School of Engineering and Technology

DEPARTMENT OF CHEMICAL ENGINEERING

Curriculum for I-VIII semesters

B.Tech Chemical Engineering
(Four years - Full time)

Syllabus I - IV Semester
Regulations 2015

PERIYAR MANIAMMAI UNIVERSITY
(Under Sec. 3 of UGC Act, 1956)
NAAC ACCREDITED

Periyar Nagar, Vallam, Thanjavur – 613403
Tamil Nadu state, India
www.pmu.edu

Periyar Maniammai University

Vision

- To be a University of global dynamism with excellence in knowledge and innovation ensuring social responsibility for creating an egalitarian society.

Mission

- **UM1**: Offering well balanced programmes with scholarly faculty and state-of-art facilities to impart high level of knowledge.
- **UM2**: Providing student - centered education and foster their growth in critical thinking, creativity, entrepreneurship, problem solving and collaborative work.
- **UM3**: Involving progressive and meaningful research with concern for sustainable development.
- **UM4**: Enabling the students to acquire the skills for global competencies.
- **UM5**: Inculcating Universal values, Self respect, Gender equality, Dignity and Ethics.

Department of Chemical Engineering

Vision

To emerge as a leading Chemical Engineering Department in academics and research which renowned for its qualified and socially responsible graduates.

Mission

DM1: To provide education experience through qualified faculties and state of the art facilities.

DM2: To develop the students with mastery of fundamental knowledge and attitude for continuous learning to assume leadership positions within chemical and other associated industries.

DM3: To create atmosphere of intellectual excitement and innovation for research and development to provide sustainable solutions.

DM4: To impart skills to make the students as competent professionals and entrepreneurs.

DM5: To nurture the students as resourceful and responsible citizens to fulfill the expectations of society following ethical values.

Programme Educational Objectives (PEOs)

Programme Educational Objectives (PEOs) are statements that describe the knowledge skills and attitude acquired

3 – 5 years after graduation.

The graduates of the Periyar Maniammai University, Chemical Engineering Program will be:

PEO1: Able to carry out chemical engineering tasks as an individual or as a team member.

PEO2: Capable to undertake research and development related activities by acquiring in depth knowledge through advanced studies in chemical engineering and its allied fields.

PEO3:Able to communicate effectively, assume leadership roles in industry, business and contribute to the welfare of society by directing their skills and technical expertise toward addressing the needs of the community and the environment

PEO4: Able to update the developments in the field of specialization by continuous learning

Mapping of University Mission with Department Mission

University Mission (UM)	Department Mission (DM)					
	1	**2**	**3**	**4**	**5**	**Total**
1	3	2	2	1	1	9
2	3	3	2	1	1	10
3	1	1	3	1	2	8
4	1	1	1	3	1	7
5	1	1	1	2	3	8
Total	9	8	9	8	8	

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Mapping of Mission and PEOs

Department Mission	Program Educational Objectives				
	1	**2**	**3**	**4**	Total
1	3	1	2	1	7
2	3	2	1	1	7
3	2	3	2	2	9
4	1	1	3	2	7
5	1	2	2	2	7
Total	10	9	8	8	

Program Outcomes (POs)

The graduates of the Periyar Maniammai University Chemical Engineering Program should be able to:

PO1: Apply the knowledge of mathematics, science, chemical engineering fundamentals to find out the solution for complex engineering problems.
PO2: Identify, formulate, research literature, and analyze complex chemical engineering problems
PO3: Design a system and conduct experiments, analyze and interpret data to provide valid conclusions.

PO4: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO5: Use internet resources, modern engineering and IT tools including prediction and modeling to complex chemical engineering activities with an understanding of the limitations.
PO6: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the Chemical engineering
PO7: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO8: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice
PO9: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings
PO10: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions
PO11: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments
PO12: Develop career skills through life-long learning.
PSO1: Specialize in petrochemical engineering.
PSO2: Specialize in biochemical engineering systems.

Graduate Attributes as per NBA

All graduates of Chemical Engineering programs are expected to have identified technical/ functional, generic and managerial competencies. The Graduate Attributes are:

1. Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. Problem analysis: Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

6. The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering
7. Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Mapping of the Program Educational Objectives and Program Outcomes

PEOs	Program outcomes														
	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2	Total
1	3	3	3	1	1	0	0	0	1	1	1	1	2	2	19
2	1	2	3	3	1	1	1	1	1	2	0	2	1	1	21
3	0	0	0	0	0	2	3	2	2	3	2	0	1	1	16
4	1	1	0	2	2	1	2	1	0	1	2	3	1	1	18
Total	5	6	6	6	4	4	6	4	4	7	5	6	5	5	

Mapping of GAs and POs

GAs	Program outcomes													
	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2
1	3	0	0	0	0	0	0	0	0	0	0	0	0	0
2	1	3	0	0	0	0	1	0	0	0	0	0	1	1
3	0	1	3	0	0	0	0	0	0	0	0	0	2	2
4	0	0	0	3	1	0	0	1	0	1	0	1	0	0
5	0	0	0	0	3	0	0	0	0	0	0	0	0	0
6	0	0	1	0	0	3	0	0	0	0	0	0	0	0
7	0	0	1	0	0	1	3	0	0	0	0	0	0	0
8	0	0	0	0	0	0	0	3	0	0	0	0	0	0
9	0	0	0	0	0	0	0	0	3	1	1	0	0	0
10	0	0	0	1	0	0	0	0	1	3	0	0	0	0
11	0	0	0	0	0	0	0	0	0	0	3	0	0	0
12	0	0	0	0	0	0	0	0	0	0	0	3	0	0

Curriculum

Abbreviations:

L – Lecture hours		**MA – Mathematics**		*** - Non credit courses**		**CP – Core with practical**
T- Tutorial hours		**CoP – Computer Programming**		**EM – Engg. Mechanics**		**MNGT – Management courses**
P – Practical hours		**BE – Basic Engineering**		**EG – Engg. Graphics**		**OE – Open Electives**
C – Credits		**AP – Applied Physics**		**CT – Core with tutorial**		**PE – Professional Electives**
SS – Self study		**UMAN – UGC Mandatory**		**CTP – Core with tutorial and practical**		**P - Project**
IPT – Implant training						

SEMESTER – I

S.No	Course Code	Name of the course	Credits				Contact Hours				
			L	T	P	C	L	T	P	SS	Total
1	XMA101	Algebra, Differential calculus and their applications	3	1	0	4	3	2	0	0	5
2	XCP102	Computer Programming	3	0	1	4	3	0	2	0	5
3	XBE103	Electrical and Electronics Engineering systems	3	1	1	5	3	2	2	0	7
4	XAP104	Applied Physics	3	1	1	5	3	2	2	0	7
5	XGS105	Study skills and language lab	1	0	1	1	1	0	2	0	3
6	XUM106	Human Ethics, Values, Rights And Gender Equality	1	0	0	1	1	0	0	2	3
	Total		14	3	4	21	14	6	8	2	30

SEMESTER – II

S.No	Course Code	Name of the course	Credits				Contact Hours				
			L	T	P	C	L	T	P	SS	Total
1	XMA201	Calculus and Laplace Transforms	3	1	0	4	3	2	0	0	5
2	XEM202	Engineering Mechanics	3	1	0	4	3	2	0	0	5
3	XBW203	Mechanical and Civil Engineering Systems	3	1	1	5	3	2	2	0	7
4	XAC204	Applied Chemistry	3	1	1	5	3	2	2	0	7
5	XEG205	Engineering Graphics	2	0	1	3	2	0	2	0	4
6	XGS206	Speech communication	1	0	0	1	1	0	2*	0	3
7	XCH207	Introduction to chemical engineering	0	0	0	0	1*	0	0	0	1
	Total		15	4	3	22	16	8	8	0	32

SEMESTER – III

S.No	Course Code	Name of the course	Credits				Contact Hours				
			L	T	P	C	L	T	P	SS	Total
1	XMA301	Transforms and Partial Differential equations	3	1	0	4	3	2	0	0	5
2	XCH302	Chemical Process Calculations	3	1	0	4	3	2	0	0	5
3	XCH303	Chemistry for Chemical Engineers	3	0	1	4	3	0	2	0	5
4	XCH304	Fluid mechanics	3	1	1	5	3	2	2	0	7
5	XCH305	Chemical Engineering Thermodynamics	3	1	0	4	3	2	0	0	5
6	XCH306	Entrepreneurship Development	2	0	0	2	2	0	0	1*	3
7	XGS307	Interpersonal communication	0	0	0	0	0	0	2	0	2
8	XCH308	Inplant training – 1	-	-	-	1	-	-	-	-	-
	Total		17	4	2	24	17	8	6	1	32

SEMESTER –IV

S.No	Course Code	Name of the course	Credits				Contact Hours				
			L	T	P	C	L	T	P	SS	Total
1	XMA401	Probability and statistics	2	1	0	3	2	2	0	0	4
2	XCH402	Inorganic Chemical Manufacturing processes	2	1	0	3	2	2	0	0	4
3	XCH403	Process Heat Transfer	3	1	1	5	3	2	2	0	7
4	XCH404	Particulate science and technology	3	1	1	5	3	2	2	0	7
5	XCH405	Engineering Materials	3	0	0	3	3	0	0	0	3
6	XCH406	Process Economics and Industrial Management	2	0	0	2	2	0	0	1*	3
7	XEN407	Technical communication	1	0	0	1	1	0	2	0	3
8	XCH408	Extracurricular activities - NCC/NSS/YRC/RRC/Sports	-	-	-	-	-	-	-	-	-
	Total		16	4	2	22	16	8	6	1	31

SEMESTER –V

S.No	Course Code	Name of the course	Credits				Contact Hours				
			L	T	P	C	L	T	P	SS	Total
1	XMA501	Numerical Methods	2	1	0	3	2	2	0	0	4
2	XCH502	Analytical Techniques	3	0	1	4	3	0	2	0	5
3	XCH503	Organic chemical manufacturing processes	3	1	0	4	3	2	0	0	5
4	XCH504	Mass Transfer Operations	3	1	1	5	3	2	2	0	7
5	XCH505	Professional electives - 1	2	1	0	3	2	2	0	0	4
6	XCH506	Total quality management	3	0	0	3	3	0	0	0	3
7	XEN507	Business communication	1	0	0	1	1	0	2	0	3
8	XCH508	In-plant Training - II	-	-	-	1	-	-	-	-	-
	Total		17	4	2	24	17	10	6	0	31

SEMESTER –VI

S.No	Course Code	Name of the course	Credits				Contact Hours				
			L	T	P	C	L	T	P	SS	Total
1	XOE601	Open elective - 1	3	0	0	3	3	0	0	0	3
2	XCH602	Process Instrumentation	3	0	0	3	3	0	0	0	3
3	XCH603	Process Equipment Design and drawing	3	1	1	5	3	2	2	0	7
4	XCH604	Chemical Reaction Engineering	3	1	1	5	3	2	2	0	7
5	XCH605	Equilibrium staged operations	3	1	0	4	3	2	0	0	5
6	XCH606	Professional Elective - 2	3	0	0	3	3	0	0	0	3
7	XUM607	Environmental Studies	0	0	0	0	3	0	0	0	3
8	XEN608	Academic Writing	0	0	0	0	0	0	2	0	2
	Total		18	3	2	23	21	6	6	0	33

SEMESTER –VII

S.No	Course Code	Name of the course	Credits				Contact Hours				
			L	T	P	C	L	T	P	SS	Total
1	XOE701	Open elective - 2	3	0	0	3	3	0	0	0	3
2	XCH702	Transport phenomena	3	1	0	4	3	2	0	0	5
3	XCH703	Process Dynamics and Control	3	1	1	5	3	2	2	0	7
4	XCH704	Professional Elective - 3	3	0	0	3	3	0	0	0	3
5	XCH705	Professional Elective - 4	3	0	0	3	3	0	0	0	3
6	XUM706	Cyber Security	0	0	0	0	3	0	0	0	3
7	XCH707	Project Phase – 1	0	0	2	2	0	0	4	0	4
8	XEN708	Career Development Skills	0	0	0	0	0	0	2	0	2
9	XCH709	Inplant Training – III	-	-	-	2	-	-	-	-	-
	Total		15	2	3	22	18	4	8	0	30

SEMESTER –VIII

S.No	Course Code	Name of the course	Credits				Contact Hours				
			L	T	P	C	L	T	P	SS	Total
1	XOE801	Open elective – 3	3	0	0	3	3	0	0	0	3
2	XCH802	Professional Elective – 5	3	0	0	3	3	0	0	0	3
3	XCH803	Professional Elective – 6	3	0	0	3	3	0	0	0	3
4	XCH804	Project Phase – 2	0	0	12	12	0	0	24	0	24
Total			9	0	12	21	9	0	24	0	33

Total Credits: = 179

LIST OF PROFESSIONAL ELECTIVES

Semester	Professional Elective	Name of the Courses	L	T	P	C
V	1	Petroleum Exploration	3	0	0	3
		Biochemical Engineering	2	1	1	3
		Fertilizer Technology	3	0	0	3
VI	2	Petroleum Refining and Petrochemicals	2	0	1	3
		Food Technology	2	0	1	3
		Electrochemical Engineering	2	0	1	3
VII	3	Natural gas Engineering	3	0	0	3
		Modelling and simulation in chemical systems	2	0	1	3
		Energy conservation and management	3	0	0	3
VII	4	Novel Separation processes	3	1	0	3
		Computational fluid dynamics techniques	2	1	1	3
		Pharmaceutical Technology	2	1	0	3
VIII	5	Process Plant Utilities	3	0	0	3
		Industrial Safety and Risk Management	3	0	0	3
		Corrosion engineering	2	0	1	3
VIII	6	Disaster Management	3	0	0	3
		Industrial Pollution Prevention and Control	2	0	1	3
		Polymer and Surface Coatings Technology	3	0	0	3

LIST OF OPEN ELECTIVES OFFERED TO OTHER DEPARTMENT STUDENTS (OE-I to OE-V)

S No.	Name of the Courses	L	T	P	C
1	Industrial Safety and Risk Management	3	0	0	3
2	Process Heat Transfer	2	1	1	3
3	Chemical Reaction Engineering fundamentals	2	1	1	3
4	Mass transfer Fundamentals	2	0	1	3
5	Process Plant Utilities	3	0	0	3
6	Industrial Pollution control and prevention	3	0	0	3
7	Battery Technology	3	0	0	3
8	Energy Conservation and Management	3	0	0	3
9	Environmental Engineering	2	1	1	3
10	Waste Water Engineering	3	0	0	3
11	Solid Waste Management	3	0	0	3
12	Process Automation	2	1	1	3

XMA101 ALGEBRA, DIFFERENTIAL CALCULUS AND THEIR APPLICATIONS

SUBCODE			SUB NAME	L	T	P	C
XMA 101			ALGEBRA, DIFFERENTIAL CALCULUS AND THEIR APPLICATIONS	3	1	0	4
C	P	A					
3	0	0		L	T	P	H
				3	2	0	5

PREREQUISITE: Basic concepts of Matrices, Numbers, Differentiation and Integration

COURSE OUTCOMES:

Course Outcomes	Domain	Level
CO1: ***Explain*** the Properties of eigen values and eigen vectors of the matrices, ***Make Use of*** orthogonal and similarity transformation and ***Construct*** the quadratic form to Canonical form.	Cognitive	Understanding Apply
CO2: ***Define*** and ***Find*** the radius and circle of curvature in cartesian and polar coordinates and to ***Explain*** evolutes and envelopes.	Cognitive	Remembering Understanding
CO3: ***Explain*** the convergence of series of positive terms, alternating series, and power series using tests of convergence .	Cognitive	Understanding
CO4: ***Find*** total and partial derivatives , Taylor serie expansions of functions and the extremum of functions and their applications.	Cognitive	Remembering
CO5. ***Solve*** the linear equations of second and higher order with constant and variable coefficients and simultaneous first order differential equations and to ***Apply*** Method of variation of parameters to ***Solve*** the differential equation.	Cognitive	Apply

UNIT I MATRICES	**15**
Eigen values and Eigenvectors of a real matrix –Properties of Eigen values and Eigen vectors – Cayley-Hamilton theorem (excluding proof) - Similarity transformation (Concept only) – Orthogonal matrix - Orthogonal transformation of a symmetric matrix to diagonal form – Reduction of quadratic form to Canonical form by Orthogonal transformation.	
UNIT II GEOMETRICAL APPLICATIONS OF DIFFERENTIAL CALCULUS	**15**
Curvature – Cartesian and polar co-ordinates – Centre and radius of curvature – Circle of curvature – Involutes and evolutes – Envelopes – Properties of envelopes and evolutes.	
UNIT III INFINITE SERIES	**15**
Sequences – Convergence of series – General properties – Series of positive terms – Tests of convergence (Comparison test, Integral test, Comparison of ratios and D'Alembert's ratio test – Statement of theorems and problems only) – Alternating series – Series of positive and negative terms – Absolute and conditional convergence – Power Series – Convergence of exponential, logarithmic and Binomial Series (Simple problems only)	

UNIT IV FUNCTIONS OF SEVERAL VARIABLES	15
Functions of two variables – Partial derivatives – Total differentiation – Taylor's expansion – Maxima and Minima – Constrained maxima and minima – Lagrange's Multiplier method – Jacobian Determinants.	
UNIT V ORDINARY DIFFERENTIAL EQUATIONS AND APPLICATIONS	**15**
Linear equations of second and higher order with constant and variable coefficients (Euler's and Legendre's equations) – Simultaneous first order linear equations with constant coefficients – Method of variation of parameters - Applications to electrical circuit problems.	

