JK Lakshmipat University

Laliya Ka Vas, P.O. Mahapura, Ajmer Road, Jaipur 302 026

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INSTITUTE OF ENGINEERING AND TECHNOLOGY

4 Year B. Tech Program

(Branch: Chemical Engineering)

Batch 2012-16

Course Structure, Detailed Syllabus

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Scheme of Examination

JK Lakshmipat University, Jaipur

Institute of Engineering and Technology

Department of Chemical Engineering

Course Structure for the Batch 2012-16

Sem	Courses							(L T P) Credits Hrs/Week
I	Engineering Drawing	Object Oriented Programming	English Communication Skills	Engineering Mathematics - I	Engineering Mechanics	Engineering Physics		(16 4 6) 23
	CE102 (2 0 2) 3	CSE202 (3 0 2) 4	LA101 (2 1 0) 3	MA101 (3 1 0) 4	ME201 (3 1 0) 4	PH101 (3 1 2) 5		26
II	Engineering Mathematics - II	Professional Communication Skills	Environmental Studies	Engineering Chemistry	Electrical & Electronics Engineering	Workshop Practice		(12 3 10) 20
	MA201 (3 1 0) 4	LA201 (1 1 2) 3	ID201 (2 0 0) 2	CH101 (3 1 2) 5	EE101 (3 0 2) 4	ME141 (0 0 4) 2		25
III	Chemical Process Calculations	Fluid Flow Operations	Heat Transfer Operations	Unit Processes in Organic Synthesis	Principles of Management for Engineers	Engineering Mathematics – III		(17 4 4) 23
	CHE301 (3 1 0) 4	CHE302 (3 1 2) 5	CHE303 (3 1 2) 5	CHE304 (3 0 0) 3	HS302 (2 0 0) 2	MA301 (3 1 0) 4		25
IV	Chemical Engineering Thermodynamics	Chemical Reaction Engineering - I	Mechanical Operations	Mass Transfer Operations - I	Principles of Economics	Numerical & Statistical **Analysis**		(18 4 8) 26
	CHE403 (3 1 0) 4	CHE404 (3 1 3) 5.5	CHE405 (3 1 3) 5.5	CHE407 (3 1 0) 4	HS701 (3 0 0) 3	MA402 (3 0 2) 4		30
V	**Practice School - I (PS 501) - 4 to 6 Weeks Duration - 4 Credits**							
	Chemical Reaction Engineering - II	Process Modeling and Simulation	Chemical Engineering Materials	Mass Transfer Operations - II	Process Instrumentation & Control	Effective Public Speaking and Employability Skills		(17 4 7) 24.5+4
	CHE501 (3 1 0)4	CHE503 (3 1 2) 5	CHE505 (3 0 0) 3	CHE507 (3 1 3) 5.5	CHE508 (3 1 2) 5	LA501 (2 0 0) 2		**28**
VI	Chemical Process Technology	Process Equipment Design	Transport Phenomena	Computational Fluid Dynamics	(Elective – I)	(Elective – II)	(HS Elective)	(20 3 5) 25.5
	CHE602 (3 0 0) 3	CHE603 (3 1 3) 5.5	CHE604 (3 1 0) 4	ME625 (3 0 2) 4	(3 0 0) 3	(3 1 0) 4	(2 0 0) 2	28
VII	Process Utility and Industrial Safety	(Elective-III)	(Elective-IV)	Intelligent Machines (AI, Robotics, IoT)	Workplace & Interpersonal Communication			(14 3 0) 17
	CHE702 (3 1 0) 4	(3 1 0) 4	(3 1 0) 4	ID303 (2 0 0) 2	CCT708 (3 0 0) 3			**17**
VII	**Practice School – II (PS 801) – 16 Weeks Duration**							16
							Total Credits	**179**

Department Electives

Elective I	Energy Engineering (CHE611)	Non-Conventional Energy Resources (CHE 612)	Engineering Optimization (MA621)	Process Plant Simulation (CHE614)	Biochemical Engineering (CHE615)	Energy Conservation & Management (CHE 613)	
Elective II	Process Design Decisions (CHE621)	Advanced Process Control (CHE626)	Pulp & Paper Technology (CHE624)	Fertilizer Technology (CHE625)	Mathematical methods in chemical engineering (CHE622)	Corrosion Engineering (CHE623)	
Elective III	Advanced Heat Transfer (CHE711)	Energy Integration Analysis (CHE712)	Computer Aided Design in Chemical Engineering (CHE714)	Nanofluid Engineering (CHE716)	Petroleum Refinery and Petro-Chemicals (CHE715)	Process Intensification (CHE713)	
Elective IV	Fluidization Engineering (CHE721)	Industrial Pollution Abatement CHE803	Sugar Technology (CHE723)	Pharmaceutical Engineering (CHE724)	Chemical vapor deposition (CHE725)	Scale-up and Pilot Plant Methods in Chemical Engineering (CHE726)	Advanced Separation Processes (CHE722)
HS Elective	Organizational Behavior (HS601)	Professional Ethics (HS602)	Technology Management (HS603)	Critical Interpretation of Literature and Cinema (HS604)			

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INSTITUTE OF ENGINEERING AND TECHNOLOGY

4 Year B. Tech Programme

(Branch: Common to all Branches)

Batch 2012-2016

SEMESTER-FIRST

Detailed Syllabus

&

Scheme of Examination

ENGLISH COMMUNICATION SKILLS

Course Code : **LA 101**

Course Title : **English Communication Skills**

Course Credits : **02**

Total Hours Per Week : **2+0+0**

Course Syllabi:

- Introduction to the course, Characteristic Features of Effective Communication and Ways to Overcome Barriers to Communication
- Vocabulary Extension: Roots, Prefixes and Suffixes
- Vocabulary Extension: Synonyms, Antonyms, Homophones, One Word Substitution
- Vocabulary Extension: Learning words through Situations
- Basics of English Grammar, Applied English Grammar
- Standard English Usage, Listening Skills
- Phonetics and Spoken English: Sounds of English
- Introducing students to the rules of Word Accent and Weak Forms in English
- Reading Comprehension, Paragraph Writing
- Art of Condensation, Essay Writing

Evaluation Scheme:

EC No.	Evaluation Component	Duration	Marks (100) (%)	Nature of Component
1.	Mid Term Test-I	1 hour	20	Closed Book
2.	Mid Term Test-II	1 hour	20	Open Book
3.	End Term Test / Comprehensive	3 hour	40	Closed Book
4.	Assignments such a Role Play, JAM, Extempore, Paragraph Writing, Vocabulary Exercises, etc.		15	Open/Closed Book
5.	Quiz	20 min.	05	Closed Book

Text Books:

Sanjay Kumar and Pushp Lata, *Communication Skills*, New Delhi: OUP, 2011

Reference Books:

R1 Meenakshi Raman and Sangeeta Sharma, *Technical Communication: Principles and Practice*, Second Edition, New Delhi: OUP, 2011.

R2 Krishna Mohan and Meenakshi Raman, *Effective English Communication,* New Delhi: Tata-McGraw Hill, 2000.

R3 Krishna Mohan and N.P.Singh, *Speaking English Effectively,* New Delhi: Macmillan,1994.

R4 V. Sasikumar and P.V. Dhamija, *Spoken English*: A Self-Learning Guide to Conversation Practice, Tata-McGraw Hill, 2007.

R5 Norman Lewis, *Word Power Made Easy*, Delhi: GoyalSaab Publishers and Distributors, 1994.

R6 A.J.Thomson and A.V.Martinet, *A Practical English Grammar,* 4th Edition, New Delhi: OUP, 1999.

R7 Asha Kaul, *Business Communication,* Second Edition*,* New Delhi: PHI, 2010.

R8 Edgar Thorpe and Showick Thorpe, *Objective English,* 2nd Edition, New Delhi: Pearson Education, 2008.

ENGINEERING MATHEMATICS-I

Course Code : **MA101**

Course Title : **Engineering Mathematics – I**

Course Credits : **03**

Total Hours per week (L+T+P) : **3+1+0**

Course Syllabi:

- Functions of two or more variables, Partial Derivatives, Total derivative, Chain Rule
- Euler's Theorem, Jacobian and transformation, Applications to errors
- Maxima-Minima of functions of two variables, Lagrange's method
- Curve tracing: Cartesian, parametric and polar coordinates, Vector functions, their derivatives and integration
- Arc length and unit tangent vector, Curvature and unit normal vector, Torsion and unit binormal vector
- Directional derivative and gradient vectors, Tangent plane, Divergence and curl of a vector field, Integral calculus, Line integral, Arc length,
- Double integral: Area, change of order of integration, changing to polar coordinate
- Triple integral: Volume integral
- Vector integration: Line integral, flux, work done, circulation, Path independence, potential function and conservative fields
- Surface area and integral, Green's theorem in the plane, Stoke's theorem, Divergence theorem
- Gamma and beta function, Sequence and series, Orthogonal function, Fourier Series

Evaluation Scheme:

EC No.	Evaluation Component (EC)	Duration	Weightage	Nature	Scope (No. of Lectures)
1	Mid-term Test-I	60 Min.	20	Closed Book	1 - 10
2	Mid-term Test-II	60 Min.	20	Open Book	11 – 25
3	Quiz / Assignment / Attendance	To be decided by Instructors	20*	Open/Closed Book	To be decided by Instructors
4	End-term/ Comprehensive	3 Hrs.	40	Closed Book	1 - 40

* EC No.3 will be based on the weightage of Quiz, Assignment and Attendance.

Text books

T1 G.B. Thomas, Jr., *Thomas' calculus*, 11th edition (Indian), Pearson education, Delhi, 2008

T2 Dennis G. Zill and Warren S. Wright, *Advanced Engineering Mathematics*, Fourth Edition (Student Edition), Jones & Barlett, Viba, New Delhi, 2011

Reference Books

R1 Rober Wrede, Spiegel M. R., *Schaum's outline of advanced calculus*, 3rd edition, Tata Mc-GrawHill, NewYork, 2011

R2 Peter V. O'Neil, *Advanced Engineering Mathematics*, Seventh Indian Reprint, Cengage Learning, New Delhi, 2011.

R3 Kreyszig, E., *Advanced Engineering Mathematics*, John Willey, Delhi (2011).

R4 Potter M.C., Goldberg J.L., Edward F.A., *Advanced Engineering Mathematics*, 3rd Edition, Oxford University Press, 2005.

ENGINEERING PHYSICS-I

Course Code	**:**	**PH101**
Course Title	**:**	**Engineering Physics-I**
Course Credits	**:**	**04**
Total Hours per Week (L+T+P)	**:**	**3+1+2**

Course Syllabi:

Theory

- Introduction to optics, Spatial Coherence, Temporal coherence, Coherence length, Coherence time and 'Q'factor for light
- Formation of Newton's rings, Measurement of wavelength of light, Diameter of Newton's rings
- Michelson's Interferometer: Production of circular & straight line fringes, Determination of wavelength of light, Determination of wavelength separation of two nearby wavelengths
- Elementary idea of anti-reflection coating and interference filters
- Single slit diffraction, position of maxima / minima and width of central maximum, intensity variation.
- Construction and theory. Formation of spectra by plane transmission grating, Determination of wavelength of light using plane transmission grating
- Introduction, Raleigh criterion, Resolving power of diffraction grating.
- Plane, circular and elliptically polarized light on the basis of electric (light) vector
- Malus law, Qualitative description of double refraction
- Quarter and half wave plates, construction, working and use of these in production and detection of plane, circular and elliptically polarized light.
- Introduction and law of optical rotation, specific rotation and its measurement using the half-shade and bi-quartz device.
- Heisenberg's Uncertainty Principle, Wave and Particle Duality of Radiation, De-Broglie's Concept of Matter waves, Quantum Nature of Light
- Photoelectric Effect and Compton Effect
- Concept of Wave Function, Physical interpretation of wave function and its properties
- Schrödinger's Wave Equation: Time dependent and time independent cases
- Particle in one-dimensional box
- Introduction of Nanotechnology, Effect on physical properties due to Nano scale

- Methods of Nano material construction, Applications
- Introduction to Photovoltaic Cell/Solar Cell and It's Principles
- Theory of Solar Cells, Types of Solar Cells, and Applications

Practical

- To determine the wave length of monochromatic light with the help of Fresnel's Biprism
- To determine the wave length of sodium light by Newton's Ring
- To determine the specific rotation of Glucose (Sugar) solution using a Polarimeter
- To measure the Numerical Aperture of an Optical Fibre.
- To convert a Galvanometer in to an ammeter of range 1.5/3 amp and calibrate it.
- To convert a Galvanometer in to a Volt of range 1.5/3 volt and calibrate it.
- To study the variation of semiconductor resistance with temperature and hence determine the Band Gap of semiconductor in the form of reverse biased P-N junction diode
- To study the variation of thermo e. m. f. of iron copper thermo couple with temperature
- To determine the wavelength of sodium light by Michelson Interferometer
- To determine coherent length and coherent time of laser using He-Ne Laser

Evaluation Scheme (Theory):

EC No.	Evaluation Component	Duration	Marks (100) (%)	Nature of Component
1.	Mid Term Test-I	1 hour	20	Closed Book
2.	Mid Term Test-II	1 hour	20	Closed Book
3.	End Term Test / Comprehensive	3 hour	40	Closed Book
4.	Assignment(s)/ Quizzes	30 min.	20	Open/Closed Book

Evaluation Scheme (Practical):

EC No.	Evaluation Component	Duration	Marks (100) (%)	Nature of Component
1.	Mid Term Test-I	2 hour	10	Closed Book
2.	Mid Term Test-II	2 hour	20	Closed Book
3.	End Term Test/Comprehensive	2 hour	40	Closed Book
4.	Attendance	Day to day	10	……
5.	Continuous evaluation, Discipline, Punctuality, Assignment & Viva Voce	Day to day	20	……

Note: The ratio of weightage between Theory and Practical content will be (60% : 40% respectively)

Text Books:

T1. G.D. Ladiwala and S. S. Sharma, "Engineering Physics-I" New Age International Publication, New Delhi, I edn. 2010.

T2. G.D. Ladiwala and S. S. Sharma, "Engineering Physics-II" New Age International Publication, New Delhi, I edn. 2010.

T3: Lab Manuals for Physics

Reference Books:

R1 Arther Beiser, "Concept of Modern Physics" Tata McGrawHill, New Delhi, 5th edn. 1997.

R2 Ajoy Ghatak, "Optics", Tata McGraw Hill, 4th edn

R3 Eyvind H Wichman, "Quantum Physics" Tata McGraw Hill, Volume 4

R4 Neeraj Mehta, "Applied Physics for Engineers", PHI, I edn. 2011

R5: Dattu R Joshi, "Engineering Physics", Tata McGraw Hill Education Pvt. Ltd. New Delhi, I edn. 2010

ENGINEERING CHEMISTRY-I

Course Code	**:**	**CH101**
Course Title	**:**	**Engineering Chemistry-I**
Course Credits	**:**	**04**
Total Hours per Week (L+T+P)	**:**	**3+1+2**

Course Syllabi:

Theory

- Introduction of water impurities, Methods for hardness determination
- Purification of water, Method for softening, Boiler problems
- Types of polymers, Plastics, Synthetic & natural rubber
- General idea of lubricants, Types of lubricants, Properties
- Types of glass, Process involve in formation of glass
- Formation &properties of cement, Chemistry of cement
- Mechanism, 3D configuration of compounds

Practical

- To determine the hardness of water by complex metric method using EDTA.
- To determine the hardness of water by HCl method.
- To determine the amount of free chlorine in given sample.
- Determination of total residual chlorine in a water sample.
- Determination of free carbon dioxide in a given sample.
- To determine the viscosity of a given sample of lubricant oil at various temperature.
- To determine flash and fire point of a given lubricant using Pensky-Martin's apparatus.
- To determine cloud and pour point of a given sample of lubricating oil using Cloud and Pour point apparatus.
- Measurement of Nitrate in water sample.
- Measurement of Oxygen in water sample.

Evaluation Scheme (Theory):

EC No.	Evaluation Component	Duration	Marks (100) (%)	Nature of Component
1.	Mid Term Test-I	1 hour	20	Closed Book
2.	Mid Term Test-II	1 hour	20	Closed Book
3.	End Term Test / Comprehensive	3 hour	40	Closed Book
4.	Assignment(s)/ Presentations/ Quizzes	30 min.	20	Open/Closed Book

Evaluation Scheme (Practical):

EC No.	Evaluation Component	Duration	Marks (100) (%)	Nature of Component
1.	Mid Term Test-I	2 hour	15	Closed Book
2.	Mid Term Test-II	2 hour	15	Closed Book
3.	End Term Test	2 hour	40	Closed Book
4.	Attendance	Day to day	10	……
5.	Continuous evaluation, Discipline, Punctuality, Assignment & Viva Voce	Day to day	20	……

Note: The ratio of weightage between Theory and Practical content will be (60% : 40% respectively)

Text Books:

1. Engineering Chemistry by Jain & Jain, **Dhanpatrai publication**

Reference Books:

1- Engineering Chemistry by B Sivasankar, (Mc-Graw Hill publication).
2- Engineering Chemistry by O.G. Palanna, (Mc-Graw Hill publication).
3- Organic Chemistry by Smith, (Mc-Graw Hill publication).
4- Organic Chemistry by IL Finar, (Pearson)
5- Engineering Chemistry (Wiely India publication).

COMPUTER PROGRAMMING & IT

Course Code	**:**	**CSE101**
Course Title	**:**	**Computer Programing & IT**
Course Credits	**:**	**4**
Total Hours Per Week (L+T+P)	**:**	**3 + 0 + 2**

Course Syllabi:

Theory

Unit I : Introduction: Stored Program Architecture of Computers, Evolution of Processors (In terms of word length & Speed only), Storage Device- Primary Memory and Secondary Storage, Working Principle of Primary Storage devices- RAM, ROM, PROM, EPROM, EEPROM, Random, Direct, Sequential access methods. Language Translators – Concept of High-Level, Assembly and Low Level programming languages. Working of Assembler, Interpreter and compiler. Representing Algorithms through flow chart, pseudo code, step by step etc.

Unit II : Number System: Data Representation, Concept of radix and representation of numbers in radix r with special cases of r=2, 8, 10 and 16 with conversion from radix r1 to radix r2. R's and (r-1)'s complement. Representation of Integer in sign-magnitude, signed 1's and 2's complement, Floating point representation. Concept of bias and normalization. Representation of alphabets, Binary Codes: Binary arithmetic, Addition and subtraction of Integers and floating point Numbers. Multiplication of Integers. Gray code, BCD 8421 and 2421, Excess-3 and Excess-3 gray codes.

Unit III : Programming in C: Structure of C Program, Concept of Preprocessor, Macro Substitution, Intermediate code, Object Code, Executable Code. Compilation Process, Basic Data types, Importance of braces ({ }) in C Program, enumerated data type, Identifiers, Scope of Variable, Storage Class, Constants, Expressions in C, Type Casting, Control Statements, printf( ), scanf ( ), reading single character, Command Line arguments.

Unit IV : Arrays in C, Pointers, Using pointers to represent arrays, Dynamic Memory allocation, structures, using typedef, Arrays of Structures & pointers, File Handling (Opening in different modes & closing of file, fscanf & fprintf only).

Unit V : Functions in C, Passing Parameters (By value & Reference), using returned data, Passing arrays, structures, array of structures, pointer to structures etc., passing characters and strings, The void pointer.

