DAV UNIVERSITY JALANDHAR

Course Scheme & Syllabus

For

B. Tech. in Chemical Engineering

1st TO 8th SEMESTER
Examinations 2019–2020 Session

Syllabi Applicable For Admissions in 2019–2020

DAV UNIVERSITY, JALANDHAR

4 year Curriculum structure

Undergraduate Degree in Engineering & Technology

Branch: Chemical Engineering

Total credits (4 year course): 185

I. Induction Program

Induction Program	15 days duration
Induction program for students to be offered right at the start of the first year	• Physical activity • Creative arts • Universal human values • Literary • Proficiency Modules • Lectures by eminent people • Visit to local areas • Familiarization to department and Innovations

II. **Semester wise structure of curriculum**

Scheme of Courses
B. Tech. in Chemical Engineering
Semester-I

S.NO.	Paper Code	Course Title	L	T	P	Cr	Nature of Course
1	MTH151A	Engineering Mathematics-I	4	0	0	4	BSC
2	CHE151A	Chemistry	4	0	0	4	BSC
3	CSE101A	Computer Fundamentals and Programming	4	0	0	4	ESC
4	EVS100A	Environmental Studies	4	0	0	0	MC/Non Credit
5	MEC101A	Engineering Drawing	2	0	4	4	ESC
6	ENG151B	Basic Communication Skills	3	0	0	3	HSMC
7	CHE152	Chemistry Lab	0	0	2	1	BSC
8	CSE103	Computer Fundamentals and Programming Lab	0	0	2	1	ESC
9	ENG152A	Basic Communication Skills Lab	0	0	2	1	HSMC
Total Credit						22	

Scheme of Courses
B. Tech. in Chemical Engineering
Semester-II

S.NO.	Paper Code	Course Title	L	T	P	Cr	Nature of Course
1	MTH152A	Engineering Mathematics-II	4	0	0	4	BSC
2	PHY151B	Engineering Physics	4	0	0	4	BSC
3	MEC103	Mechanical Engineering Fundamentals	4	0	0	4	ESC
4	ELE105	Basic Electrical Engineering	4	0	0	4	ESC
5	SGS107	Human Values and General Studies	4	0	0	0	MC/ Non Credit
6	MEC104	Manufacturing Practice	0	0	4	2	ESC
7	PHY152	Engineering Physics Lab	0	0	2	1	ESC
8	ELE106	Electrical and Electronics Technology Lab	0	0	2	1	ESC
Total credits						20	

Note: *At the end of the examination of 2nd Semester the students will undergo compulsory Swachhta Bharat Summer Internship Programme. The marks for this will be included in the 3rd Semester.*

L: Lectures T: Tutorial P: Practical Cr: Credits

BSC: Basic Science Courses **HSMC: Humanities, Social Sciences including Management**

ESC: Engineering Science Courses **MC: Mandatory Course**

DAV UNIVERSITY, JALANDHAR

Scheme of Courses
B. Tech. in Chemical Engineering
Semester-III

S.NO.	Paper Code	Course Title	L	T	P	Cr	Nature of Course
1	CHL211	Energy Engineering	3	0	0	3	PCC
2	MTH252A	Engineering Mathematics-III	4	0	0	4	BSC
3	CHL201	Mechanical Operations	4	0	0	4	PCC
4	CHL202	Chemical Process Calculations	4	0	0	4	PCC
5	CHL203	Fluid Flow	4	0	0	4	PCC
6	CHL222	Mechanical Operations Lab	0	0	3	2	PCC
7	CHL223	Fluid Flow Lab	0	0	3	2	PCC
8	CHL250	Swachhta Bharat Summer Internship Programme	0	0	0	2	SI
Total Credits						25	

Scheme of Courses
B. Tech. in Chemical Engineering
Semester-IV

S.NO.	Paper Code	Course Title	L	T	P	Cr	Nature of Course
1	CHL204	Chemical Technology-I (Inorganic)	4	0	0	4	PCC
2	CHL205	Chemical Engineering Thermodynamics	4	0	0	4	PCC
3	CHL206	Heat Transfer	4	0	0	4	PCC
4	CHL207	Chemical Process Instrumentation	4	0	0	4	PCC
5	CHL304	Process Dynamics & Controls	4	0	0	4	PCC
6	CHL330	Instrumentation & Controls Laboratory	0	0	2	1	PCC
7	CHL227	Heat Transfer Operations Lab	0	0	2	1	PCC
Total Credits						22	

L: Lectures T: Tutorial P: Practical Cr: Credits

PCC: Professional Core Courses **BSC: Basic Science Courses**

Note: *At the end of the examination of 4^{th} Semester the students will undergo compulsory industrial training for a period of 4 weeks duration in reputed industries. Every student will submit the Training Report within two weeks from the start of teaching for 5^{th} Semester. The marks for this will be included in the 5^{th} Semester.*

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Scheme of Courses
B. Tech. in Chemical Engineering
Semester-V

S. NO.	Paper Code	Course Title	L	T	P	Cr	Nature of Course
1	CHL301	Mass Transfer I	4	0	0	4	PCC
2	CHL302	Chemical Reaction Engineering I	4	0	0	4	PCC
3	CHL303A	Chemical Technology-II (Organic)	3	0	0	3	PCC
4	CHL208	Material Science and Technology	3	0	0	3	PCC
5	MTH256A	Numerical Methods	3	0	0	3	BSC
6	CHL323	Chemical Technology Laboratory	0	0	3	2	PCC
7	MTH257B	Numerical Methods Lab	0	0	2	1	BSC
8	CHL300	Industrial Training	0	0	0	2	SI
Total Credits						22	

Scheme of Courses
B. Tech. in Chemical Engineering
Semester-VI

S. NO.	Paper Code	Course Title	L	T	P	Cr	Nature of Course
1	CHL305	Mass Transfer II	4	0	0	4	PCC
2	CHL306	Chemical Reaction Engineering II	4	0	0	4	PCC
3		Professional Core Elective-I	3	0	0	3	PCC
4		Professional Core Elective-II	4	0	0	4	PCC
5		Open Elective-I	4	0	0	4	PEC
6	CHL325	Mass Transfer Lab	0	0	3	2	PCC
7	CHL327	Reaction Engineering Lab	0	0	2	1	PCC
8	CHL329	Environment Technology Lab	0	0	2	1	PCC
Total Credits						23	

L: Lectures T: Tutorial P: Practical Cr: Credits

PCC: Professional Core Courses **BSC: Basic Science Courses**

SI: Summer Internship **PEC: Professional Elective Courses**

Note:

- *Professional Core Elective -I & II should be from the basket of Professional Core Elective –I & II*
- *Open elective-I should be from the "Open Elective Basket.*
- *At the end of the examination of 6th Semester the students will undergo compulsory industrial training for a period of 6 weeks duration in reputed industries. Every student will submit the training report within two weeks from the start of teaching of 7th Semester. The marks for this will be included in the 7th semester.*

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Scheme of Courses
B. Tech. in Chemical Engineering
Semester-VII

S. NO.	Paper Code	Course Title	L	T	P	Cr	Nature of Course
1	CHL402	Transport Phenomenon	4	0	0	4	PCC
2	CHL404	Process Engineering Design-I	4	0	0	4	PCC
3		Professional Core Elective –III	4	0	0	4	PCC
4		Open Elective-II	4	0	0	4	PEC
5		Open Elective-III	4	0	0	4	OEC
6	CHL400	Industrial Training	0	0	0	2	SI
7	CHL499	Project	0	0	8	4	Proj
Total Credits						26	

Note:

- *Professional Core Elective -III should be from the basket of "Professional Core Elective -III".*
- *Open elective-II & III should be from the "Open Elective Basket"*

Scheme of Courses
B. Tech. in Chemical Engineering
Semester-VIII

S. NO.	Paper Code	Course Title	L	T	P	Cr	Nature of Course
1		Professional Core Elective -IV	4	0	0	4	PEC
2		Professional Core Elective -V	4	0	0	4	PEC
3		Open Elective-IV	4	0	0	4	OEC
4	CHL405A	Process Modeling & Simulation	3	0	0	3	PCC
5	CHL407	Process Engineering Design-II	4	0	0	4	PCC
6	CHL425	Process Modeling & Simulation Lab	0	0	2	1	PCC
7	CHL450	Seminar	0	0	4	2	HSMS
8	ENG352	Professional Communication	3	0	0	3	HSMS
Total Credits						25	

L: Lectures T: Tutorial P: Practical Cr: Credit

PCC: Professional Core Courses **HSMC: Humanities, Social Sciences including Management**

SI: Summer Internship **PEC: Professional Elective Courses**

OEC: Open Elective Courses **Proj: Project**

Note:

- *Professional Core Elective -IV& V should be from the basket of "Professional Core Elective -IV & V" respectively.*
- *Open elective-IV should be from the "Open Elective Basket"*

Professional Elective Courses -I

S. No.	Paper Code	Course Title	L	T	P	Cr
1	CHL310	Process Engineering and Economics	3	0	0	3
2	CHL350	Water conservation and management	3	0	0	3
3	CHL351	Sustainability Engineering	3	0	0	3
4		MOOC Course	3	0	0	3

Professional Elective Courses -II

S. No.	Paper Code	Course Title	L	T	P	Cr
1	CHL446	Optimization Techniques	4	0	0	4
2	CHL447	Electrochemical Technology	4	0	0	4
3	CHL457A	Alternate Energy Technology	4	0	0	4
4		MOOC Course	4	0	0	4

Professional Elective Courses -III

S. No.	Paper Code	Course Title	L	T	P	Cr
1	CHL451A	Biochemical Engineering	4	0	0	4
2	CHL452A	Membrane Separation	4	0	0	4
3	CHL453A	Polymer Processing	4	0	0	4
4		MOOC Course	4	0	0	4

Professional Elective Courses -IV

S. No.	Paper Code	Course Title	L	T	P	Cr
1	CHL454A	Fertilizer Technology	4	0	0	4
2	CHL455A	Petrochemical Technology	4	0	0	4
3	CHL456A	Corrosion Engineering	4	0	0	4
4		MOOC Course	4	0	0	4

Professional Elective Courses -V

S. No.	Paper Code	Course Title	L	T	P	Cr
1	CHL459	Paint Technology	4	0	0	4
2	CHL460	Advanced Separation Processes	4	0	0	4
3	CHL461	Application of Nano Technology in Chemical Engineering	4	0	0	4
4		MOOC Course	4	0	0	4

L: Lectures T: Tutorial P: Practical Cr: Credits

S.NO.	Paper Code	Course Title	L	T	P	Cr
1	ELE801	Electro-Mechanical Energy Conversion	4	0	0	4
2	ELE802	Transducers and Signal Conditioning	4	0	0	4
3	ELE466	MATLAB-State of the Art	4	0	0	4
4	CHL308	Environmental Engineering	4	0	0	4
5	CHL406	Industrial Safety and Hazard Management	4	0	0	4
6	CHL801	Industrial Pollution Control	4	0	0	4
7	CHL802	Fuel Cell Technology	4	0	0	4
8	MEC801	Industrial Engineering Techniques	4	0	0	4
9	MEC802	Energy Resources	4	0	0	4
10	CSE801	Software Engineering & Project Management	4	0	0	4
11	CSE802	Computer Networks	4	0	0	4
12	ECE801	Communication and Media Foundations	4	0	0	4
13	ECE802	Electronic Displays	4	0	0	4
14	ECE803	Everyday Electronics	4	0	0	4
15	CIV801	Construction Materials and Techniques	4	0	0	4
16	CIV802	Railway and Tunnel Engineering	4	0	0	4
17	MGT151A	Fundamentals of Management	4	0	0	4
18	MGT152	Fundamentals of Advertising	4	0	0	4
19	MGT153	Fundamentals of Stock Market	4	0	0	4
20	MGT154	Fundamentals of Research Methods	4	0	0	4
21	MGT155	Fundamentals of Accounting & Finance	4	0	0	4

Open Elective Basket*

L: Lectures T: Tutorial P: Practical Cr: Credits

*The open elective basket is subjected to change in accordance with the BOS of other departments.

DAV UNIVERSITY, JALANDHAR

B Tech Course Structure

S. No.	Category	Suggested Break up of credits (AICTE 2018)	Credits
1	Humanities and Social Sciences including Management courses	12	9
2	Basic Science courses	25	25
3	Engineering Science courses including workshop, drawing, basics of electrical/mechanical/computer etc.	24	21
4	Professional core courses	48	85
5	Professional Elective courses relevant to chosen specialization/branch	18	19
6	Open subjects – Electives from other technical and /or emerging subjects	18	16
7	Project work, seminar and internship in industry or elsewhere	15	10
8	Mandatory Courses [Environmental Sciences, Induction Program, Indian Constitution, Essence of Indian Traditional Knowledge]	(Non credit)	(non-credit)

Detailed

Syllabus

DAV UNIVERSITY, JALANDHAR

Course Title: Engineering Mathematics-I

Paper Code: MTH151A

L	T	P	Credits
4	0	0	4

Objective: The aim of this course is to familiarize the students with the theory of matrices which are used in solving equations in mechanics and the other streams. This course also provides a comprehensive understanding of the origin and development of ideas to exhibit the techniques origin and development of ideas to exhibit the techniques of solving ordinary differential equations.

Unit-A

Rank of matrices, Inverse of Matrices, Gauss Jordan Method, reduction to normal form, Consistency and solution of linear algebraic system of equations, Gauss Elimination Method, Eigen values and Eigen vectors, Diagonalisation of Matrix, Cayley Hamilton theorem. Orthogonal, Hermition and unitary matrices.

Unit-B

Concept of limit and continuity of a function of two variables, Partial derivatives, Homogenous Function, Euler's Theorem, Total Derivative, Differentiation of an implicit function, chain rule, Change of variables, Jacobian, Taylor's and McLaurin's series. Maxima and minima of a function of two and three variables: Lagrange's method of multipliers.

Unit-C

Formation of ordinary differential equations, solution of first order differential equations by separation of variables, Homogeneous equations, Reduce to Homogenous, exact differential equations, equations reducible to exact form by integrating factors, equations of the first order and higher degree, clairaut's equation.

Unit-D

Solution of differential equations with constant coefficients: method of differential operators. Non – homogeneous equations of second order with constant coefficients: Solution by method of variation of parameters, Simultaneously Linear differential equation.

References:

1. Grewal, B.S. *Higher Engineering Mathematics*. New Delhi: Khanna Publication, 2009.
2. Kreyszig, Erwin. *Advanced Engineering Mathematics*. New Delhi: Wiley Eastern Ltd., 2003.
3. Jain, R K, and K Iyengar S R. *Advanced Engineering Mathematics*, New Delhi: Narosa Publishing House, 2003.
4. Thomas, George B. and Finney Ross L. *Calculus and Analytic Geometry*. New Delhi Addison Wesley, 1995.

DAV UNIVERSITY, JALANDHAR

Course Title: Chemistry

Course Code: CHE151A

L	T	P	Credits
4	0	0	4

Course Objectives:

The objective of the Engineering Chemistry is to acquaint the student with the basic phenomenon/concepts of chemistry for the development of the right attitudes by the engineering students to cope up with the continuous flow of new technology. The student will able to understand the new developments and breakthroughs efficiently in engineering and technology.

Expected Prospective:

This course will equip students with the necessary chemical knowledge concerning the fundamentals as well as new technology in the field of chemistry.

Unit- A

Spectroscopy and its Applications

General Introduction: Introduction, electromagnetic spectrum, absorption and emission spectrum, atomic and molecular spectroscopy, types of molecular spectra, experimental techniques, selection rules, width and intensities of spectral lines.

UV/Visible Spectroscopy: types of electronic Transitions, Chromophores, Auxochromes, Effect of conjugation on Chromophores, Factors affecting λ_{max} and intensity of spectral lines, effect of solvent on λ_{max}, isobestic point, applications.

IR Spectroscopy: Infrared region, fundamental modes of vibrations and types, theory of infrared spectra, vibrational frequency and energy levels, anharmonic oscillator, modes of vibrations of polyatomic molecules, characteristic signals of IR spectrum, finger print region, factors affecting vibrational frequency; applications.

NMR Spectroscopy: Principle and instrumentation, relaxation processes, proton magnetic resonance spectroscopy, number of signals, Chemical shift, Spin-Spin Splitting, coupling constant, applications.

Unit- B

Water and its treatment

Introduction, hardness of water, degree of hardness, units of hardness, boiler feed water: specification, scales and sludge formation; priming& foaming, boiler corrosion, caustic Embrittlement, treatment of boiler feed water, internal treatment of water; softening of water by lime-soda, zeolite and ion exchange methods, desalination of water; Water for domestic use: purification of water for domestic use.

Corrosion and its Prevention

Introduction; different types of corrosion - wet and dry corrosion; mechanism of wet corrosion; comparison of dry and wet corrosion, Types of electrochemical corrosion: galvanic corrosion, concentration cell corrosion or differential aeration corrosion, waterline corrosion, pitting corrosion, crevice corrosion, stress corrosion, intergranular corrosion; other forms of corrosion: atmospheric corrosion, soil corrosion, microbiological corrosion, erosion corrosion, Filliform corrosion, stray current corrosion, passivity, galvanic series, factors influencing corrosion, various methods of corrosion control.

Unit-C

Chemistry in Nanoscience and Technology

Introduction, Materials self-assembly, molecular vs. material self-assembly, hierarchical assembly, self-assembling materials, two dimensional assemblies, mesoscale self-assembly, coercing colloids, nanocrystals, supramolecular structures, nanoscale materials, future perspectives applications, nanocomposites and its applications.

Unit-D

Polymers and polymerization

Introduction, monomer and repeating unit, degree of polymerization, functionality, classification of polymers: based on origin, monomers, structure, method of synthesis, tacticity or configuration, action of heat, chemical composition, ultimate form; types of polymerization, specific features of polymers, regularity and irregularity, tacticity of polymers, average molecular weights and size, determination of molecular weight by number average methods, effect of molecular weight on the properties of polymers, introduction to polymer reinforced composites.

References:

1. William Kemp, *Organic Spectroscopy*, Palgrave Foundations, 1991.

2. D. A. Skoog, F. J. Holler and A. N. Timothy, *Principle of Instrumental Analysis*, 5th Edition., Saunders College Publishing, Philadelphia, 1998.

3. C. P. Poole, Jr., F. J. Owens, *Introduction to Nanotechnology*, Wiley Interscience, 2003.

4. L.E. Foster, Nanotechnology, *Science Innovation & Opportunity*, Pearson Education, 2007.

5. P. Ghosh, *Polymer Science and technology* (2nd Edition), Tata McGraw Hill, 2008.

6. Wiley *Engineering Chemistry*, Second Edition, 2013.

DAV UNIVERSITY, JALANDHAR

Course Title: Computer Fundamentals and Programming

Course Code: CSE101A

L	T	P	Credits
4	0	0	4

Course Objective: To get basic knowledge of computers (hardware and software), its components and Operating systems. To acquire programming skills in C, basic knowledge of Internet

Unit-A

Introduction to Computers

Define a Computer System, Block diagram of a Computer System and its working, memories, Volatile and non-volatile memory, cache, virtual, secondary storage devices-Magnetic Tape, Hard Disk, CD-DVD, Magnetic Disk, Various input devices including keyboard, Mouse, Joystick, Scanners and Various output devices including Monitors, Printers, Plotters

Operating Systems

Computer Software and its types and Hardware, Operating Systems, their types and functions

Unit-B

Working Knowledge of Computer System

Introduction to word processors and its features, creating, editing, printing and saving documents, spell check, mail merge, creating power point presentations, creating spreadsheets and simple graphs.

Fundamentals of Internet Technology

Local area networks, MAN and wide area network, Internet, WWW, E-mail, Browsing and Search engines, Internet Connectivity, Network Topology, Hub, Switches, Router, Gateway.

Unit-C

Basic Constructs of C

Keywords, Identifiers, Variables, Data Types and their storage, Arithmetic Operators, Relational Operators, Logical Operators, Bitwise Operators, Increment & Decrement Operators, Expressions, Conditional Expressions, Assignment Operators and Expressions, External Variables and Scope of Variables, Structure of C Program.

Control Structures

Decision making statements: if, nested if, if – else ladder, switch, Loops and iteration: while loop, for loop, do – while loop, break statement, continue statement, goto statement.

Unit-D

Functions

Advantages of functions, function prototype, declaring and defining functions, return statement, call by value and call by reference, recursion, and storage classes.

Arrays and Strings

Declaration of arrays, initialization of array, accessing elements of array, I/O of arrays, passing arrays as arguments to a function, strings, I / O of strings, string manipulation functions (strlen, strcat, strcpy, strcmp)

References:

1. V.K. Jain: "*Fundamentals of Information Technology and Computer Programming*", PHI. Latest Edition.
2. Anita Goel: "*Computers Fundamentals*", Pearson Publications
3. Brian Kernighan and Dennis M. Ritchie: "*The C Programming Language*", Prentice Hall, 2nd Edition 2007.
4. K.N.King : "*C Programming : A Modern Approach*", W.W. Norton Company 2nd edition (2008).
5. Herbert Schildt : "*C: The Complete Reference*", Tata Mcgraw Hill Publications 4th edition.
6. Gottfired : "*Programming in ANSI C, Schaum Series*", TMH publications, 2nd Edition (1996).

DAV UNIVERSITY, JALANDHAR

Course Title: Environmental Studies

Course Code: EVS100A

L	T	P	Credits	Marks
4	0	0	**0**	Satisfactory /Unsatisfactory

Course Objective: This course aims at understanding the students in aspects of environmental problems, its potential impacts on global ecosystem and its inhabitants, solutions for these problems as well as environmental ethics which they should adopt to attain sustainable development.

Unit 1

Introduction to Environmental Studies

- Definition, components and types of Environment.
- Meaning of Environmental Studies and its Multidisciplinary nature;
- Scope and importance; Concept of sustainability and sustainable development.

