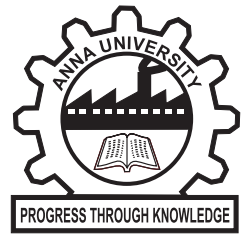

ANNA UNIVERSITY
CHENNAI - 600 025

UNIVERSITY DEPARTMENTS

REGULATIONS 2012
CURRICULA AND SYLLABI FOR
I TO VIII SEMESTERS

B.TECH. CERAMIC TECHNOLOGY
(FULL TIME)

ANNA UNIVERSITY, CHENNAI-600 025

UNIVERSITY DEPARTMENTS

R – 2012

B.TECH. CERAMIC TECHNOLOGY

I – VIII SEMESTERS CURRICULA AND SYLLABI

I SEMESTER

CODE NO.	COURSE TITLE	L	T	P	C
THEORY					
HS8151	Technical English – I	3	1	0	4
MA8151	Mathematics – I	3	1	0	4
PH8151	Engineering Physics	3	0	0	3
CY8151	Engineering Chemistry	3	0	0	3
GE8151	Computing Techniques	3	0	0	3
GE8152	Engineering Graphics	2	0	3	4
PRACTICAL					
PH8161	Physics Laboratory	0	0	2	1
CY8161	Chemistry Laboratory	0	0	2	1
GE8161	Computer Practices Laboratory	0	0	3	2
GE8162	Engineering Practices Laboratory	0	0	3	2
	Total	**17**	**2**	**13**	**27**

II SEMESTER

CODE NO.	COURSE TITLE	L	T	P	C
Theory					
HS8251	Technical English – II	3	1	0	4
MA8251	Mathematics - II	3	1	0	4
PH8255	Physics of Materials	3	0	0	3
CY8253	Chemistry for Technologists	3	0	0	3

GE8251	Engineering Mechanics	3	1	0	4
CT8201	Principles of Ceramic Technology	3	0	0	3
Laboratory					
CH8261	Unix Programming Lab	0	0	4	2
CT8211	Ceramic Science Lab	0	0	3	2
	TOTAL	**18**	**3**	**7**	**25**

III SEMESTER

CODE NO.	COURSE TITLE	L	T	P	C
Theory					
MA8357	Transform Techniques and Partial Differential Equations	3	1	0	4
CY8351	Instrumental Methods of Analysis	3	0	0	3
CT8301	Material Science	3	0	0	3
CT8302	Properties of Ceramics	3	0	0	3
CT8303	Unit Operations	3	0	0	3
ME8351	Basic Mechanical Engineering	3	0	0	3
Laboratory					
CT8311	Unit Operations Lab	0	0	3	2
ME8361	Mechanical Engineering Lab	0	0	3	2
	TOTAL	**18**	**1**	**6**	**23**

IV SEMESTER

CODE NO.	COURSE TITLE	L	T	P	C
Theory					
MA8356	Probability and Statistics	3	1	0	4
GE8351	Environmental Science and Engineering	3	0	0	3
CT8401	Ceramic Raw Materials	3	0	0	3
CT8402	Processing of Ceramic Raw Materials	3	0	0	3
CT8403	Testing Methods of Ceramics	3	0	0	3
CT8404	Traditional Ceramics	3	0	0	3

Laboratory					
CT8411	Ceramic Testing Lab	0	0	3	2
CT8412	Traditional Ceramics Lab	0	0	3	2
	TOTAL	**18**	**1**	**6**	**23**

V SEMESTER

COURSE CODE	COURSE TITLE	L	T	P	C
Theory					
CT8501	Ceramic Fabrication Processes	3	0	0	3
CT8502	Glass Engineering I	3	0	0	3
CT8503	Glaze Technology	3	0	0	3
CT8504	Refractories I	3	0	0	3
E1	Elective I	3	0	0	3
E2	Elective II	3	0	0	3
Laboratory					
CT8511	Chemical Analysis Lab	0	0	3	2
CT8512	Glaze Lab	0	0	3	2
	TOTAL	**18**	**0**	**6**	**22**

VI SEMESTER

COURSE CODE	COURSE TITLE	L	T	P	C
Theory					
CT8601	Glass Engineering II	3	0	0	3
CT8602	Refractories II	3	0	0	3
FT8651	Process Economics and Industrial Management	3	0	0	3
E3	Elective III	3	0	0	3
E4	Elective IV	3	0	0	3
Laboratory					
HS8561	Employability Skills	0	0	2	1

CT8611	Creative and Innovative Project	0	0	3	2
CT8612	Glass Lab	0	0	3	2
CT8613	Refractories Lab	0	0	3	2
	TOTAL	**15**	**0**	**11**	**22**

VII SEMESTER

COURSE CODE	COURSE TITLE	L	T	P	C
Theory					
GE8751	Engineering Ethics and Human Values	3	0	0	3
CT8701	Advanced Ceramic Processing	3	0	0	3
CT8702	Advanced Structural Ceramic Materials	3	0	0	3
E5	Elective V	3	0	0	3
E6	Elective VI	3	0	0	3
E7	Elective VII	3	0	0	3
Laboratory					
CT8711	Advanced Instrumental Lab	0	0	3	2
CT8712	Industrial Training	-	-	-	2
	TOTAL	**18**	**0**	**3**	**22**

VIII SEMESTER

COURSE CODE	COURSE TITLE	L	T	P	C
Theory					
E8	Elective VIII	3	0	0	3
E9	Elective IX	3	0	0	3
Practical					
CT8811	Project Work	0	0	12	6
	TOTAL	**6**	**0**	**12**	**12**

LIST OF ELECTIVES FOR CERAMIC TECHNOLOGY

COURSE CODE	COURSE TITLE	L	T	P	C
CT8001	Abrasives	3	0	0	3
CT8002	Advanced Refractory Materials	3	0	0	3
CT8003	Bioceramics	3	0	0	3
CT8004	Calculations in Ceramics	3	0	0	3
CT8005	Cement and Concrete	3	0	0	3
CT8006	Ceramic Fibres and Composites	3	0	0	3
CT8007	Electronic Ceramics	3	0	0	3
CT8008	Fuels and Energy Engineering	3	0	0	3
CT8009	Kilns, Furnaces and Pyrometry	3	0	0	3
CT8010	Materials Management	3	0	0	3
CT8011	Mechanical Behavior of Ceramics	3	0	0	3
CT8012	Microwave Processing of Ceramics	3	0	0	3
CT8013	Monolithics and Castables	3	0	0	3
CT8014	Non Destructive Testing	3	0	0	3
CT8015	Phase Equilibria in Ceramics	3	0	0	3
CT8016	Plant Equipment and Furnace Design	3	0	0	3
CT8017	Process Automation	3	0	0	3
CT8018	Quality Control in Ceramic Industries	3	0	0	3
CT8019	Refractory Engineering and Management	3	0	0	3
CT8020	Special Coating Technology	3	0	0	3
CT8021	Special Glasses	3	0	0	3
CT8022	Thermodynamics for Ceramics	3	0	0	3
GE8071	Fundamentals of Nano Science	3	0	0	3
MG8654	Total Quality Management	3	0	0	3

TOTAL NO.OF CREDITS : 176

HS8151 **TECHNICAL ENGLISH I** **L T P C**

(For all branches of B.E / B.Tech programmes) **3 1 0 4**

OBJECTIVES

- To enable all students of engineering and technology develop their basic communication skills in English.
- To give special emphasis to the development of speaking skills amongst the students of engineering and technology students.
- To ensure that students use the electronic media such as internet and supplement the learning materials used in the classroom.
- To inculcate the habit of reading for pleasure.

UNIT I

Listening - Introducing learners to GIE - Types of listening - Listening to audio (verbal & sounds); Speaking - Speaking about one's place, important festivals etc. – Introducing oneself, one's family / friend; Reading - Skimming a reading passage – Scanning for specific information - Note-making; Writing - Free writing on any given topic (My favourite place / Hobbies / School life, etc.) - Sentence completion - Autobiographical writing (writing about one's leisure time activities, hometown, etc.); Grammar - Prepositions - Reference words - Wh-questions - Tenses (Simple); Vocabulary - Word formation - Word expansion (root words / etymology); E-materials **-** Interactive exercises for Grammar & Vocabulary - Reading comprehension exercises - Listening to audio files and answering questions.

UNIT II

Listening - Listening and responding to video lectures / talks; Speaking - Describing a simple process (filling a form, etc.) - Asking & answering questions - Telephone skills – Telephone etiquette; Reading – Critical reading - Finding key information in a given text - Sifting facts from opinions; Writing - Biographical writing (place, people) - Lab descriptions (general/specific description of laboratory experiments) - Definitions - Recommendations; Grammar - Use of imperatives - Subject-verb agreement; Vocabulary - Compound words - Word Association; E-materials - Interactive exercises for Grammar and Vocabulary - Listening exercises with sample telephone conversations / lectures – Picture-based activities.

UNIT III

Listening - Listening to specific task - focused audio tracks; Speaking - Role-play – Simulation - Group interaction - Speaking in formal situations (teachers, officials, foreigners); Reading - Reading and interpreting visual material; Writing - Jumbled sentences - Coherence and

cohesion in writing - Channel conversion (flowchart into process) - Types of paragraph (cause & effect / compare & contrast / narrative / analytical) - Informal writing (letter/e-mail/blogs) - Paraphrasing; Grammar - Tenses (Past) - Use of sequence words - Adjectives; Vocabulary - Different forms and uses of words, Cause and effect words; E-materials - Interactive exercises for Grammar and Vocabulary - Excerpts from films related to the theme and follow up exercises - Pictures of flow charts and tables for interpretations.

UNIT IV

Listening - Watching videos / documentaries and responding to questions based on them; Speaking - Responding to questions - Different forms of interviews - Speaking at different types of interviews; Reading - Making inference from the reading passage - Predicting the content of a reading passage; Writing - Interpreting visual materials (line graphs, pie charts etc.) - Essay writing – Different types of essays; Grammar - Adverbs – Tenses – future time reference; Vocabulary - Single word substitutes - Use of abbreviations & acronyms; E-materials - Interactive exercises for Grammar and Vocabulary - Sample interviews - film scenes - dialogue writing.

UNIT V

Listening - Listening to different accents, Listening to Speeches / Presentations, Listening to broadcast & telecast from Radio & TV; Speaking - Giving impromptu talks, Making presentations on given topics; Reading - Email communication - Reading the attachment files having a poem/joke/proverb - Sending their responses through email Writing - Creative writing, Poster making; Grammar - Direct and indirect speech; Vocabulary - Lexical items (fixed / semi fixed expressions); E-materials - Interactive exercises for Grammar & Vocabulary - Sending emails with attachment – Audio / video excerpts of different accents, - Interpreting posters

TOTAL : 60 PERIODS

TEXT BOOKS

1. Mindscapes: English for Technologists and Engineers, Orient Black Swan, 2012.
2. S.P. Dhanavel, English and Communication Skills for Students of Science and Engineering. Orient Black Swan, Chennai, 2011.

REFERENCE BOOKS

1. Pickett, Nell Ann, Ann A.Laster and Katherine E.Staples. Technical English: Writing, Reading and Speaking. New York: Longman, 2001.
2. Bailey, Stephen. Academic Writing: A practical guide for students. New York: Rutledge, 2011.

3. Morgan, David and Nicholas Regan. Take-Off: Technical English for Engineering. Reading: Garnet Publishing Limited, 2008.
4. Thorn, Michael and Alan Badrick. An Introduction to Technical English. Harlow: Prentice Hall Europe, 1993.
5. Rizvi, M.Ashraf. Effective Technical Communication. New Delhi: Tata McGraw-Hill PublishingCompany, 2007.

EXTENSIVE READERS

1. Murthy, Sudha. Wise & Otherwise. New Delhi: Penguin Books India, 2006.
2. Gates, Bill and Collins Hemingway. Business @ the Speed of Thought: Succeeding in the Digital Economy. New York: Warner Business Books, 2000.

WEBSITE RESOURCES

1. www.uefap.com
2. www.eslcafe.com
3. www.listen-to-english.com
4. www.owl.english.purdue.edu
5. www.chompchomp.com

MA8151 **MATHEMATICS – I** **L T P C**

(Common to all branches of B.E. / B.Tech. Programmes) **3 1 0 4**

(I Semester)

OBJECTIVES

- To develop the use of matrix algebra techniques this is needed by engineers for practical applications.
- To make the student knowledgeable in the area of infinite series and their convergence so that he/ she will be familiar with limitations of using infinite series approximations for solutions arising in mathematical modeling.
- To familiarize the student with functions of several variables. This is needed in many branches of engineering.
- To introduce the concepts of improper integrals, Gamma, Beta and Error functions which are needed in engineering applications.
- To acquaint the student with mathematical tools needed in evaluating multiple integrals and their usage.

UNIT I MATRICES **9+3**

Eigenvalues and Eigenvectors of a real matrix – Characteristic equation – Properties of eigenvalues and eigenvectors – Cayley-Hamilton Theorem – Diagonalization of matrices – Reduction of a quadratic form to canonical form by orthogonal transformation – Nature of quadratic forms.

UNIT II INFINITE SERIES **9+3**

Sequences – Convergence of series – General properties – Series of positive terms – Tests of convergence (Comparison test, Integral test, Comparison of ratios and D'Alembert's ratio test) – Alternating series – Series of positive and negative terms – Absolute and conditional convergence – Power Series – Convergence of exponential, logarithmic and Binomial Series.

UNIT III FUNCTIONS OF SEVERAL VARIABLES **9+3**

Limits and Continuity – Partial derivatives – Homogeneous functions and Euler's theorem – Total derivative – Differentiation of implicit functions – Change of variables –Jacobians – Partial differentiation of implicit functions – Taylor's series for functions of two variables – Errors and approximations – Maxima and minima of functions of two variables – Lagrange's method of undetermined multipliers.

UNIT IV IMPROPER INTEGRALS **9+3**

Improper integrals of the first and second kind and their convergence – Evaluation of integrals involving a parameter by Leibnitz rule – Beta and Gamma functions – Properties – Evaluation of integrals using Beta and Gamma functions – Error functions.

UNIT V MULTIPLE INTEGRALS **9+3**

Double integrals – Change of order of integration – Double integrals in polar coordinates – Area enclosed by plane curves – Triple integrals – Volume of Solids – Change of variables in double and triple integrals – Area of a curved surface.

TOTAL : 60 PERIODS

TEXT BOOKS

1. Grewal B.S., "Higher Engineering Mathematics", Khanna Publishers, New Delhi, 40th Edition, 2007.
2. Ramana B.V., "Higher Engineering Mathematics", Tata McGraw Hill Co. Ltd., New Delhi, 11th Reprint, 2010.

REFERENCES

1. Jain R.K. and Iyengar S.R.K., “Advanced Engineering Mathematics”, Narosa Publications, New Delhi, 3rd Edition, 2007.
2. Bali N., Goyal M. and Watkins C., “Advanced Engineering Mathematics”, Firewall Media (An imprint of Lakshmi Publications Pvt., Ltd.,), New Delhi, 7th Edition, 2009.
3. Greenberg M.D., “Advanced Engineering Mathematics”, Pearson Education, New Delhi, 2nd Edition, 5th Reprint, 2009.
4. Peter V.O’Neil, “Advanced Engineering Mathematics”, Cengage Learning India Pvt., Ltd, New Delhi, 2007.

PH8151 ENGINEERING PHYSICS L T P C

(Common to ALL Branches of B.E./B.Tech. Programmes) 3 0 0 3

OBJECTIVE

To introduce the basic physics concepts relevant to different branches of Engineering and Technology.

UNIT I PROPERTIES OF MATTER 9

Elasticity - Poisson’s ratio and relationship between moduli (qualitative) - Stress-strain diagram - factors affecting elasticity - bending of beams - cantilever - bending moment - theory and experiment of Young’s modulus determination - Uniform and non-uniform bending - I shaped girders - twisting couple - hollow cylinder - shaft - torsion pendulum - determination of rigidity modulus- moment of inertia of a body (regular and irregular).

UNIT II ACOUSTICS AND ULTRASONICS 9

Classification of sound - loudness and intensity - Weber-Fechner Law - standard intensity and intensity level - decibel - reverberation - reverberation time - rate of growth and decay of sound intensity - derivation of Sabine’s formula - absorption coefficient and its determination - factors affecting acoustics of buildings : focussing, interference, echo, Echelon effect, resonance - noise and their remedies. Ultrasonics - production - magnetostriction and piezoelectric methods - detection of ultrasound - acoustic grating - industrial applications - NDT - Ultrasonic method: scan modes and practice.

UNIT III THERMAL PHYSICS 9

Thermal expansion - thermal stress - expansion joints - bimetallic strips - thermal conductivity - conductions in solids - Forbe's and Lees' disc methods - Rectilinear flow of heat through a rod - flow of heat through a compound materials - radical flow of heat through a spherical shell - thermal insulation of buildings – Laws of blackbody radiation: Kirchoffs law, Stephens law, Wiens law, Raleigh-Jean law and Planks law (derivation). Laws of thermodynamics - Otto and diesel engines and their efficiency - entropy - entropy of Carnot's cycle - reverse Carnot's cycle - refrigerator.

UNIT IV APPLIED OPTICS 9

Interference - Michelson interferometer: construction, working, determination of wave length and thickness - anti-reflection coating - air wedge and its application - Lasers - Einstein's coefficients - CO_2, Nd:YAG and semiconductor lasers - homo junction and hetro junction - construction and working - applications - Optical fibres - classification (index & mode based) - principle and propagation of light in optical fibres - acceptance angle and numerical aperture - fibre optic communication system - active and passive sensors.

UNIT V SOLID STATE PHYSICS 9

Nature of bonding - growth of single crystals (qualitative) - crystal systems - crystal planes and directions - expressions for interplanar distance - coordination number and packing factor for simple structures: SC, BCC, FCC and HCP - structure and significance of NaCl, ZnS, diamond and graphite - crystal imperfections: point defects, dislocations and stacking faults - unit cell, Bravais space lattices - miller indices.

TOTAL : 45 PERIODS

TEXT BOOKS

1. Gaur R.K., and Gupta, S.L., Engineering Physics, Dhanpat Raj Publications, 2003.
2. Palanisamy, P.K., Engineering Physics, Scitech Publications (P) Ltd, 2006.
3. Arumugam, M., Engineering Physics, Anuradha Publications, 2000.

REFERENCE BOOKS

1. Sankar, B.N., Pillai.S.O., Engineering Physics, New Age International (P) Ltd., 2007.
2. Rajendran.V Engineering Physics, Tata McGraw-Hill, 2009.

CY8151	ENGINEERING CHEMISTRY	L T P C
	(Common to all branches of Engineering and Technology)	3 0 0 3

UNIT I CHEMICAL THERMODYNAMICS 9

Second law: Entropy - entropy change for an ideal gas, reversible and irreversible processes; entropy of phase transitions; Clausius inequality. Free energy and work function: Helmholtz and Gibbs free energy functions; Criteria of spontaneity; Gibbs-Helmholtz equation; Clausius-Clapeyron equation; Maxwell relations – Van't Hoff isotherm and isochore. Chemical potential; Gibbs-Duhem equation – variation of chemical potential with temperature and pressure.

UNIT II POLYMER CHEMISTRY 9

Introduction: Classification of polymers – Natural and Synthetic; Thermoplastic and Thermosetting. Functionality – Degree of polymerisation. Types and mechanism of polymerisation: Addition (Free Radical, cationic, anionic and living); condensation and copolymerisation. Properties of polymers: Tg, Tacticity, Molecular weight – weight average, number average and polydispersity index. Techniques of polymerisation: Bulk, emulsion, solution and suspension.

UNIT III KINETICS AND CATALYSIS 9

Introduction – reaction velocity, factors affecting reaction velocity, rate constant, order of reaction, molecularity, pseudo molecular reactions, zero, first, second and third order reactions, reactions of fractional orders, determination of order of reactions. Catalysis: Auto catalysis - Enzyme Catalysis: Michaelis-Menton equation; factors affecting enzyme catalysis. Heterogeneous Catalysis: Types of adsorption isotherms: Langmuir–Hinselwood and Rideal–Eley Mechanism.

UNIT IV PHOTOCHEMISTRY AND SPECTROSCOPY 9

Photochemistry: Laws of photochemistry - Grotthuss–Draper law, Stark–Einstein law and Lambert-Beer Law. Photoprocesses - Internal Conversion, Inter-system crossing, Fluorescence, Phosphorescence, Chemiluminescence and Photo-sensitisation. Spectroscopy: Electromagnetic spectrum - Absorption of radiation – Electronic, Vibrational and rotational transitions. Width and intensities of spectral lines. Spectrophotometric estimation of iron. UV-visible and IR spectroscopy – principles, instrumentation (Block diagram) and applications.

UNIT V NANOCHEMISTRY **9**

Basics - distinction between molecules, nanoparticles and bulk materials; size-dependent properties. Nanoparticles: Nanocluster, nanorod, nanotube and nanowire. Synthesis: Precipitation, thermolysis, hydrothermal, solvothermal, electrodeposition, chemical vapour deposition, laser ablation; Properties and Applications. Risk discussion and Future perspectives.

TOTAL : 45 PERIODS

TEXT BOOKS

1. P. Kannan and A. Ravikrishnan, “Engineering Chemistry”, Sri Krishna Hitech Publishing Company Pvt. Ltd. Chennai, 2009.
2. S. Vairam, P. Kalyani and Suba Ramesh, “Engineering Chemistry”, Wiley India, 2011

REFERENCE BOOKS

1. P.W. Atkins and de Paula Julio, “Physical Chemistry”, Oxford University Press, 8th Ed., (Indian Student Edition) (2009).
2. K. K. Rohatgi-Mukherjee, “Fundamental of Photochemistry” New Age International (P) Ltd., New Delhi, 1986.
3. G.A. Ozin and A.C. Arsenault, “Nanochemistry: A Chemical Approach to Nanomaterials”, RSC Publishing, 2005.
4. V.R.Gowariker, N.V.Viswanathan and Jayadev Sreedhar, “Polymer Science”, New Age International P (Ltd.,), Chennai, 2006

GE8151 COMPUTING TECHNIQUES **L T P C**
3 0 0 3

UNIT I INTRODUCTION **8**

Generation and Classification of Computers- Basic Organization of a Computer –Number System – Binary – Decimal – Conversion – Problems. Need for logical analysis and thinking – Algorithm – Pseudo code – Flow Chart.

UNIT II C PROGRAMMING BASICS **10**

Problem formulation – Problem Solving - Introduction to ‘ C’ programming –fundamentals – structure of a ‘C’ program – compilation and linking processes – Constants, Variables –

Data Types – Expressions using operators in 'C' – Managing Input and Output operations – Decision Making and Branching – Looping statements – solving simple scientific and statistical problems.

UNIT III ARRAYS AND STRINGS **9**

Arrays – Initialization – Declaration – One dimensional and Two dimensional arrays. String- String operations – String Arrays. Simple programs- sorting- searching – matrix operations.