	LECTURE	TUTORIAL	TOTAL
	45	30	75

TEXT

1. Grewal, B.S. Higher Engineering Mathematics, 40th Edition, Khanna Publication, Delhi, 2007.
2. Kreyszig, E, Advanced Engineering Mathematics, Eighth Edition, John Wiley and Son(Asia) Ltd, Singapore, 2001.

REFERENCES

1. Bali N.P and Narayana lyengar, Engineering Mathematics, Laxmi Publications (P) Ltd, New Delhi, 2003.
2. Veerarajan T, Engineering Mathematics Fourth Edition, Tata – McGraw Hill Publishing Company Ltd, New Delhi, 2005.
3. Kandasamy P., Thilagavathy K, and Gunavathy K, Engineering Mathematics Volume I, II and III, S. Chand & Co, New Delhi, 2005.
4. Venkataraman M. K, Engineering Mathematics, Volume I and II Revised enlarge Fourth Edition, The National Publishing Company, Chennai, 2004.

E REFERENCES

www.nptel.ac.in

Advanced Engineering Mathematics Prof. Pratima Panigrahi

Department of Mathematics Indian Institute of Technology, Kharagpur.

	GA1	GA2	GA3	GA4	GA5	GA6	GA7	GA8	GA9	GA10	GA11	GA12
CO 1	3									1		1
CO 2	3									1		1
CO 3	3	2								1	1	2
CO 4	3	2			1					1	1	1
CO 5	3	2			1					1	1	1
	15	6	0	0	2	0	0	0	0	5	3	6

1 - Low , 2 – Medium , 3- high

XCP 102 COMPUTER PROGRAMMING

SUBCODE	SUB NAME	L	T	P	C
XCP102	COMPUTER PROGRAMMING	3	0	1	4
C:P:A = 3:1:0					
		L	T	P	H
		3	0	2	5

	Course Outcomes	Domain	Level
CO1	***Define*** programming fundamentals and ***Solve*** simple programs using I/O statements.	Cognitive Psychomotor	Remember Guided Response
CO2	***Define*** syntax and ***write simple programs*** using control structures and arrays	Cognitive Psychomotor	Remember Guided Response
CO3	***Explain*** and ***write simple programs*** using functions and pointers	Cognitive Psychomotor	Understand Guided Response
CO4	***Explain*** and ***write simple programs*** using structures and unions	Cognitive Psychomotor	Understand Guided Response
CO5	***Explain*** and ***write simple programs*** using files and ***Build*** simple projects	Cognitive Psychomotor	Understand Guided Response

UNIT I	PROGRAMMING FUNDAMENTALS AND INPUT /OUTPUT STATEMENTS	9 + 6

Theory

Program – Flowchart – Pseudo code – Software – Introduction to C language – Character set – Tokens: Identifiers, Keywords, Constants, and Operators – sample program structure -Header files – Data Types - Output statements – Input statements.

Practical

1. Program to display a simple picture using dots.
2. Program for addition of two numbers
3. Program to swap two numbers
4. Program to solve any mathematical formula.

UNIT II	CONTROL STRUCTURE AND ARRAYS	9 + 6

Theory

Control Structures – Conditional Control statements: Branching, Looping - Unconditional control structures: switch, break, continue, goto statements – Arrays: One Dimensional Array – Declaration – Initialization – Accessing Array Elements – Searching – Sorting – Two Dimensional arrays - Declaration – Initialization – Matrix Operations – Multi Dimensional Arrays - Declaration – Initialization. Storage classes: auto – extern – static. Strings: Basic operations on strings.

Practical

1. Program to find greatest of 3 numbers using Branching Statements
2. Program to display divisible numbers between n1 and n2 using Looping Statement
3. Program to remove duplicate element in an array.
4. Program to perform string operations.

UNIT III	FUNCTIONS AND POINTERS	9 + 6

Theory

Functions: Built in functions – User Defined Functions - Parameter passing methods - Passing

arrays to functions – Recursion - Programs using arrays and functions. Pointers - Pointer declaration - Address operator - Pointer expressions & pointer arithmetic - Pointers and function - Call by value - Call by Reference - Pointer to arrays - Pointers and structures - Pointers on pointer.

Practical

1. Program to find factorial of a given number using four function types.
2. Programs using Recursion
3. Programs using Pointers

UNIT IV	**STRUCTURES AND UNIONS**	**9 + 6**

Theory

Structures and Unions - Giving values to members - Initializing structure - Functions and structures - Passing structure to elements to functions - Passing entire function to functions - Arrays of structure - Structure within a structure and Union.

Practical

1. Program to read and display student mark sheet Structures with variables
2. Program to read and display student marks of a class using Structures with arrays
3. Program to create linked list using Structures with pointers

UNIT V	**FILES**	**9 + 6**

Theory

File management in C - File operation functions in C - Defining and opening a file - Closing a file - The getw and putw functions - The fprintf & fscanf functions - fseek function – Files and Structures.

Practical

1. Program for copying contents of one file to another file.
2. Program using files using structure with pointer

	LECTURE	**PRACTICAL**	**TOTAL**
	45	**30**	**75**

TEXT BOOKS

1. Byron Gottfried, "Programming with C", III Edition, (Indian Adapted Edition), TMH publications, 2010
2. Yeshwant Kanethker, “Let us C”, BPB Publications, 2008

REFERENCES

1. Brian W. Kernighan and Dennis M. Ritchie, "The C Programming Language", Pearson Education Inc. (2005).
2. Behrouz A. Forouzan and Richard. F. Gilberg, "A Structured Programming Approach Using C", II Edition, Brooks–Cole Thomson Learning Publications, 2001.
3. Johnsonbaugh R. and Kalin M., “Applications Programming in ANSI C”, III Edition, Pearson Education India, 2003.
4. https://iitbombayx.in/courses/IITBombayX/BMWCS101.1x/2015_T1/courseware

Mapping of COs with GAs:

	GA1	GA2	GA3	GA4	GA5	GA6	GA7	GA8	GA9	GA10	GA11	GA12
CO1	3	2			2							2
CO2	3	2			2							2
CO3	3	2	1	2	2							2
CO4	3	2	1	2	2							2
CO5	3	2	1		2			1			2	2

	GA1	GA2	GA3	GA4	GA5	GA6	GA7	GA8	GA9	GA10	GA11	GA12
Original	15	10	3	4	10			1			2	10
Scaled to 0,1,2,3 scale	3	2	1	1	2			1			1	2

XBE 103 ELECTRICAL AND ELECTRONICS ENGINEERING SYSTEMS

CO1: Cog (Rem), Psy (Mechanism, Set): ***Describe*** AC and DC circuits and measuring devices. ***Construct*** and ***test*** AC, DC circuits and measuring devices.

CO2: Cog (Understand): ***Explain*** different types of Electrical machines.

CO3: Cog (Rem), Psy (Set): Describe semiconductor devices and ***show*** the input output characteristics of basic semiconductor devices.

CO4: Cog (Understand), Psy (COR, Set): ***Explain*** logic gates and their applications and ***construc***t ***and verify*** the logic gates and construct simple adders and subtractors using logic gates.

CO5: Cog (Rem): ***Describe*** microprocessors in detail.

SUB CODE	**SUB NAME**	**L**	**T**	**P**	**C**
XBE 103	Electrical and Electronics Engineering Systems	3	1	1	5
C:P:A		**L**	**T**	**P**	**H**
3:1:0		3	2	2	7
Unit- 1	**FUNDAMENTAL OF DC AND AC CIRCUITS, MEASUREMENTS**			**10 + 9 + 20**	
Fundamentals of DC– Ohm's Law – Kirchoff's Laws - Sources - Voltage and Current relations – Star/Delta Transformation - Fundamentals of AC – Average Value, RMS Value, Form Factor - AC power and Power Factor, Phasor Representation of sinusoidal quantities - Simple Series, Parallel, Series Parallel Circuit - Operating Principles of Moving coil and Moving Iron Instruments (Ammeter, Voltmeter) and Dynamometer type meters (Watt meter and Energy meter).					
Unit- 2	**ELECTRICAL MACHINES**			**8 + 9**	
Construction, Principle of Operation, Basic Equations, Types and Application of DC Generators, DC motors - Basics of Single Phase Induction Motor and Three Phase Induction Motor - Construction, Principle of Operation of Single Phase Transformer, Three phase transformers, Auto transformer.					
Unit- 3	**SEMICONDUCTOR DEVICES**			**9 + 3 + 5**	
Classification of Semiconductors, Construction, Operation and Characteristics: PN Junction Diode – Zener Diode, PNP, NPN Transistors, Field Effect Transistors and Silicon Controlled Rectifier – Applications.					
Unit- 4	**DIGITAL ELECTRONICS**			**9 + 6 + 5**	
Basic of Concepts of Number Systems, Logic Gates, Boolean Algebra, Adders, Subractors, multiplexer, demultiplexer, encoder, decoder, Flipflops, Up/Down counters, Shift Registers.					
Unit- 5	**MICROPROCESSORS**			**9 + 3**	
Architecture, 8085, 8086 - Interfacing Basics: Data transfer concepts - Simple Programming concepts.					

1. Study of Electrical Symbols, Tools and Safety Precautions, Signal Generators, Power Supplies and Voltage Regulators.
2. Study of Active and Passive Elements - Resistors, Inductors and Capacitors, Bread Board and Printed Circuit Board.
3. Verification of AC Voltage, Current and Power in Series connection and Parallel connection.
4. Fluorescent lamp connection with choke.
5. Staircase Wiring.
6. Calibration of Ammeter, Voltmeter, Wattmeter, Energy meter, Multimeter and Lux meter.
7. Testing of DC Voltage and Current in series and parallel resistors which are connected in breadboard by using Voltmeter, Ammeter and Multimeter.
8. Measuring input signal magnitude and frequency by using Cathode Ray Oscilloscope.
9. Forward and Reverse bias characteristics of PN junction diode and Zener diode.
10. Input and Output Characteristics of NPN transistor.
11. Verification of Truth Tables of Logic Gates.
12. Construction and verification of simple adders and subtractors.

Lecture = 45; Tutorial = 30; Lab = 30; Total = 105 Hours

TEXT BOOKS:

1.	Mittle, V. N., 2007. Basic Electrical and Electronics Engineering. 1st ed. New Delhi: Tata McGraw-Hill.
2.	Malvino, A. P., 2006. Electronics Principles. 7th ed. New Delhi: Tata McGraw-Hill.
3.	Rajakamal, 2007. Digital System-Principle & Design. 2nd ed. Pearson education.
4.	Moris Mano, 1999. Digital Design. Prentice Hall of India.
5.	Ramesh, S. Gaonkar, 2013. Microprocessor Architecture, Programming and its Applications with the 8085. 6th ed. India: Penram International Publications.

REFERENCE BOOKS:

1.	Corton,H., 2004. Electrical Technology. CBS Publishers & Distributors.
2.	Syed, A. Nasar, 1988. Electrical Circuits. Schaum Outline Series, McGraw-Hill.
3.	Jacob Millman and Christos, C. Halkias, 2010. Electronics Devices and Circuits. 3rd ed. New Delhi: McGraw-Hill.
4.	Millman, J. and Halkias, C. C., 2011. Integrated Electronics: Analog and Digital Circuits and Systems. 2nd ed. New Delhi: McGraw-Hill.
5.	Mohammed Rafiquzzaman, 1992. Microprocessors - Theory and Applications: Intel and Motorola. Prentice Hall International.

E-REFERENCES:

1.	NTPEL, Basic Electrical Technology (Web Course), Prof. N. K. De, Prof. T. K. Bhattacharya and Prof. G. D. Roy, IIT Kharagpur.
2.	http://freevideolectures.com/Course/2335/Basic-Electrical-Technology#, Prof. L. Umanand , IISc Bangalore.
3.	http://nptel.ac.in/Onlinecourses/Nagendra/, Dr. Nagendra Krishnapura , IIT Madras.

4.	http://www.nptelvideos.in/2012/11/basic-electrical-technology.html, Dr. L. Umanand, IISC Bangalore.

CO/GA	GA1	GA2	GA3	GA4	GA5	GA9	GA10	GA11	GA12
CO1	3	2	2	2	1	1	-	-	1
CO2	3	2	-	2	1	-	-	-	1
CO3	3	-	-	-	1	1	-	-	1
CO4	3	2	2	2	1	1	-	-	1
CO5	3	-	-	-	1	-	-	-	1
Total	15	6	4	6	5	3			5
Scaling	3	1	1	1	1	1			1

XAP 104 APPLIED PHYSICS

COURSE CODE	COURSE NAME	L	T	P	C
XAP104	APPLIED PHYSICS	3	1	1	5
C:P:A = 2.8:0.8:0.4					
		L	T	P	H
		3	2	2	7

COURSE OUTCOMES

CO1. Cog: R, U, Psy: (M); ***Identify*** the basics of mechanics, ***explain*** the principles of elasticity, viscosity and ***determine*** its significance in engineering systems and technological advances.

CO2.Cog: R, Ana, Aff: Rec; ***Describe*** the production, propagation, perception & ***analysis*** of acoustical wave and ***locate*** basic acoustical problem encountered in constructed buildings.

CO3. Cog: U, App, Psy: (M), Aff: Rec; ***Understand*** the fundamental phenomena in optics by ***measurement*** and ***describe*** the working principle and ***application*** of various lasers and fibre optics.

CO4. Cog: U, Ana, Psy: (M), Aff: Rec; ***Analyse*** different crystal structures, ***discuss*** and ***use*** physics principles of latest technology by ***visualizing.***

CO5. Cog: U, App; ***Develop Knowledge*** on engineering materials, its properties and ***application.***

THEORY

UNIT - I MECHANICS AND PROPERTIES OF MATTER **9+6+12**

Mechanics: Force - Newton's laws of motion - work and energy - impulse and momentum - torque - law of conservation of energy and momentum - Friction.

Elasticity: Stress - Strain - Hooke's law - Stress strain diagram - Classification of elastic modulus - Moment, couple and torque - Torsion pendulum - Applications of torsion pendulum - Bending of beams - Experimental determination of Young's modulus: Uniform bending and non-uniform bending - I shape girders.

Viscosity: Coefficient of viscosity - Laminar flow - streamline flow - turbulent flow - Reynold's number - Poiseuille's method.

UNIT - II ACOUSTICS, ULTRASONICS AND SHOCK WAVES **9+6**

Acoustics: Classification of sound - Characteristics of musical sound - Loudness - Weber Fechner law - Decibel - Absorption coefficient - Reverberation - Reverberation time - Sabin's formula (growth and decay) - Factors affecting acoustics of buildings (reverberation time, loudness, focussing, echo, echelon effect - resonance and noise) and their remedies.

Ultrasonics: Production: Magnetostriction and Piezoelectric methods - NDT: Ultrasonic flaw detector.

Shock waves: Definition of Mach number - Description of a shock wave - Characteristics -

Methods of creating shock waves.

UNIT – III OPTICS, LASERS AND FIBRE OPTICS	9+6+12

Optics: Dispersion - Optical instrument: Spectrometer - Determination of refractive index and dispersive power of a prism - Interference of light in thin films: air wedge - Diffraction: grating.
LASER: Introduction - Population inversion -Pumping - Laser action - Nd-YAG laser - CO_2 laser - Semiconductor Laser (homojunction) - Applications
Fibre Optics: Principle and propagation of light in optical fibre - Numerical aperture and acceptance angle - Types of optical fibre - Fibre optic communication system

UNIT –IV SOLID STATE PHYSICS	9+6+6

Crystal Physics: Lattice - Unit cell - Lattice planes - Bravais lattice - Miller indices - Sketching a plane in a cubic lattice - Calculation of number of atoms per unit cell - Atomic radius - Coordination number - Packing density for SC, BCC, FCC and HCP structures.
Semiconductors: Semiconductor properties - Types of semiconductor - Intrinsic - Extrinsic: P-type and N-type semiconductor - PN junction diode - Biasing - Junction diode characteristics.

