllabus		Lectures
4.1.1	Module 1 **Fourier Series** 4.1.1.1 Definition of Fourier Series, Full range Fourier series for $(0, 2\pi)$, $(0, 2l)$, $(-\pi, \pi)$ and $(-1, 1)$ 4.1.1.2 Half Range sine and cosine series, Parseval's identity and complex form of Fourier series	10
4.1.2	Module 2 **Fourier Transform and Matrices** 4.1.2.1 Orthogonal and Orthonormal function, Fourier sine and cosine integral 4.1.2.2 Characteristic values and vectors, their properties for Hermitian and real symmetric matrices, Cayley Hamilton theorem (without proof)	10
4.1.3	Module 3 **Matrices** 4.1.3.1 Digonalization of square matrix, Functions of square matrix, minimal polynomial, Derogatory and non-derogatory matrix. 4.1.3.2 Quadratic form, Congruent and orthogonal reduction of quadratic forms, Rank, Index, Signature and Class value of quadratic form	10
4.1.4	Module 4 **Complex Integration** 4.1.4.1 Line integral of a function of complex variable, Cauchy's theorem for analytic function, Cauchy's integral formula (with proof) and deductions. 4.1.4.2 Singularities and Poles, Taylor's and Laurent's Series (without proof)	10

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4.1.5	Module 5 **Applications of Complex Integration and Numerical Method** 4.1.5.1 Residue Theorem and its Evaluation, Residue Theorem application to evaluate real integrals of type $2\pi \int f(\cos\theta, \sin\theta)d\theta$ and $\int_{-\infty}^{\infty} f(x)dx$ 4.1.5.2 Numerical solution of partial differential equation, Liebmann's method for Laplace equation, Derivative boundary conditions, Explicit and implicit methods for the heat equation. 4.1.5.3 Crank Nicolson Method, Bender Smidth method.	12
4.1.6	Module 6 **Optimization (NLPP)** 4.1.6.1 Objective function and constraint maxima and minima for one and two constraint, Hessian Matrix. Lagrange's multiplier method (for not more than two constraints), Kuhn – Tucker conditions.	08

Theory Examination:

1. Question paper will comprise of 7 questions, each of 20 marks
2. Only 5 questions need to be solved.
3. Question 1 will be compulsory and it will be based on entire syllabus.
4. Remaining questions will be mixed in nature. (for example if Q2 has part (a) from module 3 then part (b) will from any module other than module 3.)
5. In question paper, weightage of each module will be proportional to number of respective lecture hours as mentioned in the syllabus.

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Term Work:

Term Work will be in the form of Journal which will consist of minimum six tutorial assignments covering the entire portion and a written test paper.

The distribution of marks for term work shall be as follows:-

Journal	: 10 marks
Test	: 10 marks
Attendance (Practical & Theory)	: 05 marks

The final certification and acceptance of the term work ensures the satisfactory performance of practical work and minimum passing of the term work.

Books for Reference

1. A Text Book of Applied Mathematics by P.N. & J.N. Wartikar (volume 1& 2).
2. Higher Engineering Mathematics by Dr.B.S. Grewal.
3. Mathematical Methods in Chemical Engineering by Jenson V.G. & Jeffrey G.V. – Academic Press 1970.
4. Mathematical Methods in Chemical Engineering by Pushpavanam S., Prentice Hall of India 1998.
5. Numerical Methods by Kanda Swami.

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CLASS: S.E. CHEMICAL ENGINEERING			
SUBJECT: Advanced Chemistry - II		Semester – IV	
Periods Per Week (Each of 60 min.)	Lectures	04	
	Practical	03	
	Tutorial	----------	
Evaluation System	Theory Examination	Hours	Marks
	Practical Examination	03	100
	Oral Examination	03	25
	Term Work	-----	
	Total		25
			150