UNIT IV FUNCTIONS AND POINTERS **9**

Function – definition of function – Declaration of function – Pass by value – Pass by reference – Recursion – Pointers - Definition – Initialization – Pointers arithmetic – Pointers and arrays- Example Problems.

UNIT V STRUCTURES AND UNIONS **9**

Introduction – need for structure data type – structure definition – Structure declaration – Structure within a structure - Union - Programs using structures and Unions – Storage classes, Pre-processor directives.

TOTAL : 45 PERIODS

TEXT BOOKS

1. Pradip Dey, Manas Ghosh, "Fundamentals of Computing and Programming in C", First Edition, Oxford University Press, 2009
2. Ashok N. Kamthane, "Computer programming", Pearson Education, 2007.
3. Yashavant P. Kanetkar. " Let Us C", BPB Publications, 2011.

REFERENCES

1. Kernighan,B.W and Ritchie,D.M, "The C Programming language", Second Edition, Pearson Education, 2006
2. Byron S Gottfried, " Programming with C", Schaum's Outlines, Second Edition, Tata McGraw-Hill, 2006.
3. R.G. Dromey, "How to Solve it by Computer", Pearson Education, Fourth Reprint, 2007

GE8152 **ENGINEERING GRAPHICS** **L T P C**
2 0 3 4

OBJECTIVES

To develop in students, graphic skills for communication of concepts, ideas and design of engineering products and expose them to existing national standards related to technical drawings.

CONCEPTS AND CONVENTIONS (NOT FOR EXAMINATION) 1

Importance of graphics in engineering applications – Use of drafting instruments – BIS conventions and specifications – Size, layout and folding of drawing sheets – Lettering and dimensioning.

UNIT I PLANE CURVES AND FREE HAND SKETCHING 14

Basic Geometrical constructions, Curves used in engineering practices

Conics – Construction of ellipse, parabola and hyperbola by eccentricity method – Construction of cycloid – construction of involutes of square and circle – Drawing of tangents and normal to the above curves, **Scales:** Construction of Diagonal and Vernier scales.

Visualization concepts and Free Hand sketching: Visualization principles –Representation of Three Dimensional objects – Layout of views- Free hand sketching of multiple views from pictorial views of objects

UNIT II PROJECTION OF POINTS, LINES AND PLANE SURFACES 14

Orthographic projection- principles-Principal planes-First angle projection-Projection of points. Projection of straight lines (only First angle projections) inclined to both the principal planes - Determination of true lengths and true inclinations by rotating line method and trapezoidal method and traces

Projection of planes (polygonal and circular surfaces) inclined to both the principal planes by rotating object method.

UNIT III PROJECTION OF SOLIDS 14

Projection of simple solids like prisms, pyramids, cylinder, cone and truncated solids when the axis is inclined to one of the principal planes by rotating object method and auxiliary plane method.

UNIT IV PROJECTION OF SECTIONED SOLIDS AND DEVELOPMENT OF SURFACES 14

Sectioning of above solids in simple vertical position when the cutting plane is inclined to the one of the principal planes and perpendicular to the other – obtaining true shape of section. Development of lateral surfaces of simple and sectioned solids – Prisms, pyramids cylinders and cones. Development of lateral surfaces of solids with cut-outs and holes

UNIT V ISOMETRIC AND PERSPECTIVE PROJECTIONS 15

Principles of isometric projection – isometric scale –Isometric projections of simple solids and truncated solids - Prisms, pyramids, cylinders, cones- combination of two solid objects in simple vertical positions and miscellaneous problems. Perspective projection of simple solids-Prisms, pyramids and cylinders by visual ray method and vanishing point method.

COMPUTER AIDED DRAFTING (DEMONSTRATION ONLY) 3

Introduction to drafting packages and demonstration of their use.

TOTAL: 75 PERIODS

TEXT BOOK

1. N.D.Bhatt and V.M.Panchal, “Engineering Drawing”, Charotar Publishing House, 50th Edition, 2010

REFERENCES

1. K.R.Gopalakrishna., “Engineering Drawing” (Vol I&II combined) Subhas Stores, Bangalore, 2007
2. Luzzader, Warren.J., and Duff,John M.,,’’ Fundamentals of Engineering Drawing with an introduction to Interactive Computer Graphics for Design and Production”, Eastern Economy Edition, Prentice Hall of India Pvt Ltd, New Delhi, 2005
3. M.B.Shah and B.C.Rana, “Engineering Drawing”, Pearson, 2nd Edition, 2009
4. K.Venugopal and V.Prabhu Raja, “Engineering Graphics”, New Age International (P) Limited ,2008.
5. K. V.Natrajan, “A text book of Engineering Graphics”, Dhanalakshmi Publishers, Chennai, 2009.
6. Basant Agarwal and Agarwal C.M., “Engineering Drawing”, Tata McGraw Hill Publishing Company Limited, New Delhi,2008.

PUBLICATION OF BUREAU OF INDIAN STANDARDS

1. IS 10711 – 2001: Technical products Documentation – Size and lay out of drawing sheets.
2. IS 9609 (Parts 0 & 1) – 2001: Technical products Documentation – Lettering.
3. IS 10714 (Part 20) – 2001 & SP 46 – 2003: Lines for technical drawings.
4. IS 11669 – 1986 & SP 46 – 2003: Dimensioning of Technical Drawings.
5. IS 15021 (Parts 1 to 4) – 2001: Technical drawings – Projection Methods.

SPECIAL POINTS APPLICABLE TO UNIVERSITY EXAMINATIONS ON ENGINEERING GRAPHICS:

1. There will be five questions, each of either or type covering all units of the syllabus.
2. All questions will carry equal marks of 20 each making a total of 100.
3. The answer paper shall consist of drawing sheets of A3 size only. The students will be permitted to use appropriate scale to fit solution within A3 size.
4. The examination will be conducted in appropriate sessions on the same day

PH8161	PHYSICS LABORATORY	L T P C
	(common to all branches of B.E./B.Tech. Programmes)	**0 0 2 1**

1.	Torsional pendulum	Determination of rigidity modulus of wire and moment of inertia of disc
2.	Non – uniform bending	Determination of young's modulus
3.	Lee's disc	Determination of thermal conductivity of a bad conductor
4.	Potentiometer	Determination of thermo e.m.f. of thermocouple
5.	Air wedge	Determination of thickness of a thin sheet of paper
6.	i. Optical fibre	Determination of Numerical Aperture and acceptance angle
	ii. Compact disc	Determination of width of the groove using laser
7.	Acoustic grating	Determination of velocity of ultrasonic waves in liquids
8.	Post office box	Determination of Band gap of a semiconductor
9.	Spectrometer	Determination of wavelength using grating
10.	Viscosity of liquids	Determination of co-efficient of viscosity of a liquid by Poiseuille's flow

TOTAL : 30 PERIODS

CY8161 **CHEMISTRY LABORATORY** **L T P C**

(Common to all branches of Engineering and Technology) **0 0 2 1**

1. Estimation of HCl using Na_2CO_3 as primary standard and Determination of alkalinity in water sample.
2. Determination of total, temporary & permanent hardness of water by EDTA method.
3. Determination of DO content of water sample by Winkler's method.
4. Determination of chloride content of water sample by argentometric method.
5. Estimation of copper content of the given solution by Iodometry.
6. Determination of strength of given hydrochloric acid using pH meter.
7. Determination of strength of acids in a mixture of acids using conductivity meter.
8. Estimation of iron content of the given solution using potentiometer.
9. Estimation of iron content of the water sample using spectrophotometer (1,10-phenanthroline / thiocyanate method).
10. Estimation of sodium and potassium present in water using flame photometer.
11. Determination of molecular weight of poly vinyl alcohol using Ostwald viscometer.
12. Pseudo first order kinetics – ester hydrolysis.
13. Corrosion experiment – weight loss method.
14. Determination of CMC.
15. Phase change in a solid.

TOTAL: 30 PERIODS

REFERENCE BOOKS

1. A text of quantitative inorganic analysis, A. L. Vogel , ELBS London. 1995.
2. Experiments in physical chemistry, D.P. Shoemarker and C.W. Gardad, McGraw Hill, London, 2001.
3. American Public Health Association.

GE8161 **COMPUTER PRACTICES LABORATORY** **L T P C**

0 0 3 2

LIST OF EXPERIMENTS

1. Search, generate, manipulate data using MS office/ Open Office
2. Presentation and Visualization – graphs, charts, 2D, 3D

3. Problem formulation, Problem Solving and Flowcharts
4. C Programming using Simple statements and expressions
5. Scientific problem solving using decision making and looping.
6. Simple programming for one dimensional and two dimensional arrays.
7. Solving problems using String functions
8. Programs with user defined functions
9. Program using Recursive Function and conversion from given program to flow chart.
10. Program using structures and unions.

TOTAL : 45 PERIODS

GE8162 ENGINEERING PRACTICES LABORATORY L T P C
0 0 3 2

OBJECTIVE

To provide exposure to the students with hands-on experience on various basic engineering practices in Civil, Mechanical, Electrical and Electronics Engineering.

GROUP – A (CIVIL & ELECTRICAL)

1. CIVIL ENGINEERING PRACTICE 12

PLUMBING

- Basic pipe connections involving the fittings like valves, taps, coupling, unions, reducers, elbows and other components used in household fittings. Preparation of plumbing line sketches.
- Laying pipe connection to the suction side of a pump – inlet.
- Laying pipe connection to the delivery side of a pump – out let.
- Practice in mixed pipe connections: Metal, plastic and flexible pipes used in household appliances.

WOOD WORK

- Sawing, planning and making common joints: T-Joint, Mortise and Tennon joint, Dovetail joint.

STUDY

- Study of joints in door panels, wooden furniture
- Study of common industrial trusses using models.

2. ELECTRICAL ENGINEERING PRACTICE **9**

- Basic household wiring using switches, fuse, indicator – lamp etc.,
- Preparation of wiring diagrams
- Stair case light wiring
- Tube – light wiring
- Study of iron-box, fan with regulator, emergency lamp

GROUP – B (MECHANICAL AND ELECTRONICS) **15**

3. MECHANICAL ENGINEERING PRACTICE

WELDING

- Arc welding of butt joints, lap joints, tee joints
- Gas welding Practice.
- Basic Machining
- Simple turning, drilling and tapping operations.
- Machine assembly Practice.
- Study and assembling the following:
- Centrifugal pump, mixies and air conditioners.
- Demonstration on
  - (a) Smithy operations like the production of hexagonal bolt.
  - (b) Foundry operation like mould preparation for grooved pulley.

4. ELECTRONIC ENGINEERING PRACTICE **9**

- Soldering simple electronic circuits and checking continuity.
- Assembling electronic components on a small PCB and testing.
- Study of Telephone, FM radio, low-voltage power supplies.

TOTAL: 45 PERIODS

HS8251 **TECHNICAL ENGLISH II** **L T P C**

(For all branches of B.E / B.Tech programmes) **3 1 0 4**

OBJECTIVES

- To make the students acquire listening and speaking skills meant for both formal and informal contexts
- To help them develop their reading skills by exposing them to different types of reading strategies
- To equip them with writing skills needed for academic as well as workplace situations
- To make them acquire language skills at their own pace by using e-materials and language lab component

UNIT I **9+3**

Listening - Listening to informal conversations and participating**; Speaking -** Opening a conversation (greetings, comments on something, weather) - Turn taking - Closing a conversation (excuses, general wish, positive comment, thanks); **Reading -** Developing analytical skills, Deductive and inductive reasoning - Extensive reading**; Writing -** Effective use of SMS for sending short notes and messages - Using 'emoticons' as symbols in email messages; **Grammar -** Regular & irregular verbs - Active and passive voice**; Vocabulary -** Homonyms (e.g. 'can') - Homophones (e.g. 'some', 'sum'); **E-materials -** Interactive exercise on Grammar and vocabulary – blogging; **Language Lab -** Listening to different types of conversation and answering questions.

UNIT II **9+3**

Listening - Listening to situation based dialogues**; Speaking -** Conversation practice in real life situations, asking for directions (using polite expressions), giving directions (using imperative sentences), Purchasing goods from a shop, Discussing various aspects of a film (they have already seen) or a book (they have already read); **Reading -** Reading a short story or an article from newspaper, Critical reading, Comprehension skills**; Writing -** Writing a review / summary of a story / article, Personal letter (Inviting your friend to a function, congratulating someone for his success, thanking one's friend / relatives); **Grammar -** modal verbs, Purpose expressions**; Vocabulary -** Phrasal verbs and their meanings, Using phrasal verbs in sentences**; E-materials -** Interactive exercise on Grammar and vocabulary, Extensive reading activity (reading stories / novels from links), Posting reviews in blogs - **Language Lab -** Dialogues (Fill up exercises), Recording students' dialogues.

UNIT III **9+3**

Listening - Listening to the conversation - Understanding the structure of conversations; Speaking - Conversation skills with a sense of stress, intonation, pronunciation and meaning - Seeking information – expressing feelings (affection, anger, regret etc.); Reading - Speed reading – reading passages with the time limit - Skimming; Writing - Minutes of meeting – format and practice in the preparation of minutes - Writing summary after reading the articles from the journals - Format for the journal articles – elements of technical articles (abstract, introduction, methodology, results, discussion, conclusion, appendices, references) - Writing strategies; Grammar - Conditional clauses - Cause and effect expressions; Vocabulary - Words used as nouns and verbs without any change in the spelling (e.g. 'rock', 'train', 'ring'); E-materials - Interactive exercise on Grammar & vocabulary - Speed Reading practice exercises; Language Lab - Intonation practice using EFLU materials – Attending a meeting and writing minutes.

UNIT IV **9+3**

Listening - Listening to a telephone conversation, Viewing a model interview (face-to-face, telephonic and video conferencing) and observing the practices**; Speaking -** Role play practice in telephone skills - listening and responding, -asking questions, -note taking – passing on messages, Role play and mock interview for grasping the interview skills; **Reading -** Reading the job advertisements and the profile of the company concerned – scanning**; Writing -** Applying for a job – cover letter - résumé preparation – vision, mission and goals of the candidate**; Grammar -** Numerical expressions - Connectives (discourse markers); **Vocabulary -** Idioms and their meanings – using idioms in sentences**; E-materials -** Interactive exercises on Grammar & Vocabulary - Different forms of résumés- Filling up a résumé / cover letter; **Language Lab -** Telephonic interview – recording the responses - e-résumé writing.

UNIT V **9+3**

Listening - Viewing a model group discussion and reviewing the performance of each participant - Identifying the characteristics of a good listener**; Speaking -** Group discussion skills – initiating the discussion – exchanging suggestions and proposals – expressing dissent/ agreement – assertiveness in expressing opinions – mind mapping technique**; Reading -** Note making skills – making notes from books, or any form of written materials - Intensive reading **Writing -** Types of reports – Feasibility / Project report – report format – recommendations / suggestions – interpretation of data (using charts for effective presentation); **Grammar -** Use of clauses**; Vocabulary –** Collocation**; E-materials -** Interactive grammar and vocabulary exercises - Sample GD - Pictures for discussion, Interactive grammar and vocabulary exercises - Pictures for discussion; **Language Lab -** Different models of group discussion

TOTAL : 60 PERIODS

TEXT BOOKS

1. Mindscapes: English for Technologists and Engineers, Orient Black Swan, 2012.
2. S.P. Dhanavel, English and Communication Skills for Students of Science and Engineering. Orient Black Swan, Chennai, 2011.

REFERENCE BOOKS

1. Laws, Anne. **Presentations.** Hyderabad: Orient BlackSwan, 2000.
2. Lewis, Hedwig. **Body Language: A Guide for Professionals.** New Delhi: Sage Publications, 1998.
3. Naterop, Jean B. and Rod Revell. **Telephoning in English.** Cambridge: Cambridge University Press, 1987.
4. Rutherford, Andrea J. **Basic Communication Skills for Technology**. New Delhi: Pearson Education, 2001.
5. Ur, Penny. **Teaching Listening Comprehension**. Cambridge: Cambridge University Press, 1984.

EXTENSIVE READERS

1. Abdul Kalam, A P J. **Ignited Minds: Unleashing the Power within India.** New Delhi: Penguin Books India, 2002.
2. Parameswaran, Uma. **C.V.Raman: A Biography.** New Delhi: Penguin Books India, 2011.

WEB RESOURCES

1. www.esl-lab.com
2. www.englishgrammar.org
3. www.englishclub.com
4. www.mindtools.com
5. www.esl.about.com

MA8251 MATHEMATICS II L T P C

(Common to all branches of B.E. / B.Tech.Programmes in II Semester) 3 1 0 4

OBJECTIVES

- To make the student acquire sound knowledge of techniques in solving ordinary differential equations that model engineering problems.

- To acquaint the student with the concepts of vector calculus, needed for problems in all engineering disciplines.
- To develop an understanding of the standard techniques of complex variable theory so as to enable the student to apply them with confidence, in application areas such as heat conduction, elasticity, fluid dynamics and flow the of electric current.
- To make the student appreciate the purpose of using transforms to create a new domain in which it is easier to handle the problem that is being investigated.

UNIT I DIFFERENTIAL EQUATIONS 9+3

Method of variation of parameters – Method of undetermined coefficients – Homogenous equation of Euler's and Legendre's type – System of simultaneous linear differential equations with constant coefficients.

UNIT II VECTOR CALCULUS 9+3

Gradient and directional derivative – Divergence and Curl – Irrotational and Solenoidal vector fields – Line integral over a plane curve – Surface integral and volume integral - Green's, Gauss divergence and Stoke's theorems – Verification and application in evaluating line, surface and volume integrals.

UNIT III ANALYTIC FUNCTION 9+3

Analytic functions – Necessary and sufficient conditions for analyticity - Properties – Harmonic conjugates – Construction of analytic function - Conformal mapping – Mapping by functions - $w = z + c,\ az,\ \frac{1}{z},\ z^2$ Bilinear transformation.

UNIT IV COMPLEX INTEGRATION 9+3

Line integral - Cauchy's integral theorem – Cauchy's integral formula – Taylor's and Laurent's series – Singularities – Residues – Residue theorem – Application of residue theorem for evaluation of real integrals – Use of circular contour and semicircular contour with no pole on real axis.

UNIT V LAPLACE TRANSFORMS 9+3

Existence conditions – Transforms of elementary functions – Transform of unit step function and unit impulse function – Basic properties – Shifting theorems -Transforms of derivatives and integrals – Initial and final value theorems – Inverse transforms – Convolution theorem —

Transform of periodic functions – Application to solution of linear ordinary differential equations with constant coefficients.

TOTAL : 60 PERIODS

TEXT BOOKS

1. Grewal B.S., "Higher Engineering Mathematics", Khanna Publishers, New Delhi, 40th Edition, 2007.
2. Ramana, B.V. "Higher Engineering Mathematics", Tata McGraw Hill, New Delhi, 2010.

REFERENCES

1. Glyn James, "Advanced Modern Engineering Mathematics", Pearson Education,New Delhi, 2007.
2. Jain R.K. and Iyengar S.R.K., "Advanced Engineering Mathematics", Narosa Publications, New Delhi, 3rd Edition, 2007.
3. Bali N., Goyal M. and Watkins C., "Advanced Engineering Mathematics",Firewall Media (An imprint of Lakshmi Publications Pvt., Ltd.,), New Delhi, 7th Edition, 2009.
4. Peter V.O'Neil, "Advanced Engineering Mathematics", Cengage Learning India Pvt., Ltd, New Delhi, 2007.

PH8255 PHYSICS OF MATERIALS L T P C

(Common to Chemical, Ceramic, Food, Leather, Industrial Biotechnology and Pharmaceutical) 3 0 0 3

UNIT I PREPARATION AND PROCESSING OF MATERIALS 9

Phases - Phase rule – binary systems – tie line rule – lever rule – phase diagram – invariant reactions – diffusion Fick's law - Nucleation – homogeneous and heterogeneous nucleation – Free energy of formation of a critical nucleus – crystal growth – Czochralski, Bridgman, Solution methods - Thin films – preparation: PVD method - Sol-gel method – heat treatment and hardening processes.

UNIT II PROPERTIES OF CONDUCTING AND SUPERCONDUCTING MATERIALS 9

Classical free electron theory of metals –Fermi function - Schrödinger wave equation - Time independent and time dependent equations. Physical significance of wave function, particle in a box (in one dimension) – electrons in a metal - Density of energy states – effect of temperature

on Fermi energy – carrier concentration in metals - Superconducting Phenomena, Properties of superconductors – Meissner effect and Isotope effect. Type I and Type II superconductors, High Tc superconductors – Magnetic levitation and SQUIDS.

UNIT III ELECTRONIC MATERIALS **9**

Elemental and compound semiconductors - Origin of band gap in solids (qualitative) - Concept of effective mass of electron and hole – carrier concentration in an intrinsic semiconductor (derivation) – Fermi level – Variation of Fermi level with temperature – electrical conductivity – band gap determination – carrier concentration in n-type and p-type semiconductors (derivation) – variation of Fermi level with temperature and impurity concentration – Compound semiconductors – Hall effect – Determination of Hall coefficient – LED and Solar cells.

UNIT IV INSULATING AND MAGNETIC MATERIALS **9**

Dielectric, paraelectric and ferroelectric materials - Electronic, Ionic, Orientational and space charge polarization – Internal field and deduction of Clausius Mosotti equation – dielectric loss – different types of dielectric breakdown – classification of insulating materials and their applications - Introduction to magnetic materials - Domain theory of ferromagnetism, Hysteresis, Soft and Hard magnetic materials – Anti-ferromagnetic materials – Ferrites, Giant Magneto Resistance materials. Magnetic bubbles.

UNIT V CERAMIC AND NEW MATERIALS **9**

Introduction to Ceramics and its applications - Ceramic Fibres - Fibre reinforced Plastics – Fibre reinforced Metal – Metallic glasses – Shape memory alloys – Copper base alloys – Nickel – Titanium alloys – Relaxor- Ferroelectric materials – Electro and magneto rheological fluids - Sensors and Actuators – polymer semiconductos – photoconducting polymers – liquid crystals - Bio-sensors - Scintillation detectors (Position sensitive) –Bio materials – hydroxyapatite – PMMA – Silicone.

TOTAL : 45 PERIODS

REFERENCES

1. Raghavan. V. Materials Science and Engineering, Prentice Hall of India, 2002.
2. Kumar.J, Moorthy Babu. S and Vasudevan. S., Engineering Physics, Vijay Nicole Imprints, 2006
3. Palanisamy.. P.K., Materials Science, Scitech., 2003.
4. Calister, W.D., Materials Science and Engineering an Introduction, John Wiley, 2003.
5. Raghavan, V., Physical Metallurgy, Prentice Hall of India, 2002.

CY8253	CHEMISTRY FOR TECHNOLOGISTS	L T P C
		3 0 0 3

UNIT I WATER 9

Water quality parameters- determination of hardness (EDTA method), TDS, BOD, COD and iron and their significance. Softening – Zeolite and demineralization processes. Boiler troubles and remedies – removal of oils and silica, internal conditioning. Desalination by electro-dialysis and reverse osmosis. Water quality parameters and standards for textile wet processing.