UNIT –V NOVEL ENGINEERING MATERIALS AND BIOMETRICS	9+6

Novel Engineering Materials: Introduction - Metallic glasses: Melt spinning technique, properties, applications - Shape Memory Alloys: Transformation temperature, working of SMA, characteristics - Biomaterials: Properties, interaction of biomaterials with tissues, applications - Nano phase materials: Production, properties and applications.
Biometrics: Introduction - definition - instrumentation - devices -advantages

TEXT BOOKS

1. Avadhanulu M. N. and Kshirsagar P. G., "A Text Book of Engineering Physics", 7th Enlarged Revised Edition., S. Chand & Company Ltd., New Delhi, 2005.
2. Senthil Kumar G., " Engineering Physics", 2nd Enlarged Revised Edition, VRB Publishers, Chennai, 2003.
3. Mani P., "Engineering Physics", Dhanam Publications, Chennai, 2005.
4. Prabu P. and Gayathri P., " Applied Physics", PMU Press, Thanjavur, 2013

REFERENCE BOOKS

1. Gaur R.K. and Gupta S. L., "Engineering Physics", Dhanpat Rai Publishers, New Delhi, 2001.
2. Pillai S.O., "Solid State Physics", 5th Edition, New Age International Publication, New Delhi,2003.

E RESOURCES

NPTEL , Engineering Physics, Prof. M. K. Srivastava, Department of Physics, IIT, Roorkee.

LABORATORY	
1.	Torsional Pendulum - determination of moment of inertia and rigidity modulus of the given material of the wire.
2.	Uniform Bending - Determination of the Young's Modulus of the material of the beam.
3.	Non-Uniform Bending - Determination of the Young's Modulus of the material of the beam.
4.	Poiseuille's flow - Determination of coefficient of viscosity of the given liquid.
5.	Spectrometer - Determination of dispersive power of the give prism.
6.	Spectrometer - Determination of wavelength of various colours in Hg source using grating.
7.	Air wedge - Determination of thickness of a given thin wire.
8.	Laser - Determination of wavelength of given laser source and size of the given micro particle using Laser grating.
9.	Post office Box - Determination of band gap of a given semiconductor.
10.	PN Junction Diode - Determination of V-I characteristics of the given diode.

REFERENCE BOOKS

1. Srinivasan M. & others, "A text book of Practical Physics", Sultan Chand & Sons, 2001.
2. Shukla R.K., "Practical Physics", New Age International Publication, New Delhi, 2011.
3. Umayal Sundari AR., "Applied Physics Laboratory Manual", PMU Press, Thanjavur, 2012.

	LECTURE	TUTORIAL	PRACTICAL	TOTAL HOURS
	45	**30**	**30**	**105**

	GA1	GA2	GA3	GA4	GA5	GA9	GA10	GA11	GA12
CO1	3	2	2	2	1	1	-	-	1
CO2	3		1		1		-	-	1
CO3	3	2	2	2	1	1	-	-	1
CO4	3	2	2	2	1	1	-	-	1
CO5	3		2				-	-	1
Total	**15**	**6**	**9**	**6**	**4**	**3**			**5**

1 - Low, 2 – Medium, 3 – High

XGS105 STUDY SKILLS AND LANGUAGE LAB

XGS105			STUDY SKILLS AND LANGUAGE LAB	L	T	P	SS	C
				1	0	0	2	1
C	P	A		L	T	P	SS	H
1.4	0.6	0.4		1	0	0	2	3

Course Outcome:

CO1: Cog (Rem), ***Identify*** different strategies of reading and writing skills.

CO2: Aff (INT), ***Revise*** **the** library skills in their learning process.

CO3: Cog (Apply), ***Apply*** different techniques to various types of material such as a novel, newspaper, poem, drama and other reading papers.

CO4: Cog(Understanding), *use* visual aids to support verbal matters into language discourse.

CO5: Cog (Understand), Psy (Guided Response) ***Prepares*** to face the written exam with confidence and without any fear or tension.

SYLLABUS

UNITS		HOURS
I	**INTRODUCTION TO STUDY SKILLS;** Learning Skills and Strategies of Learning; Cognitive Study skills and physical study skills, Library skills (How to use Library), familiarization of library facilities by the librarian; familiarization of basic cataloguing techniques, how to ransack the library etc.	5
II	**REFERENCE SKILLS,** How to use the library facilities for research and to write assignments; how to find out reference books, articles, journals and other e- learning materials; how to use a dictionary and thesaurus.	5
III	**READING RELATED STUDY SKILLS** Process of reading, various types of reading materials and varied reading techniques; familiarization to materials written by various authors; features of scientific writing and familiarization to scientific writing by renowned authors; note making skills	5
IV	**WRITING RELATED STUDY SKILLS** Process of writing, characteristics of writing, discourse analysis, use of visual aids, and note making and note taking skills	5
V	**EXAM PREPARATION SKILLS;** Anxiety reduction skills; familiarization with various types of exam/evaluation techniques etc.	5
	LANGUAGE LAB (Practical)	
	SOUNDS OF ENGLISH LANGUAGE; Vvowels, consonants, diphthongs, word stress, sentence stress, intonation	5

	patterns, connected speech etc	
	VOCABULARY BUILDING Grammar, synonyms and antonyms, word roots, one-word substitutes, prefixes and suffixes, idioms and phrases.	5
	READING COMPREHENSION Rreading for facts, meanings from context, scanning, skimming, inferring meaning, and critical reading. Active listening, listening for comprehension etc.	10
	L=15 hrs Self Study -25 hrs 5 Total:45 Hrs	
	Text books	
	Appropriate Chapters/Units from the following textbooks 1. V.R. Narayanaswamy ,Strengthen Your Writing Orient Longman, 2000 2. Ghosh, R N; Inthira, S R, A Course in written English: Oxford Univ Press, New Delhi, 2001 3. Jaya Sasikumar, Champa Tickoo, Writing With A Purpose, Published by Oxford University Press, 2000 4. Freeman, Sarah: Study Strategies. New Delhi: Oxford University Press, 1979 5. Paul Gunashekar M.L. Tickoo, Reading for Meaning, S. Chand & Company Ltd., 2000 6. Bernard Hartley, Peter Viney, Streamline English: Departures, Oxford English,1990. 7. Bernard Hartley, Peter Viney, Streamline English: Destinations, Oxford : Oxford University Press, 1992. 8. Bernard Hartley, Peter Viney, Streamline English Directions, Oxford University Press 1982.	
	References	
	1. Jaya Sasikumar, Champa Tickoo, Writing With A Purpose, Oxford University Press 2001. Freeman, Sarah*:* Study Strategies. *New Delhi: Oxford University Press*, 1979. 2. Reading for Meaning, Paul Gunashekar M.L. Tickoo, Published by S. Chand & Company Ltd. Sultan Chand & Company**,** 2000 3. Susan Fawcett Evergreen: A Guide to Writing with Readings Paperback – January 4, 2013.	

	GA1	GA2	GA3	GA4	GA5	GA6	GA7	GA8	GA9	GA10	GA11	GA12
CO1										2		
CO2										**2**		
CO3				2						**1**		
CO4												1
CO5				2						**1**	2	1
Total				4						**6**	2	2

XUM 106 HUMAN ETHICS, VALUES, RIGHTS AND GENDER EQUALITY

Course Outcomes (COs) are

CO1: Cog (Remember, Understanding) ***Relate*** and ***Interpret*** the human ethics and human relationships
CO2: Cog (Understanding, Applying) ***Explain*** and ***Apply*** gender issues, equality and violence against women
CO 3: Cog (Analyzing) *Affective* (Receiving) ***Classify*** and ***Develop*** the identify of human rights and their violations
CO4: Cog (Understanding, Analyze) ***Classify*** and ***Dissect*** necessity of human rights and report on violations.
CO5: Cog (Remember), *Affective* (Respond) ***List*** and **respond** to family values, universal brotherhood, fight against corruption by common man and good governance.

SUBCODE	**SUB NAME**	**L**	**T**	**P**	**C**
XUM 106	**HUMAN ETHICS, VALUES, RIGHTS AND GENDER EQUALITY**	**2**	**0**	**0**	**1**
C:P:A = 1.8:0:0.2		**L**	**T**	**P**	**H**
		1+2 * *SS	**0**	**0**	**3**

UNIT I	**7**
HUMAN ETHICS AND VALUES Human Ethics and values - Understanding of oneself and others- motives and needs- Social service, Social Justice, Dignity and worth, Harmony in human relationship: Family and Society, Integrity and Competence, Caring and Sharing, Honesty and Courage, Valuing Time, Co-operation, Commitment, Sympathy and Empathy, Self respect, Self-Confidence and Personality- Living in harmony at various levels.	
UNIT II GENDER EQUALITY	**9**
Gender Equality - Gender Vs Sex -, Concepts, definition, Gender equity, equality, empowerment. Status of Women in India Social, Economical, Education, Health, Employment, HDI, GDI, GEM. Contributions of Dr. B.R. Ambethkar, Thanthai Periyar and Phule to Women Empowerment.	
UNIT III WOMEN ISSUES AND CHALLENGES	**9**
Women Issues and Challenges- Female Infanticide, Female feticide, Violence against women, Domestic violence, Sexual Harassment, Trafficking, Access to education, Marriage. Remedial Measures – Acts related to women: Political Right, Property Rights, Right to Education, Medical Termination of Pregnancy Act, and Dowry Prohibition Act.	
UNIT IV HUMAN RIGHTS	**9**
Human Rights Movement in India – The preamble to the Constitution of India, Human Rights and Duties, Universal Declaration of Human Rights (UDHR), Civil, Political, Economical, Social and Cultural Rights, Rights against torture, Discrimination and forced Labour, Rights of Children. National Human Rights Commission and other statutory Commissions, Creation of Human Rights Literacy and Awareness. - Intellectual Property	

Rights (IPR). National Policy on occupational safety, occupational health and working environment.

UNIT V GOOD GOVERNANCE AND ADDRESSING SOCIAL ISSUES | **11**

Good Governance - Democracy, People's Participation, Open and Transparence governance, Corruption, Impact of corruption on society, on how and whom to make corruption complaints, fight against corruption and related issues and character building, Fairness in criminal justice administration, Government system of Redressal. Issues and intervention in situations of family violence, substance abuse and corruption. Creation of People friendly environment and universal brotherhood.

	LECTURE	SELF STUDY	TOTAL
	15	30	45

REFERENCES

1. Aftab A, (Ed.), Human Rights in India: Issues and Challenges, (New Delhi: Raj Publications, 2012).
2. Bajwa, G.S. and Bajwa, D.K. Human Rights in India: Implementation and Violations (New Delhi: D.K. Publications, 1996).
3. Chatrath, K. J. S., (ed.), Education for Human Rights and Democracy (Shimala: Indian Institute of Advanced Studies, 1998).
4. Jagadeesan. P. Marriage and Social legislations in Tamil Nadu, Chennai: Elachiapen Publications, 1990).
5. Kaushal, Rachna, Women and Human Rights in India (New Delhi: Kaveri Books, 2000)
6. Mani. V. S., Human Rights in India: An Overview (New Delhi: Institute for the World Congress on Human Rights, 1998).
7. Singh, B. P. Sehgal, (ed) Human Rights in India: Problems and Perspectives (New Delhi: Deep and Deep, 1999).
8. Veeramani, K. (ed) Periyar on Women Right, (Chennai: Emerald Publishers, 1996)
9. Veeramani, K. (ed) Periyar Feminism, (Periyar Maniammai University, Vallam, Thanjavur: 2010).
11. Planning Commission report on Occupational Health and Safety http://planningcommission.nic.in/aboutus/committee/wrkgrp12/wg_occup_safety.p
11. Central Vigilance Commission (Gov. of India) website: http://cvc.nic.in/welcome.html.

	CO1	CO2	CO3	CO4	CO5	Total	Scaled total
GA6	2	2	2	2	2	10	2
GA7	1				1	2	1
GA8	3	3	3	3	3	15	3
GA9			2	2	0	4	1
GA10			2	2	1	5	1

XMA 201 CALCULUS AND LAPLACE TRANSFORMS

SUBCODE			SUB NAME	L	T	P	C
XMA 201			CALCULUS AND LAPLACE TRANSFORMS	3	1	0	4
C	P	A					
3	0	0		L	T	P	H
				3	2	0	5

PREREQUISITE: Basic concepts of Differentiation, Integration, Vectors and Complex numbers.

COURSE OUTCOMES:

Course outcomes	Domain	Level
CO1: ***Make Use of*** standard results to ***Find*** the Laplace transforms of derivatives and integrals and to ***solve*** differential equations.	Cognitive	Remembering Apply
CO2: ***Apply*** multiple integral concepts to ***Find*** the area, volume and to understand the order of integration.	Cognitive	Remembering Apply
CO3: ***Define*** the gradient, divergent curl of vectors. ***Find*** directional derivative, unit vector normal to the surface. ***Apply*** corresponding theorems to ***Find*** the line, surface and Volume integrals.	Cognitive	Remembering Apply
CO4: ***Construct*** and examine the analytic functions, and their the complex Conjugate and to ***Explain*** the concept of conformal mapping and to ***Construct*** the bilinear transformation.	Cognitive	Understanding Apply
CO5: ***Explain*** the poles , singularities and residues of functions and to ***solve*** the problems using contour integration.	Cognitive	Understanding Apply

UNIT I LAPLACE TRANSFORMS **15**

Transforms of elementary functions – properties – derivatives and integrals of transforms- Transforms of derivatives and integrals - Transforms of unit step function and impulse function - Transform of periodic functions – Convolution Theorem – Inverse transforms – Solutions of differential and integral equations.

UNIT II MULTIPLE INTEGRALS **15**

Double integration – Cartesian and polar coordinates – change of order of integration - area as a double integral – change of variables between Cartesian and polar coordinates - triple integration-– Simple applications (Finding area & volume of a certain region).

UNIT III VECTOR CALCULUS	15
Gradient, divergence and curl - directional derivative – normal and tangent to a given surface – angle between two surfaces – irrotational and solenoidal vector fields - Line, Surface and Volume Integral – Green's theorem in a plane, Gauss divergence theorem and Stoke's theorem (excluding proof).	
UNIT IV ANALYTIC FUNCTIONS	**15**
Function of a complex variable – analytic function – necessary and sufficient condition (excluding proof) – Cauchy Riemann equations – properties of analytic functions - harmonic conjugate - construction of an analytic function – Conformal mapping: w= z + c, cz, $\frac{1}{z}$, sinz, coshz, $z+\frac{k^2}{z}$ - Bilinear transformation.	
UNIT V COMPLEX INTEGRATION	**15**
Statement and application of Cauchy's integral theorem and integral formula - Taylor's and Laurent's expansion - Residues – Cauchy's Residue Theorem - Contour integration over unit circle.	

LECTURE	TUTORIAL	TOTAL
45	30	75

TEXT

3. Grewal, B.S. Higher Engineering Mathematics, 41st Edition, Khanna Publication, Delhi, 2011.
4. Kreyszig, E, Advanced Engineering Mathematics, Eighth Edition, John Wiley and Son(Asia) Ltd, Singapore, 2001.

REFERENCES

5. Bali N.P and Narayana lyengar, Engineering Mathematics, Laxmi Publications (P) Ltd, New Delhi, 2003.
6. Veerarajan T, Engineering Mathematics Fourth Edition, Tata – McGraw Hill Publishing Company Ltd, New Delhi, 2005.
7. Kandasamy P., Thilagavathy K, and Gunavathy K, Engineering Mathematics Volume I, II and III, S. Chand & Co, New Delhi, 2005.
8. Venkataraman M. K, Engineering Mathematics, Volume I and II Revised enlarge Fourth Edition, The National Publishing Company, Chennai, 2004.

