

DEPARTMENT OF BIOTECHNOLOGY

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**PERIYAR
MANIAMMAI**
INSTITUTE OF SCIENCE & TECHNOLOGY
(Deemed to be University)
Established Under Sec. 3 of UGC Act, 1956 • NAAC Accredited
think • innovate • transform

CURRICULUM (From I – VIII Semesters) & SYLLABI (From I –IV Semesters) Regulation 2018

*(For the candidates admitted from 2018-19 onwards
Based on Outcome Based Education)*

FOR

**B. Tech (Biotechnology)
DEGREE PROGRAMME**

UNIVERSITY VISION

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

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.

CORE VALUES

- + Student – centric vocation
- + Academic excellence
- + Social Justice, equity, equality, diversity, empowerment, sustainability
- + Skills and use of technology for global competency.
- + Continual improvement
- + Leadership qualities.
- + Societal needs
- + Learning, a life – long process
- + Team work
- + Entrepreneurship for men and women
- + Rural development
- + Basic, Societal, and applied research on Energy, Environment, and Empowerment.

DEPARTMENT OF BIOTECHNOLOGY

VISION	To become state of art department fostering biotechnology education and research to produce technologist, scientist and entrepreneurs for the benefit of society and environment.
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MISSION	DM1	To offer programs with state of art infrastructure, learning and impart training in biotechnology
	DM2	To develop graduates of highly skilled, with entrepreneurial, professional, ethical and socially responsibility to work in or create various biotechnology industries
	DM3	To pursue research biotechnology, food and pharmaceutical industries, academic and R&D institutions whenever necessity arises.
	DM4	To contribute socio-economic developments through sustainable Bio technological intervention utilizing rural knowledge in health, food processing and agriculture practices.

Table: 1 Mapping of University Mission (UM) and Department Mission (DM)

	DM1	DM2	DM3	DM4	Total
UM1	3	1	2	0	6
UM2	1	3	2	1	7
UM3	0	1	3	2	6
UM4	2	3	2	1	6
UM5	0	3	1	2	6

1-Low 2- Medium 3 – High

PROGRAMME EDUCATIONAL OBJECTIVES

Based on the mission of the department, the programme educational objectives is formulated as

PEO1	To have a strong foundation in basic and applied science along with basic engineering fundamentals for their successful career in Biotechnology and related fields.
PEO2	To work at technically adequate level in formulating experiments and find solutions, to ever demanding problems in Biotechnology.
PEO3	To be a skillful professional biotechnologist who can apply principles of the subject to develop excellent research tools and capabilities through project works.
PEO4	To emphasize on interdisciplinary research emerging science and technology so that students can address important national and global needs, and work in the direction of technology transfer and their commercialization.
PEO5	To develop the qualities like creativity, leadership, teamwork, skill, and professional ethics, thus contributing towards the growth and development of society.

Table: 2 Mapping of Program Educational Objectives (PEOs) with Department Mission (DM)

	PEO1	PEO2	PEO3	PEO4	PEO5	Total
DM1	2	2	2	1	1	8
DM2	2	3	2	1	2	10
DM3	2	2	1	3	2	10
DM4	1	1	1	2	3	8
Total	7	8	6	7	8	

1- Low 2 – Medium 3-High

GRADUATE ATTRIBUTES

1. **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization for 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 public health and safety, and 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 modelling 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 practice.
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 the 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.

PROGRAM OUTCOMES

PO 1	The fundamental concepts of both engineering and life sciences and apply it to a wide range of interdisciplinary work.
PO 2	An ability to analyze complex engineering problems, conduct experiments in biotechnology and apply in the field by generating innovative, economical and feasible solutions
PO 3	An experience to develop a process that meets the specific needs of societal and environmental problems to draw meaningful conclusions.
PO 4	To draw conclusion in research based methods for value addition to existing products.
PO 5	Soft-skills through classroom seminars, institutional and industry interactions use of modern technique and ICT tools.
PO 6	An ability to apply contextual knowledge to assess the issues in public health, society and environment.
PO 7	An ability to update the modern techniques in biotechnological essential for protecting the environment and sustainable development.
PO 8	An ability to demonstrate themselves as morally responsible citizens by being aware of his/her roles, duties, professional and ethical responsibilities and rights.
PO 9	A Positive attitude and interpersonal skills to function in multidisciplinary teams and setups.
PO 10	An ability to communicate, comprehend and write effective reports
PO 11	An enthusiasm for life-long learning and urge to contribute to technology and society by working in a need-based and problem-solving projects
	PROGRAM SPECIFIC OUTCOME
PSO1	Knowledge and skills to become an herbal biotechnology entrepreneur for product commercialization.
PSO2	An ability to extend the research initiatives in bioenergy fields.