Detailed Syllabus		
4.2.1	Module 1 **Instrumental methods of Analysis** 4.2.1.1 Chromatography – paper, Gas-liquid, Thinlayer, HPLC and applications 4.2.1.2 Optical Methods (Instrumentation & applications) UV, IR, flame photometry, NMR-Spectroscopy, Moss Bauer spectroscopy, Electron spin resonance spectroscopy (spectral interpretation and characterization of compounds)	Lectures 12
4.2.2	Module 2 **Potentiometry, conductometry, Amyhetometry** 4.2.2.1 Polarography methods and applications. Titrations, Acid-base, precipitation and complxometric	08
4.2.3	Module 3 **Im exchange and solvent extraction techniques** 4.2.3.1 Im exchange resins, cation and anion exchangers, Desalination by im exchange and separation of lanthanides. 4.2.3.2 Solvent extraction introduction, Distribution ratio, calculations, Batch extraction, counter current extraction, Numericals based on solvent extraction.	10
4.2.4	Module 4 **Colloidal State** 4.2.4.1 Origin of charge on colloidal particles concept of double layer, Helmholtz and system models, analitative idea of electrokinetic phenomenon, electrophoresis, electro-osmosis, streaming	

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	potential and Dorn effect. 4.2.4.2 Colloidal electrolytes, Donnam Membrane equilibrium, Emulsions O/W and W/O types emulsifying agents surfactant, Micelle formation. Applications of surfactants in detergents, pesticide formulations and food industry.	10
4.2.5	Module 5 4.2.5.1 Synthesis and Properties of malonic ester and Aceto acetic ester. 4.2.5.2 Aromaticity and aromatic character. Introduction, Discussion of aromatic character of Benzene, Furan, Parole, Thiophene, pyridine, Naphthalene, Anthracene, Huckel rule of aromaticity.	10
4.2.6	Module 6 **Reactions, mechanism and Industrial applications** 4.2.6.1 Knoevanagel's, Gatterman, Gatterman Koch, Kolbe's, Sommpet reaction, Wurtz fitting, Perkins, Retormatsky, Darzen condensation and Hoffmann Elimination	10

Term Work:-

Students are expected to perform at least 09 experiments from the following. One test examination and five assignments are necessary for the complete term work.

The distribution of marks for term work shall be as follows:-

Journal	: 10 marks
Test	: 10 marks
Attendance (Practical & Theory)	: 05 marks

The final certification and acceptance of the term work ensures the satisfactory performance of practical work and minimum passing of the term work.

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Practicals :-

a) Organic spotting
   Identification of organic compounds at least – 05
b) Potentiometric titrations
   i) Titration of strong acid and strong base potentiometricallly
   ii) Determination of solubility and solubility product of Agcl
c) PH-metry
   Determination of dissociation constant of malonic acid and succinic acid
d) Conductometric Titrations
   i) Titration of strong acid with strong base
   ii) Weak acid against strong base
   iii) Titration of mixture of weak acid and strong acid against strong base.
e) Flame photometry
   Determination of sodium in present in the given sample.
f) Spectro-photometry
   i) Determinaiion of Fe by KSCN method
   ii) Determination of [Cu(M3)4] + spectrophometrically
g) Organic Estimations
   a) Estimation of Glusoe Iodometrically
   b) Estimation of Ester by Hydrolytis
h) Volume strength of H2O2

Theory Examination's:

1. Question paper will comprise of 7 questions, each of 20 marks.
2. Only 5 questions need to be solved.
3. Question 1 will be compulsory and it will be based on entire syllabus.
4. (One Question will based on one modules) in this way there will be remaining six questions of 20 marks each out of Four will have to solve.

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CLASS: S.E. CHEMICAL ENGINEERING

SUBJECT: Fluid Flow — Semester – IV

Periods Per Week (Each of 60 min.)			
	Lectures	04	
	Practical	03	
	Tutorial	NIL	
Evaluation System	Theory Examination	Hours	Marks
	Practical Examination	03	100
	Oral Examination	03	25
	Term Work	----------	---------
	Total		25
			150

Detailed Syllabus

		Lectures
4.3.1	Module 1 **Introduction** 4.3.1.1 Scope and application of fluid flow, Systems of units, conversion of units 4.3.1.2 **Flow of Fluids** Introduction, Internal energy, Types of fluid- Incompressible fluid, Ideal gas, Non-ideal gas. The fluid in motion- Continuity, Momentum change in a fluid, Energy of a fluid in motion, Pressure and fluid head, Constant flow per unit area, Separation. Pressure-volume relationship- Incompressible and Compressible fluid.	10
4.3.2	Module 2 **Flow in Pipes and Channels** 4.3.2.1 The nature of fluid flow- Flow Shearing characteristics of a fluid. The drop in Pressure for flow through pipe- Shear stress in fluid, Resistance to flow in pipes, Calculation of drop in pressure along a pipe, Roughness of pipe surface. Types of flow Flow with free surface- Laminar flow down an inclined surface, Flow in open channels. Non-Newtonian behaviour- Steady-state shear dependant behaviour, Time-dependant behaviour, Viscoelastic behaviour, Characterisation of non-Newtonian fluids. Relation between rheology and structure of material, Flow in pipes and channels of regular geometry, General equations for pipe line flow. Turbulent flow	10