6 hours

Natural Resources: Renewable and Non---Renewable Resources

- Land resources and land use change; Land degradation, soil erosion and desertification.
- Deforestation: Causes and impacts due to mining, dam building on environment, forests, biodiversity and tribal populations.
- Water: Use and over---exploitation of surface and ground water, floods, droughts, conflicts over water (international & inter---state).
- Energy resources: Renewable and non-renewable energy sources, use of alternate energy sources, growing energy needs, case studies.

8 hours

Unit II

Ecosystems

- What is an ecosystem? Structure and function of ecosystem; Energy flow in an ecosystem: food chains, food webs and ecological succession. Case studies of the following ecosystems :

a) Forest ecosystem

b) Grassland ecosystem

c) Desert ecosystem

d) Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)

2 hours

Biodiversity and Conservation

Levels of biological diversity: genetic, species and ecosystem diversity; Biogeographic zones of India; Biodiversity patterns and global biodiversity hot spots

- India as a mega---biodiversity nation; Endangered and endemic species of India
- Threats to biodiversity: Habitat loss, poaching of wildlife, man---wildlife conflicts, biological invasions; Conservation of biodiversity: In---situ and Ex---situ conservation of biodiversity.
- Ecosystem and biodiversity services: Ecological, economic, social, ethical, aesthetic and Informational value.

8 hours

Unit III

Environmental Pollution

Environmental Pollution: types, causes, effects and controls; Air, water, soil and noise pollution

- Nuclear hazards and human health risks
- Solid waste management: Control measures of urban and industrial waste.
- Pollution case studies.

8 hours

Environmental Policies & Practices

- Climate change, global warming, ozone layer depletion, acid rain and impacts on human communities and agriculture
- Environment Laws: Environment Protection Act; Air (Prevention & Control of Pollution) Act; Water (Prevention and control of Pollution) Act; Wildlife Protection Act; Forest Conservation Act. International agreements: Montreal and Kyoto protocols and Convention on Biological Diversity (CBD).
- Nature reserves, tribal populations and rights, and human wildlife conflicts in Indian context.

7 hours

Unit IV

Human Communities and the Environment

- Human population growth: Impacts on environment, human health and welfare.
- Resettlement and rehabilitation of project affected persons; case studies.
- Disaster management: floods, earthquake, cyclones and landslides.

- Environmental movements: Chipko, Silent valley, Bishnois of Rajasthan.
- Environmental ethics: Role of Indian and other religions and cultures in environmental conservation.
- Environmental communication and public awareness, case studies (e.g., CNG vehicles in Delhi).

6 hours

Field work

- Visit to an area to document environmental assets: river/ forest/ flora/fauna, etc.
- Visit to a local polluted site---Urban/Rural/Industrial/Agricultural.
- Study of common plants, insects, birds and basic principles of identification.
- Study of simple ecosystems---pond, river, Delhi Ridge, etc.

5 hours

Suggested Readings:

1. Carson, R. 2002. *Silent Spring*. Houghton Mifflin Harcourt.
2. Gadgil, M., & Guha, R.1993. *This Fissured Land: An Ecological History of India*. Univ. of California Press.
3. Gleeson, B. and Low, N. (eds.) 1999.*Global Ethics and Environment*, London, Routledge.
4. Gleick, P. H. 1993. *Water in Crisis*. Pacific Institute for Studies in Dev., Environment & Security. Stockholm Env. Institute, Oxford Univ. Press.
5. Groom, Martha J., Gary K. Meffe, and Carl Ronald Carroll.*Principles of Conservation Biology*. Sunderland: Sinauer Associates, 2006.
6. Grumbine, R. Edward, and Pandit, M.K. 2013. Threats from India's Himalaya dams. *Science*, 339: 36---37.
7. McCully, P. 1996. *Rivers no more: the environmental effects of dams*(pp. 29---64). Zed Books.
8. McNeill, John R. 2000. Something New Under the Sun: An Environmental History of the Twentieth Century.
9. Odum, E.P., Odum, H.T. & Andrews, J. 1971.*Fundamentals of Ecology*. Philadelphia: Saunders.
10. Pepper, I.L., Gerba, C.P. & Brusseau, M.L. 2011. Environmental and Pollution Science. Academic Press.

11. Rao, M.N. & Datta, A.K. 1987. *Waste Water Treatment*. Oxford and IBH Publishing Co. Pvt. Ltd.
12. Raven, P.H., Hassenzahl, D.M. & Berg, L.R. 2012.*Environment*. 8th edition. John Wiley & Sons.
13. Rosencranz, A., Divan, S., & Noble, M. L. 2001. *Environmental law and policy in India*. *Tripathi 1992*.
14. Sengupta, R. 2003. *Ecology and economics*: An approach to sustainable development. OUP.
15. Singh, J.S., Singh, S.P. and Gupta, S.R. 2014. *Ecology, Environmental Science and Conservation*. S. Chand Publishing, New Delhi.
16. Sodhi, N.S., Gibson, L. & Raven, P.H. (eds). 2013. *Conservation Biology*: *Voices from the Tropics*. John Wiley & Sons.
17. Thapar, V. 1998. *Land of the Tiger*: *A Natural History of the Indian Subcontinent*.
18. Warren, C. E. 1971. *Biology and Water Pollution Control*. WB Saunders.
19. Wilson, E. O. 2006.*The Creation: An appeal to save life on earth*. New York: Norton.

DAV UNIVERSITY, JALANDHAR

Course Title: Engineering Drawing

Course Code: MEC101A

L	T	P	Credits
2	0	4	4

Course Objectives: Students will be able to use the techniques to interpret the drawings and to use it in the field work of engineering. They will learn various lines, planes, solids and their sectioning and to develop their lateral surfaces. Concepts of orthographic and isometric projections

Unit-A

Drawing Techniques

Introduction to drawing instruments, various types of lines and their convention, principles of dimensioning, Engineering symbols, Gothic lettering in single stroke as per SP-46 code (Vertical and inclined)

Scales

Concept of scaling, construction of plane and diagonal scales

Unit-B

Projection of Points

Concept of plane of projections (Principle planes), First and third angle projections; projection of points in all four quadrants, shortest distance problems

Projection of Lines and Planes

Projection of line parallel to both planes, perpendicular to one plane, inclined to one and both the reference planes and their traces. Plane perpendicular to one plane inclined to one and both the reference planes and their traces. Concept of profile plane and auxiliary planes, To find the true length, α, β, θ and Φ.

Unit-C

Projection of Solids

Right and oblique solids; solids of revolution and polyhedrons, projection of solid with axis perpendicular to one plane and parallel to one or both reference planes. Projection of solid with axis inclined to one or both reference planes.

Sectioning of Solids

Theory of sectioning, types of section planes, their practice on projection of solids, Sectioning by auxiliary planes, to find true section of truncated solids.

Unit-D

Development of Surfaces

Method of Development, Development of surfaces: Parallel line and Radial line method. Development of oblique solids, Development of curved surfaces.

Orthographic and Isometric Views

Draw orthographic views from isometric view or vice-a-versa, Missing line and missing view

References:

1. Jolhe, A.J., "*Engineering Drawing*", Tata McGraw-Hill, New Delhi.
2. Gill, P.S., *"Engineering Drawing",* S.K. Kataria and Sons, Ludhiana
3. French T.E. and Vierck, C.J., *"Graphic Science"*, McGraw-Hill, New York
4. Zozzora F., *"Engineering Drawing",* McGraw Hill, New York

DAV UNIVERSITY, JALANDHAR

Course Title: Basic Communication Skills

Course Code: ENG151B

L	T	P	Credits
3	1	0	3

Course Objectives:

- To enhance students' vocabulary and comprehension skills through the prescribed texts.
- To hone students' reading and writing skills.
- To teach the rules of English grammar descriptively.
- To make students aware about the socio-cultural aspect of English.

Learning Outcomes: Students will

- Have developed a wide vocabulary and be able to summarize ideas.
- Be able to read and analyze texts and display competence in written communication.
- Show a considerable understanding of English Grammar.
- Demonstrate sensitivity to cultural differences while communicating

Unit – A

1. **Applied Grammar (in Socio-Cultural Context)**
    - Tenses
    - Passives
    - Reported/Reporting Speech

Unit – B

1. **Reading (Communicative Approach to be Followed)**
    - Nissim Ezekiel : The Patriot (Poem)

(Sub-topic: Basic Introduction to Indianisms and Difference between Indian English & Standard English)

2. **Writing**
    - Paragraph Writing : Topic Sentence, Inductive logic, and Deductive logic

- Essays: Narrative, Descriptive, Expository, and Persuasive
- Notice: Format, Characteristics, and 5 W's,
- Email: Structure, Characteristics of Effective Emails, and Advantages

Unit – C

1. **Applied Grammar (in Socio-Cultural Context)**
    - Parts of Speech: Noun, Pronoun, Adjective, Verb, Adverb, Preposition, Conjunction, and Interjection
    - Modals: Can, Could, May, Might, Will, Would, Shall, Should, and Must

Unit – D

1. **Reading (Communicative Approach to be Followed)**

    Alleen Pace Nilsen: Sexism in English (Prose)

    (Sub-topic: Relationship between Society & Language and Sexist Language)

2. **Writing**

    Letter Writing: Formal and Informal

Teaching Methodology:

a. **Grammar:** Grammar must be taught descriptively in socio-cultural context. The contextual teaching of grammar helps a learner understand the application of grammar rules in real life situations. The learner who learns grammar in isolation is unable to use the language fluently, whereas the learner who learns grammar in context uses the language confidently and fluently in real life situations.

b. **Literary Texts:** Communicative approach should be followed to teach the texts. Classroom activities guided by the communicative approach are characterised by trying to produce meaningful and real communication, at all levels. As a result there may be more emphasis on skills than systems, lessons are more learner-centred, and there may be use of authentic materials.

Teachers can introduce the topic or theme of the text, pre-teach essential vocabulary items and use prediction tasks to arouse the interest and curiosity of students.

c. **Writing**: Some of the strategies that should be adopted are as follows:

- Regularly assign brief writing exercises in your classes.
- Provide guidance throughout the writing process, i.e. Pre-Writing, Drafting, Revising, Editing, and Publishing.
- Give students opportunities to talk about their writing.
- Encourage students to revise their work.

Testing: The examinations will be conducted as per the norm of the university.

References:

1. Books

1. Eschholz, Paul and Rosa, Alfred (ed.), *Subject and Strategy*. NY: St. Martin's Press, 1978. Print.
2. Ezekiel, Nissim. *Collected Poems 1952-1988*. New Delhi: Oxford University Press, 1999. Print.
3. Hosler, Mary Margaret. *English Made Easy*. Delhi: McGraw, 2013. Print.
4. Koneru, Aruna. *Professional Communication*. Delhi: McGraw, 2008. Print.
5. Mahanand, Anand. *English for Academic and Professional Skills*. Delhi: McGraw, 2013. Print.
6. Rani, D Sudha, TVS Reddy, D Ravi, and AS Jyotsna. *A Workbook on English Grammar and Composition*. Delhi: McGraw, 2016. Print.
7. Rizvi, M. Ashraf. *Effective Technical Communication*. Delhi: McGraw, 2018. Print.
8. Sharma, R.C. and Krishna Mohan. *Business Correspondence and Report Writing*. Delhi: McGraw, 2013. Print.
9. Tyagi, Kavita and Padma Misra. *Basic Technical Communication*. Delhi: PHI Learning, 2013. Print.

2. Websites

1. www.youtube.com (to watch standard videos)
2. http://learnenglish.britishcouncil.org/en
3. https://owl.english.purdue.edu/

DAV UNIVERSITY, JALANDHAR

Course Title: Chemistry Lab

Course Code: CHE152

L	T	P	Credits
0	0	2	1

Course Objectives:

This course is intended to learn the basic concepts of Engineering Chemistry Laboratory. The present syllabus has been framed as per the recent research trends in the subject. The various experiments have been designed to enhance laboratory skills of the undergraduate students.

Expected Prospective:

The students will be able to understand the basic objective of experiments in Engineering chemistry, properly carry out the experiments, and appropriately record and analyze the results through effective writing and oral communication skills. They will know and follow the proper procedures and regulations for safe handling and use of chemicals.

List of Practicals:

1. Verify Lambert Beer's law using spectrophotometer and $CoCl_2$ or $K_2Cr_2O_7$ solution.
2. Determine the strength of HCl solution by titrating against NaOH solution conductometerically.
3. Determination of the strength of HCl solution by titrating against NaOH using pH meter.
4. Determination of total hardness of water (tap) using standard EDTA solution and Eriochrome black T indicator.
5. Determination of alkalinity of water.
6. Determination of surface tension of given liquid by using Stalagmometer.
7. Determination of residual chlorine in a water sample.
8. Determination of Flash & Fire point of given a given lubricating oil by Pensky-Marten's apparatus.
9. Determination of the viscosity of given lubricating oil by using Redwood Viscometer.
10. Preparation of a polymer phenol/urea formaldehyde resin.
11. Determination of moisture, volatile matter and ash content in a given sample of coal by proximate analysis.
12. Determination of dissolved oxygen present in given sample of water.

References:

1. Levitt, B.P. Findlay's Practical Physical Chemistry, 9th edition, Longman Group Ltd., 1973.

2. Yadav, J.B. Advanced Practical Physical Chemistry.

3. Vogel, A. I. A textbook of Quantitative Inorganic Analysis, Longman Gp. Ltd, 4^{th} edition (2000).

DAV UNIVERSITY, JALANDHAR

Course Title: Computer Fundamentals and Programming Lab

Course Code: CSE103

L	T	P	Credits
0	0	2	1

Instruction for Students: The students will be attending a laboratory session of 2 hours weekly and they have to perform the practical related to the following list.

1. Practical know-how of various internal and external Hardware components of a computer (including basic working of peripheral devices).
2. Introduction to Operating Systems; installing Windows; basics of windows.
3. Working knowledge of Internet.
4. Introduction to word processor and mail merge.
5. Introduction to MS-Excel.
6. Working on MS-PowerPoint.
7. Introduction to basic structure of C program, utility of header and library files.
8. Implementation of program related to the basic constructs in C
9. Programs using different data types in C
10. Programs using Loops and Conditional Statements in C
11. Programs using functions by passing values using call by value method.
12. Programs using functions by passing values using call by reference method.
13. Programs using arrays single dimension in C.
14. Program to implement array using pointers
15. Programs related to string handling in C

DAV UNIVERSITY, JALANDHAR

Course Title: Basic Communication Skills Lab

Course Code: ENG152A

L	T	P	Credits
0	0	2	1

Course Objectives:

- To improve the preparation and presentation competencies necessary for oral communication in a variety of contexts, as both a speaker and a listener.
- To improve pronunciation.
- To promote interactive skills through Group Discussions and role plays.

Learning Outcomes: Students will be able to:

- Develop proper listening skills
- Articulate and enunciate words and sentences clearly and efficiently
- Show confidence and clarity in public speaking projects

Unit – A Speaking and Listening
• IPA for Language Learning - Basic Phonetics
• Movie-Clippings
• Role Plays
• Group Discussions
• Mock Interviews

Project File: Each student will prepare a project file on any of the topics given by class teacher. Student should be able to justify the contents of his/her scrap file. The file must be handwritten, not typed. Students must acknowledge all the sources of information in his/her scrap file.

Testing: The end term lab examination will be conducted as per the norm of the university. The distribution of marks in the end-term lab examination is as follows:

Component	Weightage
Project File Marks will be given for originality, creativity and presentation. Student will receive credit for his/her command of the language also.	**30 %**
Lab. Activity It may include dialogue writing (Dialogue to Prose and Prose to Dialogue), writing about a picture/some object, writing a report, writing on a topic of general interest, listening exercise, English phonetic exercise, etc. It will be decided by examiner on the spot.	**30%**
Viva Voce Questions will be based on the project file. Examiner may ask other non-technical questions related to student's life and interests.	**40%**
Total	**100%**

For the final result, marks will be calculated as per the criterion laid down by the university:

Component	Weightage
Marks Obtained in the lab examination	**80%**
Continuous Assessment (Based on Student's Regularity & Class Performance)	**20%**
Total	**100%**

Reference Books

a. Books

1. Crystal, David. *The Gift of the Gab – How Eloquence Works*. Connecticut: Yale University, 2016. Print.

2. Gangal, J. K. *A Practical Course in Spoken English*. India: Phi Private Limited, 2012. Print.
3. Hosler, Mary Margaret. *English Made Easy*. Delhi: McGraw, 2013. Print.
4. Koneru, Aruna. *Professional Communication*. Delhi: McGraw, 2008. Print.
5. Mahanand, Anand. *English for Academic and Professional Skills*. Delhi: McGraw, 2013. Print.
6. Rani, D Sudha, TVS Reddy, D Ravi, and AS Jyotsna. *A Workbook on English Grammar and Composition*. Delhi: McGraw, 2016. Print.
7. Rizvi, M. Ashraf. *Effective Technical Communication*. Delhi: McGraw, 2018. Print.
8. Sharma, R.C. and Krishna Mohan. *Business Correspondence and Report Writing*. Delhi: McGraw, 2013. Print.
9. Suzana, Roopa. *A Practical Course in English Pronunciation*. Delhi: McGraw Hill Education, 2017. Print.
10. Tyagi, Kavita and Padma Misra. *Basic Technical Communication*. Delhi: PHI Learning, 2013. Print.

b. Websites

1. www.youtube.com (to watch standard videos)
2. http://learnenglish.britishcouncil.org/en
3. https://owl.english.purdue.edu/

DAV UNIVERSITY, JALANDHAR

Course Title: Engineering Mathematics-II
Course Code: MTH152A

L	T	P	Credits
4	0	0	4

Objective:

The objective of the course is to equip the students with the knowledge of concepts of vectors and geometry and their applications. A flavour of pure mathematics is also given to the readers.

Unit-A

Functions of Complex Variables: Complex Numbers and elementary functions of complex variable De-Moivre's theorem and its applications. Real and imaginary parts of exponential, logarithmic, circular, inverse circular, hyperbolic, inverse hyperbolic functions of complex variables. Summation of trigonometric series. (C+iS method).

Unit-B

Integral Calculus: Rectification of standard curves; Areas bounded by standard curves; Volumes and surfaces of revolution of curves;

Multiple Integrals: Double and triple integral and their evaluation, change of order of integration, change of variable, Application of double and triple integration to find areas and volumes. Centre of gravity and Moment of inertia

Unit-C

Vector Calculus: Scalar and vector fields, differentiation of vectors, velocity and acceleration.
Vector differential operators: Del, Gradient, Divergence and Curl, their physical interpretations. Line, surface and volume integrals.

Application of Vector Calculus: Flux, Solenoidal and Irrotational vectors. Gauss Divergence theorem. Green's theorem in plane, Stoke's theorem (without proofs) and their applications

Unit-D

Infinite Series: Convergence and divergence of series, Tests of convergence (without proofs): Comparison test, Integral test, Ratio test, Raabe's test, Logarithmic test, Cauchy's root test and Gauss test. Convergence and absolute convergence of alternating series, Uniform Convergence and Power Series

References:

1. Grewal, B.S., *Higher Engineering Mathematics*. New Delhi: Khanna Publication, 2009
2. Kreyszig, Erwin, *Advanced Engineering Mathematics*. New Delhi: Wiley Eastern Ltd., 2003.
3. Jain, R K, and K Iyengar S R., *Advanced Engineering Mathematics*, New Delhi: Narosa Publishing House, 2003.
4. Thomas, George B. and Finney Ross L., *Calculus and Analytic Geometry*. New Delhi Addison Wesley, 1995

DAV UNIVERSITY, JALANDHAR

Course Title: Engineering Physics

Course Code: PHY151B

L	T	P	Credits
4	0	0	4

Total Lecture-60

AIM. The aim of this course on physics is to make the student of engineering understand the basic concepts of physics which will form the basis of certain concept in their respective fields.

Unit-1

PHYSICAL OPTICS: (14)

Interference: Division of wave front, Fresnel's biprism, division of amplitude, Newton's rings and applications.

Diffraction: Difference between Fraunhofer and Fresnel diffraction, Fraunhofer diffraction through a slit, plane transmission diffraction grating, its dispersive and resolving power.

Polarization: Polarized and unpolarized light, double refraction, Nicol prism, quarter and half wave plates.

Unit-II (15)

LASER: Spontaneous and stimulated emission, Laser action, Characteristics of laser beam, concept of coherence, He-Ne laser, Semiconductor laser, Ruby laser and applications, Holography.

FIBRE OPTICS: Propagation of light in fibres, numerical aperture, single mode and multimode fibres, applications

Unit-III (13)

DIELECTRICS: Molecular Theory, polarization, displacement, susceptibility, dielectric coefficient, permittivity, relations between electric vectors, Gauss's law in the presence of a dielectric, energy stored in an electric field, Behavior of dielectric in alternating field and clausius-Mossotti equation.

Unit-IV (18)

QUANTUM MECHANICS: Difficulties with Classical physics, Introduction to quantum mechanics simple concepts, Black Body radiation, Planck's Law of radiation and its limitations, Group velocity and phase velocity, Schrodinger's wave equations and their applications.

NANOPHYSICS: Introduction to Nanoscience and Nanotechnology, Electron confinement, Nanomaterials, Nanoparticles, Quantum structure, CNT, Synthesis of Nanomaterials and Application of Nanomaterials.

SUPER CONDUCTIVITY: Introduction (experimental survey), Meissner effect, Type I and type II superconductors, London equation, Elements of BCS theory, Applications of superconductors.

Suggested Books:

1. Sear, F.W. Electricity and Magnetism. London: Addison-Wesley, 1962.
2. Resnick and Halliday. Physics. New York: Wiley, 2002.
3. Lal,B. and Subramanian, N.A Text Book of Optics. New Delhi: S. Chand and Company Limited, 1982.
4. Jenkins, and White. Fundamental of Physical Optics, New York: Tata McGraw-Hill, 1937.
5. Griffiths,D. Introduction to Electrodynamics, New Delhi: Prentice Hall, 1998.
6. Beiser, A. Perspective of Modern Physics. New Delhi: McGraw Hill Ltd., 2002.
7. Verma, N.K Physics for Engineers. New Delhi: Prentice Hall, 2014.

