



**Dr.M.G.R.**  
**EDUCATIONAL AND RESEARCH INSTITUTE**  
**UNIVERSITY**  
(Decl. U/S 3 of the UGC Act 19Hrs56)  
**DEPARTMENT OF CHEMICAL ENGINEERING**

**B.Tech- Chemical Engineering – Full Time**  
**2013 Regulation**

<b>III SEMESTER</b>						
<b>S.NO</b>	<b>Sub.Code</b>	<b>Title of Subject</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
1.	BEE13034	Electrical Technology	3	0	0	3
2.	BCH13006	Chemistry II	3	0	0	3
3.	BMA13008	Mathematics –III for Chemical Engineers	3	1	0	4
4.	BCT13002	Mechanical Engineering	3	0	0	3
5.	BCE13031	Environmental Science and Engineering	3	0	0	3
6.	BBT13031	Biochemistry	3	0	0	3
7.	BCH13L03	Chemistry Lab	0	0	3	2
8.	BEE13L23	Electrical Engineering Lab	0	0	3	2
<b>Total</b>			<b>18</b>	<b>1</b>	<b>6</b>	<b>23</b>

<b>IV SEMESTER</b>						
<b>S.NO</b>	<b>Sub.Code</b>	<b>Title of Subject</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
1.	BCT13003	Computer Applications	2	0	1	3
2.	BCT13004	Introduction to Chemical Process Industries	3	0	0	3
3.	BBT13032	Industrial Microbiology	3	0	0	3
4.	BCT13005	Chemical Technology I	3	0	0	3
5.	BCT13006	Processes in Organic Synthesis	3	0	0	3
6.	BCT13007	Mechanical Operations	3	0	0	3
7.	BMA13013	Mathematics IV for Chemical Engineers	3	1	0	4
8.	BCT13L01	Technical Analysis Lab	0	0	3	2
9.	BEN13L01	Career and Confidence Building (Soft skills – I)	0	0	0	2
<b>Total</b>			<b>20</b>	<b>1</b>	<b>5</b>	<b>26</b>



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<b>V SEMESTER</b>						
<b>S.NO</b>	<b>Sub.Code</b>	<b>Title of Subject</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
1.	BCT13008	Chemical Process Calculations	3	0	0	3
2.	BCT13009	Chemical Engineering Thermodynamics I	3	0	0	3
3.	BBT13033	Cell Biology	3	0	0	3
4.	BCT13010	Chemical Technology II	3	0	0	3
5.	BCT13011	Fluid Mechanics	3	0	0	3
6.	BMA13016	Mathematics – V for Chemical Engineers	3	1	0	4
7.	BBT13L21	Biochemistry Lab	0	0	3	2
8.	BCT13L02	Chemical Engineering Lab I	0	0	3	2
9.	BEN13L02	Qualitative and Quantitative skills (Soft skills-II)	0	0	0	2
<b>Total</b>			<b>18</b>	<b>1</b>	<b>6</b>	<b>25</b>

<b>VI SEMESTER</b>						
<b>S.NO</b>	<b>Sub.Code</b>	<b>Title of Subject</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
1.	BCT13012	Chemical Engineering Thermodynamics II	3	0	0	3
2.	BCT13013	Chemical Reaction Engineering I	3	0	0	3
3.	BCT13014	Mass Transfer I	3	0	0	3
4.	BCT13015	Heat Transfer	3	0	0	3
5.	BMA13019	Special Functions, Difference Equations and Z Transforms	3	1	0	4
6.	BCT13016	Chemical process equipment design	3	0	0	3
7.	BCT13L03	Matlab Programming Fundamentals	0	0	3	2
8.	BCT13L04	Chemical Engineering Lab II	0	0	3	2
<b>Total</b>			<b>18</b>	<b>1</b>	<b>6</b>	<b>23</b>



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<b>VII SEMESTER</b>						
<b>S.NO</b>	<b>Sub.Code</b>	<b>Title of Subject</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
1.	BCT13017	Process Control and Dynamics	3	0	0	3
2.	BMG13006	Process Economics and Industrial Management	3	0	0	3
3.	BCT13018	Chemical Reaction Engineering II	3	0	0	3
4.	BCT13019	Mass Transfer II	3	0	0	3
5.	BBT13034	Bio process Principles	3	0	0	3
6.	BCT13020	Transport Phenomena	3	1	0	4
7.	BCT13L05	Chemical Process Equipment Design & Drawing with Simulation	0	0	3	2
8.	BCT13L06	Chemical Engineering Lab III	0	0	3	2
<b>Total</b>			<b>19</b>	<b>1</b>	<b>6</b>	<b>23</b>

<b>VIII SEMESTER</b>						
<b>S.NO</b>	<b>Sub.Code</b>	<b>Title of Subject</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
1.	BMG13002	Total Quality Management	3	0	0	3
2.	BCT13L07	Project work	0	0	20	10
3.		Elective I	3	0	0	3
4.		Elective II	3	0	0	3
<b>Total</b>			<b>9</b>	<b>0</b>	<b>20</b>	<b>19</b>

**I+II+III+IV+V+VI+VII+VIII=45+23+26+25+23+23+19=184**  
 Total credits earned for the award of the degree : 184

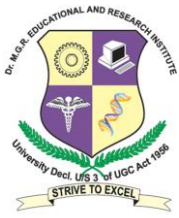


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List of Electives						
S.No	Sub.Code	Course Title	L	T	P	C
1	BCT13E01	Food Technology	3	0	0	3
2	BCT13E02	Air pollution and control	3	0	0	3
3	BCT13E03	Green chemistry and Engineering	3	0	0	3
4	BCT13E04	Environmental Engineering	3	0	0	3
5	BCT13E05	Waste water Treatment	3	0	0	3
6	BCT13E06	Drugs and Pharmaceutical Technology	3	0	0	3
7	BCT13E07	Fertilizer Technology	3	0	0	3
8	BCT13E08	Petroleum Technology	3	0	0	3
9	BCT13E09	Pulp and Paper Technology	3	0	0	3
10	BCT13E10	Polymer Technology	3	0	0	3
11	BCT13E11	Fundamentals of Nanoscience	3	0	0	3
12	BCT13E12	Frontiers of Chemical Engineering	3	0	0	3
13	BCT13E13	Professional Ethics in Engineering	3	0	0	3
14	BCT13E14	Industrial Instrumentation	3	0	0	3
15	BCT13E15	Safety in Chemical Process Industries	3	0	0	3



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**BEE13034**

**ELECTRICAL TECHNOLOGY**

**30 0 3**

**OBJECTIVE:**

- To gain knowledge on circuit systems, machines, transformers and drives

**UNIT I DC CIRCUITS**

**9Hrs**

Introduction - circuit parameters - Kirchoffs laws - circuit reduction techniques - Thevenin's Theorem - Maximum power transfer theorem.

**AC CIRCUITS:** RMS and average velocity of periodic waves - form factor - phase and phase difference - RL, RC, RLC circuits - power and power factor - Introduction to three phase systems - solution of balanced three phase circuits.

**UNIT II D.C. MACHINES**

**9Hrs**

Construction details of DC machines - principles of operation of DC generator - EMF equation - Characteristics of DC generators - principle of DC motor - Back EMF - Torque equation - Characteristics shunt, series and compound motors - Losses and efficiency - Starters - Speed control - applications.

**UNIT III TRANSFORMERS**

**9Hrs**

Principles of ideal transformers - constructional details - EMF equation - Equivalent circuit - Voltage regulation - losses and efficiency - OC and SC tests on transformer - Autotransformer - Power supplies - basic principle of SMPS and UPS.

**UNIT IV SYNCHRONOUS MACHINES AND INDUCTION MOTORS**

**9Hrs**

**CONSTRUCTION DETAILS - PRINCIPLES OF ALTERNATOR -**

Construction details - principle of alternator - EMF equation - Voltage regulation - starting of synchronous motor - effect of field excitation - Induction motor - principle of operation - torque equation - torque-slip characteristics - starting methods and speed control - principle of single-phase induction motor - applications (Qualitative treatment only).

**UNIT VELECTRICAL DRIVES**

**9Hrs**

Types of Electrical drives - Factors influencing the Choice of Electrical Drives, Heating and Cooling Curves - Loading Conditions and Classes of Duty - Determination of Power Rating - Drives for textile mills, Steel rolling mills, machine tools and Cranes & Hoist Drives. (Quantitative Treatment only)

**Total No. of Hrs:45**

**Text Books:**

1. S.K.Battacharya, "*Electrical Machines*" Tata McGraw Hill Publications, 2<sup>nd</sup> Edition, 1998.
2. Sudhakar&Shyammohan, "*Circuits & Networks Analysis & Synthesis*", Tata McGraw Hill, 2001.

**References:**

1. J.A.Edminister, "*Theory and Problems on Electrical Circuits*" McGraw Hill, 1994.
2. J.Nagrath&D.P.Kothari, "*Electrical Machines*", TMH publications."*Hughes Electrical Technology*", Revised by IMcKenzie Smith, Low Price Edition, Pearson Education, 7th Ed.



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**BCH13006**

**CHEMISTRY-II**

**3 0 0 3**

**OBJECTIVE:**

- To master the concepts of chemistry based on inorganic, organic and physical chemistry

**UNIT I ORGANO METALLIC COMPOUNDS AND HETEROCYCLIC COMPOUNDS**

Grignard reagents and their synthetic utility –Organo-Silicon compounds. Furan, Thiophene, Pyrrole, Pyridine, and Indole - Their important derivatives

**UNIT II DYES AND DYEING**

**9Hrs**

Colour and Constitution - Synthesis of some important azodyes (Methyl orange, Methyl red and Congo red) - Synthesis of Triphenylmethane dyes (Malachite green, Para Rosaniline Anthraquinone dyes (Alizarin). - Phthalin dyes - Eosin preparation - Introduction to Natural and Reactive dyes

**UNIT III PHARMACEUTICAL CHEMISTRY**

**9Hrs**

Synthesis of antimalarial drugs - Isopentaquine and chloroquine - Antibacterial drugs - Synthesis of sulphanilamide, sulphapyridine.

**UNIT IV COLLOIDS**

**9Hrs**

Introduction to colloids - properties of colloids –Electrokinetic phenomena - Donnan Membrane equilibrium - Emulsions - Gels - colloidal electrolytes.

**UNIT V PHOTOCHEMISTRY**

**9Hrs**

Laws of Photochemistry, Quantum efficiency, Photochemical reactions, Actinometry, Kinetics and mechanism of Hydrogen - Bromine reaction.

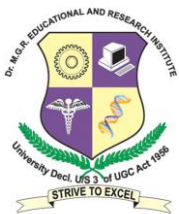
**Total No. of Hrs:45**

**Text Books:**

1. Puri B.H. and Sharma L.R., " *Principles of Physical Chemistry* ", S.NaginChand and Company, Delhi (1994).
2. Kund and Jain, " *Physical Chemistry* ", S. Chand and Company, Delhi (1996). Gordon M.Barrow, " *Physical Chemistry* ", Sixth Edition, Tata McGraw Hill (1998).
3. Tiwari, K.S., Vishnoi, N.K. and Vishnoi, S.N., " *A Text book of Organic Chemistry* ", Second Edition, Vikas Publishing House (1998), New Delhi.

**References:**

1. Agarwal, O.P., " *Synthetic Organic Chemistry* ", Vth Edition, 1980-81, Goel Publishing house, Meerut. Ashutoshkar, " *Medicinal Organic Chemistry* ", New Age International Private Ltd., 1993, Chennai.
2. Bahl, B.S. and Arun Bahl, " *Advanced Organic Chemistry* ", IIIrd Edition (1994), Sultan Chand and sons, New Delhi.
3. Mrs. Lakshmi, S., " *Pharmaceutical Chemistry* ", First Edition (1995),
4. Sultan Chand and Sons, New Delhi. Morrison, R.T. and Boyd, R.N., " *Organic Chemistry* ", VI Edition,
5. Prentice Hall Inc. (1996), USA.



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**BMA13008**

**MATHEMATICS III FOR CHEMICAL ENGINEERS 3 1 0 4**

**OBJECTIVE:**

- The aim of this course is to introduce the concepts of partial differential equations and, analytic functions, which will be applicable to chemical chemicalEngg.

**UNIT I PARTIAL DIFFERENTIAL EQUATIONS 12Hrs**

Formation – Solutions of standard types of first order equations – Lagrange's equation – Linear partial differential equations of second order and higher order with constant Coefficients.

**UNIT II FOURIER SERIES 12Hrs**

Dirichlet's conditions – General Fourier series – Half range Sine & Cosine series – Complex form of Fourier series – Parseval's identity – Harmonic Analysis.

**UNIT III APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATIONS 12Hrs**

Classification of second order linear partial differential equations – Solutions of one-dimensional wave equation, one-dimensional heat equation – Steady state solution of two-dimensional heat equation (Cartesian coordinates only) – Fourier series solutions.

**UNIT IV ANALYTIC FUNCTIONS 12Hrs**

Analytic functions – Cauchy Riemann equations in Cartesian and Polar form – Properties of analytic functions – Construction of analytic functions – Simple Transformations – Standard transformations :  $w = z^2$ ,  $w = e^z$ ,  $w = \sin z$ ,  $w = \cosh z$  – Bilinear transformations.