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4.3.3	Module 3 **Flow of Compressible fluids** 4.3.3.1 Flow of gas through orifice - Isothermal flow, Non-isothermal flow. Flow in pipe- Energy balance for flow of ideal gas, Isothermal flow of an ideal gas in a horizontal pipe, Non-isothermal flow of an ideal gas in a horizontal pipe, Adiabatic flow of an ideal gas in a horizontal pipe, Flow of non-ideal gas.	10
4.3.4	Module 4 **Flow of Multiphase Mixtures** **4.3.4.1** Two-phase gas-liquid flow- Flow regimes and flow patterns, Hold up, Pressure momentum and energy relations, Erosion. Newtonian and Non Newtonian flow past immersed bodies, Friction in flow through beds of solids, motion of particles through fluids, fluidization	10
4.3.5	Module 5 **Flow and Pressure Measurements** **4.3.5.1** Fluid pressure- Static pressure, Pressure measuring devices, Impact cell. Measurement of fluid flow- the Pitot tube, orifice meter, venturimeter, pressure recovery in orifice type meters, Variable area meters-Rota meters, other methods of measuring flow rates, Types of Valves.	10
4.3.6	Module 6 **Liquid Mixing** **4.3.6.1** Types of mixing- Single phase liquid mixing, mixing of immiscible liquids. Gas-liquid mixing, Liquid-solid mixing, Gas-liquid-solid mixing, Solid-solid mixing. Mixing mechanisms- Laminar and turbulent mixing. Scale-up of stirred vessels, Power consumption in stirred vessels- Low and high viscosity systems. Flow patterns in stirred tanks, Mixing equipment. 4.3.6.2 **Pumping of Fluids** Introduction. Pumping equipment for liquids- Reciprocating pump, Positive displacement rotary pumps. Centrifugal pump. Pumping equipment for gases- reciprocating piston compressors, Rotary blowers and compressors, Centrifugal blowers and compressors, Power requirement for pumping through pipelines	10

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Theory Examinations:

1. Question paper will comprise of 7 questions, each of 20 marks.
2. Only 5 questions need to be solved.
3. Question 1 will be compulsory and it will be based on entire syllabus.
4. (One Question will based on one modules) in this way there will be remaining six questions of 20 marks each out of Four will have to solve.

Term Work:

Students are expected to perform at least 09 experiments from the following. One test examination and five assignments are necessary for the complete term work.

The distribution of marks for term work shall be as follows:-

- Journal : 10 marks
- Test 10 marks
- Attendance (Practical & Theory) 05 marks

The final certification and acceptance of the term work ensures the satisfactor performance of practical work and minimum passing of the term work.

Practical Exam:

TERM WORK/ PRACTICAL

A minimum of seven of the following experiments must be performed

1. Reynolds Experiments
2. Flow through Pipes
3. Flow through Annulus
4. Flow through Fixed Bed
5. Viscosity by Stokes Law
6. Flow through Venturi/Orifice
7. Fluidization
8. Flow through Weirs
9. Flow through Pipe Fittings
10 Flow through Coils
11. Power Consumption in agitated Vessel
12. Efflux time of tank in Viscou
13. Characteristics of Centrifugal Pumps

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TEXT BOOK

Coulson J.M , Richardson J F., Backhurst J.R. and J. H. Harker Chemical Engineering Vol. 1, 2 Fifth Edition, Butterworth Heinemann

REFERENCE BOOKS

1. McCabe, W. L. Smith, J.C. Harriot, Unit Operations of Chemical Engineering, Mc Graw Hill International Edition.
2. Badger W. L., Banchero J.T. Introduction to Chemical Engineering

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CLASS: S.E. CHEMICAL ENGINEERING		Semester – IV	
SUBJECT: Strength of Materials and Fabrication Technology			
Periods Per Week (Each of 60 min.)	Lectures	04	
	Practical	03	
	Tutorial	NIL	
		Hours	Marks
Evaluation System	Theory Examination	03	100
	Practical Examination	----------	---------
	Oral Examination	----------	---------
	Term Work		25
	Total		125