UNIT II CHEMISTRY OF INTERFACES 9

Interface region-curved interfaces-thermodynamics of surfaces - Surface film on liquids-Adsorption of gases on Solids-adsorption isotherms. Applications of adsorption studies-detergency, wetting, foaming , defoaming, spreading, water repellency.

UNIT III OILS, FATS, SOAPS & LUBRICANTS 9

Chemical constitution, Chemical analysis of oils and fats – acid, saponification and iodine values, Definitions, determinations and significance.Definition, mechanism of lubrication, preparation of petrolubes, desirable characteristics – viscosity, viscosity index, carbon residue, oxidation stability, flash and fire points, cloud and pour points, aniline point. Semisolid lubricant – greases, preparation of sodium, lithium, calcium and axle greases and uses, consistency test and drop point test. Solid lubricants – graphite and molybdenum disulphide

UNIT IV CHEMICALS AND AUXILIARIES 9

Surfactant Chemistry, bleaching powder, sodium hypochlorite, hydrogen peroxide, chlorine dioxide, preparation, estimation of available chlorine in hypochlorite bleach liquor. determination of strength of hydrogen peroxide.

UNIT V COLORANTS 9

Theory of color and constitution: chromophore and auxochrome,classification of dyes based on application. Chemistry and synthesis of , azo dye.

TOTAL: 45 PERIODS

REFERENCES

1. Dhara S. S., “A Text Book of Engineering Chemistry”, S. Chand & Co. Ltd., New Delhi, 2002
2. Jain. P.C. and Monica Jain, “Engineering Chemistry”, Dhanpet Rai & Sons, New Delhi, 2001

3. Puri B. R., Sharma L. R. and Madhan S. Pathania, “Principles of Physical Chemistry”, Shoban Lal Nagin Chand & Co., Jalandar, 2000

4. Shore J., “Colourants and Auxiliaries: Volume I Colorants”, Wood head Publishing Ltd., 2002, ISBN 0 901956 77 5

5. Shore J., “Colourants and Auxiliaries: Volume II Auxiliaries”, Wood head Publishing Ltd., 2002, ISBN 0 901956 78 3

6. Trotman E. R., “Dyeing and Chemical Technology of Textile Fibres”, B.I Publishing Pvt. Ltd., New Delhi, 1994

7. Shenai V. A., “Chemistry of Dyes and Principles of Dyeing”, Sevak Publications, Mumbai, 1995

GE8251 ENGINEERING MECHANICS L T P C
3 1 0 4

OBJECTIVE

- To develop capacity to predict the effect of force and motion in the course of carrying out the design functions of engineering

UNIT I BASICS AND STATICS OF PARTICLES 9 + 3

Introduction – Units and Dimensions – Laws of Mechanics – Lami’s theorem, Parallelogram and triangular Law of forces –– Vectorial representation of forces – Vector operations of forces -additions, subtraction, dot product, cross product – Coplanar Forces – rectangular components – Equilibrium of a particle – Forces in space – Equilibrium of a particle in space – Equivalent systems of forces – Principle of transmissibility .

UNIT II EQUILIBRIUM OF RIGID BODIES 9 + 3

Free body diagram – Types of supports –Action and reaction forces –stable equilibrium – Moments and Couples – Moment of a force about a point and about an axis – Vectorial representation of moments and couples – Scalar components of a moment – Varignon’s theorem – Single equivalent force -Equilibrium of Rigid bodies in two dimensions – Equilibrium of Rigid bodies in three dimensions

UNIT III PROPERTIES OF SURFACES AND SOLIDS 9 + 3

Centroids and centre of mass– Centroids of lines and areas - Rectangular, circular, triangular areas by integration – T section, I section, - Angle section, Hollow section by using standard

formula –Theorems of Pappus - Area moments of inertia of plane areas – Rectangular, circular, triangular areas by integration – T section, I section, Angle section, Hollow section by using standard formula – Parallel axis theorem and perpendicular axis theorem –Principal moments of inertia of plane areas – Principal axes of inertia-Mass moment of inertia –mass moment of inertia for prismatic, cylindrical and spherical solids from first principle – Relation to area moments of inertia.

UNIT IV DYNAMICS OF PARTICLES 9 + 3

Displacements, Velocity and acceleration, their relationship – Relative motion – Curvilinear motion -Newton's laws of motion – Work Energy Equation– Impulse and Momentum – Impact of elastic bodies.

UNIT V FRICTION AND ELEMENTS OF RIGID BODY DYNAMICS 9 + 3

Friction force – Laws of sliding friction – equilibrium analysis of simple systems with sliding friction –wedge friction-. Rolling resistance -Translation and Rotation of Rigid Bodies – Velocity and acceleration – General Plane motion of simple rigid bodies such as cylinder, disc/wheel and sphere.

TOTAL : 60 PERIODS

TEXT BOOKS

1. Beer, F.P and Johnson Jr. E.R. "Vector Mechanics for Engineers (In SI Units): Statics and Dynamics", 8th Edition, Tata McGraw-Hill Publishing company, New Delhi (2004)
2. Vela Murali, "Engineering Mechanics", Oxford University Press (2010)

REFERENCES

1. Hibbeller, R.C and Ashok Gupta, "Engineering Mechanics: Statics and Dynamics", 11th Edition, Pearson Education (2010).
2. Irving H. Shames and Krishna Mohana Rao. G., "Engineering Mechanics – Statics and Dynamics", 4th Edition, Pearson Education (2006)
3. J.L.Meriam and L.G.Kraige, " Engineering Mechanics- Statics - Volume 1, Dynamics- Volume 2,Third Edition, John Wiley & Sons,(1993)
4. Rajasekaran, S and Sankarasubramanian, G., "Engineering Mechanics Statics and Dynamics", 3rd Edition, Vikas Publishing House Pvt. Ltd., (2005).

CT8201	PRINCIPLES OF CERAMIC TECHNOLOGY	L T P C
	(Fundamentals Only –Qualitative Study)	3 0 0 3

AIM

The course is aimed to impart a basic knowledge about ceramics and about various fields in ceramics.

OBJECTIVES

On completion of the course the students are expected to

- Have learnt the process of preparing a white ware article.
- Have understood the importance and types of ceramic coatings, and the process of preparing and applying the same.
- Have an idea on preparation of glass and different glass articles.
- Have knowledge on importance and types of refractories.
- Have an introduction on different advanced ceramics materials and products.

UNIT I WHITEWARE **8**

Introduction – triaxial bodies – raw materials, body composition, preparation, forming-slip casting, plastic forming, pressing, finishing, drying, firing, glazing and decoration.

UNIT II CERAMIC COATINGS **9**

Introduction, classification, Glaze – Segar formula, raw materials, glaze preparation and application, firing, glaze defects. Enamels – substrate preparation, enamel preparation, enamel coatings.

UNIT III GLASS **8**

Introduction, classification, preparation– raw materials, mixing, charging, melting, processing, manufacture of glass products-flat ware and hollow ware.

UNIT IV REFRACTORIES **10**

Introduction, classification, Raw materials, preparation, properties and uses of – silica, alumino silicate, alumina, magnesite, forsterite, dolomite, chromite, chrome magnesite, zirconia and carbon.

UNIT V ADVANCED CERAMICS **10**

Introduction, properties and applications of – oxides, carbides, nitrides; Advanced ceramic products – ceramic fibers, glass ceramics.

TOTAL : 45 PERIODS

TEXT BOOKS

1. F. Singer and S. Singer, Industrial Ceramics, Oxford and IBH Publishing Co., 1991.
2. Ryan W, Properties of Ceramic Raw Materials, Pergamon Press, 2nd Edn., 1978.

REFERENCE BOOKS

1. Sudhir Sen, Ceramic White ware, Oxford & IBH Publishing Co., New Delhi, 1992.
2. Tailor J.R and Bull A.C, Ceramic Glaze Technology, Pergamon Press, NY, 1986.
3. Heinz G. Pfaender, Schott Guide to Glass, Chapman and Hall, 1996.
4. Nandi D.N, Handbook of Refractories, Tata McGraw – Hill Publishing Co., New Delhi, 1991.
5. Norton F.H, Fine Ceramics: Technology and Applications, McGraw – Hill Co., NY, 1978.

CH8261 UNIX PROGRAMMING LAB **L T P C**
0 0 4 2

AIM

The aim is to introduce working in UNIX environment.

OBJECTIVES

- To introduce the basic commands in UNIX.
- To teach UNIX shell programming.
- To introduce programming in C with UNIX system calls.

1. Basic Unix commands

i) Directory Related Commands
ii) File Related Commands.
iii) File Compression Related Commands
iv) Network Communication Commands
v) Commands for sending messages between the users
vi) Miscellaneous Commands

2. Editors for file operations.

i) Vi Editor

ii) Gedit

iii) Kwrite

3. Filters and Pipes

i) Concatenating Files

ii) Display beginning and End of Files

iii) Cut and Paste

iv) Sorting

v) Translating Characters

vi) Count Characters, words, Lines

vii) Comparing Files

4. Grep Operations – Grep, Fast Grep, Extended Grep

5. Sed Operations – Sed Scripts, Addresses, Commands

6. Awk

7. Input Redirection and Out Redirection Commands

8. Simple shell programming.

9. Shell programming using complex control structures

1. if - fi
2. if-else-fi
3. if-elif
4. case-esac
5. while- do- done
6. For-do-done

10. Shell Programming using Arrays & Functions .

11. C Programs using file system related system calls.

12. C Programs using process related system calls.

13. Programs for inter process communication using pipes, FIFOs.

14. Programs using signals.

15. Programs using shared memory

TOTAL : 60 PERIODS

TEXT BOOK

1. Brain W. Kernighan and Rob Pike, “The programming Environment”, PHI, 2002.

REFERENCE

1. Neil Matthew, Richard Stones, “”Linux Programming”,3rd Edition,2004.

CT8211 **CERAMIC SCIENCE LAB** **L T P C**
0 0 3 2

1. Physical Identification of Ceramic Raw Materials
2. Determination of Moisture Content of Ceramic Powders
3. Determination of Loss on Ignition of Ceramic Powders
4. Preparation of Ceramic Body by Extrusion
5. Preparation of Ceramic Body by Pressing
6. Determination of Shrinkage of Ceramic Body – Dry & Fired, Volume & Linear
7. Determination of Density - True & Bulk
8. Determination of Porosity
9. Determination of Water Absorption
10. Determination of Water of Plasticity of extruded body

EQUIPMENTS REQUIRED:

1. Hot Air Oven
2. Hot Plate
3. Electronic Balance
4. Furnace

TOTAL: 30 PERIODS

MA8357 TRANSFORM TECHNIQUES AND PARTIAL DIFFERENTIAL EQUATIONS **L T P C 3 1 0 4**

OBJECTIVES

- To introduce the effective mathematical tools for the solutions of partial differential equations that model physical processes;
- To introduce Fourier series analysis which is central to many applications in engineering apart from its use in solving boundary value problems;
- To acquaint the student with Fourier transform techniques used in wide variety of situations in which the functions used are not periodic;
- To develop Z- transform techniques which will perform the same task for discrete time systems as Laplace Transform, a valuable aid in analysis of continuous time systems.

UNIT I PARTIAL DIFFERENTIAL EQUATIONS **9+3**

Formation – Solutions of first order equations – Standard types and Equations reducible to standard types – Singular solutions – Lagrange's Linear equation – Integral surface passing through a given curve – Classification of Partial Differential Equations - Solution of linear equations of higher order with constant coefficients – Linear non-homogeneous PDE.

UNIT II FOURIER SERIES **9+3**

Dirichlet's conditions – General Fourier series – Odd and even functions – Half-range Sine and Cosine series – Complex form of Fourier series – Parseval's identity – Harmonic Analysis.

UNIT III APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATION **9+3**

Method of separation of Variables – Solutions of one dimensional wave equation and one-dimensional heat equation – Steady state solution of two-dimensional heat equation – Fourier series solutions in Cartesian coordinates.

UNIT IV FOURIER TRANSFORM **9+3**

Fourier integral theorem – Fourier transform pair-Sine and Cosine transforms – Properties – Transform of elementary functions – Convolution theorem – Parseval's identity.

UNIT V Z – TRANSFORM AND DIFFERENCE EQUATIONS **9+3**

Z-transform – Elementary properties – Inverse Z-transform – Convolution theorem – Initial and Final value theorems – Formation of difference equation – Solution of difference equation using Z-transform.

TOTAL : 60 PERIODS

TEXT BOOK

1. Grewal B.S., "Higher Engineering Mathematics", Khanna Publishers, New Delhi, 40th Edition, 2007.

REFERENCES

1. Glyn James, "Advanced Modern Engineering Mathematics", Pearson Education,New Delhi, 2007.
2. Ramana, B.V. "Higher Engineering Mathematics", Tata McGraw Hill, New Delhi, 11th Reprint , 2010.
3. Bali N., Goyal M. and Watkins C., "Advanced Engineering Mathematics",Firewall Media (An imprint of Lakshmi Publications Pvt., Ltd.,), New Delhi, 7th Edition, 2009.
4. Peter V.O'Neil, "Advanced Engineering Mathematics", Cengage Learning India Pvt., Ltd, New Delhi, 2007.

CY8351 INSTRUMENTAL METHODS OF ANALYSIS L T P C
3 0 0 3

UNIT I INTRODUCTION OF SPECTROMETRY 9

Properties of electromagnetic radiation- wave properties – components of optical instruments – Sources of radiation – wavelength selectors – sample containers – radiation transducers – Signal process and read outs – signal to noise ratio - sources of noise – Enhancement of signal to noise - types of optical instruments – Principle of Fourier Transform optical Measurements.

UNIT II MOLECULAR SPECTROSCOPY 9

Molecular absorption spectrometry – Measurement of Transmittance and Absorbance – Beer's law – Instrumentation - Applications -Theory of fluorescence and Phosphorescence – Instrumenation – Applications – Theory of Infrared absorption spectrometry – IR instrumentation – Applications – Theory of Raman spectroscopy – Instrumentation – applications.

UNIT III MAGNETIC RESONANCE SPECTROSCOPY AND MASS SPECTROMETRY 9

Theory of NMR – environmental effects on NMR spectra – chemical shift- NMR-spectrometers – applicatons of ^{1}H and ^{13}C NMR- Molecular mass spectra – ion sources – Mass spectrometer. Applications of molecular mass - Electron paramagnetic resonance- g values – instrumentation.

UNIT IV SEPARATION METHODS **9**

General description of chromatography – Band broadening and optimization of column performance- Liquid chromatography – Partition chromatography - Adsorption chromatography – Ion exchange chromatography -size exclusion chromatography- Affinity chromatography- principles of GC and applications – HPLC- Capillary electrophoresis – Applications.

UNIT V ELECTRO ANALYSIS AND SURFACE MICROSCOPY **9**

Electrochemical cells- Electrode potential cell potentials – potentiometry- reference electrode – ion selective and molecular selective electrodes – Instrument for potentiometric studies – Voltametry – Cyclic and pulse voltametry- Applications of voltametry . Study of surfaces – Scanning probe microscopes – AFM and STM.

TOTAL : 45 PERIODS

TEXT BOOK

1. Instrumental Methods of Analysis. D.A. Skoog, F. James Holler, Stanky, R.Crouch . Cengage Learning – 2007.

CT8301 MATERIAL SCIENCE L T P C
3 0 0 3

AIM

The course is aimed to enable the students to have a basic knowledge about crystal systems, microstructure and dependence on various properties.

OBJECTIVES

On completion of the course the students are expected to

- Have learnt about the atomic structure and bonding.
- Have studied about the structure of solids and various imperfections.
- Have learnt the basics about phase diagrams and phase transformations.
- Have learnt the basic concepts of diffusion in solids.
- Have studied the general properties of the solids.

UNIT I CHARACTERIZATION OF CERAMIC SOLIDS 10

Classification of engineering materials – structure-property relationships – atomic structure – bonding – bond energy, bond type, bond length, ionic, metallic, covalent, vanderwaals, secondary, variation in bonding character and properties – polymorphic transformations – structure of ceramics – metallic and ceramic structures – binary, ternary, silicate structures.

UNIT II STRUCTURE OF SOLIDS AND IMPERFECTIONS 9

Crystalline and non crystalline states – inorganic solids – covalent, metals and alloys, ionic, polymers – classification – structure – crystallinity. Imperfections – point – vacancy, Schottky, Frenkel- Line – dislocations – edge, screw, properties of dislocations – surface - grain boundary, interface boundary, twin and twist boundary, stacking faults – volume imperfections.

UNIT III PHASE DIAGRAMS AND PHASE TRANSFORMATIONS 9

Phase rule – single component system – binary phase diagrams – micro structural changes during cooling – lever rule – applications of phase diagrams – phase transformations – time scale for phase changes – nucleation & growth – applications.

UNIT IV DIFFUSION 8

Fick's laws of Diffusion – Solution to Fick's second law – applications based on the second law solution. Relationship between diffusibility and atomic mobility. Atomistic mechanisms of Diffusion – vacancy , interstitial, substitutional, interstitialcy, ring mechanism. Different types of diffusivities and their interdependence – tracer diffusivity, chemical diffusivity etc. Temperature dependence of diffusivity and activation energy. Kirkendall effect and Matano interface. Surface and Volume diffusivity.

UNIT V PROPERTIES 9

Physical properties – density, specific gravity, melting behavior. Thermal Properties – heat capacity, thermal conductivity, thermal expansion. Dielectric properties – polarization, dielectric constant, dielectric strength, dielectric loss, capacitance.

TOTAL: 45 PERIODS

TEXT BOOKS

1. V.Ragavan, Materials Science & Engineering, Prentice Hall of India, New Delhi, 2004.

2. W.D.Kingery, H.K.Bowen and D.R.Uhlmann, Introduction to Ceramics, John Wiley & Sons,2nd Edn, 2004.

REFERENCES

1. David W Richerdson, Modern Ceramic Engineering, Marcel Dekker Inc, New York,3rd Edn, 2006.
2. Michael W Barsoum, Fundamentals of Ceramics, McGraw Hill Co, New York.2000.
3. Dr.M.Arumugam, Materials Science, Anuradha Agencies, 2002.
4. Upadyaya G.S and Anish Upadhyaya, Materials Science and Engineering, Viva Books Pvt. Ltd., 2006.

CT8302 PROPERTIES OF CERAMICS L T P C
3 0 0 3

AIM

The course is aimed to enable the students to have a thorough knowledge on different properties of ceramics.

OBJECTIVES

On completion of the course the students are expected to

- Have a thorough knowledge on the mechanical properties and the mechanical failure modes of ceramics.
- Have studied the thermal properties of ceramics.
- Have an understanding on the optical properties of ceramics.
- Have a better knowledge on electrical properties of ceramics.
- Have a clear understanding on the magnetic properties of ceramics.

UNIT I MECHANICAL PROPERTIES 9

Plastic deformation of different crystals, creep in single crystal, polycrystal, refractories. Viscous flow of liquids and gases. Elastic moduli, anelasticity, brittle fracture and crack propagation, strength and fracture surface work experience, static fatigue, creep fracture, effects of microstructure.

UNIT II THERMAL PROPERTIES 10

Heat capacity, density and thermal expansion of glasses, crystals, composite bodies. Thermal conduction – phonon conductivity of single phase crystalline ceramics and glasses, photon

conductivity, conductivity of multiphase ceramics, thermal stress, temperature gradients, resistance to thermal shock and thermal spalling, thermal tempering and annealing.

UNIT III OPTICAL PROPERTIES **8**

Introduction, refractive index and dispersion, reflection and refraction, absorption, scattering, polarisability, boundary reflectance and surface gloss, opacity and translucency, absorption and colour, application.

UNIT IV ELECTRICAL PROPERTIES **9**

Electrical conduction phenomena, ionic conduction in crystals and glasses, electronic conduction in crystals and glasses, non-stoichiometry and solute controlled electronic conduction, valency controlled semiconductors, mixed conduction in poor conductors, poly crystalline ceramics, electrical phenomena, dielectric loss factor for crystals and glasses, dielectric conductivity, polycrystalline and polyphase ceramics, dielectric strength.

UNIT V MAGNETIC PROPERTIES **9**

Magnetic phenomena, origin of interactions in ferromagnetic materials, spinel ferrites, rare earth garnets, ortho ferrites and illmenites, hexagonal ferrites, polycrystalline ferrites, susceptibility, permeability, flux density, types of magnetism and their origin, electronic structure and magnetic moment, exchange interaction and super exchange interaction, hysteresis loop and magnetic domain – domain structure.

TOTAL: 45 PERIODS

TEXT BOOKS

1. Kingery W.D, Bowen H.K and Uhlmann D.R, Introduction to Ceramics, John Wiley & Sons, 1991.
2. Barsoum M.W, Fundamentals of Ceramics, McGraw-Hill, 1997.

REFERENCES

1. David W.Richerson, Modern Ceramic Engineering, 3rd Edn., Taylor and Francis, 2005.
2. Moulson A.J and Herbert H. M, Electroceramics, Chapman and Hall, London, 1990.
3. Allen Dinsdale, Pottery Science: Materials, Processes and Products, Ellis Horwood Ltd., NY, 1986.

CT8303 **UNIT OPERATIONS** **L T P C**
3 0 0 3

AIM

The course is aimed to enable the students to have a better understanding on the principles of unit operations like fluid mechanics, heat transfer and mass transfer.

OBJECTIVES

On completion of the course the students are expected to

- Have a thorough knowledge on the fluid statics and the fluid flow phenomena.
- Have studied the different equations involved in fluid flow and the changes that occur in a fluid flowing past immersed solids.
- Have understood the concepts involved in transfer of heat by conduction and convection.
- Have a clear idea on principle of heat transfer by radiation and radiative heat transfer between different surfaces.
- Have studied the basic mass transfer operations commonly come across in ceramic technology, like diffusion, humidification, drying of solids and crystallization.

UNIT I FLUID STATICS AND FLUID FLOW PHENOMENA 8

Fluid statics – hydrostatic equilibrium, applications of fluid statics – manometer, gravity & centrifugal decanter. Fluid flow phenomena – laminar flow, rheological properties of fluids, turbulence, boundary layers.

UNIT II FLUID FLOW EQUATIONS AND FLOW PAST IMMERSED SOLIDS 9

Fluid flow equation – Mass balance in a flowing fluid, mechanical energy equation for flowing fluid,. Flow past immersed solids – drag and drag coefficient, flow through a bed of solids, motion of particles through fluids.

UNIT III CONDUCTIVE AND CONVECTIVE HEAT TRANSFER 10

Conductive heat transfer – basic laws of conduction, steady state conduction, unsteady state conduction. Convective heat transfer – typical heat transfer equipments, energy balance, heat flux and heat transfer coefficient, heat transfer by forced convection in laminar flow, turbulent flow and transition region between laminar and turbulent flow, natural convection.

UNIT IV RADIATIVE HEAT TRANSFER **7**

Emission of radiation, absorption of radiation by opaque bodies, radiation between surface, radiations to semi transparent materials, combined heat transfer by conduction, convection and radiation.