DAV UNIVERSITY, JALANDHAR

Course Title: **Mechanical Engineering Fundamentals**

Course Code: MEC103

L	T	P	Credits
4	0	0	4

Course Objectives:

To impart the basic knowledge of thermodynamic principles, design principles, power transmission devices, power producing and power absorbing devices.

Unit-A

Fundamental Concepts of Thermodynamics

Introduction, Thermodynamic System and its types, Boundary and its types, Surroundings, Thermodynamic properties, State, Path, process and cycles, Thermodynamic Equilibrium, Working Substance, Microscopic and Macroscopic Analysis, Units and Dimensions, Quasi Static Process, Reversible and Irreversible processes, Point Function and Path Function, Mechanical and Thermodynamic work, P-dv Work (Displacement Work), Work is a Path Function, Equations for work done in various processes

Laws of Thermodynamics

Zeroth law of Thermodynamics, Temperature, Thermometry (Measurement of temperature), Temperature Scales, Energy, Potential and Kinetic Energies at Micro and Macro Level, Internal Energy, Law of conservation of energy, Joule's Experiment, First law of thermodynamics (Open and Closed System), Energy – A property of system, Enthalpy, Entropy, Heat, Heat vs Temperature, specific heat, Heat Capacity, Specific heat at constant volume, Specific heat at constant pressure, Adiabatic Index, Limitations of first law of thermodynamics

Unit-B

Pressure

Pressure Concept and Definition, Pressure conversion Table, Atmospheric pressure, Standard Atmospheric Pressure, Gauge Pressure, Vacuum Pressure, Absolute pressure, Properties of fluid, Pressure head of a Liquid, Pascal's Law, Pressure measurement: Mechanical Gauges and Manometers, Mechanical Gauges: (Bourdon tube pressure gauge, Diaphragm pressure gauge, Dead weight), Manometers: (Principle/Advantage/Limitation/ Classification), Piezometer, Single U tube manometer (Numerical for Vacuum and Gauge pressure), [Simple problems on above topics]

Heat Transfer

Introduction, Heat Transfer vs Thermodynamics, Applications, Thermal Conductivity, Thermal Resistance, Modes of heat transfer, Spectrum of electromagnetic radiation, Surface emission properties, Absorptivity, Reflectivity and Transmissivity, Fourier law, Newton's law of cooling, Stefan Boltzmann's Law, Heat Exchangers (Applications, Selection, Classification), Thermal Insulation (Properties of insulation, Types of Insulations, Thermal Insulating Materials)

Power Absorbing Devices

Power Absorbing Devices, Difference between Hydraulic pump, Air compressor, Fan, Blower, Pump (Function, Selection, Applications), Classification of Pump, Positive displacement and Dynamic Pumps, Reciprocating Pumps and its types, Rotary Pumps and its types, Centrifugal Pump, Axial Pump

Unit-C

Power Producing Devices Boiler

States of matter, Changing State of Matter, Sublimation, Effect of temperature during change of Phase, Steam boiler, Application, Classification of boilers, Types of boilers (Brief Description), Essentials of a good boiler, Advantages of superheating the steam, Comparison between Water tube and Fire tube boilers, Function of boiler Mountings and Accessories

Turbines

Turbine, Classification based on working fluid, Classification of hydraulic turbines, Selection of hydraulic turbines, Impulse Turbines (Pelton Wheel/ Turgo/ Cross Flow), Reaction Turbines (Francis/ Kaplan/ Propeller)

Internal Combustion Engines

Heat Engine, Types of Heat Engine, Advantages, Disadvantages and Applications, Classification of IC Engine, Engine Components (Location, Function and Material), Basic Terminology used in IC engine, Four stroke Cycle Engines (SI and CI), Two stroke Cycle Engines (SI and CI)

Unit-D

Principles of Design

Need of design, Product Life Cycle, Material properties and selection, Factors affecting material selection, Stress and Strain and its types, Hooke's law, Modulus of Elasticity, Longitudinal and Lateral Strain, Poisson's ratio, Stress- Strain Curve for ductile material and brittle material, Factor of Safety, Centre of Gravity, Centroid, Centroid of areas of plain, Figures (Without

Derivation), Centroid of areas of composite sections (Without Derivation), Moment of Inertia, Radius of gyration, Theorem of perpendicular axis, Theorem of parallel axis, MI of L, I and T sections, [Simple problems on above topics]

Power Transmission Devices and Machine Elements

Individual and group drive system (advantages and Disadvantages), Belt drive (Types: V and Flat Belts and their Applications, Advantages and Disadvantages), Ropes drive (Types: Fiber and Wire Ropes and their Applications, Advantages and Disadvantages), Chain drive (Applications, advantages and Disadvantages, Sprockets), Gear drive (Types of Gears), Power transmission shafts, Types of shafts, Application of shafts, Axle, Keys (Function, Classification), Coupling (Function, Classification: Rigid and Flexible), Flanged coupling, Oldham's coupling, Universal coupling, Bearings and their types, Flywheel construction and types

References:

1. Rajan T.S. *Basic Mechanical Engineering*, New Delhi: New Age Publishers.
2. Singh Sadhu *Principles of Mechanical Engineering*, New Delhi: S Chand Publishers.
3. Shankar V.P., *Basic Mechanical Engineering*, New Delhi: Laxmi Publishers.
4. Phthak G. K., *Basic Mechanical Engineering*, New Delhi: Rajsons Publications.
5. Kumar Parveen, *Basic Mechanical Engineering*, New Delhi: Pearson Education

DAV UNIVERSITY, JALANDHAR

Course Title: Basic Electrical Engineering

Course Code: ELE105

L	T	P	Credits
4	0	0	4

Unit-A

D.C Circuit Analysis:

Voltage source, current source, dependent and independent sources, analysis of D.C circuit by KCL and KVL , Nodal and Mesh analysis, Superposition theorem, Maximum Power Transfer Theorem, Thevenin and Norton Theorems.

Unit-B

A.C Circuit Analysis:

Review of single phase A.C. circuit under sinusoidal steady state, RMS Value , Average Value, Form factor, Peak factor solution of RL, RC, R.L.C. Series circuit, the j operator, complex representation of impedance, solution of series circuit, series resonance, 3 phase A.C. Circuit, star and delta connections, line and phase quantities solution of 3 phase circuits, balance supply voltage and balanced supply voltage and balance load, Phasor diagram, measurement of power and power factor.

Unit-C

Magnetic Circuit & Transformers:

B-H Curve, saturation leakage and fringing. Hysteresis and eddy currents. Single phase transformer, basic concepts constructional, voltage, current Transformation, Ideal transformer and its phasor diagram, voltage regulation, OC/SC test, losses and efficiency, Autotransformer.

Unit-D

Rotating Electrical Machines:

Basic concepts, working principle and general construction of DC machines (motor/generators), torque and EMF expression. Generation of rotating magnetic fields, Construction and working of a three-phase induction motor, Significance of torque-slip characteristic. Loss components and efficiency, starting and speed control of induction motor.

Electrical Installations

Components of LT Switchgear: Switch Fuse Unit (SFU), MCB, ELCB, MCCB, Types of Wires and Cables, Earthing. Types of Batteries, Important Characteristics for Batteries. Various faults in Battries, Elementary calculations for energy consumption, power factor improvement and battery backup.

References:

1. M.S. Sukhija, T.K. Nagsarkar, "Basic Electrical and Electronics Engineering", Oxford University Press, 2012.
2. Ashfaq Husain, Harsoon Ashfaq, " Fundamentals of Electrical Engineering, 4th Edition, Dhanpat Rai and Co., 2013
3. V.N. Mittle, "Basic Electrical Engineering", 2nd Edition, Tata McGraw Hill Publication.
4. B.L. Theraja, A.K. Theraja, " A Text Book of Electrical Technology, Volume-1, S. Chand Publication
5. Debashisha Jena, "Basic Electrical Engineering", 1st edition, Wiley India Publication, 2012.
6. B.L. Theraja, R.S. Sedha, " Principles of Electric Devices and Circuits", S. Chand Publication, 1st edition, 2006

DAV UNIVERSITY, JALANDHAR

Course Title: Human Values and General Studies

Course Code: SGS107

L	T	P	Credits
4	0	0	0

Course Objectives

a) To sensitize students about the role and importance of human values and ethics in personal, social and professional life.

b) To enable students to understand and appreciate ethical concerns relevant to modern lives.

c) To prepare a foundation for appearing in various competitive examinations

d) To sensitize the students about the current issues and events of national and international importance

e) To provide opportunity to the students to study inter disciplinary subjects like Geography, Science, Economy, Polity, History, International Relations etc.

Unit-A

Human Values

1. **Concept of Human Values:** Meaning, Types and Importance of Values.
2. **Value Education :** Basic guidelines for value education
3. **Value crisis and its redressal**

Being Good and Responsible

1. Self-Exploration and Self Evaluation
2. Acquiring Core Values for Self-Development
3. Living in Harmony with Self, Family and Society
4. Values enshrined in the Constitution: Liberty, Equality
5. Fraternity and Fundamental Duties.

Unit-B

Value – based living

1. Vedic values of life
2. *Karma Yoga* and *Jnana Yoga*
3. *AshtaMarga* and *Tri-Ratna*

Ethical Living:

1. Personal Ethics
2. Professional Ethics
3. Ethics in Education

Unit-C

General Geography

World Geography

The Universe, The Solar System, The Earth, Atmosphere, The World we live in, Countries rich in Minerals, Wonders of the World, Biggest and Smallest.

Indian Geography

Location, Area and Dimensions, Physical Presence, Indian States and Union Territories, Important sites and Monuments, Largest-Longest and Highest in India.

General History

Glimpses of India History, Ancient Indian, Medieval India, Modern India, Various Phases of Indian National Movement, Prominent Personalities, Glimpses of Punjab history with special reference to period of Sikh Gurus

Glimpses of World History

Important Events of World History, Revolutions and Wars of Independence, Political Philosophies like Nazism, Fascism, Communism, Capitalism, Liberalism etc.

Indian Polity: Constitution of India

Important Provisions, Basic Structure, Union Government, Union Legislature and Executive, State Government: State Legislature and Executive, Indian Judiciary, The Election Commission, Panachayati Raj System, RTI etc.

General Economy

The process of liberalization, privatization, globalization and Major World Issues, Indian Economy, Indian Financial System, Major Economic Issues, Economic Terminology.

Unit-D

General Science

General appreciation and understandings of science including the matters of everyday observation and experience, Inventions and Discoveries

Sports and Recreation

The World of Sports and recreation, Who's Who is sports, Major Events, Awards and Honours.

Famous personalities, Festivals, Arts and Artists

Current Affairs

National and International Issues and Events in News, Governments Schemes and Policy Decisions

Miscellaneous

Information Who is who

Books and Authors, Persons in News, Awards and Honours, Abbreviations and Sports

References:

1. Human Values, A N Tripathi, New Age International Publishers, New Delhi, Third Edition, 2009
2. Professional Ethics, R. Surbiramanian, Oxford University Press, New Delhi, 2013.
3. Human Values and Professional Ethics, RishabhAnand, SatyaPrakashan, New Delhi, 2012
4. Human Values and Professional Ethics, Sanjeev Bhalla, SatyaPrakashan, New Delhi, 2012.
5. Human Values and Professional Ethics, RituSoryan Dhanpat Rai & Co. Pvt. Ltd., First Edition, 2010.
6. Human Values and Professional Ethics by Suresh Jayshree, Raghavan B S, S Chand & Co. Ltd. , 2007.
7. Human Values and Professional Ethics, Yogendra Singh, AnkurGarg, Aitbs publishers, 2011.
8. Human Values and Professional Ethics, Vrinder Kumar, Kalyani Publishers, Ludhiana, 2013.
9. Human Values and Professional Ethics, R R Gaur, R. Sangal, GP Bagaria, Excel Books, New Delhi 2010.
10. Values and Ethics, Dr.BramwellOsula, Dr.SarojUpadhyay, Asian Books Pvt. Ltd., 2011.
11. Indian Philosophy, S. Radhakrishnan, George Allen &Unwin Ltd., New York: Humanities Press INC, 1929.
12. Essentials of Hinduism, Jainism and Buddhism, A N Dwivedi, Books Today, New Delhi – 1979

13. Dayanand : His life and work, SurajBhan, DAVCMC, New Delhi – 2001.
14. Esence of Vedas, KapilDevDwivedi, Katyayan Vedic SahityaPrakashan, Hoshiarpur, 1990.
15. Vedic Concepts, Prof. B BChaubey, Katyayan Vedic SahityaPrakashan, Hoshiarpur, 1990.
16. Advance Objective General Knowledge, R. S. Aggarwal, S. Chand Publisher (2013)
17. Concise General Knowledge Manual 2013, S. Sen, Unique Publishers,2013
18. Encyclopedia of General Knowledge and General Awareness by R P Verma, Penguin Books Ltd (2010)
19. General Knowledge Manual 2013-14, Edgar Thorpe and Showick Thorpe, The Pearson, Delhi.
20. General Knowledge Manual 2013-14, MuktikantaMohanty, Macmillan Publishers India Ltd., Delhi.
21. India 2013, Government of India (Ministry of Information Broadcasting), Publication Division, 2013.
22. Manorama Year Book 2013-14, MammenMethew, Malayalam Manorama Publishers, Kottayam, 2013.
23. Spectrum's Handbook of General Studies – 2013-14, Spectrum Books (P) Ltd., New Delhi

CURRENT AFFAIRS

Magazines

Economic and Political Weekly, Yojna, the Week, India Today, Frontline, Spectrum. Competition Success Review, Competition Master, Civil Services Chronicle, Current Affairs, World Atlas Book

Newspapers

The Hindu, Times of India, The Hindustan Times, The Tribune

DAV UNIVERSITY, JALANDHAR

Course Title: **Manufacturing Practice**

Course Code: MEC104

L	T	P	Credits
0	0	4	2

Course Objective:

1. Know basic workshop processes, Read and interpret job drawing.
2. Identify, select and use various marking, measuring, holding, striking and cutting tools & equipment's
3. Operate and control different machines and equipment's.

CARPENTRY SHOP

a) Preparation of half lap joint

b) Preparation of Mortise and Tenon Joint

c) Preparation of a Dove & Tail joint

d) To prepare a White board duster

Welding Shop:

a) Preparation of Joint by Arc Welding

b) Preparation of Joint by using Gas Welding

c) Preparation of Joint by MIG/ TIG Welding

d) Preparation of Joint by Spot/ Seam Welding

Smithy Shop

a) To Forge the L – Hook

b) To Forge a Chisel

c) To Forge a Cube from a M.S Round

d) To forge a screw driver

Fitting Shop

a) Filing a dimensioned rectangular or square piece and prepare a sq. fitting

b) Preparation of T fitting male part

c) Preparation of U fitting Female part

d) Internal thread Cutting in Square piece and external thread cutting on a rod and assembling as a paper weight

Foundry Shop:

a) To make a Mould of solid pattern

b) To prepare a mould of sleeve fitting using gating system
c) To make a Mould of Split Pattern using Cope & Drag
d) To check the Hardness of the Mould

To check the Moisture Content in the Molding Sand

To check the Compressive Strength of Molding Sand

Sheet-Metal Shop

a) Preparation of a funnel from G.I. sheet
b) Preparation of a book rack stand from G.I. Sheet
c) Preparation of a leak proof tray with inclined edges from G.I. Sheet
d) Preparation of a square pen stand from G.I. Sheet with riveting at corners

Machine Shop

a) To make a job using step turning and grooving
b) To make a job using knurling and threading
c) To make a multi operation job on a Lathe machine
d) To make V – slot by using shaper machine

Electrical Shop

a) Layout of electrical tube light wiring
b) Layout of stair case wiring using two way switch
c) Testing and rectification of simulated faults in electrical appliances such as 'Electric Iron' Ceiling Fan. Electric kettle
d) To fabricate a circuit for the electrical wiring of, Fan with regulator and Bulb through a main switch and its testing using a series lamp

References:

1. Johl K. C., "Mechanical Workshop Practice", Prentice Hall India, 1st Edition.
2. Bawa H.S., "Workshop Technology", Tata McGraw Hill, 7th Edition.

DAV UNIVERSITY, JALANDHAR

Course Title: Engineering Physics Lab

Course Code: PHY152

L	T	P	Credits
0	0	2	1

Objective: The laboratory exercises have been so designed that the students learn to verify some of the concepts learnt in the theory courses. They are trained in carrying out precise measurements and handling sensitive equipment.

Note:

- Students are expected to perform at least eight-ten experiments out of following list. The experiments performed in first semester cannot be repeated in second Semester.
- The examination for both the courses will be of 3 hours duration

List of Experiments:

Experimental skills: General Precautions for measurements and handling of equipment, representation of measurements, Fitting of given data to a straight line, and Error analysis, Significant figures and interpretation of results.

1. To determine the Refractive Index of the Material of a given Prism using Sodium Light.
2. To determine the Dispersive Power and resolving power of the Material of a given Prism using Mercury Light.
2. To determine wavelength of sodium light using Fresnel Biprism.
3. To determine wavelength of sodium light using Newton's Rings.
4. To determination Wavelength of Sodium Light using Michelson's Interferometer.
5. To determine the wavelength of Laser light using Diffraction of Single Slit.
6. To determine the wavelength of (1) Sodium and (2) Mercury Light using Plane Diffraction Grating.
7. To determine the (1) Wavelength and (2) Angular Spread of He-Ne Laser using Plane Diffraction Grating.
8. To study the wavelength of spectral lines of sodium light using plane transmission grating.
9. To study the specific rotation of sugar solution Laurent's half shade polarimeter method
10. To study the numerical aperture and propagation losses using He-Ne laser Optical fiber set up.
11. To compare the focal length of two lenses by Nodal slide method.
12. To find the unknown low resistance by Carey Foster bridge.

13. To determine the beam divergence of the He-Ne laser.
14. To study the Meissner's effect in superconducting sample.
15. To study the Faraday law of electromagnetic induction.
16. To study the capacitance by flashing/quenching of Neon bulb kit
17. To compare the two unknown capacitances of two capacitors by using DeSauty's bridge.
18. To find our out the unknown inductance by using the Anderson's bridge method.
19. To study the numerical aperture and propagation losses for He-Ne laser by using the optical fiber set up for
20. To study the Planck's constant by using photoelectric cell method.

DAV UNIVERSITY, JALANDHAR

Course Title: Electrical and Electronics Technology Lab

Course Code: ELE106

L	T	P	Credits
0	0	2	1

List of Experiments

List of Experiments

1. To verify Ohm's Law, Kirchhoff's Current Law and Kirchhoff's Voltage Law.
2. To verify Thevenin's and Norton's theorems.
3. To verify Superposition theorem.
4. To verify Maximum Power Transfer theorem.
5. To study frequency response of a series R-L-C circuit and determine resonant frequency and Q-factor for various values of R, L and C
6. To study frequency response of a parallel R-L-C circuit and determine resonant frequency and Q-factor for various values of R, L and C.
7. To perform direct load test of a transformer and plot efficiency versus load characteristics.
8. To perform open circuit and short circuit test on transformer.
9. To perform speed control of DC motor.
10. Measurement of power in a three phase system by two wattmeter method.
11. To plot the V-I characteristics of PN-junction diode.
12. To verify the truth table of logic gates.
13. Basic safety precautions. Introduction and use of measuring instruments – voltmeter, ammeter, multi-meter, oscilloscope. Real-life resistors, capacitors and inductors.
14. Demonstration of cut-out sections of machines: dc machine (commutator-brush arrangement), induction machine (squirrel cage rotor)

DAV UNIVERSITY, JALANDHAR

Course Title: Energy Engineering

Course Code: CHL211

L	T	P	Credits
4	0	0	4

Course Objectives: The student will study different types of fuels and their combustion.
Learning outcomes: Upon completion of this course, the students will be able to:

- Analyze the energy scenario of the world.
- Carry out a comparative analysis of different types of fuels.

UNIT-A **10 HOURS**

Introduction & classification of fuels : Concept of Energy, units of energy, conversion factors, world energy resources and energy consumption, Indian energy resources and energy consumption, energy crisis, energy alternatives.

UNIT –B **14 HOURS**

Solid fuels: Principal solid fuel-coal, origin, composition and classification of coal, origin, composition and classification of coals, analysis and properties of coal, characteristics and distribution of Indian coals, coal preparation, Storage of coal, coal carbonization, briquetting, gasification and liquefaction of solid fuels.

UNIT-C **14 HOURS**

Liquid fuels: Gasoline, Naphtha, Kerosene, Diesel, storage and handling.
Gaseous fuel: Natural Gas, Producer Gas, Water Gas, LPG, LNG, storage and distribution of gaseous fuels

UNIT –D **10 HOURS**

Furnaces and Refractories: Classification of furnaces, waste heat recovery in furnaces, classification and properties of refractories, manufacturing methods of refractories.

Principles of combustion: Combustion of fuels (solid, liquid and gaseous), Combustion equipment, incomplete combustion, efficiency and heat recovery, calorific value, gas analysis.

Reference Books:

1. Rai, G.D. , *Non-conventional Energy Sources*, Khanna Publishers, 2011.
2. Sarkar Sameer, *Fuel and Combustion*, Orient Longman,3rd edition,2009.
3. Gupta. O.P, *Fuel Furnaces and Refractories,* Khanna Publishers,6th edition.
4. Haslam and Russel, *Fuels and their combustion* , McGraw Hill
5. Sukhatme S.P., *Thermal Collection and Storage*, Tata McGraw Hill

DAV UNIVERSITY, JALANDHAR

Title: Mechanical Operations

Course Code: CHL201

L	T	P	Credits
4	0	0	4

Course Objective: The objective of the course is to enable the students to understand the basic concepts of properties of particulate solids and mechanical separation aspect such as screening, filtration, sedimentation, transportation of solids etc.