**UNIT V COMPLEX INTEGRATION 12Hrs**

Cauchy's integral theorem (without proof) – Cauchy's integral formulae (without proof) – Taylor's and Laurent's series (without proof) – Singularities: Types – Residues – Cauchy's residue theorem (without proof) – Evaluation of real integrals by Contour Integration (excluding poles on real axis).

**Total No. of Hrs: 60**

**Text Books :**

- 1) Veerarajan T., *Engineering Mathematics (for first year)*, Tata McGraw Hill Publishing Co., (2007).
- 2) Veerarajan T., *Engineering Mathematics (for semester III)*, Tata McGraw Hill Publishing Co., (2005).
- 3) Singaravelu, *Engineering Mathematics III*, Meenakshi Agency, (2005).

**References:**

- 1) Kreyszig E., *Advanced Engineering Mathematics (9<sup>th</sup> ed.)*, John Wiley & Sons, (2011).
- 2) Grewal B.S., *Higher Engineering Mathematics*, Khanna Publishers, (2012).





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**BCT13002**

**MECHANICAL ENGINEERING**

**3 0 0 3**

**OBJECTIVE:**

- To get insight into thermodynamic concepts and to study about metallurgy applications.

**UNIT - I LAWS OF THERMODYNAMICS**

**9Hrs**

Scope of Thermodynamics - work transfer - heat transfer - Specific heat - Latent heat. First law of Thermodynamics and applications - Steady Flow Process and Variable Process. Second law of Thermodynamics - Kelvin-Planck and Clausius Statements - Carnot heat engine - Reversed Carnot engine - Carnot theorem Corollary of Carnot theorem. Properties of Steam - dryness fraction - Super heated Steam.

**UNIT – II VAPOUR AND GAS POWER CYCLES**

**9Hrs**

Rankine cycle - Reheat cycle - Regenerative cycle - Binary vapour power cycle. Gas power cycles - Carnot cycle - Otto cycle - Diesel cycle - Brayton cycle.

**UNIT – III STATICS AND DYNAMICS OF MECHANICS**

**9Hrs**

Statics - Laws of mechanism - concurrent forces in a plane - Resolution and composition of forces - Equilibrium of particle - resultant force.

Dynamics - Displacement, velocity and acceleration - their relationship - Linear and Circular motion - D'Alembert's principles

**UNIT – IV METALLURGY**

**9Hrs**

Classification of steel and Cast Iron - Iron-Carbide equilibrium diagram. Classification of Heat Treatment process - purpose of heat treatment - Fundamental principles of heat treatment - Annealing - Normalizing - Hardening - Tempering.

**UNIT – V TRANSMISSION SYSTEMS:**

**9Hrs**

Belt drives - Classification - Flat, V- belts and rope drives - Power Transmitted.

Gear Terminology - Classification - Law of Gearing - Gear ratio - Length of arc and path of contact and contact ratio (Derivation not required) - Simple and Compound gear Trains.

**Total No. of Hrs: 45**

**Text Books:**

1. Smith, "Chemical Thermodynamics", Reinhold Publishing Co:1977.
2. Bhaskaran.K.A and Venkatesh.A. "Engineering Thermodynamics" TMH:1973.

**References:**

1. Pandya A. and Shah. Theory of Machines" Charatakar Publishers:1975
2. P.K.Nag, "Engineering Thermodynamics", II Edition, TMH publishing Co.Ltd.,1995







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**BCH13L03                      CHEMISTRY LAB                      0                      0                      3                      2**

1. Ore/alloy analysis
2. Pigment Analysis
3. Industrial Waste Water Analysis
4. Estimation of Phenol
5. Analysis of fertilizers
6. Sugar Analysis
7. Polymer Analysis



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**BEE13L23**

**ELECTRICAL ENGINEERING LAB**

**0 0 3 2**

**LIST OF EXPERIMENTS**

1. Open circuit characteristics of D.C. shunt generator.
2. Load characteristics of D.C. shunt generator
3. Load characteristics of D.C. compound generator
4. Load test of D.C. Shunt motor
5. Study of D.C. Motor starters
6. O.C. and S.C. tests on single phase transformer
7. Load test on single phase transformer.
8. Load test on 3 phase squirrel cage induction motor
9. Study of 3 phase induction motor starters
10. Load test on 3 phase slip ring induction motor
11. O.C. and S.C. tests on 3 phase alternator
12. Synchronization and V-curves of alternator



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**BCT13003**

**COMPUTER APPLICATIONS**

**2 0 1 3**

**OBJECTIVE:**

- To gain knowledge based on various programming languages applied for chemical technology

**UNIT I:INTRODUCTION**

**9Hrs**

Review on Programming languages, Basic, Fortran, Review on operating system commands.

**UNIT II:SPREAD SHEETS**

**9Hrs**

Creating – opening and saving files – working with worksheets – entering data – editing – formatting – printing – formulae- charts - Application in Density, molecular weight, mole and percentage compositions, Empirical and Molecular formula calculations, Heat of mixing, Gas laws, Vapor pressure, Chemical Kinetics calculations.

**UNIT III:SPREAD SHEETS (DATA ANALYSIS)**

**9Hrs**

Application in data processing, Statistical analysis of data, Regression Analysis of variance, interpolation, Graphical representations.

**UNIT IV:FORTRAN**

**9Hrs**

Syntax – Mathematical and logical operations – Looping – Conditional statements – functions – Sub-functions – simple application programmes.

**UNIT V: C PROGRAMMING**

**9Hrs**

Syntax – Mathematical and logical operations – Looping – Sub-routines – file handling – simple application programmes.

**Total No. of Hrs: 45**

**Text Books:**

1. Taxali, R.K., T.K., " *dBase IV made simple* ", Tata McGraw Hill 1991.
2. Myers, A.L., Seider W.D., " *Introduction to Chemical Engineering and Computer Calculations* "

**References:**

1. Jerry, O., Breneman, G.L., " *Spreadsheet Chemistry* ", Prentice Hall, Englewood Cliffs, 1991.
2. Hanna, O.T., Scandell, O.C., " *Computational Methods in Chemical Engineering* ", Prentice Hall, 1995.





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**BBT13032**

**INDUSTRIAL MICROBIOLOGY**

**3 0 0 3**

**OBJECTIVE:**

- To explore the students about the various emerging areas of industrial micro biology

**UNIT I:INTRODUCTION**

**9Hrs**

Basic of microbial existence; history of microbiology, classification and nomenclature of microorganism, microscopic examination of microorganisms, light and electron microscopy; principles of different staining techniques like gram staining, acid fast, capsular staining, flagellar staining.

**UNIT II:MICROBES-STRUCTURE AND MULTIPLICATION**

**9Hrs**

Structural organization and multiplication of bacteria, viruses, algae and fungi with a special mention of life history of actinomycetes, yeast, mycoplasma and bacteriophage.

**UNIT III:MICROBIAL NUTRITION, GROWTH AND METABOLISM**

**9Hrs**

Nutritional requirements of bacteria and different media used for bacterial culture; growth curve and different methods to quantitate bacterial growth, aerobic and anaerobic bioenergetics and utilization of energy for biosynthesis of important molecules.

**UNIT IV: CONTROL OF MICROORGANISMS**

**9Hrs**

Physical and chemical control of microorganism; host-microbe interactions; anti-bacterial, anti-fungal and anti-viral agents, mode of action and resistance to antibiotics; clinically important microorganisms.

**UNIT V:INDUSTRIAL AND ENVIRONMENTAL MICROBIOLOGY**

**9Hrs**

Primary metabolites; secondary metabolites and their applications; preservation of food; production of penicillin, alcohol, vit. B-12; biogas; bioremediation; leaching of ores by microorganisms; biofertilizers and biopesticides; microorganisms and pollution control.

**Total No. of Hrs:45**

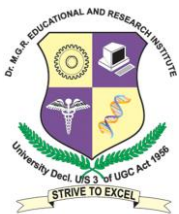
**Text Book:**

1. Pelczar MJ, Chan ECS and Krein NR, *Microbiology*, Tata McGraw Hill Edition, New Delhi, India..

**Referencs:**

1. Talaron K, Talaron A, Casita, Pelczar And Reid. *Foundations In Microbiology*, W.C.Brown Publishers, 1993.
2. Prescott LM, Harley JP, Klein DA, *Microbiology*, 3<sup>rd</sup> Edition, Wm. C. Brown publishers, 1996.





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**BCT13005**

**CHEMICAL TECHNOLOGY– I**

**3 0 0 3**

**OBJECTIVE:**

- To introduce history, importance and components of chemical engineering, concepts of unit operations and unit processes.
- Current scenario of chemical & allied process industries

**UNIT I: INTRODUCTION**

**9Hrs**

Chemical processing, the role of chemical engineers in process industries, importance of block diagrams and flow charts, UNIT operations, UNIT processes, process utilities and economics, industrial safety and pollution, outline plant and equipment design, process control and instrumentation.

**UNIT II: FERTILISER CHEMICALS**

**9Hrs**

Growth elements, Function, Nitrogenous fertilizers, Ammonium sulfate, Ammonium Nitrate and Urea, Phosphatic fertilizers, single and triple superphosphate, Ammonium phosphate, Nitro phosphate, Potassium Fertilizers, Potassium Chloride, Potassium Nitrate and phosphate, Compound fertilizers and bio-fertilizers. PHOSPHORUS INDUSTRIES : Phosphate rock, benefaction, phosphoric acid-phosphate. NITROGEN INDUSTRIES: Synthesis ammonia and nitric acid. AGRICHEMICAL INDUSTRIES: Insecticides, pesticides, herbicides, plant nutrients and regulators

**UNIT III: INDUSTRIAL CHEMICALS - I**

**9Hrs**

EXPLOSIVES AND PROPELLANTS INDUSTRIES: Explosives, types and characteristics, industrial and military explosives, propellants for rockets.

SURFACE COATING INDUSTRIES: Paints, pigments, varnishes, lacquers, industrial, and marine coatings.

PHOTOGRAPHIC CHEMICALS: Photographic chemicals, manufacture of films, plates and papers, recovery.

INDUSTRIAL GASES: Synthetic gas, natural gas, carbon dioxide sulphur-di-oxide, acetylene, helium and argon, hydrogen, oxygen, nitrogen.

**UNIT IV: INDUSTRIAL CHEMICALS - II**

**9Hrs**

CHLORINE - ALKALI INDUSTRIES: Soda ash and sodium bicarbonate, Chlorine and caustic soda; bleaching powder and related bleaching agents, hydrochloric acid.

SULPHUR AND SULPHURIC ACID INDUSTRIES: Mining and manufacturing of Sulphur, recovery of sulphur from polluting gases, sulphur trioxide and sulphuric acid.

ELECTROLYTIC AND ELECTROTHERMAL INDUSTRIES: Abrasives, Carborundum, Calcium Carbide, Aluminium and Magnesium.

**UNIT V: INDUSTRIAL CHEMICALS - II**

**9Hrs**

WATER IN INDUSTRY: Role of water treatment methods for industrial and domestic use, recovery of waste water, water conditioning.

MARINE CHEMICALS: Sodium chloride, By-products of common salt industry, value added product.

NUCLEAR INDUSTRIES: Production of uranium, thorium and zirconium from ores and minerals, separation of isotopes, waste disposal.

**Total No. of Hrs: 45**

**Text Books:**

1. Austin, G.T. Shreve, " *Chemical Process Industries* ", Fifth Edition, McGraw Hill International Book Co., Singapore, 1984.
2. Dryden, C.E., " *Outlines of Chemicals Technology* ", Edited and Revised by Gopala Rao, M. and Sittling, M., Second Edition, Affiliated East-West Press, 1993.

**References:**

1. Kent, J.A.(ed), Riggel, " *Hand book of Industrial Chemistry* ", Van Nostrand Reinhold, 1974.
2. "Chemtech 1-4 ", *Chemical Engineering Education Development Centre*, I.I.T., Madras 1975-1978.



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**DEPARTMENT OF CHEMICAL ENGINEERING**

**BCT13006**

**PROCESSES IN ORGANIC SYNTHESIS**

**3 0 0 3**

**OBJECTIVE:**

- Provides knowledge of steps of a synthesis involved in chemical reactions and conditions for each of these reactions must be designed to give an adequate yield of pure product

**UNIT I:**

Thermodynamic and kinetic concepts, nitration, amination by reduction, halogenation

**9Hrs**

**UNIT II:**

Sulfonation, amination by ammonolysis, oxidation

**9Hrs**

**UNIT III:**

Hydrogenation, hydrocarbon synthesis, hydroformylation

**9Hrs**

**UNIT IV:**

Esterification, hydrolysis, alkylation

**9Hrs**

**UNIT IV:**

Polymer chemistry, polymerisation

**9Hrs**

**Total No. of Hrs:45**

**Text Book:**

1. P.H.Grogins:Tata Mc GrawHill,Fifth edition : 1995



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**BCT13007**

**MECHANICAL OPERATIONS**

**3 0 0 3**

**OBJECTIVE:**

- To provide knowledge of particle size analysis, size reduction, storage of solids, particle mechanics, sedimentation and floatation, flow through packed beds, fluidization, filtration, fluid-solid conveying

**UNIT – I PARTICLE CHARACTERISTICS AND SIZE ANALYSIS**

**9Hrs**

General characteristics of solids, their behavior under different external forces, agglomeration, techniques for size analysis.