E REFERENCES

www.nptel.ac.in

1. Advanced Engineering Mathematics Prof. Jitendra Kumar
   Department of Mathematics Indian Institute of Technology, Kharagpur

	GA1	GA2	GA3	GA4	GA5	GA6	GA7	GA8	GA9	GA10	GA11	GA12
CO 1	3											1
CO 2	3											1
CO 3	3	2								1	1	2
CO 4	3	2			1					1	1	1
CO 5	3	2			1					1	1	1
	15	6	0	0	2	0	0	0	0	3	3	6

1 - Low , 2 – Medium , 3- high

XEM 202 ENGINEERING MECHANICS

Semester	SEMESTER II	
Subject Name	Engineering Mechanics (Common to all Branches)	
Subject Code	**XEM 202**	
Designed by	Department of Civil Engineering	
Prerequisite	Applied Physics	
L –T –P –C 3- 1 – 0- 4	C: P: A 2.6: 02: 0.2	L –T -P- H 3- 2 - 0 -5

Course Outcome:		**Domain**
CO1	***Identify*** and choose various types of loading and support conditions that act on structural and dynamic systems.	C(Understand)
CO2	***Apply*** pertinent mathematical, physical and engineering mechanics principles to the system to predict the problem.	C(Application)
CO3	***Display and Apply*** knowledge on the concepts of centroid and moment of inertia of various sections and solids.	C & A (Application) (Develop)
CO4	***Analyze and Model*** the problem using free-body diagrams and accurate equilibrium equations and finding the solution.	C(Analyze) , P (Model)
CO5	***Develop*** concepts of friction, rigid body kinematics and dynamics with an emphasis on the modeling and analysis and solving simple dynamic problems involving kinematics and momentum.	C(Create)

COURSE CONTENT		
` UNIT-I	**BASICS AND STATICS OF PARTICLES**	**15 hrs**
	Introduction - Units and Dimensions - Laws of Mechanics –Coplanar and Non coplanar Forces - Resolution and Composition of forces - Equilibrium of a particle - Equivalent systems of forces - Principle of transmissibility – single equivalent force.	

UNIT –II	**EQUILIBRIUM OF RIGID BODIES 15 hrs**
	Free body diagram - Types of supports and their reactions - requirements of stable equilibrium – Equilibrium of Rigid bodies in two dimensions - Equilibrium of rigid bodies in three dimensions.
UNIT-III	**PROPERTIES OF SURFACES AND SOLIDS 15 hrs**
	Determination of Areas and Volumes - First moment of area and the centroid - second and product moments of plane area - Parallel axis theorem and Perpendicular axis theorem - Polar moment of inertia – Mass moment of inertia - relation to area moment of inertia.
UNIT -IV	**DYNAMICS OF PARTICLES 15 hrs**
	Displacement, Velocity and Acceleration - their relationships - Relative motion - Curvilinear motion - Newton's Law - Work Energy Equation of particles - Impulse and Momentum - Impact of elastic bodies.
UNIT V	**ELEMENTS OF RIGID BODY DYNAMICS AND FRICTION 15 hrs**
	Translation and Rotation of Rigid Bodies - Velocity and acceleration - General Plane motion - Moment of Momentum Equations - Rotation of rigid Body - Work energy equation. Frictional Force - Laws of Coulomb friction - Simple Contact friction - Rolling Resistance - Belt Friction.
	L=45 hrs T -30 hrs

Text books

1. D.S.Kumar "A text book of Engineering Mechanics" Publishers S.K.Kataria and Sons , 2012
2. R.S.Khurmi "A Textbook of Engineering Mechanics" , S. Chand Publishers, 2011
3. Engineering Mechanics: Statics (14th Edition) by Russell C. Hibbeler , Best Sellers, 2015
4. Engineering Mechanics: Dynamics (14th Edition) by Russell C. Hibbeler , Best Sellers, 2015
5. Velusami.M.A. "Engineering Mechanics with Vector Approach": S.Chand Publishers, 2012
6. J. L. Meriam, L. G. Kraige "Engineering Mechanics: Dynamics",Sixth Edition 2012

References

1. Beer F.P and Johnson E.R., "Vector Mechanics for Engineers – Statics and Dynamics", Tata McGraw-Hill Publishing Company Ltd., New Delhi, 2001.
2. K.V.Natarajan, "Engineering Mechanics", Dhanalakshmi Publishers, Chennai, 2006.
3. Chandramouli, Engineering Mechanics, PHI Learning Pvt Ltd, 2011
4. Jayakumar and Kumar , Engineering Mechanics, PHI Learning Pvt Ltd, 2013

Mapping of CO's with GA 's:

	GA1	GA2	GA3	GA 4	GA5	GA6	GA7	GA 8	GA9	GA10	GA11	GA12
CO1	2	3	1	3								
CO2		3		2								
CO3									**2**			
CO4	3	3										**1**
CO5	3	3										

0 –No relation 1 - Low , 2 – Medium , 3 – High

XBW 203 MECHANICAL AND CIVIL ENGINEERING SYSTEMS

Semester	SEMESTER II		
Subject Name	Mechanical and Civil Engineering Systems		
Subject Code	XBW 203		
Prerequisite	Nil		
L –T –P –C 3- 1 - 1- 5	C:P:A 1.5:1.5:0	L –T –P –H 3- 2-2-7	

Course Outcome:		**Domain** (C or P or A)
CO1	***Define and visualize*** the working principles of the various boilers, turbines and engines	C & P (Knowledge)
CO2	***Differentiate and auscultate*** the measurements by using various metrology instruments	C and P (Comprehension)
CO3	***Categorise and palpate*** the various metal forming, joining and cutting processes	C and P (Synthesis)
CO4	***Characterize and diagonose*** the quality of the good Building materials; and measure linear and angular dimensions	C and P (Knowledge)
CO5	***Summarize and palpate*** the components of a substructures and super structures.	C and P (Evaluation)

COURSE CONTENT	
UNIT-I	**Basics of Thermal and Energy Systems 9+6+6 hrs**
	Introduction to Mechanical Engineering – Streams – Thermal, Design, and Manufacturing Conventional and non conventional sources of energy – Heat energy – Modes of heat transfer – Working principles of Boilers and Turbines – Classification of IC Engines – 4 stroke and 2 stroke engines – Petrol and diesel engines – Performance and heat balance – Working principles of hydel, steam and nuclear power plants. **Practical:** Petrol engine performance – BHP Diesel engine performance – BHP Demonstration of refrigeration and air conditioning units
UNIT –II	**Fundamentals of Machine Elements and Measurements 9+6+6 hrs**

	Engineering materials – Machine elements – fasteners and support systems – Belt drives – Types – Velocity ratio and Length of belt – Gear drives – Types – Velocity ratio. Principle of measurements – Accuracy – Precision – Errors – Measuring instruments – Scale – Vernier Caliper – Micrometer – Slip gauges – Spirit level. **Practical:** Measurements using Vernier Caliper, Micrometer, Slip gauges and Spirit level. Demonstration of transmission system in machines and suspension system in automobiles.
UNIT-III	**Elements of Manufacturing** **9+6+6 hrs**
	Manufacturing processes – Classification – Principles of metal forming – forging, moulding, casting – Principles of metal joining – welding, soldering and brazing. Machining – turning, drilling, milling and grinding – Machining time and material removal rate. **Practical:** Exposure to workshop tools Fitting exercises: Square and triangle Simple turning and drilling Demonstration of welding and mould preparation
UNIT -IV	**Surveying and Construction Materials** **9+6+6 hrs**
	Surveying: Definition – Survey Instruments – Classification of Survey – Linear and Angular Measurements – Measurement of area – Illustrative Examples. Construction Materials: Bricks – Stones – Timber – Steel – Cement – Sand – Aggregates – Concrete **Practical:** Surveying
UNIT V	**Components and of Construction of Civil Structures** **9+6+6 hrs**
	Substructure: Bearing capacity - Types of Foundation – Application – Requirement of good foundations. Superstructure: Brick masonry – Types of bond – Flooring – Beams – Columns – Lintels – Roofing – Doors and windows fittings – Introduction to bridges and dams – Building drawing

	Practical: Building drawing, Carpentry, Plumbing.
	Total Contact hrs (L-45 hrs & P-30&T-30 hrs)

Text books

1. Dr. P.K. Srividhya, P. Pandiyaraj, S. Balamurugan, "Basic Civil and Mechanical Engineering", PMU Publications, Vallam, 2013.
2. Dr. B.C.Punmia, Ashok Kumar Jain, "Basic Civil Engineering", Laxmi Publications, New Delhi, 2003.
3. Dr. B.C.Punmia, "Surveying – Volume I", Laxmi Publications, New Delhi, 2005

References

1. Venugopal K., Basic Mechanical Engineering, Anuradha Publications, Kumbakonam, 2007.
2. Shanmugam G. and Palanichamy M. S.,"Basic Civil and Mechanical Engineering", Tata Mc Graw Hill Publishing Co., New Delhi, 3rd Edition, 2009.

Mapping of CO's with GA's:

	GA1	GA2	GA3	GA4	GA5	GA6	GA7	GA8	GA9	GA10	GA11	GA12
CO1	**2**	**-**	**-**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO2	**2**			**2**		**1**	**-**	**-**	**-**	**-**	**-**	**-**
CO3		**2**			**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO4		**3**		**1**		**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO5	**1**	**1**			**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Total	**5**	**6**	**-**	**5**	**5**	**1**	**-**	**-**	**-**	**-**	**-**	**-**

1 - Low, 2 – Medium, 3 – High

XAC 204 APPLIED CHEMISTRY

COURSE CODE	COURSE NAME	L	T	P	C
XAC204	APPLIED CHEMISTRY	3	1	1	5
C:P:A = 2.8:0.8 :0.4					
		L	T	P	H
		3	2	2	7

COURSE OUTCOMES

CO1. Cog (R) and Psy (Perception): ***Identify*** and ***describe*** the various water quality parameters and methods to purify water in contest with boilers and domestics usage.

CO2. Cog (U) and Psy (Set) : ***Explain*** the fundamental principles of electrochemical reactions, its applications in redox reactions and calculate the different electrochemical processes.

CO3. Cog (Apply) ,Affec (Rece) and Psy (Mech): ***Interpret*** the types of corrosion, ***use*** *and* ***measure*** its control by various methods including protective techniques.

CO4. Cog (R &Analy) and Affec (Resp) ; ***Describe***, ***Illustrate*** and ***Discuss*** the generation of energy in batteries, nuclear reactors, solar cells, fuel cells and anaerobic digestion.

CO5. Cog (R &Apply) and Psy(Mech) ; ***Apply*** and ***measure*** the different types of spectral techniques for quantitative chemical analysis and ***list*** nanomaterials for various engineering processes.

Theory Part

UNIT - I WATER TECHNOLOGY	**7 + 8 +9**

Sources and types of water – water quality parameters – BIS and ISO specifications- hardness: types and estimation of hardness (problems) - alkalinity: types and estimation (problems) – boiler feed water – requirements – disadvantages of using hard water in boilers – internal treatment, external treatment – demineralization process – desalination using reverse osmosis – domestic water treatment - Effluent treatment processes in industries

UNIT - II ELECTROCHEMISTRY	**8+5 +15**

Basic concepts of conductance – Kohlraush's law and conductometric titrations –electrode potentials– Nernst equation: derivation and problems - reversible and irreversible cells – electrolytic and electrochemical cells – emf and its measurements - types of electrodes-reference electrodes - primary and secondary - glass electrode - determination of pH using quinhydrone and glass electrodes - electrochemical series and its applications - Galvanic cells and concentration cells - potentiometric titrations - redox titrations.

UNIT – III CORROSION AND PROTECTIVE COATINGS	**9 + 4 +3**

Corrosion- causes- types-chemical, electrochemical corrosion (galvanic, differential aeration), corrosion in electronic devices, corrosion control - material selection and design aspects - electrochemical protection – sacrificial anode method and impressed current cathodic method.

Protective coatings: paints- constituents and functions - electroplating of copper and gold, Electroless plating - Distinction between electroplating and electroless plating,
advantages of electroless plating, electroless plating of nickel and copper on PCB.

UNIT –IV ENERGY STORAGE DEVICES AND NUCLEAR ENERGY	12 + 7

Energy storage devices – Batteries: Types – primary (dry cell, alkaline cells) and secondary (lead acid, Ni-Cd and Lithium ion batteries) - Supercapacitors – Fuel cells-Hydrogen-Oxygen fuel cell- Solar cells .

Nuclear energy: nuclear fission and fusion –chain reaction and its characteristics – nuclear energy and calculations (problems) – atom bomb –Nuclear reactor- light water nuclear power plant – breeder reactor- Weapon of mass destruction- nuclear, radiological, chemical and biological weapons. Disarmament - National and International Cooperation- Chemical Weapon Convention (CWC), Peaceful Uses of Chemistry. Bio fuels: biomethanation- anaerobic digestion process, biomass: sources and harness of energy.

UNIT –V SPECTROSCOPY AND NANOCHEMISTRY	9 +6 +3

Electromagnetic spectrum - Lambert law and Beer-Lambert's law (derivation and problems) – molecular spectroscopy -UV- visible spectroscopy: electronic transitions - chromophores and auxochromes – instrumentation (block diagram) - applications – IR spectroscopy: principle – fundamental modes of vibrations – calculations of vibrational frequency – IR spectrophotometer instrumentation (block diagram) – applications of IR spectroscopy.

Nanochemistry - Basics - distinction between molecules, nanoparticles and bulk materials; size-dependent properties. Nanoparticles: Nanocluster, nanorod, nanotube and nanowire. Synthesis ; properties and applications of nano materials-Buckminister fullerenes, CNT"S(Single walled carbon nano tubes and Multi-walled carbon tubes)-Graphene- advantages and applications.

TEXT BOOKS

1. Jain and Jain , "A Text book of Engineering Chemistry", Dhanapatrai Publications,New Delhi, 2011.
2. Gadag and NityanandaShetty , "Engineering Chemistry", I.K International publishing House Pvt. Ltd, 2010.
3. P. Atkins, J.D. Paula , "Physical Chemistry" , Oxford University Press, 2009.
4. S. S. Dara, S. S. Umare, "A Text Book of Engineering Chemistry", S. Chand Publishing, 2011
5. C.P. Poole and F.J. Owens, " Introduction to Nanotechnology", , Wiley, New Delhi ,2007.

REFERENCE BOOKS

1. Puri B R Sharma L R and Madan S Pathania, " Principles of Physical Chemistry", Vishal publishing Co., Edition 2004
2. Kuriocose, J C and Rajaram, J, "Engineering Chemistry", Volume I/II, Tata McGraw-Hill Publishing Co. Ltd. New Delhi, 2000

E Resources - MOOCs:

1. http://www.mooc-list.com/course/chemistry-minor-saylororg
2. https://www.canvas.net/courses/exploring-chemistry
3. http://freevideolectures.com/Course/2263/Engineering-Chemistry-I
4. http://freevideolectures.com/Course/3001/Chemistry-I
5. http://freevideolectures.com/Course/3167/Chemistry-II
6. http://ocw.mit.edu/courses/chemistry/

Laboratory Part **30 hrs**

1. Determination of total hardness, temporary and permanent hardness of water by EDTA

method.

2. Determination of alkalinity of water sample.
3. Determination of chloride content of water sample by Argentometric method.
4. Conductometric titration of a strong acid with a strong base.
5. Determination of strength of hydrochloric acid by pH metric method.
6. Conductometric precipitation titration using barium chloride and sodiumsulphate.
7. Determination of strength of iron by potentiometric method using dichromate.
8. Potentiometric acid-base titration using quinhydrone electrode.
9. Corrosion inhibition efficiency by weight loss method.
10. Estimation of iron by colorimetric method.

REFERENCE BOOKS

1. Mendham, Denney R.C,. Barnes J.D and Thomas N.J.K., "Vogel's Textbook of Quantitative Chemical Analysis", 6th Edition, Pearson Education, 2004.
2. Garland, C. W.; Nibler, J. W.; Shoemaker, D. P. "Experiments in Physical Chemistry", 8th Ed.; McGraw-Hill: New York, 2003.
3. Sirajunnisa.A., Sundaranayagi.S.,Krishna.,Rajangam.R.,Gomathi.S., "Applied Chemistry Lab Manual", Department of Chemistry, PMU Press, Thanjavur, 2016.