UNIT V BASICS OF MASS TRANSFER OPERATIONS **11**

Diffusion – theory of diffusion, prediction of diffusivities, transient diffusion, Humidification operation – definition, humidity chart, wet bulb temperature. Drying of solids – classification of dryers, solids handling in dryer, principles of drying, cross circulation drying, through circulation drying, freeze drying, drying equipments for solids, pastes, solutions and slurries. Crystallization – crystal geometry, super saturation, mechanism of crystallization. Basic problems on material balance.

TOTAL: 45 PERIODS

TEXT BOOKS

1. Warren L.McCabe, Julian C.Smith and Peter Harriott, Unit Operations of Chemical Engineering, 7th Edn., McGraw Hill International Edition, 2005.
2. Salil K.Ghosal, Shyamal K.Sanyal and Siddhartha Datta, Introduction to Chemical Engineering, Tata McGraw-Hill Publishing Co. Ltd., New Delhi, 2003.

REFERENCES

1. Perry R.H and Green D (eds), Perry's Chemical Engineers' Handbook, 6th Edn.,McGraw-Hill, New York, 1984.
2. Walas S.M, Chemical Process Equipment, Butterworths, Stoneham, MA, 1988.
3. Treybal R.E, Mass Transfer Operations, 3rd Edn., McGraw-Hill, New York, 1980.

ME8351 BASIC MECHANICAL ENGINEERING **L T P C**
3 0 0 3

AIM

To impart knowledge on thermodynamics and thermal engineering power generating units such as engines and theory of machines

OBJECTIVE

- Students should learn thermodynamics and thermal engineering to understand the principles behind the operation of thermal equipments like IC engines and turbines etc., Students should be able to appreciate the theory behind operation of machinery and be able to design simple mechanisms

UNIT I LAWS OF THERMODYNAMICS 10

Basic concepts and hints; Zeroth law; First Law of Thermodynamics - Statement and application; Steady flow energy equation-problems- Second law of Thermodynamics – Kelvin - Plank statement and Clausius statement- problems; Limitations; Heat Engine, Refrigerator and Heat Pump, Available energy, Third law of Thermodynamics - Statement.

UNIT II HEATING AND EXPANSION OF GASES 6

Expressions for work done, Internal energy and heat transfer for Constant Pressure, Constant Volume, Isothermal, Adiabatic and Polytropic processes-Derivations and problems; Free expansion and Throttling process.

UNIT III AIR STANDARD CYCLES 6

Carnot cycle; Stirlings cycle; Joule cycle; Otto cycle; Diesel cycle; Dual combustion Cycle-Derivations and problems.

UNIT IV I.C. ENGINES, STEAM AND ITS PROPERTIES AND STEAM TURBINES 12

Engine nomenclature and classification; SI Engine; CI Engine; Four Stroke cycle, Two stroke cycle; Performance of I.C.Engine; Brake thermal efficiency; Indicated Thermal Efficiency, Specific fuel consumption.

Steam - Properties of steam; Dryness fraction; latent heat; Total heat of wet steam; Dry steam; Superheated steam. Use of steam tables; volume of wet steam, volume of superheated steam; External work of evaporation; Internal energy; Entropy of vapour, Expansion of vapour, Rankine cycle.

Steam turbines – Impulse and Reaction types - Principles of operation.

UNIT V SIMPLE MECHANISM, FLY WHEEL, DRIVES AND BALANCING 11

Definition of Kinematic Links, Pairs and Kinematic Chains;

Flywheel-Turning moment Diagram; Fluctuation of Energy.

Belt and rope drives; Velocity ratio; slip; Creep; Ratio of tensions; Length of belt; Power Transmitted; gear trains-types.

Balancing of rotating masses in same plane; Balancing of masses rotating in different planes.

TOTAL : 45 PERIODS

TEXT BOOKS

1. Nag, P.K., " Engineering Thermodynamics ", II Edition, Tata McGraw Hill Publishing Co., Ltd., 1995
2. Rajput, R .K, "Thermal Engineering", Laxmi publications (P) Ltd, 2001.
3. Khurmi R.S., and Gupta J.K, "Theory of Machines", Eurasia Publishing House (P) Ltd., 2004.

REFERENCES

1. Smith, " Chemical Thermodynamics ", Reinhold Publishing Co., 1977.
2. Bhaskaran, K.A., and Venkatesh, A., " Engineering Thermodynamics ",Tata McGraw Hill, 1973.
3. Pandya A. and Shah, " Theory of Machines ", Charatakar Publishers, 1975.
4. Khurmi R.S., and Gupta J.K, "Thermal Engineering", S.Chand & Company (P) Ltd.,2001.
5. Kothandaraman and Dhomkundwar,": A course in Thermal Engineering (SI Units)", Dhanpat Rai and Sons, Delhi (2001)

CT8311 UNIT OPERATIONS LAB L T P C
0 0 3 2

1. Determination of pressure drop in fluid using manometer
2. Determination of viscosity
3. Estimation of settling velocity of particles through fluid
4. Separation of solid from suspension by sedimentation
5. Estimation of thermal conductivity of insulating powder
6. Heat transfer by combined natural convection and radiation
7. Heat transfer in laminar flow
8. Heat transfer in turbulent flow
9. Determination of wet bulb temperature
10. Crystallization of solid from a super saturated solution
11. Drying rate estimation during drying of a solid

EQUIPMENTS REQUIRED:

1. Manometer
2. Orifice
3. Brookfield viscometer
4. Dryer

TOTAL: 30 PERIODS

ME8361 MECHANICAL ENGINEERING LABORATORY L T P C
0 0 3 2

AIM

To impart practical knowledge in operating IC engines and conduct experiments. To understand test procedures in testing material for engineering applications

OBJECTIVES

- Students will be able to understand Power-generating units such as engines and operate IC engines and conduct tests. They will be able to appreciate the theory behind the functioning of engines. Material properties, their behavior under different kinds of loading and testing can be visualized.

LIST OF EXPERIMENTS

1. Port timing diagram
2. Valve timing diagram
3. Study of 2,4 stroke I C Engines
4. Load test on 4-stroke petrol engine
5. Performance test on 4-stroke single cylinder diesel engine
6. Performance test on 4-stroke twin cylinder diesel engine
7. Heat balance test on diesel engines
8. Tension test
9. Compression test
10. Deflection test
11. Hardness test (Rockwell and Brinell)

12. Spring test
13. Torsion test
14. Impact test

TOTAL : 45 PERIODS

* Minimum 10 experiments shall be offered

MA8356 PROBABILITY AND STATISTICS L T P C
3 1 0 4

OBJECTIVES

- To make the students acquire a sound knowledge in statistical techniques that model engineering problems.
- The Students will have a fundamental knowledge of the concepts of probability.

UNIT I RANDOM VARIABLES 9+3

Discrete and Continuous random variables – Moments – Moment generating functions – Binomial, Poisson, Geometric, Uniform, Exponential, Gamma, Weibull and Normal distributions - Functions of a random variable.

UNIT II TWO-DIMENSIONAL RANDOM VARIABLES 9+3

Joint distributions – Marginal and Conditional distributions – Covariance – Correlation and Linear regression – Transformation of random variables – Central limit theorem (for independent and identically distributed random variables).

UNIT III TESTS OF SIGNIFICANCE 9+3

Sampling distributions - Tests for single mean, proportion, Difference of means (large and small samples) – Tests for single variance and equality of variances – $\chi 2$-test for goodness of fit – Independence of attributes – Non-parametric tests: Test for Randomness and Rank-sum test (Wilcoxon test).

UNIT IV DESIGN OF EXPERIMENTS 9+3

Completely randomized design – Randomized block design – Latin square design - 2^2 - factorial design - Taguchi's robust parameter design.

UNIT V STATISTICAL QUALITY CONTROL 9+3

Control charts for measurements ($\overline{X}$ and R charts) – Control charts for attributes (p, c and np charts) – Tolerance limits - Acceptance sampling.

TOTAL: 60 PERIODS

TEXT BOOKS

1. Milton, J. S. and Arnold, J.C., "Introduction to Probability and Statistics", Tata McGraw Hill, New Delhi, 4th Edition, 3rd Reprint, 2008.
2. Johnson, R.A. and Gupta, C.B., "Miller and Freund's Probability and Statistics for Engineers", Pearson Education, Asia, 8th Edition, 2011.

REFERENCES

1. Devore, J.L., "Probability and Statistics for Engineering and the Sciences", Thomson Brooks/Cole, International Student Edition, New Delhi, 7th Edition, 2008.
2. Walpole, R.E., Myers, R.H., Myers, S.L. and Ye, K., "Probability and Statistics for Engineers and Scientists", Pearson Education, Asia, 8th Edition, 2007.
3. Ross, S.M., "Introduction to Probability and Statistics for Engineers and Scientists", Elsevier, New Delhi, 3rd Edition, 2004.
4. Spiegel, M.R., Schiller, J. and Srinivasan, R.A., "Schaum's Outline of Theory and Problems of Probability and Statistics", Tata McGraw Hill, New Delhi, 2004.

GE8351 ENVIRONMENTAL SCIENCE AND ENGINEERING L T P C
3 0 0 3

UNIT I ENVIRONMENT, ECOSYSTEMS AND BIODIVERSITY 14

Definition, scope and importance of environment – need for public awareness - concept of an ecosystem – structure and function of an ecosystem – producers, consumers and decomposers – energy flow in the ecosystem – ecological succession – food chains, food webs and ecological pyramids – Introduction, types, characteristic features, structure and function of the (a) forest ecosystem (b) grassland ecosystem (c) desert ecosystem (d) aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries) – Introduction to biodiversity definition: genetic, species and ecosystem diversity – biogeographical classification of India – value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values – Biodiversity at global, national and local levels – India as a mega-diversity nation – hot-spots of biodiversity – threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife

conflicts – endangered and endemic species of India – conservation of biodiversity: In-situ and ex-situ conservation of biodiversity.

Field study of common plants, insects, birds

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

UNIT II ENVIRONMENTAL POLLUTION 8

Definition – causes, effects and control measures of: (a) Air pollution (b) Water pollution (c) Soil pollution (d) Marine pollution (e) Noise pollution (f) Thermal pollution (g) Nuclear hazards – soil waste management: causes, effects and control measures of municipal solid wastes – role of an individual in prevention of pollution – pollution case studies – disaster management: floods, earthquake, cyclone and landslides.

Field study of local polluted site – Urban / Rural / Industrial / Agricultural.

UNIT III NATURAL RESOURCES 10

Forest resources: Use and over-exploitation, deforestation, case studies- timber extraction, mining, dams and their effects on forests and tribal people – Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems – Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies – Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies – Energy resources: Growing energy needs, renewable and non renewable energy sources, use of alternate energy sources. case studies – Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification – role of an individual in conservation of natural resources – Equitable use of resources for sustainable lifestyles.

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

UNIT IV SOCIAL ISSUES AND THE ENVIRONMENT 7

From unsustainable to sustainable development – urban problems related to energy – water conservation, rain water harvesting, watershed management – resettlement and rehabilitation of people; its problems and concerns, case studies – role of non-governmental organization- environmental ethics: Issues and possible solutions – climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust, case studies. – wasteland reclamation – consumerism and waste products – environment production act

– Air (Prevention and Control of Pollution) act – Water (Prevention and control of Pollution) act – Wildlife protection act – Forest conservation act – enforcement machinery involved in environmental legislation- central and state pollution control boards- Public awareness.

UNIT V HUMAN POPULATION AND THE ENVIRONMENT 6

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

TOTAL : 45 PERIODS

TEXT BOOKS

1. Gilbert M.Masters, 'Introduction to Environmental Engineering and Science', 2nd edition, Pearson Education (2004).
2. Benny Joseph, 'Environmental Science and Engineering', Tata McGraw-Hill, New Delhi, (2006).

REFERENCE BOOKS

1. R.K. Trivedi, 'Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standards', Vol. I and II, Enviro Media.
2 Cunningham, W.P. Cooper, T.H. Gorhani, 'Environmental Encyclopedia',Jaico Publ., House, Mumbai, 2001.
3. Dharmendra S. Sengar, 'Environmental law', Prentice hall of India Pvt Ltd, New Delhi, 2007.
4. Rajagopalan, R, 'Environmental Studies-From Crisis to Cure', Oxford University Press (2005)

CT8401 CERAMIC RAW MATERIALS L T P C
3 0 0 3

AIM

The course is aimed to enable the students to have a complete knowledge on the basics of geology, mineralogy and different raw materials used commonly in ceramic industries.

OBJECTIVES

On completion of the course the students are expected to

- Have studied the basics of rock formation, its types, and mineral formation and its physical and optical properties.
- Have learnt about clay formation, clay minerals and types of clays.
- Have studied the different types of fluxes and their characteristics.
- Have learnt the types of silicate minerals, their properties and uses.
- Have an understanding on other ceramic raw materials, their properties and uses.

UNIT I GENERAL GEOLOGY AND MINEROLOGY 9

Rocks – formation, characteristics, classification into igneous, sedimentary and metamorphic. Minerals – formation, relation of mineral deposit to igneous activity, chemical and physical properties like composition, colour, streak, luster, fracture, cleavage, hardness, density and tenacity, elements of optical mineralogy.

UNIT II PLASTIC MATERIALS 10

Clay minerals. Clay structures – kaolinite and montmorillonite groups. Geology of clay deposits. Classification of clays – china clay, ball clay, fire clay, building clay etc. Beneficiation of clays. Clay properties – charged nature, cation exchange capacity, flow behaviour, plasticity, effect of heating. Mica, talc, pyrophyllite and wollastonite group – physical and chemical properties.

UNIT III FLUXES 7

Occurrence, properties and uses of natural fluxes – feldspar group, nepheline syenite, Cornish stone, lithium containing minerals. Bone ash – preparation, properties and uses.

UNIT IV SILICA AND SILICATE MATERIALS 9

Silica – occurrence, structure, polymorphic transformation, physical and chemical properties. Silicate minerals – quartz, sillimanite, kyanite, andalusite – properties and uses.

UNIT V OTHER RAW MATERIALS 10

Bauxite, magnesite, dolomite, chromite, limestone, rutile, zircon, beryllia minerals, alumina, slag and ashes, cullet – occurrence, properties and uses.

TOTAL: 45 PERIODS

TEXT BOOKS

1. Parbin Singh, Engineering and General Geology, S.K.Kataria and Sons, New Delhi, 2001.
2. Worrall W.E, Ceramic Raw Materials, Pergamon Press, NY, 1992.

REFERENCES

1. Norton F.H, Fine Ceramics: Technology and Applications, McGraw-Hill Co., NY, 1978.
2. Wilson M.J, Clay Mineralogy, Chapman and Hall, 1955.
3. Deer W.A, Howie R.A and Zussman J, Rock Forming Minerals, Longmans, London, 1967.
4. Ryan .W, Properties of Ceramic Raw Materials, Pergamon Press, 2nd Edn., 1978.

CT8402 PROCESSING OF CERAMIC RAW MATERIALS L T P C
3 0 0 3

AIM

The course is aimed to enable the students to have a complete knowledge on the steps involved in the processing of ceramic raw materials and the equipments used for those processes.

OBJECTIVES

On completion of the course the students are expected to

- Have a thorough knowledge on the quarrying of different plastic and non-plastic raw materials.
- Have a better understanding on the different equipments used for size reduction of raw materials and the laws involved in size reduction.
- Have a clear understanding on the mechanical separation operations like screening, filtration, sedimentary separation and magnetic separation.
- Have studied the principle and working of various equipments used for mixing, conveying and storage of ceramic raw materials.
- Have a clear knowledge on methods for characterizing the ceramic powder for its shape and size.

UNIT I QUARRYING **7**

Winning of clays, quarrying of non plastic materials, transportation. Clay purification methods – wet and dry methods. Weathering of clay. Beneficiation of non plastic materials.

UNIT II SIZE REDUCTION **9**

Laws of size reduction, mechanism of size reduction. Different crushers and grinders – jaw crusher, gyratory crusher, hammer mill, different types of tumbling mill, jet mill, attrition mill, vibro energy mill – principle of working. Closed circuit and open circuit grinding.

UNIT III MECHANICAL SEPARATION **10**

Introduction, types. Screening – dry and wet screening, equipments, effectiveness of screen, test sieves-ASTM, BSS, BIS, IS. Filtration – theory of filtration, batch and continuous filters, principles of cake filtration. Separation based on movement through a fluid – sedimentation, cyclone separation, air classification. Magnetic separation.

UNIT IV MIXING **9**

Mixing – mechanism of mixing, types of mixers – batch and continuous mixers – pan mixer, shaft mixer, U mixer, muller mixer and other mixers, liquid mixers – mechanism, blungers, agitators.

UNIT V CONVEYING AND STORAGE OF MATERIALS **10**

Conveying – solid conveying-types of conveyors, criteria for selecting a conveyor; liquid conveying-condition for liquid conveying, different types of pumps. Storage methods of different ceramic powders. Problems in bin storage

TOTAL : 45 PERIODS

TEXT BOOKS

1. Warren L.McCabe, Julian C.Smith and Peter Harriott, Unit Operations of Chemical Engineering, 7th Edn., McGraw Hill International Edition, 2005.
2. Charles Burroughs Gill, Materials Beneficiation, Springer Verlag, 1991.

REFERENCES

1. Ryan W and Redford C, Whitewares: Production, Testing and Quality Control, Pergamon Press, NY, 1987.
2. Vincenzini P, Fundamentals of Ceramic Engineering, Elsevier Applied Science, London,1991.

3. Paul De Garmo E, Black J.J and Ronald A.Kohser, Materials and Processes in Keishi Gotoh, Powder Technology Handbook, Marcel Dekker Inc., 1997.
4. F. Singer and S. Singer, Industrial Ceramics, Oxford and IBH Publishing Co., 1991.
5. Mohamed N.Rahaman, Ceramic Processing, Taylor & Francis, 2007.Manufacturing, 8th Edn., Prentice-Hall India Pvt. Ltd., New Delhi, 1997.
6. Tooley F.V, Handbook of Glass Manufacture, Vol I&II, Ogden Publishing Co., NY, 1960.

CT8403 TESTING METHODS OF CERAMICS L T P C
3 0 0 3

AIM

The course is aimed to enable the students to have a basic knowledge about the various testing methods of ceramic raw materials and samples and also the basics about quality control.

OBJECTIVES

On completion of the course the students are expected to

- Have learnt the basics about the testing methods for ceramic raw materials.
- Have learnt the various methods of testing the physical properties.
- Have learnt to test the various properties of glaze.
- Have an immense knowledge about testing of refractories.
- Have a basic knowledge about quality control.

UNIT I TESTING OF RAW MATERIALS 9

Sampling methods – coning and quatering– measurement of moisture content by IR moisture balance – speedy moisture test – particle size analysis – sieve test, sedimentation method –Stokes, Andreasen Pipette, sedigraph, laser diffraction, x-ray broadening, light scattering. Determination of surface area by permeametry, adsorption.

UNIT II TESTING OF PHYSICAL PROPERTIES 9

Plasticity – Pfefferkorn test, Atterberg test, Casting – Control of casting slips- fluidity, thixotropy, specific gravity, contraction – wet to dry, dry to fired, wet to fired, modulus of rupture –vitrification – density – porosity – water absorption.

UNIT III TESTING FOR GLAZE 9

Measuring coherence parameter – pick up – testing of viscosity of glazes at low temperatures and high temperatures – test for the solubility of lead frits – glaze fit –hardness testing – glaze thickness – autoclave and crazing – thermal shock measurement.

UNIT IV TESTING FOR REFRACTORIES 9

Refractoriness – RUL – cold crushing strength – permanent linear change on reheating – spalling resistance – reversible thermal expansion – thermal conductivity – creep – thermal shock resistance – hot modulus of rupture – slag resistance test.

UNIT V QUALITY CONTROL 9

Introduction – basic concepts – Indian standards for ceramic materials – ISO 9000 -zero defects – concept quality marking and certification scheme – total quality management in ceramic industries.

TOTAL : 45 PERIODS

TEXT BOOKS

1. W.Ryan & Radford C, Whitewares : Production, Testing and Quality Control, The Institute of Ceramics by Pergamon Press, Oxford, 1987.
2. Felix Singer & Sonja Singer, Industrial Ceramics, Oxford & IBH Publishing Ltd, New Delhi, 1992.

REFERENCES

1. D.Ganguli, S.Kumar, Elements of Ceramics –Vol II, Indian Institute of Ceramics, 1984.
2. Hiraoki Yanagida, The Chemistry of Ceramics, John Wiley and Sons, 1996.
3. Juran J.M and Gryna F.M, Quality Control Handbook, McGraw Hill Book Co.,1988.
4. Rashid Chesti.A, Refractories, Prentice Hall of India Pvt Ltd, 1986.
5. Kenneth Shaw, Ceramic Glazes, Elsevier Publishing Co, NY, 1971.
6. H.Lal, Total Quality Management – A Practical approach, Wiley Edn, 1990.

CT8404 **TRADITIONAL CERAMICS** **L T P C**
3 0 0 3

AIM

The course is aimed to enable the students to have a sound knowledge about the whiteware and heavy clayware products and their manufacturing processes, their properties and quality control.

OBJECTIVES

On completion of the course the students are expected to

- Have a basic knowledge about whiteware and heavy clayware, their classification and formulation.
- Be capable of classifying the various whiteware products and know the body formulation and properties.
- Have learnt in detail about the manufacturing process of various whiteware products.
- Have a better understanding about the heavy clayware products and their applications.
- Have learnt about the properties and the various properties methods.

UNIT I INTRODUCTION **9**

History – definition – whiteware – heavy clayware – classification – raw materials, batch calculation, mixing, forming, drying, firing, glazing, decoration.

UNIT II BODY FORMULATIONS **9**

Body composition – porcelain, earthenware, bone china, sanitary ware, hotel china, terracotta, majolica, steatite bodies, cordierite bodies, rutile bodies, titanate bodies, zircon bodies, lava bodies.

UNIT III WHITEWARE PRODUCTS **9**

Manufacturing process & properties – whitewares at home – tableware, kitchenware, flame resistant ware, art ware, containers, construction – floor tile, wall tiles, sanitary ware, electrical – low tension insulators, high tension insulators, high frequency low loss insulators, industrial use – abrasion resistance, chemical resistance, heat resistance.

UNIT IV HEAVY CLAYWARE PRODUCTS **9**

Introduction – classification- body composition – properties and applications of heavy clayware products – face bricks, paving bricks, hollow bricks, roofing tiles, sewer pipes, stoneware pipes, floor tiles, vitrified tiles.

UNIT V PROPERTIES & TESTING **9**

Strength – tensile, flexural, impact – absorption & porosity – moisture expansion – thermal expansion – thermal shock resistance – heat conductivity – abrasion resistance – chipping resistance – chemical durability – electrical properties – dielectric strength, dielectric constant, power & loss factor, volume resistivity.

TOTAL: 45 PERIODS

TEXT BOOKS

1. Alen Dinsdale, Pottery Science : Materials, Processes and Products, Ellis Horwood Ltd, 1986.
2. Sudhir Sen, Ceramic Whitewares : Production, Testing and Quality Control, Pergamon Press, 1987.