**UNIT – II SIZE REDUCTION**

**9Hrs**

Laws of size reduction, classification of equipment, methods of size reduction, disintegration, preparation of colloids.

**UNIT – III MECHANICAL SEPARATIONS**

**9Hrs**

Screening and Screening equipment, effectiveness of screens, gravity settling, sedimentation, thickening, centrifugal separation, impingement methods, industrial dust removing equipment with special reference to electrostatic and magnetic separators, heavy media separations, floatation.

**UNIT – IV FILTRATION, MIXING AND AGITATION**

**9Hrs**

Theory of filtration, Batch and continuous filters, centrifuges, membrane and ultra filtration. Equipment for blending and kneading, dispersion, power for agitation, correlations.

**UNIT – V STORAGE AND CONVEYING OF SOLIDS**

**9Hrs**

Conveyors, elevators, pneumatic conveying, Different methods for storage of solids.

**Total No. of Hrs: 45**

**Text Book:**

1. McCabe, W.L, Smith J.C and Harriot, P., " *UNIT Operations in Chemical Engineering* ", McGraw-Hill, Fourth Edition, 1984.

**References**

1. Coulson, J.M., Richardson, J.F., "*Chemical Engineering* ", Volume 2, Third Edition, Pergamon Press, 1977.



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**BMA13013**

**MATHEMATICS IV FOR CHEMICAL ENGINEERS**

**3 1 0 4**

**OBJECTIVE:**

- The aim of this course is to introduce the basic concepts of Probability, Design of Experiments and, Linear programming relevant to chemical Engg.

**UNIT I PROBABILITY AND RANDOM VARIABLE**

**12 Hrs**

Axioms of probability – Conditional probability – Total probability – Baye's Theorem – Random variable – Probability mass function – Probability density function – Properties – Moments (Definition and simple problems).

**UNIT II STANDARD DISTRIBUTIONS**

**12 Hrs**

Binomial – Poisson – Geometric – Uniform – Exponential – Normal distributions.

**UNIT III TESTING OF HYPOTHESIS**

**12 Hrs**

Tests of Significance – Large Sample Tests – Mean – Proportions – Small Sample Tests – t, F, Chi-square Tests: Independence of Attributes, Goodness of Fit.

**UNIT IV DESIGN OF EXPERIMENTS**

**12 Hrs**

Analysis of Variance – One way classification – Two way classification – Design of Experiments – Completely Randomized Block Design – Randomized Block Design – Latin Square Design.

**UNIT V LINEAR PROGRAMMING**

**12 Hrs**

Formulation of Linear Programming Problem – Graphical method – Simplex algorithm – Artificial variable – Big M Method – Two Phase method.

**Total No.ofhrs: 60**

**Text Books**

1. Singaravelu, *Probability and Random Processes*, Meenakshi Agency, (2008).
2. Gupta S.C., Kapoor V.K., *Fundamentals of Mathematical Statistics*, S.Chand & Co., (2007).
3. Veerarajan T., *Probability, Statistics and, Random Processes*, Tata McGraw Hill Publishing Co., (2008).

**References:**

1. Hamdy A. Taha, *Operations Research: An Introduction (9<sup>th</sup> ed.)*, Pearson, (2010).
2. Panneerselvam R., *Operations Research (2<sup>nd</sup> ed.)*, Prentice Hall of India, (2011).



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**BCT13L01**

**TECHNICAL ANALYSIS LAB**

**0 0 3 2**

**List of Experiments**

1. Oil Analysis: (3 experiments)
  - a) Acid value
  - b) Saponification value
  - c) Iodine value
  
2. Soap Analysis: (2 experiments)
  - a) Alkali Content
  - b) Fatty acid content of Soap
  
3. Estimation of purity of glycerol: by Dichromatic method
4. Analysis of water:  
Determination chlorine demand in water : Estimation of residual chlorine in water by Volumetric method
  
5. Cement Analysis (3 experiments)
  - a) Estimation of silica content
  - b) Estimation of calcium oxide content
  - c) Estimation of mixed oxide content
  
6. Fertilizer Analysis:  
Estimation of Nitrozen in Urea by Kjeldals method

**\* Minimum 10 experiments shall be offered.**



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**BEN13L01**                      **CAREER & CONFIDENCE BUILDING( SOFT SKILLS - I)**                      **0 0 0 2**

**OBJECTIVES:**

➤ **To Improve:**

1. Behavioural Patterns and Basic Etiquette
2. Value System
3. Inter Personal Skills
4. Behaving in Corporate Culture
5. Self Awareness / Confidence
6. Managing Self and Personality Styles including Body Language
7. International Culture / Cross Cultural Etiquette

**UNIT I :**

**6Hrs**

Creation of awareness of the top companies / different verticals / courses for improving skill set matrix, Industry expectations to enable them to prepare for their career - Development of positive frame of mind - Avoiding inhibitions - Creation of self awareness - Overcoming of inferiority/ superiority complex

**UNIT II :**

**6Hrs**

Selection of appropriate field vis-a-vis personality / interest to create awareness of existing industries, Preparation of Curriculum Vitae - Objectives, profiles vis-a-vis companies

**UNIT III :**

**6Hrs**

Group discussions - Do's and Don'ts - handling of Group discussions – What evaluators look for! Interpersonal relationships - with colleagues - clients - understanding one's own behaviour - perception by others - How to work with persons whose background, culture, language / work style different from one's, behaviour pattern in multi-national offices

**UNIT IV :**

**6Hrs**

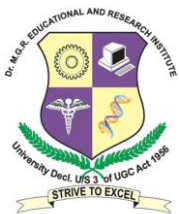
Interview - awareness of facing questions - Do's and Don'ts of personal interview / group interview, Enabling students prepare for different procedures / levels to enter into any company - books / websites to help for further preparation, Technical interview - how to prepare to face it, Undergoing employability skills test

**UNIT V :**

**6Hrs**

Entrepreneurship development - preparation for tests prior to the interview - Qualities and pre-requisites for launching a firm

**Total No. of Hrs: 30**



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**BCT13008**

**CHEMICAL PROCESS CALCULATIONS**

**3 0 0 3**

**OBJECTIVE:**

- This course brings together the concepts of engineering and economics for chemical plant design and optimization

**UNIT – I UNITS, DIMENSIONS AND GAS CALCULATIONS**

**9Hrs**

Basic and derived UNITS, use of model UNITS in calculations, Methods of expression, compositions of mixture and solutions. Ideal and real gas laws - Gas constant - calculations of pressure, volume and temperature using ideal gas law. Use of partial pressure and pure component volume in gas calculations, applications of real gas relationship in gas calculation.

**UNIT - II MATERIAL BALANCE**

**9Hrs**

Stoichiometric principles, Application of material balance to UNIT operations like distillation, evaporation, crystallisation, drying etc., - Material balance with chemical reaction - Limiting and excess reactants - recycle - bypass and purging - Unsteady state material balances.

**UNIT - III HUMIDITY AND SATURATION**

**9Hrs**

Calculation of absolute humidity, molal humidity, relative humidity and percentage humidity - Use of humidity in condensation and drying - Humidity chart, dew point.

**UNIT - IV FUELS AND COMBUSTION**

**9Hrs**

Determination of Composition by Orsat analysis of products of combustion of solid, liquid and gas fuels - Calculation of excess air from orsat technique, problems on sulphur and sulphur bearing compounds.

**UNIT - V THERMO PHYSICS AND THERMOCHEMISTRY**

**9Hrs**

Heat capacity of solids, liquids, gases and solutions, use of mean heat capacity in heat calculations, problems involving sensible heat and latent heats, evaluation of enthalpy. Standard heat of reaction, heats of formation, combustion, solution, mixing etc., calculation of standard heat of reaction - Effect of pressure and temperature on heat of reaction - Energy balance for systems with and without chemical reaction. - unsteady state energy balances.

**Total No of periods:45**

**Text Books:**

1. Bhatt, B.L., Vora, S.M., " *Stoichiometry* ", Tata McGraw-Hill, 1976.
2. Himmelblau, D.M., " *Basic Principles and Calculations in Chemical Engineering* ", EEE Sixth Edition, Prentice Hall Inc., 2003 (with CD containing programmes and problems).

**References**

1. *Process Calculation for Chemical Engineering*, Second Revised Edition, Chemical Engineering Education Development Centre, I.I.T., Madras, 1981.
2. *Process Calculations*, Venkataramani, V and Anantharaman, N, Prentice Hall of India Pvt. Ltd., 2003.



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**BCT13009**

**CHEMICAL ENGINEERING THERMODYNAMICS –I**

**3 0 0 3**

**OBJECTIVE:**

- To understand the theory and applications of classical thermodynamics, thermodynamic properties, equations of state, methods used to describe and predict phase equilibria

**UNIT – I**

**9Hrs**

Introduction – systems – surrounding – thermodynamic property – heat – work – energy forms

**UNIT - II**

**9Hrs**

First law of thermodynamics - batch systems – open systems – applications – chemical reactions

**UNIT - III**

**9Hrs**

Second law -carnot's principle – reversible – irreversible processes – entropy –criterion for reversible – irreversible – entropy balance

**UNIT - IV**

**9Hrs**

Heat engines – refrigeration – cycles.

**UNIT - V**

**9Hrs**

Fluids – state equations – ideal gas – actual gas equations – application.

**Total No of periods: 45**

**Text Books:**

1. Smith, J.M., and Van Ness, H.C., " Introduction to Chemical Engineering Thermodynamics ", Kogakushai 1976.
2. Narayanan K.V" A text book of chemical engineering thermodynamics" Prentice Hall of India pvt. Ltd 2001

**References**

1. Hougen, O.A., Watson, K.M., and Ragatz, R.A., " ChemicalProcess Principles Part II, Thermodynamics ", John Wiley 1970.
2. Dodge, B.F., " Chemical Engineering Thermodynamics ", McGraw-Hill, 1960.
3. Sandler, S.I., " Chemical and Engineering Thermodynamics 2nd edn. ", Wiley, 1989.
4. Kyle, B.G., " Chemical and Process Thermodynamics 2nd edn. ", Prentice Hall of India Pvt.Ltd., 1990.





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**BBT13033**

**CELL BIOLOGY**

**3 0 0 3**

**OBJECTIVE:**

- To provide knowledge of macromolecules and to understand the cellular components used to generate and utilize energy in cells

**UNIT I-INTRODUCTION:**

**9Hrs**

Introduction to cell-prokaryotic and eukaryotic cell, cellular organelles and their functions, cytoskeletal and plant and animal cells. cell division, mitosis and meiosis, Extra cellular matrix, cell cycle and molecules that control cell cycle.

**UNIT II- TRANSPORT ACROSS CELL MEMBRANES:**

**9Hrs**

Membrane structure and function-membrane models, transport across cell membrane, passive transport, active transport, ion pumps, co-transport, exocytosis and endocytosis. Entry of viruses and toxins into cells.

**UNIT III- RECEPTORS AND MODELS OF EXTRA CELLULAR SIGNALLING: 9Hrs**

Cell communication, cell signaling- reception, transduction and response, signal reception and initiation of transduction, signal transduction path way, cellular response to signals. Autocrine, Paracrine and Endocrine models of action.

**UNIT IV- SIGNAL TRANSDUCTION:**

**9Hrs**

Signal amplification, Different models of signal amplifications, Cyclic AMP, Role of inositol phosphates as messengers, biosynthesis of inositol triphosphates, cyclic GMP and proteins role in signal transduction, Calcium ion flux and its role in cell signalling, current models of signal amplification, Phosphorylation of protein Kinases.

**UNIT V-CELL CULTURE:**

**9Hrs**

Techniques for the propagation of prokaryotic and Eukaryotic cells. Cell line, generation of cell lines, maintenance of stock cells, Characterisation of cells, Immunocytochemistry, morphological analysis techniques, in cell culture, explant cultures primary cultures, contamination, Differentiation, Three Dimensional cultures, role of matrix in cell growth.

**Total No of periods: 45**

**Text Book:**

1. *Molecular cell biology* by Harvey Lodish, Arnold Berk, S Lawrence Zipursky, Paul Matsudaira, David Baltimore, and James Darnell. v. New York: W. H. Freeman; 2000. ISBN-10: 0-7167-3136-3.

**Reference:**

1. *Molecular Biology of the Cell: Reference Fifth Edition* by Bruce Alberts , Alexander Johnson , Julian Lewis , Martin Raff , Keith Roberts , Peter Walter.



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**BCT13010**

**CHEMICAL TECHNOLOGY II**

**3 0 0 3**

**OBJECTIVE:**

- To study process technologies of various organic and inorganic process industries.