Detailed Syllabus		Lectures
4.4.1	Module 1 **Stress and Strain** 4.4.1.1 Types of stresses and strains, Modulus of elasticity, Modulus of rigidity, Bulk modulus, Possion's ratio, Relations between elastic constants, Study of stress-strain curve, Thermal stresses and strains for simple and composite bars. **Shear Force and Bending Moment** 4.4.1.2 Basic concept of shear force, bending moment and axial force. Shear force, bending moment and axial force diagrams for statically determinate beams (Excluding beams with internal hinge)	13
4.4.2	Module 2 **Bending Stresses** 4.4.2.1 Theory of simple bending, Expression for bending stress, position of neutral axis, section modulus, moment of resistance, Problem on Bending Stresses in symmetrical and unsymmetrical sections **Shear Stresses in Beams** 4.4.2.2 Distribution of shear stress across plane sections used commonly for structural purposes. **Direct and Bending Stresses** 4.4.2.3 Introduction, Load eccentric to one or both the axes, Resultant stresses at the corners, Condition for no tension in the section, Practical application- Chimneys involving lateral loads.	11

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4.4.3	Module 3 **Columns and Struts** 4.4.3.1 Introduction, Classification of columns, Equivalent length concept, Euler's theory for long columns with different end conditions, (Derivation only for column with both ends hinged), Rankine's Hypothesis for columns **Thick and Thin Cylinders:-** 4.4.3.2 Thin and Thick cylinders under internal pressure, Design of composite shell using Lame's theory	08
4.4.4	Module 4 **FABRICATION TECHNOLOGY** 4.4.4.1 Cold working & Hot working of metals, cold working-shearing & cutting ,forming & Drawing, Bending of sheets ,rods & pipes .Hot working – Hot spinning & Hot rolling 4.4.4.2 Welding- classification ,types, Gas welding , glass cutting, electric arc welding, spot welding, TIG/MIG welding, Arc welding, Plasma , ultrasonic, Laser beam welding, Flaws in welding, Simple Calculations involving strength of welded joints, Riveted Joints, Temporary Joints 4.4.4.3 NDT, Visual methods, Magnetic partied test, Surface Penetrate liquid method, Radiography, Ultrasonic technology	10
4.4.5	Module 5 4.4.5.1 Plastics, Types of plastics, important properties, additives used, molding characteristics etc. 4.4.5.2 Refractories – Types, applications, fabrication with refractory materials, Lining of Vessels /pipes, PVC, rubber, refractory, FRP glass, lead lining	06
4.4.6	Module 6 4.4.6.1 Injection molding, Types, molding equipments, technique, process parameters & their effect on quality of molding, various defects in molding, causes & remedies, Blow molding, Types-Extrusion, injection & stretch blow molding, process parameters & their effect on quality of molding, Defects in molding, causes & remedies, Rotational molding & fabrication with FRP	12

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Practicals:

List of experiments

1. Tension test on mild and tor steel bar(Stress-strain behavior determination)
2. Shear test on mild steel.
3. Rockwell hardness test.
4. Brinell hardness test.
5. Impact test (Izod and Charpy)
6. Flexure test on timber beam (Central point load)
7. Flexure test on timber beam (Two point load)

Theory Examinations:

Question paper will comprise of 7 questions, each of 20 marks.
Only 5 questions need to be solved.
Question 1 will be compulsory and it will be based on entire syllabus.
(One Question will based on one modules) in this way there will be remaining six questions of 20 marks each out of Four will have to solve.

Term work:

Each student is to appear for at least one written test during the term.

Report on experiments performed as detailed above, assignments based on the theory syllabus and the graded answer paper of the term test shall be submitted as term work.

The distribution of term work marks will be as follows:

Report of experiments performed & Assignments : 10 marks.

Attendance : 05 marks.

Written test: 10 marks.