Learning Outcomes: After completion of the course students will be able to

- Describe size reduction energy requirements, estimate performance of equipment, selection and sizing of equipment.
- Analyze filtration data and select systems based on requirements, estimate filtration area for given requirements, understand filter aids and their usage.
- Use different Particulate characterization parameters and equipment.

UNIT-A **12 HOURS**

Characterization and Handling of Solids:

Characterization of solid particles: Shape, size, specific surface, Particle size distribution, average diameter of particle mixture.

Properties of particulate masses: Major distinctive properties, pressures in masses of particles, angle of internal friction, angle of repose.

Conveying of bulk solids: Basic idea of conveyor, conveyor selection, screw, belt, vibrating, continuous flow and pneumatic conveyors.

Storage and weighing: bulk storage, bin storage, feeders (vibrating hopper, screw feeder, belt feeder), batch and continuous weighing.

UNIT-B **12 HOURS**

Size Reduction: Principles of Comminution: Criteria for Comminution, characteristics of products, Energy and Power requirements, Bond's, Rittinger's and Kick's Law and Work Index. Size Reduction Equipment: Crushers, Grinders, and ultrafine grinders cutting machines, equipment operation.

Screening, Screen analysis, screening equipment namely stationary Screens & Grizzles, Gyrating Screen, Vibrating Screens, material balance over screen, capacity & effectiveness of screen

UNIT-C **12 HOURS**

Settling:
Motion of particles through fluids: Terminal velocity, hindered settling, Stoke's law
Fluidization:
Fluidization and fluidized bed, conditions for fluidization, Ergun equation and Kozeny-Carman equation, minimum fluidization velocity, types of fluidization, expansion of fluidized beds and particulate fluidization, continuous fluidization; industrial applications.

Mechanical separation
Solid-Liquid Separation: Concept of filtration, Plate & Frame filter press, Shell & Leaf filters, continuous Rotary Vacuum Filter, Principle of filtration, Centrifugal filtration,

Gas-Solid Separation: Cyclones, hydro cyclones, Gravity Settling chambers, Fabric filters, Wet scrubbers, electrostatic precipitators.,

UNIT-D **12 HOURS**

Agitation and Mixing: Agitation of low viscosity particle suspensions: axial flow impellers, radial flow impellers, close-clearance stirrer, unbaffled tanks, baffled tanks, basic idea for designing agitators. Power number, Froude number, power consumption in agitation

Mixing of Solids: Types of mixers, various mixers for cohesive solids, power requirements, mixing index, axial mixing, Mixers for free flowing solids: ribbon blenders, screw mixers, tumbling mixers import wheels, mixing index in blending granular solids, mixing index at zero time, rate of mixing.

Reference Books:

1. McCabe, W.L, Smith J .C. and Harriott P, *Unit operations of chemical Engineering,* McGraw-HILL, 7th edition, 2005.
2. Richardson, J.F., Harker, J.H. and Backhurst, J.R., Coulson and Richardsons *Chemical Engineering,* Vol. 2, Butterworth-Heinemann., 2007.
3. Foust, A.S, Wenzel, L.A, Clump, C.W., Maus, L. and Anderson, L.B., *Principles of Unit Operations,* John Wiley., 2008.
4. Perry, R.H, and Green, D.W., *Perry's Chemical Engineers,* Handbook, McGraw Hill .2007.
5. Narayanan, C.M. and Bhattacharya, B.C., *Mechanical Operations for Chemical Engineers Incorporating Computer Aided Analysis,* Khanna Publishers., 2005.
6. K Swain Anup, Patra Hemlata, Roy G K, *Mechanical Operations,* McGraw Hill Education (India) Private Limited ,1st edition,

Web References:

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Gate Academy/www.youtube.com
NPTEL- Chemical Engineering
Chemical Engineering Guy/www.youtube.com
LearnChemE/www.youtube.com

DAV UNIVERSITY, JALANDHAR

Course Title: Chemical Process Calculations

Course Code: CHL202

L	T	P	Credits
4	0	0	4

Course Objective: The objective of the course is to enable the students to understand the basic concepts of gases, liquids and solids and some basic mathematical tools. Learn what material balances energy balances are, and how to apply them and finally, to learn how to deal with the complexity of big problems.

Learning outcomes: After the completion of the course students are able to

- Apply knowledge of mathematics, science, and engineering.
- Design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, health and safety, and sustainability.

UNIT-A **10 HOURS**

Introduction to Chemical Engineering Calculations

Units and dimensions, mole concept, conventions in methods of analysis and measurement, basis, temperature, pressure, the chemical equations and stoichiometry, limiting and excess reactant, conversion and yield. Gases Vapors, Liquids and Solids: Ideal gas law calculations, real gas relationships, Equations of state.

UNIT -B **12 HOURS**

Material Balance without chemical reaction:

Material balance, program of analysis of material balance problems, solving material balance problems that do not involve chemical reactions, Absolute Humidity, Relative Humidity, Saturation, Dry bulb temperature, Wet bulb temperature, Adiabatic saturation temperature & use of psychometric Chart.

UNIT-C **12 HOURS**

Material Balance with chemical reaction:

Solving material balances problems involving chemical reactions, multiple subsystems, recycle, bypass, and purge calculations.

UNIT -D **14 HOURS**

Energy Balance

Concepts and units, calculation of enthalpy changes, application of the general energy balance without reactions occurring energy balances that account for chemical reaction, reversible processes and the mechanical energy balances, heats of solution and mixing, Application of material and energy balance to the evaporators, reactors and other industrial processes (steady state operations), Basic calculations using chemical flow sheet simulator

Reference Books:

1. Himmelblau, D.M. and Riggs, J.M.,*Basic Principles and Calculations in Chemical Engineering,* Prentice Hall of India .,2003.
2. Bhatt, B.I. and Vora, S.M., *Stoichiometry*, Tata McGraw Hill, 2004.
3. Hougen, O.A., Watson, K.M. and Ragatz, R.S., *Chemical Process Principles,* Volume I, C.B.S. Publications., 2004.
4. Felder, R.M. & Rousseau, R.W., *Elementary Principles of Chemical Processes,* 2nd Edition, John Wiley & Sons.

Web References:

Web References:

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Gate Academy/www.youtube.com
NPTEL- Chemical Engineering
Chemical Engineering Guy/www.youtube.com
LearnChemE/www.youtube.com

DAV UNIVERSITY, JALANDHAR

Course Title: Fluid Flow

Course Code: CHL203

L	T	P	Credits
4	0	0	4

Course Objective: The course introduces the students to the principles of fluid mechanics that are of fundamental importance to chemical engineers i.e. fluid statics and dynamics, boundary layer, laminar and turbulent flows, fluid machinery etc. It is a prerequisite to Heat Transfer, Mass Transfer I & II.

Learning Outcomes: After completion of the course the students will be able to understand the fluid properties, fluid statics and characteristics of fluids. Students have a clear understanding of mechanisms of flow meters and fluid machinery.

UNIT-A **12HOURS**

Introduction

Concept of fluid, difference between solids, liquids and gases; ideal and real fluids, Introduction to fluid statics and fluid flow

Fluid Statics

Normal forces in fluid, different types Manometers of, Forces on submerged bodies (planer and curved), Rigid body motion (translation and rotation) Buoyancy and stability. Dimensional Analysis of Fluid Flow Problems using Rayleigh method and Buckingham π method, Dimensionless numbers and their significance

Fluid Properties

Concept of capillarity, vapor pressure, compressibility and bulk modulus, Newtonian and non- Newtonian Fluids, Nature of turbulence, Eddy Viscosity, Flow in Boundary Layers.

UNIT-B **14 HOURS**

Basic Equation of Fluid Flow

Momentum Balance, Continuity equation, Bernoulli's Equations, Navier Stokes Equations, Derivation and Application, System and control volume approaches, Reynolds transport theorem, Moody diagram

Flow of Incompressible Fluids

Concept of boundary layer, Laminar and Turbulent flow in pipes, Velocity distribution in pipes, Frictional Losses in pipes and fittings, effect of roughness, Fanning Equation, Estimation of Economic Pipe Diameter, Derivation of Hagen Poiseuille's equation and friction factor

UNIT-C **12HOURS**

Flow of compressible fluids

Compressible flow, basic equation, Mach number and its significance and isentropic flow through nozzles

Flow Measurement

In closed channels - Pitot tube, Orifice meter, venturimeter, Rotameter. In open channels- Notches, Weirs

UNIT-D **10 HOURS**

Fluid Machinery

Classification, design and performance of Pumps, Positive displacement pumps and its types, Centrifugal pumps- characteristic curves, Net Positive Suction Head and cavitation, Turbines, Compressors, Blowers, Selection and specification

References Books:

1. Smith J. C., McCabe W. L., Harriot P. H., *Unit Operations of Chemical Engineering*, 7th Edition, Singapore, McGraw Hill., 2005.
2. Kumar D. S., *Fluid Mechanics & Fluid power engineering,* S. K. Kataria& Sons.,2003
3. Bansal, R.K., *Fluid Mechanics and Hydraulic Machines,* 7th Edition, Laxmi Publications., 2007.
4. Perry's, *Handbook of Chemical Engineering,* 7th Edition, New York, McGraw Hill., 1997.
5. Sekhar G. C., *Unit Operations in Chemical Engineering,* 7th Edition, Pearson Practice Series, 2005.

Web References:

Stanford/www.youtube.com
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NPTEL- Chemical Engineering
Chemical Engineering Guy/www.youtube.com
LearnChemE/www.youtube.com

DAV UNIVERSITY, JALANDHAR

Course Title: Engineering Mathematics-III	L	T	P	Credits
Course Code: MTH252A	4	0	0	4

Objective:
The objective of the course is to enable the students to understand the basic concepts related to Laplace transforms, Fourier series, ordinary differential and partial differential equations and their applications.

Unit-A **14 HOURS**

Fourier series: Periodic functions, Euler's formula. Dirichlet's conditions. Fourier series of discontinuous functions. Fourier series of Even and Odd functions, half range expansions, Fourier series of different wave forms, Complex form of Fourier series. Fourier Transformation.

Unit-B **14 HOURS**

Laplace Transforms: Laplace transforms of various standard functions, Linear property of Laplace transforms, Shifting property and change of scale, inverse Laplace transforms, transform of derivatives and integrals, Laplace transform of unit step function, impulse function, periodic functions, applications to solution of ordinary linear differential equations with constant coefficients, and simultaneous differential equations.

Unit-C **14 HOURS**

Partial Differential Equations: Formulation of partial differential equations, Linear partial differential equations, homogeneous partial differential equations with constant coefficients.
Wave equation and Heat conduction equation in one dimension. Two dimensional Laplace equation and their applications, solution by the method of separation of variables.

Unit-D **15 HOURS**

Analytic Function: Limits, continuity and derivative of the function of complex variable, Analytic function, Cauchy-Riemann equations, conjugate functions, harmonic functions; **Complex Integration:** Line integrals in the complex plane, Cauchy's theorem, Cauchy's integral formula and derivatives of analytic function. Taylor's and Laurent's expansions (without proofs), singular points, poles, residue, Integration of function of complex variables using the method of residues.

Reference Books:

1. Grewal, B.S. *Higher Engineering Mathematics*. New Delhi: Khanna Publication, 2009
2. Kreyszig, Erwin. *Advanced Engineering Mathematics*. New Delhi: Wiley Eastern Ltd., 2003.
3. Jain, R K, and K Iyengar S R. *Advanced Engineering Mathematics*, New Delhi: Narosa Publishing House, 2003.
4. Thomas, George B. and Finney Ross L. *Calculus and Analytic Geometry*. New Delhi Addison Wesley, 1995

DAV UNIVERSITY, JALANDHAR

Course Title: Mechanical Operations Lab

Course Code: CHL222

L	T	P	Credits
0	0	3	2

List of Experiments

1. Analysis of various sizes of given material by sieve analysis and determination of cumulative and differential analysis.
2. Determination of specific cake resistance and medium resistance of a leaf filter.
3. Determination of the specific cake resistance and medium resistance in a vacuum filter.
4. To study the working of continuous type thickener.
5. Determination of screening efficiency in a vibrating screen.
6. Plate and frame filter press: determination of cake resistance and filter medium resistance.
7. Determination of power consumption and study of agitation and mixing characteristic of a fluid.
8. To plot Power number Vs Reynolds number for the given set of impeller with baffled/ unbaffled mixing.
9. To study effect of RPM on the power consumption of a Ball Mills
10. To determine the efficiency of a Ball Mill

This is only the suggested list of practicals. Instructor may frame additional practicals relevant to the course

DAV UNIVERSITY, JALANDHAR

Course Title: Fluid Flow Lab

Course Code: CHL223

L	T	P	Credits
0	0	3	2

List of Experiments

1. To find coefficient of friction in pipes of different materials.

2. To verify Bernoulli's equation using hydraulic bench.

3. To find losses due to sudden expansion and sudden contraction in pipes.

4. To calculate Reynold's number for laminar and turbulent flow.

5. To calculate metacentric height.

6. To determine volumetric and mass flow rates through the Venturimeter.

7. To determine volumetric and mass flow rates using Orifice meter.

8. To calibrate and to find mass flow rate through Rotameter.

10. To measure the velocity of flow at different points along the cross section in a pipe

This is only the suggested list of practicals. Instructor may frame additional practicals relevant to the course

DAV UNIVERSITY, JALANDHAR

Course Title: Chemical Technology -1(Inorganic)

Course Code: CHL204

L	T	P	Credits
4	0	0	4

Course Objectives:

The objective of the course is to enable the students to understand the basic flow chart symbols and flow charts for typical chemical processes.

Learning outcomes: Upon completion of this course, the students will be able to:

- Understand the processes involved in manufacturing of various inorganic and organic chemicals.
- Prepare the process flow diagrams.
- Analyze important process parameters and engineering problems during production

Unit-A **12 HOURS**

Sulphur and Chlor-alkali industry: Sulphur dioxide, sulphuric acid, oleum, Brine Electrolysis manufacture of caustic soda and chlorine, Solvey and modified solvey process, diaphragm cells, membrane cells, hydrochloric acid.

Unit-B **12 HOURS**

Cement & Glass: Cement- types and manufacture of Portland cement. Glass- manufacturing of glass, application of special glasses.

Ceramics- Refractories: Introduction, properties of ceramics, classification of refractories, important steps involved in the manufacture of refractories.

Unit-C **12 HOURS**

Industrial gases: Manufacture and uses of carbon dioxide, oxygen, nitrogen and acetylene.

Paints: Introduction, classification of paints, manufacture of paints.

Dyes: Classification of dyes, manufacture of dyes, various physical and chemical properties of dyes and their industrial uses.

Unit-D **12 HOURS**

Fertilizers: Nitrogenous fertilizers- Manufacture of Ammonia, Nitric acid, Urea, CAN, Ammonium Sulphate. Phosphatic fertilizers- superphosphate and triple superphosphate. Potassic fertilizers- Potassium Chloride and Potassium Sulphate. Corrosion problems and materials of construction

Reference Books:

1. M.Gopala Rao, Marshall Sitting, *Outlines of Chemical Technology*, East West Press, 3rd edition, 2011.

2. Austin G. T., *Shreve's Chemical Process Industries*, 5th Edition, McGraw Hill Book Company, New Delhi, 2012.
3. Bose, P.K., *Chemical Engineering Technology*, Vol. 1,2, Books and Allied (Pvt) Ltd, 2011
4. Shukla S. D., Pandey G. N., *A text book of Chemical Technology, Vol. I, II,* Vikas Publishing House Pvt. Ltd., New Delhi, 2000

Web References:

Stanford/www.youtube.com
Gate Academy/www.youtube.com
NPTEL- Chemical Engineering
Chemical Engineering Guy/www.youtube.com
LearnChemE/www.youtube.com

DAV UNIVERSITY, JALANDHAR

Course Title: Chemical Engineering Thermodynamics

Course Code: CHL205

L	T	P	Credits
4	0	0	4

Course Objective: This course covers the application of thermodynamic principles to chemical engineering problems. The concept of equations of state, phase and chemical equilibrium with emphasis on vapor/liquid systems and their applications to separation processes is included.

Learning outcomes: Upon completion of this course, the students will be able to:

- Apply fundamental concepts of thermodynamics to engineering applications.
- Estimate thermodynamic properties of substances in gas and liquid states.
- Determine thermodynamic efficiency of various energy related processes.

Unit-A **8 HOURS**

Basic Concepts and First Law: System, surrounding, processes, state and properties, intensive and extensive properties, State and path functions, Reversible & irreversible processes, Zeroth law of thermodynamics. General statement of first law of thermodynamics, First law for cyclic process and non-flow processes, Heat capacity. Derivation for closed system and steady state flow process- flow calorimeter and heat capacity.

Unit-B **12 HOURS**

P-V-T Behavior: P-V-T behavior of pure fluids, Equations of state and ideal gas law, Processes involving ideal gas law: Constant volume, constant pressure, Constant temperature, adiabatic and polytropic processes, Equations of state for real gases: Van der Waals equation, Redlich – Kwong equation, Virial equation, Principles of corresponding states.

Second Law of Thermodynamics: General statements of the Second law, concept of Entropy, Carnot's principle, Calculations of entropy change, Clausius Inequality, Entropy and Irreversibility, Third law of thermodynamics.

Unit-C **14 HOURS**

Thermodynamic Properties of Pure Fluids: Work function, Gibbs free energy, Fundamental property relations, Maxwells equations, Residual properties, two phase system, Thermodynamic diagram Equations for U and H, Effect of temperature on U, G, H and S, Entropy heat capacity relations, Relationship between C_p and C_v, Clapeyron equation, Gibbs-Helmholtz equation, Fugacity and fugacity coefficient, determination of fugacity of pure fluids.

Properties of Solutions: Partial molar properties, estimation, Gibbs-Duhem equation, Chemical potential, Fugacity in solutions, Henry's law and dilute solutions, Activity in solutions, Activity coefficients, Property changes of mixing, excess properties (Qualitative treatment) Activity & Activity coefficients, Ideal and non-ideal solutions.

Unit -D **14 HOURS**

Phase Equilibria: Chemical potential, criterion for VLE for ideal solutions, Raoult's law, P-x,y and T-x,y diagrams, Non ideal solutions- Azeotropes types, VLE at low pressures, VLE Correlations- van laar, Margules and Wilson equation. Gibbs-Duhem equation and its application to vapour- liquid equilibria, VLE at high pressures, Liquid-liquid equilibrium

Chemical Reaction Equilibrium: Reaction stoichiometry, Criteria of chemical reaction equilibrium, Equilibrium constant and standard free energy change, Effect of temperature, pressure on equilibrium constants and other factors affecting equilibrium conversion, Liquid phase reactions, Heterogeneous reaction equilibria, Phase rule for reacting system

Recommended Books

1. Smith J. M., Van Ness H. C., Abbott M. M., *Introduction to Chemical Engineering Thermodynamics,* 7th Edition, Tata McGraw Hill, 2005.
2. Rao Y. V. C., *Chemical Engineering Thermodynamics,* 7th Edition, Universities Press (India) Ltd., Hyderabad, 2005.
3. Narayanan K.V., *A Textbook of Chemical Engineering Thermodynamics,* 2nd edition, Prentice Hall India Learning Private Limited, 2013.
4. Kyle B. G., *Chemical and Process Thermodynamics*, Third Edition, Prentice Hall Inc., 1999.
5. Denbigh K. G., *Principles of Chemical Equilibrium,* 4th Edition, Cambridge University Press, 1981.
6. Halder G., *Introduction to Chemical Engineering Thermodynamics,* Prentice Hall Inc., 2009

Web References:

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Gate Academy/www.youtube.com
NPTEL- Chemical Engineering
Chemical Engineering Guy/www.youtube.com
LearnChemE/www.youtube.com

DAV UNIVERSITY, JALANDHAR

Course Title: Heat Transfer
Course Code: CHL206

L	T	P	Credits
4	0	0	4

Course Objective: The objective of the course is to enable the students to understand the basic Heat transfer and their fundamental relations.

Learning Outcomes: After completion of this course the students will be able to:

- Solve conduction, convection and radiation problems
- Design and analyze the performance of heat exchanger and evaporators
- Calculate heating and cooling requirements for reactors.

UNIT -A **12 HOURS**

Introduction to modes of heat transfer:

Conduction: Review of Fourier's Law, one-dimensional heat conduction through composites having plane wall, spherical & cylindrical geometry, Steady state heat flow with heat source through plane wall and cylindrical surface, Thermal conductivity of materials. Optimal thickness of insulation, Unsteady-state conduction; Lumped heat capacity system, semi-infinite solid, differential equations of heat transfer, special forms, two and three dimensional problems

UNIT-B **12 HOURS**

Convection: Free and forced convection, concept of heat transfer co-efficient, dimensionless numbers in free and forced convection, Dimensional analysis, Determination of Heat transfer coefficient using heat and momentum transfer analogies, experimental determination of heat transfer coefficient and common working correlations. Thermal boundary layers.

Extended Surfaces: Fins, types of fins, and their applications.

UNIT-C **12 HOURS**

Radiation Heat Transfer: Radiation: Distribution of radiant energy, Definition of emissivity, absorptivity, Reflectivity and Transmissivity, concept of Black and Grey bodies, Planck's Law of monochromatic radiation, Kirchhoff's Law, Wein's displacement law, Stefan-Boltzmann law, definition of intensity of radiation. Radiation formula for radiation exchange between simple bodies, two parallel surfaces and between any source and receiver.

Condensation and Boiling: Condensation heat transfer phenomenon, film condensation on vertical plates and cylinders as well as on horizontal cylinders. Effects of non-condensable gases and vapor velocity on condensation, pool boiling, forced convection boiling, working correlations for pool boiling.

UNIT -D **12 HOURS**

Evaporation: Types of Evaporators, single and multiple effects, single and multiple effects calculations, evaporator capacity, economy, effect of liquid head and boiling point elevation, methods of feeding.