Practical

1. Simple OS Commands, compiling program, compiler options, linking libraries.
2. Simple input output program integer, real character and string. (Formatted & Unformatted)
3. Conditional statement programs (if, if-else-if, switch-case)
4. Looping Program. (for, while, do-while)
5. Program based on array (one, two and three dimensions)
6. Program using Function (with and without recursion)
7. Simple programs using pointers.
8. File handling. Program using Structure and Union

Evaluation Scheme (Theory):

Sr. No.	Evaluation Component	Duration (Hours)	Marks (100)	Nature of Component
1.	Midterm test-I	1	20	Closed Book
2.	Midterm test-II	1	20	Closed Book
3.	Assignment	Continuous	10	Open Book
4.	Quiz	Continuous	10	Closed Book
5.	End Term	3	40	Closed Book

Evaluation Scheme (Practical):

Sr. No.	Evaluation Component	Duration (Hours)	Marks (100)	Nature of Component
1.	Mid Term Test-I	2	20	Closed Book
2.	Mid Term Test-II	2	20	Closed Book
3.	Viva voce evaluation	Day to Day	10	Closed Book
4.	Attendance	Day to Day	10	
5.	End Term Examination	2	40	Closed Book

Note: The ratio of weightage between Theory and Practical content will be (60% : 40% respectively)

Text Books:

T1. Reema Thareja "*Computer Fundamentals and Programming in C*" Oxford Education, first.2012

T2. Balagurusamy, "*Programming in ANSI C*" Tata Mcgraw Hill, sixth, 2012.

Reference Books:

R1 Yashwant Kanetkar, "Let us C" BPB publication, fifth, 2012.

ENVIRONMENTAL STUDIES

Course Code : ID 101

Course Title : Environmental Studies

Course Credits : 2

Total Hours per Week (L+T+P) : 3 + 0 + 0

Course Syllabi:

- Understanding environment, The global crisis, Basic Concepts
- Forest and Grassland ecosystems, Desert Ecosystems, Aquatic Ecosystems
- Introduction to Biodiversity, Biodiversity Conservation
- Water Resources, Energy Resources, Forest Resources
- Land, Food, and Mineral Resources
- Air and Noise Pollution, Water, Soil, and Marine Pollution
- Solid Waste Management and Disaster Management
- Population Growth, Environment and Human Health, Sustainable Development
- Global Warming, Acid Rain, and Ozone Depletion
- Different types of laws and regulations

Evaluation Scheme:

S. No.	Evaluation Component	Duration	Weightage	Date	Nature	Scope (No. of Lectures)
1	First Test	55 Min.	20		Closed Book	1 – 10
2	Second Test	55 Min.	20		Closed Book	11 – 25
3	Quizzes /Assignments (Class room)	To be decided by Instructors	20		Open/Closed Book	To be decided by Instructors
4	Comprehensive	3 Hrs.	40		Closed Book	1 – 40

Text Books:

T-1. Rajagopalan, R., "Environmental Studies: From Crisis to Cure", Oxford University Press, New Delhi, 2e, 2011

Reference Books:

R1 Ranjit Daniels & J. Krishnaswamy "Environmental Studies", Wiley India

R2 Davis & Cornwell "Environmental Engineering", Mc Graw Hill

WORKSHOP PRACTICE

Course Code	**:**	**ME 141**
Course Title	**:**	**Workshop Practice**
Course Credits	**:**	**2**
Total Hours per Week (L+T+P)	**:**	**0+0+3**

Course Syllabi:

Practical

- Basics of manufacturing, types of production systems, ethics, safety in workshop.
- Metrology, quality, Least Count of a measuring Instrument, measurement with Varnier Caliper or Micrometer.
- Machining – Demonstration of Turning, Step Turning, Facing, etc.
- Casting – Demonstration of sand casting process
- Forging – Demonstration of forging operations
- Sheet metal working applications.
- Hands on practice of Sheet metal working operations using hand tools- Preparation of Funnel.
- Gas Welding, Demonstration of Gas Welding
- Hands on practice of Joining of metal parts by Arc Welding- Preparation of a Lap Joint model.
- Mechanical joining processes, Arc Welding
- Hands on practice of Joining of metal parts by Arc Welding- Preparation of a Butt Joint model.
- Introduction to wood working, Wood working Tools, Types of wood, Types of joints.
- Hands on practice of Wood working operations using hand tools- preparation of Lap Tee Joint, Mechanical joining processes, Soldering, Brazing.
- Machining – Demonstration of Shaping operations
- Hands on practice of Fitting operations using hand tools- Prepare a job in fitting shop.

Evaluation Scheme (Practical):

EC No.	Evaluation Component	Duration	Marks (100) (%)	Nature of Component
1.	Mid Term Test-I	2 hour	15	Open Book
2.	Mid Term Test-II	2 hour	15	Closed Book

3.	End Term Test	2 hour	40	Closed Book
4.	Attendance	Day to day	10	……
5.	Continuous evaluation, Discipline, Punctuality, Assignment & Viva Voce	Day to day	20	……

Text Books:

T1. H S Bawa, "Workshop Practice", TMH, New Delhi, 2nd Edition, 2011

T2. B S Nagendra Parashar and R K Mittal, "Elements of Manufacturing Process", Prentice Hall of India, New Delhi, 2010 print

T3. B S Raghuwanshi, "A Course in Workshop Technology", Dhanpat Rai & Co., New Delhi, Volume I & II, 2011 reprint,

T4. Serope Kalpakjian and Steven R. Schmid, "Manufactuirng Engineering and Technology," Pearson Education (Low Cost Indian Edition), New Delhi, 4th Edition, 2005

Reference Books:

R1 K. Venkata Reddy, "Workshop Practice Manual", BS Publications, Hyderabad,6th Edition, 2011 print

R2 P. kannaiah and K. L. Narayana, "Engineering Practices Laboratory", SciTech Publications, Chennai, 2006

ENGINEERING GRAPHICS

Course Code : **CE101**

Course Title : **Engineering Graphics**

Course Credits : **2**

Total Hours per Week (L+T+P) : **0 + 0 + 3**

Course Syllabi:

Practical

- Introduction to Engineering Drawing & AutoCAD
- Drawing Setup, formatting, Basic Commands, Draw Toolbar
- Advanced Command, Object & Modify toolbar
- Orthographic Projection-I, Dimensioning
- Orthographic Projection-II, Orthographic Projection-III
- Isometric Projection-I, Isometric Projection-II, Isometric Projection-III

Evaluation Scheme:

EC No.	Evaluation Component	Duration	Marks	Nature of Component
1.	Mid Term Test-I	1 hour	20	Closed Book
2.	Mid Term Test-II	1 hour	20	Closed Book
3.	End Term Test / Comprehensive	3 hour	40	Closed Book
4.	Assignment(s)/ Quizzes*	30 min.	20	Open Book

Note: A total of 3 quizzes will be conducted. Out of these, the best performance will be considered for final evaluation.

Text Books:

T1. Kulkarni D M, Rastogi A P, Sarkar A K, Engineering Graphics with AutoCAD, PHI Learning Pvt. Ltd., New Delhi, India, Fourth Printing (Revised Edition), 2012.

T2. Bhatt N D, Engineering Drawing, Charotar Book Stall, Anand, India.

Reference Books:

R1 Jolhe D A, Engineering Drawing with an introduction to AutoCAD, TMH, New Delhi, India.

R2 Gill P S, Engineering Drawing (Geometrical Drawing), S K Kataria & Sons, Delhi, India.

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INSTITUTE OF ENGINEERING AND TECHNOLOGY

4 Year B. Tech Programme

(Branch: Common to all Branches)

Batch 2012-2016

SEMESTER-SECOND

Detailed Syllabus

&

Scheme of Examination

PROFESSIONAL COMMUNICATION SKILLS

Course Code	**:**	**LA 201**
Course Title	**:**	**Professional Communication Skills**
Course Credits	**:**	**03**
Total Hours per Week	**:**	**2+0+2**

Course Syllabi (Theory):

- Introduction to the course. Characteristic Features of Effective Communication and Ways to Overcome Barriers to Communication.
- Importance of Non-Verbal Communication. Importance of Paralinguistic Features and Vocal Cues.
- Group Discussion. Job Interviews.
- Public Speaking.
- Business Letters and Resume.
- Business Reports, Technical Proposals.
- E-mail Writing, Other Business Writings.
- Editing and Proofreading.

Text Book: Sanjay Kumar and Pushp Lata, Communication Skills, New Delhi: OUP, 2011.

Reference Books:

1. Meenakshi Raman and Sangeeta Sharma, Technical Communication: Principles and Practice, Second Edition, New Delhi: OUP, 2011.
2. Krishna Mohan and Meenakshi Raman, Effective English Communication, New Delhi: Tata-McGraw Hill, 2000.
3. Krishna Mohan and N.P.Singh, Speaking English Effectively, New Delhi: Macmillan,1994.
4. V. Sasikumar and P.V. Dhamija, Spoken English: A Self-Learning Guide to Conversation Practice, Tata-McGraw Hill, 2007.
5. Norman Lewis, Word Power Made Easy, Delhi: GoyalSaab Publishers and Distributors, 1994.

6. A.J.Thomson and A.V.Martinet, A Practical English Grammar, 4th Edition, New Delhi: OUP, 1999.
7. Asha Kaul, Business Communication, Second Edition, New Delhi: PHI, 2010.
8. Edgar Thorpe and Showick Thorpe, Objective English, 2nd Edition, New Delhi: Pearson Education, 2008.

Evaluation Scheme (Theory):

EC No.	Evaluation Component	Duration	Marks (100) (%)	Nature of Component
1.	Mid Term Test-I	1 hour	20	Closed Book
2.	Mid Term Test-II	1 hour	20	Open Book
3.	End Term Test / Comprehensive	3 hour	40	Closed Book
4.	Class Participation	Day to day	10	……..
4.	Assignment(s)/ Quizzes	30 min.	10	Open/Closed Book

Course Syllabi (Practical):

- Sounds of English
- Accent and Intonation
- Listening Skills
- Reading Comprehension
- Vocabulary Extension
- Professional Presentations
- Group Discussions
- Job Interviews

Evaluation Scheme (Practical):

EC No.	Evaluation Component	Duration	Marks (100) (%)	Nature of Component

1.	Mid Term Test	2 hour	20	Closed Book
2.	End Term Test	2 hour	40	Closed Book
3.	Class Participation	Day to day	15	… ……
4.	Continuous Evaluation (Discipline, Punctuality, Assignment & Viva Voce)	Day to day	25	……

Note: The ratio of weightage between Theory and Practical content will be (60% : 40% respectively)

ENGINEERING MATHEMATICS-II

Course Code	**:**	**MA201**
Course Title	**:**	**Engineering Mathematics - II**
Course Credits	**:**	**03**
Total Hours per Week (L+T+P)	**:**	**3+1+0**

Course Syllabi (Theory):

- **Ordinary Differential equation**: Differential equation of first order, Differential equation of higher order with constant coefficients, Differential equation of second order with variable coefficients, Solution in series
- **Partial differential equation**: Partial Differential Equations of First Order, Heat equation, wave equation, Laplace equation, Variable separable technique for solving PDE, Boundary value problems
- **Matrix Algebra**: Matrices, Rank of a Matrix, System of Linear Algebraic Equations, Linear Independence and Dependence, Eigen Values and Eigen Vectors, Diagonalization, Cayley Hamilton Theorem
- **Linear Algebra**: Unit Vector Space, Subspaces, Bases and Dimensions, Coordinates, Row Equivalence and Computations concerning Subspaces, Linear Transformations, The Algebra of Linear Transformations, Representation by matrices
- **3-Dimensional Geometry**: Equation of a sphere, Intersection of a sphere and a plane, tangent plane, Intersection of two spheres, orthogonality of two spheres, Right circular cone. Right circular cylinder

TEXT AND REFERENCE BOOKS

1. Dennis G. Zill and Warren S. Wright, *Advanced Engineering Mathematics*, Fourth Edition (Student Edition), Jones & Barlett, Viba, New Delhi, 2011
2. Peter V. O'Neil, *Advanced Engineering Mathematics*, Seventh Indian Reprint, Cengage Learning, New Delhi, 2011.
3. G.B. Thomas, Jr., *Thomas' calculus*, 11th edition (Indian), Pearson education, Delhi, 2008
4. Erwin Kreyszig, *Advanced Engineering Mathematics*, Wiley 9th Edition.
5. B.V.Ramana, *Higher Engineering Mathematics*, Tata Mcgra Hill.

Evaluation Scheme (Theory):

EC No.	Evaluation Component	Duration	Marks (100) (%)	Nature of Component
1.	Mid Term Test-I	1 hour	20	Closed Book
2.	Mid Term Test-II	1 hour	20	Open Book
3.	End Term Test / Comprehensive	3 hour	40	Closed Book
4.	Class Participation	Day to day	10	……..
4.	Assignment(s)/ Quizzes	30 min.	10	Open/Closed Book

ENGINEERING PHYSICS-II

Course Code	**:**	**PH201**
Course Title	**:**	**Engineering Physics - II**
Course Credits	**:**	**04**
Total Hours per Week (L+T+P)	**:**	**3+1+2**

Course Syllabi (Theory):

Application of Schrodinger Equations and Band Theory of Solids

- Particle in three-dimensional boxes, Degeneracy.
- Barrier penetration and tunnel effect, Tunneling probability, Alpha Decay.
- Distinction between Insulators, Semiconductors and Conductors, Intrinsic and Extrinsic Semiconductors.

Statistical Mechanics

- Introduction, Macroscopic and Microscopic Systems, Phase Space.
- Maxwell-Boltzman Statistics, Bose-Einstein Statistics, Fermi-Dirac Statistics.
- Sommerfeld Free Electron Gas Model of Solids.

Laser and Fibre Optics

- Theory of Laser Action, Einstein's Coefficients, Threshold Conditions for Laser Action.
- Theory, Design, and Applications of He-Ne Laser.
- Theory of Semiconductor Lasers.
- Optical Fibre, Numerical Aperture, and Maximum Angle of Acceptance.

Special Theory of Relativity

- Postulates of Special Theory of Relativity, Lorentz Transformations, Relativistic Velocity Addition.
- Relativity of Length, Mass, and Time, Mass-Energy Relation, Relativistic Energy and Momentum.

Nuclear Radiation Detectors

- Characteristics of Gas Filled Detectors, Constructions, Working, and Properties of Ionization Chamber.
- Proportional Counter, G.M. Counter, Paralysis Time, Quenching.
- Scintillation Counter.

Electro Dynamics

- Scalar and Vector fields, Definitions of Gradient, Divergence and Curl.
- Maxwell's Equations, Poynting vector.

Text Books:

T1. G.D. Ladiwala and S. S. Sharma, "Engineering Physics-I" New Age International Publication, New Delhi, I edn. 2010.

T2. G.D. Ladiwala and S. S. Sharma, "Engineering Physics-II" New Age International Publication, New Delhi, I edn. 2010.

Reference Books:

R1 Arther Beiser, "Concept of Modern Physics" Tata McGrawHill, New Delhi, 5th edn. 1997.

R2 Ajoy Ghatak, "Optics", Tata McGraw Hill, 4th edn

R3 Eyvind H Wichman, "Quantum Physics" Tata McGraw Hill, Volume 4

R4 Neeraj Mehta, "Applied Physics for Engineers", PHI, I edn. 2011

R5: Dattu R Joshi, "Engineering Physics", Tata McGraw Hill, New Delhi, I edn. 2010

Evaluation Scheme (Theory):

EC No.	Evaluation Component	Duration	Marks (100) (%)	Nature of Component
1.	Mid Term Test-I	1 hour	20	Closed Book
2.	Mid Term Test-II	1 hour	20	Open Book
3.	End Term Test / Comprehensive	3 hour	40	Closed Book
4.	Class Participation	Day to day	10	……..
4.	Assignment(s)/ Quizzes	30 min.	10	Open/Closed Book

Course Syllabi (Practical):

- To determine the height of object with the help of a Sextant.

- To determine the dispersive power of material of a Prism for Violet Red and Yellow colours of Mercury light with the help of a spectrometer.
- To determine the wave length of prominent lines of mercury by plane diffraction Grating with the help of spectrometer.
- To determine the ferromagnetic constants retentivity, permeability and susceptibility by tracing I-H curve using C.R.O.
- To study the Charge & Discharge of a condenser and hence determine time constant (Both current and voltage graphs are to be plotted).
- To determine the high resistance by method of leakage, using a Ballistic Galvanometer.
- To determine dielectric constant of a material using moving coil Ballistic Galvanometer.
- To study characteristics of G.M. Counting System.
- To determine the absorption coefficient of lead using lead sheet by G.M. Counting System.
- To verify the expression for the resolving power of a Telescope.
- To determine the specific resistance of the material of a wire by Carey Fosters Bridge.

Evaluation Scheme (Practical):

EC No.	Evaluation Component	Duration	Marks (100) (%)	Nature of Component
1.	Mid Term Test	2 hour	20	Closed Book
2.	End Term Test	2 hour	40	Closed Book
3.	Class Participation	Day to day	15	……
4.	Continuous Evaluation (Discipline, Punctuality, Assignment & Viva Voce)	Day to day	25	……

Note: The ratio of weightage between Theory and Practical content will be (60% : 40% respectively)

ENGINEERING CHEMISTRY-I

Course Code	**:**	**CH 201**
Course Title	**:**	**Engineering Chemistry- II**
Course Credits	**:**	**04**
Total Hours per Week (L+T+P)	**:**	**3+1+2**

Course Syllabi (Theory):

- Methods & introduction of Coal
- Introduction of Solid state and structure of solids, Cubic system & Bragg's law
- Structure and properties of graphite, Liquid Crystal
- Introduction of Kinetics, Arrhenius theory, Gibbs law
- One component system
- Corrosion, Mechanism of corrosion
- Introduction of Nanotechnology
- Introduction of Optical fiber
- Introduction of Fuel

Text Books:

2. Engineering Chemistry by Jain & Jain, **Dhanpatrai publication**

Reference Books:

6- Engineering Chemistry by B Sivasankar, (Mc-Graw Hill publication).
7- Engineering Chemistry by O.G. Palanna, (Mc-Graw Hill publication).
8- Organic Chemistry by Smith, (Mc-Graw Hill publication).
9- Organic Chemistry by IL Finar, (Pearson)
10- Engineering Chemistry (Wiely India publication).

Evaluation Scheme (Theory):

EC No.	Evaluation Component	Duration	Marks (100) (%)	Nature of Component
1.	Mid Term Test-I	1 hour	20	Closed Book

2.	Mid Term Test-II	1 hour	20	Closed Book
3.	End Term Test / Comprehensive	3 hour	40	Closed Book
4.	Class Participation	Day to day	10	……..
5.	Assignment(s)/ Quizzes	30 min.	10	Open/Closed Book

Course Syllabi (Practical):

- Proximate analysis of solid fuel.
- Determination of calorific value of solid fuels.
- Measurement of pH of given sample by pH meter.
- Measurement of conductivity of given sample by conductivity meter.
- Measurement of Fluoride in water sample.
- To determine the strength of copper sulphate with the help of Hypo solution.
- To determine the strength of Ferrous Ammonium sulphate solution
- To determine the strength of NaOH and Na_2CO_3 in given alkali mixture
- Determination of Barium as barium sulphate gravimetrically.
- Determination of Na/K/Ca by Flame photometer in a given sample.

Evaluation Scheme (Practical):

EC No.	Evaluation Component	Duration	Marks (100) (%)	Nature of Component
1.	Mid Term Test	2 hour	20	Closed Book
2.	End Term Test	2 hour	40	Closed Book
3.	Class Participation	Day to day	15	……
4.	Continuous Evaluation (Discipline, Punctuality, Assignment & Viva Voce)	Day to day	25	……

Note: The ratio of weightage between Theory and Practical content will be (60% : 40% respectively)

ELECTRICAL & ELECTRONICS ENGINEERING

Course Code	**:**	**EE201**
Course Title	**:**	**Electrical & Electronics Engineering**
Course Credits	**:**	**04**
Total Hours per Week (L+T+P)	**:**	**3+1+2**

Course Syllabi (Theory):

- Introduction to electrical circuits, Loop analysis, Node-voltage analysis
- Wye (Y) – Delta (Δ) and Delta (Δ) – Wye (Y) transformations
- Superposition theorem, Thevenin theorem
- Fundamental aspects of single phase ac supply, Phasor representation
- Steady state analysis of series circuits, Apparent, active and reactive power, power factor
- Three-phase supply and network, Measurement of three-phase power
- Basics of transformer, Practical single phase transformer, Auto transformer
- Rotating Electrical Machines, Introduction to Semiconductor
- Diode and its working, Applications of diodes
- Bipolar Junction Transistor, Transistor configuration

Text Books:

T_1: S.N.Singh "Basic Electrical Engineering", Prentice-Hall of India Pvt. Ltd, 2011.