E Resources - MOOCs:

1.http://freevideolectures.com/Course/2380/Chemistry-Laboratory-Techniques
2. http://freevideolectures.com/Course/2941/Chemistry-1A-General-Chemistry-Fall-2011
3.http://ocw.mit.edu/courses/chemistry/5-301-chemistry-laboratory-techniques

	LECTURE	TUTORIAL	PRACTICAL	TOTAL HOURS
	45	**30**	**30**	**105**

	GA1	GA2	GA3	GA4	GA5	GA6	GA7	GA8	GA9	GA10	GA12
CO1	3	3	3			1	2	1	1	1	2
CO2	2	1	0			1		1	1		1
CO3	3	3	3	2	2	1	2		1	1	1
CO4	3	3	2	2	2	1	2		1	1	1
CO5	2	2	1	1	1	1	1	1	1		1
Total	**13**	**12**	**9**	**5**	**5**	**5**	**7**	**3**	**5**	**3**	**6**

0-No relation 1 – Low relation, 2 – Medium relation, 3 – High relation

XEG 205 ENGINEERING GRAPHICS

Subject Name	Engineering Graphics	L	T	P	C
Subject Code	XEG 205	2	1	0	3
Prerequisite	Nil	L	T	P	H
C:P:A	0.66 : 0.66 : 0.66	2	2	0	4

Course Outcome		**Domain** (C or P or A)
CO1	***Apply*** the national and international standards, ***construct*** and ***practice*** various curves	C(Ap), P(GR) and A(Res)
CO2	***Interpret***, ***construct*** and ***practice*** orthographic projections of points, st. lines and planes.	C(Under) ,P(Mech) and A(Res)
CO3	***Construct Sketch*** and ***Practice*** projection of solids in various positions and true shape of sectioned solids.	C(Apply) ,P(CoR) and A(Res)
CO4	***Interpret***, ***Sketch*** and ***Practice*** the development of lateral surfaces of simple and truncated solids, intersection of solids.	C(Under) ,P(CoR) and A(Res)
CO5	***Construct***,***sketch*** and ***practice*** isometric and perspective views of simple and truncated solids.	C(Apply) ,P(CoR) and A(Res)

COURSE CONTENT		
`UNIT-I	**INTRODUCTION, FREE HAND SKETCHING OF ENGG OBJECTS AND CONSTRUCTION OF PLANE CURVE**	**6+6**
	Importance of graphics in engineering applications – use of drafting instruments – BIS specifications and conventions as per SP 46-2003. Pictorial representation of engineering objects – representation of three dimensional objects in two dimensional media – need for multiple views – developing visualization skills through free hand sketching of three dimensional objects. Polygons & curves used in engineering practice – methods of construction – construction of ellipse, parabola and hyperbola by eccentricity method – cycloidal and involute curves – construction – drawing of tangents to the above curves.	
UNIT–II	**PROJECTION OF POINTS, LINES AND PLANE SURFACES**	**6+6**
	General principles of orthographic projection – first angle projection – layout of views – projections of points, straight lines located in the first quadrant – determination of true lengths of lines and their inclinations to the planes of projection – traces – projection of polygonal surfaces and circular lamina	

	inclined to both the planes of projection.	
UNIT-III	**PROJECTION OF SOLIDS AND SECTIONS OF SOLIDS**	**6+6**
	Projection of simple solids like prism, pyramid, cylinder and cone when the axis is inclined to one plane of projection – change of position & auxiliary projection methods – sectioning of above solids in simple vertical positions by cutting plane inclined to one reference plane and perpendicular to the other and above solids in inclined position with cutting planes parallel to one reference plane – true shapes of sections.	
UNIT-IV	**DEVELOPMENT OF SURFACES AND INTERSECTION OF SOLIDS**	**6+6**
	Need for development of surfaces – development of lateral surfaces of simple and truncated solids – prisms, pyramids, cylinders and cones – development of lateral surfaces of the above solids with square and circular cutouts perpendicular to their axes – intersection of solids and curves of intersection – prism with cylinder, cylinder & cylinder, cone & cylinder with normal intersection of axes and with no offset.	
UNIT V	**ISOMETRIC AND PERSPECTIVE PROJECTIONS**	**6+6**
	Principles of isometric projection – isometric scale – isometric projections of simple solids, truncated prisms, pyramids, cylinders and cones – principles of perspective projections – projection of prisms, pyramids and cylinders by visual ray and vanishing point methods.	

	LECTURE: 30	**TUTORIAL: 30**	**TOTAL :60**

TEXT BOOKS

1. Bhatt,N.D, "Engineering Drawing", Charotar Publishing House, 46th Edition-2003.
2. Natarajan,K.V, " A Textbook of Engineering Graphics", Dhanalakshmi Publishers, Chennai, 2006 .
3. Dr. P.K. Srividhya, P. Pandiyaraj, "Engineering Graphics", PMU Publications, Vallam, 2013

REFERENCES

1. Luzadder and Duff, "Fundamentals of Engineering Drawing" Prentice Hall of India PvtLtd, XI Edition - 2001.
2. Venugopal,K. and Prabhu Raja, V., "Engineering Graphics", New Age International(P) Ltd., 2008.
3. Gopalakrishnan.K.R,. "Engineering Drawing I & II", Subhas Publications, 1998.
4. Shah,M.B and Rana,B.C.,"Engineering Drawing", Pearson Education,2005.

E RESOURCES

1. http://periyarnet/Econtent
2. http://nptel.ac.in/courses/112103019/

Mapping of CO's with GA:

	GA1	GA2	GA3	GA4	GA5	GA12
CO1	3	2	3	1	1	1
CO2	3	2	1	1	1	1
CO3	3	2	1	1	1	1
CO4	3	2	1	1	1	1
CO5	3	2	1	1	1	1
Total	15	10	7	5	5	5
Scaled	3	2	2	1	1	1

1 – Low Relation, 2 – Medium Relation, 3 – High Relation

XGS 206 SPEECH COMMUNICATION

COURSE CODE	SUBJECT NAME			Category		
		L	T	P	SS	Credits
XGS 206	Speech Communication	1	0	0	2	1
C:P:A		L	T	P	SS	Hour
1.6:1:0.4		1	0	0	2	3

COURSE OUTCOMES (COs)

CO1: Cog: R: I***dentify*** different styles to various forms of public speaking skills and presentation skills.

CO2:Cog: U: ***Understand*** and identify the proper tone of language required in writing and speaking.

CO3: Psy: A: ***Adapting*** the speech structures and developing the speech outline.

CO4: Aff: R: Ability to ***communicate*** and develop presentation skills.

CO5: Psy: R: **Calibrates** the speaker to face the audience without any anxiety.

SYLLABUS

UNIT	Content	Hours Allotted
I	**Introduction to public speaking** Functions of oral communication; skills and competencies needed for successful speech making; importance of public speaking skills in everyday life and in the area of business, social, political and all other places of group work	9
II	**Types of Speech** Manuscript, impromptu, rememorized and extemporaneous speeches; analyzing the audience and occasion; developing ideas; finding and using supporting materials.	9
III	**Organization of Speech** Introduction, development and conclusion; language used in various types of speeches; Adapting the speech structures to the Audience; paralinguistic features	9
IV	**Basic tips** how to present a paper/assignment etc; using visual aids to the speeches; using body language to communicate.	9
V	**Speech Anxiety** Public speaking and speech anxiety, public speaking and critical listening Speech practice (4-6 speeches per student)	9

Lecture	Self Study	Total
15 Hours	25 Hours	45 Hours

TEXT

1. Gordon H. Mills Technical Writing –Oxford Press, 1978
2. Barun K. Mitra, Effective Technical Communication: A guide for scientists and Engineers. Author, Publication: Oxford University press. 2007

Mapping of COs with GAs:

	GA1	GA2	GA3	GA4	GA5	GA6	GA7	GA8	GA9	GA10	GA11	GA12
CO1										2		
CO2										**2**		
CO3				2						**1**		
CO4												1
CO5				2						**1**	2	1

XCH 207 INTRODUCTION TO CHEMICAL ENGINEERING

COURSE OUTCOMES (COs)

CO1: Cog: U: ***Explain*** the salient features of chemical engineering field.
CO2: Cog: R: ***Understand the different aspects of chemical engineering education***.
CO3: Cog Analyse: Ability to ***Analyze*** chemical engineering resources in internet.

SEMESTER I					
COURSE CODE	**SUBJECT NAME**	**Category**			
		L	**T**	**P**	**Credits**
XCH 207	Introduction to Chemical Engineering	**2**	**0**	**0**	**0**
C:P:A		**L**	**T**	**P**	**Hours**
2:0:0		**2**	**0**	**0**	**2**

UNIT	Content	Hours Allotted
I	**Unit-I Introduction:** Introduction to chemical engineering; history of chemical engineering and chemical technology; Scope of Chemical Engineering - Overview of chemical industries in India and abroad – Major chemical industries and their importance	**8**
II	**Unit-II Various Aspects of Chemical Engieering:** Introduction of various aspects of chemical Engineering – Features of organized chemical processing- from chemistry to chemical engineering - Unit operations – Unit processes – flow sheets – material and energy balances – thermodynamics – heat and mass transfer – chemical reaction engineering – fluid mechanics – process equipments etc.,	**8**
III	**Unit-III Chemical Engineering Resources:** Introduction to chemical engineering resources in internet – Magazines and journals – research trends – Future challenges – Chemical Engineering societies/organization Case study and Industrial visit	**8**
	Lecture **24 Hours** / **Total** **24 Hours**	

Text Books:

1. S.K. Ghosal, S.K., Sanyal and S. Datta, *Introduction to Chemical Engg.*, TMH Book Company, 1998.

References:

1. McCabe and Smith. *Unit operations in Chemical Engineering*, McGraw Hill, Co.2005.
2. Badger and Banchero, *Introduction to Chemical Engineering*, McGraw Hill, Co.2000.
3. www.sciencedirect.com
4. http://nptel.ac.in/course.php?disciplineId=103

Mapping COs with POs

	GA1	GA2	GA3	GA4	GA5	GA6	GA6	GA7	GA8	GA9	GA10	GA11	GA12
CO1		**1**	**2**	**2**									
CO2		**3**	**2**	**1**									
CO3		**1**	**2**		**2**			**1**		**1**			**1**
Total		**5**	**6**	**3**	**2**			**1**		**1**			**1**

XMA 301 TRANSFORMS AND PARTIAL DIFFERENTIAL EQUATIONS

SUBCODE			SUB NAME	L	T	P	C
XMA 301			TRANSFORMS AND PARTIAL DIFFERENTIAL EQUATIONS	3	1	0	4
C	P	A					
3	0	0		L	T	P	H
				3	2	0	5

PREREQUISITE: Algebra , Calculus and Laplace transforms

COURSE OUTCOMES:

Course outcomes:	Domain	Level
CO1: ***Explain*** and ***Demonstrate*** the basic concepts in partial differential equations and to ***solve*** linear, nonlinear, homogeneous and nonhomogeneous partial Differential equations.	Cognitive	Remembering Understanding
CO2: ***Demonstrate*** the basic concept and properties of Fourier series and to ***state*** Parseval's identity and Diritchlet's condition.	Cognitive	Remembering Understanding
CO3: ***Solve*** the standard Partial Differential Equations, arising in engineering Problems, like Wave equation and Heat flow equation by Fourier series method.	Cognitive	Apply
CO4: ***Explain*** and ***Apply*** the concept of Fourier transform and its properties.	Cognitive	Understanding Apply
CO5: ***State*** and ***Apply*** the properties of Z transform and to ***Find*** the Z transform and inverse Z transform .	Cognitive	Remembering Apply

UNIT I Partial Differential Equations	**15**
Formation of partial differential equations by elimination of arbitrary constants and arbitrary functions – Solution of standard types of first order partial differential equations – Lagrange's linear equation – Linear partial differential equations of second and higher order with constant coefficients.	
UNIT II Fourier Series	**15**
Dirichlet's conditions – General Fourier series – Odd and even functions – Half range sine series – Half range cosine series –Parseval's identity – Harmonic Analysis.	
UNIT III Applications of Boundary Value Problems	**15**
Classification of second order quasi linear partial differential equations – Solutions of one dimensional wave equation – One dimensional heat equation – Steady state solution of two dimensional heat equation (Insulated edges excluded) – Fourier series solutions in Cartesian coordinates.	
UNIT IV Fourier Transform	**15**

Fourier integral theorem (without proof) – Fourier transform pairs – Fourier Sine and Cosine transforms – properties – Transforms of simple functions – Convolution theorem – Parseval's identity.

UNIT V Z – Transform and Difference Equations | **15**

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

	LECTURE	TUTORIAL	TOTAL
	45	30	75

TEXT

1. Grewal, B.S., "Higher Engineering Mathematics", 40th Edition Khanna Publishers, New Delhi, (2007).
2. Narayanan, S., Manicavachagom Pillay, T.K. and Ramaniah, G., "Advanced Mathematics for Engineering Students", Volumes II and III, S.Viswanathan (Printers and Publishers)Pvt. Ltd. Chennai, (2002).

REFERENCES

1. Churchill, R.V. and Brown, J.W., "Fourier Series and Boundary Value Problems", Fourth Edition, McGraw Hill Book Co., Singapore, (1987).
2. Kandasamy, P., Thilagavathy, K., and Gunavathy, K., " Engineering Mathematics Volume III", S. Chand & Company Ltd., New Delhi, (1996).
3. Bali N.P. and Manish Goyal, "A Text Book of Engineering Mathematics" 7th Edition Lakshmi Publications (P) Limited, New Delhi, (2007)

E REFERENCES

www.nptel.ac.in

2. Advanced Engineering Mathematics, Prof. Jitendra Kumar , Department of Mathematics, Indian Institute of Technology, Kharagpur.

	GA1	GA2	GA3	GA4	GA5	GA6	GA7	GA8	GA9	GA10	GA11	GA12
CO 1	3									1		1
CO 2	3									1		1
CO 3	3	2								1	1	2
CO 4	3	2			1					1	1	1
CO 5	3	2			1					1	1	1
	15	6	0	0	2	0	0	0	0	5	3	6

1 - Low , 2 – Medium , 3- high

XCH 302 CHEMICAL PROCESS CALCULATIONS

CO 1: Cog (Understand): ***Explain*** the different methods to express composition of mixtures.

CO 2: Cog (Understand, Apply): ***Classify*** and ***solve*** the problems involving material balances.

CO 3: Cog (Understand, Apply): ***Classify*** and s***olve*** problems involving humidity and drying.

CO 4: Cog (Understand, Apply): ***Classify*** and ***solve*** problems involving fuels and combustion.

CO 5: Cog (Understand, Apply): ***Classify*** and s***olve*** the problems involving energy balances.

SUBCODE	**SUB NAME**	**L**	**T**	**P**	**C**
XCH302	Chemical Process Calculations	3	1	0	4
C:P:A = 3:0:0					
		L	**T**	**P**	**H**
		3	2	0	**5**

Unit-I Units and Dimensions **8+3**

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

Unit –II Material Balances **10+4**

Stoichiometric principles, Application of material balance to unit operations like distillation, evaporation, crystallization, drying etc., - Material balance with chemical reaction - Limiting and excess reactants - recycle - bypass and purging.

Unit-III Humidification and Drying: **8+2**

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

Unit-IV Fuels And Combustion **9+2**

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

Unit-V Thermo Physics & Thermochemistry **10+4**

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

	LECTURE	**TUTORIAL**	**TOTAL**
	45	**15**	**60**

TEXT

1. Himmelblau, D.M., "*Basic Principles and Calculations in Chemical Engineering*", Sixth Edition, Prentice Hall Inc., 2003.
2. Bhatt, B.L. and Vora, S.M., Stoichiometry (SI Units, Third Edition, 1996, Tata Mc Graw Hill Publishing Ltd., New Delhi, 1996
3. K.V.Narayanan and Lakshmikutty, Chemical Process Calculations, Prentice Hall, 2004.

REFERENCES

1. M. Coulson, J.F. Richardson, with J.R. Backhurst and J.H. Harker, Coulson "Richardson, *Chemical Engineering*, Volume-1" , 6th ed., Butterworth-Heinemann, 1999
2. K.A. Gavhane, "Introduction to Process Calculations and Stoichiometry"

E REFERENCES

1. NPTEL Lectures (http://www.nptel.ac.in/courses/103103035/33)

CO's versus GA's mapping

CO/GA	GA 1	GA 2	GA 3	GA 4	GA 7	GA 11
CO 1	2	3	1	0	0	1
CO 2	1	3	2	1	1	1
CO 3	1	3	1	0	1	0
CO 4	1	3	1	0	1	0
CO 5	1	3	1	1	1	1
Original	**6**	**15**	**6**	**2**	**4**	**3**
Scaled	**2**	**3**	**2**	**1**	**1**	**1**

XCH303 Chemistry for Chemical Engineers

CO1. **Cog:** (Remembering, Understanding) ***Define*** *and* ***Classify*** mechanism, thermodynamics and kinetics for unit processes in organic synthesis. **Psy:** (Mechanism) ***Measure*** the kinetics and order of reactions

CO2. **Cog:** (Remembering, Understanding) ***Define*** and ***Relate*** transition metals with co-ordination chemistry.

CO3. **Cog:** (Understanding, Applying) ***Explain*** and ***Experiment with*** Adosrption and Catalyst, theories and applications. **Psy:** Measure the adsorption rate and catalyst performance.