Heat Exchangers: Various types of heat exchangers, Design of heat transfer equipment-double pipe heat exchanger, concept of LMTD, DPHE sizing; shell and tube heat exchanger.

Reference Books:

1. McCabe, W.L, Smith J .C. and Harriott P,*Unit Operations of Chemical Engineering,*McGraw-HILL, 7th edition, 2005.
2. Holman, J.P., *Heat Transfer,* McGraw Hill, 9th edition, 2004.
3. Rao, Y.V.C., *Heat Transfer,* University Press (India) Ltd, New Delhi,Ist edition, 2000.
4. Kern, D. Q., *Process Heat Transfer,* McGraw Hill, Tata McGraw Hill, 2004.
5. Foust, A.S., Wenzel, L.A, Clump, C.W., Maus, L. and Anderson, L.B., *Principles of Unit Operations*, John Wiley, 2th edition 2008.

Web References:

Stanford/www.youtube.com
Gate Academy/www.youtube.com
NPTEL- Chemical Engineering
Chemical Engineering Guy/www.youtube.com
LearnChemE/www.youtube.com

DAV UNIVERSITY, JALANDHAR

Course Title: Chemical Process Instrumentation

Course Code: CHL207

L	T	P	Credits
4	0	0	4

Course Objective: The objective of the course is to enable the students to understand the basic concepts related to instruments used in chemical process industry.

Learning outcomes: upon the completion of the course students are able to

- Understand the principle of pressure measuring equipment.
- Understand the principle of temperature measuring equipment.
- Understand the principle of flow measuring equipment.

UNIT -A

INTRODUCTION **10 HOURS**

Process instrumentation diagrams, importance of instruments in chemical process industries, general principles of measurement, static and dynamic characteristics of instruments, sensors and transducers.

UNIT-B **12 HOURS**

TEMPERATURE MEASUREMENT

Thermocouple, resistance thermometers, bimetallic thermistors, optical and radiation pyrometer.

LIQUID LEVEL MEASUREMENT

Direct and indirect method for the measurement in open vessels, pressure vessels.

UNIT-C **14 HOURS**

FLOW MEASUREMENTS

Variable head meters, variable area meters, positive displacement type meters (reciprocating piston, oscillating or rotary piston, bi-rotor types), electromagnetic flowmeters and mass flow meters, open channel flow meters.

PRESSURE MEASUREMENT

Differential manometer, bourdon and bellow type gauge, measurement of vacuum, pressure transducers.

UNIT-D **12 HOURS**

MISCELLANEOUS MEASUREMENTS

Instruments for gas analysis. Gas chromatography, mass spectroscopy. Measurement of nuclear radiation, viscosity, conductivity, humidity and pH value, UV Spectrophotometer.

BOOKS RECOMMENDED:

1. Eckman, D.P. *lndustrial lnstrumentation,* Wiley Eastern Ltd, 2004
2. Krishnaswamy, K. *Industrial Instrumentation,* Volume 1, New Age International P Limited, 2003.
3. Singh, S.K, *Industrial Instrumentation and Control*, 3rd Edition, McGraw Hill Education (India) Pvt Ltd, 2008.
4. Coughanour, D.R., *Process Systems Analysis and Control,* Indian Edition (3e) McGraw Hill, 2013.

Web References:

Stanford/www.youtube.com
Gate Academy/www.youtube.com
NPTEL- Chemical Engineering
Chemical Engineering Guy/www.youtube.com
LearnChemE/www.youtube.com

DAV UNIVERSITY, JALANDHAR

Course Title: **Process Dynamics and Controls**

Course Code: CHL304

L	T	P	Credits
4	0	0	4

Course Objectives: The student will
1. Understand a control system with various input functions, characteristics and transfer functions
2. Know the behaviour of a control system for I and II order type
3. Understand different closed loop systems and Controllers (P, I, D and On – Off modes)

Learning outcomes: upon the completion of the course students are able to

- Set up a model, analyse and solve the first and second order system for its dynamic behavior
- Evaluate the process stability in Laplace domain
- Design control system using frequency response analysis
- Identify advanced control techniques for chemical process.

UNIT-A **12HOURS**

Laplace Transformation. Inversion by partial fractions. Properties of transform. Linear Open-loop System, Response of first-order systems, physical examples of first order system, response of first order systems and Transportation Lag

UNIT-B **12 HOURS**

Linear closed-loop systems, control systems, Controllers and Final control elements, closed-loop Transfer functions. Transient response of Simple control Systems Control valve, Construction, valve sizing and characteristics.

UNIT-C **12 HOURS**

Stability, Routh Test of stability, Root Locus. Introduction to Frequency Response, Bode diagram, Gain Margins and Phase Margins.

UNIT-D **12 HOURS**

Controller tuning (Ziegler- Nichols Controller settings), Process identification, Identification methods: Step test data, Sine Wave testing, Pulse testing, Introduction to advanced control technique, cascade control, ratio control, feed forward control, feed backward control.

Reference Books:

1. Coughanour, D.R., *Process Systems Analysis and Control,* 3rd edition, McGraw Hill 2013.
2. Stephanopoulous, G., *Chemical Process Control: An introduction to Theory and Practice*, Prentice Hall of India, 1990.

3. Peacock D.G., Richardson J.F., *Chemical Engineering,* Volume 3, 3rd Ed., Butterworth Heinemann, 1994.
4. Harriott, P., *Process Control,* Tata McGraw Hill,2001
5. Eckman, D.P., *Industrial instrumentation***,** John Wiley & Sons ,2004

Web References:

Stanford/www.youtube.com
Gate Academy/www.youtube.com
NPTEL- Chemical Engineering
Chemical Engineering Guy/www.youtube.com
LearnChemE/www.youtube.com

DAV UNIVERSITY, JALANDHAR

Course Title: : Heat Transfer operation Lab

Course Code: CHL227

L	T	P	Credits
0	0	2	1

List of Experiments

1. Heat transfer through conduction in metal rod.
2. Determination of heat transfer coefficient by forced convection.
3. Determination of heat transfer coefficient by natural convection
4. Determination of heat transfer coefficient for pin fin by natural convection.
5. Determination of heat transfer coefficient for pin fin by forced convection.
6. Determination of overall heat transfer for parallel flow in double pipe heat exchange.
7. Determination of overall heat transfer coefficient for counter flow in double pipe heat exchanger
8. Determination of emissivity of the given test plate.
9. Determination of heat transfer coefficient in shell & tube heat exchanger.

This is only the suggested list of practicals. Instructor may frame additional practicals relevant to the course

DAV UNIVERSITY, JALANDHAR

Course Title: Instrumentation & Controls Lab

Course Code: CHL330

L	T	P	Credits
0	0	2	1

List of Experiments

1. Determination the time constant of a given Mercury Thermometer.
2. Determination of time constant in a liquid level tank
3. Determination of time constant in interacting and non-interacting tank
4. Determination of time constant in a heated tank
5. To study the effect of proportional controller in a liquid level tank
6. To study the effect of proportional Integral controller in a liquid level tank

This is only the suggested list of practicals. Instructor may frame additional practicals relevant to the course

DAV UNIVERSITY, JALANDHAR

Course Title: Mass Transfer-I

Course Code: CHL301

L	T	P	Credits
4	0	0	4

Course Objectives: The objective of this course is to present the principles of mass transfer and their application to separation and purification processes. The concept of mass transfer coefficients, rate expressions and some mass transfer operations is developed.

Learning outcomes: upon the completion of the course students are able to

- Solve problems related to diffusion and interphase mass transfer and mass transfer equipment.
- Perform design calculation related to absorption and humidification.

UNIT-A **12 HOURS**

Introduction: Importance and classification of mass transfer operations in Chemical Engineering.

Diffusion: Diffusion in gases and liquids, Fick's First law of diffusion, Mass balance in simple situations - with and without chemical reaction.

Diffusion in solids, diffusion through porous solids and polymers, unsteady state diffusion

Eddy diffusion: Mass transfer coefficients and their correlations. Theories of mass transfer, Interphase mass transfer, problems on mass transfer resistance. J_d factor, Analogies in mass, heat and momentum transfer processes.

Interphase Mass transfer:

Theories of Mass transfer, Individual and overall mass transfer coefficients, Convective mass transfer. Mass balance in concurrent and counter-current continuous contact equipment, Concept of operating line, Multi-stage counter current operations, Concept of ideal stage, Stage efficiencies, Design of continuous contact equipment, HTU and NTU concepts.

Effect of chemical reaction on mass transfer

UNIT-B **14 HOURS**

Gas-Liquid Contacting Equipment: Equipment for gas-liquid operations: general characteristics and operational features of tray towers and packed towers, tray design, flow through a packed towers, spray towers, venture-scrubbers

Gas Absorption: Equilibrium in gas-liquid systems: Two components and multicomponent systems, ideal and non-ideal solutions, Selection of suitable solvent, Counter-current multistage operations- one component transferred, Real trays and tray efficiencies. Reactive absorption.

Gas Absorption Equipment: Continuous contact equipment: Packed towers, HETP & NTU, Overall transfer coefficients and transfer units

UNIT-C **10 HOURS**

Humidification: VLE & Enthalpy, Reference substance plots, vapour gas mixtures, concept of adiabatic saturation, psychometric charts, adiabatic operations-humidification operations and water cooling operations. Dehumidification Equipments: water cooling towers & spray chambers

UNIT-D **12 HOURS**

Adsorption & Ion-Exchange Operations: Adsorption and adsorbents-Type and nature, Adsorption equilibria and various popular mathematical models, Selection of adsorbents, Adsorption hysteresis, Batch adsorption, Stage wise adsorption-single stage and multiple stage, Ion-Exchange, Equilibrium distribution of ions.

Adsorption & Ion-Exchange Operation Equipments: Adsorption in a fixed bed. Adsorption equipments-agitated vessels for liquid-solid contact, fluidized and teeter beds, slurry adsorption of gases and vapours, steady-state-moving-bed absorbers,

Reference Books:

1. Treybal, R.E., *Mass Transfer Operations*, 3rd Edition, McGraw Hill, 2012.
2. Dutta, B.K, *Principles of Mass Transfer and Separation Processes,*PHI Learning Pvt. Ltd, 2007 Coulson JM, Richardson JF and Sinnott RK,*Chemical Engineering*, Vol I, II, IV and V, 5th Edition, Pergmen Press, 2002.
3. Badger &Banchero, *Introduction to Chemical Engineering,* TMH, 6th Reprint, 1998.
4. Geankoplis, C. J., *Transport Processes and Unit Operation,* Prentice Hall (I), 2000.

Web References:

Stanford/www.youtube.com
Gate Academy/www.youtube.com
NPTEL- Chemical Engineering
Chemical Engineering Guy/www.youtube.com
LearnChemE/www.youtube.com

DAV UNIVERSITY, JALANDHAR

Course Title: Chemical Reaction Engineering-I

Course Code: CHL302

L	T	P	Credits
4	0	0	4

Course Objectives: The students will study design of various types of reactors for the application to chemical industry and learn the fundamentals related to homogeneous chemical reactions and their kinetics.

Learning outcomes: After the completion of the course students are able to

- Develop rate laws for homogeneous reactions and analyze batch reactor data by integral and differential methods.
- Design ideal reactors for homogeneous single and multiple reactions.
- Select the appropriate type reactor/scheme and demonstrate the temperature effect on reaction rate and design non-isothermal reactors.

UNIT-A

Introduction **12 HOURS**

Introduction & Importance of Chemical Reaction Engineering, Kinetics of homogeneous reactions, Concepts of reaction rates, rate equation, rate constant, order & molecularity, Mechanism for Elementary & Non-elementary reaction., single and multiple reactions, temperature dependent term of rate equation.

Interpretation of Batch Reactor

Constant volume batch reactor, integral method of analysis of data, series and parallel reactions, reversible reactions, variable volume batch reactor, differential methods of analysis.

UNIT-B **12 HOURS**

Introduction to Reactor Design

Ideal batch reactor, mixed flow reactor, plug flow reactor, holding and space time, design for single reactions, size comparison analytical and graphical method, plug flow reactors in series & parallel, mixed reactor in series, recycle reactors, autocatalytic reactor.

UNIT –C **12 HOURS**

Design for Multiple Reactions

Reactions in parallel and series in CSTR, reactions in parallel and series in Plug flow reactor, autocatalytic reactions, choice of reactors for simple and complex reactions, yield & selectivity.

UNIT-D **12 HOURS**

Temperature and Pressure Effects

Heat of reaction from thermodynamics, optimum temperature progression, Equilibrium constant and its temperature dependence.

Selection of reactor

Choosing the right kind of reactor for single reaction, reaction is series, parallel reactions, and complex reactions, continuous versus non-continuous operations

Recommended Books:

1. Levenspiel O., *Chemical Reaction Engineering*, 3rd Edition, John Wiley & Sons, Singapore, 2010
2. Fogler H. S., *Elements of Chemical Reaction Engineering,* 4th Edition, Prentice Hall Inc.,2009
3. Smith J. M., *Chemical Engineering Kinetics,* 3rd Edition, McGraw Hill, 1981.
4. Hill C. G., *Chemical Engineering Kinetics and Reactor Design,* John Wiley, 1977.
5. Coulson J. M., Richardson J. F., *Chemical Engineering Volume 3***,** Pergamon Press, 1999.

Web References:

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NPTEL- Chemical Engineering
Chemical Engineering Guy/www.youtube.com
LearnChemE/www.youtube.com

DAV UNIVERSITY, JALANDHAR

Course Title: Chemical Technology-II (Organic)

Course Code: CHL303A

L	T	P	Credits
3	0	0	3

Course Objectives: The students will
1. Study the Organic, Petroleum Process industries.
2. Learn to write flow chart symbols and flow charts for typical chemical processes

Learning outcomes: Upon completion of the course students will be able to

- Understand the processes involved in manufacturing of various inorganic and organic chemicals.
- Prepare the process flow diagrams.
- Analyze important process parameters and engineering problems during production.

UNIT-A **10HOURS**

Oils and fats: Major oil seeds, solvent process, hydrogenation of oils. Soaps and Detergents: Raw material, manufacturing of detergents, biodegradability, and glycerin manufacture, fat splitting, purification of fatty acids,

UNIT-B **10HOURS**

Sugar Industry: Cane production and varieties, manufacturing equipment and technology, cane sugar refining, Bagasse utilization,
Fermentation: Production of ethyl alcohol from molasses, citric acid and antibiotics like penicillin.

UNIT-C **10HOURS**
Pharmaceuticals: Preparation of different pharma products: antibiotics (Pencillin), synthetic drugs, vitamins.
Pesticides: Manufacturing of Dichloro diphenyl trichloroethane (DDT), Benzene Hexa chloride (BHC), Dichloro phenol and monochloro acetic acid (2, 4 –D)

UNIT –D **10 HOURS**
Pulp and paper: pulping processes, recovery of chemicals, stock preparation and paper making, recovery of chemicals, viscose rayon. Surface-coating Industries: paints, pigments, varnishes, Lacquers.

Reference Books:

1. Dryden C. E., *Outlines of Chemical Technology,* 2nd Edition, East–West Press Pvt. Ltd., New Delhi, 1999.
2. Austin G. T., *Shreve's Chemical Process Industries*, 5th Edition, McGraw Hill Book Company, New Delhi, 2012.
3. Groggins, P.H., *Unit Processes in Organic Synthesis,* 5th Edition Tata McGraw Hill ,2003

4. Garry, James H., Handwerk, G. E. and Kaiser, M.J., *Petroleum Refining Technology and Economics,* Taylor & Francis ,2007

Web References:

Stanford/www.youtube.com
Gate Academy/www.youtube.com
NPTEL- Chemical Engineering
Chemical Engineering Guy/www.youtube.com
LearnChemE/www.youtube.com

DAV UNIVERSITY, JALANDHAR

Course Title: Material Science and Technology

Course Code: CHL208

L	T	P	Credits
3	0	0	3

Course Objective: The objective of the course is to enable the students to understand the basic concepts of Microstructure and information on selection of materials for design and manufacturing.

Learning outcomes: Upon completion of the course students will be able to

- Draw phase diagram.
- Describe causes of mechanical failure
- List types of corrosion and describe method to control them
- List properties of different engineering materials

UNIT-A **10 Hours**

Introduction to materials, bonding between atoms: metallic bonding, ionic bonding, covalent bonding, Van der Waals bond, thermal expansion, elastic modulus and melting point of materials, Role of materials selection in design, structure-property-processing-performance relationships.

Miller indices of directions and planes, packing of atoms inside solids, close-packed structures, structure of ceramics, ionic solids, glass and polymers, density of various materials.

Imperfections in solids: vacancies, equilibrium concentration of vacancies, interstitial and substitutional impurities in solids, dislocations, types and characteristics of dislocations, interfacial defects, stacking faults.

UNIT-B **10 Hours**

Structure of materials and Strength of Materials: Yield strength, tensile strength and ductility of materials: stress strain behaviour of metals, ceramics and polymers, tensile test, plastic deformation, necking, creep behaviour and fatigue

Corrosion, Degradation and Recycling

UNIT –C **10 Hours**

Semi-crystalline materials: Classification, structure and configuration of ceramics, polymers, copolymers, liquid crystals and amphiphiles.

Non-crystalline/amorphous materials: Silicates, glass transition temperature, viscoelasticity

Polymer nano-composite materials: Nanocomposites, role of reinforcement-matrix interface strength on composite behaviour.

UNIT-D **08 Hours**

Biomaterials, material related to catalyst such as zeolites, silica etc. and other selected materials. Introduction to experimental techniques: XRD, NMR, PSA, etc. for material characterization highlighting links between molecular structure and macroscopic properties.

Reference Books:

1. Khanna, O. P. *Material Science*, Dhanpat Rai Publications, New Delhi, 2010.
2. VanVlack, H.L.,*Elements of Materials Science*, 6th Edition, Addision-Wesly Publishing Company, NY, 1989.
3. Raghavan V., *Material Science and Engineering***,** A First Course, 5th Edition, Prentice Hall of India Pvt. Ltd., New Delhi, 2004.
4. William D. Callister, *Materials Science and Engineering: An Introduction,* 6th Edition, Wiley, 2006.
5. Hajra Choudhary S. K**.,** *Material Science and Processes,* Indian Book Distributing Co., 1982.

Web References:

Stanford/www.youtube.com
Gate Academy/www.youtube.com
NPTEL- Chemical Engineering
Chemical Engineering Guy/www.youtube.com
LearnChemE/www.youtube.com

DAV UNIVERSITY, JALANDHAR

Course Title: Numerical Methods

Paper Code: MTH256A

L	T	P	Credits
3	0	0	3

Course Objectives

The aim of this course is to teach the applications of various numerical techniques for a variety of problems occurring in daily life. At the end of the course, the students will be able to understand the basic concepts in Numerical Analysis of differential equations.

Unit-A

Approximate numbers, Significant figures, rounding off numbers, Error Absolute, Relative and percentage

Non-Linear Equations: Bisection, Regula-Falsi, Secant, Newton-Raphson, General Iteration Method. Rate of convergence

Unit-B

Systems of Simultaneous Linear Equations: Direct methods: Gauss elimination method, Gauss Jordon method, Matrix inversion method; Iterative methods: Jacobi method and Gauss-Seidel method, Power method for finding largest Eigen value.

Unit-C

Operators: Forward, Backward and Shift (Definitions and some relations among them). Newton forward and backward, Gauss backward and forward interpolation, Sterling formula,

Bessel formula, Lagrange's interpolation, Hermite Interpolation, Newton divided difference

Interpolation. Numerical Differentiation, Maximum and Minimum values of a tabulated function.

Unit-D

Numerical Integration: General Quadrature formula, Trapezoidal Rule, Simpson's 1/3-Rule, Simpson's 3/8-Rule, Boole's rule, Weddle's Rule.

Numerical solutions to first order ordinary differential equations: Taylor's Series method, Picard's Method, Euler's and modified Euler's methods, Runge-Kutta method.

References:

1. Jain, M.K. *Numerical Analysis for Scientists and Engineers*. New Delhi: S.B.W. Publishers, 1971.
2. Grewal B.S. *Numerical Methods in Engineering & Science with Programs in C& C++.* New Delhi: Khanna Publishers, 2012.
3. Golub G.H. and Ortega, J.M. *Scientific Computing and Differential Equations: An Introduction to Numerical Methods*. London: Academic Press, 1992.
4. John H. Mathews and Kurtis D. Fink, *Numerical Methods using Matlab*, 4th Ed., PHI Learning Private Limited, 2012.

Course Title: Chemical Technology Lab

Course Code: CHL323

L	T	P	Credits
0	0	3	2

List of Experiments:

1. To find Acid value of vegetable oil
2. To find Iodine value of vegetable oil
3. To Saponification of polymer
4. Determination of NPK value
5. Preparation of soap
6. Preparation of polymer(Urea Formaldehyde)
7. To determine the Moisture, Volatile and Ash content in a given coal sample by Proximate Analysis
8. Determination of viscosity by Ostwald Viscometer

This is only the suggested list of practicals. Instructor may frame additional practicals relevant to the course

Course Title: Numerical Methods Lab

Paper Code: MTH257B

L	T	P	Credits
0	0	2	1

List of Programs:

1. WAP on Basic Operations (Conditional statement If, for loop).
2. WAP on Bisection, False Position and Secant Method.
3. WAP Newton Raphson Method.
4. WAP to solve the system of linear equations using Gauss Elimination Method.
5. WAP to solve the system of linear equations using Gauss Jacobi Method.
6. WAP to solve the system of linear equations using Gauss Seidel Method
7. WAP on Newton interpolation.
8. WAP on Lagrange's Interpolation.
9. WAP on Trapezoidal rule.
10. WAP on Simpson's rules.
11. WAP on Euler's Method.
12. WAP on Runge-Kutta Methods.