T_2 J. Millman and C. Halkias, Integrated Electronics, McGraw Hill,2th Edition, 6th Indian Reprint, 2011

Reference Books:

R_1 T.K.Nagsarkar,M.S. Sukhija,"Basic Electrical Engineering", Oxford University press, 2nd edition, 2011.

R_2 A.S. Sedra and K.C. Smith, Microelectronic Circuits, Saunder's College Publishing, 1991.

Evaluation Scheme (Theory):

EC No.	Evaluation Component	Duration	Marks (100) (%)	Nature of Component
1.	Mid Term Test-I	1 hour	20	Closed Book

2.	Mid Term Test-II	1 hour	20	Closed Book
3.	End Term Test / Comprehensive	3 hour	40	Closed Book
4.	Class Participation	Day to day	10	……..
5.	Assignment(s)/ Quizzes	30 min.	10	Open/Closed Book

Course Syllabi (Practical):

ELECTRICAL LAB

1. Single line diagram of a power system and a distribution sub-station and basic functional study of main components used in power systems.
2. Make house wiring including earthing for 1-phase energy meter, MCB, ceiling fan, tube light,three pin socket and a lamp operated from two different positions. Basic functional study of components used in house wiring
3. Study the construction and basic working of ceiling fan, single phase induction motor and three phase squirrel cage induction motor. Connect ceiling fan along with regulator and single phase induction motor through auto-transformer to run and vary speed.
4. (a) Basic functional study and connection of moving coil & moving iron ammeters and voltmeters, dynamometer, wattmeter and energy meter.
   (b) Run a 3-phase squirrel cage induction motor at no load and measure its voltage, current,power and power factor. Reverse the direction of rotation.
5. Study the construction, circuit, working and application of the following lamps:
   (i) Fluorescent lamp, (ii) Sodium vapour lamp, (iii) Mercury vapour lamp, (iv) Halogen lamp and (v) Neon lamp
6. (a) Study the construction and connection of single phase transformer and auto-transformer.Measure input and output voltage and fin turn ratio.
   (b) Study the construction of a core type three phase transformer. Perform star and delta connection on a 3-phase transformer and find relation between line and phase voltage.

ELECTRONICS LAB

7. Identification, testing and applications of resistors, inductors, capacitors, PN-diode, Zener diode,LED, LCD, BJT, FET, UJT, SCR, Photo diode and Photo transistor.
8. (a) Functional study of CRO, analog & digital multi-meters and function / signal generator.
   (b) Study the single phase half wave and bridge rectifier and effects of filters on waveform.
9. Study the BJT amplifier in common emitter configuration. Measure voltage gain, plot gain frequency response and calculate its bandwidth.
10. (a) Study the construction and basic working of SCR.
    (b) Study the single phase half wave and bridge controlled rectifier and observe the effect of firing angle on waveform.

Evaluation Scheme (Practical):

EC No.	Evaluation Component	Duration	Marks (100) (%)	Nature of Component
1.	Mid Term Test	2 hour	20	Closed Book
2.	End Term Test	2 hour	40	Closed Book
3.	Class Participation	Day to day	15	……
4.	Continuous Evaluation (Discipline, Punctuality, Assignment & Viva Voce)	Day to day	25	……

Note: The ratio of weightage between Theory and Practical content will be (60% : 40% respectively)

ENGINEERING MECHANICS

Course Code	**:**	**ME 201**
Course Title	**:**	**Engineering Mechanics**
Course Credits	**:**	**3**
Total Hours per Week (L+T+P)	**:**	**3+1+0**

Course Syllabi (Theory):

- Fundamentals of engineering mechanics, Laws of Motion, Equilibrium, Conditions for equilibrium, Equations of equilibrium.
- Statics of Particles and Rigid Bodies: System of forces, Resultant force, Resolution of force, Moment and Couples.
- Trusses: Truss analysis, analysis of frames and machines.
- Friction: Types of Friction, Laws of friction, Angle of friction, Angle of repose, Applications of Friction.
- Lifting Machines: Mechanical advantage, Velocity Ratio, Efficiency of machine, Ideal machine, Ideal effort and ideal load, Reversibility of machine, Law of machine, Lifting machines; System of Pulleys, Simple wheel and axle, Wheel and differential axle, Weston's differential pulley block, Worm and worm wheel.
- Properties of Plane Surfaces: Centroids & Centre of Mass, area of moments, principle moments of inertia, Second moment of mass.
- Virtual work: Principle of Virtual Work, Active forces and active force diagram.
- Kinematics of Particles and Rigid Bodies: Velocity, Acceleration, Types of Motion, Equations of Motion, Rectangular components of velocity and acceleration, Angular velocity and Angular acceleration, Radial and transverse velocities and accelerations, Projectiles motion on plane and Inclined Plane, Relative Motion.
- Kinetics of Particles and Rigid Bodies: Equation of motion in rectangular coordinate, radial and transverse components, Equation of motion in plane for a rigid body.
- Work, Energy and Power: Work of a force, weight, spring force and couple, Power, Efficiency, Energy, Kinetic energy of rigid body, Principle of work and energy, Conservative and Non-conservative Force, Conservation of energy.
- Impulse and Momentum: Linear and angular momentum, Linear and angular impulse, Principle of momentum for a particle and rigid body, Principle of linear impulse and momentum for a particle and rigid body, Principle of angular momentum and Impulse, Conservation of angular momentum, Angular momentum of rigid body.

Reference Books:

R1. Vector Mechanics for Engineers, Beer and Johnston, Tata McGraw-Hill.

R2. Engineering Mechanics, Hibbeler, Pearson Education.

R3. Engineering Mechanics, Meriam and Kraige, John Wiley & Sons.

R4. Engineering Mechanics, Timoshenko and Young, Tata McGraw-Hill.

R5. Engineering Mechanics, Shames, Pearson Education.

R6. Engineering Mechanics, Boresi and Schmidt, CL-Engineering.

R7. Engineering Mechanics, Andrew Pytel & Kiusalas, Cengage Learning.

Evaluation Scheme (Theory):

EC No.	Evaluation Component	Duration	Marks (100) (%)	Nature of Component
1.	Mid Term Test-I	1 hour	20	Closed Book
2.	Mid Term Test-II	1 hour	20	Closed Book
3.	End Term Test / Comprehensive	3 hour	40	Closed Book
4.	Class Participation	Day to day	10	…….
5.	Assignment(s)/ Quizzes	20-60 min	10	Open/Closed Book

MACHINE DRAWING

Course Code	**:**	**ME 241**
Course Title	**:**	**Machine Drawing**
Course Credits	**:**	**3**
Total Hours per Week (L+T+P)	**:**	**0+0+3**

Course Syllabi (Practical):

- **SECTIONAL VIEWS:** Conversion of pictorial view into sectional orthographic projections, sectional views with different types of sections such as revolved, broken aligned section missing views. Representation of those views with Auto-CAD
- **ADVANCE ISOMETRIC VIEWS:** Isometric view of complex objects and Machine Parts "Sectional Isometric Views" with AutoCAD
- Introduction to Oblique views and perspective projection and exploded views of an assembly using AutoCAD
- **INTERSECTION OF SURFACE:** Interpenetration of solids, prism and prism, cylinder and cylinder, cylinder and prism, cone and cylinder, cone and prism.
- **LATEST ISI CONVENTIONS:** Conventions covering the standard practice in machine drawing. Conventions for various components like bearing, gears, springs, key and key ways, threads, tap holes and materials. Working drawing for welded joints, Use of specifications for limits, fits and tolerances, Conventions used for surface roughness i.e. Machined surface, rough surface, etc. Bearing and bearing mountings, Engine and machine tool components.

Text Books:

T1. Yarwood, Alf. **"Introduction to Auto – CAD 2011 2D and 3D Design",** Elsevier, **1st** edition, 2010

T2. Ellen Finkelstein, **"Auto-CAD 2011 & Auto-CAD LT 2011 Bible,"** Wiley India Edition

T3. Ajeet Singh, **"Machine Drawing: Includes AutoCAD,"** TMH, 2nd edition

Reference Books:

R1 Bhatt, N.D. "**Machine Drawing**", Charotar Pulisher, 38th edition, 2003.

R2 James E Fuller, **"Using Auto-CAD,"** Denmark Publishing Co.

R3 Dhawan, R.K. "**Machine Drawing**", S. Chand and Co, 2005

R4 Radhakrishnan, P., **"Computer Graphics and Design**", Dhanpatrai and Sons.

Evaluation Scheme:

EC No.	Evaluation Component	Duration	Marks (100) (%)	Nature of Component
1.	Mid Term Test	2 hour	20	Closed Book
2.	End Term Test	2 hour	40	Closed Book
3.	Class Participation	Day to day	15	……
4.	Continuous Evaluation (Discipline, Punctuality, Assignment & Viva Voce)	Day to day	25	……

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INSTITUTE OF ENGINEERING AND TECHNOLOGY

4-Year B. Tech Programme

(Branch: Chemical Engineering)

Batch 2012-2016

SEMESTER-THIRD

Detailed Syllabus

&

Scheme of Examination

CHEMICAL PROCESS CALCULATIONS

Course Code	**:**	**CHE301**
Course Title	**:**	**Chemical Process Calculations**
Course Credits	**:**	**5.5**
Total Hours per week (L+T+P)	**:**	**3+1+0**

Course Syllabi (Theory):

- Units and Dimensions, Conversion of units and conversion factors, Dimensional consistency and Mole unit, Density, specific gravity, mole fraction and mass fraction, Basis, Temperature and Pressure
- The chemical Equation and stoichiometry, The material balance, Program of Analysis of Material balance problems, Material balances without chemical reactions, Material balances with chemical reactions, Solving material balance problems involving multiple subsystems
- Recycle bypass and purge calculations, Ideal gas law calculations, ideal gas mixtures and partial pressure, Vapor pressure, saturation, Partial saturation and humidity
- The General energy balance, Calculation of enthalpy changes, Energy balances that account for chemical reactions
- Heats of solution and mixing, Humidity charts and their use, Analyzing the degrees of freedom in a steady-state process, solving material and energy balances using flow sheeting codes

Evaluation Scheme (Theory):

EC No.	Evaluation Component	Duration	Marks (100) (Weightage %)*
1.	Mid Term Test-I	1 hour	20
2.	Mid Term Test-II	1 hour	20
3.	End Term Test	3 hour	40
4.	Class Participation	Day to day	10
5.	Additional continuous Evaluation (Quizzes, Assignments, Presentations, and others)	30 min.	10

Text Book:

1. Himmelblau, D. M. “Basic principles & calculations in chemical Engg”, PHI, 6th ed., 1997.

Reference Book:

2. Felder, R. M. & R. W. Rousseau, “Elementary Principles of Chemical Processes”, John Wiley & Sons, Inc., 3rd ed., 2000.

FLUID FLOW OPERATIONS

Course Code	**:**	**CHE302**
Course Title	**:**	**Fluid Flow Operations**
Course Credits	**:**	**7**
Total Hours per week (L+T+P)	**:**	**3+1+2**

Course Syllabi (Theory):

- Definition of a fluid, Basic equations, Dimensions and unit, Dimensionless equations and Consistent units, Dimensional equations, Method of analysis.
- Concept of fluid continuum, Velocity and stress field, Viscosity, Viscosity of gases and liquids, Surface tension, Description and classification of fluid motions.
- Basic equations of fluid statics, Pressure variation in static fluids, Hydrostatic Equilibrium in a centrifugal field, Buoyancy and stability.
- Basic laws for a system, Conservation of mass and momentum equations for integral control volumes, Angular momentum principle [fixed control volume analysis only], First and second law of thermodynamics.
- Conservation of mass and momentum equation [Navier-Stokes equations: Rectangular coordinates only], Motion of fluid elements.
- Euler's equations, Bernoulli's equation, Relation between first law of thermodynamics and Bernoulli's equation
- Buckingham PI theorem/ Reyleigh method, Significant dimensionless group in fluid mechanics
- Flow between parallel plates, Flow in pipes of various cross-sections, Energy considerations of the flow, Pumps, Flow measurement techniques (venturi and orifice meters, pitot tubes etc.)
- Boundary layer concept, Boundary layer thickness, Pressure gradient in boundary layer, Drag & flow through beds of solids
- Agitated vessels and accessories, flow patters in vessels, velocity patterns

  and gradients, power consumption, blending & mixing, static mixers

Course Syllabi (Practical):

Sr. No.	NAME OF THE EQUIPMENTS
1	BERNOULLI'S THEOREM
2	LOSSES DUE TO FRICTION IN PIPE LINES
3	LOSSES DUE TO PIPE FITTINGS, SUDDEN ENLARGEMENT & CONTRACTION
4	DISCHARGE THROUGH VENTURIMETER, ORIFICEMETER & ROTAMETER
5	PITOT TUBE
6	DARCY'S LAW APPARATUS
7	PRESSURE DROP THROUGH PACKED BED
8	HYDRODYNAMICS OF PACKED BED
9	FLUIDIZED BED CHARACTERISTICS
10	FLOW THROUGH HELICAL COIL
11	DRAG CO-EFFICIENT APPARATUS
12	PRESSURE DROP IN TWO PHASE FLOW

Evaluation Scheme (Theory):

EC No.	Evaluation Component	Duration	Marks (100) (Weightage %)*
1.	Mid Term Test-I	1 hour	20
2.	Mid Term Test-II	1 hour	20
3.	End Term Test	3 hour	40
4.	Class Participation	Day to day	10
5.	Additional continuous Evaluation (Quizzes, Assignments, Presentations, and others)	30 min.	10

Evaluation Scheme (Practical):

EC No.	Evaluation Component	Duration	Marks (100) (Weightage %)*
1.	Mid Term Test	2 hour	20
2.	End Term Test	2 hour	40
3.	Class Participation and/or Attendance	Day to day	15
4.	Additional Continuous Evaluation (Assignments, Discipline, Punctuality, & Viva Voce)	Day to day	25

***Note: The ratio of weightage between Theory and Practical content will be (60%: 40% respectively)**

Text Books

T1 Fox, R.W. and A.T. McDonalds, *Introduction to Fluid Mechanics (5th Ed.)*, John Wiley & Sons Inc., 2001. [ISBN: 9971-51-355-2]

T2 McCabe, W.L., J.C. Smith and P. Harriott, *Unit Operations of Chemical Engineering (7th Ed.)*, McGraw Hill Inc., 2005. [ISBN 007-124710-6]

Reference Books

R1 Bird, R.B., W.E. Stewart and E.N. Lightfoot, *Transport Phenomena (2nd Ed.)*, John Wiley and Sons Inc., 2002.

R2 Welty, J.R., C.E. Wicks, R.E. Wilson, and G. Rorrer, *Fundamentals of Momentum, Heat and Mass Transfer (4th Ed.)*, John Wiley and Sons Inc., 2001.

R3 Coulson, J. M. and J. F. Richardson (with J. R. Backhurst and J. H. Harker), *Coulson & Richardson's Chemical Engineering- Volume 1 (5th Ed.)*, Pergamon Press.

HEAT TRANSFER OPERATIONS

Course Code	**:**	**CHE303**
Course Title	**:**	**Heat Transfer Operations**
Course Credits	**:**	**7.5**
Total Hours per Week (L+T+P)	**:**	**3 + 1 + 3**

Course Syllabi (Theory):

- Analogy with momentum transfer, Introduction to conductive, convective and radiative heat transfer
- One dimensional steady state conduction for cartesian, radial and spherical coordinate system, with and without heat source, Fins and their function, Thermal contact resistance
- Lumped heat capacity system, Transient heat flow in a semi-infinite solid, Convective boundary conditions
- Viscous flow; Inviscid flow; Laminar and turbulent boundary layer; Boundary layer heat transfer
- Empirical relations for pipe and tube flow; Flow across cylinders and spheres; Flow across tube banks; Liquid metal heat transfer
- Theory and empirical relations for free convection from different geometric configurations such as plates, inclined surface, cylinder, sphere etc.; Combined free and forced convection
- Mechanism and properties of radiation; Shape factor; Back body and gray body radiation; Gas radiation; Radiation shield; Radiation network
- Theory and empirical relations for film and dropwise condensation and boiling phenomena; Heat pipe
- Concept of overall heat transfer coefficient; LMTD method, effectiveness-NTU method, and Kern's method for heat exchanger design; Compact heat exchangers
- Types of evaporators; Evaporator capacity and economy; Single and multiple effect evaporators

Course Syllabi (Practical):

List of Experiments	
No.	Name of the experiment
1.	*Friction in pipelines and fittings*
2a.	Flow through packed beds

2b.	Flow through fluidized beds
3.	Diffusion coefficient
4.	Gas absorption
5.	*Helical coil heat exchanger*
6.	Shell and tube heat exchanger
7.	Double pipe heat exchanger
8.	Heat transfer in boiling kettle
9.	Mass transfer with chemical reaction.

Evaluation Scheme (Theory):

EC No.	Evaluation Component	Duration	Marks (100) (Weightage %)*
1.	Mid Term Test-I	1 hour	20
2.	Mid Term Test-II	1 hour	20
3.	End Term Test	3 hour	40
4.	Class Participation	Day to day	10
5.	Additional continuous Evaluation (Quizzes, Assignments, Presentations, and others)	30 min.	10

Evaluation Scheme (Practical):

EC No.	Evaluation Component	Duration	Marks (100) (Weightage %)*
1.	Mid Term Test	2 hour	20
2.	End Term Test	2 hour	40
3.	Class Participation and/or Attendance	Day to day	15
4.	Additional Continuous Evaluation (Assignments, Discipline, Punctuality, & Viva Voce)	Day to day	25

***Note: The ratio of weightage between Theory and Practical content will be (60%: 40% respectively)**

Text book (TB):

1. Holman, J.P., "Heat Transfer (9th Ed.)", McGraw Hill, 2002.

Reference books (RB):

1. McCabe, W.L., J.C. Smith, and P. Harriott, "Unit Operations of Chemical Engineering (6th Ed.)", McGraw Hill, 2001.
2. Bird, R.B., W.E. Stewart, and E.N. Lightfoot, "Transport Phenomena", John Wiley & Sons, 1994.
3. Welty, J.R., C.E. Wicks, R.E. Wilson, and G.L. Rorrer, "Fundamentals of Momentum, Heat and Mass Transfer (4th Ed.)", John Wiley & Sons, 2001.
4. Binay, K. Dutta, "Heat Transfer- Principles and Applications (1st Ed.) ", Prentice-Hall of India, 2001.