REFERENCES

1. F.Singer & S.Singer, Industrial Ceramics, Oxford & IBH Publishing Co, 1991.
2. Mohamed N.Rahaman, Ceramic Processing, Taylor & Francis, 2007.
3. Rexford Newcomb Jr, Ceramic Whitewares : History, Technology and Applications, Pitman Publishing Corporation, 1947.

CT8411 CERAMIC TESTING LAB **L T P C**
0 0 3 2

1. Particle Size Distribution by Screen Analysis
2. Particle Size Distribution by Hydrometer Method
3. Particle Size Distribution by Andreasen Pipette Method
4. IR Moisture Analysis
5. Pfefferkorn Test for Plasticity
6. Thixotropic Behaviour of Slurry by Torsion Viscometer
7. Glaze Testing by Autoclave

8. Cold Crushing Strength of Refractory.
9. Modulus of Rupture of Ceramic Body
10. Determination of Slip Specific Gravity

TOTAL : 45 PERIODS

EQUIPMENTS REQUIRED

1. Sieve Shaker
2. IR Mositure Analyser
3. Universal Testing Machine
4. Autoclave
5. Pfefferkorn Apparatus
6. Torsion Viscometer

CT8412 TRADITIONAL CERAMICS LAB L T P C
0 0 3 2

1. Preparation of Ceramic Slip in a Pot Mill
2. Determination of Slip Specific Gravity.
3. Determination of Slip Viscosity.
4. Effect of Water on Viscosity of Slip.
5. Effect of Deflocculant on Viscosity of Slip.
6. Determination of Residue in a Slip.
7. Plaster Mould Making.
8. Determination of Setting Time and Setting Temperature of Plaster of Paris
9. Forming of Solid Slip Cast Article.
10. Forming of Drain Slip Cast Article.
11. Biscuit Firing.

EQUIPMENTS REQUIRED:

1. Pot Mill
2. Gibbs Viscometer

3. Hot Air Oven
4. Sieves
5. Moulds
6. Furnace

TOTAL : 45 PERIODS

CT8501 CERAMIC FABRICATION PROCESSES L T P C
3 0 0 3

AIM

The course is aimed to enable the students to have a thorough knowledge about the different ceramic fabrication process and the other final operations involved after the fabrication of the product.

OBJECTIVES

On completion of the course the students are expected to

- Have complete knowledge about the slip casting process.
- Have a complete knowledge about the various plastic forming process.
- Have a complete knowledge about the various dry forming process.
- Have a sound understanding on the mechanism of drying and the construction and working of the various drying equipments.
- Understand effectively the importance of firing and the mechanism and types of firing equipments.

UNIT I SLIP FORMING PROCESS 9

Introduction. Slip- selection of materials, particle size measurement, viscosity, surfactant concentration, binders, pH, zeta potential, settling, solid recovery, slip recovery, slip conditioning and storage. Plaster mould – process, preparation. Slip casting – methods, mechanisms.

UNIT II PLASTIC FORMING PROCESS 9

Plastic mass preparation – pug mill, pugging defects. Shaping methods – extrusion, jiggering, injection molding, roller machine, compression molding.

UNIT III DRY FORMING PROCESS **9**

Theory of packing. Pressing- Uniaxial pressing – stress distribution on green body – defects and remedies, vibration compaction, isostatic pressing, reactive hot pressing – advantages – defects and remedies.

UNIT IV DRYING AND FINISHING **9**

Mechanism of drying – transfer of heat – factors that control drying – types of dryers – intermittent and continuous dryers – process of drying – drying defects – finishing – cutting and trimming – sponging, fettling and towing – scumming.

UNIT V FIRING **9**

Action of heat on ceramic bodies – physical changes, chemical changes. Firing equipments, firing schedules – fast firing, firing range. Problems, defects. Liquid phase sintering, vitrification, microstructure control.

TOTAL: 45 PERIODS

TEXT BOOKS

1. Alan G. King, Ceramic Technology and Processing, Noyes Publication, USA, 2002.
2. James S. Reed, Principles of Ceramic Processing, John Wiley and Sons, NY, 1988.

REFERENCES

1. Norton F. H, Fine Ceramics Technology and Applications, McGraw-Hill Co., 1978.
2. Terpstra, Ceramic Processing, Chapman and Hall, 1995.
3. I.J. McColm, N.J.Clark, Forming, Shaping and Working of High Performance Ceramics, Chapman and Hall, 1998.
4. Sudhir Sen, Ceramic Whiteware, Oxford & IBH Publishing Co., New Delhi, 1992.

CT8502 GLASS ENGINEERING – I **L T P C**
3 0 0 3

AIM

The course is aimed to enable the students to have a complete knowledge on the principle behind glass formation, raw materials and melting of glass batch, glass properties and quality control in glass.

OBJECTIVE

On completion of the course the students are expected to

- Have understood the principle behind glass formation and structures of different glasses.
- Have studied about the raw materials for glass making and calculation of a glass batch for a given composition.
- Have learnt about the reactions involved in the conversion of solid glass batch into a liquid glass melt.
- Have studied about the thermo-dynamical, thermal, mechanical, electrical and other properties of glass.
- Have learnt the defects found in a flat ware and a hollow ware, and the quality control procedure for a coated glass.

UNIT I PRINCIPLES OF GLASS FORMATION 10

Definition. Difference between a glass and crystalline material. Glass Formation – atomistic hypothesis of glass formation, kinetic approach to glass formation. Structures of glasses – fundamental laws, elements of structural models for glasses, structural models for silicate glasses. Phase diagrams of glass forming oxide systems – $CaO\text{-}Al_2O_3\text{-}SiO_2$, $Na_2O\text{-}CaO\text{-}SiO_2$ etc.

UNIT II RAW MATERIALS AND PREPARATION OF GLASS BATCH 10

Raw materials – Glass formers, intermediates and modifiers, cullet, minor ingredients like oxidizing/reducing agents, refining agents, decolourisers, colouring oxides – description and importance. Selection of glass composition, change in properties in relation to change in composition, Glass batch calculation.

UNIT III GLASS MELTING PROCESS 10

Physiochemical reactions during glass melting – effect of particle size and pre-sintering on melting. Refining – sources of gas bubbles, identification of gases, solubility of gases in glass, growth & rise of bubbles, refining agents. Homogenization – sources of inhomogenity, rate of homogenization in relation to diffusion kinetics, convection currents & rise of bubbles. Effect of colourants in glass melting.

UNIT IV PROPERTIES OF GLASS 8

Thermodynamic & thermal properties – density, surface tension, thermal expansion, specific heat, thermal conductivity. Mechanical properties – viscosity, elastic properties, hardness,

strength. Electrical & Transport properties – electrical conductivity, dielectric property, ionic diffusion. Other properties – refractive index, dispersion, chemical durability.

UNIT V TESTING AND QUALITY CONTROL 7

Flat glass defects – origin, characteristics. Container glass defects – origin, remedies. Test procedures for normal glass and coated glass.

TOTAL: 45 PERIODS

TEXT BOOKS

1. James E.Shelby, Introduction to Glass Science & Technology, The Royal Society of Chemistry, 1997.
2. Paul, Chemistry of Glasses, 2nd Edn, Chapman & Hall, 1990.

REFERENCES

1. D.Ganguli, S.Kumar, Elements of Ceramics –Vol II, Indian Institute of Ceramics, 1984.
2. Fundamentals of Glass Manufacturing Process 1991, Proceedings of the First Conference of the European Society of Glass Science and Technology, Society of Glass Technology, 1991.
3. Tooley F.V, Handbook of Glass Manufacture, Vol I&II, Ogden Publishing Co., NY, 1960.
4. A. Charles A Harper, Handbook of Ceramic Glasses & Diamonds, McGraw Hill, 2001.
5. Glass Furnaces-Design, Construction & Operation, Wolfgang Trier, Society of Glass Technology, 2000.
6. Narottam P Banral, R.H.Doremus, Handbook of Glass Properties, Academic Press, Inc, 1986.

CT8503 GLAZE TECHNOLOGY L T P C
3 0 0 3

AIM

The course is aimed to enable the students to have a complete knowledge about the importance of glazing and the processing and application of glazes.

OBJECTIVES

On completion of the course the students are expected to

- Have learnt the definition of glazes and classification of glazes.

- Have a thorough knowledge about the raw materials and properties of the glaze raw materials.
- Have a thorough knowledge about the various glazing techniques.
- Have learnt the properties and defects produced by glazing.
- Have complete understanding about the various methods of decorating the glazed article.

UNIT I INTRODUCTION TO GLAZE 9

Definitions – composition of glaze – classification of different types of glazes – engobe – frit preparation – frit rules – compounding of lead and leadless glazes, alkaline glazes, calcarious glazes and feldspatic glazes.

UNIT II RAW MATERIALS AND PROCESSING 9

Glaze raw materials – effect of individual materials – opacifiers – colouring agents – stains – mixed colours – metallic lustures – unit operations and processes – glaze properties – grain size – specific gravity – viscosity – glaze control – additives – glaze suitability – fired properties of glazes.

UNIT III GLAZING TECHNIQUES AND SPECIAL GLAZES 9

Glazing techniques – dipping, pouring, spraying, brushing, dusting and other techniques-special glazes – matt glazes, snake skin glazes, crackled glazes, salt glazes and other glazes.

UNIT IV PROPERTIES AND DEFECTS 9

Glaze body reactions- interface layers- thermal characteristics- mechanical, optical and chemical properties of glazes - glaze defects and remedies- crazing, peeling, crawling, rolling, blisters, pin holes, dunting.

UNIT V DECORATION 9

Classification of decoration methods- advantages- different decorating techniques- painting, spraying, stenciling, stamping, printing, lithographic transferring, silk screen printing, dusting, engobing, liquid gold decoration and decoration techniques.

TOTAL: 45 PERIODS

TEXT BOOKS

1. Kenneth Shaw, Ceramic Glazes, Elsevier Publishing Co., NY, 1971.
2. Tailor J.R and Bull A.C, Ceramics Glaze Technology, Pergamon Press, NY, 1986.

REFERENCES

1. Emmanuel Cooper, The Potter Book of Glaze Recipes, B.T.Batsford Ltd., London, 1986.
2. Hiraoki Yanagida, The Chemistry of Ceramics, John Wiley and Sons, 1996.
3. Terpstra, Ceramic Processing, Chapmann and Hall, 1995.

CT8504 REFRACTORIES- I L T P C
3 0 0 3

AIM

The course is aimed to enable the students to have a basic knowledge about the various types of refractories used in the industries.

OBJECTIVES

On completion of the course the students are expected to

- Have learnt the basics about refractories and its demand.
- Have a sound knowledge about silica refractories.
- Have learnt about properties and applications of alumino silicate refractories.
- Have learnt about the various basic refractories.
- Have a knowledge about special refractories.

UNIT I INTRODUCTION 9

Definition – production - demand & growth of refractories in India - Layout of a refractory plant - classification of refractory - fundamental properties of refractories - factors for selection and use of refractories.

UNIT II SILICA REFRACTORIES 9

Raw materials & composition - manufacturing process steps – phase transformation of quartzite - properties & uses.

UNIT III ALUMINOSILICATE REFRACTORIES **9**

Al_2O_3 – SiO_2 phase diagram, - types of raw materials - different alumino silicate refractories – manufacturing steps – properties & applications.

UNIT IV BASIC REFRACTORIES **9**

Manufacturing process - properties and uses of magnesite, forsterite, dolomite and chrome based refractories.

UNIT V SPECIAL REFRACTORIES **9**

Different Carbide & nitride refractories - carbon and carbon based refractory – zirconia – beryllia - thoria refractory - fused cast refractories – cermets – ceramic fibers.

TOTAL : 45 PERIODS

TEXT BOOKS

1. D.N.Nandi, Handbook of Refractories, Tata McGraw Hill Publishing Co, New Delhi, 1991.
2. Chesters J.H, Refractories: Production & Properties, Iron & Steel Institute, London, 1973.

REFERENCES

1. B.M.Coope & E.M.Dickson, Raw Materials for the Refractories Industries, An Industrial Minerals Consumer Survey, 1981.
2. Shaw K, Refractories & Their Uses, App,Science Publishers, UK,1972.

CT8511 CHEMICAL ANALYSIS LAB **L T P C**
0 0 3 2

1. ALUMINO SILICATE MATERIALS

- Silica
- Alumina
- Iron Oxide
- Alkali Oxides
- Alkaline Earth Oxides

2. HIGH SILICA MATERIALS

- Silica
- Alumina
- Iron Oxide
- Alkali Oxides
- Alkaline Earth Oxides

3. FELDSPATHIC MATERIALS

- Silica
- Alumina
- Iron Oxide
- Alkali Oxides
- Alkaline Earth Oxides

TOTAL: 45 PERIODS

CT8512 GLAZE LAB L T P C
0 0 3 2

1. Preparation of Glaze Slip.
2. Fusion Studies.
3. Particle Size and Particle Size Distribution of Glaze.
4. Determination of Viscosity of Glaze Slip.
5. Determination of Flow Properties of Glaze Slip.
6. Preparation of Coloured Glazes.
7. Application of Glazes.
8. Glost Firing.
9. Decoration.
10. Measurement of Thickness of Glaze.
11. Determination of Scratch Resistance.
12. Crazing Analysis.
13. Determination of Acid Resistance by boiling acid.

14. Determination of Alkali Resistance by boiling alkali.
15. Determination of Thermal Expansion of Glaze using Dilatometer.

EQUIPMENTS REQUIRED:

1. Dilatometer
2. Pot Mill
3. Particle Size Analyser
4. Hot Air Oven
5. Furnace

TOTAL: 45 PERIODS

CT8601 GLASS ENGINEERING – II L T P C
3 0 0 3

AIM

The course is aimed to enable the students to have a thorough knowledge on furnaces used for glass melting, fabrication of glass and the treatments to the final glass article.

OBJECTIVES

On completion of the course the students are expected to

- Have learnt the different furnaces used for glass melting, their design and operation.
- Have a better understanding on the heating process in tank furnace and the measurement and control of parameters in tank furnace.
- Have studied the fabrication methods of glass flat ware and hollow ware.
- Have a clear understanding on the purpose and process of annealing of glass products.
- Have learnt the different value adding processes done to glass.

UNIT I GLASS MELTING FURNACES 8

Construction and operation of pot furnace and day tank furnace. Tank furnace – types, design & construction, refractories used. Electric tank furnace – design & operation, electrodes used, electric boosting in tank furnace.

UNIT II OPERATION OF TANK FURNACE 10

Heating process – temperature distribution, efficiencies, heat balance, thermal insulation & cooling. Measurement and control – temperature, pressure, volume and fuel/air mixture, glass level. Reversal, heating and cooling of glass furnace, hot repairs.

UNIT III FABRICATION PROCESS 9

Forehearth & Feeder, hand operations, flatware – sheet glass, float glass, plate glass, patterned glass. Hollow ware – press & blow, blow & blow, IS machine, bulbs & tubes.

UNIT IV ANNEALING 9

Introduction, nature of generation & release of strain, temporary & permanent strain, dependence of strain on cooling rate, detection & measurement of strain, annealing equation, problems in annealing, annealing glass plate, optical glass, ideal annealing cycle.

UNIT V VALUE ADDING PROCESSES IN GLASS 9

Mirror, chemical vapour deposition, physical vapour deposition process, laminated glass, tempered glass, decorated glasses, vycor & micro porous glass, sealing glass, neutral glass, photosensitive glass, glass ceramic, glass fibers.

TOTAL: 45 PERIODS

TEXT BOOKS

1. Glass Furnaces-Design, Construction & Operation, Wolfgang Trier, Society of Glass Technology, 2000.
2. Volf V.B, Technical Approach to Glass, Elsevier, 1990.

REFERENCES

1. Tooley F.V, Handbook of Glass Manufacture, Vol I&II, Ogden Publishing Co., NY, 1960.
2. Alexis G.Pincus, Melting Furnace Operation in the Glass Industry, Magazines for Industry Inc., NY, 1980.
3. Cummings K, The Technique for Glass Forming, B.T.Batsford Ltd., London, 1980.
4. James E.Shelby, Introduction to Glass Science & Technology, The Royal Society of Chemistry, 1997.

CT8602	REFRACTORIES- II	L T P C
		3 0 0 3

AIM

The course is aimed to enable the students to have a sound knowledge about the various types of refractories used in the various applications.

OBJECTIVES

On completion of the course the students are expected to

- Have learnt the basics about refractories used in iron & steel industry.
- Have a sound knowledge about refractories used in non ferrous and non metallic industries.
- Have learnt about refractories used in glass and ceramic industry.
- Have learnt about the refractories used for insulation.
- Have a knowledge about special refractories used in space and atomic/nuclear energy.

UNIT I REFRACTORIES FOR IRON & STEEL INDUSTRY 9

Refractories used in - coke oven, blast furnace, open hearth furnace, LD converter, THF, EAF, IF, Ladle furnace, slide plate system, nozzle, shroud, continous casting, monolithics – gunning technique, refractory slag and metal interactions.

UNIT II REFRACTORIES FOR NON FERROUS & NON METALLIC INDUSTRIES 9

Refractories in non ferrous industries – copper, aluminum, lead - Refractories in non metal industries – hydrocarbon industry, fertilizer industry, cement industry.

UNIT III REFRACTORIES FOR GLASS AND CERAMIC INDUSTRY 9

Refractories for glass industry – refractory practices in sidewall, throat, forehearth and roof of glass tank, regenerator systems, refractories for ceramic industry – kiln design – LTM concept, kiln furniture's – types, properties, requirements – applications in different ceramic industry.

UNIT IV REFRACTORIES FOR INSULATION 9

Purpose of insulation – types of insulating materials and preparation of insulating refractories, ceramic fibre products – design and installation – ceramic coatings.

UNIT V REFRACTORIES FOR SPACE & NUCLEAR APPLICATIONS 9

Ceramics for space – materials used in space satellite, missiles, rockets nozzles, ceramics for nuclear reactors – types of reactors, structural ceramic materials, ceramic fuel elements, control rod elements.

TOTAL: 45 PERIODS

TEXT BOOKS

1. D.N.Nandi, Handbook of Refractories, Tata McGraw Hill Publishing Co, New Delhi, 1991
2. Shaw K, Refractories & Their Uses, App. Science Publishers, UK,1972

REFERENCE

1. Chesters J.H, Steel Plant Refractories, 2nd Edn, United Steel Company Limited, UK, 1973

FT8651 PROCESS ECONOMICS AND INDUSTRIAL MANAGEMENT L T P C
3 0 0 3

AIM

To introduce process economics and industrial management principles to chemical engineers.

OBJECTIVES

- The objective of this course is to teach principles of cost estimation, feasibility analysis, management, organization and quality control that will enable the students to perform as efficient managers.

UNIT I PRINCIPLES OF PRODUCTION MANAGEMENT AND ORGANISATION 15

Planning, organization, staffing, coordination, directing, controlling, communicating, organization as a process and a structure; types of organizationsMethod study; work

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

UNIT II ENGINEERING ECONOMICS FOR PROCESS ENGINEERS - INTEREST, INVESTMENT COSTS AND COST ESTIMATION 10

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

UNIT III PROFITABILITY, INVESTMENT ALTERNATIVE AND REPLACEMENT 8

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

UNIT IV ANNUAL REPORTS AND ANALYSIS OF PERFORMANCE 4

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

UNIT V ECONOMIC BALANCE AND QUALITY AND QUALITY CONTROL 8

Essentials of economic balance – Economic balance approach, economic balance for insulation, evaporation, heat transfer.
Elements of quality control, role of control charts in production and quality control.

TOTAL : 45 PERIODS

TEXT BOOKS

1. Peters, M. S. and Timmerhaus, C. D., " Plant Design and Economics for Chemical Engineers ", 5th Edn., McGraw Hill, 2002.
2. Holand, F.A., Watson, F.A. and Wilkinson, J.K., " Introduction to process Economics ", 2nd Edn., John Wiley, 1983.
3. Narang, G.B.S. and Kumar, V., " Production and Costing ", Khanna Publishers, New Delhi, 1988.

REFERENCES

1. Allen, L.A., " Management and Organization", McGraw Hill.Perry, R. H. and Green, D., " Chemical Engineer's Handbook ", 7th Edn., McGraw

HS8561	EMPLOYABILITY SKILLS	L T P C
	(Lab / Practical Course)	0 0 2 1

(Common to all branches of Fifth or Sixth Semester B.E / B.Tech programmes)

OBJECTIVES

- To enhance the employability skills of students with a special focus on Presentation skills, Group discussion skills and Interview skills
- To help them improve their soft skills, including report writing, necessary for the workplace situations

1. Making presentations – introducing oneself – introducing a topic – answering questions – individual presentation practice
2. Creating effective PPTs – presenting the visuals effectively
3. Using body language with awareness – gestures, facial expressions, etc.
4. Preparing job applications - writing covering letter and résumé
5. Applying for jobs online - email etiquette
6. Participating in group discussions – understanding group dynamics - brainstorming the topic
7. Training in soft skills - persuasive skills – sociability skills - questioning and clarifying skills – mock GD
8. Writing reports – collecting, analyzing and interpreting data – drafting the report
9. Attending job interviews – answering questions confidently
10. Interview etiquette – dress code – body language – mock interview

TOTAL 30: PERIODS

REQUIREMENTS FOR A CLASS OF 30 STUDENTS

1. A PC or a lap top with one or two speakers
2. A Collar mike and a speaker
3. An LCD projector and a screen
4. CD’s and DVD’s on relevant topics
5. Individual chairs for conducting group discussions

REFERENCE BOOKS

1. Dhanavel, S.P. 2010. English and Soft Skills. Hyderabad: Orient BlackSwan Ltd.
2. Corneilssen, Joep. How to Prepare for Group Discussion and Interview. New Delhi: Tata-McGraw-Hill, 2009.
3. D'Abreo, Desmond A. Group Discussion and Team Building. Mumbai: Better Yourself Books, 2004.
4. Ramesh, Gopalswamy, and Mahadevan Ramesh. The ACE of Soft Skills. New Delhi: Pearson, 2010.
5. Gulati, Sarvesh. Corporate Soft Skills. New Delhi: Rupa and Co. 2006.
6. Van Emden, Joan, and Lucinda Becker. Presentation Skills for Students. New York: Palgrave Macmillan, 2004.

EXTENSIVE READERS

1. Covey, Stephen R. The 7 Habits of Highly Effective People. New York: Free Press, 1989.
2. Bagchi, Subroto. The Professional. New Delhi: Penguin Books India, 2009.

WEB RESOURCES

1. www.humanresources.about.com
2. www.careerride.com

CT8611 CREATIVE AND INNOVATIVE PROJECT L T P C
0 0 3 2

The goal of this course is to help students to identify innovative projects that promotes and inhibit creativity. By the end of the period, students should be familiar with current thinking in their field, and able to apply the concepts to relevant research problems or practical applications related to Ceramic Technology.

This will drive them to learn concepts, models, frameworks, and tools that Ceramic Engineer need in a world where creativity and innovation is fast becoming a pre-condition for competitive advantage.