**UNIT – I PULP AND PAPER INDUSTRIES**

**9Hrs**

Wood and Wood extracts – Wood Chemicals - Cellulose derivatives, Manufacture of pulp – different processes of pulping – Manufacture of paper – Manufacture of Boards

**UNIT– IISUGAR, STARCH INDUSTRIES AND OILS, FATS, SOAPS AND DETERGENT INDUSTRIES**

**9Hrs**

Raw and refined sugar by products of sugar industries, Starch and starch derivatives. Vegetable oils and animal fats, their nature, analysis and extraction methods, hydrogenation of oils, fatty acids and alcohols, waxes, soaps, synthetic detergents.

**UNIT – III PETROLEUM AND PETROCHEMICAL INDUSTRIES**

**9Hrs**

Petroleum refining, physical and chemical conversion products, lubricating oils, petrochemical precursors, methane, olefines, acetylenes and aromatics and products obtained from them by various UNIT processes.

**UNIT – IV RUBBER AND POLYMERS**

**9Hrs**

Monomers – Thermosetting and Thermoplastic materials – General properties and Applications of Resins – Polymerisation processes – different types - Natural rubber; Synthetic rubber such as SBR, NBR, CR - Fundamental methods of processing of synthetic Rubbers.

**UNIT - V SYNTHETIC FIBRE AND FILM INDUSTRIES**

**9Hrs**

Natural and synthetic fibres – properties of - Poly amides – manufacture of Nylon 6. 6. Polyesters Fibres – manufacturer of – Cellulosic Fibres – Viscose Rayon production manufacture of films - cellulose Acetate, PVC, Polyesters - polyethylene

**Total No of periods: 45**

**Text Books**

1. Austin, G.T., " *Shreve's Chemical Process Industries* ", Fifth Edition, McGraw-Hill International Book Co, Singapore, 1984.
2. Dryden, C.E., " *Outlines of Chemical Technology* ", Edited and Revised by Gopala Rao. M. and M.Sittig, Second edition, Affiliated East-West press, 1993.

**References**

1. Kent, J.A.(ed), " *Riggel's Hand Book of Industrial Chemistry* ", Van Nostrand Reinhold, 1974.
2. CHEMTECH 1-4, *Chemical Engineering Education Development Centre I.I.T., Madras 1975-78.*



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**BCT13011**

**FLUID MECHANICS**

**3 0 0 3**

**OBJECTIVE:**

- To understand basic concept of fluid flow and its application to chemical process industries including pipe flow, fluid machinery and agitation & mixing.

**UNIT- I INTRODUCTION**

**9Hrs**

Concept of fluid - the fluid as a continuum - properties of a fluid - density - viscosity - surface tension - heat capacity - vapour pressure.

**UNIT- II FLUID STATICS**

**9Hrs**

Application to manometry - Floatation - gravity settling - centrifugal separation - acceleration.

**UNIT- III FLOW OF FLUIDS**

**9Hrs**

Bernoulli's theorem and application - laminar flow - turbulent flow - pressure drop - Newtonian and non-newtonian flow.

**UNIT- IV COMPRESSIBLE FLUID FLOW**

**9Hrs**

Mach no - nozzle flow - flow of fluid through packed bed - fluidization.

**UNIT- V INDUSTRIAL PIPING**

**9Hrs**

Valves - fluid moving machinery - pumps - characteristics of centrifugal pump - other types of pumps - compressors - work - blowers of pumps

**Total No of periods:45**

**Text Books**

1. Noel de Nevers, " Fluid Mechanics for Chemical Engineers ", Second Edition, McGraw-Hill, 1991.
2. McCabe, W.L, Smith J.C and Harriot .P., " UNIT Operations in Chemical Engineering ", McGraw-Hill, Sixth Edition 2000.

**References**

1. Chemical engineering hand book by Perry.
2. White, F.M., " *Fluid Mechanics* ", 4<sup>th</sup> Edition, McGraw-Hill Inc., 1999.



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**BMA13016**

**MATHEMATICS V FOR CHEMICAL ENGINEERS**

**3 1 0 4**

**OBJECTIVE:**

- The aim of this course is to introduce the basic concepts of Numerical methods like Interpolation, Numerical differentiation, Numerical integration and, Linear programming relevant to chemical Engg.

**UNIT I TRANSPORTATION AND ASSIGNMENT 12Hrs**

Formulation of Transportation problem – North West corner method – Least cost method – Vogel’s approximation method – Optimality test – MODI method – Degeneracy – Assignment problem: Hungarian method – Travelling salesman problem.

**UNIT II INTERPOLATION 12Hrs**

Newton forward and backward differences – Central differences – Stirling’s and Bessel’s formulae – Interpolation with Newton’s divided differences – Lagrange’s method.

**UNIT III NUMERICAL DIFFERENTIATION AND INTEGRATION 12Hrs**

Numerical differentiation with interpolation polynomials – Numerical integration by Trapezoidal and Simpson’s (both 1/3<sup>rd</sup> & 3/8<sup>th</sup>) rules – Two and three point Gaussian Quadrature formulae – Double integrals using Trapezoidal and Simpson’s rules.

**UNIT IV NUMERICAL SOLUTIONS OF ORDINARY DIFFERENTIAL EQUATIONS 12Hrs**

Single step methods – Taylor’s series – Euler & Modified Euler method – RungeKutta method of fourth order for first & second order differential equations – Multi step methods – Milne’s predictor-corrector method – Adam-Bashforth’s predictor-corrector method.

**UNIT V NUMERICAL SOLUTIONS OF PARTIAL DIFFERENTIAL EQUATIONS 12 Hrs**

Finite difference solutions for one dimensional heat equation (both implicit & explicit) – Bender-Schmidt method – Crank-Nicolson method – One dimensional wave equation – Two dimensional Laplace and Poisson equations – Liebmann’s method.

**Total No.ofhrs: 60**

**Text Books:**

1. Veerarajan T., *Numerical Methods*, Tata McGraw Hill Publishing Co., (2005).
2. Sastry S.S., *Introductory Methods of Numerical Analysis*, Prentice Hall of India, (2003).

**References:**

1. Hamdy A. Taha, *Operations Research: An Introduction (9<sup>th</sup> ed.)*, Pearson, (2010).
2. Panneerselvam R., *Operations Research (2<sup>nd</sup> ed.)*, Prentice Hall of India, (2011).



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**BBT13L21**

**BIOCHEMISTRY LAB**

**0 0 3 2**

1. Buffer Preparation.
2. Qualitative analysis of Carbohydrate

- a. Monosaccharide
- b. Disaccharide

c. Polysaccharide

3. Qualitative analysis of Protein

- a. Albumin
- b. Peptone
- c. Casein

4. Estimation of Carbohydrate by Benedict's method.
5. Estimation of Protein by Lowry's method.
6. Isolation of Protein from Milk.
7. Isolation of Starch from Potato.
8. Isolation of Cholesterol from Egg Yolk.
9. Paper Chromatography.
10. Thin layer Chromatography.

**Reference:**

1. Experimental Biochemistry by Beedu Sashidhar Rao & Vijay Deshpande.



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**BCT13L02**

**CHEMICAL ENGINEERING LAB-I**

**0 0 3 2**

**A) MECHANICAL OPERATIONS**

**List of Experiments \***

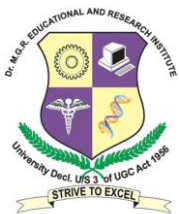
1. Jaw crusher
2. Crushing rolls
3. Ball mill
4. Size analysis by sieving
5. Size analysis by sub-sieving
6. Filter press
7. Leaf filter
8. Cyclone separator
9. Sedimentation
10. Elutriator
11. Rotary Drum filter
12. Effectiveness of screens

**B) FLUID MECHANICS**

**List of Experiments \***

1. Calibration of constant and variable Head meters
2. Calibration of Weirs
3. Drag reduction studies
4. Flow through straight pipe
5. Flow through Vertical concentric pipe
6. Pressure drop studies in packed column
7. Fluidisation
8. Open drum orifice and draining time
9. Flow through helical coil and spiral
10. Characteristic curves of centrifugal pump
11. Viscosity measurement of non Newtonian fluids
12. Flow of air thro' orifice using Aircompressor

**\* Minimum 10 experiments shall be offered.**



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**BEN13L02**

**QUALITATIVE AND QUANTITATIVE SKILLS (SOFT SKILLS-II)**

**0 0 0 2**

**PURPOSE**

The purpose of this course is to build confidence and inculcate various Soft skills and to help Students to identify and achieve their personal potential at the end of this training program the participant will be able to, explain the concept of problem solving

- Outline the basic steps in problem solving
- List out the key elements
- Explain the use of tools and techniques in problem solving
- Discuss the personality types and problem solving techniques.
- By adapting different thinking styles in group and lean environment.
- Recognizing and removing barriers to thinking in challenging situations.
- Make better decision through critical thinking and creative problem solving.

**METHODOLOGY**

The entire program is designed in such a way that every student will participate in the class room activities. The activities are planned to bring out the skills and talents of the students which they will be employing during various occasions in their real life.

1. Group activities + individual activities
2. Collaborative learning
3. Interactive sessions
4. Ensure Participation
5. Empirical Learning

**UNIT I :**

Self Introduction- Narration – Current News Update – Numbers – Height & Distance – Square & Cube Roots

**UNIT II :**

Current Tech Update – Verbal Aptitude Test 1 – GD – 1 Odd man out series – Permutation & Combination – Problems on ages

**UNIT III :**

GD –II – Resume Writing – Mock Interview I / reading comprehension

**UNIT IV :**

Mock Interview II / reading comprehension – Mock Interview III / reading comprehension – GD – III – Ratio & Proportion – Clocks – H.C.F. & L.C.M

**UNIT V :**

GD – IV – Verbal Aptitude Test II – Review – Partnership – Puzzles – Test

**Total No. of Hrs: 30**

**REFERENCES**

1. Pushplata, Sanjay Kumar (2007) *Communicate or Collapse: A Handbook of Effective Public Speaking Group Discussions and Interview*, Prentice – Hall, Delhi
2. Thorpe, Edgar (2003) *Course in Mental Ability and Quantitative Aptitude*, TMHI
3. Thorpe, Edgar (2003) *Test of Reasoning*, Tata McGraw-Hill
4. Prasad, H.M (2001) *How to prepare for Group Discussion and Interview*, TMH
5. Career Press Editors (2003) *101 Great Resumes*, Jaico Publishing House
6. Agarwal, R. S.(2004) *A Modern Approach to Verbal and Non- Verbal Reasoning*, S. Chand & Co.
7. Mishra Sunita and Muralikrishna (2004) *Communication Skills for Engineers* (1<sup>st</sup>ed.) Pearson







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**BCT13013**

**CHEMICAL REACTION ENGINEERING-I**

**3 0 0 3**

**OBJECTIVES:**

- To apply knowledge from calculus, differential equation, thermodynamics, general chemistry, and material and energy balances to solve reactor design problems.
- To simulate several types of reactors in order to choose the most appropriate reactor for a given need.
- To design chemical reactors with associated cooling/heating equipment

**UNIT - I REACTION KINETICS**

**9Hrs**

Law of mass action, rate equation, elementary, non-elementary reactions and their mechanisms, theories of reaction rate and temperature dependency, analysis of experimental reactor data, evaluation of rate equation, integral and differential analysis for constant variable volume system, fitting of data complex reaction mechanism.

**UNIT - II IDEAL REACTORS**

**9Hrs**

Design for homogeneous systems, batch, stirred tank and tubular flow reactor, design of reactors for multiple reactions, combination reactor system, size comparison of reactors.

**UNIT - III CHOICE OF REACTORS**

**9Hrs**

Factors affecting choice, optimum yield and conversion, selectivity, reactivity and yield problems, consecutive, parallel and mixed reactions, recycle.

**UNIT - IV HEAT EFFECTS IN REACTORS**

**9Hrs**

Isothermal and nonisothermal homogeneous reactor systems, adiabatic reactors, rates of heat exchanges for different reactors, design for constant rate heat input and constant heat transfer coefficient, operation, batch and continuous reactors, optimum temperature progression.

**UNIT - V REACTOR STABILITY AND REACTION EQUILIBRIA**

**9Hrs**

Criteria for stability of reactors, limit cycles and oscillating reaction, parameter sensitivity. Equilibrium in chemically reactive systems, evaluation of reaction equilibrium constant, effect of temperature on equilibrium, application to system involving gaseous components, computation of equilibrium composition.

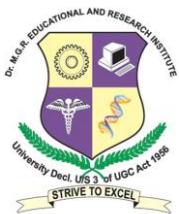
**Total No of Hrs: 45**

**Text Books:**

1. Smith.J.M., "*Chemical Engineering Kinetics* ", McGraw-Hill Third Edition.

**References:**

2. Levenspiel.O, "*Chemical Reaction Engineering* ", John Wiley, Second Edition.



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**BCT13014**

**MASS TRANSFER-I**

**3 0 0 3**

**OBJECTIVE:**

- The purpose of this course is to introduce the undergraduate students with the most important separation equipments in the process industry.
- To provide proper understanding of UNIT operations.

**UNIT - I            DIFFUSION**

**9Hrs**

Molecular and eddy diffusion in gases and liquids, steady state diffusion under stagnant and laminar flow conditions Diffusivity measurement and prediction, multicomponent diffusion, diffusion in solids and its applications.