Reference Books:

1. Gottfried, S. Byron. *Programming with C*. Delhi: Tata McGraw Hill, 2010. Print.
2. Balagurusamy, E. *Programming in ANSI C*. Delhi: McGrawHill, 2012. Print.
3. Pratap, R. *Getting Started with MATLAB: A Quick Introduction for Scientists & Engineers* Oxford Publications. 2010
4. Hanly R. Jeri, and Elliot B. Koffman. *Problem Solving and Program Design in C*. USA: Addison Wesley, 2013. Print.
5. Kanetker, Yashwant. *Let us C*. Delhi: BPB Publications, 2005. Print.
6. Balagurusamy, E. *Object oriented programming with C++*. Delhi: McGrawHill, 2008. Print.

DAV UNIVERSITY, JALANDHAR

Course Title: Mass Transfer II

Course Code: CHL305

L	T	P	Credits
4	0	0	4

Course Objectives: The objective of this course is to present the principles of mass transfer and their application to separation and purification processes. The concept of various mass transfer operations is developed which are extensively used.

Learning Objectives: After completion of this course students will be able to

- Solve problems involving mass transfer due to diffusion chemical reaction and convection.
- Size some basic mass transfer equipment.
- Solve mass transfer problems involving distillation, extraction and drying operations.

UNIT-A **12HOURS**

Distillation: Limitations and applications, prediction of VLE using thermodynamic & experimental techniques. Dew point & bubble point estimations for binary. Distillation methods – flash distillation, differential distillation for binary systems, steam distillation, optimum reflux ratio. Fractionation of binary mixtures using McCabe – Thiele method and enthalpy concentration method (Ponchon and Savarit method). Packed distillation columns. Azeotropic& extractive distillation preliminaries and molecular distillation. Introduction to multicomponent distillation.

UNIT-B **12HOURS**

Liquid-Liquid Extraction Operations: Liquid-Liquid Equilibria, Equilateral triangle coordinate systems, Suitable solvent selection, Design calculations for single stage and multiple extraction, Multistage extraction using partially miscible & immiscible solvents.

Liquid-Liquid Extraction Operation Equipments: Liquid-Liquid Extraction Equipments- Spray Towers, Packed Towers, Mechanically Agitated Countercurrent Extractors, Rotating Disc Extractor.

UNIT-C **12HOURS**

Leaching Operations: Liquid-Solid Equilibria, Design calculations for single stage and multiple stage leaching.

Leaching Operations Equipment: Unsteady State leaching systems: Percolation tank, batch settling, Steady state continuous operations- Agitated vessels, thickeners, continuous countercurrent decantation, classifiers, method of calculations related to single stage and multistage leaching

UNIT-D **10HOURS**

Drying Operation and Equipment: Drying equilibria, Physical mechanism of drying, batch drying rate of dying curve, time of drying, drying rate data, Drying equipments-Batch and continuous dryers.

Crystallization Operations and Equipments: Solid-liquid phase equilibria, nucleation and crystal growth, crystal size distribution, batch crystallization, crystallization equipments.

Reference Books:

1. Treybal, R.E., *Mass Transfer Operations,* McGraw Hill, 3rd Edition (Indian), 2012.
2. Dutta, B.K, *Principles of Mass Transfer and Separation Processes,*PHI Learning Pvt. Ltd, 2007.
3. Coulson JM, Richardson JF and Sinnott RK,*Chemical Engineering,* Vol I, II, IV and V, 4th Edition, Pergmen Press, 1998.
4. Geankoplis, *Transport Processes and Unit Operations*, Prentice-Hall of India, 1993.
5. McCabe, W.L., and Smith, J.C., *Unit Operations of Chemical Engineering,* McGraw Hill, 7th Edition, 2005.

Web References:

Stanford/www.youtube.com
Gate Academy/www.youtube.com
NPTEL- Chemical Engineering
Chemical Engineering Guy/www.youtube.com
LearnChemE/www.youtube.com

DAV UNIVERSITY, JALANDHAR

Course Title: Chemical Reaction Engineering-II

Course Code: CHL306

L	T	P	Credits
4	0	0	4

Course Objectives: The students will
1. Learn heterogeneous reaction systems.
2. Study the design and analyze performance of non-ideal reactors.
3. Study catalytic systems and its deactivation studies for students to handle such process systems.

Learning Outcomes: After completion of this course students will be able to

- Predict the conversion in a non-ideal reactor using tracer information.
- Design reactors for fluid-solid reactions.
- Design reactors for catalytic reactions.
- Design towers for gas–liquid reactions with and without mass transfer considerations.

UNIT-A **12HOURS**

Basics of Non Ideal flow: Importance & interpretation of RTD, C, E & F curves & Statistical interpretation. Dispersion model. Tanks in series model. Conversion in non- ideal flow reactors for simple systems.

Kinetics of heterogeneous reactions: Introduction to catalysts & their classification, Concepts of physical adsorption and Chemisorption, Preparation of solid catalysts, Deactivation of Catalysts, Synthesis of rate law, mechanism & rate limiting step for catalytic reactions, Determination of BET surface area and pore volume of the catalyst, Langmuir Hinshelwood rate equations and parameter estimation

UNIT-B **10HOURS**

Diffusion through porous catalyst particles:
Effectiveness factor for pore diffusion resistance through a single cylindrical pore, Significance of Thiele modulus, Heat effects during reaction, Performance equations for solid- gas reactions for different reactor types & determination of controlling resistance

UNIT-C

Kinetics and design of Fluid-Particle Reactions: **12HOURS**
Modelling of gas-solid non-catalytic reactions and determination of parameters, combination of resistances & determination of rate controlling step. Analysis of rate data design outline and selection of fixed bed, fluid bed and slurry reactors

UNIT-D

Kinetics & Design of Fluid-Fluid Reactions: **14HOURS**

Interface behavior for liquid-phase reaction, Regimes for different reaction kinetics for liquid-liquid reactions, Determination of reaction rate & tower height based on film and penetration theories, Concept of Enhancement factor & Hatta number. Reactor systems and design for gas-liquid-solid non-catalytic system

Reference Books:

1. Levenspiel O., *Chemical Reaction Engineering,* 3rd Edition, John Wiley & Sons Singapore, 2010.
2. Fogler H. S., *Elements of Chemical Reaction Engineering,* 4th Edition, Prentice Hall Inc., 2009.
3. Smith J. M., *Chemical Engineering Kinetics,* 3rd Edition, McGraw Hill, 1981.
4. Hill C. G., *Chemical Engineering Kinetics and Reactor Design,* John Wiley, 1977.
5. Coulson J. M., Richardson J. F., *Chemical Engineering* ,Volume 6", 3rd Edition Pergamon Press

Web References:

Stanford/www.youtube.com
Gate Academy/www.youtube.com
NPTEL- Chemical Engineering
Chemical Engineering Guy/www.youtube.com
LearnChemE/www.youtube.com

DAV UNIVERSITY, JALANDHAR

Course Title: Mass Transfer Lab

Course Code: CHL325

L	T	P	Credits
0	0	3	2

List of Experiments

1. To plot the ternary phase diagram for acetic-acid–water Toluene.
2. To draw the tie line and to determine plait point for ternary system.
3. To determine the diffusivity of acetone in air.
4. To study the drying characteristics of the given wet material (Natural Convection).
5. To determine the Mass Transfer Coefficient for vaporization of naphthalene in air.
6. To verify Rayleigh's Equation for Batch distillation.
7. To find HETP and HTU for packed distillation column.
8. To purify turpentine oil having high boiling point using steam distillation.
9. To determine VLE data for methanol–water and to compare it with literature data.
10. To determine the mass transfer coefficient by carrying out liquid-liquid extraction in a packed column using acetic acid- toluene-water system.
11. To study the drying characteristics of the given wet material (forced convection).
12. To study the process of crystallization in an agitated batch crystallizer and to plot a graph between weight of crystals vs. temp.
13. To find out mass transfer coefficient in a drop wise liquid–liquid extraction. To Study the Heat and Mass Balance in Cooling Tower.

This is only the suggested list of practicals. Instructor may frame additional practicals relevant to the course

DAV UNIVERSITY, JALANDHAR

Course Title: Chemical Reaction Engineering Lab

Course Code: CHL326

L	T	P	Credits
0	0	3	2

List of Experiments:

1. Determination of rate constant for saponification reaction in a batch reactor
2. Determination of porosity and spheri01city of the given catalyst.
3. RTD study in a Packed bed reactor
4. To study the adsorption of acetic acid on charcoal and prove the validity of Freundlich and Langmuir adsorption isotherm
5. To study the adsorption of oxalic acid on charcoal and prove the validity of Freundlich and Langmuir adsorption isotherm

This is only the suggested list of practicals. Instructor may frame additional practicals relevant to the course

DAV UNIVERSITY, JALANDHAR

Course Name: Environment Technology Lab
Course Code: CHL329

L	T	P	Credits
0	0	2	1

List of Experiments:

1. To determine the Total Solids of a given sample.
2. To find out Total Dissolved Solids of a given sample.
3. To find out Fixed and Volatile solids of the given sample.
4. To determine Acidity of the given sample.
5. To determine the Alkalinity of the given sample.
6. To determine the Total Hardness of the given sample.
7. To estimate the content of Chlorides in the given water sample
8. To find the quantity of the Dissolved Oxygen present in the given sample.
9. To determine the BOD of a given wastewater sample.
10. To determine the COD of a given wastewater sample.

This is only the suggested list of practicals. Instructor may frame additional practicals relevant to the course

DAV UNIVERSITY, JALANDHAR

Course Title: Transport Phenomenon

Course Code: CHL402

L	T	P	Credits
4	0	0	4

Course Objectives: The student will
1. Learn the mechanisms and Laws transport phenomena, Effect of temperature and pressure on transport properties
2. Study velocity distributions in laminar flow for simple fluid flow situations by shell balances

Learning Outcomes: After completion of this course students will be able to

- Analyze heat, mass, and momentum transport in a process.
- Formulate problems along with appropriate boundary conditions.
- Develop steady and transient solution for problems involving heat, mass, and momentum transport.

UNIT-A **10 HOURS**

Introduction: Transport Phenomena and Unit Operation, Equilibrium and Rate Processes, Fundamental variables and units, The analogy between Heat, Mass & Momentum Transfer, Concept of Thermal Conductivity, Diffusion Coefficient & Viscosity, Newtonian and non-Newtonian fluids; Newton's law of viscosity, Fourier's law of heat conduction and Fick's law of diffusion.

UNIT-B **14 HOURS**

Momentum Transport: Velocity Distribution, Equation of continuity in Cartesian, polar and spherical coordinates, Laminar flow of Newtonian fluid over an inclined plate, through circular tube and through annulus, Bingham flow in a circular tube, Equation of Change: Partial, total and substantial times derivatives, Equation of motion and Navier's -Stokes equation and their applications to solve problems of different geometries.

Flow with More Than One Independent Variable: Unsteady-state Newtonian fluid flow, Stream function, Potential function and two-dimensional viscous flow, Boundary layer theory.

UNIT-C **10 HOURS**

Energy Transport: Temperature Distribution: Heat conduction with an electrical, viscous, chemical and nuclear heat source, Heat conduction in a cooling fin, Equation of Change, Equation of energy in rectangular, spherical and cylindrical geometries, Equations of energy for convection in non-isothermal flow, Forced convection, Free convection.

UNIT-D **14HOURS**

Mass Transfer: Concentration distribution with shell mass balances, Diffusion through stagnant gas film, Diffusion with moving interface, Diffusion through a non-isothermal spherical film, Gas absorption with chemical reaction in an agitated tank, Diffusion with heterogeneous and homogeneous

chemical reaction, Diffusion and chemical reaction inside porous catalyst, Equation of Change, Equation of component continuity for binary and ternary mixtures and various simplifying assumptions.

Reference Books

1. Bird, R. B., Stewart, W. E., and Lightfoot, E. N., *Transport Phenomena,* 2nd Edition, Wiley, 2006.
2. Raj, B., *Introduction to Transport Phenomena,* PHI Learning, 2012.
3. Geankoplis, C. J., Transport *Processes and Unit Operations,* Prentice-Hall 1993.
4. Bennett, C.O., and Myers, J.E., *Momentum, Heat, and Mass Transfer,* 3rd Edition, McGraw-Hill, 1983.
5. Welty, J. R., Wicks, C. E., and Wilson, R. E., *"Fundamentals of Momentum, Heat, and Mass Transfer,* John Wiley and Sons, 1984.
6. William J. T., *Introduction to Transport Phenomena*, Prentice Hall 1999.

Web References:

Stanford/www.youtube.com
Gate Academy/www.youtube.com
NPTEL- Chemical Engineering
Chemical Engineering Guy/www.youtube.com
LearnChemE/www.youtube.com

DAV UNIVERSITY, JALANDHAR

Course Title: Process Engineering Design-I

Course Code: CHL404

L	T	P	Credits
4	0	0	4

Course Objectives: The students will
1. Study design safe process and design appropriate equipment like reactors, mass transfer heat transfer equipment, pipelines storage tanks etc.

2. Study relevant codes for design of chemical plant equipment as per the standard procedures specified by design code books

Learning Outcomes: After completion of this course students will be able to

- Determine the parameters of equipment design and important steps involved in design.
- Design pressure vessels.
- Mechanically Design different types of mass transfer equipment.

UNIT-A **12 HOURS**

Introduction

Introduction to principles involved in the design and construction of plant, design codes and standard Materials of construction
Mechanical properties of materials, corrosion resistance, commonly used material of construction

UNIT-B **12 HOURS**

Design preliminaries

Stresses and strain, elasticity, Hooke's law, factor of safety, Poisson's ratio, design pressure, design temperature, corrosion allowance, weld joint efficiency factor, design loadings, dilation of pressure vessels, criteria of failure.

UNIT-C **12 HOURS**

Storage Tanks

Thin cylindrical vessels subjected to internal pressure, circumferential and longitudinal stresses, thin spherical shells Introduction to Indian standards for storage tanks, fixed roof and open roof tanks

UNIT-D **12 HOURS**

Mechanical design

Mechanical design of tall vessels for distillation and absorption columns, design of supports for vertical and horizontal vessels, Flanges

Equipment Fabrication and Testing

Design of welded joints, types of welded joints and their specifications, post weld heat treatment, inspection and non-destructive testing of equipment

Recommended Books:

1. Bhattacharya B. C., *Chemical Equipment Design,* CBS Publisher, 2011.
2. Coulson, Richardson & Sinnott, R.K., *An Introduction to Chemical Engineering Design,* Chemical Engineering, Volume 6 , 4th Edition, Pergamon Press, 2007.
3. Joshi , M.V., *Process Equipment Design,* 3rd Edition, Macmillan India,2007.
4. Perry's, *Handbook of Chemical Engineering,* 7th Edition, McGraw Hill, 1997

Web References:

Stanford/www.youtube.com
Gate Academy/www.youtube.com
NPTEL- Chemical Engineering
Chemical Engineering Guy/www.youtube.com
LearnChemE/www.youtube.com

DAV UNIVERSITY, JALANDHAR

Course Title: Process Modeling & Simulation

Paper Code: CHL405A

L	T	P	Credits
3	0	0	3

Course Objective: The student will
1. Study the principles of model building and precautions
2. Learn the approach to solution by the method of shell balances and a review of continuity equation, energy equation, equation of motion, transport equation of state equilibrium and Kinetics.
3. Learn the classification of mathematical models

Learning outcomes: Upon completion of this course, the students will be able to:

- Analyze physical and chemical phenomena involved in various process.
- Develop mathematical models for various chemical processes.
- Use various simulation approaches.
- Simulate a process using excel.

UNIT-A **10 HOURS**

Introduction: Uses of mathematical models. Scope of coverage, Principles of formulations Fundamental Laws: Continuity equations, energy equations, equations of motion, Transport equations, equation of state, equilibrium, Chemical kinetics.

UNIT-B **10 HOURS**

Mathematical Models: Series of isothermal CSTR & constant hold-up CSTR's, CSTR's With variable hold ups two heated tanks, gas phase pressurized CSTR' Non isothermal CSTR & single component vaporizer, multicomponent flash drum, batch, reactor with Mass transfer.

UNIT –C **10 HOURS**

Mathematical Modeling of Mass Transfer and Heat transfer Processes: Ideal binary distillation column multi component non ideal distillation column, batch distillation with hold up, liquid extraction, absorption, adsorption, heat exchanger.

UNIT-D **10 HOURS**

Interacting and Non-Interacting Systems: Real CSTR modeled with and exchange volume Real CSTR modeled using by passing and dead space. Two CSTR's with interchange.

Reference Books:

1. Luyben W.L., *Process Modeling, Simulation and Control for Chemical Engineering,* McGraw-Hill, 1998.
2. Denn, M. M., *Process Modeling, Longman Sc & Tech*, 1987.
3. Himmelblau, D.M and Bischoff, K.B., *Process Analysis and Simulation: Deterministic Systems,* John Wiley, 1968.
4. Holland, C. D., *Fundamentals and Modeling of Separation Processes: Absorption, Distillation, Evaporation and Extraction,* Englewood Cliffs, Prentice-Hall, 1974.

Web References:

Stanford/www.youtube.com
Gate Academy/www.youtube.com
NPTEL- Chemical Engineering
Chemical Engineering Guy/www.youtube.com
LearnChemE/www.youtube.com

DAV UNIVERSITY, JALANDHAR

Course Title: Process Engineering Design II

Course Code: CHL407

L	T	P	Credits
4	0	0	4

Course Objectives: The students will study design safe process and design appropriate equipment like reactors, mass transfer heat transfer equipment, pipelines storage tanks etc.
Learning Outcomes: After completion of this course students will be able to

- Determine the parameters of equipment design and important steps involved in design.
- Different types of heat transfer equipment.
- Design different types of mass transfer equipment.

UNIT-A **10HOURS**

Process flow sheets, material and energy balance, flow sheet presentation, Manual flow sheet calculations.

UNIT-B **12HOURS**

Process design and specifications of double pipe heat exchanger, shell and tube heat exchanger, plate type heat exchanger, condensers, reboiler, evaporators and furnaces

UNIT-C **14HOURS**

Design of distillation column for binary mixtures using Mc-Cabe Thiele, Plate-to-Plate calculation methods for fractionators, design of batch fractionating columns, design of fractionators internals for sieve-tray**,** multicomponent distillation column design.

UNIT-D **12HOURS**

Absorber/Stripper design of stage-wise and continuous contact equipment (packed column), height of column and diameter calculation, design of various internals of absorber and stripper

Reference Books

1. Coulson, Richardson & Sinnott, R.K, Chemical Engineering, *An Introduction to Chemical Engineering Design,* 4the Edition, Volume 6 Pergamon Press, 2007.
2. Kern, D.Q., *Process Heat Transfer,* International Student Edition, McGraw Hill , 2002.
3. Ludwig E.E., *Applied Process Design in Chemical and Petrochemical Plants Vol I, II, III,* Gulf PublishingCo.,1995
4. Brownell, L.E. and Young, E.H., *Process Equipment Design,* Wiley Eastern India Limited, 1991.
5. Perry, R.H. and Green, D*, Chemical Engineer's Handbook,* 8th Edition, McGraw Hill, New York. 2008.
6. Seader, J. D., Henley, E.t6 J., *Separation Process Principles,* Wiley 2001.

DAV UNIVERSITY, JALANDHAR

Course Title: Process Modeling & Simulation Lab

Course Code: CHL425

L	T	P	Credits
0	0	2	1

LIST OF EXPERIMENTS

1. Model and simulate a gravity flow tank.
2. Simulate the non-isothermal CSTR
3. Simulate three CSTR's arranged in series.
4. Simulate ideal binary distillation column.
5. Model and simulate a batch reactor.
6. Simulate two interacting tank system in series.
7. Simulate two non-interacting tank system in series.
8. Simulate a heat exchanger.
9. Simulate a real CSTR modeled using by passing and dead space.

This is only the suggested list of practicals. Instructor may frame additional practicals relevant to the course

DAV UNIVERSITY, JALANDHAR

Course Title: Professional Communication

Course Code: ENG352

L	T	P	Credits
3	0	0	3

Course Objective: This paper, with a practice-oriented approach, aims to hone students' skills in the major dimensions of professional communication.

Learning Outcome: Students will show adequate understanding of professional communication skills.

Unit-1

- Professional Communication: Technical Communication and Business Communication
- Verbal and Non-Verbal Communication
- Barriers to Communication

(**N.B.** As the topics are largely theoretical, teacher shall introduce the topics in classroom in the form of lectures and encourage students to read on their own from the reference books. All these topics will be supported by examples from real life situations.)

Unit-2

- Reading Skills: Active & Passive Reading, Reading strategies, and Developing a Good Reading Speed
- Listening Skills: Types of Listening & Effective Listening Strategies
- Speaking Skills: Basics in Phonetics
- Writing Skills: Topic Sentence and Paragraph (descriptive, narrative, expository, and persuasive)

(**N.B.** Teacher will encourage students to apply the theoretical knowledge while practicing the four skills. Opportunities to practice the language skills should be created for students in the classroom.)

Unit-3

- Conversation: Formal and Informal
- Panel Discussion and Group Discussion
- Oral Presentation

(N.B. Teacher will give supporting examples from the industry and encourage students to do relevant exercises.)

Unit-4

- C.V. and Cover Letter

- Interview Skills
- Professional Letters
- Report Writing and Memo

(N.B. Teacher will give supporting examples from the industry and encourage students to do relevant exercises.)

Testing: The examinations will be conducted as per the norm of the university.