Each student will choose problem related to research or industrial problem that has been difficult for them to "solve." At the end of the semester, each student or group of students have to submit a report for evaluation.

TOTAL: 30 PERIODS

CT8612 **GLASS LAB** **L T P C**
0 0 3 2

1. Preparation of Soda Lime Glass
2. Influence of cullet size on melting behavior of soda lime glass.
3. Influence of cullet % on melting behavior of soda lime glass
4. Influence of refining agent on the melting behavior of soda lime glass.
5. Preparation of Amber Glass
6. Determination of Density.
7. Determination of Specific Gravity.
8. Determination of Refractive Index.
9. Determination of Thermal Expansion.
10. Determination of Chemical Durability.
11. Identification of defects in glass.

EQUIPMENTS REQUIRED

1. Sieve Shaker
2. Hot Plate
3. Hot Air Oven
4. Furnace

TOTAL : 30 PERIODS

CT8613 **REFRACTORIES LAB** **L T P C**
0 0 3 2

1. Preparation of silica refractory of various compositions
2. Preparation of fire clay refractory with different percentage of grog
3. Preparation of high alumina refractories of various compositions.
4. Determination of density, porosity and strength of silica refractory.
5. Comparison of Properties of various compositions of fireclay refractories
6. Comparison of Properties of various compositions of high alumina refractories
7. Influence of shaping methods on physical properties of refractories.
8. Influence of firing temperature on the physical properties of refractories.
9. Preparation of insulating refractory with different pore formers

10. Determination and comparison of properties of different insulating refractories.
11. Comparing the characteristics of a dense and porous refractory.

EQUIPMENTS REQUIRED:

1. Universal Testing Machine
2. Hot Plate
3. Extruder

TOTAL: 45 PERIODS

GE8751 ENGINEERING ETHICS AND HUMAN VALUES L T P C
3 0 0 3

UNIT I HUMAN VALUES 10

Morals, values and Ethics – Integrity – Work ethic – Service learning – Civic virtue – Respect for others – Living peacefully – Caring – Sharing – Honesty – Courage – Valuing time – Cooperation – Commitment – Empathy – Self confidence – Character – Spirituality.

UNIT II ENGINEERING ETHICS 9

Senses of 'Engineering Ethics' – Variety of moral issues – Types of inquiry – Moral dilemmas – Moral Autonomy – Kohlberg's theory – Gilligan's theory – Consensus and Controversy – Models of professional roles - Theories about right action – Self-interest – Customs and Religion – Uses of Ethical Theories

UNIT III ENGINEERING AS SOCIAL EXPERIMENTATION 9

Engineering as Experimentation – Engineers as responsible Experimenters – Codes of Ethics – A Balanced Outlook on Law – The Challenger Case Study

UNIT IV SAFETY, RESPONSIBILITIES AND RIGHTS 9

Safety and Risk – Assessment of Safety and Risk – Risk Benefit Analysis and Reducing Risk – The Three Mile Island and Chernobyl Case Studies

Collegiality and Loyalty – Respect for Authority – Collective Bargaining – Confidentiality – Conflicts of Interest – Occupational Crime – Professional Rights – Employee Rights – Intellectual Property Rights (IPR) – Discrimination

UNIT V GLOBAL ISSUES **8**

Multinational Corporations – Environmental Ethics – Computer Ethics – Weapons Development – Engineers as Managers – Consulting Engineers – Engineers as Expert Witnesses and Advisors – Moral Leadership – Sample Code of Conduct

TOTAL : 45 PERIODS

TEXTBOOK

1. Mike W. Martin and Roland Schinzinger, “Ethics in Engineering”, Tata McGraw Hill, New Delhi, 2003.

REFERENCES

1. Charles B. Fleddermann, “Engineering Ethics”, Pearson Prentice Hall, New Jersey, 2004.
2. Charles E. Harris, Michael S. Pritchard and Michael J. Rabins, “Engineering Ethics – Concepts and Cases”, Thompson Wadsworth, A Division of Thomson Learning Inc., United States, 2000
3. John R Boatright, “Ethics and the Conduct of Business”, Pearson Education, New Delhi, 2003
4. Edmund G Seebauer and Robert L Barry, “Fundamentals of Ethics for Scientists and Engineers”, Oxford University Press, Oxford, 2001

WEB SOURCES

1. www.onlineethics.org
2. www.nspe.org
3. www.globalethics.org
4. www.ethics.org

CT8701 ADVANCED CERAMIC PROCESSING **L T P C**
3 0 0 3

AIM

The course is aimed to enable the students to have a thorough knowledge on the advanced processing techniques in ceramics.

OBJECTIVES

On completion of the course the students are expected to

- Have a thorough knowledge on the preparation of ceramic powder by mechanical and chemical methods.
- Have studied the additives used in ceramic forming and different ceramic forming processes in dry powder, slurry and plastic consistency.
- Have a better understanding on the mechanisms of solid state and liquid phase sintering, and crystal growth during sintering.
- Have learnt the advanced sintering processes and their mechanisms.
- Have understood the processes involved in machining and surface finishing of ceramic products.

UNIT I POWDER PROCESSING 9

Powder preparation by mechanical methods – comminution, mechano-chemical synthesis. Powder synthesis by chemical methods – solid state reaction, liquid solutions, vapour phase reactions. Synthesis of nano scale ceramic powder–liquid solution technique, vapour phase technique.

UNIT II FORMING 10

Additives in ceramic forming – solvents, dispersant, binder, plasticizer, other additives. Forming of ceramics – dry and semidry pressing - die compaction and isostatic compaction; casting methods - slip casting, pressure casting, gel casting, electrophoretic deposition; plastic forming methods - extrusion, co-extrusion, injection molding, solid freeform fabrication - particle filled polymer methods, powder methods, suspension methods- Porous ceramic forming- foaming, intrusion, organic additives.

UNIT III SINTERING MECHANISMS 10

Solid state sintering – driving force, effect of surface curvature and boundary defects, mechanism, stages of sintering. Liquid phase sintering – stages, kinetic and thermodynamic factors, phase diagram in liquid phase sintering. Grain growth – different grain growth process, control of grain growth, grain growth and pore evolution in a porous compact, interaction between pore and grain boundary.

UNIT IV ADVANCED SINTERING **7**

Pressure assisted sintering – hot pressing and hot iso-static pressing. Reaction bonded sintering, microwave sintering.

UNIT V MACHINING AND SURFACE FINISHING OF CERAMICS **9**

Mechanism of material removal and its effect on strength, surface grinding and mechanical polishing, non abrasive finishing, ceramic surface coating, joining of ceramics – metal ceramic joints.

TOTAL: 45 PERIODS

TEXT BOOKS

1. Mohamed N.Rahaman, Ceramic Processing, Taylor & Francis, 2007.
2. David W. Richerson, Modern Ceramic Engineering, 3rd Edn., Taylor & Francis, 2005.

REFERENCES

1. Paul De Garmo E, Black J.J and Ronald A.Kohser, Materials and Processes in Manufacturing, 8th Edn., Prentice – Hall India Pvt. Ltd., New Delhi, 1997.
2. Reed J.S, Introduction to the Principles of Ceramic Processing, Wiley, New York, 1988.
3. John G.P.Binner (Ed), Advanced Ceramics Processing and Technology, Noyes Publications, New Jersey, 1990.
4. Burtrand Lee and Sridhar Komarnei (Eds.), Chemical Processing of Ceramics, 2nd Edn., Taylor & Francis, 2005.

CT8702 ADVANCED STRUCTURAL CERAMIC MATERIALS **L T P C**
3 0 0 3

AIM

The course is aimed to enable the students to have a thorough knowledge about the various ceramic materials used for structural applications.

OBJECTIVES

- On completion of the course the students are expected to have studied the structural characteristics and properties of oxide, carbide, nitride, carbon and other ceramic materials used for structural applications.

UNIT I OXIDE CERAMICS **9**

Structural characteristics, properties and applications of silica, alumina, zirconia, magnesia, titania, thoria, mullite, uranium oxide and plutonium oxide.

UNIT II CARBIDES **9**

Structural characteristics, properties and applications of silicon carbide, boron carbide, tungsten carbide, titanium carbide.

UNIT III NITRIDES **9**

Structural characteristics, properties and applications of silicon nitride, boron nitride, titanium nitride, aluminum nitride.

UNIT IV ADVANCED CERAMICS **9**

Carbon compounds, borides, silicides, Sialon and cermets, high temperature superconducting oxides.

UNIT V SINGLE CRYSTALS **9**

Introduction, techniques for forming- Kyropolar technique. Czochralski method, edge defined-film fed growth method, Bridgman technique, floating zone method, flux technique, hydro-thermal growth technique, micro pulling down technique.

TOTAL : 45 PERIODS

TEXT BOOKS

1. Mc Colm, Ceramic Science for Materials Technologists, Blackie & Sons Ltd.,Glasgow, 1983.
2. Handbook of Advanced Ceramics, Vol.I, Somiya.S et al (ed), Academic Press, 2003.

REFERENCES

1. Brook R.J (ed), Concise Encyclopedia of Advanced Ceramic Materials, Pergamon Press, 1991.
2. Noboru Ichinose, Introduction to Fine Ceramics, John Wiley and Sons, 1987.
3. Gernot Kostorz, High Tech Ceramics, Academic Press, NY, 1989.

CT8711 ADVANCED INSTRUMENTAL LAB L T P C
0 0 3 2

1. Analysis of Trace Elements using Spectrophotometer, Flame Photometer and Atomic Absorption Spectroscopy.
2. Thermal Analysis – TGA, DTA, DSC.
3. Determination of Viscosity by Brookfield Viscometer.
4. Particle Size Analysis – Laser Diffraction.
5. Microscopy – Optical, SEM.
6. Vicker's Hardness.
7. Modulus of Rupture.
8. Modulus of Elasticity.
9. Creep, Wear and Abrasion Resistance.
10. Surface Area Measurement – BET.

EQUIPMENTS REQUIRED:

1. Spectrophotometer
2. Atomic absorption Spectrometer
3. Flame Photometer

TOTAL : 45 PERIODS

CT8712 INDUSTRIAL TRAINING (6WEEKS) L T P C
0 0 0 2

All the students have to undergo practical industrial training of six week duration in recognized establishments. At the end of which they have to submit a report. The internal assessment will

be based on the report and presentation and the examination marks be based on viva voce examination.

CT8811 **PROJECT WORK** **L T P C**
0 0 12 6

AIM

The project work aims to train the students on systematic analysis of a problem and to enable them to bring out a solution it.

OBJECTIVE

- The objective of the project is to make use of the knowledge gained by the student at various stages of the degree course.
- Each student is required to submit a report on the project assigned to him/her by the department. The report should be based on the literature collected from the many sources and the actual analysis done by the student on the given project.

CT8001 **ABRASIVES** **L T P C**
3 0 0 3

AIM

The course aimed to enable the students to have a basic knowledge about the types, manufacturing process, properties and applications of abrasives.

OBJECTIVES

On completion of the course the students are expected to

- Have a basic understanding on the abrasives, and different raw materials and their characteristics.
- Have studied the stages involved in the manufacture of a coated abrasive.
- Have learnt about the different types of back ups used in a coated abrasive and how they affect the grinding characteristic.

- Have a good knowledge on the manufacturing of bonded abrasive, its types and characteristics.
- Have learnt the fundamentals of grinding operation, grinding aids and about polishing.

UNIT I INTRODUCTION **6**

Abrasives – definition, classification, applications. Abrasive grains – classification, characteristics like hardness, toughness etc. Backings – cloth, paper, fibre, combination backing, their characteristics. Adhesives – classification, characteristics.

UNIT II MANUFACTURE OF COATED ABRASIVES **8**

Raw material selection and preliminary treatments, maker coating, abrasive coating – methods and types of coating, sizer coating, drying and humidification, flexing, conversions – slitting, belt making, sheet cutting, disc cutting. Individual disc coating process. Quality control and testing.

UNIT III BACK UPS **7**

Contact wheels – cloth contact wheels, rubber contact wheels, hardness, face serrations, shape, wheel diameter, speed, belt tension, dressing and protection of contact wheels – their characteristics. Drum, rolls, pads and platens – types, characteristics, choice and uses. Working principle of coated abrasive.

UNIT IV MANUFACTURE OF BONDED ABRASIVES **12**

Abrasive grain type and characteristics required for bonded abrasives. Types of bonds – vitrified, silicate, resinoid, shellac, rubber and oxychloride. Bonded wheel manufacture with different bonds and their characteristics. Shapes and sizes of wheels. Factors determining grinding action – characteristics of abrasive grain, bond type, structure. Other types of wheels – Diamond wheels, reinforced wheels, mounted wheels

UNIT V BASICS OF GRINDING AND POLISHING **12**

Grinding wheel – definition, abrasives chosen, grinding chips, chemical reactions, grade selection, wheel wear, chemical grinding aids. Grinding fluids – properties, types and purpose. Types of grinding – cylindrical grinding, centre less grinding, surface grinding, internal grinding. Polishing – definition, types.

TOTAL: 45 PERIODS

TEXT BOOKS

1. Coes L Jr., Abrasive, Springer Verlag, New York, 1971.
2. Coated Abrasives – Modern Tool of Industry, Coated Abrasive Manufacturer's Institute, Cleaveland, Ohio, 1982.

REFERENCES

1. Metzger J.L, Super Abrasive Grinding, Butterworths, UK, 1986.
2. Francis T.Farago, Abrasive Methods Engineering, Vol.2, Industrial Press Inc., NY, 1980.
3. Edwards R, Cutting tools, The Institute of Materials, Cambridge, 1993.
4. Kenneth B.Lewis, William F.Schleicher, The Grinding Wheel, The Grinding Wheel Institute, Cleaveland, Ohio, 1976.

CT8002 ADVANCED REFRACTORY MATERIALS L T P C
3 0 0 3

AIM

The course is aimed to enable the students to have a basic knowledge about the various types of refractories used in the industries.

OBJECTIVES

On completion of the course the students are expected to

- Have learnt the basics about refractories materials.
- Have a sound knowledge about carbon based refractory materials.
- Have learnt about properties and applications of insulation materials.
- Have learnt about the various Composite refractory materials.

UNIT I INTRODUCTION 9

Basic advanced refractory materials – ternary and multiple mixtures, continuous particle size distribution, -Bonding mechanisms – direct bond and chemical bond

UNIT II FUNDAMENTALS OF ADVANCED REFRACTORY MATERIALS 9

Study of relevant binary and ternary phase diagrams to understand the effect of impurities, minor additives, firing temperature and atmosphere and process control. Physical and thermomechanical properties of fired or heat treated refractories. Correlation of microstructure – properties of the above refractories

UNIT III SUPER REFRACTORIES, REFRACTORY FIBERS AND INSULATION REFRACTORIES 9

Super refractories –SiC- Sialon- fused and electrocast refractories -cermets – ceramic fibers.- Insulation-types and application, Economic thickness of insulation, Heat savings and application criteria, Refractory-types, selection and application of refractories, Heat loss.

UNIT IV COMPOSITE REFRACTORIES 9

Composite refractories: alumina-carbon, magnesia-carbon, Spinel, magnesia Hercynite-magnesia galaxite refractories - processing, property optimization through microstructural control and quality optimization

UNIT V SLIDE GATE AND BLACK REFRACTORIES 9

New generation slide gate refractories with improved performance-Alumina carbon alumina-silicon carbide- carbon, zirconia-carbon- - Manufacture and use of carbon containing refractories - Black refractories -processing, property optimization through microstructural control and quality optimization

TOTAL : 45 PERIODS

TEXT BOOKS

1. M. Rigaud and C. Allaire, Advances in Refractories for the Metallurgical Industries IV, Canadian Institute of Mining, Metallurgy and Petroleum, 2004.
2. Hancock J D Refractories for industrial users Cartworth Industries Netherton GB 1988.

REFERENCES

1. Harbison walker Modern refractory Practice 5th edition Harbison Walker Refractories Pittsburgh PA 1992.
2. The Technical Association of Refractories Japan Refractories Handbook 1998.

CT8003 **BIOCERAMICS** **L T P C**
3 0 0 3

AIM

The course is aimed to enable the students to have a sound knowledge about the applications of ceramic materials in biological field.

OBJECTIVES

On completion of the course the students are expected to

- Have learnt the various applications of ceramic materials in the medical field.
- Have a complete knowledge about the various calcium phosphate based ceramic materials along with the preparation, properties and applications.
- Have studied about the different bioactive glasses and glass ceramic materials.
- Have studied about the different bioactive composites.
- Have studied about the different bioactive coatings.

UNIT I MATERIALS IN MEDICINE **9**

Implant areas – dental, orthopedic. Implant materials – bio polymers, bio metals, ceramic implants – porous ceramics, surface active ceramics, resorbable ceramics. Biological performance of the materials, body reaction to implant materials – corrosion, biodegradation and biocompatibility. Invitro and invivo test methods of implant materials.

UNIT II CALCIUM PHOSPHATE CERAMICS **9**

Chemistry of calcium phosphate bio ceramics – preparation, mechanical properties and biological performance of tri calcium phosphate, tetra calcium phosphate, biphasic calcium phosphate, hydroxyapatite and other phosphates. Calcium phosphate bone cements – preparation, properties, setting behavior and bio compatibility.

UNIT III BIOACTIVE GLASSES AND GLASS CERAMICS **9**

Surface active glasses, bioactive glass – preparation, mechanical properties, bonding mechanism to living tissue – interfacial bonding. Doped bioactive glasses. High strength bioactive glass ceramics – mechanical and biological properties, bone bonding mechanism, mechanism of surface apatite formation, compositional dependence.

UNIT IV BIOACTIVE COMPOSITES **9**

Hydroxyapatite composites with zirconia, alumina and titania – preparation and properties. SiC whisker reinforced hydroxyapatite and bioactive glass ceramics, zirconia toughened and bioactive glass ceramics, bioglass-hydroxyapatite composites, carbon composites.

UNIT V BIOACTIVE COATINGS **9**

Importance of bioactive coatings. Hydroxyapatite coated metal implants – coating methods, characterization and properties. Bioglass and bioactive glass ceramics coating over metals and alloys.

TOTAL: 45 PERIODS

TEXT BOOKS

1. Yamamura T, Hench L.L and Wilson J, CRC Handbook of Bioactive Ceramics, Vol I & II, CRC Press, Boca Raton, 1990.
2. Park J.B, Biomaterials: An Introduction, Plenum Press, New York, 1979.

REFERENCES

1. Bonfield V, Hastings C.H and Tanner K.E (eds.), Bioactive Ceramics, Vol 4, Butterworth – Heinemann Ltd., Oxford, 1991.
2. Hans Bach, Low Thermal Expansion Glass Ceramics, Springer, 1995.
3. Hench L.L and Ethridge E.C, Biomaterials: An Interfacial Approach, Academic Press, New York, 1982.

CT8004 CALCULATIONS IN CERAMICS **L T P C**
3 0 0 3

AIM

The course is aimed to enable the students to have a basic knowledge about the methods of calculating the various ceramic properties.

OBJECTIVES

On completion of the course the students are expected to

- Have learnt the basic methods of calculating the properties of ceramic raw materials.

- Have learnt to calculate the properties of ceramic bodies.
- Have learnt to calculate the properties of suspensions.
- Have learnt to formulate glaze batches by varying the parameters.
- Have learnt to formulate glass batches.

UNIT I ULTIMATE & RATIONAL ANALYSIS 9

Ultimate analysis, proximate analysis, rational analysis of clay, stone and feldspar -mica convention – substitution of clays in body recipes – triangular plot.

UNIT II DETERMINATION OF PHYSICAL PROPERTIES 9

Shrinkage – Drying, Firing, Total, Volume, Moisture content – relationship between percentage moisture content and volume shrinkage - loss on ignition –density - specific gravity – effect of porosity on the function of ceramic materials – pore structure density – apparent volume – true volume – apparent solid volume, porosity – apparent, true, sealed pores.

UNIT III CALCULATIONS OF BODY & SUSPENSIONS 9

Density of a slip – calculations relating to mixtures of solid particles and water –dilution problems – Brongniarts Formula – dry measurement, wet measurement –effect of specific gravity – density of the body slip – dimensions of the mixing ark –adjustments to the wet recipe – addition of body stain.

UNIT IV GLAZE CALCULATIONS 9

Molecular weights – formula and use of chemical equations – oxides – percentage composition and formula – calculation of a recipe from a simple glaze formula – given the recipe of a glaze calculate the formula – synthesis of a fritted glaze – given the recipe calculate the formula for a fritted glaze – calculation of the percentage composition of the mill batch.

UNIT V GLASS CALCULATIONS 9

Determination of molecular formula of glass from chemical composition of the glass and from glass batch – determination of batch from molecular formula of glass – determination of batch from the given chemical composition.

TOTAL: 45 PERIODS

TEXT BOOKS

1. R.Griffiths & C.Radford, Calculations in Ceramics, Johns Hill, 1965.
2. A.I.Andrews, Ceramic Tests and Calculations, John Wiley & Sons, 1928.

REFERENCES

1. Hiraoki Yanagida, The Chemistry of Ceramics, John Wiley and Sons, 1996.
2. Terpstra, Ceramic Processing, Chapmann and Hall, 1995.
3. Tooley F.V, Handbook of Glass Manufacture, Vol I&II, Ogden Publishing Co., NY, 1960.
4. Alexis G.Pincus, Melting Furnace Operation in the Glass Industry, Magazines for Industry Inc., NY, 1980.
5. R.Charan, Handbook of Glass Technology.

CT8005 CEMENT AND CONCRETE L T P C
3 0 0 3

AIM

The course is aimed to enable the students to have a complete knowledge on the manufacture, quality control and types of cement, and preparation, properties and different types of concrete.

OBJECTIVES

On completion of the course the students are expected to

- Have studied the raw materials, manufacturing process and mechanism of hydration of cement.
- Have learnt the tests done on cement and the quality control procedures.
- Have studied the different types of cements and their characteristics.
- Have learnt the types of aggregates and admixtures used for concrete making and the preparation of a concrete mixture.
- Have understood the different properties of concrete and the testing methods of the same.

UNIT I CEMENT 7

Raw materials, manufacturing process. Composition of cement phases – effect of composition on burnability of clinker, influence of minor components. Hydration of cement.

UNIT II TESTING AND QUALITY CONTROL OF CEMENT 8

Tests on properties of cement – consistency of standard paste, setting time, soundness, strength of cement. Quality control – litre-weight test, microscopic and X-ray investigation of clinker materials.

UNIT III TYPES OF CEMENT 10

Types of Portland cement, blast furnace slag cement, trief cement, high alumina cement, white and coloured cement, oil well cement, hydrophobic cement, water proof cement, super sulphate cement, sulphate resisting cement.

UNIT IV CONCRETES 10

Aggregates – types, characteristics. Admixtures – types, characteristics. Proportioning of concrete mixtures – consideration, procedure. Recent advances in concretes – types, significance, characteristics.

UNIT V PROPERTIES OF CONCRETE 10

Strength, permeability, creep, thermal expansion, shrinkage, moisture movement, penetration of X-ray, abrasion resistance, fire resistance, freeze-thaw resistance, electrical properties.