**UNIT - II            MASS TRANSFER COEFFICIENTS**

**9Hrs**

Concept of mass transfer coefficients, mass transfer under laminar and turbulent flow past solids, boundary layers, mass transfer at fluids surfaces correlation of mass transfer coefficients,  $JD$ ,  $HTU$ , and  $NTU$  concepts, theories of mass transfer and their applications, interphase mass transfer and overall mass transfer coefficients in binary and multicomponent systems, application to gas-liquid and liquid-liquid systems.

**UNIT - III            HUMIDIFICATION AND AIR CONDITIONING**

**9Hrs**

Basic concepts, psychrometric chart construction, Humidification and dehumidification operations, design calculations, cooling tower principle and operation, types of equipment, design calculation.

**UNIT - IV            DRYING**

**9Hrs**

Theory and mechanism of drying, drying characteristics of materials, batch and continuous drying, calculation for continuous drying, drying equipment, design and performance of various drying equipments.

**UNIT - V            CRYSTALLISATION**

**9Hrs**

Nuclei formation and crystal growth, theory of crystallisation, growth coefficients and the factors affecting these in crystallisation, batch and continuous industrial crystallisers, principle of design of equipment.

**Total No of periods: 45**

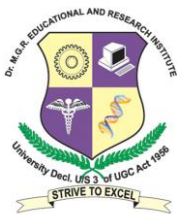
**Text Books**

1. Treybal, R.E., " *Mass Transfer Operations* ", McGraw-Hill Kogakusha, 1980.
2. McCabe, W.L., Smith, J.C., and Harriot, P., " *UNIT Operations in Chemical Engineering* ", McGraw-Hill Edn, 1993.

**References**

1. Roman Zarzytci, Andrzej Chacuk, " *Absorption: Fundamentals and Application* ", Pergamon Press, 1993.
2. Skelland, A.H.P., " *Diffusional Mass Transfer* ", Krieger, Malabar FL (1985). Strigle (jr), R.F., " *Packed Tower Design and Applications* ", Second Edition, Gulf Publishing Company, USA., 1994.
3. Coulson, J.M., Richardson, J.F., " *Chemical Engineering* " Vol. I, Pergamon Press, 1977.
4. Foust, A.S., Wenzel, L.A., Clump, C.W., Naus, L., and Anderson, L.B., " *Principles of UNIT Operations* ", Second Edition, Wiley, 1980.





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**BMA13019      SPECIAL FUNCTIONS, DIFFERENCE EQUATIONS  
AND Z-TRANSFORMS**

**3 1 0 4**

**OBJECTIVE:**

- The aim of this course is to introduce the concepts of Bessel's & Legendre's equations and Z-Transforms to chemical students

**UNIT – I IMPROPER INTEGRALS AND SERIES SOLUTIONS**

**9Hrs**

Improper integrals-Gamma and Beta functions, Series solutions-Ordinary point, regular singular point of second order linear ordinary differential equation, series solution to a second order linear ordinary differential equation about an ordinary point and a regular singular point.

**UNIT – II BESSEL FUNCTIONS**

**9Hrs**

Bessel's equation, Bessel functions, Recurrence relations, Orthogonality property, Generating function, Equations reducible to Bessel's equation, Modified Bessel functions. Applications to boundary value problems.

**UNIT – III LEGENDRE POLYNOMIALS**

**9Hrs**

Legendre's equation, Legendre Polynomials, Rodrigue's formula generating function, recurrence relations, orthogonality property, Applications to boundary value problems.

**UNIT IV HERMITE AND LAGUERRE POLYNOMIALS**

**9Hrs**

Hermite and Laguerre equations and their solutions-Polynomials, Rodrigue's formula, generating functions, recurrence relations, orthogonality property.

**UNIT V DIFFERENCE EQUATIONS AND Z-TRANSFORM**

**9Hrs**

Linear difference equation with constant coefficients, elementary properties of z transform applications of z transform, application of z transform to difference equations.

**Total No of Hrs: 45**

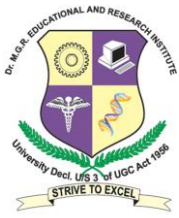
**Text Book**

1. Andrews.L.A., " Special Function for Scientist and Engineers ", McGraw-Hill, 1992.

**References**

1. Narayanan, S.Manicavachagam Pillay and Ramanaiah.G, " *Advanced Mathematics for Engineering Students* " Vol II and III S.Viswanathan Printers Private Limited, Madras, 1985.
2. Grewal, B.S., " *Higher Engineering Mathematics* ", Khanna Publishers, Delhi, 1989.
3. Andrews, L.C., and Shivamoggi, B.K., " *Integral Transforms for Engineers and applied Mathematicians* ", MacMillan, New York, 1988.





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**BCT13L03**

**MATLAB PROGRAMMING FUNDAMENTALS**

**0 0 3 2**

Introduction - Data types - Common system commands and Mathematical operators.

**ARRAYS AND STRUCTURES**

Handling of arrays - Cell arrays and structures - Matrices - Strings.

**CONTROL STRUCTURES**

M-File Scripts - Input/Output function - conditional control statements - Loop control statements.

**FUNCTIONS**

Workspace - Arguments - Variables - Nested functions.

**FILE I/O HANDLING MATLAB**

fopen and fclose function - fprintf and fscanf function - Writing, Reading and Loading data.

**LIST OF EXERCISES**

Writing Programs and Sub Programs using MATLAB for Solving

- Quadratic Equations
- Linear Algebraic Equations - Gauss Seidel, Gauss Jordan, Gauss Elimination
- Jacobi Methods, Cramer's Rule- Multiple Effect Evaporator and Similar Problems
- Polynomial root finding Techniques- Newton Raphson Method, Secant Method
- Regula Falsi Method, Power Method to find dominant Eigen Value
- Phase Equilibrium Problems, Equation of State Determination of Bubble and Dew Point Differential Distillation- Minimum Reflux Ratio Calculations
- Numerical Integration-Trapezoidal Rule, Simpsons 1/3 and 3/8 rule, Weddles Rule
- Mass Transfer Problems- Rayleigh's Equation, NTU in Absorption, Determination of Drying time from batch drying data- Determination of reactor size
- Milne's Method, Laplace Equation, Predictor-Corrector Methods
- Heat conduction problems and chemical reaction Engineering problems

**TEXT BOOK**

1. Kirani Singh Y. and Chaudhuri B.B., *MATLAB Programming*, Prentice-Hall of India, 2007

**REFERENCES**

1. Etter, Delores M., *Engineering Problem solving with MATLAB*, Prentice-Hall, 1993
2. Lindfield, George and John Penny, *Numerical Methods Using MATLAB*, Prentice-Hall, 2000



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**BCT13L04**

**CHEMICAL ENGINEERING LAB-II**

**0 0 3 2**

**A) HEAT TRANSFER**

**List of Experiments**

1. Thermal Conductivity measurement
2. Emissivity measurement
3. Stefan-Boltzmann Constant verification
4. Thermocouple calibration
5. Natural Convection
6. Forced Convection
7. Parallel Flow Double Pipe Heat Exchanger
8. Counter Flow Double Pipe Heat Exchanger

**B) MASS TRANSFER LAB**

**List of Experiments**

1. Simple distillation
2. Steam distillation
3. Packed column distillation
4. Bubble cap distillation
5. Diffusivity measurements
6. Liquid-liquid extraction
7. Vacuum Dryer
8. Tray dryer
9. RDC
10. Adsorption
11. Surface Evaporation

**\* Minimum 10 experiments shall be offered.**



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**BCT13017**

**PROCESS CONTROL AND DYNAMICS**

**3 0 0 3**

**OBJECTIVE:**

- To gain the knowledge of process instruments.
- To understand dynamic modeling of a physical process using first principles.
- To design various control schemes, and to apply the control system in various processes.

**UNIT- I**

**9Hrs**

Laplace transformation, transform of standard functions, derivatives and integrals, inversion, theorems in Laplace transformation, application. Open-loop systems, first order systems and their transient response for standard input functions, first order systems in series, linearization and its application in process control, second order systems and their dynamics, transfer function for chemical reactors and dynamics.

**UNIT- II**

**9Hrs**

Closed loop control systems, development of block diagram for feed-back control systems, servo and regulator problems, Transfer function for controllers and final control element, principles of pneumatic and electronic controllers, transportation lag, transient response of closed-loop control systems and their stability.

**UNIT- III**

**9Hrs**

Introduction to frequency response of closed-loop systems, control system design by frequency, Bode diagram, stability criterion, Nyquist diagram; Tuning of controller settings.

**UNIT- IV**

**9Hrs**

Controller mechanism, introduction to advanced control systems, cascade control, feed forward control, control of distillation towers and heat exchangers, introduction to microprocessors and computer control of chemical processes.

**UNIT- V**

**9Hrs**

Principles of measurements and classification of process control instruments, measurements of temperature, pressure, fluid flow, liquid weight and weight flow rate, viscosity and consistency,  $p^H$ , concentration, electrical and thermal conductivity, humidity of gases, composition by physical and chemical properties and spectroscopy.

**Total No of Hrs: 45**

**Text Books**

1. Patranabis .D, *Principles of Process control*, II edition, Tata McGraw Hill Publishing Co Ltd., 1981.
2. Peter Harriott, *Process control*, Tata McGraw Hill Publishing Co., Reprint 2004.

**References**

1. Thomas, E. Marlin, *Process Control*, 2<sup>nd</sup> Edn, McGraw Hills International Edn 2000. George Stephanopoulos, *Chemical Process Control*, Prentice Hall of India 2003.
2. Norman H. CEAGLSKE, *Automatic process control for chemical engineers*, John Wiley & Sons, Japan





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**BMG13006      PROCESS ECONOMICS AND INDUSTRIAL MANAGEMENT      3 0 0 3**

**OBJECTIVES:**

- Gives an idea about the process sequences that thrive to get quality raw material to arrive at lowest final product

**UNIT - I      PRINCIPLES OF MANAGEMENT AND ORGANISATION      9Hrs**

Planning, organisation, staffing, coordination, directing, controlling, communicating, organisation as a process and a structure; types of organisations.

**UNIT - II      PRODUCTION AND MANAGEMENT      9Hrs**

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

**UNIT - III      INTEREST, INVESTMENT COSTS AND COST ESTIMATION 9Hrs**

Time Value of money; capital costs and depreciation, estimation of capital cost, manufacturing costs and working capital, invested capital and profitability. Estimation of project profitability, sensitivity analysis; investment alternatives; replacement policy; forecasting sales; inflation and its impact.

**UNIT - IV      ANNUAL REPORTS AND ANALYSIS OF PERFORMANCE 9Hrs**

Principles of accounting; balance sheet; income statement; financial ratios; analysis of performance and growth. Different UNIT operations with single and multiple variables.

**UNIT - V      QUALITY CONTROL      9Hrs**

Elements of quality control, role of control charts in production and quality control. Final product Quality control.

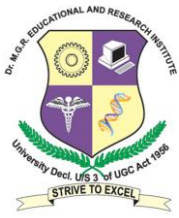
**Total No of Hrs: 45**

**Text Book**

1. Holand, F.A., Watson, F.A and Wilkinson, J.K., "*Introduction to process Economics* ", John Wiley, 1974.
2. Sumanth, D.T., "*Production Engineering and Management* ", McGraw-Hill, 1984.
3. Shukla, M.C., "*Business Organisation and Management* ", Sultan Chand and Sons, 1975.

**References**

1. Davis, G.S, "*Chemical Engineering Economics and Decision Analysis* ", CENDC, I.I.T., Madras, 1981.



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**BCT13018**

**CHEMICAL REACTION ENGINEERING - II**

**3 0 0 3**

**OBJECTIVE:**

- To apply the knowledge of material energy balances, mass transfer and chemical reaction engineering for solving problems involving heterogeneous reaction systems.
- To understand and apply the principles of non-ideal flow in the design of reactors.

**UNIT - I NON-IDEAL REACTORS**

**9Hrs**

The residence time distribution as a factor performance; residence time functions and relationship between them in reactor; basic models for non-ideal flow; conversion in non-ideal reactors.

**UNIT - II HETEROGENEOUS PROCESS AND SOLID CATALYSIS**

**9Hrs**

Rate equations for heterogeneous reactions nature of catalysis, adsorption isothermal and rates of adsorption, desorption and surface reaction analysis of rate equation and rate controlling steps, surface area and pore-volume distribution, catalyst preparation.

**UNIT - III GAS-SOLID CATALYTIC REACTORS**

**9Hrs**

Diffusion within catalyst particle effective thermal conductivity mass and heat transfer within catalyst pellets; effective factors, Thiele Modulus, fixed bed reactors.

**UNIT - IV GAS-SOLID NON-CATALYTIC REACTORS**

**9Hrs**

Models for explaining the kinetics; volume and surface models; controlling resistances and rate controlling steps; time for complete conversion for single and mixed sizes, fluidised and static reactors.

**UNIV - V GAS-LIQUID REACTIONS**

**9Hrs**

Absorption combined with chemical reactions; mass transfer coefficients and kinetic constants; application of film penetration and surface renewal theories; Hatta number and enhancement factor for first order reaction, tower reactor design.