References:

1. Crystal, David. *The Gift of the Gab – How Eloquence Works*. Connecticut: Yale University, 2016. Print.
2. Gangal, J. K. *A Practical Course in Spoken English*. India: Phi Private Limited, 2012. Print.
3. Hosler, Mary Margaret. *English Made Easy*. Delhi: McGraw, 2013. Print.
4. Koneru, Aruna. *Professional Communication*. Delhi: McGraw, 2008. Print.
5. Mahanand, Anand. *English for Academic and Professional Skills*. Delhi: McGraw, 2013. Print.
6. Rani, D Sudha, TVS Reddy, D Ravi, and AS Jyotsna. *A Workbook on English Grammar and Composition*. Delhi: McGraw, 2016. Print.
7. Rizvi, M. Ashraf. *Effective Technical Communication*. Delhi: McGraw, 2018. Print.
8. Sharma, R.C. and Krishna Mohan. *Business Correspondence and Report Writing*. Delhi: McGraw, 2013. Print.
9. Suzana, Roopa. *A Practical Course in English Pronunciation*. Delhi: McGraw Hill Education, 2017. Print.
10. Tyagi, Kavita and Padma Misra. *Basic Technical Communication*. Delhi: PHI Learning, 2013. Print.

a. Websites

1. www.youtube.com (to watch standard videos)
2. http://learnenglish.britishcouncil.org/en
3. https://owl.english.purdue.edu/

DAV UNIVERSITY, JALANDHAR

Course Title: Process Engineering Economics

Course Code: CHL310

L	T	P	Credits
3	0	0	3

Course Objectives: The student will

1. Learn basics of Cost estimation, Working Capital and Capital Investment and understand the time value of money
2. Study depreciation methods and learn tax calculation methods
3. Learn the methods of estimation of profitability of an industry

Learning Outcomes: After completion of the course students are able to

- Perform and evaluate present worth, future worth and annual worth analyses on one of more economic alternatives.
- To perform and evaluate payback period and capitalized cost on one or more economic alternatives.
- To carry out and evaluate benefit/cost, life cycle and breakeven analyses on one or more economic alternatives.

UNIT-A **10 HOURS**

Cost Estimation

Cash flow for industrial operation, factors affecting investment and production costs, capital investment-fixed investments and working capital, Cost indices. Estimating equipment costs by scaling. Methods for estimating capital investment, Estimations of total product cost, Gross profit, net profit, and cash flow

UNIT-B **10 HOURS**

Interest

Simple and compound interest, nominal and effective rates of interest, continuous interest

Time value of money

Cost of capital, Income tax effects, loan payments, time value of money, discrete cash flow and continuous cash flow, compounding and discounting factors, ordinary annuity, perpetuities and capitalized costs.

UNIT-C **10 HOURS**

Taxes and Insurance

Type of taxes and tax returns, type of insurance and returns, types of insurance of legal responsibility

Depreciation

Types of depreciation, service life, salvage value, present value and methods of determining depreciation, single unit and group depreciation.

UNIT-D **10 HOURS**

Profitability Alternative investment and Replacements:

Methods for profitability evaluation, Determination of acceptable investment, Alternatives when an investment must be made and analysis with a small increment investment, replacement, methods of profitability evaluation for replacements

Optimum design:

Procedure with one variable optimum reflex ratio in distillation and other examples

BOOKS RECOMMENDED:

1. Peters, M.S. Timmerhaus, K.D, *Plant Design and Economics of Chemical Engineers,* 5th Edition , MC Graw Hill,New York, 2011 **.**
2. Desai, V., *Dynamics of Entrepreneurial Development & Management,* Himalaya Publishing House.
3. Schweyer, H. E., *Process Engineering Economics*, McGraw Hill, NY.
4. Gupta, C.B., Kanka, S.S., Entrepreneurship *& Small Business Management,* S Chand & Sons, 2007.
5. Ulrich G.D. *A Guide to chemical Engineering process Design and Economics,* John Wiley, 1984.

Web References:

NPTEL- Chemical Engineering

DAV UNIVERSITY, JALANDHAR

Course Title: Water Conservation and Management

Course Code: CHL350

L	T	P	Credits
3	0	0	3

Course Objectives:

The objective of the course is to enable the students to have an increased awareness among students on water conservation. The students will understand the water cycle, Identifying Water Sources, Quality Standards, Identifying and Reducing Water Pollution, water harvesting

Learning Outcomes: Upon completion of course

Students will learn about various resources of water, water flow measurement, conservation methods of water.

UNIT-A **10 Hours**

Water resources of India and their utilization, ground water and wells, water cycle, water storage, water conservation in homes; water conservation in the work place; water management-water quality, controlling use and quality of water

UNIT-B **10 Hours**

Water flow measurement: float method, current meter method, weirs and orifices, surface drainage of agriculture land, sub surface drainage, Water conveyance systems, open channel and underground pipeline, pipelines for water distribution, structure for pipelines,

UNIT-C **10 Hours**

Water quality and pollution, types and Sources of pollution**,** water quality modeling, environmental guidelines for water quality, minimizing evaporation, water sanitation, water audits

Water conservation in agriculture; water conservation in process industry; water conservation in construction industry, water conservation in service industry

UNIT-D **10 Hours**

Water Conservation and Recycling: Perspective on recycle and reuse, Waste water reclamation

Water Harvesting Household rooftop rainwater harvesting, Water collection and rainwater storage, Rainwater harvesting tank, rainwater harvesting systems, Simple point of use water purification systems, Community-level rainwater harvesting

References:

1. Mal B. C., introduction to Soul and water Conservation Engineering, Kalyani Publisher, first edition, 2011
2. Nakra, C.P., Farm machines and equipment, Dhanpat Rai Publishing Company, New Delhi, 2009.
3. Srivastava, A.C. and Primlari, R., Elements of Farm Machinary, Oxford & IBH Publishing Company, New Delhi, 2008.

DAV UNIVERSITY, JALANDHAR

Course Title: Sustainability Engineering

Course Code: CHL351

L	T	P	Credits
3	0	0	3

Course Objectives:

The objective of the course is to enable the students to have an increased awareness among students on issues in areas of sustainability, and to establish a clear understanding of the role and impact of various aspects of engineering and engineering decisions on environmental, societal and economic problems.

Learning Outcomes: Upon completion of course

- Students have an increased awareness on issues in the area of sustainability.
- Students get an understanding of the role engineering and technology with sustainability development.

UNIT-A **10 Hours**

Sustainability-Introduction, need and concept of sustainability, social-environmental and economic sustainability, nexus between technology and sustainable development, challenges for sustainable development multilateral environmental agreements and protocols- clean development mechanism (CDM), environmental legislations in India-Water Act, Air act

UNIT-B **10Hours**

Air Pollution, Effect of air pollution, water pollution-sources, sustainable waste water treatment, solid waste-sources, impact of solid wastes, zero waste concept, 3 R concept, Global environmental issues- resource degradation, climate change, global warming, ozone layer depletion, regional and local environmental issues. Carbon credit and carbon trading foot print.

UNIT –C **10 Hours**

Environmental management standards, ISO 14000 series, life cycle analysis (LCA)-scope and goal, Bio-mimicking, environment Impact assessment (EIA)-procedures of EIA in India

UNIT –D **10 Hours**

Energy Sources: basic concepts-conventional and non-conventional, solar energy, fuel cells, wind energy, small hydro-plants, bio-fuels, energy derived from oceans, geothermal energy

Green Engineering, sustainable urbanization, industrialization and poverty reduction, social and technological change, industrial processes, material selection, pollution prevention, industrial ecology, industrial symbiosis

References:

1. Allen, D. T. and Shonnard, D. R., Sustainability Engineering: Concept, Design and Case Studies, Prentice Hall.
2. Environmental Impact Assesment Guidelines, Notification of Government of India, 2006.
3. Peavy H. S., Rowe D. R., Tchobanoglous G., “Environmental Engineering”, McGraw Hill Book Company, International Edition, (1985).

DAV UNIVERSITY, JALANDHAR

Course Title: Alternate Energy Technology

Paper Code: CHL457A

L	T	P	Credits
4	0	0	4

Course Objective: The students will study the non-conventional sources of energy which has higher priority with reference to national needs. It deals with the different non-conventional energy systems such as solar energy, wind energy, energy from biomass and biogas, geothermal energy, energy from oceans, chemical energy sources.

Learning Outcomes: After successfully completing this course student should be able to:
Know various sources of non-conventional energy sources- solar, wind, geothermal.

Unit-A **14 HOURS**

Introduction: Energy, Present and future trends of energy consumption, Resources in India and worldwide, Introduction to different non-conventional energy sources.
Solar energy: Solar radiation and its measurement, Limitation in application of solar energy, Solar collectors types and constructional details, Solar water heating, Application of solar energy for residential and industrial heating, Drying, Space cooling, Water desalination, solar pond, solar distillation, solar refrigeration, Photovoltaic power generation using silicon cells.

UNIT-B **12 HOURS**

Bio-Fuels: Importance, Combustion, Pyrolysis and other thermo chemical processes for biomass utilization performance analysis, Alcoholic fermentation, anaerobic digestion for biogas production
Wind Power: Principle of energy from wind, Windmill construction, Operational details, Electricity generation and Mechanical power production.

UNIT-C **12 HOURS**

Tidal Power: Introduction, Causes of tides and their energy potential, Enhancement of tides, Power generation from tides and problems, Principles of ocean thermal energy conversion (OTEC) analysis.
Geothermal Energy: Geo thermal wells and other resources dry rock and hot aquifer analysis, harnessing geothermal energy resources.

UNIT-D **10HOURS**

Nuclear Fuels:

Introduction, resources in India, nuclear reactors: classification, materials used in nuclear power reactors. Radioactive radiation hazards

Reference Books:

1. Rai, G.D., *Non-Conventional Energy Sources*, Khanna Publishers ,2001.
2. Twiddle, J. Weir, T., *Renewable Energy Resources,* Cambridge University Press, 1986.
3. Duffie, J. A., Beckman, W. A., *Solar Engineering of Thermal Processes,* John Wiley, 1980.
4. Sukhatme, S. P., *Solar Energy: Principles of Thermal Collection and Storage,* Tata McGraw-Hill, 2001.
5. Garg, H.P. and Prakash, J., *Solar Energy: Fundamentals and Applications*, Tata McGraw-Hill .2001.

DAV UNIVERSITY, JALANDHAR

Course Title: Electrochemical Technology

Course Code:CHL447

L	T	P	Credits
4	0	0	4

Course Objectives: Students will learn about the Electrochemistry and its industrial applications.

Learning Outcomes: After successfully completing this course student should be able to:

- Define and explain the concepts of Electrical Potential, Electrical Field, Electrostatic Work, Voltage, Current, Electrochemical Potential, Activation Energy, Electrode & Electrochemical Equilibrium.
- Formulate and calculate relevant transport phenomena such as migration and the characteristics of (diluted) electrolytes. Relate the conversion of matter to the transport of electrical charge.
- Apply knowledge of electrokinetic phenomena to design microfluidic unit operations.
- Use of technical measures to characterize properties of galvanic elements and capacitors.
- Demonstrate fundamental knowledge of major industrial electrochemical processes and electrochemical reactor design including economic and environmental considerations.

Unit-A **12 Hour**

Introduction: Electrochemistry basics; Thermodynamics of ideally polarizable and non-polarizable interfaces. Electrochemical cells; reversible and irreversible cells, EMF

Electrode kinetics: Equilibrium potential, Nernst equation, overpotential and its different types. Equilibrium exchange current density; Butler-Volmer equation; high field and low field approximations; charge transfer resistance and polarizability of the interface. Rate determining step, stoichiometric number, reaction order. Determination of kinetic parameters

Unit-B **12 Hour**

Electro-analytical techniques: Potentiometry and amperometry. Linear sweep voltammetry and cyclic voltammetry. Analysis of cyclic voltammograms. Potential steps under mass transfer control; Cottrell equation for a planar and spherical electrode. Faradaic impedance

Unit-C **12 Hour**

Electrodes and electrolytic membranes: Electrodes for the electrochemical reactors. Preparation, characteristics and applications of graphite, magnetite, lead dioxide coated anodes, noble metal coated anodes, noble metal oxide coated anodes, steel cathodes, coated cathodes, diaphragms and ion exchange membranes.

Unit-D **12 Hour**

Industrial applications: Chlor alkali industry. Manufacture of potassium and ammonium persulphates, hydrogen peroxide, potassium permanganate. Production of hydrogen by water electrolysis. Electrodialysis and electrochemical incineration. Batteries and fuel cells. Electrometallurgy

Recommended Books:

1. Bockris, J.O.M., & Reddy, A.K.N., *Modern Electrochemistry, Vol.1 & 2*, Plenum, New York 1970.
2. Hartmut Wendt, & Gerhard Kreysa, *Electrochemical Engineering: Science and Technology in Chemical and Other Industries*, Springer, 1999.
3. Linden, D. and Reddy T. B. , *Hand Book on Batteries and Fuel Cell*, McGraw Hill Book Co., 2002

DAV UNIVERSITY, JALANDHAR

Course Title: Optimization Techniques

Course Code: CHL446

L	T	P	Credits
4	0	0	4

Course Objectives: Students will learn about the basic concepts of optimization techniques and to use them for optimum utilization of resources.

Learning outcomes: upon completion of this course, the students will be able to:

- Formulate the objective functions for constrained and unconstrained optimization problems.
- Use different optimization strategies.
- Solve problems using non-traditional optimization techniques.
- Use of different optimization techniques for problem solving.

UNIT– A **10 Hour**

Introduction:

Origin of Operational Research (OR) and its role in solving industrial problems, General approach for solving OR problems

Linear Programming:

Formulation of linear mathematical models: Graphical and simplex techniques for solution of linear programming problems, Big M method and two phase method, Introduction to duality theory and sensitivity analysis.

UNIT – B **12Hour**

Transportation and Assignment Models:

Various initial basic feasible solutions methods, Optimization of transportation and assignment using different methods considering the concept of time and cost function

Dynamic Programming:

Introduction to deterministic and probabilistic dynamic programming

UNIT – C **12 Hour**

Network models:

Shortest route and traveling sales - man problems, PERT &CPM introduction, analysis of time bound project situations, construction of networks, identification of critical path, slack and float.

UNIT – D **14 Hour**

Replacement Models: Replacement of items that deteriorate, Replacement of items whose maintenance and repair costs increase with time, replacement of items that fail suddenly;

replacement of items whose maintenance costs increase with time and value of money also changes, individual replacement policy, group replacement policy.

Optimization Techniques: Introduction, Theory and algorithms, classical method, non-linear optimization-Unconstrained optimization, constrained optimization: Langrangian multiplier method.

References:

1. Swarup K, Gupta P. K., "Operations Research", 18th Edition, Jain Book Agency, 2015.
2. Gupta P. K., Hira D.S., "Operations Research", S. Chand & Co, 2013.
3. Hillier, F.S. and G.J. Lieberman, G. J., "Introduction to Operation Research", 8th edition, Mc Graw Hills, 2005.

DAV UNIVERSITY, JALANDHAR

Course Title: Biochemical Engineering

Course Code: CHL451A

L	T	P	Credits
4	0	0	4

Course Objectives: The students will
1. Study introduction to the application of chemical engineering principles in biochemical systems.
2. Be enabled to understand the biological systems and kinetics of enzymatic reactions.
3. Learn the kinetics of growth of microorganisms, hence be able to control the process

Learning outcomes: upon completion of course students are able to apply kinetics of enzymatic reactions and can design bioreactors

UNIT-A **14 HOURS**

Introduction

Bioprocess engineering and technology. Role of a Chemical engineer in bioprocess industry. An introduction to basic biological sciences. Microbiology: Structure of cells: Prokaryotes and Eukaryotes. Classification of micro-organisms, Taxonomy, Whitaker's 5-kingdom concept. Characteristics and control of microorganisms. Environmental and Industrial microbiology

Biochemistry: Chemicals of Life: Lipids, Sugars, Polysaccharides, Amino acids and proteins, Vitamins, Biopolymers, Nucleic Acids: RNA, DNA and their derivatives (Structure, Biological function and Importance for life only to be studied).

UNIT-B **14 HOURS**

Enzymes and Proteins: Detailed structure of proteins and enzymes: Primary, Secondary, Tertiary and quaternary, functions, Production and purification of Enzymes (Methods only).Nomenclature and Classification of enzymes, Mechanism and Kinetics using various models.Kinetics of Enzyme action: Michaelis–Menten rate equation. Derivation with Equilibrium and Pseudo- (quasi-) steady state approximations, Experimental determination of rate parameters: Batch and continuous flow experiments.

UNIT-C **12 HOURS**

Enzyme Inhibition: Effect of Inhibitors (Competitive, noncompetitive, uncompetitive, substrate and product inhibitions), Temperature and pH on the rates enzyme catalyzed reactions.

Fermentation Technology: Ideal reactors: A review of Batch and Continuous flow reactors for bio kinetic measurements. Microbiological reactors: Operation and maintenance of typical aseptic aerobic fermentation processes. Formulation of medium: Sources of nutrients. Alternate

bioreactor configurations, Introduction to sterilization of bioprocess equipment, Design of batch & continuous sterilization equipment

UNIT-D **12 HOURS**

Growth Kinetics of Microorganisms: Transient growth kinetics (Different phases of batch cultivation). Quantification of growth kinetics: Substrate limited growth, Models with growth inhibitors, Logistic equation, Filamentous cell growth model. Continuous culture: Optimum Dilution rate, Critical Dilution rate in Ideal Chemostat, Introduction to Fed-batch reactors. Strategies and Steps involved in product purification.

Reference Books:

1. Bailey and Ollis, *Biochemical Engineering Fundamentals*, 2nd Edition, McGraw Hill, 1986.
2. Shuler, M. L. and Kargi, F., *Bioprocess Engineering,* 2nd Edition, Prentice Hall, 2002.
3. Pelczer, *Microbiology Concept and Application,* 5th Edition, McGraw Hill, 2001 Reprint.
4. Stanbury and Whittaker, *Principles of Fermentation Technology*, 2nd Edition.

DAV UNIVERSITY, JALANDHAR

Course Title: Membrane Separation

Course Code: CHL452A

L	T	P	Credits
4	0	0	4

Course Objective: The student will learn different membrane separation technological processes and their design.

Learning outcomes: The students will be able to:

- understand the principles and materials properties for different membrane separation processes
- Identify the best membrane modules and manufacturing process for different applications
- Identify and design the suitable membrane separation technique for intended problem

UNIT-A **12 HOURS**

Fundamental, mechanisms of membrane transport. Gaseous diffusion, Membrane, osmosis and reverse osmosis, porosity, permeability, salt rejection, different membrane processes.

UNIT-B **12 HOURS**

Physical and chemical properties of membranes, cellulosic and non-cellulosic membrane

UNIT-C **12 HOURS**

Techniques of membrane formation, membrane characteristics, type of membrane modules, liquid membranes.

UNIT-D **12 HOURS**

Separation processes: Design, operation, maintenance and industrial applications of different membrane separation processes such as Reverse Osmosis, Ultra filtration, Electro Dialysis, nanofiltration pervaporation dialysis.

Reference Books:

1. Wilson, Sirkar, *Membrane Handbook,* McGraw Hill, London, 2001.
2. Nune, Peinemann, *Membrane Technology in Chemical Industries,* Wiley, New York, 2000.
3. Cheryan M., *Ultra filtration Handbook,* Technomic, New York, 1985.
4. Noble, Stern, *Membrane Separation and Technology, Principles and Applications,* Elsevier, 1995.
5. Baker R. W., *Membrane Technology and Applications,* Wiley, New York, 2000.

DAV UNIVERSITY, JALANDHAR

Course Title: Polymer Processing

Course Code: CHL453A

L	T	P	Credits
4	0	0	4

Course Objectives: The student will learn about the different classification of polymer and rubbers and their strength properties

Learning outcomes: upon completion of course students will learn the following

- Classification of polymers, identification of their physical properties and establishing structure-property relations.
- Formulation of polymeric compounds to meet specific product properties.
- Knowledge of polymer processing operations, polymerization kinetics and choice of operation depending on the material and final product requirements.
- Identification of methods for rheological measurements and analysis of the results.

UNIT-A **12 HOURS**

Definition, types of polymers, functionality, polymerization reactions, polycondensation. Addition-free radical and chain polymerization. Co-polymerization kinetics of radical chain and tonic polymerization. Gelation phenomena.

UNIT-B **12 HOURS**

Molecular weight estimation: Average molecular weight, number average and weight average molecular weight. polydispersity, degree of polymerization. Methods of determination of molecular weight.

Polymerization Processes: Bulk, solution, suspension and emulsion polymerization. Thermoplastic composites, fiber reinforcement fillers.

UNIT-C **12 HOURS**

Polymer Processing: Thermoforming, injection moulding, extrusion moulding, calendaring rotational casting, film casting, blow moulding, foaming' Fiber spinning wet dry and melt.

UNIT-D **12 HOURS**

Polymerization Kinetics

Chemistry of step reaction polymerization, Mechanism and kinetics of poly condensation reactions, Relationship between average functionality, extent of reaction and degree of polymerisation. Mechanism and kinetics of free- radical chain polymerization, kinetic chain length, chain transfer reactions, Inhibition and retardation

Refrence Books :

1. Gowarikar, V.R., Viswanathan, Sreedhar, J., *Polymer science*, Wiley eastern Limited,1993.
2. Ghosh, P., *Polymer Science and Technology: Plastics, Rubber, Blends and Composites* ,McGrraw Hill, 2010.
3. Billmeyer, F. W., *Textbook of polymer science,* John Wiley, 1984.

DAV UNIVERSITY, JALANDHAR

Course Title: Fertilizer Technology

Course Code: CHL454A

L	T	P	Credits
4	0	0	4

Objective: The main objective of this courts is to study the various manufacturing processes, uses and application of different fertilizer.

Learning outcomes: upon completion of course students will be able to

- Use reactions and unit operations steps in manufacturing of various fertilizers
- Characterize fertilizers on the basis of different properties.
- Identify engineering problems in fertilizer manufacturing.
- Handle the fertilizers.
- Select appropriate synthesis fertilizer.

UNIT-A **12 HOURS**

Micro and macro nutrients fertilizer grades, different types of fertilizer, fertilizer storage and handling. Nitrogenous fertilizers

Synthesis gas: various feed stocks, merits/demerits. Synthesis gas production by stem reforming and partial oxidation, purification methods, shift convertors, carbon dioxide removal systems, final gas purification

UNIT-B **12 HOURS**

Ammonia synthesis: Different types of reactors, their design considerations and operations. Urea: Physiochemical consideration. Various processes: Calcium ammonium nitrate sulphate, methods of production.