TOTAL: 45 PERIODS

TEXT BOOKS

1. P. Kumar Mehta and Paulo J.M. Monteiro, Concrete – Microstructure, Properties and Materials, 3rd Edn., Tata McGraw Hill, 2006.
2. A.M.Neville, Properties of Concrete, 4th Edn., Pearson Education, 1995.

REFERENCES

1. A.M.Neville and J.J.Brooks, Concrete Technology, Pearson Education, 1987.
2. Peter C.Hewlett (Editor), Lea's Chemistry of Cement and Concrete, 4th Edn., Elsevier, 1998.
3. Deborah DL. Chung, Multifunctional Cement Based Materials, Marcel Dekker Inc., 2003.
4. J. Bensted and P.Barnes (Editors), Structure and Performance of Cements, 2nd Edn., Spon Press, 2002.

CT8006 **CERAMIC FIBRES AND COMPOSITES** **L T P C**
3 0 0 3

AIM

The course is aimed to enable the students to have a sound knowledge about the different types of ceramic fibres, composites, their properties and applications.

OBJECTIVES

On completion of the course the students are expected to

- Have studied the different fibre reinforcements, their manufacturing routes, properties and applications.
- Have studied the different types of matrices, its manufacturing techniques and properties.
- Have a basic knowledge about the types, manufacturing process and properties of composites.
- Have a basic knowledge about the properties of composite materials.
- Have a sound knowledge about the different types of whiskers.

UNIT I REINFORCEMENTS **9**

Fibre definition, fibre flexibility; Glass fibres – types, manufacturing process, properties, glass wool forming process; Alumina fibres, mullite fibres, zirconia fibres, boron fibres, carbon fibres and graphite fibres – manufacturing techniques, properties and applications; Strength of reinforcements.

UNIT II TYPES OF MATRICES **9**

Introduction, types – polymer, ceramic, metal, glass, thermosetting and thermoplastic matrices.

UNIT III COMPOSITES **9**

Definition, classification – metal / polymer / ceramic matrix composites, particulate and fibre reinforcements – processing methods, microstructure. Carbon-carbon composites, nano composites.

UNIT IV PROPERTIES OF COMPOSITES **9**

Elastic and strength properties – fracture behavior – fibre matrix load transfer – failure of a composite – criteria, damage of composites from physical and mechanisms to

modeling, long term behavior of composite materials, high temperature stability – wear and friction.

UNIT V WHISKERS **9**

Background of whisker growth – whisker nucleation and growth – composite processing – whisker purification, whisker / matrix powder mixing, densification, SiC and Si_3N_4 whiskers, VLC synthesis, properties.

TOTAL : 45 PERIODS

TEXT BOOKS

1. Anthony R.Bunsell and Marie-Helene Berger, Fine Ceramic Fibres, Marcel Dekker Inc., 1999.
2. Chawla K.K, Ceramic Matrix Composites, Chapman and Hall, 1993.

REFERENCES

1. Hull D and Clyne T.W, An Introduction to Composite Materials, 2nd Edn.,Cambridge University Press, 1996.
2. Bunsell A.R and Renard J, Fundamentals of Fine Fibre Reinforced Composite Materials, IOP Publishing Ltd., 2005.
3. Warren R, Ceramic Matrix Composites, Blackie, 1992.

CT8007 ELECTRONIC CERAMICS **L T P C**
3 0 0 3

AIM

The Course is aimed to enable the students to know the basic concepts of ceramic materials used for electronic applications and their applications in various fields.

OBJECTIVES

On completion of the course the students are expected to

- Have studied the use of ceramic materials as insulators and capacitors and their properties.
- Have learnt the processing, properties and various applications of ceramic materials in ferroelectric applications.

- Have learnt the manufacture, characteristics and properties of magnetic ceramics.
- Have a basic knowledge about superconductivity.
- Have a basic knowledge about the manufacture, characteristics and properties of varistors and fuel cells.

UNIT I CERAMIC INSULATORS 9

Porcelain insulators – triaxial, steatite, non feldspathic types – composition, properties and uses – dielectric strength – dielectric breakdown mechanisms – factors affecting dielectric strength – dielectric constant and loss-polarization- different types of polarization – effect of frequency and temperature.

UNIT II CERAMIC CAPACITORS 9

Capacitance-ferroelectric behavior – barium titanate – effect of solid solutions – additives – film capacitors, single layer discrete capacitors – multilayer capacitors – basic principles and fabrication processes.

UNIT III FERROELECTRIC CERAMICS 9

Piezo-electricity – barium titanate, relaxor ferroelectrics, multiferroics, ferroelectricity, manufacture of barium titanate based ceramics – properties of ferroelectric ceramics – hysteresis loop – PZT – PLZT materials, compositional systems, processing and fabrication – mixed oxide and chemical precipitation processes.

UNIT IV MAGNETIC CERAMICS 9

Classification of magnetic materials – domain theory – Ferromagnetism – Spinel ferrites – structure, types of ferrites – manganese, zinc ferrites – hexagonal ferrites – garnets – standard ceramic processing and fabrication techniques-GMR.

UNIT V VARISTORS AND FUEL CELLS 9

Introduction- ZnO varistors – PN junction diode– electrical characteristics, fabrication of ZnO varistor behavior- microstructure – gas sensors fuel cells – types, principle, working, solid oxide fuel cells – applications- structure and operation principle of oxygen sensors, NOx sensors.

TOTAL: 45 PERIODS

TEXT BOOKS

1. Hench L.L and J.K.West, Principles of Electronic Ceramics, John Wiley, NewYork, 1990.
2. Moulson AJ and HM Herbert, Electroceramics, Chapman and Hall, London, 1990.

REFERENCES

1. Setter N and Colla SL, Ferroelectric Ceramics, Birkhauser Ver Lag, 1993.
2. S.Somiya, F.Aldinger, N.Clausen, RM Sprigs, K.Uchino, K.Koumoto, M.Kaneno, Handbook of Advanced Ceramics : Vol.II, Processing and their applications, Academic Press, 2003.
3. Buchanan RC, Ceramic Materials for Electronics, Marcel Dekker Inc., NY, 1991.

CT8008 FUELS AND ENERGY ENGINEERING L T P C
3 0 0 3

AIM

The course is aimed to enable the students to have a thorough knowledge about different types of fuels used in industries and the mechanism involved in converting the fuel into a useful source of energy.

OBJECTIVES

On completion of the course the students are expected to

- Have a complete knowledge idea about the occurrence and characteristics of the different types of solid fuels.
- Have a better knowledge about the different types of liquid fuels and their properties.
- Have a complete understanding about the different liquid fuels and their properties.
- Have a basic knowledge about the combustion process involved in the fuels.
- Have an idea about the ways of heat transfer and the different heat recovery systems.

UNIT I SOLID FUEL 9

Wood, charcoal, coal characteristics – formation of coal, grading of coal, handling and storage of coal, coal washing, hardness and grindability of coal, calorific value, coal analysis. Manufacture of coke. Agro based solid fuels – wheat, rice, bagasse, solid oxide fuel cells.

UNIT II LIQUID FUEL **9**

Origin and composition of natural oil, refining process of liquid petroleum products, synthetic liquid fuels – calorific value, storage and handling of liquid fuels. Bio fuels – importance.

UNIT III GASEOUS FUELS **9**

Composition and calorific value – natural gas, liquefied petroleum gas, oil gas, coal gas, producer gas, water gas, other gaseous fuels. Non conventional fuels – importance, hydrogen fuel.

UNIT IV COMBUSTION PROCESS **9**

Air requirement, combustion processes of solid, liquid, gaseous fuels, control of combustion process, combustion stoichiometry.

UNIT V HEAT TRANSFER **9**

Heat transfer to charge by conduction, convection and radiation in a kiln, heat loss through kiln wall, opening, cooling etc., heat balance and thermal efficiency, heat recovery – recuperator and regenerator, co-generator – importance.

TOTAL: 45 PERIODS

TEXT BOOKS

1. Samir Sarkar, Fuels and Combustion, 2nd Edn., Orient Longman, Bombay, 1990.
2. Om Prakash Gupta, Elements of Fuels, Furnaces and Refractories, Khanna Publishers, 1995.

REFERENCES

1. Wilfrid Francis and Martin C.Peter, Fuels and Fuel Technology, Pergamon Press, 1980.
2. J.P.Holman, Heat Transfer, McGraw – Hill, 1997.
3. J.D.Gilchrist, Fuels, Furnaces and Refractories, Pergamon Press, NY, 1977.
4. A.K.Shaha, Combustion Engineering and Fuel Technology, Oxford & IBH Publishing Co., New Delhi, 1974.

CT8009 **KILNS, FURNACES AND PYROMETRY** **L T P C**
3 0 0 3

AIM

The course is aimed to enable the students to have a thorough knowledge on the equipments involved in firing of a ceramic article and the temperature measurement methods.

OBJECTIVES

On completion of the course the students are expected to

- Have a thorough knowledge on the different burners used based on the fuel type and the types of flame produced from burners.
- Have studied the different types of furnaces and their operation.
- Have an understanding on the different factors involved in designing a furnace.
- Have a better knowledge on different types of kilns, their construction and working.
- Have a clear understanding on the temperature and heat measurement techniques in kilns and furnaces.

UNIT I BURNERS AND FLAMES **9**

Burner – classification, atomization, low pressure burner for gaseous fuel, high pressure burner for liquid fuels, advantage & disadvantage of different burners. Flames – nature of flames, laminar & turbulent, premixed & diffusion, burning velocity.

UNIT II FURNACES **9**

Introduction, definition, classification – metal heating furnaces, reheating furnace, continuous furnace, sintering furnace, crucible furnaces, electric furnace, unit melters and smelters, muffle furnace, glass tank furnace.

UNIT III FURNACE DESIGN **9**

Factors for consideration, heating capacity, furnace design, heat economics, furnace atmosphere, draught establishment, chimney calculation, heat transfer, safety aspects.

UNIT IV KILNS **9**

Introduction, definition, classification – draught kiln, chamber kiln, tunnel kiln, roller kiln, rotary kiln, continuous kiln, shuttle kiln, top hat kiln, muffle kiln, Hoffman's kiln – principle, materials used in foundation and construction, working.

UNIT V PYROMETRY **9**

Introduction and thermometry, thermocouples, radiation pyrometers, low temperature measurement, temperature control, heat work recorders – Segar cone, Holdcroft's bar, Buller rings, Watkin recorders.

TOTAL: 45 PERIODS

TEXT BOOKS

1. Suryanarayana A.V.K, Fuels, Furnaces, Refractories and Pyrometry, BS Publications, 2005.
2. Robert D.Reed, Furnace Operation, Gulf Publishing Co., Paris, 1991.

REFERENCES

1. Harold E. Soisson, Instrumentation in Industry, John Wiley and Sons, NY, 1995.
2. Sarkar B.K, Thermal Engineering, Tata McGraw-Hill Publishing Co. Ltd., 1998.
1. Shaha A.K, Combustion Engineering and Fuel Technology, Oxford & IBH Publishing Co., New Delhi, 1974.
2. Daniel Rhodes, Kilns: Design, Construction and Operation, Chilton Book Co., Pennsylvania, 1974.

CT8010 MATERIALS MANAGEMENT **L T P C**
3 0 0 3

AIM

The course is aimed to enable the students to have a basic knowledge about importance of material management and its applications in various sectors.

OBJECTIVES

On completion of the course the students are expected to

- Have learnt the basic concepts about materials management.
- Have studied about the importance of purchasing.
- Have studied the importance of management in warehouse and stores.
- Have studied the importance of management in inventory.
- Have studied the concepts of different material procurement procedures.

UNIT I INTRODUCTION **9**

Introduction to material management, importance of integrated materials management, need for integrated materials management, concept, definition, scope and advantage- an overview, A-B-C analysis, codification, variety reduction, standardization.

UNIT II PURCHASE MANAGEMENT **9**

Material planning and purchase, purchase system, procedures, price forecasting, purchasing of capital equipment, vendor development, account procedure, purchasing decisions, procurement policies.

UNIT III WARE HOUSING AND STORE MANAGEMENT **9**

Store keeping principles-past and latest techniques, stores-general layout, cost aspect and productivity, problems and development, store system procedures incoming material control, store accounting and stock incoming material control, store accounting and stock verification, value analysis.

UNIT IV INVENTORY MANAGEMENT **9**

Introduction, basic models, definition of commonly used terms, replenishment model, choice of system etc., inventory work in progress, safety stock, computerization in materials management control, information to materials management case study, spare parts .

UNIT V MATERIAL PROCUREMENT PROCEDURES **9**

Arbitration act- octroi, central and local sales tax, excise duties- custom tariff, import, control policies, procurement from government agencies and international market- insurance, DGS and D tariff.

TOTAL: 45 PERIODS

TEXT BOOKS

1. Goplakrishnan P and Sundraesan M, Materials Management, An Integrated Approach, Prentice Hall of India Private Ltd., New Delhi, 1982.
2. Peckam H.H, Effective Materials Management, Prentice Hall of India Private ltd., 1984.

REFERENCES

1. Datta A.K., Materials Management Procedure, Test and Cases, Prentice Hall of India Private Ltd., New Delhi, 1984.
2. Prichard J.W and Eagle R.H., Modern Inventory Management, NY, Wiley and Breach Science Publishers, 1972.

CT8011 MECHANICAL BEHAVIOUR OF CERAMICS L T P C
3 0 0 3

AIM

The course is aimed to enable the students to have a detailed understanding about the behaviour of ceramic materials with different mechanical properties.

OBJECTIVES

On completion of the course the students are expected to

- Have learnt in detail about the elastic property and brittle nature of ceramics.
- Have understood the fracture behaviour of ceramics.
- Have studied the behaviour of the materials in strength and engineering design.
- Have learnt the creep behaviour of ceramic materials.
- Have understood the thermal shock behaviour of the ceramic materials.

UNIT I ELASTIC BEHAVIOUR 7

Elastic constants – effect of atomic structure and microstructure. Response to stress – elastic deformation of isotropic and crystalline materials – measurement techniques.

UNIT II FRACTURE MECHANICS 8

Theoretical strength and stress concentrations, linear elastic fracture mechanics, micro structural aspects, fracture testing techniques.

UNIT III STRENGTH AND ENGINEERING DESIGN 10

Strength testing, statistical treatment to strength, time dependent strength behaviour – subcritical crack growth, stable crack propagation, cyclic fatigue – SPT diagram. Toughening of Ceramics.

UNIT IV CREEP BEHAVIOUR **10**

Creep – definition, types – diffusion creep, dislocation creep, viscous creep. Microstructure dependence of creep, creep deformation maps.

UNIT V THERMAL BEHAVIOUR **10**

Thermal stress, thermal shock resistance parameters, thermal stresses and cracking, testing technique, applications of thermal stress.

TOTAL: 45 PERIODS

TEXT BOOKS

1. John B.Wachtman, Mechanical Properties of Ceramics, John Wiley & Sons, New York, 1996.

2. Davidge R.W, Mechanical Behaviour of Ceramics, Ceramic Book Literature Service, London, 1979.

REFERENCES

1. Kingery W.D, Bowen H.K and Uhlmann D.R, Introduction to Ceramics, John Wiley & Sons, 1991.
2. Barsoum M.W, Fundamentals of Ceramics, McGraw-Hill, 1997. Hasselman D.P.H and Heller R.A (eds.), Thermal Stresses in Severe Environments

CT8012 MICROWAVE PROCESSING OF CERAMICS **L T P C**
3 0 0 3

AIM

The course is aimed to enable the students to the basic concepts about processing the ceramic materials in microwave atmosphere.

OBJECTIVES

On completion of the course the students are expected to

- Have learnt the introduction about microwave processing.
- Have learnt the concepts of microwave heating circuit.

- Have learnt the applicator types of microwave.
- Have studied the industrial applications of microwave processing.
- Have studied the hazard and safety of microwave processing.

UNIT I INTRODUCTION **9**

Dielectric Behavior of materials- power dissipation- propagation factor and skin depth- heat and mass transfer phenomena- temperature distribution- wall loss.

UNIT II MICROWAVE HEATING CIRCUIT **9**

Power sources- klystron and magnetron- operating characteristics- protection system- high frequency breakdown phenomena- automatic control of the process- automation, tuning and machining.

UNIT III APPLICATION TYPES **9**

Travelling wave applicators- multimode applications- power transfer- uniformity of heating.

UNIT IV INDUSTRIAL APPLICATIONS **9**

Microwave drying- microwave sintering- application to laboratory models and pilot system- comparison with pilot heating.

UNIT V HAZARDS AND SAFETY **9**

Exposure standards- industrial- frequency band- leakage from industrial equipment- batch system- continuous flow system- safety precautions.

TOTAL : 45 PERIODS

TEXT BOOKS

1. Metaxas A.C and Meredith RJ, Industrial Microwave Heating, Peter Peregrinus Ltd., UK, 1983.
2. Snyder W.B, Sutton W.H, Iskander M.F and Johnson D.L (Ed), Microwave Processing of Materials, Volume I & II, MRS, Pittsburgh, 1991.

REFERENCES

1. Binner J.G.P (Ed), Advanced Ceramic Processing and Technology, Volume I, Noyes Publications, New Jersey, 1990.
2. Randall M German, Sintering Technology, Marcel Dekker, Inc, 1996.

CT8013	MONOLITHICS AND CASTABLES	L T P C
		3 0 0 3

AIM

The course is aimed to enable the students to have a sound knowledge about the types, properties and applications of monolithics and castables.

OBJECTIVES

On completion of the course the students are expected to

- Have learnt the types of castables, its composition and characteristics.
- Have a better understanding on the use of plastic refractories, ramming and gunning mixes as monolithic materials.
- Have studied about the composition and characteristics of mortars, coatings and dry vibratables.
- Have a clear idea on the methods of installing different monolithic materials, the application design and the lining materials used while laying monolithics.
- Have studied the wear mechanisms that cause failure in a monolithic lining and the methods to test a monolithic.

UNIT I CASTABLES **10**

Introduction, types – conventional castables, low cement castables, ultra low cement castables, cement free castables – composition, characteristics, applications. Other castables – insulating castables, pumpable castables – composition, characteristics, applications.

UNIT II PLASTIC REFRACTORIES, RAMMING AND GUNNING MIXES **10**

Plastic refractories – introduction, composition, properties and applications. Ramming mix – introduction, binder systems, characteristics and applications. Gunning mix – introduction, binder systems, characteristics and applications.

UNIT III MORTARS, COATINGS AND DRY VIBRATABLES **7**

Mortars – introduction, classification, characteristics. Coatings – introduction, characteristics. Dry vibratables – introduction, principle and applications.

UNIT IV MONOLITHIC INSTALLATION **10**

Methods of installations of castables, plastic refractories, ramming mix and gunning mix. Drying and heating up of installed monolithic lining. Application designs – blast furnace trough design, trough lining, and form design, tundish, steel ladle, electric arc furnace. Linings in installation – anchors, steel fibre reinforcements.

UNIT V WEAR MECHANISMS AND TESTING **8**

Wear mechanisms – introduction, abrasion, penetration, corrosion, spalling. Tests done on monolithics – chemical analysis, density, porosity, strength, high temperature properties, corrosion, erosion.

TOTAL : 45 PERIODS

TEXT BOOKS

1. Subrata Banerjee, Monolithic Refractories, World Scientific Publishing Co. Pte. Ltd., 1998.
2. Taikabutsu Overseas Vol.9 No.1, Recent Progress in Castable Refractories, Techno Japan, Fuji Marketing Research Co. Ltd., Japan, 1995.

REFERENCES

1. Charles A.Schacht, Refractories Handbook, Marcel Dekker Inc, New York, 2004.
2. Norton F.H, Refractories, 4th Edn., McGraw Hill Book Co., 1968.
1. Nandi D.N, Handbook of Refractories, Tata McGraw-Hill Publishing Co., New Delhi, 1991.
2. Akira Nishikawa, Technology of Monolithic Refractories, Plibrico, Japan Co. Ltd., Tokyo, 1984.

CT8014 NON DESTRUCTIVE TESTING **L T P C**
3 0 0 3

AIM

The course is aimed to enable the students to have a basic knowledge about the various non-destructive methods of testing.

OBJECTIVES

On completion of the course the students are expected to

- Have studied the basic concepts of non-destructive testing and surface NDT methods
- Have learnt about small business and preparation of feasibility chart.
- Have a basic knowledge about establishment of a business.
- Have learnt about how to manage a business unit.
- Have some basic concepts about promotion of entrepreneurship and practical knowledge about some case studies.

UNIT I SURFACE NDT METHODS 7

Introduction- Definition of terms, discontinuities and defects/flaws- fracture mechanics concept of design and the role of NDT- life extension and life prediction- penetrant testing and magnetic particle testing - basic principle, limitations & advantages – development and detection of large flux – longitudinal and circular magnetization – demagnetization.

UNIT II RADIOGRAPHIC TESTING 12

Electromagnetic spectrum – sources - x-ray, gamma ray – x-ray generation, spectrum ,equipment controls, properties, attenuation and differential attenuation- interaction of radiation with matter – radiographic testing – principle and mechanism, recording medium- films and fluorescent screens- non-imaging detectors- film radiography detectors- film radiography-calculation of exposure for X-ray and gamma rays- quality factors- image quality indicators and their use in radiography.

UNIT III ULTRASONIC TESTING 11

Ultrasonic waves- velocity, period, frequency and wavelength- reflection and transmission-near and far field effects and attenuation- generation- piezoelectric and magnetostriction methods- normal and angle probes- methods of Ultrasonic testing- Principle of pulse echo method- Equipment – examples- rail road inspection, wall thickness measurement- range and choice of frequency.

UNIT IV EDDY CURRENT TESTING 8

Introduction- principles of eddy current inspection- conductivity of a material- magnetic properties- coil impedance- lift off factor and edge effects- skin effect- inspection frequency-

coil arrangements - inspection probes- types of circuit- Reference pieces- phase analysis-display methods-typical application of eddy current techniques.

UNIT V OTHER METHODS **7**

Imaging- principle and applications- testing of composites- acoustic emission testing-application of AET- on-line monitoring or continuous surveillance and application in materials science- optical methods of NDT- photo elasticity- evaluation procedure-Holographic NDT procedure- Speckle phenomenon- speckle interferometry-speckle shear interferometry.

TOTAL: 45 PERIODS

TEXT BOOKS

1. B.Hull and V.John, Non Destructive Testing, McMillan Education Ltd, 1968.
2. Mc Gonnagle, W.J, Non-destructing testing methods, Mc Graw Hill Co., NY, 1961.

REFERENCES

1. Metals Handbook, Volume 2, 8th Edn, ASTM, Metals Park, Ohio.
2. Dainty, Laser Speckle & Related Phenomena, Springer – Verlag, New York, 1984.

CT8015 PHASE EQUILIBRIA IN CERAMICS **L T P C**
3 0 0 3

AIM

The course is aimed to enable the students to have a thorough knowledge about the importance of phase equilibrium and analyzing different systems.