**Table 3 Mapping of Program Educational Objectives (PEOs)
with Program Outcomes (POs)**

B. Tech	PO											PSO	
	1	2	3	4	5	6	7	8	9	10	11	1	2
PEO1	3	2	2	1	1	1	2	1	1	1	2	1	1
PEO2	1	3	3	2	1	2	1	1	2	2	2	1	2
PEO3	1	3	3	2	1	2	1	1	2	2	2	1	2
PEO4	1	1	3	1	1	1	1	1	3	2	1	1	1
Total	6	9	11	6	4	6	5	4	8	7	7	4	6

1 - Low

2 – Medium

3 - High

STRUCTURE OF B. Tech BIOTECHNOLOGY PROGRAMME

S. No	Topic	Symbol	Credits
1.	Humanities and Social Sciences including Management	HSMC	12
2.	Basic Sciences	BSC	22
3.	Engineering Sciences including workshop, drawing, basics of electrical/mechanical/computer etc.	ESC	19
4.	Professional Subjects: Subjects relevant to chosen specialization/branch	PCC-CE	70
5.	Professional Elective courses relevant to chosen specialization/branch	PEC-CE	12
6.	Open Subjects: Electives from other technical and/or emerging subjects	OEC-CE	12
7.	Project work, seminar and internship in industry or elsewhere	PROJ-CE	13
8.	Mandatory Courses [Environmental Sciences, Induction Program, Indian Constitution, Essence of Indian Traditional Knowledge]	MC	0
TOTAL			160

HUMANITIES & SOCIAL SCIENCES INCLUDING MANAGEMENT

S. No	Code No.	Subject	Semester	Credits
1.	HSMC HS101	Communication skills/ English	2	3
2.	HSMC HS102	Entrepreneurship Development	3	3
3.	HSMC HS103	Employability Skills and report writing	5	3
4.	HSMC HS104	Process Engineering Economics and Industrial Management	6	3
TOTAL				12

BASIC SCIENCE COURSES

Sl. No	Code No.	Subject	Semester	Credits
1.	BS101	Calculus and Linear Algebra	1	4
2.	BS102	Applied Physics for Engineers	1	6
3.	BS104	Applied Chemistry for Engineers	2	5
4.	BS105	Calculus ODE and Complex variables	2	4
5.	BS106	Probability and Statistics	3	3
TOTAL				22

ENGINEERING SCIENCE COURSES

S. No	Code No.	Subject	Semester	Credits
1.	ESC	Engineering Graphics	1	3
2.	ESC	Electrical and Electronics Engineering Systems	1	5
3.	ESC	Programming for Problem Solving	2	5
4.	ESC	Workshop Practices	2	3
5.	ESC	Material Science	4	3
			TOTAL	19

PROFESSIONAL CORE COURSES

S. No	Code No.	Subject	Semester	Credits
1.	PCC	Biochemistry -I	3	3
2.	PCC	Unit operations	3	5
3.	PCC	Mass and energy Balance Computations	3	3
4.	PCC	Cell biology and Microbiology	3	5
5.	PCC	Genetics and Molecular biology	4	3
6.	PCC	Analytical techniques	4	5
7.	PCC	Biochemistry-II	4	5
8.	PCC	Chemical Engineering Thermodynamics	4	4
9.	PCC	Bioprocess Engineering	5	5
10.	PCC	Recombinant DNA Technology	5	5
11.	PCC	Plant biotechnology	5	3
12.	PCC	Biochemical Engineering	6	5
13.	PCC	Animal biotechnology	6	3
14.	PCC	Immunology	6	5
15.	PCC	Skill oriented minor course	6	1

16.	PCC	Bioinformatics and computational biology	7	4
17.	PCC	Downstream processing	7	5
18.	PCC	Skill oriented minor course	7	1
TOTAL				70

PROFESSIONAL ELECTIVE COURSES

S. No	Code No.	Subject	Semester	Credits
1.	PEC	Core Elective- I	5	3
2.	PEC	Core Elective- II	6	3
3.	PEC	Core Elective- III	7	3
4.	PEC	Core Elective- IV	7	3
TOTAL				12

OPEN ELECTIVE COURSES

S. No	Code No.	Subject	Semester	Credits
1.	OE	Open Elective- I	5	3
2.	OE	Open Elective- II	6	3
3.	OE	Open Elective- III	7	3
4.	OE	Open Elective- IV	7	3
TOTAL				12

SEMESTER-WISE STRUCTURE OF CURRICULUM

REGULATIONS – 2018

(Applicable to the students admitted from the Academic year 2018-19)

SEMESTER I

Sub. Code	Category	Name of the Course	Hours per week			C
			L	T	P	
XMA101	BS	Calculus and Linear Algebra	3	1	0	4
XES102	UGC MC	Environmental Sciences	3*	0	0	0
XBE103	ESC	Electrical and Electronics Engineering Systems	2	1	2	5
XAP104	BS	Applied Physics for Engineers	3	1	2	6
XEG105	ESC	Engineering Graphics	0	0	3	3
TOTAL			11	3	7	18

*Non credit Hours

SEMESTER II

Sub. Code	Category	Name of the Course	Hours per week			C
			L	T	P	
XMA201	BS	Calculus, ordinary Differential Equations and complex variables	3	1	0	4
XCP202	ESC	Programming for Problem Solving	3	0	2	5
XGS203	HSMC	English	2	0	1	3
XAC 204	BS	Applied Chemistry for Engineers	3	1	1	5
XWP205	ESC	Workshop Practices	1	0	2	3
TOTAL			12	2	6	20