UNIT PROCESSES IN ORGANIC SYNTHESIS

Course Code	**:**	**CHE304**
Course Title	**:**	**Unit Processes in Organic Synthesis**
Course Credits	**:**	**04**
Total Hours per week (L+T+P)	**:**	**3+0+0**

Course Syllabi (Theory):

Atoms to molecules to materials for Engineers, Hybridization, sigma and pi bonds shape of the simple inorganic compounds, Molecular orbital theory and its application; Structure and stereo structure of molecules, Conformations, Newman, Sawhorse, Fischer, projections wedge and dash structural representation, equivalence of structural representations, Chirality, optical activity and isomerism, Dynamic stereochemistry, Geometrical isomerism in simple acyclic and cyclic molecules; Materials and their Characterization, Micro and macroscopic properties of molecules, Intermolecular forces, Molecular aggregation micelles; Purification, Physical (crystallization, fractional crystallization , distillation , fractional distillation, steam distillation) and chemical methods of purification; General chromatographic (Adsorption and partition) techniques(column thin layer and paper chromatography) and their application; Criteria of purity, Melting and Boiling point, chromatography , particle size measurement and surface area Characterization, Surface tension, Viscosity ,Conductivity , and Absorption Spectroscopy (IR, UV – Visible , NMR); Stability and Reactivity of Molecules, Electron displacement effects – inductive, electromeric, resonance and hyper conjugation, Reactive sites in molecules - functional groups. Reactions Dynamics, Chemical kinetics, Order and molecularity, zero, first and second order reactions, pseudo first order reaction , temperature dependence of reaction rates, Catalysis and some industrially important catalytic reactions; Reaction Mechanism, Fission of a covalent Bond, types of reactions – nucleophilic (SN1 & SN2, SNi, SNAr) and electrophilic substitution reactions (Nitration, Sulphonation, Halogenation, and Friedel Crafts reaction) and their mechanism , regio and Stereochemistry of involved reactions; Water and its treatment , Alkalinity of water, estimation of alkalinity, Hard and soft water, hardness- units, determination of hardness by complexometric Titration, Removal of hardness of water- Zeolite , ion exchange process, Boiler Feed water, descaling of boilers desalination of brackish water, Reverse osmosis, potable water; Polymers and Polymerization (ionic, anionic and free radical induced), Properties of polymers , Number average and Weight average molecular weighs, characterization of polymer samples , polymer blends, Stereo structures of polymers, Dendrimers, Some examples of common polymers used in Industry, Natural and Synthetic rubber, Silicones, Composites, Adhesives, Conducting polymers, Biodegradable polymers; Metallic corrosion and its prevention, electrolysis , Industrial electrolytic processes-(aluminium). Fuel cells and batteries.

Evaluation Scheme (Theory):

EC No.	Evaluation Component	Duration	Marks (100) (Weightage %)*

1.	Mid Term Test-I	1 hour	20
2.	Mid Term Test-II	1 hour	20
3.	End Term Test	3 hour	40
4.	Class Participation	Day to day	10
5.	Additional continuous Evaluation (Quizzes, Assignments, Presentations, and others)	30 min.	10

Text/References Books:

1. Organic Chemistry, P.Y. Bruice , Ninth Impression, 2011, Pearson India
2. Chemistry 3 , A. Burrows, john Holman, A, Parsons, G. Pilling, G.Price, Oxford University Press, 2009
3. Engineering Chemistry, A Text book of Chemistry for Engineers published by John Wiley and Sons,India 2011
4. Unit processes in Organic Synthesis by Groggins, Tata McGraw Hill, 2001
5. Spectroscopic Methods in Organic Chemistry, D H Williams and I. Fleming, Tata McGraw Hill, 1991

ENGINEERING MATHEMATICS - III

Course Code	**:**	**MA301**
Course Title	**:**	**Engineering Mathematics – III**
Course Credits	**:**	**5.5**
Total Hours per week (L+T+P)	**:**	**3+1+0**

Course Syllabi (Theory):

- Introduction of Integral transform, basic definition of Laplace Transform (LT), condition for existence of LT, The inverse transform and transforms of derivatives
- Translation theorems, Additional operational properties: Derivatives of transforms, transform of integrals and periodic functions, Dirac delta function, Error function, Applications of LT:ODE, system of linear differential equations, PDE
- Fourier Integral, Fourier Transform: definition and properties, Fast Fourier transform, Special functions, Sturm-Liouville Problem, Bessel Function, Legendre Function
- Calculus of variation, Functions of complex variable, Analytic function, Cauchy-Riemann(CR) equations, Contour integral, Cauchy-Goursat Theorem, Independence of path, Cauchy Integral formula
- Taylor series and Laurent series, Zeros and Poles, Residue and Residues Theorem, Evaluation of real integrals, Conformal mappings

Evaluation Scheme (Theory):

Sr. No.	Evaluation Component	Duration	Marks (100) (%)
1.	Mid Term Exam	2 hours	20%
2.	End Term Exam	3 hours	50%
3.	Continuous Evaluation (Quizzes, Assignments, Presentations, Class Participation)	-	30%

Textbook

T1 Dennis G. Zill and Warren S. Wright, *Advanced Engineering Mathematics*, Fourth

Edition (Student Edition), Jones & Barlett, Viba, New Delhi, 2011

Reference Books

R1 B V Ramana, *Higher Engineering Mathematics*, Tata McGrawHill publication, New Delhi, 2011.

R2 Peter V. O'Neil, *Advanced Engineering Mathematics*, Seventh Indian Reprint, Cengage Learning, New Delhi, 2011.

R3 Kreyszig, E., *Advanced Engineering Mathematics*, John Willey, Delhi (2011).

R4 Potter M.C., Goldberg J.L., Edward F.A., *Advanced Engineering Mathematics*, 3rd Edition, Oxford University Press, 2005.

FOUNDATION OF MANAGEMENTS

Course Code	**:**	**BBA011**
Course Title	**:**	**Foundation of Management**
Course Credits	**:**	**4**
Total Hours Per Week (L+T+P)	**:**	**3+0+0**

Course Syllabi (Theory):

- **Concepts of management:** Functions and Responsibilities of managers, Principles of management and visiting various, Schools of management Thoughts in developing, Excellent managers
- **Planning:** Nature and purpose of planning, Planning process and principles, Types of planning, Advantages and disadvantages of planning, Concept of objectives and types of objectives, Case analysis
- **Organizing:** Nature and purpose of organizing, Process of organizing, Span of management and determination of span of management, Principles of organizing, Departmentalization, delegation and, Decentralization. Case analysis
- **Directing and leading:** Requirements of Effective directions, Giving orders, motivation, Nature of leadership, leadership and management, Recapitulation and case discussion
- **Controlling:** concept and process, Need for controlling and types of control methods, Essentials of effective control, Benefits and problems in control systems. Case analysis
- Social responsibilities of business: Meaning, Social responsibility of business towards different groups, Social performance of business in India, Social audit, Business ethics and corporate governance

Evaluation Scheme (Theory):

Sr. No.	Evaluation Component	Duration	Marks (100) (%)
1.	Mid Term Exam	2 hours	20%

2.	End Term Exam	3 hours	50%
3.	Continuous Evaluation (Quizzes, Assignments, Presentations, Class Participation)	-	30%

Text Books:

T1. Tripathy, P.C. and Reddy, P. N. "Principles of Management". . McGraw Hill, New Delhi. 4th ed. 2008.

Reference Books:

R1 Koontz, Herold and Weihrich, Heinz. "Management". McGraw Hill, New York. 9th ed. 1988.

R2 Stoner, James A. F. and Freeman, R Edward. "Management". Prentice Hall of India, New Delhi. 6th e, 1989.

R3 Bateman, T. S. and Snell, S. A. "Management: Leading and Collaborating in a Competitive World", McGraw Hill Irwin. 8th edition,2009.

R3 Draft, R. L. "Principles of Management". Cengage learning.2009

R4 Schermerhron, J. R. "Introduction to Management", 10th edition, Wiley India. 2009

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INSTITUTE OF ENGINEERING AND TECHNOLOGY

4-Year B. Tech Programme

(Branch: Chemical Engineering)

Batch 2012-2016

SEMESTER-FOURTH

Detailed Syllabus

&

Scheme of Examination

CHEMICAL REACTION ENGINEERING

Course Code	**:**	**CHE401**
Course Title	**:**	**Chemical Reaction Engineering**
Course Credits	**:**	**7.5**
Total Hours per Week (L+T+P)	**:**	**3 + 1 + 3**

Course Syllabi (Theory):

- Scope and objectives of the course, methodology, concept of mole balances, Different types of reactors, mole balances, Conversion and reactor sizing, Reactor sizing for batch and flow systems
- Basic definitions and stoichiometric tables, Design structure, design of batch and flow reactors, Pressure drop in reactors, Reversible reactions and unsteady-state operation
- Differential and integral methods of analysis, Differential reactors, comparison of experimental reactors, Maximizing desired product in parallel and series reactions
- Stoichiometric tables, Applications of PSSH and specific examples, Energy balance, Steady state reactor design of CSTR and PER, Equilibrium conversion, nonadiabatic operation, multiple study states, multiple reactions, Batch reactors
- Catalysts and mechanism of catalytic reactions, Mechanism, rate-limiting step and rate law, Design of reactors for Gas-solid reactions, Deducing the rate law from experimental data; CVD, Diffusion and reaction in porous catalysts
- RTD, measurement and characteristics, RTD in ideal reactors, Zero-parameter models, One-parameter models, Two-parameter models

Course Syllabi (Practical):

1. ISOTHERMAL C.S.T.R.
2. CASCADE C.S.T.R.
3. PLUG FLOW REACTOR (STRAIGHT TUBE TYPE)
4. ISOTHERMAL PLUG FLOW REACTOR (COILED TUBE TYPE)
5. ISOTHERMAL BATCH REACTOR
6. ISOTHERMAL SEMI-BATCH REACTOR
7. PACKED BED REACTOR
8. COMBINED FLOW REACTOR
9. LIQUID PHASE CHEMICAL REACTOR
10. RTD STUDIES IN C.S.T.R.

11. RTD STUDIES IN PLUG FLOW REACTOR (COILED TUBE TYPE)

12. RTD OF PACKED BED REACTOR

13. HYDRODYNAMICS OF TRICKLE BED REACTOR

14. CONDENSATION POLYMERISATION

15. SPINNING BASKET REACTOR

Evaluation Scheme (Theory):

EC No.	Evaluation Component	Duration	Marks (100) (Weightage %)*
1.	Mid Term Test-I	1 hour	20
2.	Mid Term Test-II	1 hour	20
3.	End Term Test	3 hour	40
4.	Class Participation	Day to day	10
5.	Additional continuous Evaluation (Quizzes, Assignments, Presentations, and others)	30 min.	10

Evaluation Scheme (Practical):

EC No.	Evaluation Component	Duration	Marks (100) (Weightage %)*
1.	Mid Term Test	2 hour	20
2.	End Term Test	2 hour	40
3.	Class Participation and/or Attendance	Day to day	15
4.	Additional Continuous Evaluation (Assignments, Discipline, Punctuality, & Viva Voce)	Day to day	25

***Note: The ratio of weightage between Theory and Practical content will be (60%: 40% respectively)**

Text Book:

H. Scott Fogler "Elements of Chemical Reaction Engineering", PHI, 3rd Ed, 2002.

Reference Books:

1. O. Levenspiel, "Chemical Reaction Engineering", John Wiley, 3rd Ed., 1999.
2. J.M. Smith, "Chemical Engineering Kinetics", McGraw Hill, 3rd Ed., 1981.

MASS TRANSFER OPERATIONS

Course Code	**:**	**CHE402**
Course Title	**:**	**Mass Transfer Operations**
Course Credits	**:**	**7.5**
Total Hours per Week (L+T+P)	**:**	**3 + 1 + 3**

Course Syllabi (Theory):

- Unit operations and unit process, Basic concepts: phase, equilibrium, property, system, driving force, chemical potential. Classification of mass transfer operations.
- Molecular diffusion and fluxes, Molecular diffusion in Gases (stagnant film, equimolal counter diffusion), Diffusivity of gases and liquids.
- Relations between mass transfer coefficients, Reynolds analogy. Equilibrium, diffusion between phases, material balances, stages.
- Equilibrium solubility of gases in liquids, one component transfer: material balance for counter - and co-current processes, multi stage operations, non-isothermal operations, calculation of height of packed absorber/desorber, multi-component systems, absorption with chemical reaction.
- Vapor-liquid equilibrium, flash vaporization, differential distillation, Continuous distillation, multistage columns, overall mass and enthalpy balances, McCabe-Thiele method, Ponchon-Savarit method, use of open steam, multiple feed, side streams, azeotropic and extractive distillations.
- Liquid-liquid equilibrium, distribution curves, triangular and solvent free coordinates, systems of three liquids-one pair partially soluble, insoluble liquids, effect of temperature, continuous counter-current multi-stage extraction, continuous counter-current extraction with reflux.
- Solid-liquid extraction, underflow and overflow locus, Multistage cross current extraction, Calculation of no. of stages for cross current flow.

Course Syllabi (Practical):

Sr. No.	NAME OF THE EQUIPMENTS
1	LIQUID-LIQUID EXTRACTION IN A PACKED TOWER
2	YORK SCHEIBEL'S EXTRACTION UNIT
3	SOLID-LIQUID EXTRACTION (BONNOTTO TYPE)

4	SIEVE PLATE DISTILLATION COLUMN
5	SIMPLE BATCH DISTILLATION SETUP
6	ABSORPTION IN WETTED WALL COLUMN
7	VAPOUR IN AIR DIFFUSION APPARATUS
8	FLUIDIZED BED DRYER
9	BATCH CRYSTALLIZER
10	VAPOUR-LIQUID EQUILIBRIUM SET-UP
11	MASS TRANSFER WITH & WITHOUT CHEMICAL REACTION (SOLID- LIQUID)
12	ADSORPTION IN PACKED BED

Evaluation Scheme (Theory):

EC No.	Evaluation Component	Duration	Marks (100) (Weightage %)*
1.	Mid Term Test-I	1 hour	20
2.	Mid Term Test-II	1 hour	20
3.	End Term Test	3 hour	40
4.	Class Participation	Day to day	10
5.	Additional continuous Evaluation (Quizzes, Assignments, Presentations, and others)	30 min.	10

Evaluation Scheme (Practical):

EC No.	Evaluation Component	Duration	Marks (100) (Weightage %)*
1.	Mid Term Test	2 hour	20
2.	End Term Test	2 hour	40
3.	Class Participation and/or Attendance	Day to day	15
4.	Additional Continuous Evaluation (Assignments, Discipline, Punctuality, & Viva Voce)	Day to day	25

*Note: **The ratio of weightage between Theory and Practical content will be (60%: 40% respectively)**

Text Books:

T1. Treybal, R.E., "Mass Transfer Operations," 3rd Ed. (International Edition), McGraw-Hill Book Company, Singapore, 1980.

T2. McCabe, W. L., Smith, J. C., Harriott, P., "Unit Operations of Chemical Engineering," 7th Ed. (International Edition), McGraw-Hill Education (Asia), Singapore, 2005.

Reference Books:

R1. Foust, A. S., Wenzel, L. A., Clump, C. W., Anderson, L. B., "Principles of Unit Operations," 2nd Ed., John Wiley and Sons, New York, 1980.

R2. Perry, R. H., Green, D. W., "Perry's Chemical Engineers' Hand Book," 7th Ed., McGraw-Hill, New York, 2001.

CHEMICAL ENGINEERING THERMODYNAMICS

Course Code	**:**	**CHE403**
Course Title	**:**	**Chemical Engineering Thermodynamics**
Course Credits	**:**	**5.5**
Total Hours per Week (L+T+P)	**:**	**3 + 1 + 0**

Course Syllabi (Theory):

- Scope and Objectives of course, methodology, First law, Closed System, State and State functions
- Equilibrium, Phase rule, Reversible Process, Const-V and Const-P Processes,Enthalpy, heat capacity, First law for Open systems, PVT behaviour of pure substances, Virial Equations, Ideal gas
- Applications of Virial Equations, Cubic Equations of State, Generalized correlations for gases and liquids, Sensible heat effects, Latent heat, Standard heats of reaction, formation, combustion
- Temperature dependence of $\Delta H°$, heat effects of industrial reactions, Statements of second law, Heat engines, Thermodynamic temperature Scale, Entropy, ΔS for an ideal gas, Entropy balance for Open Systems, Ideal work, Lost work, Third law, Property relations for homogeneous phases.
- Residual properties and their calculations by cubic equations, Two-phase systems, thermodynamic diagrams and tables
- Generalized property correlations for gases, Duct flow of compressible fluids, Expansion Processes, Compression Processes, Carnot refrigerator, Vapour-compression cycle, Choice of refrigerant, Absorption refrigeration, Heat pump, Liquefaction Processes
- Nature of Equilibrium, Phase rule, Duhem's theorem, VLE; Qualitative behavior, Simple models for VLE, VLE by Modified Raoult's law, K-value correlations, Fundamental Property Relation, Chemical potential and Phase equilibrium, Partial Properties, Ideal gas mixtures, Fugacities of pure species
- Fugacities of Species in solution, Generalized Correlations, Ideal Solution, Excess Properties,
- Liquid-phase properties from VLE data, Models for Excess Gibbs energy, Property changes of Mixing, Heat effects of Mixing processes, Reaction coordinate, Equilibrium criteria for chemical reactions, Equilibrium constants and their variation with temperature
- Evaluation of Equilibrium constants, Relation of Equilibrium Constants with Compositions, Equilibrium conversions for Single Reactions, Phase Rule and Duhem's theorem for Reacting Systems, Multireaction Equilibria

Evaluation Scheme (Theory):

EC No.	Evaluation Component	Duration	Marks (100) (Weightage %)*
1.	Mid Term Test-I	1 hour	20
2.	Mid Term Test-II	1 hour	20
3.	End Term Test	3 hour	40
4.	Class Participation	Day to day	10
5.	Additional continuous Evaluation (Quizzes, Assignments, Presentations, and others)	30 min.	10

Text Book:

1. J.M.Smith, and Others,"Intro to Chemical Engineering Thermodynamics", MGHFSE, 6th ed., 2001.

Reference Books:

2. YVC Rao, "Chemical Engineering Thermodynamics", Universities Press,1997.
3. KV Narayanan, "A Textbook of Chemical Engineering Thermodynamics". Prentice Hall of India, 2001.

ENERGY ENGINEERING

Course Code	**:**	**CHE421 (Elective-I)**
Course Title	**:**	**Energy Engineering**
Course Credits	**:**	**4**
Total Hours Per Week (L+T+P)	**:**	**3 + 0 + 0**

Course Syllabi (Theory):

Sources of Energy; Energy Conversion and Conservation; Energy efficiency, energy services; Plant engineering, environmental compliance and alternative energy technologies; Power generation by steam, Hydroelectric, Diesel oil, Nuclear fission and Natural gas, Co-generation of power. Selection of power generation process; Energy Economic Analysis, Energy Auditing and Accounting, Energy minimization; Energy Loads; Application in building design, HVAC, lighting, refrigeration, etc. to both reduce energy loads and increase efficiency of current systems; Energy production, conversion, transference, distribution, and utilization; Sustainability; Energy Management; Climate Change and Climate Modeling; Carbon Sequestration and Carbon reduction targets;

Evaluation Scheme (Theory):

EC No.	Evaluation Component	Duration	Marks (100) (Weightage %)*
1.	Mid Term Test-I	1 hour	20
2.	Mid Term Test-II	1 hour	20
3.	End Term Test	3 hour	40
4.	Class Participation	Day to day	10
5.	Additional continuous Evaluation (Quizzes, Assignments, Presentations, and others)	30 min.	10

Text Books

1. Albert Thumann, D. Paul Mehta, "Handbook of Energy Engineering", Fairmount Press Inc., 2008
2. Roger A. Hinrichs, Merlin H. Kleinbach, "Energy: Its uses and the environment", Cengage Learning, 5th edition, 2011

References:

1. Tyler Hicks, " Handbook of Energy engineering Calculations", Mc Graw Hill Professional, 2011
2. Francis, W and M.C. Peter, "Fuels and fuel technology", Pergamon Press, 1980.
3. Nagpal, G.R, "Power Plant Engineering", Khanna Publishers, 1973
4. Rused, C. K., Elements of Energy Conservation , McGraw-Hill Book Co., 1985

ENERGY CONSERVATION & MANAGEMENT

Course Code	**:**	**CHE422 (Elective-I)**
Course Title	**:**	**Energy Conservation & Management**
Course Credits	**:**	**04**
Total Hours per week (L+T+P)	**:**	**3+0+0**

Course Syllabi (Theory):

Energy conservation, Growth and demand of energy, Energy availability, Comparison of specific energy use in select industry, Potential and status of energy in India, Energy saving potential in industries, Potential of energy efficiency in India, Energy available for industrial use and the role of conservation, Energy management and policy, Comprehensive energy conservation planning (CECP), Definition and principles of energy conservation, Energy conservation technologies, Cogeneration concept and scope, Energy audit and management, Energy conservation in utilities.