CO4. **Cog:** (Remembering, Understanding) ***Define*** and ***Classify*** the stereochemistry concepts.

CO5. **Cog:** (Remembering, Understanding) ***Define*** and ***Classify*** the biomolecules. **Psy:** (Mechanism) **Measure** the glucose and protein contents.

SUBCODE	**SUB NAME**	**L**	**T**	**P**	**C**
XCH303	Chemistry for Chemical Engineers	**3**	**0**	**1**	**4**
C:P:A = 3:1:0					
		L	**T**	**P**	**H**
		3	0	2	**5**

Unit-I Unit processes in organic synthesis	**9+6**
Mechanism, thermodynamics and kinetics of nitration, Halogenation, sulphonation and sulphation, nitrating, sulphonating and sulphating agents, egs- preparation of nitrobenzene, nitroacetanilide, preparation of chloral and vinyl chloride, preparation of dodecylbenzene sulphonate, preparation of lauryl alcohol and dimethyl ether.Details of equipment used in the Unit processes.	
Unit-II Transition metals and Co-ordination chemistry	**9+6**
Electronic configuration of first series transition metals, shapes of d- orbital characteristics (variable oxidation states, magnetic property, color of transition metal compounds). Ligands, C.N. and geometry , nomenclature of complexes, chelates . Theories of co-ordination- i) Werner ii) EAN iii) VBT for tetrahedral and octahedral complexes iv) CFT (including crystal field splitting in octahedral field and tetrahedral field, CFSE for octahedral complexes , applications of CFT)	
Unit-III: Adsorption	**9+6**
Introduction to Freundlich and Langmuir theories of adsorption (revision) ,adsorption from solution, B.E.T. Theory of adsorption of gases, ,activation energy Catalysis: characteristics, types, adsorption theory of catalysis, promoters, poisons, enzyme catalysis, industrial applications of catalysts; i) Zeolites- structure, properties (adsorption, catalysis), applications as catalyst for reactions(amination of alcohol. NO x pollution control, alkylation ,cracking conversion of methanol), ii) Co-ordination catalysts- In Wacker process, carbonylation, photolysis of water iii) Oxide catalysts- oxide surface structure, application of V_2O_5, $Fe_2(MoO_4)$ for oxidation.	
Unit-IV Stereochemistry	**9+**

	6
Basic concepts, conformation isomerism of ethane, propane, butane, cyclohexane, monosubstituted cyclohexane, optical isomerism with 1 and 2 chiral centres, AA, AB type, erythro, threo, meso diastereomerism, geometrical isomerism (compounds with one double bond)	
Unit-V Biomolecules	**9+ 6**
Carbohydrate: Classification, reactions of glucose, D. L configuration, Cyclic structure of glucose, cellulose, starches. Cellulose acetate, nitrate, ether. Proteins-formation of peptide linkage, features of peptide linkage, alpha-helical configuration, beta-pleated structure, primary, secondary, tertiary, quaternary structures of proteins. Amino acids-alpha- amino acids, classification, properties and reactions. General introduction of cofactors and coenzymes, catalytic site of enzyme, factors affecting enzyme activity, classification of enzymes. Vitamins and hormones (in short)	

List of experiments:

1. Adsorption of acetic acid on charcoal to verify Freundlich isotherm
2. Determination of purity of sod. Carbonate by titration method
3. Preparation of tris ethylene diammine nickel (II) thiosulphate
4. Preparation of tetramine copper (II) sulphate, pot. trioxalato aluminate
5. Preparation of osazone derivative of glucose
6. Estimation of glucose/acetone in solution
7. Oxidation of toluene to benzoic acid by oxidation with KMnO4
8. Conversion of benzoic acid into its anilide derivative and its crystallization
9. Purification of organic compounds by crystallization and sublimation (one each)
10. Determination of chloride content by Mohrs method
11. Preparation of nitrobenzene
12. Sulphonation of benzene/toluene
13. Protein Estimation
14. Enzyme kinetics

Any 12 experiments

	LECTURE	**PRACTICAL**	**TOTAL**
	45	**30**	**75**

TEXT

1. I.L.Finar, Organic Chemistry- vol 1 and 2, 6th Edition, Pearson Education, 2002
2. Arun Bahl and B.S.Bhal, A textbook of Organic Chemistry, 21st Edition, S.Chand & Co, NewDelhi
3. Puri and Sharma, Principle of Physical Chemistry, 46th Edition, Vishal Publishing, 2013.
4. Ernest L. Eliel, Samuel H. Wilen, Stereochemistry of Organic Compounds, First Edition, Wiley Publishing, 1994
5. Voet and Voet, Biochemistry, 4th Edition, Wiley Publishing, 2010.

REFERENCES

1. A.I.Vogel., "*Qualitative Inorganic analysis* ", V.Edition, Prentice-Hall of India (P) Ltd., New Delhi, 1991

E REFERENCES

1. NPTEL Lectures
2. www.vlab.co.in

CO's Versus GA's mapping

CO/GA	GA 1	GA 2	GA 3	GA 4	GA 7	GA 12
CO1	2	2	1	2	1	1
CO2	2	1	0	0	0	0
CO3	2	2	1	2	1	1
CO4	2	0	0	0	0	0
CO5	2	0	0	0	0	0
Original	10	5	2	4	2	2
Scaled	2	1	1	1	1	1

XCH304 Fluid Mechanics

CO1. Cog: (Remembering, Understanding) ***List*** *and* ***Classify*** of fluids and measure pressure difference for flow of fluids.

CO2. Cog: (Understanding) ***Explain*** the characteristics of fluid statics and pressure measurement through manometers

CO3. Cog: (Analyse) ***Analyse*** the flow rate of fluids using flow measuring devices

CO4. Cog: (Analyse) ***Categorize*** the characteristics of incompressible fluid flows.

CO5. Cog: (Applying) ***Apply*** th***e*** mathematical relations using Dimensional analysis by Rayleighs and Buckinghm –π method.

CO6. Cog: (Remembering, Understanding) ***Select and Compare*** the various types of pumps, transportation and metering devices for fluid handling

SUBCODE	**SUB NAME**	**L**	**T**	**P**	**C**
XCH304	**Fluid Mechanics**	3	1	1	5
C:P:A = 4:1:0					
		L	**T**	**P**	**H**
		3	2	2	**7**

Syllabus:

Unit-I Introduction: Fluids, Properties of fluids, Classification of fluids, Newton's law of viscosity, Rheological classification of fluids, Pressure and temperature dependence, Types of flow, Lines to describe the flow, Application of fluid flow in Chemical Engineering.	**8+2=10**
Unit-II Fluid Statistics And Its Applications: Hydrostatic equilibrium, Parametric equation, Hydrostatic equilibrium in centrifugal field; Concept of atmospheric, gauge and absolute pressure, manometers, pressure measurement by simple and differential manometer.	**8+3+9=20**
Unit-III Basic Equations Of Fluid Flow And Flow Measuring Devices: Basic equations of fluid flow: Continuity equation, equation of motion, Flow measurement using Venturimeter, Orificemeter, Rotameter & Pitot Tube.	**6+3+9=18**
Unit-IV Flow of Incompressible Fluids In Conduits: Shear stress distribution, Relation between skin friction and wall shear, The friction factor; Laminar flow through circular pipe, on inclined plane, through annular space; Relation between average and maximum velocity, Major and Minor Loses, Darcy Weisbach equation, Friction factor chart	**9+3+3=15**
Unit-V Boundary Layer and Dimensional Analysis: Concept of hydrodynamic boundary layer, Growth over a flat plate, Different thickness of boundary layer, Fundamental dimensions of quantities, Dimensional homogeneity, Dimensional analysis by Rayleigh's method and Buckingham's method, Dimensionless numbers.	**7+3+2=12**
Unit-VI Flow Past Immersed Bodies And Transportation Of Fluids: Drag and drag coefficient, Flow through beds of solids, Motion of particles through fluids, fluidization, pipes and tubings, Joints and fittings, Major and minor	9+3+3=15

losses, Different types of valves, Pumps: Centrifugal pump, Performance of centrifugal pumps.	
Lecture Hours	**47**
Tutorial Hours	**17**
Practical Hours	**26**
Total Hours	**90**
Practicals: 1. Determination of viscosity. 2. Reynolds experiment to determine laminar and turbulent flow. 3. Flow through packed bed 4. Calibration of venturimeter 5. Calibration of orifice meter 6. Flow through pipe fitting(Minor Losses) 7. Determination of friction factor (Major Losses) 8. Verification of Darcy's law 9. Characteristics of centrifugal pump 10. Verification of stokes law 11. Calibration of rotameter 12. Verification Of Bernoulli theorem 13. Flow through fluidized bed column Minimum 10 Practical from the above list should be performed	
Text Books: 1. Noel. D. Nevers, "*Fluid Mechanics for Chemical Engineers*", McGraw Hill, 3rd International Edition, 2005 2. McCabe and Smith. *Unit operations in Chemical Engineering*, McGraw Hill, Co.2005. 3. R K Bansal, "*A Textbook of Fluid Mechanics and Hydraulic Machines*", 9th ed. Laxmi Publications, New Delhi, 2004 4. R.W. Fox, A.T. MacDonald and P.J. Pritchard, *Introduction to Fluid Mechanics* Wiley, 2008	
References: 1. NPTEL Lectures 2. M. Coulson, J.F. Richardson, with J.R. Backhurst and J.H. Harker, Coulson "Richardson, *Chemical Engineering*, Volume-1" , 6th ed., Butterworth-Heinemann, 1999 3. www.vlab.co.in	

CO's Versus GA's mapping

CO/GA	GA 1	GA 2	GA 3	GA 4	GA 7	GA 12
CO1	2	2	1	0	1	2
CO2	2	2	1	1	1	2
CO3	2	2	1	0	0	0
CO4	3	2	1	0	1	0
CO5	3	2	1	1	1	1
CO6	3	2	1	1	0	1
Original	15	12	6	3	4	6
Scaled	3	3	2	1	1	2

XCH305 CHEMICAL ENGINEERING THERMODYNAMICS

CO1. Cog (Understanding): ***Classify*** the basic thermodynamic terminology and scope, thermodynamics laws and their applicability and limitations.
CO2. Cog (Understanding, Applying): ***Interpret*** and ***Apply*** the equation of state to Explain the P-V-T behavior of gases and/or liquids.
CO3. Cog (Understanding, Applying): ***Relate*** and ***Solve*** the changes in U, H, S and G for ideal gases, and also for non-ideal gases through the thermodynamic property relations.
CO4. Cog (Understanding, Applying): ***Classify*** and ***Apply*** thermodynamic equations to properties of solutions.
CO5. Cog (Understanding, Applying): ***Compare*** and ***solve*** phase equilibria of pure component and mixtures of thermodynamic properties.

SUBCODE	SUB NAME	L	T	P	C
XCH305	Chemical Engineering Thermodynamics	3	1	0	4
C:P:A=3:0:0					
		L	**T**	**P**	**H**
		3	**2**	**0**	**5**

Syllabus:	
Unit-I Introduction to Chemical Engineering Thermodynamics and First Law: The scope of thermodynamics, fundamental and derived quantities, First law of thermodynamics: Formation of 1st law of thermodynamics, state and path functions, thermodynamic systems, steady state flow system, phase rule, reversible process heat capacity.	9+3
Unit-II Volumetric Properties of Pure Fluids: The P.V.T. behavior of pure substance, the viral equation, the ideal gas, the constant volume, constant pressure, adiabatic, polytrophic processes, real gas, applications of Viral equation, critical properties, vander Waal equation, Benedict- Webb – Rubin equation, Redlich –Kwong equation.	9+3
Unit-III Thermodynamic Properties of Fluids: Fundamental property relations for closed systems, Maxwell relationships, residual properties, residual properties by equations of state, two-phase systems, Clausius-Clapeyron equation, type of thermodynamic diagram, availability.	9+3
Unit – IV 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.	9+3
Unit–V Phase Equilibria: Pure component and mixtures-Latent heat correlation-van Laar, Margules equations - Gibbs'-Duhem equation-consistency tests - partially miscible and immiscible systems-Azeotropes-retrograde condensation-thermodynamics diagram	9+3
LECTURE / **TUTORIAL**	**TOTAL**

45	15	60

Textbooks:

1. Smith J.M., Van Ness H.C., Abbot M.M. "Chemical Engineering Thermodynamics". 6th Edition. McGraw-Hill, 2001.
2. Narayanan K.V. "A Text Book Of Chemical Engineering Thermodynamics". Prentice Hall India, 2001.

References:

5. NPTEL Lectures
6. Y.V.C.Rao, Chemical Engineering Thermodynamics, Prentice Hall, 2005

CO's Versus GA's mapping

CO/GA	GA 1	GA 2	GA 3	GA 4	GA 7	GA 12
CO1	2	2	1	0	0	2
CO2	2	2	2	1	1	2
CO3	2	2	1	0	1	0
CO4	2	1	1	0	1	0
CO5	2	1	1	1	1	0
Original	10	8	6	2	4	4
Scaled	2	2	2	1	1	1

XCH 306 ENTREPRENEURSHIP DEVELOPMENT

COURSE CODE	COURSE NAME	L	T	P	C
XCH 306	ENTREPRENEURSHIP DEVELOPMENT	3	0	0	3
C:P:A = 3:0:1					
		L	T	P	H
		3	0	0	3

Course Outcome:		Domain
On the successful completion of the course, students will be able to		
CO1	***Recognise*** and ***describe*** the personal traits of an entrepreneur.	A(Receiving) C(Understand)
CO2	***Determine*** the new venture ideas and ***analyse*** the feasibility report.	C(Understand and Analyse)
CO3	***Develop*** the business plan and ***analyse*** the plan as an individual or in team.	Affective (Receiving) and C (Analyze)
CO4	***Describe*** various parameters to be taken into consideration for launching and managing small business.	C(Understand)
CO5	***Describe*** Technological management and Intellectual Property Rights	C(understand)

There are 6 Cs and 2 As for 3:0:1

UNIT I ENTREPRENEURIAL TRAITS AND FUNCTIONS	9
Definition of Entrepreneurship; competencies and traits of an entrepreneur; factors affecting Entrepreneurship Development; Role of Family and Society ; Achievement Motivation; Entrepreneurship as a career and national development;	
UNIT -II NEW PRODUCT DEVELOPMENT AND VENTURE CREATION	**9**
Ideation to Concept development; Sources and Criteria for Selection of Product; market assessment ; Feasibility Report ;Project Profile; processes involved in starting a new venture; legal formalities; Ownership; Case Study.	
UNIT –III ENTREPRENEURIAL FINANCE	**9**
Financial forecasting for a new venture; Finance mobilization; Business plan preparation; Sources of Financing, Angel Investors and Venture Capital; Government support in startup promotion.	
UNIT –IV LAUNCHING OF SMALL BUSINESS AND ITS MANGEMENT	**9**
Operations Planning - Market and Channel Selection - Growth Strategies - Product Launching – Incubation, Monitoring and Evaluation of Business - Preventing Sickness and Rehabilitation of Business Units.	
UNIT –V TECHNOLOGY MANAGEMENT, IPR PORTFOLIO FOR NEW PRODUCT VENTURE	**9**
Technology management; Impact of technology on society and business; Role of Government in supporting Technology Development and IPR protection; Entrepreneurship Development Training and Other Support Services.	

	LECTURE	TUTORIAL	TOTAL

	45	**0**	**45**

TEXT BOOKS

- Hisrich, 2016, *Entrepreneurship*, Tata McGraw Hill, New Delhi.
- S.S.Khanka, 2013, *Entrepreneurial Development*, S.Chand and Company Limited, New Delhi.