OBJECTIVES

On completion of the course the students are expected to

- Have learnt the basics of phase equilibrium and phase diagrams.
- Have studied the thermodynamics behind phase equilibria.
- Have a better understanding on the different two component and three component phase diagrams.
- Have studied the types and theory behind phase transformations and also about nucleation and growth.

- Have gained knowledge on the different experimental methods to determine phase diagram

UNIT I INTRODUCTION **9**

Introduction, phase, component, variable, Gibb's phase rule, single component system – H_2O, SiO_2, iron, Hume Rothery's rule; binary phase diagrams – eutectic, incongruent, solid solutions, complex diagrams.

UNIT II THERMODYNAMICS OF PHASE EQUILIBRIA **9**

Introduction, criteria of phase equilibrium, criterion of stability, phase equilibria in single component system and multi component system; binary solutions – constant pressure system, constant temperature system, partially miscible system, immiscible system, liquid-liquid equilibrium diagrams, ternary equilibrium diagrams.

UNIT III PHASE DIAGRAMS **9**

$Al_2O_3 – SiO_2$, $MgO – Al_2O_3$, $MgO – SiO_2$, $Al_2O_3 – ZrO_2$, $K_2O – Al_2O_3 – SiO_2$, $MgO – Al_2O_3 – SiO_2$, $Na_2O – Al_2O_3 – SiO_2$. Prediction of alkali corrosion of alumino silicate refractories using phase diagrams.

UNIT IV PHASE TRANSFORMATIONS **9**

Introduction, Time Scale for phase transformations, types of transformations – spinoidal, nucleation & growth, theory of transformation kinetics; nucleation and growth – nucleation kinetics, homogeneous nucleation, heterogeneous nucleation, growth and overall transformation kinetics.

UNIT V EXPERIMENTAL METHODS **9**

Techniques for determining phase diagrams – dynamic, static, microscopic methods – optical, electron microscopy, X-ray methods, thermal analysis.

TOTAL: 45 PERIODS

TEXT BOOKS

1. Kingery W.D, Yet Ming Chiang and Dunbar P.Birnie III, Physical Ceramics – Principles for Ceramic Science and Engineering, John Wiley & Sons, 1995.
2. Floyd A.Hammel, Phase Equilibria in Ceramic Systems, Marcel Dekker, 1984.

REFERENCES

1. Kingery W.D, Bowen H.K and Uhlmann D.Rm Introduction to Ceramics, 2nd Edn., John Wiley & Sons, 2004.
2. Allen M.Alper, Phase diagrams in Advanced Ceramics, Academic Press Inc., 1995.
3. Barsoum M.W, Fundamentals of Ceramics, McGraw Hill, 1997.

CT8016 PLANT EQUIPMENT AND FURNACE DESIGN L T P C
3 0 0 3

AIM

The course is aimed to enable the students to have a sound knowledge about designing the layout of the plant and designing of furnaces.

OBJECTIVES

On completion of the course the students are expected to

- Have learnt the factors for selection of a plant layout.
- Have studied the ways of assembling the various sections in the plant for proper functioning.
- Have studied the principles of designing equipments.
- Have studied the principle and designing of furnaces.
- Have studied the construction of furnaces.

UNIT I PLANT DESIGN 9

Proper location of the plant- factors to be considered, factory buildings- layouts with necessary details.

UNIT II ASSEMBLING 9

Assembling of economics, engineering and industrial data, calculations and data necessary for the process route- electrical, piping instruments, motors, compressors etc- flow diagrams- process, design and overall technical report.

UNIT III EQUIPMENT DESIGN 9

Design principles- crushers, filter press, sieves, pugmill and different types of pug moulds- tunnel, chamber and electrical.

UNIT IV FURNACE DESIGN **9**

Design of furnaces- tank furnace, tunnel kiln, chamber kiln, rotary kiln, muffle furnace, blast furnace, open hearth furnace, stack calculations- chimney foundations. Essential operations- firing, charging, melting, preheating- air, gas, fuel, flame systems, furnace high temperature measurements and temperature control instruments.

UNIT V FURNACE CONSTRUCTION **9**

Furnace life and selection of proper refractories, thermal currents and atmosphere, safe firing schedule. Basic knowledge about furnace construction, capacity, fuel and firing efficiencies- design, construction and thermal calculation of one of the furnaces.

TOTAL: 45 PERIODS

TEXT BOOKS

1. Sule D.R., Manufacturing Facilities: Location, Planning and Design, PWS- kent, Boston, 1988.
2. Karbandha O.P., Process, Plant and Equipment Costing, Savek Publishers, Bombay, 1977.

REFERENCES

1. Robert D Reed, Furnace Operation, Gulf Publishing Co., Paris, 1991.
2. Harold E Soissson, Instrumentation in Industry, John Wiley & Sons, NY, 1995.
3. Brownhell L.E. and Young E.H., Chemical Plant Design, McGraw Hill, 1950.

CT8017 **PROCESS AUTOMATION** **L T P C**
3 0 0 3

AIM

The course is aimed to enable the students to have a basic knowledge about the control instruments and its applications in various fields.

OBJECTIVES

On completion of the course the students are expected to

- Have studied the principle and classification of process control equipments.
- Have learnt basic concepts on process control.

- Have learnt the basics about advanced control instruments.
- Have learnt about digital control instruments.
- Have learnt the optimal control instruments.

UNIT I INTRODUCTION **9**

Principles of measurement and classification of process control instruments; temperature, pressure fluid flow, liquid level, velocity, fluid density, viscosity, conductivity etc., instrument scaling; sensors; transmitters and control valves; instrumentation symbols and labels.

UNIT II PROCESS AUTOMATION **9**

Basic Concepts; terminology and techniques for process control; control modes; tuning process controllers.

UNIT III ADVANCED CONTROL **9**

Advanced control techniques, feed forward and ratio control; controller design; adaptive control system; statistical process control; expert system; multivariable control techniques; supervisory control.

UNIT IV DIGITAL CONTROL **9**

Digital control techniques; z transforms; sampling and filtering; response of discrete time systems; sampled data control systems; design of digital controllers.

UNIT V OPTIMAL CONTROL **9**

Optimization and simulation; optimization techniques; single and multivariable constrained optimization; dynamic simulation of distillation columns and reactors.

TOTAL : 45 PERIODS

TEXT BOOKS

1. Nakara, B.C & ChoudaryK.K., Instrumentation and Analysis, Tata McGraw Hill, New Delhi, Eighth Reprint, 1993.
2. Stephanopoulos G., Chemical Process Control, Tata McGraw Hill, New Delhi, 1993.

REFERENCES

1. Karl J.Astrom & Bjorn Willermans; Computer Controlled Systems, Prentice Hall of India Pvt.Ltd. 1994.
2. Chemical Engineering Refreshers series on Process Automation, McGraw Hill Publications, New York, 1991.

CT8018 QUALITY CONTROL IN CERAMIC INDUSTRIES L T P C
3 0 0 3

AIM

To impart knowledge on various quality control aspects and issues followed in ceramic industries.

OBJECTIVES

At the end of the course the students would

- Be aware on the basic concepts of standardization.
- Have a comprehensive insight in the Indian standard specifications.
- Have a basic knowledge on the concepts of quality control in ceramic industries.
- Have learnt the statistical methods of quality control.
- Have a basic knowledge about the reliability and maintainability of quality concept.

UNIT I CONCEPTS OF STANDARDISATION 9

Historical development of standards – aims, techniques, management, formulation, implementation of company standards- economic benefits of standardization.

UNIT II INDIAN STANDARDS FOR CERAMIC MATERIALS 9

IS Specification- Specification for different raw materials- test procedures- products- tiles- sanitary ware- insulators- chemical resistant wares- structural ceramic materials- refractories.

UNIT III CONCEPTS OF QUALITY 9

Quality engineering- planning for quality and reliability- quality standards- specification of inspection methods, setting of standard quality levels- introduction to ISO 9000- design of quality experiments using statistics- analysis of variance.

UNIT IV STATISTICAL QUALITY CONTROL **9**

Introduction to taguchi methods and 6 sigma concepts- objectives of statistical quality control- inspection and its importance- difference between inspection and quality control, basic statistical methods- techniques of quality control- control charts for attributed- control charts for variables.

UNIT V DECORATION **9**

Definition of reliability, factors affecting reliability- MTTF- MTBF- evaluation of reliability, quality management- organizing for quality- economy of quality- techniques of ABC analysis- quality management education- zero defects concept-

TOTAL: 45 PERIODS

TEXT BOOKS

1. H.Lal, Total Quality Management- A Practical Approach, Wiley Eastern, 1990.
2. Juran J.M and Gryna F.M, Quality Control Handbook, McGraw Hill Book Co., 1988.

REFERENCES

1. Jerome D West and Ferdinand K Leoy, A Management Guide to PERT/CPM.
2. Guide on Company Standardization by Institute of Standards & Engineers, 1989.
3. International Organization for Standardization, 1992, Case Postal 56, CH-1211-Geneva 20- Switzerland- ISO- 9000 Compendium – Vision 2000- ISBN92- 67- 101722.

CT8019 REFRACTORY ENGINEERING AND MANAGEMENT **L T P C**
3 0 0 3

AIM

The course is aimed to enable the students to have a basic knowledge about Refractory lining and the structural and mechanical behavior of refractory linings

OBJECTIVES

On completion of the course the students are expected to

- Have learnt the basics of structural and mechanical behavior of refractory linings
- Have a sound knowledge about heat transfer in refractory linings

- Have learnt about the wear of refractory linings.
- Have a knowledge about basic principles of thermal design

UNIT I INTRODUCTION **9**

Introduction-types of loading-Stress controlled and strain controlled loads –Design philosophy of structures based on load types –Material properties required for structural analysis.

UNIT II CRITERIA FOR SELECTION OF REFRACTORY MATERIALS **9**

ASTM strength tests– Choosing best refractory for thermomechanical application – Verification from field test study- static compressive stress strain data-Creep data -Influence of stress state on the strength of refractories –Thermal expansion data

UNIT III REFRACTORY LININGS JOINTS **9**

Joints –Refractory mortar joint fundamentals- finite element analysis of a mortar joint – behavior of structural masonry mortar joint-Influence of mortar joint thickness on mortar joint behavior - mechanical behavior of dry joint – Fundamental of refractory Hinges- Aspects of Hinge behavior -An analytical study of Hinge joint

UNIT IV FUNDAMENTALS OF DIFFERENT LINING DESIGNS **9**

Basics of refractory brick arch behavior – Fundamentals of brick lined cylindrical shells – Brick dome behavior –fundamentals of flat brick linings -Cylindrical refractory-lined vessel analysis –Refractory sprung arch – spherical refractory silica brick dome. Dos and Don'ts in Refractory lining design

UNIT V STRUCTURE –PROPERTY- PERFORMANCE STUDY **9**

Correlation between structure and property-correlation between property and performance of refractories.-Postmortem studies – microstructural studies.

TOTAL: 45 PERIODS

TEXT BOOKS

1. C. A. Schacht, Refractory Linings: Thermo-mechanical Design and Applications, CRC Press, 1995.
2. S. C. Caniglia and G. L. Barna, Handbook of Industrial Refractories Technology, William Andrews Publishing, NY, 1992.

REFERENCES

1. C. A. Schacht, Refractories Handbook, CRC Press. , NY, 2004
2. S. Banerjee, The Changing Refractories Industry: New Technologies, Materials and Markets, Business Communication Co, 1999.

CT8020 SPECIAL COATING TECHNOLOGY L T P C
3 0 0 3

AIM

The course is aimed to enable the students to have a complete knowledge about the advanced ceramic coating technology processes, properties and applications.

OBJECTIVES

On completion of the course the students are expected to

- Have studied the classification and raw materials used for the special coatings.
- Have learnt in detail about enamel coating.
- Have studied the concept of vapour phase coatings.
- Have studied about the various special coating techniques.
- Have studied the properties and applications of special coatings.

UNIT I COATINGS – FUNDAMENTALS 9

Definition of thin film and coatings, preparation of substrate- Role of substrate- substrate selection- nucleation and thin film growth- residual stress, thickness measurements.

UNIT II VAPOUR PHASE COATINGS 9

PVD - basic evaporation process - evaporation techniques - sputtering – ion plating- CVD process- CVD reactor- CVD kinetics- product and process route.

UNIT III SPECIAL COATINGS 9

Plasma spray- pack coating- slurry coating- sol gel coating- hot dip coating- electrophoresis- electro chemical coating- corrosion resistant coating and other coatings.

UNIT IV SURFACE ANALYTICAL METHODS **9**

XRD – glancing incidence, x-ray diffraction- electron microscopy techniques- auger electron spectroscopy, secondary ion mass spectroscopy, photoelectron spectroscopy.

UNIT V PROPERTIES AND APPLICATIONS **9**

Thermal, mechanical. Optical and chemical properties- hardness- wear and erosion resistance- high temperature properties- applications- defects and remedies.

TOTAL : 45 PERIODS

TEXT BOOKS

1. Hocking M.G.Vasantasree V Sidky PS, Metallic and Ceramic coatings, Longman, 1989.
2. Boriosenko Al, HighTemperature Protective Coatings,American Publishing Co., New Delhi, 1986.

REFERENCES

1. Lisa C Klien (Ed),Sol Gel Technique for Thin Films, Fibres, Performs, Electronis and Speciality Shapes, Noyes publications, New Jersy, 1988.
2. Orlando Auciello and Rainer Waser, Science and Technology of Electro ceramic Thin film, NATO ASI series- Kluwer Academic publishers, 1995.

CT8021 **SPECIAL GLASSES** **L T P C**
3 0 0 3

AIM

The course is aimed to enable the students to have a thorough knowledge about the special applications of glasses in various fields.

OBJECTIVES

On completion of the course the students are expected to

- Have a clear understanding on the types and properties of heat resistant and safety glasses.
- Have studied the manufacture, types and applications of optical glasses.

- Have studied the composition of glass fibres and optical fibres, and their applications.
- Have learnt the composition, preparation and properties of glass ceramics.
- Have a knowledge on the methods and types of coatings on glass, their applications and quality control.

UNIT I HEAT RESISTANT AND SAFETY GLASSES 9

Borosilicate glasses – pyrex glass and jona type, composition – fabrication of laboratory ware – vycor glass. Safety glasses – toughened glass, laminated glass.

UNIT II OPTICAL GLASSES 9

Manufacture of crown and flint glass – ophthalmic glass filters – photo chromic glass – laser glass – electro chromic glass – GRIN lenses and components – chalcogenide, chalcohallide and halide glasses – applications in optical components.

UNIT III GLASS FIBRES 9

Composition for fibre glass, glass wool, manufacturing process and applications. Optical fibres – optical properties of fibres, silica based glass fibres – applications in optical communication.

UNIT IV GLASS CERAMICS 9

Glass composition, heat treatment schedule, crystal nucleation in glass, nucleating agent, microstructure and properties, applications, machinable glass ceramics.

UNIT V COATED GLASS 9

Coating methods – physical vapour deposition, chemical vapour deposition. Types of coatings, characteristics of coated glass, applications of coated glasses, quality control of coated glass.

TOTAL: 45 PERIODS

TEXT BOOKS

1. Lewis M.H, Glasses and Glass Ceramics, Chapman and Hall, London, 1989.
2. Cable M and Parker M.J, High Performance Glasses, Chapman and Hall, NY, 1992.

REFERENCES

1. Heinz G.Plaender, Schott Guide to Glass, Chapman and Hall, 1996.
2. Hans Bach, Low Thermal Expansion Glass Ceramics, Springer, 1995.
3. Philips C.J, Glass, Its Industrial Applications, Reinhold Publishing Co., NY, 1960.

CT8022 THERMODYNAMICS FOR CERAMICS L T P C
3 0 0 3

AIM

The course is aimed to enable the students to have a basic knowledge about thermodynamics and the applications of thermodynamic laws of various systems.

OBJECTIVES

On completion of the course the students are expected to

- Have an understanding about the basic concepts of thermodynamics and the thermodynamic laws.
- Have an idea about the behavior of gases under conditions of temperature, pressure and volume.
- Have a basic knowledge about concepts of heat capacity.
- Have learnt the various applications of thermodynamics and solve some thermodynamic problems.
- Have a knowledge about solution thermodynamics.

UNIT I BASIC CONCEPTS 9

Fundamental concepts – system, process, state, properties, force, work, pressure, energy, equilibrium state, phase rule. Thermodynamic laws – zeroth law, internal energy, first law for flow process, non flow process, enthalpy, limitations, second law, entropy, Clausius inequality, third law.

UNIT II PVT BEHAVIOUR 9

PVT behavior – equation of state – concept of ideal gas – constant volume constant pressure, constant temperature, adiabatic process, isotropic process – equation of state for real gases – compressibility chart – heat effects accompanying a chemical reaction.

UNIT III CONCEPTS OF HEAT CAPACITY 9

Free energy and entropy – Gibb's equation – Helmholtz equation – equilibrium constant and heat of reaction – Clausius – Claypeyron equation – partial free energy – Gibb's phase rule and its interpretation – condensed system – one component system – polymorphic transformations – P-T diagram of silica.

UNIT IV APPLICATIONS OF THERMODYNAMICS 9

Flow process – continuity equation – energy equation – Bernoulli's equation – flow through nozzles, pipes – ejectors - throttling process – compressors – Carnot cycle – refrigeration cycle – vaporization of liquid – Rankine cycle – diesel cycle.

UNIT V SOLUTION THERMODYNAMICS 9

Classification of thermodynamics properties – relationship among thermodynamics properties – fugacity – activity – thermodynamic diagrams – partial molar properties – chemical potential – activity in solutions – property changes of mixing – heat effects of mixing process.

TOTAL: 45 PERIODS

TEXT BOOKS

1. K.V.Narayanan, A Text Book of Chemical Engineering Thermodynamics, Prentice Hall India Pvt Ltd, New Delhi, 2001.
2. J.M.Smith and H.C.Van Hess, Introduction to Chemical Engineering Thermodynamics, Kogakushai, 1976.

REFERENCES

1. Robert E Treybac, Mass Transfer Operations, McGraw Hill, 1981.
2. S.I.Sandler, Chemical Engineering Thermodynamics, John Wiley & Sons, NY, 1989.

GE8071 FUNDAMENTALS OF NANO SCIENCE L T P C
3 0 0 3

UNIT I INTRODUCTION 10

Nanoscale Science and Technology- Implications for Physics, Chemistry, Biology and Engineering-Classifications of nanostructured materials- nano particles- quantum dots, nanowires-ultra-thinfilms-multilayered materials. Length Scales involved and effect on

properties: Mechanical, Electronic, Optical, Magnetic and Thermal properties. Introduction to properties and motivation for study (qualitative only).

UNIT II PREPARATION METHODS 10

Bottom-up Synthesis-Top-down Approach: Precipitation, Mechanical Milling, Colloidal routes, Self-assembly, Vapour phase deposition, MOCVD, Sputtering, Evaporation, Molecular Beam Epitaxy, Atomic Layer Epitaxy, MOMBE.

UNIT III PATTERNING AND LITHOGRAPHY FOR NANOSCALE DEVICES 5

Introduction to optical/UV electron beam and X-ray Lithography systems and processes, Wet etching, dry (Plasma /reactive ion) etching, Etch resists-dip pen lithography

UNIT IV PREPARATION ENVIRONMENTS 10

Clean rooms: specifications and design, air and water purity, requirements for particular processes, Vibration free environments: Services and facilities required. Working practices, sample cleaning, Chemical purification, chemical and biological contamination, Safety issues, flammable and toxic hazards, biohazards.

UNIT V CHARECTERISATION TECHNIQUES 10

X-ray diffraction technique, Scanning Electron Microscopy - environmental techniques, Transmission Electron Microscopy including high-resolution imaging, Surface Analysis techniques- AFM, SPM, STM, SNOM, ESCA, SIMS-Nanoindentation

TOTAL: 45 PERIODS

TEXT BOOKS

1. A.S. Edelstein and R.C. Cammearata, eds., Nanomaterials: Synthesis, Properties and Applications, (Institute of Physics Publishing, Bristol and Philadelphia, 1996)
2. N John Dinardo, Nanoscale characterization of surfaces & Interfaces, Second edition, Weinheim Cambridge, Wiley-VCH, 2000

REFERENCES

1. G Timp (Editor), Nanotechnology, AIP press/Springer, 1999
2. Akhlesh Lakhtakia (Editor) The Hand Book of Nano Technology, “Nanometer Structure”, Theory, Modeling and Simulations. Prentice-Hall of India (P) Ltd, New Delhi, 2007.

MG8654 **TOTAL QUALITY MANAGEMENT** **L T P C**
3 0 0 3

AIM

To provide comprehensive knowledge about the principles, practices, tools and techniques of Total quality management.

OBJECTIVES

- To understand the various principles, practices of TQM to achieve quality.
- To learn the various statistical approaches for Quality control.
- To understand the TQM tools for continuous process improvement.
- To learn the importance of ISO and Quality systems

UNIT I INTRODUCTION **9**

Introduction - Need for quality - Evolution of quality - Definition of quality - Dimensions of product and service quality - Basic concepts of TQM – TQM Framework - Contributions of Quality Gurus – Barriers to TQM – Cost of Quality.

UNIT II TQM PRINCIPLES **9**

Quality statements - Customer focus –Customer orientation, Customer satisfaction, Customer complaints, Customer retention - Continuous process improvement – PDCA cycle, 5s, Kaizen - Supplier partnership – Partnering, Supplier selection, Supplier Rating.

UNIT III TQM TOOLS & TECHNIQUES I **9**

The seven traditional tools of quality – New management tools – Six-sigma: Concepts, methodology, applications to manufacturing, service sector including IT – Bench marking – Reason to bench mark, Bench marking process – FMEA – Stages, Types.

UNIT IV TQM TOOLS & TECHNIQUES II **9**

Quality circles – Quality Function Deployment (QFD) – Taguchi quality loss function –TPM – Concepts, improvement needs – Performance measures - BPR.

UNIT V QUALITY SYSTEMS **9**

Need for ISO 9000- ISO 9000-2000 Quality System – Elements, Documentation, Quality auditing- QS 9000 – ISO 14000 – Concepts, Requirements and Benefits –Quality Council – Leadership, Employee involvement – Motivation, Empowerment, Team and Teamwork, Recognition and Reward.

TOTAL : 45 PERIODS

TEXT BOOK

1. Dale H.Besterfiled, et al., “Total Quality Management”, Pearson Education Asia, Third Edition, Indian Reprint , 2006.

REFERENCE BOOKS

1. James R. Evans and William M. Lindsay, “The Management and Control of Quality”, (6th Edition), South-Western (Thomson Learning), 2005.
2. Oakland, J.S. “TQM – Text with Cases”, Butterworth – Heinemann Ltd., Oxford, Third Edition , 2003.
3. Suganthi,L and Anand Samuel, “Total Quality Management”, Prentice Hall (India) Pvt. Ltd., 2006 .
4. Janakiraman,B and Gopal, R.K, “Total Quality Management – Text and Cases”,Prentice Hall (India) Pvt. Ltd., 2006.