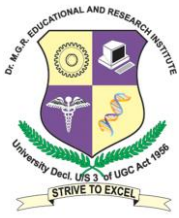
**Total No of Hrs: 45**

**Text Book**

1. Fogler. H.S., "*Elements of Chemical reaction engineering*" 3<sup>rd</sup> edition, Prentice Hall of India Pvt. Ltd., 1999 (Indians Reprint 2003)

**References**

1. Levenspiel, O; "*Chemical Reaction Engineering*", 2nd Edition, John Wiley, 1972.
2. Smith J.M., "*Chemical Engineering Kinetics*", 3rd edition, McGraw-Hill, New York, 1981.



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**BCT13019**

**MASS TRANSFER-II**

**3 0 0 3**

**OBJECTIVE:**

- To teach the students different separation techniques and also to know the design of a distillation column.
- To understand the calculations involved in liquid-liquid extraction and solid liquid extraction.

**UNIT - I            ABSORPTION**

**9Hrs**

Equilibrium and operating line concept in absorption calculations; types of contactors, design of packed and plate type absorbers; Operating characteristics of stagewise and differential contactors, concepts of NTU, HTU and overall volumetric mass transfer coefficients; multicomponent absorption; mechanism and model of absorption with chemical reaction; thermal effects in absorption process.

**UNIT - II            DISTILLATION**

**9Hrs**

Vapour-liquid equilibria, Raoult's law and deviations from ideality, methods of distillation; fractionation of binary and multicomponent system; design calculations by McCabe-Thiele and Ponchon-Savarit, methods; continuous contact distillation tower (packed tower) design; extractive and azeotropic; distillation low pressure distillation; steam distillation.

**UNIT - III          LIQUID-LIQUID EXTRACTION**

**9Hrs**

Equilibrium in ternary systems; equilibrium stagewise contact calculations for batch and continuous extractors, differential contact extraction equipment - spray, packed and mechanically agitated contactors and their design calculations; pulsed extractors, centrifugal extractors.

**UNIT - IV          SOLID-LIQUID EXTRACTION (LEACHING)**

**6Hrs**

Solid-liquid equilibria; leaching equipment-batch and continuous types; calculation of number of stages.

**UNIT - V          ADSORPTION, ION EXCHANGE AND MISCELLANEOUS  
SEPARATION PROCESSES**

**6Hrs**

Theories of adsorption of gases and liquids; industrial adsorbents, adsorption equipment for batch and continuous operation; design calculation of ion-exchange resins; principle of ion-exchange; industrial equipment. Membrane separation process; solid and liquid membranes; concept of osmosis; reverse osmosis; electrodialysis; their applications; foam separation process; Thermal and sweep diffusion process.

**Total No. of Hrs: 45**

**Text Books**

1. R.E. Treybal, " *Mass Transfer Operations* ", McGraw-Hill, Kogakusha, 1980.
2. W.L. McCabe, J.C. Smith, and Harriot. P., " *UNIT Operations of Chemical Engineering* ", sixth edition McGraw-Hill. International Edition, 2001.

**References**

1. C. Judson King " *Separation Processes* ", Tata McGraw-Hill 1974.
2. A.H.P. Skelland, " *Diffusional Mass Transfer* ", Krieger, Malapur, FL (1985).
3. Roman Zarfky and Andrzej Chacuk, " *Absorption Fundamentals and Applications*", Pergamon Press, 1993.
4. P. Wankat " *Equilibrium Stage Separations* ", Prentice Hall, 1993.
5. R.F. Strigle (jr), *Packed Tower Design and Application*, 2nd Edn Gulf Publishing company U.S.A. 1994.



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**BBT13034**

**BIOPROCESS PRINCIPLES**

**3 0 0 3**

**OBJECTIVE:**

- To provide broader aspect of bio process calculations, basic principles of bioprocess operations, medium design optimization and bioreactor handling

**UNIT - I                    OVERVIEW OF FERMENTATION PROCESSES                    9Hrs**

Overview of fermentation industry, general requirements of fermentation processes, basic configuration of fermentor and ancillaries, main parameters to be monitored and controlled in fermentation processes.

**UNIT - II                    RAW MATERIALS AND MEDIA DESIGN                    9Hrs**  
**FOR FERMENTATION PROCESS**

Criteria for good medium, medium requirements for fermentation processes, carbon, nitrogen, minerals, vitamins and other complex nutrients, oxygen requirements, medium formulation of optimal growth and product formation, examples of simple and complex media, design of various commercial media for industrial fermentations – medium optimization methods

**UNIT - III                    STERILIZATION KINETICS                    9Hrs**

Thermal death kinetics of microorganisms, batch and continuous heat sterilization of liquid media, filter sterilization of liquid media, air sterilization and design of sterilization equipment - batch and continuous.

**UNIT - IV                    METABOLIC STOICHIOMETRY AND ENERGETICS   9Hrs**

Stoichiometry of cell growth and product formation, elemental balances, degrees of reduction of substrate and biomass, available electron balances, yield coefficients of biomass and product formation, maintenance coefficients energetic analysis of microbial growth and product formation, oxygen consumption and heat evolution in aerobic cultures, thermodynamic efficiency of growth.

**UNIT - V                    KINETICS OF MICROBIAL GROWTH AND                    9Hrs**  
**PRODUCT FORMATION**

Modes of operation - batch, fed batch and continuous cultivation. Simple unstructured kinetic models for microbial growth, Monod model, growth of filamentous organisms, product formation kinetics - leudeking-piret models, substrate and product inhibition on cell growth and product formation.

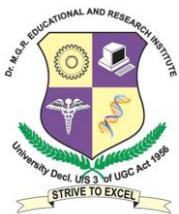
**Total No. of Hrs: 45**

**Text Books:**

1. Bailey and Ollis, " *Biochemical Engineering Fundamentals*", McGraw Hill (2nd Ed.), 1986.
2. Shule and Kargi, " *Bioprocess Engineering* ", Prentice Hall, 1992.

**References:**

1. Pauline Doran, *Bioprocess Engineering Calculation*, Blackwell Scientific Publications.
2. Peter F. Stanbury, Stephen J. Hall & A. Whitaker, *Principles of Fermentation Technology*, Science & Technology Books.
3. Harvey W. Blanch, Douglas S. Clark, *Biochemical Engineering*, Marcel Dekker, Inc



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**BCT13020**

**TRANSPORT PHENOMENA**

**3 1 0 4**

**OBJECTIVE:**

- This course will provide the fundamentals to solve real life problems involving transports of momentum, energy and mass in biological, mechanical and chemical systems using a unified approach.

**UNIT – I PHILOSOPHY AND FUNDAMENTALS OF TRANSPORT PHENOMENA**

**12Hrs**

Importance of transport phenomena; analogous nature of transfer process; basic concepts, conservation laws; continuous concept, field, reference frames, substantial derivative and boundary conditions; methods of analysis; differential, integral and experimental methods.

**UNIT – II TRANSPORT BY MOLECULAR MOTION**

**12Hrs**

Phenomenological laws of transport properties, Newtonian and non Newtonian fluids; rheological models; theories of transport properties of gases and liquids; effect of pressure and temperature.

**UNIT - III ONE DIMENSIONAL TRANSPORT IN LAMINAR FLOW  
(SHELL BALANCE)**

**12Hrs**

General method of shell balance approach to transfer problems; Choosing the shape of the shell; most common boundary conditions; momentum flux and velocity distribution for flow of Newtonian and non-newtonian fluids in pipes for flow of Newtonian fluids in planes, slits and annulus heat flux and temperature distribution for heat sources such as electrical, nuclear viscous and chemical; forced and free convection; mass flux and concentration profile for diffusion in stagnant gas, systems involving reaction and forced convection.

**UNIT – IV EQUATIONS OF CHANGE AND THEIR APPLICATIONS**

**12Hrs**

Conservation laws and equations of change; Development of equations of continuity motion and energy in single multicomponents systems in rectangular co-ordinates and the forms in curvilinear co-ordinates; simplified forms of equations for special cases, solutions of momentum mass and heat transfer problems discussed under shell balance by applications of equation of change, scale factors; applications in scale-up

**UNIT - V TRANSPORT IN TURBULENT AND BOUNDARY LAYER FLOW  
ANALOGIES BETWEEN TRANSPORT PROCESSES**

**12Hrs**

Turbulents phenomena; phenomenological relations for transfer fluxes; time smoothed equations of change and their applications for turbulent flow in pipes; boundary layer theory; laminar and turbulent hydrodynamics thermal and concentration boundary layer and their thicknesses; analysis of flow over flat surface. ANALOGIES BETWEEN TRANSPORT PROCESSES: Importance of analogy; development and applications of analogies between momentum and mass transfer; Reynolds, Prandtl, Von Karman and Colburn analogies.

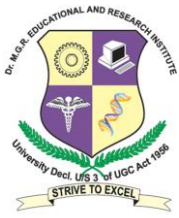
**Total No of Hrs:60**

**Text Book**

1. R.B. Bird, W.E. Stewart and E.W. Lightfoot, “*Transport Phenomena*”, John Wiley, 1978
2. Robert, S Brodkey, Harry C. Hershey, “*Transport Phenomena*”, McGraw-Hill International Edn 1988.

**Reference**

1. L.S. Sissom, and D.R. Pitts, “*Elements of Transport Phenomena*”, McGraw-Hill, New York, 1972.
2. R.W. Fahien, “*Elementary Transport Phenomena*”, McGraw-Hill, New York, 1983.
3. J.R. Welty, R.W. Wilson, and C.W. Wicks, “*Fundamentals of Momentum Heat and Mass Transfer*”, 2<sup>nd</sup> Edn. John Wiley, New York, 1973.



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**BCT13L05 CHEMICAL PROCESS EQUIPMENT DESIGN & DRAWING WITH SIMULATION**

**0 0 3 2**

All Tables/Chemical Engineers' Handbook/Data Books/Graph Sheets are permitted during the Examination.)

1. Fundamental principles, equations, general design and drawing considerations of cooling towers, evaporators and driers.
2. Heat exchangers, condensers and reboilers.
3. Distillation columns- sieve tray, and bubble cap tray columns and packed column.
4. Equipments for absorption and adsorption of gases.
5. Equipments for liquid-liquid extraction and solid-liquid extraction.



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**BCT13L06      CHEMICAL ENGINEERING LAB-III**

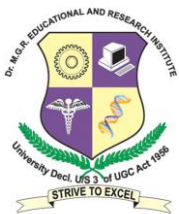
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**CHEMICAL REACTION ENGINEERING**

**List of Experiments \***

1. Kinetic studies in a batch reactor
2. Kinetics in a plug flow reactor
3. Kinetics in a PFR followed by a CSTR
4. RTD in a PFR
5. RTD in a packed bed
6. RTD in CSTRs in series
7. Combined Reactor
8. Packed Bed Reactor
9. Adiabatic Reactor
10. Catalytic Reactor
11. Kinetics in Semi-batch Reactor

**\*Minimum 10 experiments shall be offered.**



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**BMG13002**

**TOTAL QUALITY MANAGEMENT**

**3 0 0 3**

**OBJECTIVE:**

- To introduce the main principles of business and social excellence.
- To generate knowledge and skills of students to use models and quality management methodology for the implementation of total quality management in any sphere of business and public sector.

**UNIT – I INTRODUCTION 9Hrs**

Definition of Quality, Dimensions of Quality, Quality Planning, Quality costs - Analysis Techniques for Quality Costs, Basic concepts of Total Quality Management, Historical Review, Principles of TQM, Leadership – Concepts, Role of Senior Management, Quality Council, Quality Statements, Strategic Planning, Deming Philosophy, Barriers to TQM Implementation.

**UNIT – II TQM PRINCIPLES 9Hrs**

Customer satisfaction – Customer Perception of Quality, Customer Complaints, Service Quality, Customer Retention, Employee Involvement – Motivation, Empowerment, Teams, Recognition and Reward, Performance Appraisal, Benefits, Continuous Process Improvement – Juran Trilogy, PDSA Cycle, 5S, Kaizen, Supplier Partnership – Partnering, sourcing, Supplier Selection, Supplier Rating, Relationship Development, Performance Measures – Basic Concepts, Strategy, Performance Measure.

**UNIT – III STATISTICAL PROCESS CONTROL (SPC) 9Hrs**

The seven tools of quality, Statistical Fundamentals – Measures of central Tendency and Dispersion, Population and Sample, Normal Curve, Control Charts for variables and attributes, Process capability, Concept of six sigma, New seven Management tools.

**UNIT – IV TQM Tools 9Hrs**

Benchmarking – Reasons to Benchmark, Benchmarking Process, Quality Function Deployment (QFD) – House of Quality, QFD Process, Benefits, Taguchi Quality Loss Function, Total Productive Maintenance (TPM) – Concept, Improvement Needs, FMEA – Stages of FMEA.

**UNIT – V QUALITY SYSTEMS 9Hrs**

Need for ISO 9000 and Other Quality Systems, ISO 9000:2000 Quality System – Elements, Implementation of Quality System, Documentation, Quality Auditing, QS 9000, ISO 14000 – Concept, Requirements and Benefits.