SEMESTER III

Sub. Code	Category	Name of the Course	Hours per week			C
			L	T	P	
XMA301	BS	Probability and Statistics	3	0	0	3
XBT302	PCC	Biochemistry-I	3	0	0	3
XBT303	PCC	Unit operations	2	1	2	5
XBT304	PCC	Mass and Energy Balance Computations	2	1	0	3
XBT305	PCC	Cell biology and Microbiology	3	0	2	5
XEP306	HSMC	Entrepreneurship Development	3	0	0	3
TOTAL			16	2	4	22

SEMESTER IV

Sub. Code	Category	Name of the Course	Hours per week			C
			L	T	P	
XES401	ESC	Material Science	3	0	0	3
XBT402	PCC	Genetics and Molecular biology	3	0	0	3
XBT403	PCC	Analytical Techniques	2	1	2	5
XBT404	PCC	Biochemistry-II	3	0	2	5
XBT405	PCC	Chemical Engineering Thermodynamics	3	1	0	4
XBT406	UGC MC	Indian Constitution	3*	0	0	0
		TOTAL	17	2	4	20

SEMESTER V

Sub. Code	Category	Name of the Course	Hours per week			C
			L	T	P	
XBT501	PCC	Plant biotechnology	3	0	0	3
XBT502	PCC	Bioprocess Engineering	3	1	1	5
XBT503	PCC	Recombinant DNA Technology	2	1	2	5
XBT504	PEC	Core Elective- I	3	0	0	3
XBT505	OE	Open Elective- I	3	0	0	3
XMC506	HSMC	Employability Skills and report writing	3	0	0	3
XMC507	MC	Essence of Indian Traditional Knowledge	3*	0	0	0
		TOTAL	20	2	3	22

SEMESTER VI

Sub. Code	Category	Name of the Course	Hours per week			C
			L	T	P	
XBT601	PCC	Biochemical Engineering	3	1	1	5
XBT602	PCC	Animal biotechnology	3	0	0	3
XBT603	PCC	Immunology	3	0	2	5
XBT604	PEC	Core Elective- II	3	0	0	3
XMC605	HSMC	Process Engineering Economics and Industrial Management	3	0	0	3
XBT606	OE	Open Elective- II	3	0	0	3
XBT607	PCC	Skill oriented minor course	0	0	1	1
		TOTAL	18	1	4	23

SEMESTER VII

Sub. Code	Category	Name of the Course	Hours per week			C
			L	T	P	
XBT701	PEC	Core Elective- III	3	0	0	3
XBT702	PCC	Bioinformatics and Computational Biology	2	0	2	4
XBT703	PCC	Downstream processing	2	1	2	5
XBT704	PEC	Core Elective- IV	3	0	0	3
XBT705	OE	Open Elective- III	3	0	0	3
XBT706	OE	Open Elective- IV	3	0	0	3
XBT707	PCC	Skill oriented Minor course	0	0	1	1
XBT708	PROJ	In-Plant training - I	0	0	0	1
Total			16	1	5	23

SEMESTER VIII

Sub. Code	Category	Name of the Course	Hours per week			C
			L	T	P	
XBT801	PROJ	Project work	0	0	24	12
TOTAL						12

TOTAL CREDITS - 160

Professional Core Elective Courses:

S. No	Semester	Course Name	L	T	P	Credits
1	5	Mass Transfer Fundamentals	3	0	0	3
2	5	Food technology	3	0	0	3
3	6	Nanobiotechnology	3	0	0	3
4	6	Cancer Biology	3	0	0	3
5	6	Chemical Reaction Engineering	3	0	0	3
6	7	Pharmaceutical Biotechnology	3	0	0	3
7	7	Heat Transfer	3	0	0	3

8	7	Stem cell biotechnology	3	0	0	3
9	7	Protein Engineering	3	0	0	3
10	7	Metabolic Engineering	3	0	0	3

Track I

Sub. Code	Category	Name of the Course	Hours per week			C
			L	T	P	
A	PEC	Mass Transfer Fundamentals	3	0	0	3
B	PEC	Biosafety Bioethics and IPR	3	0	0	3
C	PEC	Food technology	3	0	0	3

Track II

Sub. Code	Category	Name of the Course	Hours per week			C
			L	T	P	
A	PEC	Nanobiotechnology	3	0	0	3
B	PEC	Cancer Biology	3	0	0	3
C	PEC	Chemical Reaction Engineering	3	0	0	3

Track III

Sub. Code	Category	Name of the Course	Hours per week			C
			L	T	P	
A	PEC	Pharmaceutical Biotechnology	3	0	0	3
B	PEC	Biostatistics	3	0	0	3
C	PEC	Heat Transfer	3	0	0	3