Evaluation Scheme (Theory):

EC No.	Evaluation Component	Duration	Marks (100) (Weightage %)*
1.	Mid Term Test-I	1 hour	20
2.	Mid Term Test-II	1 hour	20
3.	End Term Test	3 hour	40
4.	Class Participation	Day to day	10
5.	Additional continuous Evaluation (Quizzes, Assignments, Presentations, and others)	30 min.	10

Text Books

1. Energy Conservation In Process Industry, W. F. Kenny
2. Energy Engineering and Management, Amlan Chakrabarti - Prentice hall India 2011

Reference Books:

1. Energy Management Principles, CB Smith, - Pergamon Press, New York,
2. Bureau of energy efficiency, Hand outs New Delhi
3. Energy Management Hand Book, W. C. Turner. - John Wiley and sons
4. Handbook on Energy Efficiency, TERI, New Delhi, 2009
5. Energy Auditing and Conservation; Methods, Measurements, Management & Case Study, Hamies, - Hemisphere Publishing , Washington, 1980.
6. Industrial Energy Management & Utilization, Write, Larry C - Hemisphere Publishers, Washington, 1998.

NUMERICAL & STATISTICAL ANALYSIS

Course Code	**:**	**MA 402**
Course Title	**:**	**Numerical & Statistical Analysis**
Course Credits	**:**	**5.5**
Total Hours per Week (L+T+P)	**:**	**3 + 0 + 2**

Course Syllabi (Theory):

- **Modeling, Computers, and Error Analysis**: Mathematical Modeling and solution using Programming and Software, Computer Arithmetic and Errors: Approximations and Round-Off Errors, Truncation Errors and the Taylor Series
- **Transcendental and polynomial equation**: Solution of non-linear Equations: Bracketing Methods, Open Methods, Roots of Polynomials
- **Linear Algebraic Equations**: LU Decomposition and Matrix Inversion, Iterative methods for solving system of linear equations.
- **Interpolation and approximation**: Interpolation for equally and unequally spaced points, Lagrangian Polynomial, Curve Fitting: Least-Squares Regression
- **Numerical Differentiation and Integration**: Numerical Differentiation and Integration, Newton-Cotes Integration Formulae.
- **Ordinary Differential Equations**: Single step methods for solving first order ordinary differential equation
- **Random Variables and probability distributions**: Introduction to probability, Discrete and continuous random variables, probability mass, probability density and cumulative distribution functions, Mathematical expectation, Chebyshev's inequality, Discrete and continuous probability distributions
- **Sampling distributions**: Sampling, Types of sampling, sampling errors, sampling distribution of means, variance and proportions for normal population, The Central Limit Theorem, Chi-Square, t and F distributions
- **Estimation**: Estimators, Point and interval estimation, confidence intervals for parameters in one sample and two sample problems of normal populations, confidence intervals for proportions
- **Testing of Hypotheses**: Null and alternative hypotheses, the critical and acceptance regions, two types of error, Parametric and Non-parametric tests, Chi-square goodness of fit test, Contingency tables.
- **Correlation and regression**: Types of Relationships, Scatter Diagrams, Regression Line, Coefficients of Determination and Correlation.

- **Analysis of variance**: One way analysis of variance, experimental design, two way analysis of variance without interaction

Course Syllabus (Practical):

Computer Programming in C and Matlab; Introduction to SPSS for solving statistical techniques.

List of experiments:

1. To find the solution of Non-linear equations.
2. To find solution of system of equations.
3. To find the best fitted curve for a given set of points.
4. To differentiate a function numerically.
5. To integrate a functions numerically.
6. To find solution of a differential equation numerically.
7. Working on SPSS

Evaluation Scheme (Theory):

EC No.	Evaluation Component	Duration	Marks (100) (Weightage %)*
1.	Mid Term Test-I	1 hour	20
2.	Mid Term Test-II	1 hour	20
3.	End Term Test	3 hour	40
4.	Class Participation	Day to day	10
5.	Additional continuous Evaluation (Quizzes, Assignments, Presentations, and others)	---	10

Evaluation Scheme (Practical):

EC No.	Evaluation Component	Duration	Marks (100) (Weightage %)*
1.	Mid Term Test	2 hour	20
2.	End Term Test	2 hour	40
3.	Class Participation and/or Attendance	Day to day	15

4.	Additional Continuous Evaluation (Assignments, Discipline, Punctuality, & Viva Voce)	Day to day	25

***Note: The ratio of weightage between Theory and Practical content will be (60%: 40% respectively)**

Text and Reference books:

1. K. E. Atkinson, *Introduction to Numerical Analysis*, John Wiley and Sons.
2. M.K. Jain, S. R. K. Iyengar, R. K. Jain, *Numerical Methods For Scientific And Engineering Computation*, New age International publishers, New Delhi.
3. Steven C Chapra, Raymond P Canale, *Numerical Methods for Engineers*, 6/e, Mc Graw Hill
4. Srimanta Pal, *Numerical Methods: Principles, Analyses and Algorithms*, Oxford University Press, New Delhi.
5. Cheney and Kincaid, *Numerical Methods and Applications*, Cengage Publications, New Delhi.
6. Cleve B. Moler, *Numerical Computing with MATLAB*, Prentice Hall of India, New Delhi .
7. Rishard A. Johnson, *Miller and Freund's probability and Statistics for Engineers*, PHI, 8th Ed.
8. Ravichandran J., Probaility and statistics for Engineers, Wiley India, New Delhi.
9. Douglas C. Montgomery and George C. Runger, *Applied Statistics and Probability for Engineers*, John Wiley & Sons, Inc., 3rd Edition (2004).
10. Prem S. Mann, *Introductory Statistics*, Wiley publication, 7th edition.

PRINCIPLES OF ECONOMICS

Course Code	**:**	**HS401**
Course Title	**:**	**Principles of Economics**
Course Credits	**:**	**4**
Total Hours per Week (L+T+P)	**:**	**3 + 0 + 0**

Course Syllabi (Theory):

- Definition of Economics and role of economics in Engineering and Technology; Basic economic terms; The economy, working of an economy, kinds of an economy and its basic problems; Laws of Demand and Supply and market Equilibrium; Elasticity of demand its measurements and application, Production function and law of Variable Proportion and Law of Returns to Scale; Concepts of cost and revenue, short run and long run cost function; Profit maximization hypothesis, Price and output determination under Perfect Competition, Monopolistic competition and Monopoly.
- Measurement of macroeconomic aggregates, National Income, Consumption, saving and investment function; Macroeconomic issues: Inflation, Unemployment and Economic growth International aspects of macro economics; Foreign Exchange rate and Balance of payments.

Evaluation Scheme (Theory):

EC No.	Evaluation Component	Duration	Marks (100) (Weightage %)*
1.	Mid Term Test-I	1 hour	20
2.	Mid Term Test-II	1 hour	20
3.	End Term Test	3 hour	40
4.	Class Participation	Day to day	10

5.	Additional continuous Evaluation (Quizzes, Assignments, Presentations, and others)	30 min.	10

Text Book:

T.R. Jain and M.L. Grover, "Economics for Engineers", V. K. (India) Enterprises

Reference Books:

- D N Dwivedi "Principles of Economics", Vikas Publishing House Pvt Ltd.
- G. Mankiew. Economics Principles and Applications. Cengage Learning

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INSTITUTE OF ENGINEERING AND TECHNOLOGY

4-Year B. Tech Programme

(Branch: Chemical Engineering)

Batch 2012-2016

SEMESTER-FIFTH

Detailed Syllabus

&

Scheme of Examination

PROCESS DYNAMICS & CONTROL

Course Code	**:**	**CHE501**
Course Title	**:**	**Process Dynamics & Control**
Course Credits	**:**	**7**
Total Hours per Week (L+T+P)	**:**	**3 + 1 + 2**

Course Syllabi (Theory):

- Need of process control, process control strategies, process control activities, Modeling principles, dynamic models, degrees of freedom analysis, solution of dynamic models, Solution of differential equation, Development and properties of transfer functions, linearization of non-linear models, state-space and transfer function matrix models
- Response of first and second order processes, Dynamic response of higher order systems, Model development using non-linear regression, fitting first and second order models, neural network model, discrete time models, identification of systems, Concept & type of feedback control, block diagram representation, response of it, PID controller
- Transducers, transmitters, final control elements, Influence of process design on process control, degrees of freedom for process control, Selection of variables, Closed loop representation, transfer functions, stability analysis, Performance criterion, Model based design, controller tuning relations, Bode, Nyquist, Gain and Phase margin, closed-loop frequency response and sensitivity functions
- Ratio control, feed forward controller design based on steady state and dynamics equation, feedforward-feed-back controller, Cascade control, time-delay compensation, inferential control, adaptive control, Predictions for SISO and MIMO problems, MPC calculations, Set-point calculations, design and tuning parameters, Signal processing, data filtering, tuning of digital PID controllers, minimum variance control

Course Syllabi (practical):

Sr. No.	NAME OF THE EQUIPMENTS
1	PRESSURE CONTROL TRAINER
2	LEVEL CONTROL TRAINER
3	TEMPERATURE CONTROL TRAINER
4	FLOW CONTROL TRAINER

5	CONTROL VALVE CHARACTERISTICS (Linear, Equal Percent & Quick Opening)
6	CHARACTERISTICS OF P.I.D. CONTROLLER
7	Study of I/P and P/I With mini compressor
8	Cascade control trainer: Level + Flow (SCADA) With mini compressor and SCADA software
9	Multiprocess trainer: Level, Flow, Cascade, Ratio & Feedforward (SCADA)
10	First-order and second-order system
11	PLC trainer
12	Flapper - Nozzle system With mini compressor
13	Multi variable control trainer
14	Interacting & Non - interacting system
15	DCS Trainer (Hybrid controller)

Evaluation Scheme (Theory):

EC No.	Evaluation Component	Duration	Marks (100) (Weightage %)*
1.	Mid Term Test-I	1 hour	20
2.	Mid Term Test-II	1 hour	20
3.	End Term Test	3 hour	40
4.	Class Participation	Day to day	10
5.	Additional continuous Evaluation (Quizzes, Assignments, Presentations, and others)	30 min.	10

Evaluation Scheme (Practical):

EC No.	Evaluation Component	Duration	Marks (100) (Weightage %)*
1.	Mid Term Test	2 hour	20
2.	End Term Test	2 hour	40
3.	Class Participation and/or Attendance	Day to day	15
4.	Additional Continuous Evaluation (Assignments, Discipline, Punctuality, & Viva Voce)	Day to day	25

***Note: The ratio of weightage between Theory and Practical content will be (60%: 40% respectively)**

Text Book:

1. Seborg, D. E., Edgar, T. F. and Mellichamp, D.A., "Process Dynamics and Control", 2nd Ed., John Wiley and Sons, 2004,

Reference Books:

1. Coughanowr, D.R., Process Systems Analysis and Control, 2nd Ed., McGraw-Hill, 1991.
2. George Stephanopoulos, Chemical Process Control: An Introduction to Theory and Practice, Prentice Hall, 1984.

CHEMICAL SYSTEM MODELING

Course Code	**:**	**CHE502**
Course Title	**:**	**Chemical System Modeling**
Course Credits	**:**	**5.5**
Total Hours per Week (L+T+P)	**:**	**3 + 1 + 0**

Course Syllabi (Theory):

Introduction to Process Synthesis, Analysis, Design and Simulation; Classification and development of mathematical models to various chemical engineering systems; Understanding of Similarity Criteria, Variables and Parameters; Modeling of various Chemical systems covering heat, mass, and momentum transfer,and reactions; Sources and data banks of physical & thermodynamic properties, Modularity & Routing.

Evaluation Scheme (Theory):

EC No.	Evaluation Component	Duration	Marks (100) (Weightage %)*
1.	Mid Term Test-I	1 hour	20
2.	Mid Term Test-II	1 hour	20
3.	End Term Test	3 hour	40
4.	Class Participation	Day to day	10
5.	Additional continuous Evaluation (Quizzes, Assignments, Presentations, and others)	30 min.	10

Text Books:

B.V.Babu, "Process Plant Simulation", Oxford University Press, India (2004).

Reference Books:

R1 Godfrey, C Onwubolu and B.V. Babu, "New Optimization Techniques in Engineering; Springer-Verlag, Germany, (2004).

R2 William L. Luyben, "Process Modeling, Simulation and Control for Chemical Engineers", Mc Graw Hill Publishing Company, New York, 2nd Edition (1990).

R3 R.G.E. Franks, "Modeling and Simulation in Chemical Engineering", John Wiley & Sons Inc., New York (1972).

SEPARATION PROCESSES

Course Code	**:**	**CHE 503**
Course Title	**:**	**Separation Processes**
Course Credits	**:**	**5.5**
Total Hours per Week (L+T+P)	**:**	**3 + 1 + 0**

Course Syllabi (Theory):

Liquid-Liquid extraction, Ternary liquid-liquid systems, Equipment, General design considerations, Hunter-Nash graphical equilibrium-stage method; Leaching and washing, Equilibrium-stage model for leaching and washing, Rate-based model for leaching, Equipment for leaching; humidification and water cooling, Drying of wet solids, Principles of drying, Cross circulation drying, Through circulation drying, dryers; adsorption, ion exchange; crystallization, crystal geometry, equilibrium, super saturation, Nucleation Crystal growth, equipment Crystallizer design

Evaluation Scheme (Theory):

EC No.	Evaluation Component	Duration	Marks (100) (Weightage %)*
1.	Mid Term Test-I	1 hour	20
2.	Mid Term Test-II	1 hour	20
3.	End Term Test	3 hour	40
4.	Class Participation	Day to day	10
5.	Additional continuous Evaluation (Quizzes, Assignments, Presentations, and others)	30 min.	10

Text Book:

Seader, J.D., Henley, E.J., "Separation Process Principles," 2nd Edition, Wiley India Pvt. Ltd., New Delhi, 2006.

Reference Books:

R1. Treybal, R.E., "Mass Transfer Operations," 3rd Ed. (International Edition), McGraw-Hill Book Company, Singapore, 1980.

R2. Dutta, B. K., "Principles of Mass Transfer and Separation Processes," Prentice-Hall of India Pvt. Ltd., New Delhi, 2007.

MECHANICAL OPERATIONS

Course Code	**:**	**CHE 504**
Course Title	**:**	**Mechanical Operations**
Course Credits	**:**	**7.5**
Total Hours per Week (L+T+P)	**:**	**3 + 1 + 3**

Course Syllabi (Theory):

- Characterization of Solid particles, properties of masses of particles, Storage and conveying of solids, mixing of solids, Mixers, Size reduction, equipment for size reduction
- Screening, screening equipment, Filtration equipment, Filtration calculations, Membrane filtration, gravity settling processes, Centrifugal sedimentation processes
- Principles of drying, Cross circulation drying, Through circulation drying, dryers, Adsorption, Ion Exchange
- Chromatography, Separation of gases , Separation of liquids, Introduction, crystal geometry, equilibria, super saturation,
- Nucleation, Crystal growth, equipment , Crystallizer design

Course Syllabi (Practical):

S. No.	Name of Experiment
1.	Crushing, grinding, screening
2.	Vacuum filtration
3.	Plate and frame filtration
4.	Rotary drum filtration
5.	Froth flotation
6.	Sedimentation and thickening
7.	Centrifugal double cone classifier
8.	Drying
9.	Centrifugal pump characteristics

10.	Reciprocating pump characteristics

Evaluation Scheme (Theory):

EC No.	Evaluation Component	Duration	Marks (100) (Weightage %)*
1.	Mid Term Test-I	1 hour	20
2.	Mid Term Test-II	1 hour	20
3.	End Term Test	3 hour	40
4.	Class Participation	Day to day	10
5.	Additional continuous Evaluation (Quizzes, Assignments, Presentations, and others)	30 min.	10

Evaluation Scheme (Practical):

EC No.	Evaluation Component	Duration	Marks (100) (Weightage %)*
1.	Mid Term Test	2 hour	20
2.	End Term Test	2 hour	40
3.	Class Participation and/or Attendance	Day to day	15
4.	Additional Continuous Evaluation (Assignments, Discipline, Punctuality, & Viva Voce)	Day to day	25

***Note: The ratio of weightage between Theory and Practical content will be (60%: 40% respectively)**

Text Books:

TB McCabe W. L., and Smith J. M., & Harriott P., *Unit Operations of Chemical Engineering*, 7th Ed., McGraw-Hill International Edition, 2006.

Reference Books:

R1 *Chemical Engineering* (Volumes 1-6), Coulson J. M., Richardson J. F. & others, Pergamon Press, London, 1978 & 1997.

R2 *Principles of Unit Operations*, Foust A. N. & others, 2nd Edition, John Wiley & Sons, 1980.

R3 *Unit Operations*, Brown G. G. & others, Chapman & Hall, 1950.

R4 *Chemical Engineers Handbook*, Perry, R. H. (Ed.), McGraw-Hill, New York (all editions).

CHEMICAL ENGINEERING MATERIALS

Course Code	**:**	**CHE505**
Course Title	**:**	**Chemical Engineering Materials**
Course Credits	**:**	**04**
Total Hours per week (L+T+P)	**:**	**3+0+0**

Course Syllabi (Theory):

- Introduction, Unit cell, Crystallographic directions and planes, Linear and planner densities, close-packed crystal structures, Crystal structures of ceramics
- Determination of crystal structure, Bragg's Law, diffraction technique, Vacancies and interstitials, dislocations and grain boundaries, Optical and electron microscopy, grain size determination
- Steady and non-steady diffusion, Stress-strain, elastic and plastic deformations, Slip systems, plastic deformation, strengthening mechanisms
- Phases, microstructures, phase equilibria, Fe-Fe3C phase diagram, development of microstructure in Fe-C alloys, Avrami rate equations, Isothermal transformation diagrams, continuous cooling transformations, Mechanical behavior of Fe-C alloys, tempered martensite, Molecular weight, molecular configurations of polymers,
- Mechanisms of deformation and strengthening in polymers, glass transitions

Evaluation Scheme (Theory):

EC No.	Evaluation Component	Duration	Marks (100) (Weightage %)*
1.	Mid Term Test-I	1 hour	20
2.	Mid Term Test-II	1 hour	20
3.	End Term Test	3 hour	40
4.	Class Participation	Day to day	10
5.	Additional continuous Evaluation (Quizzes, Assignments, Presentations, and others)	30 min.	10

Text Book:

T1. Materials Science and Engineering-An introduction by W.D. Callister, 7th edition, John Wiley (2007) ISBN 10: 81-265-1076-5 or ISBN 13: 978-81-265-1076-4.

Reference Books:

R1. Materials science and engineering by V. Raghavan, 4th edition, Prentice Hall of India, ISBN 10: 81-203-1261-9

R2. Materials science and engineering by Smith, Hashemi, and Prakash, 4th edition (2008), Tata McGraw Hill education pvt. Limited, ISBN 10: 0-07-066717-9 or ISBN 13: 978-0-07-066717-4.

R3: Materials science and engineering by Askeland and Fulay, Cengage Learning, ISBN 10: 81-315-1255-X or ISBN 13: 978-81-315-1255-5.

R4: Essentials to Materials Science and Engineering by Askeland and Phule, Thomson learning, Indian reprint 2007, ISBN 10: 81-315-0233-3.

ENVIRONMENTAL POLLUTION CONTROL

Course Code	**:**	**CHE521 (Elective-II)**
Course Title	**:**	**Environmental Pollution Control**
Course Credits	**:**	**4**
Total Hours per Week (L+T+P)	**:**	**3 + 0 + 0**

Course Syllabi (Theory):

- Air pollution: sources & effects, Air pollution sampling & measurement, Meteorological aspects of air pollutant dispersion, Air pollution control methods and equipment
- Adsorption, bio-filtration, combustion, Sources & classification of water pollutants, Wastewater sampling and analysis, Wastewater treatment, Wastewater treatment, Advanced wastewater treatment
- Solid waste management, Hazardous Waste Management, Noise pollution, EIA & Environmental Audit, Topics from different research papers
- Exposure to environmental engineering laboratory.