**Total No. of Hrs:45**

**Text Book**

1. Dale H.Besterfield, et al., *Total Quality Management*, Pearson Education Asia, 1999 (Indian reprint 2002).

**References**

1. JaesR.Evans& William M.Lindsay, *The Management and Control of Quality*, (5<sup>th</sup> Edition), South-Western (Thomson Learning), 2002 (ISBN 0-324-06680-5).
2. Feigenbaum.A.V. *“Total Quality Management*, McGraw Hill, 1991.
3. Oakland.J.S. *“Total Quality Management Butterworth – Hcinemann Ltd., Oxford. 1989.*
4. Narayana V. and Sreenivasan, N.S. *Quality Management – Concepts and Tasks*, New Age International 1996.
5. Zeiri. *“Total Quality Management for Engineers Wood Head Publishers, 1991.*





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<b>BCT13L07</b>	<b>PROJECT WORK</b>	<b>0</b>	<b>0</b>	<b>20</b>	<b>10</b>
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**Project:**

Project works are to be done by the students whose duration will be larger than one week.

**Criteria for Project Design:**

1. Projects suggested by the staff on the basis of collected industrial problem.
2. Projects to cater to development of infrastructure of the department.
3. Projects to cater to preparation for application for funding agents.
4. Projects to cater to obtaining relevant data for doctoral programme.
5. Projects to recalibrate and standardize existing equipment.
6. Projects to establish relevant instrumentation and analytical procedures.
7. Projects to give students an opportunity if they suggest an innovative / alternate approach to the existing solution.





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**BCT13E02AIR POLLUTION AND CONTROL                      3 00 3**

**OBJECTIVE:**

- To enable the students to learn about Air Pollution, effects of air pollution.
- Sampling of pollutants, Meteorology and air pollution, atmospheric stability, Plume rise and dispersion and Prediction of air quality

**UNIT I INTRODUCTION                      9Hrs**

Air Pollution Regulatory Framework History – Air Pollution Regulatory Framework - Regulatory System – Laws and Regulations – Clean air Act – Provisions for Recent Developments.

**UNIT II AIR POLLUTION GASES 9Hrs**

Measurement fundamentals – chemicals and physical properties – Phase 77 – Equalization laws – Incinerators – Design and Performance – Operation and Maintenance - Absorbers – Design operation and improving performances Absorbers.

**UNIT III PARTICULATE AIR POLLUTION 9Hrs**

Particle Collection mechanisms– Fluid particle Dynamics – Particle size Distribution – Efficiency – Gravity Settling chambers Cyclones- Electrostatic precipitators Bannouses

**UNIT IV HYBRID SYSTEM**

**9Hrs**

Heat electrostatic precipitation – Genizing Heat Scrubbers – Dry Scrubbers –Electrostatically Augmented Fabric Filtration

**UNIT V AIR POLLUTION CONTROL EQUIPMENT**

**9Hrs**

Introduction – Installation – Cost Model.

**Total No. of Hrs: 45**

**Text books:**

1. Air Pollution Control Engg, Noel de nevey – McGraw Hill.

**References:**

1. Air Pollution Control Equipment Louis Theodore, Burley Intuscence 2008.
2. Air Pollution Control CD Cooper and FC.AlleyWairland Press III Edition2002.



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**BCT13E03GREEN CHEMISTRY AND ENGINEERING**

**3 0 0 3**

**OBJECTIVE:**

- To make the students aware of global environmental issues, concepts behind pollution prevention, environmental risks, green chemistry, methods to evaluate environmental costs and life cycle assessments.

**UNIT I**

**9Hrs**

Overview of Major Environmental Issues, Global Environmental Issues. Air Quality Issues. Water Quality Issues, Ecology, Natural Resources, Description of Risk. Value of Risk Assessment in the Engineering Profession. Risk-Based Environmental Law. Risk Assessment Concepts. Hazard Assessment. Dose-Response. Risk Characterization.

**UNIT II**

**9Hrs**

Pollution Prevention- Pollution Prevention Concepts and Terminology. Chemical Process Safety. Responsibilities for Environmental Protection. Environmental Persistence. Classifying Environmental Risks Based on Chemical Structure. Exposure Assessment for Chemicals in the Ambient Environment.

**UNIT III 9Hrs**

Green Chemistry. Green Chemistry Methodologies. Quantitative/Optimization- Based Frameworks for the Design of Green Chemical Synthesis Pathways. Green Chemistry Pollution Prevention in Material Selection for UNIT Operations. Pollution Prevention for Chemical Reactors. Pollution Prevention for Separation Devices. Pollution Prevention Applications for Separative Reactors. Pollution Prevention in Storage Tanks and Fugitive Sources.

**UNIT IV**

**9Hrs**

Process Energy Integration. Process Mass Integration. Case Study of a Process Flow sheet- Estimation of Environmental Fates of Emissions and Wastes.

**UNIT V 9Hrs**

Magnitudes of Environmental Costs. A Framework for Evaluating Environmental Costs. Hidden Environmental Costs. Liability Costs. Internal Intangible Costs. External Intangible Costs. Introduction to Product Life Cycle Concepts. Life-Cycle Assessment. Life-Cycle Impact Assessments. Streamlined Life-Cycle Assessments. Uses of Life-Cycle Studies.

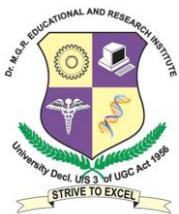
**Total No. of Hrs:45**

**Textbooks:**

1. Mukesh Doble and Anil Kumar Kruthiventi, Green Chemistry and Engineering, Elsevier, Burlington, USA, 2007.

**References:**

2. Allen, D.T., Shonnard, D.R, Green Engineering: Environmentally Conscious Design of Chemical Processes. Prentice Hall PTR 2002.



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**BCT13E04ENVIRONMENTAL ENGINEERING 3 0 0 3**

**OBJECTIVE:**

- To provide technical expertise in Environmental Engineering which will enable them to have a career and professional accomplishment in the public or private sector

**UNIT I ENVIRONMENT AWARENESS 9Hrs**

Environment – friendly chemical Process; Hazard and risk analysis; Environmental Audit.

**UNIT II CHEMICAL ENGINEERING PROCESSES**

**9Hrs**

UNIT Operations – application of - Abatement of water pollution; Current strategies to control air pollution; Disposal of solid wastes

**UNIT III RECYCLING METHODOLOGY**

**9Hrs**

Economic recovery and recycling of waste; Transport fuel- Bio-diesel for a cleaner environment.

**UNIT IV CLEAN TECHNOLOGY 9Hrs**

Towards Eco- friendly products of chemical industry; Pesticides – Their transfer and Transformation in the environment, Biological and electrochemical technology for effluent treatments

**UNIT V POLLUTION PREVENTION 9Hrs**

Mass exchange network synthesis for pollution control and minimization Implications of environmental constraints for process design, policies for regulation of environmental impacts, Concept of common effluent treatment; Environmental legislations, Role of Government and Industries

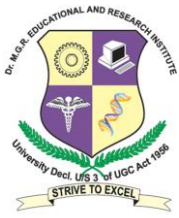
**TOTAL No. of Hrs: 45**

**TEXTBOOKS:**

1. Rao, C.S Environmental Pollution control Engineering, Wiley- Eastern Ltd. 1991.
2. Peavy H.S. Rowe D.R., and George Technological, Environmental Engineering, Mc Graw Hill Book Company, Ny, 1985.
3. Rao M.N and H.V.N. Rao. “Air pollution” ,Tata McGraw Hill Publishing Co.Ltd. 1989. Theodore L and Buomlore A.J Air pollution control equipments. Prentice
4. Hall Inc, NY. 1982.

**REFERENCES:**

1. Coulson, J.M. Richardson, J.F and R.K Sinnott, Chemical Engineering Vol.6, Pergomon Press, 1989.
2. Gilbert M. Mastrs, Introduction to Environmental Engineering and Science, Prentice - Hall of India, New Delhi, 1994.
3. Wahi S.K., Agnihotri A.K and Sharmma J.S (Editors) Environmental Management in Petroleum Industry, Wiley Eastern Ltd., New Delhi 1996.
4. Smith, R., “Chemical Process Design”, McGraw Hill, New York, 1995.
5. Paul L Bishop (2000) “Pollution Prevention Fundamentals and Practice”, McGraw Hill, International.



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**BCT13E05**

**WASTEWATER TREATMENT**

**3 0 03**

**OBJECTIVE:**

- To focus on the wastewater transport system and the theory and design technique for the wastewater treatment process.

**UNIT I WASTE WATER TREATMENT AN OVERVIEW**

**9Hrs**

Terminology – Regulations – Health and Environment Concerns in wastewater management – Constituents in waste water inorganic – Organic and metallic constituents.

**UNIT II PROCESS ANALYSIS AND SELECTION**

**9Hrs**

Components of waste water flows – Analysis of Data – Reactors used in wastewater treatment – Mass Balance Analysis – Modeling of ideal and non ideal flow in Reactors – Process Selection.

**UNIT III CHEMICAL UNIT PROCESSES**

**9Hrs**

Role of UNIT processes in waste water treatment chemical coagulation – Chemical precipitation for improved plant performance chemical oxidation – Neutralization – Chemical Storage.

**UNIT IV BIOLOGICAL TREATMENT**

**9Hrs**

Overview of biological Treatment – Microbial metabolism – Bacterial growth and energetics – Aerobic biological oxidation – Anaerobic fermentation and oxidation – Trickling filters – Rotating biological contractors – Combined aerobic processes – Activated sludge film packing.

**UNIT V ADVANCED WASTE WATER TREATMENT**

**9Hrs**

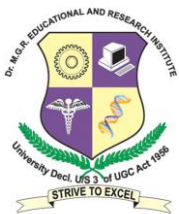
Technologies used in advanced treatment – Classification of technologies Removal of Colloids and suspended particles – Depth Filtration – Surface Filtration – Membrane Filtration Absorption – Ion Exchange – Advanced oxidation process.

**TOTAL No. of Hrs: 45**

**Text books:**

1. Waste water Engineering Treatment and Reuse: Mc Graw Hill, G.Tchobanoglous, FI Biston, 2002.
2. Industrial Waste Water Management Treatment and Disposal by Waste Water Mc Graw Hill III Edition 2008.





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**BCT13E07**

**FERTILIZER TECHNOLOGY**

**3 0 0 3**

**OBJECTIVE:**

- To enable the students to learn the fertilizer manufacturing including new or modified fertilizer products and new techniques

**UNIT I NITROGENOUS FERTILISERS**

**9Hrs**

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

**UNIT II PHOSPHATIC FERTILISERS**

**9Hrs**

Raw materials; phosphate rock, sulphur; pyrites etc., processes for the production of sulphuric and phosphoric acids; phosphates fertilizers – groundrock phosphate; bone meal-single superphosphate, triple superphosphate, triplex superphosphate, thermal phosphates and their methods of production, characteristics and specifications.

**UNIT III POTASSIC FERTILISERS**

**9Hrs**

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

**UNIT IV COMPLEX AND NPK FERTILISERS**

**9Hrs**

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

**UNIT V MISCELLANEOUS FERTILISERS**

**9Hrs**

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

**TOTAL No. of Hrs: 45**

**TEXT BOOKS:**

1. "Handbook of fertilizer technology", Association of India, New Delhi, 1977.
2. Menno, M.G.; "Fertilizer Industry - An Introductory Survey", Higginbothams Pvt. Ltd., 1973.

**REFERENCES:**

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







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**BCT13E09PULP AND PAPER TECHNOLOGY**

**3 0 0 3**

**OBJECTIVE:**

- Focused on papermaking science and technology and is intended to be especially valuable to students majoring in programs leading to careers incorporate or government positions which would interface with the paper related industries.

**UNIT I INTRODUCTION**

**9Hrs**

Introduction Basic pulp and paper technology – Wood haves dry – Wood as a raw material.

**UNIT II WOODYARD OPERATION**

**9Hrs**

Woodyard operation - Mechanical pulping – Chemical pulping – Secondary fibre pulp processing.

**UNIT III PAPER MACHINE**

**9Hrs**

Paper Machine wet and addition paper machine dry and operation – Paper machine - Wet and operation.

**UNIT IV PAPER AND PAPERBOARD**

**9Hrs**

Paper and paperboard frames and products – Surface treatments – Finishing operation – End uses.

**UNIT V PROPERTIES AND TESTING OF PULP AND PAPER**

**9Hrs**

Properties and Testing of pulp and paper Process control – Quality assurance – Water and air pollution control.

**TOTAL No. of Hrs: 45**

**TEXTBOOK:**

1. Pulp and paper chemistry and Technology Monica ER Monica, Goran Gellerstedt Gunnar Hennksson De Gneyter 2009.



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**BCT13E10**

**POLYMER TECHNOLOGY**

**3 00 3**

**OBJECTIVE:**

- To enable the students to compute molecular weight averages from the molecular weight distribution, Condensation polymerization and transition in polymers

**UNIT I INTRODUCTION**

**6Hrs**

History of Macromolecules – structure of natural products like cellulose, rubber, proteins – concepts of macro molecules – Staudinger's theory of macromolecules – difference between simple organic molecules and macromolecules.