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Recommended Books:

1. Mechanics of Materials ,E. P. Popov, Prentice Hall of India Pvt. Ltd.
2. Engineering Mechanics, Timoshenko & Young, Tata McGraw Hill
3. Mechanics of Structures (Vol.I) , S. B. Junarkar, Charotar Book Publishing Co.
4. Strength of Materials, R. K. Rajput, S. Chand Publications.
5. A Course in Workshop Technology Vol I 7 Vol II, B. S. Raghuvanshi, Dhanpat Rai & Sons
6. Workshop Technology Vol I & Vol II, Hajra & Choudhary, Media Promoter & Pub. Pvt. Ltd.
7. Machine Drawing, N.D. Bhatt & Panchal, Chartor Publications.
8. ASM Handbook Vol 17- Welding, Brazing & Soldering, ASM International USA

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CLASS: S.E. CHEMICAL ENGINEERING			Semester – IV
SUBJECT: Material Science and Technology			
Periods Per Week (Each of 60 min.)	Lectures	03	
	Practical	-----	
	Tutorial	02	
Evaluation System	Theory Examination	Hours	Marks
		03	100
	Practical Examination	----------	---------
	Oral Examination	----------	---------
	Term Work		25
	Total		125

Detailed Syllabus		
4.5.1	Module 1	Lectures
	Introduction to Materials 4.5.1.1 Scope of materials science and technology and its importance in chemical course- B.E. Chemical Engg. **Atomic Structure and Chemical Bonding** 4.5.1.2 Structure of the Atom, the quantum states, the periodic table, ionization potential, electron affinity and electro negativity. Wave nature of electron and Schrodinger wave equation. Chemical Bonding: Bond energy. Bond type and bond length, ionic bonding Covalent bonding, metallic bonding, secondary bonding (dispersion bonding, dipole bonding and hydrogen bonding). Variation in bonding character and properties..	10
4.5.2	Module 2 **Crystal Structure and Determination** 4.5.2.1 Geometry Crystals The space lattices (a brief mention of the Bravais lattices), basis, cubic and hexagonal crystal structure. Crystal directions andylances. (Willer indices and planes) Structure Determination by X-ray diffraction: The Bragg law of x-ray diffiaction, the Bragg spectrometer the powder method and structure determination.	10
	Crystal Imperfections 4.5.2.2 Point imperfections, dislocations or line imperfections. Burgers vector, critical resolved	

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	shear stress, dislocation theory, surface imperfection and volume imperfection.	
4.5.3	Module 3 **Structure of solids** 4.5.5.1 Ionically bonded structures, properties of ionic solid, covalently-bonded structures, properties of covalent solids, metallically-bonded structures and their properties, molecularly-bonded structures and their properties. **Deformation of Materials** 4.5.3.2 Elastic deformation, anelastic deformation, Plastic deformation of a signle crystal, deformation by a slip critical resolved shear stress, dislocation theory; work hardening.	10
4.5.4	Module 4 **Mechanical Properties** 4.5.4.1 Fundamental properties: Fatigue:- mechanism of fatigue failure, characteristics of fatigue failure, factors affecting fatigue strength; Creep: types of creep, creep curve, design for creep, factors affecting creep, mechanism of creep; fracture: types of factures, cleavage, brittle cracture and Griffith crack theory; Factors affecting mechanical properties. Changes in mechanical properties by heat treatment.	10
4.5.5	Module 5 **Electrical and magnetic Properties of Materials:** 4.5.5.1 Electrical conductivity, Band Model of Conductivity (brief description) Semiconductors, Valence band model (brief description) Dielectric Properties and dielectric materials. Ferroelectricity, Piezo-electricity Introduction to Magnetism and Magnetic Properties (Definitions and brief explanations) Magnetization and Classification of magnetic materials, hysteresis Introduction to Superconductivity: (Definition and brief explanation) Critical transition temperature. Type I and type II superconductors, Applications Thermoelectricity: Thermocouples, Thermoelectric electromotive force, Seebeck effect, Peltier effect, Thompson effect, Laws of intermediate metals and temperatures, Uses of	10

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	thermocouple as a thermometer, pyrometer	
4.5.6	Module69 **Selection of Materials of Construction for Chemical Process Industries** 4.5.6.1 Factors determining choice of materials a) General factors (topic 6,7 and 8 of this syllabus) b) Corrosion: Definition, units of measurement. Eight forms of corrosion (sub types, mechanisms and examples) Prevention of corrosion 4.5.6.2 Engineering Materials a) Metals and alloys and their applications (ferrous and nonferrous) b) Nonmetalic materials: Polymeric materials and applications, Ceramics (Clays, Refractories and Glasses), Others (eg Graphite)	10

Theory Examinations:

1. Question paper will comprise of 7 questions, each of 2[illegible] marks.
2. Only 5 questions need to be solved.
3. Question 1 will be compulsory and it will be based on entire syllabus.
4. (One Question will based on one modules) in this way there will be remaining six questions of 20 marks each out of Four will have to solve.