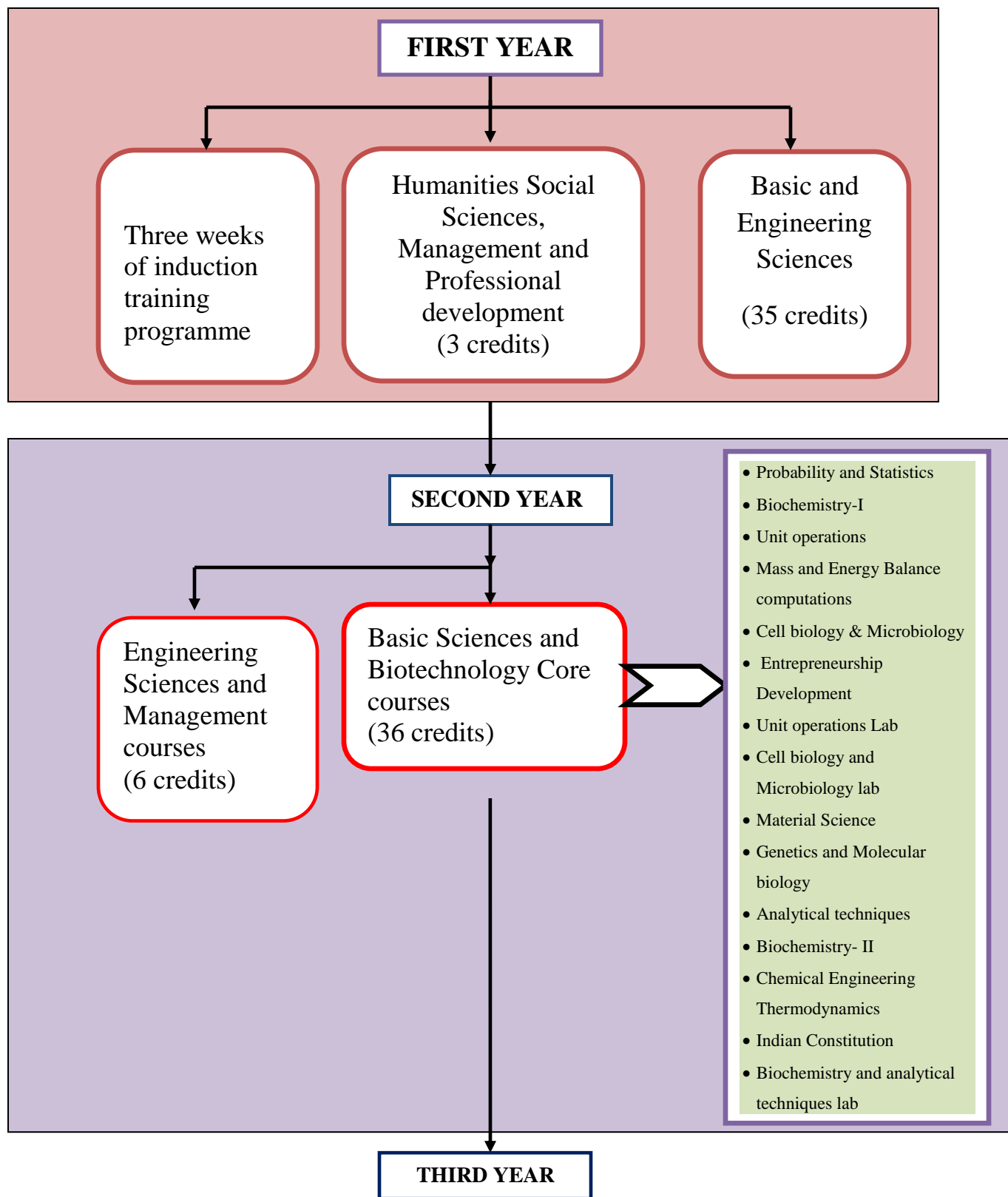
TRACK IV

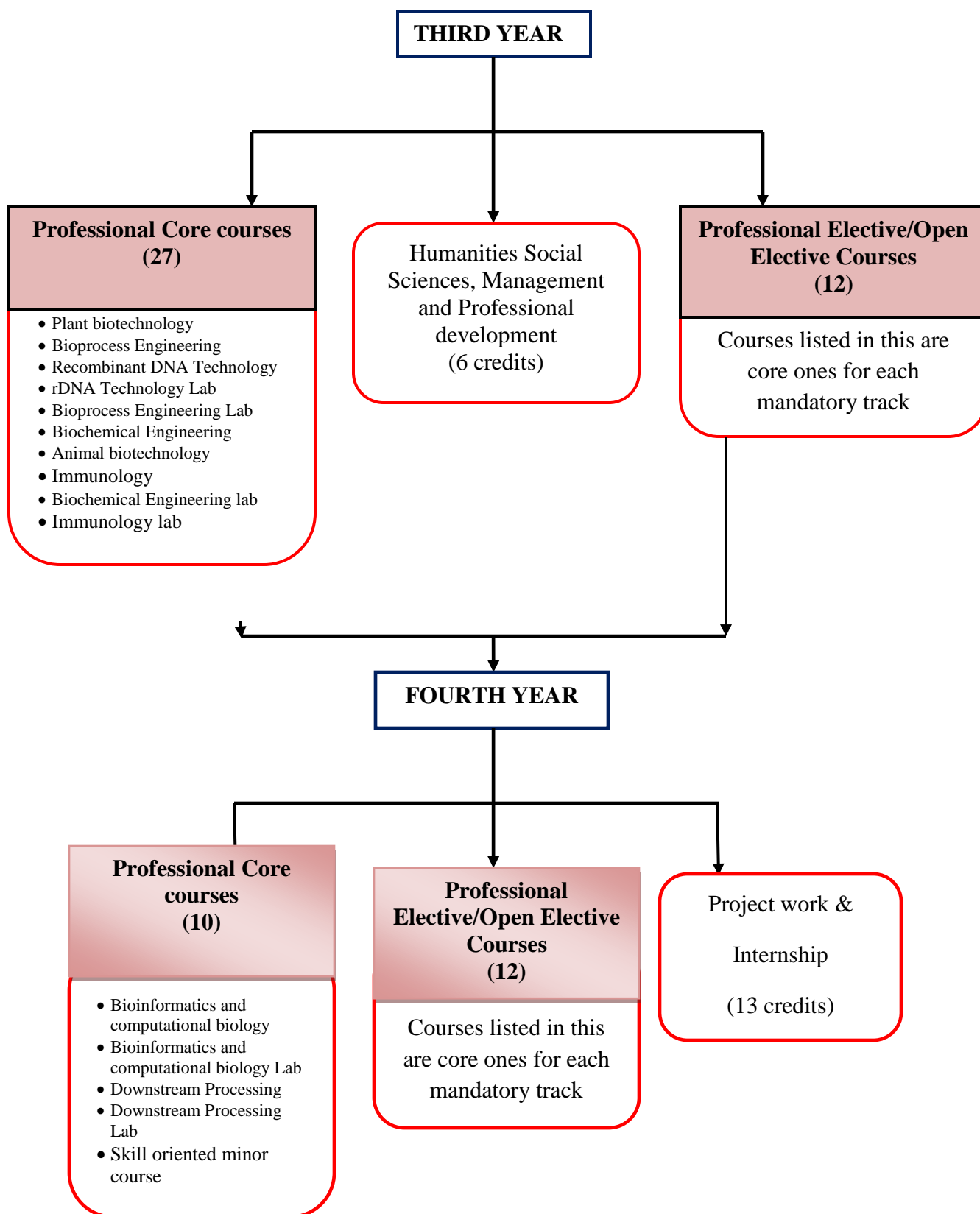
A	PEC	Stem cell biotechnology	3	0	0	3
B	PEC	Protein Engineering	3	0	0	3
C	PEC	Metabolic Engineering	3	0	0	3

OPEN ELECTIVE COURSE

Sub. Code	Category	Name of the Course	Hours per week			C
			L	T	P	
XBT OE 1	OE	Intellectual property Rights	3	0	0	3
XBT OE 2	OE	Industrial safety and Risk assessment	3	0	0	3
XBT OE 3	OE	Food and Nutrition	3	0	0	3
XBT OE 4	OE	Introduction to MATLAB	3	0	0	3
XBT OE 6	OE	Project Management	3	0	0	3

FLOW CHART FOR THE ENTIRE PROGRAMME





Course Code			XMA 101	L	T	P	C
Course Name			MATHEMATICS I (CALCULUS AND LINEAR ALGEBRA)	3	1	0	4
C	P	A		L	T	P	H
3	0.5	0.5		4	1	0	5
PREREQUISITE: Differentiation and Integration							
COURSE OUTCOMES:							
Course outcomes:				Domain	Level		
CO1: Apply orthogonal transformation to reduce quadratic form to canonical forms.				Cognitive	Remembering Applying		
CO2: Apply power series to tests the convergence of the sequences and series. Half range Fourier sine and cosine series.				Cognitive	Applying Remembering Guided		
				Psychomotor	Response		
CO3: Find the derivative of composite functions and implicit functions. Euler's theorem and Jacobian				Cognitive	Remembering		
				Psychomotor	Guided Response		