Evaluation Scheme (Theory):

EC No.	Evaluation Component	Duration	Marks (100) (Weightage %)*
1.	Mid Term Test-I	1 hour	20
2.	Mid Term Test-II	1 hour	20
3.	End Term Test	3 hour	40
4.	Class Participation	Day to day	10
5.	Additional continuous Evaluation (Quizzes, Assignments, Presentations, and others)	30 min.	10

Text Book

1. Rao, C. S., "Environmental Pollution Control Engineering", *New Age International (P) Ltd.,* New Delhi, 2nd ed., 2006.

Reference Books

1. Peavy *et al*. "Environmental Engineering", *McGraw Hill*, New York, 1986.
2. Davis, M. L. and D. A. Cornwell, "Introduction to Environmental Engineering", *McGraw Hill,* New York, 3rd ed., 1998.
3. Sincero, A. P. and G. A. Sincero, "Environmental Engineering: A Design Approach", *Prentice Hall of India*, New Delhi, 2004.
4. Subramanian, V., "A text Book in Environmental Science", *Narosa Publishing House,* New Delhi, 2002.
5. McCabe *el al*., "Unit Operations of Chemical Engineering" *McGraw-Hill Publications,* Boston, 7th ed., 2005.
6. Hammer, M. J. and M. J. Hammer Jr., "Water and Wastewater Technology", *Prentice Hall of India*, New Delhi, 4th ed., 2004.
7. Research papers from different journals.

SOLID WASTE MANAGEMENT

Course Code	**:**	**CE 724 (Elective-II)**
Course Title	**:**	**Solid Waste Management**
Course Credits	**:**	**4**
Total Hours per Week (L+T+P)	**:**	**3+0+0**

Course Syllabi (Theory):

- ***Introduction to Environment:*** Ecosystem –meaning- Types -Components- Structure – Functions, Levels of organization in nature- Food chain and Trophic structure, Biogeochemical Cycles, Energy flow.
- ***Municipal solid waste***: Definition - Sources and types of solid waste- composition and its determinants of Solid waste-factors influencing generation-quantity assessment of solid wastes-methods of sampling and characterization.
- ***Collection:*** Collection of Solid waste – collection services – collection system, equipments – time and frequency of collection – labour requirement – factors affecting collection – analysis of collection system – collection routes – preparation of master schedules.
- ***Transfer and Transport:*** Need for transfer operation – transfer stations – types – transport means and methods – location of transport stations - Manpower requirement – collection routes: Transfer stations – selection of location, types & design requirements, operation & maintenance.
- ***Processing techniques*** – purposes mechanical volume reduction – necessary equipments – chemical volume reduction – incinerators – mechanical size reduction selection of equipments – components separation – methods – drying and dewatering. Recovery of Resources, conversion products and energy recovery – recoverable materials – processing and recovery systems – incineration with heat recovery.
- ***Refuse disposal*** – various methods – incinerations – principle features of an incinerator – site selection and plant layout of an incinerator - sanitary landfill- methods of operation – advantages and disadvantages of sanitary land fill - site selection – reactions accruing in completed landfills – gas and leachate movement and control – equipments necessary.

Evaluation Scheme (Theory):

EC No.	Evaluation Component	Duration	Marks (100) (Weightage %)*
1.	Mid Term Test-I	1 hour	20
2.	Mid Term Test-II	1 hour	20
3.	End Term Test	3 hour	40

4.	Class Participation	Day to day	10
5.	Additional continuous Evaluation (Quizzes, Assignments, Presentations, and others)	30 min.	10

Text Books:

1. PERT & CPM by B.C. Punmia. George Techobanoglous et al,"Integrated Solid Waste Management" McGraw - Hill, 1993.
2. Techobanoglous Thiesen Ellasen; Solid Waste Engineering Principles and Management, McGraw - Hill 1997.
3. R.E.Landrefh and P.A.Rebers," Municipal Solid Wastes-Problems & Solutions" ,Lewis, 1997.

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Reference Books:

1. Manual on Municipal 1 Solid waste Management, CPHEEO, Ministry of Urban Development, Govt. Of. India, New Delhi, 2000.
2. Blide A.D.& Sundaresan, B.B,"Solid Waste Management in Developing Countries", INSDOC, 1993.
3. Ecology Science and Practice; Claude Fourie, Christian Ferra, Paul Medori, Tean Devaux, Oxford and IBH Publishing Co (Pvt) LTD, special Indian edition.
4. Principles of Ecology- P.S.Verma, V.K.Agarwal.S.Chand & Company (Pvt) LTD 1989.

PRACTICE SCHOOL – I

Course Code	**:**	**PS501**
Course Title	**:**	**Practice School – I**
Course Credits	**:**	**4**
Duration	**:**	**6 Weeks**

Course Syllabi:

This course is for 6 weeks at the end of 4th semester during summer term of 4 year full time B. Tech. and 5 year Integrated Dual degree (B.Tech + M.Tech, B.Tech + MBA) programs in all the engineering disciplines. The objective of this programme is to provide the students an understanding of working of corporate world in various functions associated with an Industry/Organization. During this programme, they will observe and learn various real world applications of their curricula and develop an understanding of vast engineering operations and its various facets such as inventory, productivity, management, information systems, human resource development, data analysis etc. The general nature of PS-1 assignments is of study and orientation.

Evaluation Scheme:

S. No.	Evaluation Component	Marks (100) (Weightage %)
1	Quiz-I	4
2	Quiz-II	4
3	Group Discussion-I	4
4	Group Discussion-II	4
5	Seminar-I	4
6	Seminar-II	4
7	Diary-I	4
8	Diary-II	4
9	Observation-I	4
10	Observation- II	4
11	Mid Term Evaluation (Project Report and Presentation/Viva)	20
12	Final Evaluation (Project Report and Presentation/Viva)	40

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INSTITUTE OF ENGINEERING AND TECHNOLOGY

4-Year B. Tech Programme

(Branch: Chemical Engineering)

Batch 2012-16

SEMESTER-SIXTH

Detailed Syllabus

&

Scheme of Examination

PROCESS DESIGN DECISIONS

Course Code	**:**	**CHE601**
Course Title	**:**	**Process Design Decisions**
Course Credits	**:**	**5.5**
Total Hours per Week (L+T+P)	**:**	**3 + 1 + 0**

Course Syllabi (Theory):

- Introduction, Nature of Process Synthesis & Analysis, Energy Integration Analysis, Engineering Economics for Conceptual Design
- Economic Decision Making, Input Information and Batch vs. Continuous, Input-Output Structure of the Flow sheet, Recycle Structure of the Flow sheet
- Separation System, Cost Diagrams & Quick Screening of Process Alternatives, Preliminary Process Optimization, Process Retrofits

Evaluation Scheme (Theory):

EC No.	Evaluation Component	Duration	Marks (100) (Weightage %)*
1.	Mid Term Test-I	1 hour	20
2.	Mid Term Test-II	1 hour	20
3.	End Term Test	3 hour	40
4.	Class Participation	Day to day	10
5.	Additional continuous Evaluation (Quizzes, Assignments, Presentations, and others)	30 min.	10

Text Books:

T1 James M. Douglas, "Conceptual Design of Chemical Processes", McGraw Hill, New York, International Edition (1988).

Reference Books:

R1 Max Stone Peters, Klaus D. Timmerhaus, and Ronald West “Plant Design and Economics for Chemical Engineers”, McGraw Hill, New York, 5th Edition (2002).

R2 Warren D. Seider, J. D. Seader, and Daniel R. Lewin, “Product & Process Design Principles: Synthesis, Analysis, and Evaluation”, John Wiley & Sons, New York, 2nd Edition (2004).

R3 Robin Smith, “Chemical Process Design”, International Editions, McGraw Hill, Singapore (2000).

R4 Richard Turton, Richard C. Bailie, Wallace B. Whiting, Joseph A. Shaeiwitz, “Analysis, Synthesis, and Design of Chemical Processes”, International Edition, Prentice Hall, New Jersey (1998).

R5 Dale F. Rudd, and Charles C. Watson, “Strategy of Process Engineering”, John Wiley & Sons, New York (1968).

CHEMICAL PROCESS TECHNOLOGY

Course Code	**:**	**CHE 602**
Course Title	**:**	**Chemical Process Technology**
Course Credits	**:**	**4**
Total Hours per Week (L+T+P)	**:**	**3 + 0 + 0**

Course Syllabi (Theory):

- Chemical Industries – Facts and figures, Unit operations and Unit Process concepts, General Principles applied in studying an Industry, Unit operations and Unit Process concepts, General Principles applied in studying an Industry
- Project formulation, its evaluation and implementation, Chamber Process, Contact Process, DCDA Process, Ammonia Oxidation Processes: Mono Pressure and Mixed Pressure Processes, Urea Production Processes; Ammonium Nitrate Production Processes;
- Phosphate and Potash based fertilizers production processes; Phosphoric acid manufacturing processes, Kraft Process, sulfite Process, Mechanical Pulping; Paper making, Production of lignin chemicals
- Dry and wet cement manufacturing processes, Mechanical and solvent based extraction processes, Hydrogenation of oils; isomerization, interesterification, Soap manufacturing processes, glycerin recovery process, alfol process of detergent production
- Coal combustion, carbonization and liquefaction technologies, Origin and classification of petroleum, atmospheric and vacuum distillation processes; Reforming, Solvent deasphalting , solvent dewaxing, Chemicals from C_1 compounds, Chemicals from C_2 compounds, Chemicals from C_3 compounds, Chemicals from C_4 compounds, Various polymerization processes

Evaluation Scheme (Theory):

EC No.	Evaluation Component	Duration	Marks (100) (Weightage %)*
1.	Mid Term Test-I	1 hour	20
2.	Mid Term Test-II	1 hour	20
3.	End Term Test	3 hour	40

4.	Class Participation	Day to day	10
5.	Additional continuous Evaluation (Quizzes, Assignments, Presentations, and others)	30 min.	10

Text Book:

1. "Dryden's Outlines of Chemical Technology for the 21st Century" Edited by M. Gopala Rao and Marshall Sittig. East West Press, 3rd Ed., 1997.

Reference Books:

2. George T. Austin, Shreve's Chemical Process Industries by, McGraw Hill, 5th Edn., 1984.
3. D. Sen, Reference book on Chemical Engineering, Vol- I", New Age International Publishers, 2005

PROCESS EQUIPMENT DESIGN

Course Code	**:**	**CHE603**
Course Title	**:**	**Process Equipment Design**
Course Credits	**:**	**7**
Total Hours per Week (L+T+P)	**:**	**3 + 1 + 2**

Course Syllabi (Theory):

- Introduction, Considerations in process equipment design, Materials of construction, Mechanical Properties, Materials, Corrosion, Protective Coatings, Choice of Materials, Criteria in vessel design, Design of shells for flat bottomed cylindrical vessels.
- Shell design of large storage tanks, Design of bottoms and roofs for flat bottomed cylindrical vessel, Proportioning and Head Selection for cylindrical vessels with formed closures, Stress Considerations in the selection of Flat plate and conical closures, Design of pressure vessels
- Design of high pressure vessels, Design of shell & tube hear exchanger, Process Design, Design of shell & tube hear exchanger, Mechanical Design, Design of Distillation and Absorption column, Column sizing approximation, Plate Contactors, Plate Hydraulic Design, Design of Distillation and Absorption column
- Stresses in column shell, Design and construction features of column internals, Design of reaction vessels, Design considerations of heating systems, Design of agitator system components
- Shaft, agitator, couplings, bearings, stabilizers, seals, Design of supports for vessels, Skirt supports, saddle supports, Design of Flanges, Process Hazards and safety measures in equipment design

Course Syllabi (Practical):

1. Mechanical design of storage vessel including roof design
2. Mechanical design of high pressure vessel
3. Mechanical design of reaction vessel carrying out exothermic reaction
4. Mechanical design of distillation column
5. Mechanical design of heat exchanger unit
6. Hydraulic design of distillation column
7. Hydraulic design of absorption column
8. Mechanical design of agitated vessel
9. Mechanical design of chimney

Evaluation Scheme (Theory):

EC No.	Evaluation Component	Duration	Marks (100) (Weightage %)*
1.	Mid Term Test-I	1 hour	20
2.	Mid Term Test-II	1 hour	20
3.	End Term Test	3 hour	40
4.	Class Participation	Day to day	10
5.	Additional continuous Evaluation (Quizzes, Assignments, Presentations, and others)	30 min.	10

Evaluation Scheme (Practical):

EC No.	Evaluation Component	Duration	Marks (100) (Weightage %)*
1.	Mid Term Test	2 hour	20
2.	End Term Test	2 hour	40
3.	Class Participation and/or Attendance	Day to day	15
4.	Additional Continuous Evaluation (Assignments, Discipline, Punctuality, & Viva Voce)	Day to day	25

***Note: The ratio of weightage between Theory and Practical content will be (60%: 40% respectively)**

Text Book (s)

1. **"**Process Equipment Design"- Lloyd E. Brownell, Edwin H. Young, John Wiley & Sons Publications, 2004.
2. "Process Equipment Design"- M V Joshi, V V Mahajani, Macmillan India Limited, New Delhi.

Reference Book

1. Coulsonos and Richardson's Chemical Engineering, Volume 6, Sinnott, R.K., Asian Books Pvt. Ltd, 1998

TRANSPORT PHENOMENA

Course Code	**:**	**CHE604**
Course Title	**:**	**Transport Phenomena**
Course Credits	**:**	**5.5**
Total Hours Per Week (L+T+P)	**:**	**3 + 1 + 0**

Course Syllabi (Theory):

- Scope and objectives of course, methodology, Newton's law of viscosity, molecular theories of viscosity, Convective momentum transport, Shell momentum balances, boundary conditions, Examples, Equations of continuity, motion and mechanical energy, Examples
- Dimensional analysis, Time-dependent flow of Newtonian fluids, Solving flow problems using stream functions and velocity potential, Boundary layer theory, Fourier's law of heat conduction, molecular theories of thermal conductivity, Convective transport of energy, work associated with molecular motions, Shell energy balances, examples, Forced and free convection, Various forms of energy equations, Examples
- Dimensional analysis, Unsteady state heat conduction in solids and in laminar flow, Boundary layer theory for non-isothermal flow, Fick's law of binary diffusion, molecular theories of diffusion, Mass and molar transport by convection, summary of mass and molar fluxes, Shell mass balance, boundary conditions, Examples, Equations of continuity, summary of multicomponent equations of change, Examples
- Dimensional analysis, Time-dependent diffusion, Steady state transport in binary boundary layers, Time-smoothed equations of change and velocity profiles, Empirical expressions for turbulent momentum flux; turbulent flow in ducts etc., Time-smoothed equations of change and temperature profiles for turbulent flow in tubes, Time-smoothed concentrations and equation of continuity and applications

Evaluation Scheme (Theory):

EC No.	Evaluation Component	Duration	Marks (100) (Weightage %)*
1.	Mid Term Test-I	1 hour	20
2.	Mid Term Test-II	1 hour	20
3.	End Term Test	3 hour	40
4.	Class Participation	Day to day	10

5.	Additional continuous Evaluation (Quizzes, Assignments, Presentations, and others)	30 min.	10

Text Book:

1. Bird, Stewart and Lightfoot, 'Transport Phenomena', John Wiley & Sons, 2002, 2nd ed.

Reference Books:

1. Fox and McDonald, 'Introduction to fluid dynamics,' John Wiley & Sons, 2000, 5th ed.
2. Holman, J.P., 'Heat transfer', McGraw Hill, 1997, 8th ed.

COMPUTATIONAL FLUID DYNAMICS

Course Code	**:**	**CHE621 (Elective-III)**
Course Title	**:**	**Computational Fluid Dynamics**
Course Credits	**:**	**4**
Total Hours per Week (L+T+P)	**:**	**3 + 0 + 0**

Course Syllabi (Theory):

Philosophy of computational fluid dynamics (CFD), governing equations of fluid dynamics, mathematical behavior of partial differential equations, basics of the numerics : basic aspects of discretization, grids with appropriate transformations, and simple CFD techniques, applications, numerical solutions of quasi-onedimensional nozzle flows, numerical solution of a two-dimensional supersonic flow, incompressible couette flow, and supersonic flow over a flat plate, advanced topics in CFD.

Evaluation Scheme (Theory):

EC No.	Evaluation Component	Duration	Marks (100) (Weightage %)*
1.	Mid Term Test-I	1 hour	20
2.	Mid Term Test-II	1 hour	20
3.	End Term Test	3 hour	40
4.	Class Participation	Day to day	10
5.	Additional continuous Evaluation (Quizzes, Assignments, Presentations, and others)	30 min.	10

Text Book

Anderson, John D, "Computational Fluid Dynamics", McGraw-Hill International Edition , 1995

Reference Books

1. R. Pletcher, J. Tannehill and D. Anderson, Computational Fluid Mechanics and Heat Transfer, 3rd Edn., CRC Press, 2012.
2. H.K. Versteeg and W. Malalasekera, An introduction to computational fluid dynamics: The finite volume method, 3rd Edn., Pearson Education, 2007.

3. C. Hirsch, Numerical Computation of Internal and External Flows, Vol.1 (1988) and Vol.2 (1990), John Wiley & Sons.
4. J. H. Fergiger and M. Peric, Computational Methods for Fluid Dynamics, 3rd Edn., Springer, 2002.
5. T. J. Chung, Computational Fluid Dynamics, 2nd Edn., Cambridge University Press, 2010.
6. C. A. J. Fletcher, Computational Techniques for Fluid Dynamics Vols. 1 and 2, 2nd Edn., , Springer, 1991.
7. S.V. Patankar, Numerical Heat Transfer and Fluid Flow, Hemisphere, 1980.

CORROSION ENGINEERING

Course Code	**:**	**CHE622 (Elective-III)**
Course Title	**:**	**Corrosion Engineering**
Course Credits	**:**	**4**
Total Hours per Week (L+T+P)	**:**	**3 + 0 + 0**

Course Syllabi (Theory):

- Corrosion Engg., environments, corrosion damage, classification of corrosion, Introduction, corrosion rate expressions. Electrochemical aspects: Electrochemical reactions, polarization, passivity.
- Environmental effects: effects of oxygen and oxidizers, velocity, temperature, corrosive concentration, galvanic coupling. Metallurgical and other aspects: metallic properties, economic considerations, importance of inspection.
- Uniform attack, galvanic corrosion, Crevice corrosion:environmental factors, mechanism, combating crevice corrosion, Filiform corrosion, Pitting: pit shape and growth, autocatalytic nature of pitting, solution composition, velocity, metallurgical variables; evaluation of pitting damage, prevention
- Intergranular corrosion: Austenitic stainless steels, weld decay, control for austenitic stainless steels, knife-line attack, integranular corrosion of other alloys, Selective leaching: dezincification-characteristics, mechanism, prevention: graphitization, other alloy systems, high temperatures
- Erosion corrosion: surface films, velocity, turbulence, impingement, galvanic effect, nature of metal or alloy; combating erosion corrosion, cavitation damage, fretting corrosion.
- Stress corrosion: crack morphology, stress effects, time to cracking, environmental factors, metallurgical factors, meachanism, multi-environment charts, classification of mechanisms, methods of prevention, corrosion fatigue, Hydrogen damage: characteristics environmental factors, hydrogen blistering, hydrogen embrittlement, prevention
- Materials; Metals and alloys: cast irons, carbon steels and irons, Low alloy steels, Stainless steels, various metals and their alloys, Non-metallics: rubbers and other elastomers, various thermoplastics and thermosettings, laminates and reinforced plastics
- Other non-metallics: various ceramics, carbon and graphite, Materials selection: metals and alloys, non-metallics, Alteration of environment: changing mediums, lowering temperature, decreasing velocity, removing oxygen or oxidizers, changing concentration; Inhibitors of various types, Design: wall thickness, design rules, Cathodic and anodic protection, Coatings: metallic and other inorganic coatings; organic coatings

Evaluation Scheme (Theory):

EC No.	Evaluation Component	Duration	Marks (100) (Weightage %)*
1.	Mid Term Test-I	1 hour	20
2.	Mid Term Test-II	1 hour	20
3.	End Term Test	3 hour	40
4.	Class Participation	Day to day	10
5.	Additional continuous Evaluation (Quizzes, Assignments, Presentations, and others)	30 min.	10

Text Book:

1. Fontana M.G., "Corrosion Engineering", McGraw-Hill Companies, 1986, 3rd ed.

Reference Book:

2. Mattsson E., "Basic Corrosion Technology for Scientists and Engineers", The Institute of Materials, London, 1996, 2nd ed.