REFERENCE BOOKS

- Mathew Manimala, 2005, *Entrepreneurship Theory at the Crossroads, Paradigms & Praxis*, Biztrantra ,2nd Edition.
- Prasanna Chandra, 2009, *Projects – Planning, Analysis, Selection, Implementation and Reviews*, Tata McGraw-Hill.
- P.Saravanavel, 1997, *Entrepreneurial Development*, Ess Pee kay Publishing House, Chennai.
- Arya Kumar,2012, *Entrepreneurship: Creating and Leading an Entrepreneurial Organisation*, Pearson Education India.
- Donald F Kuratko, T.V Rao, 2012, *Entrepreneurship: A South Asian perspective*, Cengage Learning India.
- Dinesh Awasthi, Raman Jaggi, V.Padmanand, *Suggested Reading / Reference Material for Entrepreneurship Development Programmes* (EDP/WEDP/TEDP), EDI Publication, Entrepreneurship Development Institute of India, Ahmedabad. Available from: http://www.ediindia.org/doc/EDP-TEDP.pdf

E RESOURCES

- Jeff Hawkins, " Characteristics of a successful entrepreneur", ALISON Online entrepreneurship courses, "https://alison.com/learn/entrepreneurial-skills
- Jeff Cornwall, "Entrepreneurship -- From Idea to Launch", Udemy online Education, https://www.udemy.com/entrepreneurship-from-idea-to-launch/

MAPPING COURSE OUTCOME WITH GRADUATE ATTRIBUTES:

	GA1	GA2	GA3	GA4	GA5	GA6	GA7	GA8	GA9	GA10	GA11	GA12
CO1									3	3	3	1
CO2			1	2	3	2	1	1	1	2	3	
CO3						1		2	3	3		2
CO4						1	1	2	3		3	3
CO5						1	1	3				3
			1	2	3	5	3	8	10	8	9	9
			1	1	1	2	1	2	3	2	2	2

XGS 307 INTERPERSONAL COMMUNICATION

XGS 307			INTERPERSONAL COMMUNICATION	L	T	P	C
				1	0	1	0
C	P	A		L	T	P	H
1	1	0		1	0	2	3

COURSE OUTCOMES:

CO1: C: *Recognize* culture and a need for interpersonal communication.
CO2: C:U: *Demonstrate* on the need for effective communication between two people.
CO3:C:U: *Explain* on family and social relationships and need for socialization.
CO4:P:GR: *Practice* the IP principles as to how to reduce and repair conflict in interpersonal relationships.
CO5: C: *Make use* to use effective and appropriate language at various interpersonal situations to avoid conflict.

SYLLABUS

Units	.	Hours
I	Universals of interpersonal communications; Axioms of interpersonal Communication; culture in interpersonal communication and the self in interpersonal communication	9
II	Apprehension and assertiveness; aggressiveness and assertiveness; perception in interpersonal communication; listening in interpersonal communication**.**	9
III	Verbal and non verbal messages; relationship and involvement; relationship maintenance and repair.	9
IV	Power in interpersonal relationship; conflict in interpersonal relationship; friends and relatives; primary and family relationships.	9
V	Socialization, need for socialization and benefits of socialization among students.	9

Lecture (L) : 30 Hrs
Interactive Session (IS) : 15 Hrs
Total : 45 Hrs

TEXT BOOKS

1. ***DeVito***, ***Joseph***, The ***Interpersonal Communication*** Book, 13th Edition - **,** Published by ***Longman*** Pub Group, Updated in its ***13th edition***,2000
2. Kathleen S. Verderber, Inter-Act: Interpersonal Communication Concepts, Skills and Contexts, Rudolph F. Verderber, 2000
3. Clifford Whitcomb, Effective Interpersonal and Task Communication Skills for Engineers, Atlantic Publishers. 2010

	GA 1	GA 2	GA 3	GA 4	GA 5	GA 6	GA 7	GA 8	GA 9	GA10	GA11	GA12
CO1										2		
CO2										**2**		
CO3				2						**1**		
CO4												1
CO5										**1**	2	

3–High Relation, 2–Medium Relation, 1–Low Relation, 0–No Relation

XCH 308 Inplant Training/ Internship programme-1
C:P:A = 2:2:2/ 1:1:1

CO1: Cog(U) ***Relate*** classroom theory with workplace practice
CO2: Affective(Respond) ***Comply with*** Factory discipline, management and business practices.
CO3: Affective (Value) ***demonstrates*** teamwork and time management.
CO4: Psychomotor(Perception , Set) ***Describe*** and ***Display*** hands-on experience on practical skills obtained during the programme.
CO5: Cog(E) ***Summarize*** the tasks and activities done by technical documents and oral presentations.
All COs are equally weighted
Note:
Revised Bloom Taxonomy of the Cognitive Domain
Simpson's Taxonomy of the Psychomotor Domain
Krathwohl's Taxonomy of the Affective Domain

Table 1: Mapping COs with B.Tech GAs

	GA1	GA2	GA3	GA4	GA5	GA6	GA7	GA8	GA9	GA10	GA11	GA12
CO1	**2**											
CO2							**1**	**3**			**1**	
CO3									**3**	**1**	**3**	**1**
CO4		**1**	**2**	**1**	**3**							**3**
CO5				**3**						**3**		**1**
Total	**2**	**1**	**2**	**4**	**3**	**0**	**1**	**3**	**3**	**4**	**4**	**5**
Scaled	**1**	**1**	**2**	**1**	**1**	**0**	**1**	**1**	**1**	**1**	**1**	**1**

XPS 401 PROBABILITY AND STATISTICS

SUBCODE			SUB NAME	L	T	P	C
XPS 401			PROBABILITY AND STATISTICS	3	0	0	3
C	P	A					
3	0	0		L	T	P	H
				3	0	0	3

PREREQUISITE: Basic concepts of Probability theory , Differentiation and Integration

COURSE OUTCOMES:

COURSE OUTCOMES	Domain	Level
CO1: ***Define*** discrete and continuous random variables and to ***Find*** the expected values and moment generating functions of discrete and continuous distributions.	Cognitive	Remembering
CO2: ***Explain*** the joint distribution and Marginal distribution and to ***Find*** the correlation and regression.	Cognitive	Remembering Understanding
CO3: ***Define*** null and alternate hypothesis, ***Apply*** test statistic.	Cognitive	Remembering Apply
CO4: ***Explain*** the concept of analysis of variance and to ***Compare*** between one and two factor analysis of variance tests.	Cognitive	Understanding
CO5. ***Explain*** the purpose, function and basic methods of statistical process control **a**nd to ***Apply*** the statistical techniques to measure the quality of a product, service, or process.	Cognitive	Understanding Apply

UNIT I Random variables:	**9**
Discrete and continuous random variables - Moments, Moment Generating functions – Binomial, Poisson, Geometric, Uniform, Exponential and Normal distributions.	
UNIT II Two dimensional Random variables:	**9**
Joint distributions – Marginal and conditional distributions – covariance – Correlation and linear regression .	
UNIT III Testing of hypothesis:	**9**
Large sample tests- procedure of testing hypothesis- small sample tests- Student's t-test, F- test, chi-square test- independence of attributes and goodness of fit.	
UNIT IV Design of Experiments :	**9**
Analysis of variance – one and two way classifications - CRD- RBD- LSD.	
UNIT V Statistical Quality Control	**9**
Introduction – Process control – control charts for variables – Mean and Range charts- control charts for attributes: p chart, np chart, c chart and their applications in process control.	

	LECTURE	TUTORIAL	TOTAL
	45	0	45

TEXT

1.Gupta .S.C and Kapoor .V.K, "Fundamentals of Mathematical Statistics", 11th extensively revised edition, Sultan Chand & Sons, (2007).
2. Veerarajan .T, Probability, "Statistics and Random Processes", Tata McGraw Hill, 3rd edition, (2008).
3. Kandasamy.P, Thilagavathy.K,Gunavathy.K, "Probability , Statistics and Queueing Theory", S.Chand & Company Ltd, (2004).

REFERENCES

1. Ross. S, "A first Course in Probability", Fifth Edition, Pearson Education, New Delhi (2002).
2. Johnson .R.A., "Miller & Freund's Probability and Statistics for Engineers", Sixth Edition, Pearson Education, Delhi, (2000).
3. Walpole .R. E, Myers, Myers .R. S. L. and Ye. K, "Probability and Statistics for Engineers and Scientists", Seventh Edition, Pearsons Education, Delhi, (2002).
4. Lipschutz. S and Schiller. J, "Schaum's outlines - Introduction to Probability and Statistics", McGraw-Hill, New Delhi, (1998).

E REFERENCES

www.nptel.ac.in

3. Advanced Engineering Mathematics Prof. Somesh Kumar
Department of Mathematics, Indian Institute of Technology, Kharagpur.

	GA1	GA2	GA3	GA4	GA5	GA6	GA7	GA8	GA9	GA10	GA11	GA12
CO 1	3									1		1
CO 2	3									1		1
CO 3	3	2								1	1	2
CO 4	3	2			1					1	1	2
CO 5	3	2			1					1	1	2
	15	6	0	0	2	0	0	0	0	5	3	8

1 - Low , 2 – Medium , 3- high

XCH402 Inorganic Chemical Manufacturing processes

CO 1: Cog (Understand) ***Explain*** chlor-alkali industries.
CO 2: Cog (Understand) ***Explain*** the manufacturing process of inorganic acids.
CO 3: Cog (Understand, Apply) ***Illustrate*** and ***identify*** various inorganic chemicals.
CO 4: Cog (Understand, Apply) ***Classify*** inorganic chemicals and ***solve*** environmental issues.
CO 5: Cog (Understand) ***Explain*** fertilizers.

SUBCODE	**SUB NAME**	**L**	**T**	**P**	**C**
XCH402	**Inorganic Chemical Manufacturing processes**	2	1	0	3
C:P:A = 3:0:0					
		L	**T**	**P**	**H**
		2	2	0	**4**

Unit-I Chlor-Alkali Industries **6+2**

Alkalies: Chlor-alkali industries: Manufacture of soda ash, Manufacture of caustic soda and chlorine- common salt.

Unit-II Sulphur and Sulphuric acid **7+3**

Acids: Sulphur and Sulphuric acid: Mining of sulphur and manufacture of sulphuric acid. Manufacture of hydrochloric acid.

Unit-III Cement and Glass **7+3**

Cement: Types and Manufacture of Portland cement, Glass: Manufacture of glasses and special glasses, Ceramics: Refractories and its classification.

Unit-IV Industrial Gases, Water and Paints **6+4**

Industrial Gases: Carbon dioxide, Nitrogen, Hydrogen, Oxygen and Acetylene - Water Treatment: Industrial and municipal water treatment - Manufacture of paints – Pigments

Unit-V Fertilisers **6+4**

Fertilisers: Nitrogen fertilisers; synthetic ammonia, nitric acid, urea, Ammonium Chloride, CAN, Ammonium Sulphate - Phosphorous Fertilisers: Phosphate rock, phosphoric acid, Super phosphate and Triple Super phosphate - MAP, DAP, Potassium Fertilisers; Potassium chloride, Potassium sulphate and Bio fertilizers

	LECTURE	**TUTORIAL**	**TOTAL**
	32	**16**	**48**

TEXT

1. Shreve, "*Chemical Process Industries*", 5th Edn., McGraw Hill, New York, 1984
2. W.V.Mark, S.C. Bhatia *" Chemical Process Industries volume I and II*", 2ndEdition 2007.

REFERENCES

1. Gopal and M. Sittig , " *Dryden's Outlines of Chemical Techno*logy", 2nd Ed.n., 1965
2. Kirk and Othmer, Encyclopedia of Chemical Technology.

E REFERENCES

1. NPTEL Lectures

CO's versus GA's mapping

CO/GA	GA 1	GA 2	GA 3	GA 7
CO 1	2	0	1	0
CO 2	2	0	1	0
CO 3	2	0	1	0
CO 4	2	1	1	2
CO 5	2	1	1	0
Original	**10**	**2**	**5**	**2**
Scaled	**2**	**1**	**1**	**1**

XCH403 Process Heat Transfer

CO1. **Cog**: (Remembering), ***Define*** modes of heat transfer. ***Recall*** basic units and dimensions in heat transfer. ***Psy*** (Mechanism) ***Measure*** thermal conductivity of insulating material

CO2.Cog: (Applying) ***Solve*** differential equation for steady state and unsteady state heat conduction.

CO3. **Cog**: (Analyzing)**,** ***Distinguish*** heat convection with and without phase change. ***Psy*** (Perception) ***Identify*** natural and forced convection heat transfer.

CO4. **Cog**: (Understanding) ***Summarize*** radiation between heat transfer surfaces. ***Psy***(Set) ***Show*** Stefan Boltzman constant for radiation heat transfer.

CO5.**Cog**: (Applying) ***Solve*** material and energy balance calculations for an evaporator. ***Psy*** (Mechanism) ***measure*** the Economy of multiple effect evaporators.

CO6.**Cog**: (Applying), ***Construct and Develop*** heat exchange equipments. ***Psy*** (Mechanism) Calculate ***heat*** transfer coefficient of Parallel and counter flow heat exchangers.

SUBCODE	**SUB NAME**	**L**	**T**	**P**	**C**
XCH403	Process Heat Transfer	3	1	1	5
C:P:A = 3:0:0					
		L	**T**	**P**	**H**
		3	1	3	**7**

Unit-I Modes of heat transfer	**6+3+2=11**
Conduction heat transfer, convection heat transfer, radiation heat transfer, Thermal conductivity, thermal insulation, units and dimensions.	
Unit-II Conduction	**8+3=11**
Fourier's law, General differential equation of conduction, Steady state heat conduction through a plane slab, composite slab, hollow cylinder, composite cylinder and hollow sphere. Contact resistance, heat transfer between surfaces and surrounding, critical thickness of insulation. Heat transfer through extended surfaces of uniform cross section. Transient/Unsteady State Heat Conduction	
Unit-III Convection	**10+9+3=22**
Convection without phase change: Natural and forced convection, principal heat balance equation in laminar flow Empirical equations for convection heat transfer in turbulent flow through tubes, through annulus and over a flat plate. Dimensional analysis, dimensional groups used in heat transfer. Convection with phase change: Condensation: Modes and features, Nusselt's equation, condensation on vertical and horizontal plate Boiling: Pool boiling of saturated liquid, types of boiling, concept of critical heat flux	
Unit-IV Radiation	**7+6+2=15**
Properties and definitions, Stefan-Boltzmann law, Wein's displacement law, Kirchoff's law, View factors, Radiation between surfaces, Radiation involving gases and vapors. Radiation shields.	
Unit-V Evaporation	**6+6+2=14**
Introduction, types of evaporators, material and energy balance, boiling point elevation, capacity and economy, multiple effect evaporators	

Unit-VI Heat Exchangers:	8+**6+3=17**

Heat Transfer Equipment: Construction and working - Double pipe heat exchanger. Shell and tube heat exchangers. Condensers.
Design of Heat Transfer Equipment: Process design of double pipe heat exchanger. Shell and tube heat exchanger and condensers.

1 Jacketed Pan/Kettle
2 Parallel and Counter flow Heat exchanger
3 Evaporator
4 Heat loss in pipes
5 Horizontal Condenser
6 Drop Wise and Film Wise Condenser
7 Thermal conductivity of Insulating Material
8 Stefan Boltzman constant
9 Natural convection
10 Forced convection
11 Critical Heat flux Apparatus
12 Finned Tube Heat Exchanger

	LECTURE	**TUTORIAL**	**PRACTICAL**	**TOTAL**
	45	**15**	**30**	**90**

TEXT

1. McCabe, Unit Operations of Chemical Engineering, McGraw Hill, NY, 5th Edition, 2000
2. J P Holman, "Heat Transfer" 9th edition, Tata McGraw Hill Publications, New Delhi (2004)

REFERENCES

1. Coulson, J.M and Richardson, J.F, Chemical Engineering, Vol 1, Chemical Engineering, Pergemon and ELBS, 5th Edition, McGraw Hill, 2000.
2. Kern, D. Q., Process Heat Transfer, McGraw Hill, NY, 1965.
   Rao, Y.V.C., Heat Transfer, I Edition, University Press (India) Ltd, New Delhi, 2000

E REFERENCES

1. NPTEL Lectures
2. www.vlab.co.in

COs versus GAs mapping

CO/GA	GA1	GA2	GA3	GA4	GA8	GA9	GA10	GA11	GA12
CO1	3	2	3	1	0	0	0	0	1
CO2	2	2	2	1	0	1	1	1	-
CO3	2	2	2	2	1	1	1	1	1
CO4	2	1	2	2	1	1	1	1	1
CO5	3	2	3	3	1	1	1	1	-
CO6	1	2	3	3	1	1	1	1	1
	13	11	15	12	4	5	5	5	4
	3	3	3	1	1	1	1	1	

XCH 404 PARTICULATE SCIENCE AND TECHNOLOGY

CO1. Cog (Remembering) Psy(COR) ***Name*** the different type of separation processes required for a given feed material and ***Calibrate*** the separation process.
CO2.Cog (Understanding) Psy(COR) ***Explain*** the suitable equipment from different types of size reduction methods such as crushing, grinding .***Measure*** the size of the material using size reduction equipment.
CO3. Cog (Remembering, Understanding) ***Find*** and ***Illustrate*** the calculate the terminal velocity of the particles and understanding of fluid flow through packed and fluidized beds, types, equation and transport
CO4. Cog (Remembering) Psy(Set) ***Find*** the filtration problems and ***Show*** the area of the thickener
CO5.Cog (Understanding, Applying) ***Explain*** and ***Apply*** the mixing processes, conveying of solids and calculate the power requirements for different type of mechanical operations.