CO4: Explain the functions of two variables by Taylors expansion, by finding maxima and minima with and without constraints using Lagrangian Method. Directional derivatives, Gradient, Curl and Divergence.				Cognitive	Remembering Understanding		
				Affective	Receiving		
CO5: Apply Differential and Integral calculus to notions of Curvature and to improper integrals.				Cognitive	Applying		

UNIT 1: MATRICES	15
Linear Transformation - Eigen values and Eigen vectors -Properties of Eigen values and Eigen vectors - Cayley-Hamilton Theorem – Diagonalisation of Matrices – Real Matrices: Symmetric - Skew-Symmetric and Orthogonal Quadratic form – canonical form - Nature of Quadratic form and Transformation of Quadratic form to Canonical form (Orthogonal only).	
UNIT 2: SEQUENCES AND SERIES	15
Sequences: Definition and examples-Series: Types and convergence- Series of positive terms – Tests of convergence: comparison test, Integral test and D'Alembert's ratio test-. Fourier series: Half range sine and cosine series- Parseval's Theorem.	
UNIT 3: MULTIVARIABLE CALCULUS: PARTIAL DIFFERENTIATION	15
Limits and continuity –Partial differentiation – Total Derivative – Partial differentiation of Composite Functions: Change of Variables – Differentiation of an Implicit Function - Euler's Theorem- Jacobian.	