BIOCHEMICAL ENGINEERING

Course Code	**:**	**CHE623 (Elective-III)**
Course Title	**:**	**Biochemical Engineering**
Course Credits	**:**	**4**
Total Hours per Week (L+T+P)	**:**	**3 + 0 + 0**

Course Syllabi (Theory):

- *Various aspects of Biochemical Engineering, The structure of cells and Important cell types, Lipids, Polysaccharides, Nucleotides, Proteins etc.*
- Reaction mechanisms, Comparison with chemical catalysis, Michaelies-Menten and Briggs-Haldane kinetic models. Various methods for kinetic parameter evaluation, Enzyme inhibition, Inhibition kinetic models, Application to drug industries, Physico-chemical factors influencing enzyme activity. Enzyme deactivation and kinetic models.
- Immobilized enzyme technology: Methods of immobilization; Immobilized enzyme kinetics; Analysis of external and intraparticle mass transfer, Terminology; Metabolic reaction coupling: ATP & NAD; Carbon catabolism and various pathways; Aerobic and anaerobic respiration.
- Stoichiometry of growth and product formation, Isolation of pure culture, Strain improvement by mutation, protoplast fusion and recombination DNA technique, Introduction, Ideal Reactors for Kinetics measurements, Biomass growth, Substrate uptake and product formation Kinetics measurements: Steady state and transient growth, Structured and unstructured kinetic models.
- Death kinetics, Mass and heat transfer in bioreactors, gassed reactors, immobilized and cell reactor systems, Ideal & non-ideal bioreactors, Modes of reactor operations: Batch, Fed-batch & continuous, Design of bioreactor, fermenter, Sterilization: Batch & Continuous, instrumentation, control, optimization, process scale-up, criteria and correlations
- Filtration, Centrifugation, Sedimentation, Emerging technologies for cell recovery, Extraction, Sorption, Cell disruption method, Precipitation, Coagulation, Flocculation, Dialysis, Electrodialysis, Reverse osmosis, Ion exchange, HPLC, Chromatography and

fixed-bed adsorption, Membrane separations, and Electrophoresis, Complete commercial bioprocess: Commercial enzymes, antibiotics and Organic acids, Bioprocess economics and feasibility studies

Evaluation Scheme (Theory):

EC No.	Evaluation Component	Duration	Marks (100) (Weightage %)*
1.	Mid Term Test-I	1 hour	20
2.	Mid Term Test-II	1 hour	20
3.	End Term Test	3 hour	40
4.	Class Participation	Day to day	10
5.	Additional continuous Evaluation (Quizzes, Assignments, Presentations, and others)	30 min.	10

TEXT BOOK:

TB: 'Biochemical Engineering Fundamentals' by J. E. Bailey & D. F. Ollis (1987) 2nd Ed., McGraw Hill International Edition

REFERENCE BOOKS:

R1: 'Bioprocess Engineering: Basic Concepts' by Michael L. Shuler & F. Kargi (2003) Prentice-Hall.

R2: 'Principles of fermentation technology' P. F. Stanbury & A. Whitaker (1984), Pergamon Press.

R3: Chemical Engineering, Vol. 3 by Coulson & Richardson (1998), Asian Books.

OPTIMIZATION TECHNIQUES

Course Code	**:**	**MA601**
Course Title	**:**	**Optimization Techniques**
Course Credits	**:**	**5.5**
Total Hours per Week (L+T+P)	**:**	**3 + 1 + 0**

Course Syllabi (Theory):

- **Introduction:** Introduction to Optimization, Formulating a Mathematical Model, Deriving Solutions from the Model
- **Linear Programming Problems:** Introduction to Linear Programming, The Linear Programming Model, Solving L.P.P - The Simplex Method, The Revised Simplex Method, Duality Theory and Sensitivity Analysis, The Dual Simplex Method, Linear Goal Programming and Its Solution, The Transportation Problem, The Assignment Problem
- **Network Optimization Models:** The Terminology of Networks, The Shortest-Path Problem, The Minimum Spanning Tree Problem, Project Management with PERT/CPM
- **Other Optimization Models:** Dynamic Programming, Integer Programming, Game Theory, Non-linear Programming
- **Simulations:** Simulation V/S mathematical modeling, Monte Carlo simulation, simulation language, ARENA, Example & cases.

Evaluation Scheme (Theory):

EC No.	Evaluation Component	Duration	Marks (100) (Weightage %)*
1.	Mid Term Test-I	1 hour	20
2.	Mid Term Test-II	1 hour	20
3.	End Term Test	3 hour	40
4.	Class Participation	Day to day	10
5.	Additional continuous Evaluation (Quizzes, Assignments, Presentations, and others)	30 min.	10

Text & Reference Books

1. Hillier F.S. and Lieberman G.J., *Introduction to Operations Research: Concepts and Cases*, Tata Mc Graw Hill, 8th Ed., (Indian Adapted Edition), 2005.
2. Taha. H. A, *Operations Research: An Introduction*, Pearson Education, 7th ed., 2003.
3. Ronald L. Rardin, *Optimization in Operations Research*. Pearson Education, First Indian Reprint 2002.
4. Pant.J.C*., Introduction to Optimization: Operations Research*, Jain Brothers, 5th Ed., 2000.
5. Sharma. S. D., *Operations Research*, Kedarnath Ramnath & Co., 15th Edition, 2006.

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INSTITUTE OF ENGINEERING AND TECHNOLOGY

4-Year B. Tech Programme

(Branch: Chemical Engineering)

Batch 2012-2016

SEMESTER-SEVENTH

Detailed Syllabus

&

Scheme of Examination

PROCESS PLANT SIMULATION

Course Code	**:**	**CHE721 (Elective IV/V/VI/VII/VIII)**
Course Title	**:**	**Process Plant Simulation**
Course Credits	**:**	**4**
Total Hours Per Week (L+T+P)	**:**	**3 + 0 + 0**

Course Syllabi (Theory):

- Introduction, Mathematical Modeling, Chemical Systems Modeling, Modular Approaches to Process Simulation, Equation Solving Approach
- Decomposition of Networks, Convergence Promotion, Physical and Thermodynamic Properties, Optimization Techniques
- Specific Purpose Simulation, Dynamic Simulation

Evaluation Scheme (Theory):

EC No.	Evaluation Component	Duration	Marks (100) (Weightage %)*
1.	Mid Term Test-I	1 hour	20
2.	Mid Term Test-II	1 hour	20
3.	End Term Test	3 hour	40
4.	Class Participation	Day to day	10
5.	Additional continuous Evaluation (Quizzes, Assignments, Presentations, and others)	30 min.	10

Text Books:

TB B V Babu, "Process Plant Simulation", Oxford University Press, India (2004).

Reference Books:

R1 Godfrey C Onwubolu and B V Babu, "New Optimization Techniques in Engineering; Springer-Verlag, Germany (2004).

R2 William L Luyben, "Process Modeling, Simulation and Control for Chemical Engineers", Mc Graw Hill Publishing Company, New York, 2nd Edition (1990).

R3 R G E Franks, "Modeling and Simulation in Chemical Engineering", John Wiley & Sons Inc., New York (1972).

SCALE-UP STUDIES

Course Code	**:**	**CHE722 (Elective IV/V/VI/VII/VIII)**
Course Title	**:**	**Scale-up Studies**
Course Credits	**:**	**4**
Total Hours Per Week (L+T+P)	**:**	**3 + 0 + 0**

Course Syllabi (Theory):

Scale-up concepts, Methods and advice on how to scale-up, Translate a process or model to larger sizes; Designs, Modeling and processing of Scale-up operation, Importance of the process geometry;

Different scale-up methods, Establishment viable process objectives, General scale-up, Examples and illustrations of scale-up methods; Scale-up traps and pitfalls; Importance of process objectives, Basic concepts of importance using different areas as examples; Power analysis as a useful tool in scale-up, Examples of power analysis in applications and the controlling mechanisms; Scale-up in the mixing, Contacting area, Equipment, Operating conditions, Optimum designs and processing conditions; Development of methods to perform process translation in mixing, practicality examination; Correlations and data for process accuracy in pilot studies; Use of analogies in solving processing problems.

Evaluation Scheme (Theory):

EC No.	Evaluation Component	Duration	Marks (100) (Weightage %)*
1.	Mid Term Test-I	1 hour	20
2.	Mid Term Test-II	1 hour	20
3.	End Term Test	3 hour	40
4.	Class Participation	Day to day	10
5.	Additional continuous Evaluation (Quizzes, Assignments, Presentations, and others)	30 min.	10

Text/Reference Books:

1. Marko Zlokarnik “Scale-up in Chemical Engineering” WILEY VCH verlag GmbH & co. KGaA, weinheim 2006.
2. William Hoyle, “Pilot plants and scale-up of chemical processes” Royal Society of Chemistry, Information Services, 1997.
3. J.P. Euzen, P. Trambouze, “Scale-Up Methodology for Chemical Processes”.
4. ATTILIO BISIO, RABORT L. KABEL, “SCALEUP OF CHEMICAL PROCESSES”.
5. William Hoyle, “Pilot plants and scale-up of chemical processes” Royal Society of Chemistry, Information Services, 1997.
6. Richard Fleming, “Scale-up: In Practice” Reinhold Publishing Corporation, 1958.
7.

PROCESS PLANT SAFETY

Course Code	**:**	**CHE723 (Elective IV/V/VI/VII/VIII)**
Course Title	**:**	**Process Plant Safety**
Course Credits	**:**	**4**
Total Hours per Week (L+T+P)	**:**	**3 + 0 + 0**

Course Syllabi (Theory):

- Role of safety, Accident and loss statistics, Chemical Hazards and worker safety, Identification evaluation and control of occupational conditions, Personal protective devices, Safety aspects of site selection, plant layout and unit plot planning
- Flow of liquids through a hole, a hole in a tank, pipes, Flow of vapors through holes, pipes, Flashing liquids, Environmental monitoring, Flammability characteristics, MOC, Detonation and deflagration, Confined explosions, VCE, BLEVE, Blast damage due to overpressure, Energy of mechanical and Chemical explosions
- Purging, Static electricity, explosion-proof equipments, Sprinkler systems, Relief concepts, Relief types, Relief systems, Checklists, F & EI, HAZOP, Safety reviews, Probability theory, Event and Fault trees, Heat, mass and momentum transfer, Simultaneous heat and mass transfer, Size reduction, Material Handling.
- On-site and off-site emergency plans, safety audit, Accident investigation, Static electricity, Chemical reactivity, System designs, procedures, List of Major accidents (1970-1998)

Evaluation Scheme (Theory):

EC No.	Evaluation Component	Duration	Marks (100) (Weightage %)*
1.	Mid Term Test-I	1 hour	20
2.	Mid Term Test-II	1 hour	20
3.	End Term Test	3 hour	40
4.	Class Participation	Day to day	10
5.	Additional continuous Evaluation (Quizzes, Assignments, Presentations, and others)	30 min.	10

Text Books:

T1: Fulekar M.H., "Industrial Hygiene and Chemical Safety", I.K. International, New Delhi, 2006.

T2: Crowl D.A., and J.F. Louvar, "Chemical Process Safety: Fundamentals with Applications", Prentice Hall PTR, Englewood Cliffs, New Jersey, 1st ed., 1990.

Reference Books:

R1: Fawcett H.H. and W.S. Wood, "Safety and Accident Prevention in Chemical Operations", John Wiley & Sons, Inc., New York, 1965.

R2: Sanders R.E., "Chemical Process Safety: Learning from case Histories", Butterworth-Heinemann, Boston, 1999.

FERTILIZER TECHNOLOGY

Course Code	**:**	**CHE724 (Elective IV/V/VI/VII/VIII)**
Course Title	**:**	**Fertilizer Technology**
Course Credits	**:**	**4**
Total Hours Per Week (L+T+P)	**:**	**3 + 0 + 0**

Course Syllabi (Theory):

Introduction

- Fertilizer industry in India
- Feed stock and raw materials

Phosphatic fertilizers

- Ground rock phosphate
- Single Super-phosphate

Technology/ Production of Fertilizer Products

- Phosphoric acid
- Nitric acid
- Sulphuric acid
- Ammonia

Modernization of Older Plants (Revamping)

Urea

Potassic Fertilizers

Complex fertilizers

Evaluation Scheme (Theory):

EC No.	Evaluation Component	Duration	Marks (100) (Weightage %)*
1.	Mid Term Test-I	1 hour	20
2.	Mid Term Test-II	1 hour	20
3.	End Term Test	3 hour	40
4.	Class Participation	Day to day	10

5.	Additional continuous Evaluation (Quizzes, Assignments, Presentations, and others)	30 min.	10

Text Books

T1 "Handbook on Fertilizer Technology", Fertilizer Association of India, Sixth Edition, 2001.

Reference Books

R1 G. F. Austin, "Shreve's Chemical Process Industries", 5th Edition, McGraw Hill Publication.

R2 "Ammonia: Principles and Industrial Practice", Max Appl, Wiley-Vch, 1999.

R3 "Fertilizer Manual", United nations, New York, 1967.

R4 "Synthetic Nitrogen Products", Gary_Maxwell, Springer Science, 2005.

PULP & PAPER TECHNOLOGY

Course Code	**:**	**CHE725 (Elective IV/V/VI/VII/VIII)**
Course Title	**:**	**Pulp & Paper Technology**
Course Credits	**:**	**4**
Total Hours Per Week (L+T+P)	**:**	**3 + 0 + 0**

Course Syllabi (Theory):

Selection of pulp and paper making raw materials, Wood Anatomy- identification, Preparation of wood chips, Chip screening, Storage and chip conveying, Chemical composition of fibrous raw materials, Chemical Pulping, Mechanical Pulping, Chemical thermo-mechanical (CTP) processes, Waste Paper Pulping, Bleaching and washing, Chemical Recovery, Description of various grades of pulp & paper, Mechanical and chemical properties of pulp, Paper making, cellulose derivatives-preparation & end use, Environmental aspects in pulp and paper industry.

Evaluation Scheme (Theory):

EC No.	Evaluation Component	Duration	Marks (100) (Weightage %)*
1.	Mid Term Test-I	1 hour	20
2.	Mid Term Test-II	1 hour	20
3.	End Term Test	3 hour	40
4.	Class Participation	Day to day	10
5.	Additional continuous Evaluation (Quizzes, Assignments, Presentations, and others)	30 min.	10

Text Books/Reference Books:

1. Handbook of pulping and papermaking by Christopher J. Biermann, 2nd ed Academic press (1996).
2. Handbook for Pulp and Paper Technologists by G. A. Smook 3rd edition , Angus Wilde Publications, 1992

ADVANCED HEAT TRANSFER

Course Code	**:**	**CHE726 (Elective IV/V/VI/VII/VIII)**
Course Title	**:**	**Advanced Heat Transfer**
Course Credits	**:**	**4**
Total Hours Per Week (L+T+P)	**:**	**3 + 0 + 0**

Course Syllabi (Theory):

- Steady-state conduction – multiple dimensions, Unsteady-state conduction, Principles of convection, forced and natural convection
- Radiation heat transfer, Condensation & boiling heat transfer, Heat exchanger analysis & design
- Heat Exchanger Networks

Evaluation Scheme (Theory):

EC No.	Evaluation Component	Duration	Marks (100) (Weightage %)*
1.	Mid Term Test-I	1 hour	20
2.	Mid Term Test-II	1 hour	20
3.	End Term Test	3 hour	40
4.	Class Participation	Day to day	10
5.	Additional continuous Evaluation (Quizzes, Assignments, Presentations, and others)	30 min.	10

Text Book:

1. Holman J. P., "Heat Transfer", 9th Ed., Tata McGraw-Hill, New Delhi, 2004.

Reference Books:

R1 Kern, D. Q., "Process Heat Transfer," McGraw-Hill, New York, 1950.

R2 Douglas, J. M., "Conceptual Design of Chemical Processes", McGraw-Hill, New York, 1988.

R3 Perry J. H. "Chem. Engrs Hand Book", 7th Ed., McGraw-Hill, 2001.

R4 Frank Kreith & Mark. S. Bohn, "Principles Of Heat Transfer", 4th Ed., Harper & Row Publishers, New York, 1986.

R5 Kays, W. M. & Crowford, M. E., "Convective Heat and mass Transfer", 3rd Ed., McGraw-Hill, 1993.

ENERGY INTEGRATION ANALYSIS

Course Code	**:**	**CHE727 (Elective IV/V/VI/VII/VIII)**
Course Title	**:**	**Energy Integration Analysis**
Course Credits	**:**	**4**
Total Hours Per Week (L+T+P)	**:**	**3 + 0 + 0**

Course Syllabi (Theory):

- Energy Targeting, Area Targeting, Unit Targeting, Cost Targeting, ΔT_{min} Optimization, Logic of Pinch Technology
- The Continuous Targeting Algorithm, Diverse Pinch for Different Heat Transfer Coefficient, Continuous Heat Cascades for Diverse and Conventional Pinch Concepts
- Basic Pinch Design Method, MER Networks for Multiple Utilities and Multiple Pinches, Balanced Grid Networks, Constrained Heat Exchanger Networks
- Loop Breaking and Path Relaxation, Systematic Energy Relaxation Approach, Eliminating Units Using Bypass, Design Tools to Achieve Targets, Evolution of Constrained Networks, Cost Evolution of Networks
- HRAT and EMAT, Pseudo-pinch Design Method, Flexible Pinch Design Method, Compensation Principle Design Method
- Basic Thermal Design, Kern's Method, Bell-Delaware Method, Rapid Design Algorithm, Area Targeting Based on Pressure Drops, The Interfacing Methodology, Stream Pressure Drop Optimization
- Retrofit by Inspection, Retrofit-Fixed Heat Transfer Coefficient, Retrofit-Specified Pressure Drops, Debottlenecking
- Distillation and Evaporation Processes, Reaction Processes
- Utility Targeting and MER Networks, Area Targeting, Optimal HEN through Superstructure, Network Load Optimization

Evaluation Scheme (Theory):

EC No.	Evaluation Component	Duration	Marks (100) (Weightage %)*
1.	Mid Term Test-I	1 hour	20
2.	Mid Term Test-II	1 hour	20

3.	End Term Test	3 hour	40
4.	Class Participation	Day to day	10
5.	Additional continuous Evaluation (Quizzes, Assignments, Presentations, and others)	30 min.	10

Text Book:

Uday V Shenoy, “Heat Exchanger Network Synthesis: Process Optimization by Energy and Resource Analysis”, I edition, Gulf Publishing Company, Houston Texas, 1995.