SUBCODE	**SUB NAME**	**L**	**T**	**P**	**C**
XCH404	Particulate science and technology	3	1	1	5
C:P:A = 4:1:0					
		L	**T**	**P**	**H**
		3	1	3	**7**

Unit-I Particle Technology	**8+3+9=20**
Particle shape, particle size, different ways of expression of particle size, shape factor, sphericity, mixed particles size analysis, screens – ideal and actual screens, differential and cumulative size analysis, effectiveness of screen, specific surface of mixture of particles, number of particles in a mixture, standard screens industrial screening equipment, motion of screen, grizzly, gyratory screen, vibrating screen, trommels, sub sieve analysis – Air permeability method, sedimentation and elutriation methods	
Unit-II Size Reduction	**9+3+9=21**
Introduction – types of forces used for communition, criteria for communition, characteristics of communited products, laws of size reduction, work index, energy utilization, methods of operating crushers – free crushing, choke feeding, open circuit grinding, closed circuit grinding, wet and dry grinding, equipment for size reduction – Blake jaw crusher, gyratory crusher, smooth roll crusher, tooth roll crusher, impactor, attrition mill, ball mill, critical speed of ball mill, ultra fine grinders, fluid energy mill, colloid mill, cutters – knife cutter.	
Unit-III Flow of Fluid Past Immersed Bodies	**8+3+3=14**
Drag, drag coefficient, pressure drop – Kozeny – Carman equation, Blake- Plummer, Ergun equation, fluidization, conditions for fluidization, minimum fluidization velocity, types of fluidization, application of fluidization, slurry transport, pneumatic conveying.	
Unit-IV Motion of Particles Through Fluids	**10+3+9=22**
Mechanics of particle motion, equation for one dimensional motion of particles through a fluid in gravitational and centrifugal field, terminal velocity, drag coefficient, motion of spherical particles in Stoke's region, Newton's region and intermediate region, criterion for settling regime, hindered settling, modification of equation for hindered settling. Centrifugation – principle - types of centrifugal separators, cyclones and hydroclones Filtration – types of filtration – specific cake resistance – types of filters – merits and demerits.	

Unit-V Agitation And Mixing	**10+3=13**

Application of agitation, Agitation equipment, Types of impellers – Propellers, Paddles and Turbines, Flow patterns in agitated vessels, Prevention of swirling, Standard turbine design, Power correlation and Power calculation, Mixing of solids, Types of mixers- change can mixers, Muller mixers, Mixing index, Ribbon blender, Internal screw mixer, Tumbling mixer. Sampling, Storage and Conveying of Solids: Sampling of solids, storage of solids, Open and closed storage, Bulk and bin storage, Conveyors – Belt conveyors, Chain conveyor, Apron conveyor, Bucket conveyor, Bucket elevators, Screw conveyor.

1. Study of crushing strength of solid materials using jaw crusher
2. Study of crushing strength of solid materials using crushing rolls
3. Study of crushing strength of solid materials using ball mill.
4. Study of vibrating Screen.
5. Study of characterization of filtration using to Filter Press
6. Study of characterization of solid materials using leaf Filter
7. Study of separation of fine particles using cyclone separator
8. Study of separation of fine particles using sedimentation
9. Study of separation of solid particles using drum Filter
10. Study of separation of fine particles using screens and determination of effectiveness of factor

LECTURE	**TUTORIAL**	**PRACTICAL**	**TOTAL**
45	**15**	**30**	**90**

TEXT BOOK

1. McCabe W.L., Unit Operation Of Chemical Engineering, V Edition, McGraw Hill International, Singapore, 2000.
2. Badger, W.L. and Banchero J.T., Introduction to Chemical Engineering, III Edition, McGraw Hill International, Singapore, 1999.
3. Coulson, J.M. and Richardson, J.F., Chemical Engineering Vol.2, 4, Particle Technology and Separation Process, 1998.

REFERENCES

1. Brown G., Unit Operation, I Edition, CBS Publishers, New Delhi, 1995.
2. Perry, R and Green, W.D., Perry's Chemical Engineering Hand book, VII Edition, McGraw Hill International Edition, New York, 2000.
3. Foust, A.S. et.al, Principles of Unit Operation, III Edition, John Wiley and Sons, New York, 1997.

E REFERENCES

1. NPTEL Lectures
2. www.vlab.co.in

COs versus GAs mapping

CO /GA	GA1	GA2	GA3	GA4	GA5	GA6	GA7	GA8	GA9	GA10	GA11	GA12
CO1	3	1	1	-	-	-	-	-	2	-	-	-
CO2	3	2	1	-	-	-	1	-	1		-	1
CO3	2	1	-	1	-	-	-	-	1	1	-	1
CO4	3	1	1	1	-	-	1	-	2		-	-
CO5	3	1	1	1	-	-	1	1	1	1	-	1
Total	14	6	4	3	-	-	3	1	7	2	-	4
	3	1							2			

XCH 405 ENGINEERING MATERIALS

Semester	SEMESTER IV	
Subject Name	Engineering Materials	
Subject Code	XCH 405	
Prerequisite	Nil	
L –T –P –C 3- 0 – 0- 3	C:P:A 3:0:0	L – T –P – H 45 - 0 – 0 - 45

Course Objective:

- To understand the Basic Properties of Engineering Materials.
- To identify the applications of magnetic, super conducting and dielectric materials
- To identify the heat treatment process and mechanical applications.
- To study about modern engineering materials,
- To study Nano materials and their properties.

Course Outcome:		**Domain** (C or P or A)
CO1	Study the Basic Properties of Engineering Materials.	C
CO2	Analyze the heat treatment process and its applications.	C
CO3	Analyze of nonmetallic materials and application.	C
CO4	Inspection of engineering materials (mechanical and metallurgical)	C
CO5	List the properties and applications of modern engineering materials.	C

Domain	**Cognitive - C** **Psychomotor - P** **Affective - A**

Course Content		
` UNIT-I	**BASIC PROPERTIES OF METALLIC MATERIALS**	**9**
	Basic Crystallography- Crystal structure – BCC, FCC and HCP structure – unit cell – crystallographic planes and directions, miller indices. Crystal imperfections, point, line, planar and volume defects – Grain size, ASTM grain size number.	

	Frank Reed source of dislocation Elastic & plastic modes of deformation, slip & twinning, strain hardening, seasons cracking, Iron carbide equilibrium diagram. Classification of steel and cast Iron microstructure, properties and application effect, yield point phenomenon, cold/hot working, recovery, re-crystallization, and grain growth, strengthening of metals.		
UNIT –II	**HEAT TREATMENT OF MATERIALS**		**9**
	Heat Treatment- Definition – Full annealing, stress relief, recrystallisation – normalising, hardening and tempering of steel. Isothermal transformation diagrams –cooling curves superimposed on I.T. diagram CCR Hardenability, Austempering, martempering.Case hardening, carburising, nitriding, cyaniding, carbonitriding – Flame and Induction hardening. Ferrous and Non Ferrous Metals-Effect of alloying additions on steel (Mn, Si, Cr, Mo, V Ti & W) - stainless and tool steels – HSLA. Gray, White malleable, spheroidal -Graphite - alloy cast-iron. Copper and Copper alloys – Brass, Bronze and Cupronickel. Aluminium and Al-Cu – precipitation strengthening treatment – Bearing alloys..		
UNIT-III	**NON METALLIC MATERIALS**		**9**
	Non-Metallic Materials- Polymers – types of polymer, commodity and engineering polymers – Properties and applications of PE, PP, PS, PVC, PMMA, PET, PC, PA, ABS, PI, PAI, PPO, PPS, PEEK, PTFE Polymers. Urea and Phenol formaldehydes. Fibre and particulate reinforced composites and resin plastics. Powder metallurgy, Manufacturing Process, Compacting, Sintering, Vacuum processing. Properties of Powder processed materials, high energy compaction. Metal matrix composites, preparation properties and uses.		
UNIT -IV	**INSPECTION OF ENGINEERING MATERIALS**		**9**
	Mechanical Properties and Testing- Mechanism of plastic deformation, slip and twinning. Types of fracture – Testing of materials under tension, compression and shear loads – tests (Brinell, Vickers and Rockwell) Impact test, Izod and charpy, fatigue and creep test.		
UNIT V	**MODERN ENGINEERING MATERIALS**		**9**
	Metallic glasses- preparation of metallic glasses- properties – applications of the metallic glasses - Shape Memory Alloys (SMA) - Characteristics, properties of NiTi alloy - applications of the Shape memory alloys - advantages and disadvantages of SMA - Nanomaterials-synthesis –chemical vapour deposition – Sol Gels – ball Milling – properties of nanoparticles and applications of nanoparticles - Carbon Nanotubes(CNT)–structure–properties–applications of the CNTs.		
	LECTURE: 45	**TUTORIAL: 0**	**TOTAL :45**

Text books

1. Engineering Materials: Properties and selection/ Kenneth G. Budinski, Michael K. Budinski/ Prentice Hall
2. Engineering materials / R K Rajput / S Chand and company Ltd.
3. Deformation and Fracture Mechanics of Engineering Materials/R. W. Hertzberg/ John Wiley & Sons.

4. Powder Metallurgy: An Advanced Technique Of Processing Engineering Materials/ B. K. DATTA/ PHI Learning Pvt. Ltd.
5. Materials Science and Engineering /Raghavan/ Prentice-Hall of India.

References

1. Koch, C. C. Nanostructured materials: processing and applications: William Andrew Pub.
2. James F Shackelford, S "Introduction to materials Science for Engineers", 6 th Macmillan Publishing Company, New York, 2004
3. William D CallisterJr, "Materials Science and Engineering – An Introduction", John Wiley and Sons Inc., 6 th edition, New York, 2003
4. Jayakumar S, "Materials Science", RK Publishers, Coimbatore, 2004
5. Bolton, W., Engineering materials technology: Butterworth-Heinemann.

E RESOURCES

1. NPTEL courses, http://www.nptel.iitm.ac.in/courses.php?disciplineId=112: related web and video resources under Mechanical Engineering &Metallurgy and Material Science categories
2. http://www.intechopen.com/books

Mapping of CO's with GA:

	GA1	GA2	GA3	GA4	GA5	GA6	GA7	GA8	GA9	GA10	GA11	GA12
CO1	3	1	1		2	2	3	3	1	3		1
CO2	3	1	1		1	2	3	2	1	2		1
CO3	3	1	1		1	2	3	2	1	2		1
CO4	3	1	1		2	2	3	3	1	3		2
CO5	3	1	1		1	3	3	1	1	2		2
total	15	5	5		7	11	15	10	5	12		7
Scaled	**3**	**1**	**1**		**2**	**3**	**3**	**2**	**1**	**2**		**2**

1 - Low, 2 – Medium, 3 – High

XCH406 PROCESS ECONOMICS AND INDUSTRIAL MANAGEMENT

CO 1: Cog (Understand) ***Summarize*** the value of money for economic aspects.

CO 2: Cog (Understand, Apply) ***Explain*** and ***identify*** the capital requirements for process plants.

CO 3: Cog (Understand, Apply) ***Explain*** and ***identify*** the best alternates for process plants.

CO 4: Cog (Understand, Analyze) ***Compare*** various projects and ***analyze*** economic feasibility.

CO 5: Cog (Understand) ***Explain*** the principles of management and marketing.

SUBCODE	**SUB NAME**	**L**	**T**	**P**	**C**
XCH406	**Process Economics and Industrial Management**	2	0	0	2
C:P:A = 3:0:0					
		L	**T**	**P**	**H**
		2	0	0	**3**

Unit-I Value of Money	**7**
Value of money – Equivalence – Equations for economic studies and equivalence – Amortization – Capital recovery – Depreciation – Depletion.	
Unit-II Cost and its Evaluation	**10**
Capital requirements for process plants – Cost indices – Equipment costs – Service facilities – Capital requirements for complete plan – Balance sheet – Cost – Earnings – Profits and returns – Variable costs – Fixed costs – Income statement – Economic production charts – Capacity factors.	
Unit-III Economics of Selecting Alternates and its Balances	**10**
Annual cost methods – Present worth method – Equivalent alternate – Rate of return and payment time – Cash flow analysis – Economic balance in batch operations – Cyclic operations and multiple equipment units	
Unit –IV Project Design and Development:	**10**
Choosing a project – Market survey – Importance of techno-economic viability studies – Sourcing of processes – Process alternatives – Fixing most economic processes – Technology – Scanning – Plant location principles – Plant lay out – Process flow sheets – Preparation of budgetary investment and production costs.	
Unit -V Management and Marketing	**8**
Concepts of management – Principles – Management functions – Scientific management – Advanced techniques management – Bar chart, CPM, Pert technique – Types of organizations – Merits and demerits. Concepts of Marketing – Need – Research – Sales forecasting – Product cycle – Fundamentals of labour management and industries relation.	

	LECTURE	**TUTORIAL**	**TOTAL**
	45	**0**	**45**

TEXT

1. Couper, J. R., "Process Engineering Economics", CRC Press, 2003.
2. White, J. A., Case, K. and Prat, D., "Principles of Engineering Economics Analysis" 4th Edition, John – Wiley Publishers, 1997.

REFERENCES

1. Towler, G. and Sinnott, R. K., "Chemical Engineering Design: Principles, Practice and Economics of Plant and Process Design", Elsevier, 2007.
2. Brown T., "Engineering Economics and Economic Design for Process Engineers", CRC Press, 2007.
3. Peters, M. S and Timmerhaus, K. D., "Plant Design and Economics for Chemical Engineering", 4th Edition, McGraw Hill, 1991

E REFERENCES

1. 1. NPTEL Lectures (http://nptel.ac.in/courses/103103039/)

CO/GA	GA1	GA2	GA3	GA11	GA12
CO1	1	2	0	1	1
CO2	2	3	2	2	1
CO3	2	3	2	2	1
CO4	3	3	2	3	1
CO5	0	0	0	1	1
Original	**8**	**11**	**6**	**9**	**5**

XGS 407 TECHNICAL COMMUNICATION

COURSE CODE	SUBJECT NAME			Category		
		L	T	P	SS	Credits
XGS 407	TECHNICAL COMMUNICATION	1	0	0	2	1
C:P:A		L	T	P	SS	Hour
1.8:0.8:0.4		1	0	0	2	3

COURSE OUTCOMES (COs)

CO1: Cog: C: I***dentify*** the features of a technical project report and Knowledge on the linguistic competence to write a technical report

CO2: Cog: Syn: I***ntegrate*** both technical subject skill and language skill to write a project.

CO3: Aff: (Res): Confidence to ***present*** a project in 10 to 15 minutes

CO4: Cog: C The learner ***identifies*** and absorbs the pronunciation of sounds in English Language and learns how to mark the stress in a word and in a sentence properly `

CO5: Psy: P: ***Enables*** the speaker speaks clearly and fluently with confidence and it trains the learner to listen actively and critically

UNIT	Content	Hours Allotted
I	**BASIC PRINCIPLES OF GOOD TECHNICAL WRITING,** Style in technical writing, out lines and abstracts, language used in technical writing: technical words, jargons etc	9
II	**SPECIAL TECHNIQUES** used in technical writing: Definition, description of mechanism, Description of a process, Classifications, division and interpretation	9
III	**REPORT/ PROJECT** layout the formats: chapters, conclusion, bibliography, annexure and glossary, Graphics aids etc - Presentation of the written project 10 – 15 minutes	9
IV	**SOUNDS OF ENGLISH LANGUAGE;** Vowels, consonants, diphthongs , word stress, sentence stress, intonation patterns, connected speech etc. - Vocabulary building – grammar, synonyms and antonyms, word roots, one-word substitutes, prefixes and suffixes, idioms and phrases.	9
V	**READING COMPREHENSION** Reading for facts, meanings from context, scanning, skimming, inferring meaning, critical reading, active listening, listening for comprehension etc.	9

Lecture	Self Study	Total
15 Hours	30 Hours	45 Hours

Mapping of COs with GAs:

	GA1	GA2	GA3	GA4	GA5	GA6	GA7	GA8	GA9	GA10	GA11	GA12
CO1										2		

TEXT

1. Gordon H. Mills, Technical Writing – April, 1978, Oxford Univ Press
2. Barun K. Mitra, Effective Technical Communication: A Guide for scientists and Engineers. Author, Publication: Oxford University press. 2007

Software for lab: English Teaching software (Young India Films**)**

CO2										**2**		
CO3				**2**						**1**		
CO4												**1**
CO5				**2**						**1**	**2**	**1**