UNIT 4: MULTIVARIABLE CALCULUS: MAXIMA AND MINIMA AND VECTOR CALCULUS		15
Taylor's theorem for function of Two variables- Maxima, Minima of functions of two variables: with and without constraints - Lagrange's Method of Undetermined Multipliers – Directional Derivatives - Gradient, Divergence and Curl.		
UNIT 5: DIFFERENTIAL AND INTEGRAL CALCULUS		15
Evolutes and involutes; Evaluation of definite and improper integrals; Beta and Gamma functions and their properties; Applications of definite integrals to evaluate surface areas and volumes of revolutions.		
LECTURE	TUTORIAL	TOTAL
60	15	75
Text Books:		
<ol style="list-style-type: none"> 1. Ramana B.V., "Higher Engineering Mathematics", Tata McGraw Hill New Delhi, 11th Reprint, 2015. (Unit-1, Unit-3 and Unit-4). 2. N.P. Bali and Manish Goyal, "A text book of Engineering Mathematics", Laxmi Publications, Reprint, 2014. (Unit-2). 3. B.S. Grewal, "Higher Engineering Mathematics", Khanna Publishers, 40th Edition, 2010. (Unit-5). 		
Reference Books:		
<ol style="list-style-type: none"> 1. G.B. Thomas and R.L. Finney, "Calculus and Analytic geometry", 9th Edition, Pearson, Reprint, 2002. 2. Veerarajan T., "Engineering Mathematics for first year", Tata McGraw-Hill, New Delhi, 2008. 3. D. Poole, "Linear Algebra: A Modern Introduction", 2nd Edition, Brooks/Cole, 2005. 4. Erwin kreyszig, "Advanced Engineering Mathematics", 9th Edition, John Wiley & Sons, 2006. 		

Cos Versus GA mapping

Table 1: Mapping of Cos with GAs:

	GA1	GA2	GA3	GA4	GA5	GA6	GA7	GA8	GA9	GA10	GA11	GA12
CO 1	3	2			2					1		2
CO 2	3	1								1		1
CO 3	3	1								1		1
CO 4	3	2								1		1
CO 5	3	2			1					1		2
	15	8	0	0	3	0	0	0	0	5	0	7
Scaled Value	3	2			1					1		

1 – 5 → 1,

6 – 10 → 2,

11 – 15 → 3

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

Course Code	XES 102	L	T	SS	P	C
Course Name	ENVIRONMENTAL SCIENCES	3*	0	0	0	0
		L	T	SS	P	H
C:P:A	1.4: 0.3 : 0.3	3	0	0	0	3
COURSE OUTCOMES			DOMAIN		LEVEL	
CO1	<i>Describe</i> the significance of natural resources and <i>explain</i> anthropogenic impacts.	Cognitive		Remember Understand		
CO2	<i>Illustrate</i> the significance of ecosystem, biodiversity and natural geo bio chemical cycles for maintaining ecological balance.	Cognitive		Understand		
CO3	<i>Identify</i> the facts, consequences, preventive measures of major pollutions and <i>recognize</i> the disaster phenomenon	Cognitive Affective		Remember Receive		
CO4	<i>Explain</i> the socio-economic, policy dynamics and <i>practice</i> the control measures of global issues for sustainable development.	Cognitive		Understand Apply		
CO5	<i>Recognize</i> the impact of population and the concept of various welfare programs, and <i>apply</i> the modern technology towards environmental protection.	Cognitive		Understand Analysis		
UNIT - I INTRODUCTION TO ENVIRONMENTAL STUDIES AND ENERGY						12
Definition, scope and importance – Need for public awareness – Forest resources: Use, deforestation, case studies. – Water resources: Use and over-utilization of surface and ground water, dams-benefits and problems – Mineral resources: Uses, environmental effects of mining, case studies-iron mining(Goa), bauxite mining(Odisha) – Food resources: effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies – Energy resources: Growing energy needs, renewable and non-renewable energy sources, use of alternate energy sources, case studies – Land resources: Land as a resource, land degradation – Role of an individual in conservation of natural resources – Equitable use of resources for sustainable lifestyles.						
UNIT – II ECOSYSTEMS AND BIODIVERSITY						7
Concept of an ecosystem – Structure and function of an ecosystem – Producers, consumers and decomposers – Biogeochemical cycles – Food chains, food webs and ecological pyramids – Introduction, types, characteristic features, structure and function of the (a) Forest ecosystem (b) Grassland ecosystem (c) Desert ecosystem (d) Aquatic ecosystem (ponds, streams, lakes, rivers, oceans, estuaries) – Introduction to Biodiversity – Definition: genetic, species and ecosystem diversity - Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity.						
UNIT – III ENVIRONMENTAL POLLUTION						10
Definition – Causes, effects and control measures of: (a) Air pollution (b) Water pollution (c) Soil pollution (d) Marine pollution (e) Noise pollution (f) Thermal pollution (g) Nuclear hazards – Solid waste management– Role of an individual in prevention of pollution – Pollution case studies – Disaster management: flood, earthquake, cyclone and landslide.						
UNIT –IV SOCIAL ISSUES AND THE ENVIRONMENT						10
Rain water harvesting – Resettlement and rehabilitation of people; its problems and concerns, climate change, global warming, acid rain, ozone layer depletion, nuclear accidents – Consumerism and waste products – Environment Protection Act – Air (Prevention and Control of Pollution) Act – Water						