PROCESS IDENTIFICATION

Course Code	**:**	**CHE728 (Elective IV/V/VI/VII/VIII)**
Course Title	**:**	**Process Identification**
Course Credits	**:**	**4**
Total Hours Per Week (L+T+P)	**:**	**3 + 0 + 0**

Course Syllabi (Theory):

- History, Philosophy, Principles, Definition, need of process, Intensification, Process Intensifying Equipment, Process Intensifying Equipments, Examples of their application on the commercial scale
- Use of high gravity fields, HiGee Reactor, Spinning Disc Reactors, Principles, Micro-reactors, Microchannel, heat exchangers, Monolithic, catalyst and reactors, Concept and principle, Reactivedistillation, extraction, precipitation, adsorption, absorption, and fermentation-pervaporation,
- Adsorptive distillation, Membrance, absorption and stripping, Principles, Integration of reaction, heat and mass transfer, Reverse flow reactor, Reverse flow reactor, Reactive distillation, Extractive, fermentation, Membrane Reactors
- Methodology, Application, De-bottle-necking, Principles, Design, Integrated plants, Traditional Approach, Strategies

Evaluation Scheme (Theory):

EC No.	Evaluation Component	Duration	Marks (100) (Weightage %)*
1.	Mid Term Test-I	1 hour	20
2.	Mid Term Test-II	1 hour	20
3.	End Term Test	3 hour	40
4.	Class Participation	Day to day	10
5.	Additional continuous Evaluation (Quizzes, Assignments, Presentations, and others)	30 min.	10

Text Book:

1. Andrzej Stankiewicz, Jacob A. Moulijn. Re-engineering the Chemical Processing Plant: Process Intensification, Marcel Dekker, Inc., New York, 2004.

Reference Book:

1. Joseph Mizrahi, Developing an Industrial Chemical Process: An Integrated Approach, CRC Press, 2002.

COMPUTER AIDED DESIGN IN CHEMICAL ENGINEERING

Course Code : CHE729 (Elective IV/V/VI/VII/VIII)

Course Title : Computer Aided Design in Chemical Engineering

Course Credits : 4

Total Hours Per Week (L+T+P) : 3 + 0 + 0

Course Syllabi (Theory):

Role of Computer-Aided Design (CAD) in chemical industry;. Approaches to CAD, potential and pitfalls; Estimation of physical/chemical properties application to the design of chemical processing units; Evaluation of the design, sensitivity analysis; Applications include use of computer programs (software packages and student-created programs for the design of process units, e.g. distillation, towers, multiple effect evaporators, multicomponent absorbers, heat exchanger networks, etc.).

Evaluation Scheme (Theory):

EC No.	Evaluation Component	Duration	Marks (100) (Weightage %)*
1.	Mid Term Test-I	1 hour	20
2.	Mid Term Test-II	1 hour	20
3.	End Term Test	3 hour	40
4.	Class Participation	Day to day	10
5.	Additional continuous Evaluation (Quizzes, Assignments, Presentations, and others)	30 min.	10

Text Book

- Sinnot R K, "Chemical Engineering Volume 6, Chemical Engineering Design (Coulson and Richardson's Chemical Engineering Series)", Third Edition, Butterworth Heinemenn (An imprint of Elsevier science)
- Aspen Plus manual, CHEMCAD manual

PETROLEUM REFINING & PETROCHEMICALS

Course Code	**:**	**CHE730 (Elective IV/V/VI/VII/VIII)**
Course Title	**:**	**Petroleum Refining & Petrochemicals**
Course Credits	**:**	**4**
Total Hours Per Week (L+T+P)	**:**	**3 + 0 + 0**

Course Syllabi (Theory):

- Origin & formation of petroleum, reserves & deposites of world, Indian refineries, oil & gas scene, HBJ gas grid, crude and gas reserves, Hydrocarbon series, isomeric compounds, composition of petroleum, sulpher compounds.
- Evaluation of Petroleum, Thermal properties of petroleum fractions, Important products – properties and test methods, Desalting of Crudes, Heating of Crude – Pipe still heaters, Distillation of petroleum (Atmospheric, Vacuum), Thermal cracking, Catalytic cracking, Catalytic reforming, Naphtha cracking, Delayed coking, Hydro cracking, Hydro treating, Alkylation, Isomerisation.
- Source of Asphalt (Bitumen), Air blowing of bitumen, Up gradation of heavy crudes, Natural gas, Petroleum, Classification of Petrochemicals., Ethylene, Propylene, Butylenes, Acetylene, Butadienes, Chloroprene, Cyclohexane, BTX.
- Synthesis gas, Methanol, Ethanol, EO, PO, IA, Acetone, Allyl alcohol, Glycerol, Acrylonitrile, Acrylic acid and Derivatives, Phenol, Aniline, Nylon Monomers, Polyester Monomers, Styrene, Other monomers, Plastics, Rubbers, Fibers, Resins, Detergents, Pesticides, Dyes, Protein, Explosives.

Evaluation Scheme (Theory):

EC No.	Evaluation Component	Duration	Marks (100) (Weightage %)*
1.	Mid Term Test-I	1 hour	20
2.	Mid Term Test-II	1 hour	20
3.	End Term Test	3 hour	40
4.	Class Participation	Day to day	10
5.	Additional continuous Evaluation (Quizzes, Assignments, Presentations, and others)	30 min.	10

Text Books:

T1. B.K. Bhaskara Rao, “Modern Petroleum Refining Processes”, Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi, 4th ed., 2002.

T2. Maiti S., “Introduction to Petrochemicals”, Oxford & IBH Publishing Co., Pvt., Ltd., New Delhi, 2nd Ed., 2002.

Reference Book:

R1. Nelson, W.L., “Petroleum Refinery Engineering”, McGraw-Hill Kogakusha, Ltd., Tokyo, 4th ed., (International student edition), 1958.

R2. Watkins, R.N., “Petroleum Refinery Distillation”, Gulf Pub. Company, Houston, 2nd ed., 1979.

FLUIDIZATION ENGINEERING

Course Code	**:**	**CHE731 (Elective IV/V/VI/VII/VIII)**
Course Title	**:**	**Fluidization Engineering**
Course Credits	**:**	**4**
Total Hours Per Week (L+T+P)	**:**	**3 + 0 + 0**

Course Syllabi (Theory):

- Types of adsorption; type of isotherm; adsorption kinetics; adsorbent, Basic modeling approach with suitable boundary condition, Upcoming adsorption techniques and their modeling approach; application of adsorption in different areas
- Introduction to cryogenic systems; low temperature properties and phenomena; application as separation and purification technique, Gas liquefaction, different air liquefaction cycles
- Cryogenic distillation; refrigeration systems, techniques for storage and transportation, Classification of membrane based on structures, flow, fabrication *etc.* Gas and liquid phase separation; pervaporation; liquid membrane; membrane reactor, Modeling approach; design considerations and applications
- Introduction to bio-kinetics, Types of bio-reactors and different techniques for bio-separation, Modeling approach, design considerations and applications, Concept of reactive distillation; supercritical fluid extraction, Modeling approach, design considerations and applications

Evaluation Scheme (Theory):

EC No.	Evaluation Component	Duration	Marks (100) (Weightage %)*
1.	Mid Term Test-I	1 hour	20
2.	Mid Term Test-II	1 hour	20
3.	End Term Test	3 hour	40
4.	Class Participation	Day to day	10
5.	Additional continuous Evaluation (Quizzes, Assignments, Presentations, and others)	30 min.	10

Text Book (TB)

2. Gupta, R. K. and A. K, Ghoshal "Advanced Separation Technology", *EDD Notes**, BITS, Pilani, 2000.

Reference Books (RB)

1 Seader, J. D. and E. J. Henley, " Separation Process Principles", *John Wiley & Sons, Inc. (Wiley India (P) Ltd.,* New Delhi), 2nd Ed., 2006.
3. Ruthven, D. M., S. Farooq and K. S. Knaebel, "Pressure Swing Adsorption", *VCH Publishers*, NY, 1994.
4. Barron, R., "Cryogenic Systems", *Oxford University Press*, NY, 2nd Ed. 1985.
5. Bailey, J. E. and D. V. Ollis, "Biochemical Engineering Fundamentals", *Mc-Graw Hill*, 1986.
6. Ruthven, D. M. "Principles of Adsorption and Adsorption Processes", John Wiley and Sons, 1984.
7. Mukhopadhyay M., "Natural Extracts using Supercritical Carbon Dioxide", *CRC Press*, LLC, Boca Raton, Florida, USA, 2000.
8. Research Papers from Refereed Journals / Resources.
9. Dynamic addition of reference material will be shared.

ADVANCED SEPARATION PROCESSES

Course Code	**:**	**CHE732 (Elective IV/V/VI/VII/VIII)**
Course Title	**:**	**Advanced Separation Processes**
Course Credits	**:**	**4**
Total Hours Per Week (L+T+P)	**:**	**3 + 0 + 0**

Course Syllabi (Theory):

Adsorption-based separation, Concept of adsorber design, application of adsorption in different areas; cryogenic separation, Gas liquefaction, different air liquefaction cycles, Cryogenic distillation, refrigeration systems, techniques for storage and transportation; Membrane separation, Gas and liquid phase separation, pervaporation, liquid membrane, membrane reactor; biotechnology-based separation, Introduction to bio-kinetics, Types of bio-reactors and different techniques for bio-separation; Recent advancements on the above areas and new concepts such as simulated moving bed adsorption, thermally coupled pressure swing adsorption, reactive distillation, bio-filtration, supercritical fluid extraction

Evaluation Scheme (Theory):

EC No.	Evaluation Component	Duration	Marks (100) (Weightage %)*
1.	Mid Term Test-I	1 hour	20
2.	Mid Term Test-II	1 hour	20
3.	End Term Test	3 hour	40
4.	Class Participation	Day to day	10
5.	Additional continuous Evaluation (Quizzes, Assignments, Presentations, and others)	30 min.	10

Text Book

Seader, J. D. and E. J. Henley, " Separation Process Principles", *John Wiley & Sons, Inc. (Wiley India (P) Ltd.,* New Delhi), 2nd Ed., 2006.

Reference Books

1. Ruthven, D. M., S. Farooq and K. S. Knaebel, “Pressure Swing Adsorption”, *VCH Publishers*, NY, 1994.
2. Barron, R., “Cryogenic Systems”, *Oxford University Press*, NY, 2nd Ed. 1985.
3. Bailey, J. E. and D. V. Ollis, “Biochemical Engineering Fundamentals”, *Mc-Graw Hill*, 1986.
4. Ruthven, D. M. “Principles of Adsorption and Adsorption Processes”, John Wiley and Sons, 1984.
5. Mukhopadhyay M., “Natural Extracts using Supercritical Carbon Dioxide”, *CRC Press*, LLC, Boca Raton, Florida, USA, 2000.
6. Research Papers from Refereed Journals / Resources.

SUGAR TECHNOLOGY

Course Code	**:**	**CHE733 (Elective-IV/V/VI/VII)**
Course Title	**:**	**Sugar Technology**
Course Credits	**:**	**4**
Total Hours per Week (L+T+P)	**:**	**3+0+0**

Course Syllabi (Theory):

Composition of cane and cane juice, Aim of clarification , clarification efficiency; Cabonation process, Double sulphitation process, Phosphitation Process;Various juice heaters, Various clarifiers , Vacuum Filters.Milk of lime preparation, Sulphur burner and preparation of SO_2 Gas; Juice Sulphitation , Syrup Sulphitation , Use of different chemicals; Aim of evaporation, Different types of evaporators, Different types of vapour bleeding System , Steam economy , DEVC cum Quad System, Quintuple System; Scale formation, De scaling, Cleaning procedure.Different types of condensers, Condensates, Ammonia gas, Entrainment; Syrup / Melt Clarification , Filtrate Clarification.

Evaluation Scheme (Theory):

EC No.	Evaluation Component	Duration	Marks (100) (Weightage %)*
1.	Mid Term Test-I	1 hour	20
2.	Mid Term Test-II	1 hour	20
3.	End Term Test	3 hour	40
4.	Class Participation	Day to day	10
5.	Additional continuous Evaluation (Quizzes, Assignments, Presentations, and others)	30 min.	10

Text Books

1. Introduction To Cane Sugar Technology by G.H. Jenkin
2. Principles of Sugar Technology by P. Honig.

References:

1. Hand Book of Sugar Technology by R.B.L. Mathur.
2. Hand Book of Cane Sugar Engineering by E. Hugot.
3. Cane Sugar Hand Book by Meade And Chen.

PHARMACEUTICAL ENGINEERING

Course Code	**:**	**CHE 734 (Elective-IV/V/VI/VII)**
Course Title	**:**	**Pharmaceutical Engineering**
Course Credits	**:**	**4**
Total Hours per Week (L+T+P)	**:**	**3+0+0**

Course Syllabi (Theory):

Introduction, Pharma engineering and its significance, unit operations and unit processes; Stoichiometry, General principles, material balance-tie substances, chemical reactions and molal units, rate process, steady, unsteady and equilibrium state, laws of combining weights, applications of gas laws, energy balance, fuels and combustion; Fluid Flow, Type of steady flow, Reynold number & its significance, types of pressure, viscosity, concept of boundary layers, total energy balance and total mechanical energy balance, losses in mechanical energy of fluids, basic equations of fluid flow, valves, flow meters, manometers and measurement of flow rate and pressure; Transportation of Materials, Solids- Bins, bunkers, conveyers, air transport, Liquids- Pipelines, fittings, valves, pumps, measurement of flowing liquids, Gases- Fans, blowers and compressors; Filtration, Theory and mechanism of filtration process, factors affecting rate of filtration, filter media, filter aids, types of filters, operation of filters, industrial filters-leaf filter, filter press, rotary filter, Edge filters etc, Mathematical problems on filtration, optimum cleaning cycle in batch filters, Applications in pharmacy. Centrifugation, Principle and theory of centrifugation, industrial centrifuges-perforated basket, centrifuge, sedimentation type centrifuge, continuous centrifuges etc. Mathematical problems, applications in pharmacy, Materials of Pharmaceutical Plant, Construction, Factors affecting the material selection for pharmaceutical plants, metals and nonmetals, corrosion and its prevention.

Evaluation Scheme (Theory):

EC No.	Evaluation Component	Duration	Marks (100) (Weightage %)*
1.	Mid Term Test-I	1 hour	20
2.	Mid Term Test-II	1 hour	20
3.	End Term Test	3 hour	40
4.	Class Participation	Day to day	10

5.	Additional continuous Evaluation (Quizzes, Assignments, Presentations, and others)	30 min.	10

Books Recommended

- Elementary Chemical Engineering - Max S. Peters, Published by McGraw Hill BookCompany, New York, 1954
- Perry's Chemical Engineer's Handbook - Robert H Perry, Green D.W., Maloney J.O.7th Edition, 1998, McGraw – Hill Inc., New York.
- Tutorial Pharmacy by Cooper & Gunn, ed. S.J.Carter, CBS Publishers & Distributors, Delhi, 6th Edition, 2000.
- Unit Operations of Chemical Engineering, 5th edition - McCabe, Smith & Harriott, McGraw – Hill Inc., New York.
- Pharmaceutical Engineering – K.Sambamurthy, 2002 NAI (P) Ltd., Delhi.
- Pharmaceutics : The Science of Dosage Form Design - M.E. Aulton.
- The Theory & Practice of Industrial Pharmacy – Lachman L., Lieberman H.A. & Kanjig J.L., 3rd edition, 1990 Varghese Publishing House, Bombay.
- Alfonso G. Remington: The Science & Practice of Pharmacy. Vol.I & II 20th edition, 2000. Lippincott, Williams & Wilkins Philadelphia.
- Paradkar A.R. Introduction to Pharmaceutical Engineering, 3rd Edition, 2001, Nirali Prakashan, Pune.
- Subramanyam C.V.S., Thimma J, Suresh S.S. et. al., Pharmaceutical Engineering : Principles and Practice, 2002, Vallabh Prakashan, Delhi.
- P.J.Shah, A Textbook of Engineering Drawing Vol. I and II, 6th Edition, 2003, Ahmedabad
- Engineering Drawing, 34th edition, N.D.Bhatt Charutar Publishing House, 1994
- Engineering Drawing & Graphic Technology, 13th edition by Thomas E. French, Charles J. Vierch, Rebot J. Foster, McGraw Hill International Edition, New Delhi, 1972
- Filtration in Pharma. Industry by Tehodere H. Meltzed, Marcel Dekker Inc., New York, 1987
- Introduction to Chemical Engineering by Walter L. Badger & Julius T. Banchero, Mcgraw Hill International edition, New Delhi, 1955.

CHEMICAL VAPOR DEPOSITION

Course Code	**:**	**CHE 735 (Elective-IV/V/VI/VII)**
Course Title	**:**	**Chemical vapor deposition**
Course Credits	**:**	**04**
Total Hours per Week (L+T+P)	**:**	**3+0+0**

Course Syllabi (Theory):

A simplified multi-step fab sequence, Applications of thin films, thin film deposition, chemical vapor deposition, advantages and disadvantages of various methods of chemical vapor deposition; Process Fundamentals, definition, CVD reaction rate control, heat transport; APCVD Fundamentals, use of APCVD in semiconductor processing, typical APCVD continuous belt reactor., deposition area boundaries, APCVD process gases, equipments; LPCVD Fundamentals, the pressure and temperature characteristics of the LPCVD process, key components of a typical LPCVD system, two practical advantages of LPCVD processing, major types of LPCVD reaction chambers and the advantages and disadvantages; PECVD Fundamentals, plasma, ion, RF, radical, excitation, relaxation, ionization, recombination, plasma potential and plasma shielding, regions of various plasma discharge.

Evaluation Scheme (Theory):

EC No.	Evaluation Component	Duration	Marks (100) (Weightage %)*
1.	Mid Term Test-I	1 hour	20
2.	Mid Term Test-II	1 hour	20
3.	End Term Test	3 hour	40
4.	Class Participation	Day to day	10
5.	Additional continuous Evaluation (Quizzes, Assignments, Presentations, and others)	30 min.	10

Text Books:

1. D.M. Dobkin, Michael K. Zuraw, “Principles of Chemical Vapor Deposition”, Kluwer Academic Publishers, 2003
2. Anthony C. Jones, Michael L. Hitchman , “Chemical Vapour Deposition”, RSC Publishisng, 2009

SEMINAR

Course Code	**:**	**SEM701**
Course Title	**:**	**Seminar**
Course Credits	**:**	**2.5**
Total Hours per Week (L+T+P)	**:**	**0 + 0 + 4**

Course Syllabi (Theory):

Operation Procedure

1. Student has to devote full semester for SEM701 course.
2. Student has to report to the Supervisor regularly.
3. Seminars s evaluation has to be carried out in the presence of a two member Committee comprising.
4. Experts in the relevant area constituted by the Supervisor.

Final Seminar Report to be submitted has to be in formal hard bound cover bearing of the Institute emblem.

Reference Books:

Based on literature survey to be done with peer reviewed journals and magazines.

Evaluation Scheme (Theory):

S. No.	Evaluation Component	Duration (Hours)	Marks (100)	Nature of Component
1.	Presentation	Weekly	25	Open Book
2.	Report(Soft Copy)	Weekly	25	Open Book
3.	Assignment	Continuous	10	Open Book
4.	Final Presentation		20	Open Book
5.	Final Report(Hard Copy)		20	Open Book

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INSTITUTE OF ENGINEERING AND TECHNOLOGY

4 Year B. Tech Programme

(Branch: Chemical Engineering)

Batch 2012-2016

SEMESTER-EIGHTH

Detailed Syllabus

&

Scheme of Examination

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PRACTICE SCHOOL – II

Course Code : **PS801**

Course Title : **Practice School – II**

Course Credits : **16**

Duration : **Five and Half Months**

Course Syllabi:

This course is for five and half months (summer and one semester) in VII or VIII Semester. The objective of this programme is to provide the students, an opportunity to work on live projects of corporate world in various fields. During this programme, they will work on real world applications of their curricula through organizational function of their choice. The students are expected to be involved directly in problem solving efforts of specific interest to the host organization. The learning of PS-I will help them in completing PS-II successfully.

Evaluation Scheme:

S. No.	Evaluation Component	Marks (100) (Weightage %)
1	Quiz-I	4
2	Quiz-II	4
3	Group Discussion-I	4
4	Group Discussion-II	4
5	Seminar-I	4
6	Seminar-II	4
7	Diary-I	4
8	Diary-II	4
9	Observation-I	4
10	Observation- II	4
11	Mid Term Evaluation (Project Report and Presentation/Viva)	20
12	Final Evaluation (Project Report and Presentation/Viva)	40