TERM WORK:

Term work should consist of at least one assignment (detailed note on a topic or numerical problems where applicable) on each of topics through above. In addition at least two chemical process industries as case studies for materials of construction in various equipments.

The distribution of marks for term work shall be as follows:-

Journal : 10 marks

Test : 10 marks

Attendance (Practical & Theory) : 05 marks

The final certification and acceptance of the term work ensures the satisfactory performance of practical work and minimum passing of the term work.

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TEXT BOOKS:

V. Raghavan, Physical Metallurgy: Principles and Practice, Prentice Hall of India, New Delhi, 1983

V. Raghavan Materials Science and Engineering, Addison Wesley New York, 1989

M.G. Fontana, Corrosion Engineering, Tata Mcgraw Hill, 1985

REFERENCE BOOKS

1. J.F. Schackelford, Introduction to Material Science for Engineers, 2nd ED, McMillan New York 1990
2. L.H. Vlac, Elements of Material Science and Engineering: A first Course, 4th ED, Prentice Hall of India, New Delhi 1997
3. W.D. Callister Jr, Materials Science and Engineering, John Wiley New York 1997
4. Z.D. Jastrzebski, The Nature and Properties of Engineering Materials John Wiley 1987
5. R. Perry and D.W. Green, Perrys Chemical Engineers Handbook, 7th Ed. 2001
6. Smith Materials Science

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CLASS: S.E. CHEMICAL ENGINEERING			
SUBJECT: Plant Utilities		Semester – IV	
Periods Per Week (Each of 60 min.)	Lectures	04	
	Practical	-----	
	Tutorial	01	
Evaluation System	Theory Examination	Hours	Marks
	Practical Examination	03	100
	Oral Examination	----------	---------
	Term Work	----------	---------
	Total		25
			125

Detailed Syllabus		Lectures
4.6.1	Module 1 **Introduction** 4.6.1.1 Identification of common plant utility Importance of utility in industry **Water** 4.6.1.2 Row water storage and treatment Treatment of water, soft water and DM water Cooling water system Fire water system	10
4.6.2	Module 2 **Steam** **4.6.2.1** Properties of Steam Steam generation of boiler Types of boiler and their operation Steam generation by utilizing process waste heat using thermic fluid Re-generators and re-evaporators Distribution of steam in plant Efficient use of steam	10
4.6.3	Module 3 **Air** 4.6.3.1 Compressed air from blower and compressor Air drying system for instrument air and plant air Humidification and de-humidification of air	10
4.6.4	Module 4 **Refrigeration** 4.6.4.1 Principal of refrigeration Refrigeration system like compression refrigeration, absorption refrigeration, and chilled water system	10

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	Types of refrigerants	
4.6.5	Module 5 **Vacuum System** 4.6.5.1 Selection of Vacuum System Operation of various process equipment under vacuum distillation, reactor, evaporators	10
4.6.6	Module 6 **Flaring and venting** 4.6.6.1 Introduction Type of vent flares	10

Theory Examinations:

1. Question paper will comprise of 7 questions, each of 20 marks.
2. Only 5 questions need to be solved.
3. Question 1 will be compulsory and it will be based on entire syllabus.
4. (One Question will based on one modules) in this way there will be remaining six questions of 20 marks each out of Four will have to solve.

TERM WORK

- A minimum of 10 assignments should be given at regular interval
- The performance of the students should be evaluated based on each assignment giving suitable weightage to punctuality and contents.
- Point 1 and 2 above should account for 15 marks (out of 25 marks) for term work
- Average of minimum of two tests should account for 10 (out of 25 marks) marks for term work.
- Suggested list of topics from where the assignment and practical are to be taken up are as follow :
    1. Performance study of cooling tower
    2. Heat balance in boiler / thermic fluid system
    3. Performance study of chilled water system
    4. Performance of Humidification and De- Humidification system
    5. Performance of Ion Exchange for soft water and DM water generation
    6. Study of following
        - Steam trap
        - Emergency vents and safety valves
        - Utility line diagram
    7. Study of compressors
    8. Study of vacuum systems

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Text Book / Reference Book :

1. Wangham D. A. , Theory and practice of Heat Engine, ELBS Cambridge University Press, 1970
2. Lyle O. Efficient Use of Steam, 1963
3. Thikeld J. K., Thermal Environmental Engineering, Prentice Hall, 1970.

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