(Prevention and control of Pollution) Act – Wildlife Protection Act – Forest Conservation Act – Public awareness.

UNIT –V HUMAN POPULATION AND THE ENVIRONMENT	6
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Population growth, variation among nations – Population explosion– Environment and human health – HIV / AIDS– Role of Information Technology in Environment and human health.

	LECTURE	TUTORIAL	PRACTICAL	SELF STUDY	TOTAL
HOURS	45	0	0	0	45

TEXT BOOKS

1. Miller T.G. Jr., Environmental Science, Wadsworth Publishing Co, USA, 2000.
1. Townsend C., Harper J and Michael Begon, Essentials of Ecology, Blackwell Science, UK, 2003
2. Trivedi R.K and P.K.Goel, Introduction to Air pollution, Techno Science Publications, India, 2003.
3. Disaster mitigation, Preparedness, Recovery and Response, SBS Publishers & Distributors Pvt. Ltd, New Delhi, 2006.
4. Introduction to International disaster management, Butterworth Heinemann, 2006.
5. Gilbert M.Masters, Introduction to Environmental Engineering and Science, Pearson Education Pvt., Ltd., Second Edition, New Delhi, 2004.

REFERENCE BOOKS

1. Trivedi R.K., Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standards, Vol. I and II, Enviro Media, India, 2009.
2. Cunningham, W.P.Cooper, T.H.Gorhani, Environmental Encyclopedia, Jaico Publ., House, Mumbai, 2001.
3. S.K.Dhameja, Environmental Engineering and Management, S.K.Kataria and Sons, New Delhi, 2012.
4. Sahni, Disaster Risk Reduction in South Asia, PHI Learning, New Delhi, 2003.
5. Sundar, Disaster Management, Sarup & Sons, New Delhi, 2007.
6. G.K.Ghosh, Disaster Management, A.P.H.Publishers, New Delhi, 2006.

E RESOURCES

1. <http://www.e-booksdirectory.com/details.php?ebook=10526>
2. <https://www.free-ebooks.net/ebook/Introduction-to-Environmental-Science>
3. <https://www.free-ebooks.net/ebook/What-is-Biodiversity>
4. https://www.learner.org/courses/envsci/unit/unit_vis.php?unit=4
5. <http://bookboon.com/en/pollution-prevention-and-control-ebook>
6. <http://www.e-booksdirectory.com/details.php?ebook=8557>
7. <http://www.e-booksdirectory.com/details.php?ebook=6804>
8. <http://bookboon.com/en/atmospheric-pollution-ebook>
9. <http://www.e-booksdirectory.com/details.php?ebook=3749>
10. <http://www.e-booksdirectory.com/details.php?ebook=2604>
11. <http://www.e-booksdirectory.com/details.php?ebook=2116>
12. <http://www.e-booksdirectory.com/details.php?ebook=1026>
13. <http://www.faadooengineers.com/threads/7894-Environmental-Science>

Table: 1 Mapping of COs with POs:

	PO1	PO 2	PO 3	PO 4	PO 5	PO6	PO 7	PO8	PO9	PO1 0	PO 11	PO12	PSO 1	PSO2
CO 1	3	3	1	1	1	1			1	1	1			
CO 2	3	3	1	1	1	1			1	1	1			
CO 3	2	2	2	1	2	2	1	1	1	1	1			
CO 4	2	2	1	1	1	1	1	1	1	1	1			
CO 5	2	2	1	1	1	1	1	1	1	1	1			
Tot al	12	12	6	5	6	6	3	3	5	5	5			
Sca led val ue	3	3	2	1	2	2	1	1	1	1	1			