UNIT-C **12 HOURS**

Phosphatic fertilizer: Raw materials, triple super phosphate, phosphoric acid, processes of manufacture and their limitations.

UNIT-D **12 HOURS**

Potash fertilizer: Methods of production of potassium chloride and potassium sulphate. Complex NPK fertilizer: mono and di ammonium phosphates, urea ammonium phosphate, mixed fertilizer, granulation techniques.

Reference Books:

1. A.V. Slack, *Chemistry and Technology of fertilizer*, Interscience Publishers, 1966.
2. Dryden C. E., *Outlines of Chemical Technology*, 2nd Edition, East–West Press Pvt. Ltd., New Delhi, 1999.
3. Austin G. T., *Shreve's Chemical Process Industries,* 5th Edition, McGraw Hill Book Company, New Delhi, 2012

DAV UNIVERSITY, JALANDHAR

Course Title: Petrochemical Technology

Course Code: CHL455A

L	T	P	Credits
4	0	0	4

Course Objective: The students will study about the petroleum industries and the operations that is carried out in them.

Learning outcomes: Upon completion of this course, the students will be able to:

- Select the appropriate characterization parameters.
- Specify the properties of petroleum products.
- Attain knowledge of various separation & conversion processes involved in petroleum refining.
- Attain knowledge of manufacturing of various petrochemical products.

UNIT –A **10 HOURS**

An overview

Introduction to petroleum industry, world petroleum resources, petroleum industry in India, Origin, exploration & drilling of petroleum crude, Transportation of crude and products, Sources of petrochemicals-Natural gas and petroleum, classification of petrochemicals

UNIT –B **14 HOURS**

Crude pretreatment: Refining and distillation of petroleum crude, composition and classification of petroleum crude, methods of evaluation: ASTM, TBP and EFV distillation. Properties and specifications of petroleum products such as LPG, gasoline, naphtha, kerosene, diesel, lubricating oils and waxes

UNIT –C **12HOURS**

Separation Processes: Design and operation of topping and vacuum distillation units and tube still furnaces. Solvent extraction processes for lube oil base stock and for aromatics from naphtha and kerosene steams, solvent dewaxing.

UNIT –D **12 HOURS**

Conversion Processes: Thermal cracking: visbreaking and coking processes, catalytic cracking, thermal reforming and catalytic reforming, alkylation, polymerization, isomerization and hydroprocessing, Safety and pollution considerations in refineries.

References Books:

1. Rao, B.K., *Modern Petroleum Refining Processes*, 5th Edition, Oxford & IBH Publishing Co., 2009.
2. Nelson, *Petroleum Refinery Engineering,* 4th Edition, McGraw Hill, 1987.
3. Guthrie, V. B., *Petroleum Products Handbook,* McGraw Hill, 1960.

DAV UNIVERSITY, JALANDHAR

Course Title: Corrosion Engineering

Course Code: CHL456A

L	T	P	Credits
4	0	0	4

Course Objective: The main objective of this course is to study the different types of corrosion and their prevention methods.

Learning Outcomes: Upon completion of course students are able to understand the causes of and the mechanisms of various types of corrosion, including uniform corrosion, galvanic corrosion, crevice corrosion, pitting corrosion, intergranular corrosion and various modes of environmentally assisted cracking

UNIT –A **12HOURS**

Basic concepts: Definition and importance, electrochemical nature and forms of corrosion, Corrosion rate and its determination.

Electrochemical thermodynamics and kinetics: Electrode potentials, Potential-pH (Pourbiax) diagrams, Reference electrodes and experimental measurements, Faraday's laws, electrochemical polarization, mixed potential theory, Experimental polarization curves, Instrumentation and experimental procedure.

UNIT –B **12HOURS**

Galvanic and concentration cell corrosion: Basic concepts, Experimental measurements, and determination of rates of galvanic corrosion, Concentration cells.

Corrosion measurement through polarization techniques: Tafel extrapolation plots, Polarization resistance method, Instrumental methods and Errors in measurement of polarization resistance, Commercial corrosion probes, other methods of determining polarization curves.

UNIT –C **12HOURS**

Passivity: Basic concepts of passivity, Properties of passive films, Experimental measurement, Applications of Potentiostatic Anodic Polarization, Anodic protection.

Pitting and crevice corrosion: Basic concepts, Mechanisms of pitting and crevice corrosion, Secondary forms of crevice corrosion, Localized pitting, Metallurgical features and corrosion: Inter-granular corrosion, Weldment corrosion, De-alloying and dezincification.

Environmental induced cracking: Stress corrosion cracking, Corrosion fatigue cracking, Hydrogen induced cracking, some case studies, Methods of prevention and testing, Erosion, Fretting and Wear.

UNIT–D **12HOURS**

Environmental factors and corrosion: Corrosion in water and Aaqueous Ssolutions, Corrosion in sulphur bearing solutions, microbiologically induced corrosion, Corrosion in soil, Corrosion of concrete, Corrosion in acidic and alkaline process streams.

Atmospheric and elevated temperature corrosion: Atmospheric corrosion and its prevention, Oxidation at elevated temperatures, Alloying, Oxidising environments.

Prevention and control of corrosion: Cathodic protection, Coatings and inhibitors, Material selection and design.

References Books:

1. Fontana, M.G., *Corrosion Engineering,* Tata McGraw-Hill , 2005.
2. Jones, D.A., *Principal and Protection of Corrosion,* Prentice-Hall ,1995.
3. Pierre R. Roberge, *Corrosion engineering: principles and practice,* McGraw-Hill , 2008.
4. Mantell, C.L., *Electrochemical Engineering*, McGraw-Hill, New York, 1960.
5. Sastri, V.S., Ghali, E. and Elboujdaïni, M.,*Corrosion prevention and protection: practical solutions*, John Wiley and Sons, 2007

DAV UNIVERSITY, JALANDHAR

Course Title: Paint Technology

Paper Code: CHL459

L	T	P	Credits
4	0	0	4

Course Objectives: The student will learn basics of paint manufacturing process, Paint applications, Quality control of paints Safety and Hazards in paint industry.

Learning outcomes: Upon completion of the course students will understand

- The basic ingredients required for paint formulation.
- The various factors to affect the stability of the paint.
- Decide the dosage of various additives in coating formulation.

UNIT-A **12 HOURS**

Introduction: Paints and their general ingredients, function of ingredients and classification of paints. Decorative and industrial coating: latest types of surface coating and their advantages. Raw materials of Paints like drying oil boiled oils, natural and synthetic resins. Extends and prime pigments and additives, Varnishes and Lacquers: Classification of varnishes and lacquers. Formulation and manufacture of varnishes and lacquers

UNIT-B **12 HOURS**

Paint Manufacturing: Formulation and manufacture of paints and machinery used in paint manufacture.

Paint Applications: Surface Preparation Selection of industrial paints for different end uses. Practical aspects for use & application of paints. Type of surfaces and paint, application techniques for large surfaces.

UNIT-C **12 HOURS**

Surface preparation and treatments: Surface Preparation: (a) Mechanical - Hard cleaning, power tool cleaning, flame cleaning, Blast cleaning, cleaning & welds (b) Chemical - Solvent wiping & degreasing, alkali cleaning emulsification. Application techniques: Paint application techniques. Paint defects: Classification, causes & remedies

UNIT-D **12 HOURS**

Quality control of paints, various tests of paints, Quality control and management of paints, Safety and Hazards: Safety practices and devices used in paint industries. Health hazards and prevention in paint industries, Case studies.

Reference Books:

1. Morgan W.M., *Outlines of Paint Technology.*, 3rd ed, CBS Publishers & Distributors, 2003
2. Paul S., *Surface coating*, 2nd ed., John Wiley & Sons Ltd, 1996
3. Dryden C. E., *Outlines of Chemical Technology*, 2nd Edition, East–West Press Pvt. Ltd., New Delhi, 1999.
4. Austin G. T., *Shreve's Chemical Process Industries*, 5th Edition, McGraw Hill Book Company, New Delhi, 201

DAV UNIVERSITY, JALANDHAR

Course Title: Advanced Separation Process

Paper Code: CHL460

L	T	P	Credits
4	0	0	4

Course Objectives: The student will learn new techniques of separation, possible cases of industrial application, estimation of separation coefficient.

Learning Outcomes: After completion of the course students are able to

- Apply modern separation techniques in various applications
- Analyze and design novel membranes for intended application
- Analyze and design pervaporation, chromatography and dialysis based separation processes

Unit-A: **12 hours**

Introduction: Review of conventional processes, recent advances in separation techniques based on size, surface properties, ionic properties and other special characteristics of substances, Process concept, Theory and equipment used in cross flow filtration, cross flow electro filtration, dual functional filter, Surface based solid - liquid separations involving a second liquid

Unit-B: **12 hours**

Membrane Separation: Principle of membrane separations process; Classification, characterization and preparation of membrane. Types and choice of membranes, Plate and frame, tubular, spiral wound and hollow fiber membrane reactors and their relative merits, Commercial, pilot plant and laboratory membranes permeators involving dialysis, reverse osmosis, Nan filtration, ultra filtration, Microfiltration and Donnan dialysis, Economics of membrane operations, Ceramic membranes.

Unit -C: **10 hours**

Separation By Adsorption Techniques: Mechanism, Types and choice of adsorbents, Normal adsorption techniques, Affinity chromatography and immune chromatography. Types of equipment and commercial processes, recent advances and process economics

Unit -D: **12 hours**

Ionic Separations: Controlling factors, Applications, Types of equipment employed for electrophoresis, Di-electrophoresis, Ion exchange chromatography and electro dialysis, Commercial Processes.

Other Techniques: Separations involving lyophilisation, Pre evaporation and permeation techniques for solids, liquids and gases. Industrial viability and examples, Zone melting, Adductive crystallization, Supercritical fluid extraction, Oil spill Management.

Reference Books:

1. Seader, J.D, and Henley E.J., "*Separation Process Principles*", John Wiley & Sons, Inc., 3rd edition, 2013.
2. King, C.J. "Separation Processes", Tata McGraw-Hill Publishing Co., Ltd., 2nd edition, 2013.
3. McCabe,W.L, Smith J .C. and Harriott P , *Unit operations of chemical Engineering*, McGraw-HILL, 7th edition,2005.

4. Ronald W.Roussel - " Handbook of Separation Process Technology ", John Wiley,New York, 1st edition 1987.

DAV UNIVERSITY, JALANDHAR

Course Title: Application of Nano Technology in Chemical Engineering

Paper Code: CHL461

L	T	P	Credits
4	0	0	4

Course Objectives: The students will study

1. Applied thermodynamic principles
2. Various methods of producing nanomaterials
3. Methods of analysis
4. Nanolithography and nano manipulation

Learning outcomes: Upon completion of course the students are able to understand various method of producing nanomaterial.

Unit-A **12HOURS**

Overview to Thermodynamics: The first and second laws of thermodynamics. Thermodynamic functions, heat capacity, enthalpy, entropy. Phase equilibrium in one component system, real gases, the interactions between gases. Ehrenfest classification of phase transition, the physical liquid surface; surface tension, curved surfaces, capillary action. Theory of Solution and related topics: Liquid mixtures: free energy as a function of composition, ideal solutions and excess functions. Equilibrium Electrochemistry; electrochemical cells, Methods for calculation of thermodynamic equilibrium. Electrochemical processes.

Unit –B **12HOURS**

Fabrication of Nanomaterials by Physical Methods: -Inert gas condensation, Arc discharge, RF plasma, Plasma arc technique, Ion sputtering, Laser ablation, Laser pyrolysis, Ball Milling, Molecular beam epitaxy, Chemical vapour deposition method and Electro deposition.

Unit-C **12HOURS**

Scanning Electron Microscopy (SEM), Scanning Probe Microscopy (SPM), TEM and EDAX analysis, X-ray diffraction. Optical Microscope and their description, operational principle and application for analysis of nanomaterials, UV-VIS-IR Spectrophotometers, Principle of operation and application for band gap measurement.

Unit-D **12HOURS**

Nanolithography and nanomanipulation, Ebeam lithography and SEM based nanolithography and nanomanipulation, Ion beam lithography, oxidation and metallization. Mask and its application. Deep UV lithography, X-ray based lithography.

Reference Books:

1. Mark James Jackson, " **Microfabrication and Nanomanufacturing**", CRC Press, 2005
2. Principe, E. L., Gnauck, P. and Hoffrogge, P., "**A Three Beam Approach to TEM Preparation Using In-situ Low Voltage Argon Ion Final Milling in a FIB-SEM Instrument Microscopy and Microanalysis,**" Cambridge University Press, 2005.
3. Shaw, L.L., "**Processing & properties of structural nano materials**", John Wiley and Sons, 2010.

4. Narayanan, K.V., "**Textbook of Chemical Engineering Thermodynamics**"**,** Prentice Hall of India Private Limited, New Delhi, 2001.

DAV UNIVERSITY, JALANDHAR

Course Title: Industrial pollution control

Course Code: CHL801

L	T	P	Credits
4	0	0	4

Course Objectives: The main objective of this course is to understand the various types of industrial pollution and their control methods

Learning outcomes: The students will be able to:

- Quantify and analyze the pollution load.
- Analyze/design of suitable treatment for wastewater
- Model the atmospheric dispersion of air pollutants.
- Selection and design of air pollution control devices.
- Analyze the characteristics of solid waste and its handling & management..

UNIT-A **10 Hours**

Introduction: Pollution due to industries with special reference to chemical process industries.

Wastewater characterization: Solids analysis of wastewater, Physical characteristics of wastewater, Chemical characteristics of wastewater; inorganic pollutants, organic pollutants; their harmful effects. Wastewater discharge standards and regulations.

UNIT-B **12 Hours**

Wastewater treatment: Primary treatment of wastewater; Flow equalization, Primary clarifiers, construction and working. Secondary treatment of wastewater; biological treatment methods; aerobic suspended growth processes, attached growth processes. Working of aerobic lagoons, activated sludge process, trickling filters, Wastewater treatment by adsorption, membrane separation

UNIT-C **14 Hours**

Air pollutants: Natural and anthropogenic sources of air pollutants such as particulates, oxides of sulphur, oxides of nitrogen, carbon monoxide, hydrocarbons etc. Secondary air pollutants. Environmental impacts of air pollutants. Ambient and emission standards for air pollutants

Meteorological factors in Air pollution: Atmospheric turbulence. Lapse rate and atmospheric stability, Wind velocity and distribution, wind rose diagram, Plume behavior

UNIT-D **12 Hours**

Air pollution control: Air pollution control devices; settling chambers, cyclone separators, bag filters, electrostatic precipitators; construction and working. Control of gaseous pollutants.

Solid waste management: Biochemical treatment, Thermochemical treatment, landfilling

References:

1. Metcalf & Eddy, *Wastewater Engg. Treatment, Disposal, Reuse*; Tata McGraw Hill

2. Dhameja, S. K . *Environmental Science*, S. K. Kataria & Sons, 2010.
3. Rao , C.S, *Environmental Pollution Control Engineering,* New Age Publication,3rd Edition ,2013.
4. Rao M. N., Rao H. V. N., *Air Pollution,"*Tata McGraw Hill Publishing Company Ltd.,2005.

DAV UNIVERSITY, JALANDHAR

Title: Fuel Cell Technology

Course Code: CHL802

L	T	P	Credits
4	0	0	4

Course Objectives: The course is aimed at providing the information about fuel cells, their types, fundamentals, technology and the problems associated with fuel cell technology.

Learning outcomes: Upon completion of the course the students are able to gain an advanced understanding of fuel cells, the various types available and how they work and have an advanced knowledge on different fuels, how they are produced and the impact they have on the environment.

UNIT-A **10 Hours**

Introduction:

Fuel Cell definition and basics- cathode, anode, electrolyte, Difference between a fuel cell and a battery, Advantages and disadvantages, Basic fuel cell operation

UNIT-B **14 Hours**

Fuel Cell Fundamentals Relationship between Gibb's free energy and electric work/ electric voltage, Reversible Voltage/ potential of fuel cell using standard electrode potentials, Effect of temperature and pressure on fuel cell potential, Nernst equation, Fuel cell efficiency, concept of OCV Current density, Losses in fuel cell- activation loss, ohmic loss and concentration loss,

UNIT-C **14 Hours**

Fuel cell performance curve 1-D model for a fuel cell, application of model to SOFC and PEMFC Types of Fuel Cells Construction, fuels and usage of Phosphoric Acid Fuel Cell, Polymer Electrolyte Membrane Fuel Cell, Alkaline fuel cell, Molten Carbonate Fuel Cell, Solid Oxide Fuel cell Relative advantages and disadvantages of the various types of fuel cells

UNIT-D **10 Hours**

Fuel Cell Systems Fuel cell stack, engineering issues related to Fuel Cell Technology Hydrogen as a fuel, availability and engineering issues

References:

1. Hayre R.O., Cha S., Colella W., Prinz F. B., *Fuel Cell Fundamentals*, John Wiley and Sons, 2006
2. Berger E. D., *Handbook of Fuel Cell Technology*, Prentice-Hall, 1968
3. Vielstich W., Lamm A., Gasteiger H. A., *Handbook of Fuel Cells*, Vol. 2, Wiley, 2003

DAV UNIVERSITY, JALANDHAR

Course Title: Environmental Engineering

Course Code: CHL308

L	T	P	Credits
4	0	0	4

Course Objectives: The main objective of this course is to understand the various types of industrial pollution and their control methods

Learning outcomes: Upon completion of the course the students are able to gain the knowledge of various types of pollution and their control actions. The students will also gain the knowledge of solid waste, biomedical and hazardous waste management.

UNIT-A **12HOURS**

Air Pollution Control Engineering

Introduction, Definition, Sources, Characteristics and Perspective of Air Pollutants, Effects of Air Pollution on Biodiversity, Economic Effects of Air Pollution, Air Quality and Emission Standards, Engineering Systems of Control of Air Pollution by Equipment and by Process Changes.

UNIT-B **14HOURS**

Water Pollution Control Engineering

Introduction, Definition, Sources, Characteristics and Perspective of Water and Wastewater Pollutants, Effects of Water Pollution on Biodiversity, Economic Effects of Water Pollution, Water Quality and Emission Standards, Physical, Chemical and Biological Parameters(BOD and COD). Waste water sampling and analysis,Waste water treatment techniques, primary treatment involving removal of suspended particles through flocculation, settling, skimming and friction. Secondary treatment: biological treatment, aerobic and anaerobic digestion, activated sludge processes, trickling filters and oxidation periods and Advance Treatment.

UNIT-C **10 HOURS**

Solid Waste Management

Introduction, Definition, Sources, Characteristics and Perspective of Solid Waste, Generation, Separation, Handling, Storage and Transportation of Solid Waste, Chemical and Biological Treatment of Solid Waste

UNIT-D **12HOURS**

Biomedical and Hazardous Waste Management

Introduction, Definition, Sources, Characteristics and Perspective of Biomedical and Hazardous Waste, Handling, Storage, Transportation of Biomedical and Hazardous Waste, Physical, Chemical and Biological Treatment of Biomedical and Hazardous Wastes

Recommended Books:

1. Rao , C.S, *Environmental Pollution Control Engineering*,New Age Publication,3rd Edition , 2013.
2. Rao M. N., Rao H. V. N*., Air Pollution,* Tata McGraw Hill Publishing Company Ltd.,2005.
3. Dhameja, S. K. *Environmental Science,* S. K. Kataria& Sons, 2010.
4. Metcalf and Eddy, Inc., *Wastewater Engineering-Treatment and Reuse,* Tata McGraw Hill Publishing Company Ltd., Fourth Edition, 2004.
5. Rittmann BE., McCarty P. L., *Environmental Biotechnology: Principles and Application,* McGraw Hill International Editions, First Edition, 2001.
6. Kiely G., *Environmental Engineering,* Tata McGraw Hill, Special Indian Edition, 2007.

DAV UNIVERSITY, JALANDHAR

Course Title: Industrial Safety & Hazardous Management

Paper Code: CHL406

L	T	P	Credits
4	0	0	4

Course objectives: The student will learn classification of hazards and their identifications, awareness of different hazards in process, risk analysis techniques.

Learning Outcomes: By the end of the course the students will be able to

- Analyze the effect of release of toxic substances
- Understand the industrial laws, regulations and source models.
- Apply the methods of prevention of fire and explosions.
- Understand the relief and its sizing methods.
- Understand the methods of hazard identification and preventive measures

UNIT-A **12 HOURS**

Definition, identification, classification and assessment of various types of industrial hazards., General principles of industrial safety, importance of safety in chemical industrial, Protective and preventive measures in hazard control.

UNIT-B **12HOURS**

Standard safety procedures for disaster control, Indian legislation on safety and prevention of hazards and safety code. Environmental Protection Act (1986)

UNIT-C **12HOURS**

Toxic chemicals, Maximum allowable concentration and other standards biological threshold limit values, toxicity and radioactivity. Regulations for storage and handling of hazardous substances and labelling

UNIT-D **12HOURS**

Hazards, hazards classification, hazard due to the explosion' Dow's fire and explosion index, HMOP, : Hazard & Operability (HAZOP) studies ,guide words and their meaning, application of guide words to hazardous operation deviation, possible causes, Consequences and actions required, event trees and fault trees.

Refrence Books:

1. Raghavan K. V. and Khan AA., *Methodologies in Hazard Identification and Risk Assessment*, Manual by CLRI, 1990.
2. Marshal V. C., *Major Chemical Hazards,* Ellis Horwood Ltd., Chichester, 1987.
3. Sam Mannan, Lees, *Loss Prevention in the Process Industries, Hazard Identification, Assessment and Control,* 4th Edition, Butterworth Heineman, 2012. Wells, G. L., *Safety in process plant design,* New York, J. Wiley, 1980.