**UNIT II ADDITION POLYMERIZATION**

**12Hrs**

Chemistry of Olefins and Dienes – double bonds – Chemistry of free radicals – monomers – functionality – Polymerization: Initiation – types of initiation – free radical polymerization – cationic polymerization – anionic polymerization – coordination polymerization – industrial polymerization – bulk, emulsion, suspension and solution polymerization techniques – Kinetics – Copolymerization concepts.

**UNIT III CONDENSATION POLYMERIZATION**

**9Hrs**

Simple condensation reactions – Extension of condensation reactions to polymer synthesis – functional group reactivity – polycondensation – kinetics of polycondensation – Carother's equation – Linear polymers by polycondensation – Interfacial polymerization – crosslinked polymers by condensation – gel point.

**UNIT IV MOLECULAR WEIGHTS OF POLYMERS**

**9Hrs**

Difference in molecular weights between simple molecules and polymers – number average and weight average molecular weights – Degree of polymerization and molecular weight – molecular weight distribution – Polydispersity – molecular weight determination. Different methods – Gel Permeation Chromatography – Osmometry, Light Scattering.

**UNIT V TRANSITIONS IN POLYMERS**

**9Hrs**

First and second order transitions – Glass transition,  $T_g$  – multiple transitions in polymers – experimental study – significance of transition temperatures – crystallinity in polymers – effect of crystallization – in polymers – factors affecting crystallization crystal nucleation and growth – relationship between  $T_g$  and  $T_m$  – Relationship between properties and crystalline structure.

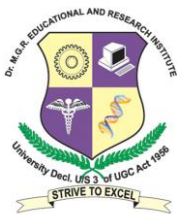
**TOTAL No. of Hrs: 45**

**Textbooks:**

1. Billmeyer, F.W., Jr, Text Book of Polymer Science, Ed. Wiley-Interscience, 1984.
2. Seymour, R.B., and Carraher, C.E., Jr., Polymer Chemistry, 2nd Ed., Marcel Dekker, 1988.
3. Gowariker, V.T., Viswanathan, N.V., and Sreedar, J., Polymer Science, Wiley Eastern Ltd., 1988.

**References:**

1. Joel, R.F; Polymer Science and Technology, Eastern Economy Edition, 1999.
2. Rodriguez, F., Cohen, C., Oberic, K and Arches, L.A., Principles of Polymer Systems, 5th edition, Taylor and



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**BCT13E11FUNDAMENTALS OF NANOSCIENCE 3 0 0 3**

**OBJECTIVE:**

- To enable the students to learn about basis of nanomaterial science, preparation method, types and application

**UNIT I INTRODUCTION**

**8Hrs**

Nanoscale Science and Technology- Implications for Physics, Chemistry, Biology and Engineering- Classifications of nanostructured materials- nanoparticles- 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 GENERAL METHODS OF PREPARATION**

**9Hrs**

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

**UNIT III NANOMATERIALS**

**12Hrs**

Nanoforms of Carbon - Buckminster fullerene- graphene and carbon nanotube, Single wall carbon Nanotubes (SWCNT) and Multi wall carbon nanotubes (MWCNT)- methods of synthesis (arc-growth, laser ablation, CVD routes, Plasma CVD), structure-property Relationships applications- Nanometal oxides- ZnO, TiO<sub>2</sub>, MgO, ZrO<sub>2</sub>, NiO, nanoalumina, CaO, AgTiO<sub>2</sub>, Ferrites, Nanoclays 9Hrs functionalization and applications- Quantum wires, Quantum dots- preparation, properties and applications

**UNIT IV CHARACTERIZATION TECHNIQUES**

**9Hrs**

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

**UNIT V APPLICATIONS 7**

NanoInfoTech: Information storage- nanocomputer, molecular switch, superchip, nanocrystal, Nanobiotechnology: nanoprobe in medical diagnostics and biotechnology, Nano medicines, Targeted drug delivery, Bioimaging- Micro Electro Mechanical Systems (MEMS), Nano Electro Mechanical Systems (NEMS)- Nanosensors, nano crystalline silver for bacterial inhibition, Nanoparticles for sun barrier products - In Photostat, printing, solar cell, battery

**TOTAL No. of Hrs: 45**

**Textbooks:**

1. A.S. Edelstein and R.C. Cammarata, eds., "Nanomaterials: Synthesis, Properties and Applications", Institute of Physics Publishing, Bristol and Philadelphia, 1996.
2. N John Dinardo, "Nanoscale characterisation of surfaces & Interfaces", 2<sup>nd</sup> 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.



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**BCT13E12**

**FRONTIERS OF CHEMICAL ENGINEERING 3 00 3**

**OBJECTIVE:**

- To enable the students to understand the chemical product design and available renewable energy resources

**UNIT I PROCESS INTENSIFICATION**

**9Hrs**

Novel reactor configurations; combination of reaction and separation; use of different energy fields, lab on a chip.

**UNIT II CHEMICAL PRODUCT DESIGN**

**9Hrs**

Scope and importance; identification of needs and specifications; sources of ideas and screening ideas; selection of product idea; process development for product manufacture; specialty chemical manufacture; economic aspects.

**UNIT III RENEWABLE ENERGY**

**9Hrs**

Hydrogen production, Hydrogen economy, Fuel Cell Technology, biofuel cells and bio-hydrogen, solar energy

**UNIT IV MATERIALS ENGINEERING**

**9Hrs**

Polymers and composites, ceramics and glasses, colloidal dispersions and nanoparticles, thin films and electronic materials

**UNIT V BIOENGINEERING**

**9Hrs**

Biomechanics, biotransport and biomaterials, biomolecular and cellular engineering, drug discovery and development.

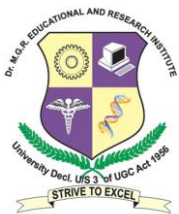
**TOTAL No. of Hrs: 45**

**Text Books:**

1. Keil, F. J., Modeling of Process Intensification Wiley-VCH Verlag GmbH & Co. KGaA 2007
2. Cussler, E.I. and Moggridge, G.D., "Chemical product design" Cambridge University Press, Cambridge, 2001
3. Hoffmann, P., Tomorrow's energy: hydrogen, fuel cells, and the prospects for cleaner planet, MIT Press, Sabon, 2002

**References:**

1. Mitchell, B.S., An introduction to materials engineering and science for chemical and materials engineers, John Wiley and Sons Inc., New Jersey, 2004



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**BCT13E13**

**PROFESSIONAL ETHICS IN ENGINEERING 3 0 0 3**

**OBJECTIVE:**

- To enable the students to create an awareness on Engineering Ethics and Human Values, to instill Moral and Social Values and Loyalty and to appreciate the rights of others.

**UNIT I HUMAN VALUES**

**10Hrs**

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 – Introduction to Yoga and meditation for professional excellence and stress management.

**UNIT II ENGINEERING ETHICS**

**9Hrs**

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**

**9Hrs**

Engineering as Experimentation – Engineers as responsible Experimenters – Codes of Ethics – A Balanced Outlook on Law.

**UNIT IV SAFETY, RESPONSIBILITIES AND RIGHTS**

**9Hrs**

Safety and Risk – Assessment of Safety and Risk – Risk Benefit Analysis and Reducing Risk – Respect for Authority – Collective Bargaining – Confidentiality – Conflicts of Interest – Occupational Crime – Professional Rights – Employee Rights – Intellectual Property Rights (IPR) – Discrimination

**UNIT V GLOBAL ISSUES**

**8Hrs**

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

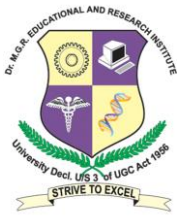
**TOTAL No. of Hrs: 45**

**Text Books:**

1. Mike W. Martin and Roland Schinzinger, "Ethics in Engineering", Tata McGrawHill, New Delhi, 2003.
2. Govindarajan M, Natarajan S, SenthilKumar V. S, "Engineering Ethics", Prentice Hall of India, New Delhi, 2004.

**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", Cengage Learning, 2009
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
5. Laura P. Hartman and Joe Desjardins, "Business Ethics: Decision Making for Personal Integrity and Social Responsibility" Mc Graw Hill education, India Pvt. Ltd., New Delhi 2013.
6. World Community Service Centre, 'Value Education', Vethathiripublications, Erode, 2011



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**BCT13E14INDUSTRIAL INSTRUMENTATION 3 0 0 3**

**OBJECTIVE:**

- To impart knowledge on measuring of process variables, analytical instrumentation, automatic process controls.

**UNIT I**

**5Hrs**

Introduction – Variables, UNITs & standards of measurement, Measurement terms – characteristic. Data Analysis.

**UNIT II**

**12Hrs**

Process Variables Measurement–Temperature systems– Thermocouples, Thermo resistive system, Filled-system thermometers, Radiation thermometry, Location of temperature measuring devices in equipments, Pressure system –Mechanical pressure elements Pressure Transducers and Transmitters, Vacuum measurement, Resonant wire pressure Transducer, Flow system –Differential producers, Variable area flow meters, Velocity, vortex, mass, ultrasonic & other flow meters, positive displacement flow meters, Open –channel flow measurements, Force systems, Strain gauges Humidity Moisture system, Humidity Measurement, Moisture measurement system, Rheological system, Viscosity measurement, Radiation system, Nuclear radiation instrumentation.

**UNIT III**

**12Hrs**

Analytical instrumentation – Analysis instruments, Sample conditioning for process analyzers, X-ray Analytical methods, Quadrupole mass spectrometry, Ultra violet Absorption Analysis, Infra red process analyzers, Photometric reaction product analysers Oxygen analyzers, Oxidation – reduction potential measurements, pH measuring systems, Electrical conductivity and Resistivity measurements, Thermal conductivity, gas analysis, Combustible, Total hydrocarbon, and CO analyzer, Chromatography.

**UNIT IV**

**9Hrs**

Fundamentals of Automatic process control – Control algorithms–Automatic controllers – Electronic controllers –Electric controllers (Traditional) – Hydraulic controllers – Fluidics - Programmable controllers.

**UNIT V**

**7Hrs**

Sensors, Transmitters and control valves - Pressure, Flow, Level, Temperature and Composition sensors, Transmitters, Pneumatic and electronic control valves, Types, Actuator, accessories, Instrumentation symbols and Labels.

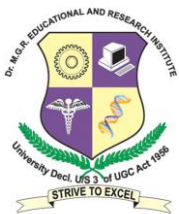
**TOTAL No. of Hrs: 45**

**Textbooks:**

1. Fribance, “Industrial Instrumentation Fundamentals” ,Mc Graw Hill Co. Inc. New York 1985
2. Eckman D.P. “Industrial Instrumentation”, Wiley Eastern Ltd., 1989.
3. Considine D M and Considine G D “Process Instruments Controls” Handbook 3rd Edition, McGraw – Hill Book Co., NY, 1990.
4. Scborg D E, Edgar T.F and Mellichamp D.A, “Process Dynamics and Control” John Wiley 1989.

**References:**

1. Ernest Doebelin, Measurement systems, McGraw – Hill Book, Co., NY, 1975.
2. Astrom K.J., Bjonwittenmark, Computer controlled systems, Prentice- Hall of India, New Delhi 1994.
3. Cartis Johnson, Process Control Instrumentation Technology, Prentice-Hall of India, New Delhi 1993.



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**DEPARTMENT OF CHEMICAL ENGINEERING**

**BCT13E15 SAFETY IN CHEMICAL PROCESS INDUSTRIES 3 0 03**

**OBJECTIVES**

- To impart the principles of safety in chemical process operations.
- To educate the students the importance of safety procedures and safety regulations in chemical industries.

**UNIT I :INTRODUCTION**

**9Hrs**

Safety in industries – need for development – importance of safety consciousness in Indian Chemical Industry – social environmental setup – Tolerance limit of the society – Psychological attitude towards safety programmes

**UNIT II: SAFETY PROGRAMMES**

**9Hrs**

Elements of safety programmes – Effective realization – Economic and social benefits – Effective communication training at various levels of production and operation.

**UNIT III : SAFETY PERFORMANCE**

**9Hrs**

Appraisal – Effective steps to implement safety procedures – Periodic inspection and study of plant layout and constant maintenance – Periodic advice and checking to follow safety procedures – proper selection and replacement of handling equipments – personal protective equipment.

**UNIT IV: ACCIDENTS**

**9Hrs**

Industrial accidents – accident costs – identification of accident spots – remedial measure – identification and analysis of causes of injury to men and machines – accident prevention – accident proneness – vocational guidance, fault free analysis – Fire prevention and fire protection.

**UNIT V: HEALTH HAZARDS AND LEGAL ASPECTS**

**9Hrs**

Health hazards – occupational – Industrial health hazards – health Standards and rules – safe working environments – parliamentary legislation – Factories act – Labor Welfare Act – ESI Act – Workmen Compensation Act.

**Total No of Hrs:45**

**Text Book**

1. William Handley, *Industrial Safety Hand Book*, Mc Graw-Hill Book Company, 2<sup>nd</sup> edition, 1969.
2. Fawatt, H.H and Wood, W.S., *Safety and Accident Prevention in Chemical operation*, Inter-science, 1965.

**Reference**

1. Heinrich, H.W, Dan Perterson, P.E and Nester Rood, *Industrial Accident Prevention*, McGraw- Hill, 1980.
2. Blake, R.P., *Industrial Safety*, PHI, III ed, 1963.