1-5 → 1, 6-10 → 2, 11-15 → 3

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

Course Code	XBE 103	L	T	P	C
Course Name	ELECTRICAL AND ELECTRONICS ENGINEERING SYSTEMS	2	1	2	5
PREREQUISITES	Physics	L	T	P	T
C:P:A	3:1:0	3	2	2	7
COURSE OUTCOMES		DOMAIN		LEVEL	
CO1	<i>Define, Relate</i> , the fundamentals of electrical parameters and <i>build</i> and <i>explain</i> AC, DC circuits by Using measuring devices	Cognitive		Remember	
		Psychomotor		Understand	
				Mechanism set	
CO2	<i>Define and Explain</i> the of operation of DC and AC machines.	Cognitive		Remember	
				Understand	
CO3	<i>Recall and Illustrate</i> various semiconductor devices and their applications and displays the input output characteristics of basic semiconductor devices.	Cognitive		Remember	
		Psychomotor		Understand	
				Mechanism	
CO4	<i>Relate and Explain the</i> number systems and logic gates. <i>Construct</i> the different digital circuit.	Cognitive		Remember	
		Psychomotor		Understand	
				Origination	
CO5	<i>Label and Outline the</i> different types of microprocessors and their applications.	Cognitive		Remember	
				Understand	
UNIT I- FUNDAMENTAL OF DC AND AC CIRCUITS, MEASUREMENTS				9+9+12	
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 II – ELECTRICAL MACHINES				9 + 6+0	
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 III – SEMICONDUCTOR DEVICES				9 + 3+8
Classification of Semiconductors, Construction, Operation and Characteristics: PN Junction Diode – Zener Diode, PNP, NPN Transistors, Field Effect Transistors and Silicon Controlled Rectifier – Applications.				
UNIT IV – DIGITAL ELECTRONICS				9 + 6+10
Basic of Concepts of Number Systems, Logic Gates, Boolean Algebra, Adders, Subtractors, multiplexer, demultiplexer, encoder, decoder, Flipflops, Up/Down counters, Shift Registers.				
UNIT V – MICROPROCESSORS				9+ 6+0
Architecture, 8085, 8086 - Interfacing Basics: Data transfer concepts – Simple Programming concepts				
LIST OF EXPERIMENTS :				
1.	Study of Electrical Symbols, Tools and Safety Precautions, Power Supplies.			
2.	Study of Active and Passive elements – Resistors, Inductors and Capacitors, Bread Board.			
3.	Verification of AC Voltage, Current and Power in Series and Parallel connection.			
4.	Testing of DC Voltage and Current in series and parallel resistors which are connected in breadboard by using Voltmeter, Ammeter and Multimeter.			
5.	Fluorescent lamp connection with choke.			
6.	Staircase Wiring.			
7.	Forward and Reverse bias characteristics of PN junction diode.			
8.	Forward and Reverse bias characteristics of zener diode.			
9.	Input and Output Characteristics of NPN transistor.			
10.	Construction and verification of simple Logic Gates.			
11.	Construction and verification of adders.			
12.	Construction and verification of subtractor.			
	LECTURE	TUTORIAL	PRACTICAL	TOTAL
	45	30	30	105

TEXT BOOKS

1. Metha V.K., 2008. Principles of Electronics. Chand and Company.
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. Morris Mano, 1999. Digital Design. Prentice Hall of India.
5. Ramesh, S. Gaonkar, 2000. Microprocessor Architecture, Programming and its Applications with the 8085. 4th ed. India: Penram International Publications.

REFERENCE BOOKS:

1. Corton,H.,2004. Electrical Technology. CBS Publishers & Distributors.
2. Syed, A. Nasar, 1998, Electrical Circuits. Schaum Series.
3. Jacob Millman and Christos, C. Halkias, 1967. Electronics Devices.New Delhi: McGraw-Hill.
4. Millman, J. andHalkias, C. C., 1972. Integrated Electronics: Analog and Digital Circuits and Systems. Tokyo: McGraw-Hill, Kogakusha Ltd.
- 5.Mohammed Rafiquzzaman, 1999. 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. Prof.L.Umanand, <http://freevidelectures.com/Course/2335/Basic-Electrical-Technology#>, IISc Bangalore.
3. <http://nptel.ac.in/Onlinecourses/Nagendra/>, Dr. Nagendra Krishnapura , IIT Madras.
4. Dr.LUmanand , <http://www.nptelvideos.in/2012/11/basic-electrical-technology.html>, IISC Bangalore

Course Code	XAP 104	L	T	P	C
Course Name	APPLIED PHYSICS FOR ENGINEERS	3	1	2	6
C:P:A	2.8:0.8:0.4	L	T	P	H
PREREQUISITE:	Basic Physics in HSC level	3	1	3	7
COURSE OUTCOMES		Domain		Level	
CO1	<i>Identify</i> the basics of mechanics, <i>explain</i> the principles of elasticity and <i>determine</i> its significance in engineering systems and technological advances.	Cognitive: Psychomotor:		Remember, Understand Mechanism	
CO2	<i>Illustrate</i> the laws of electrostatics, magneto-statics and electromagnetic induction; <i>use</i> and <i>locate</i> basic applications of electromagnetic induction to technology.	Cognitive: Psychomotor: Affective:		Remember, Analyze, Mechanism Respond	
CO3	<i>Understand</i> the fundamental phenomena in optics by measurement and <i>describe</i> the working principle and application of various lasers and fibre optics.	Cognitive: Psychomotor: Affective:		Understand, Apply Mechanism Receive	
CO4	<i>Analyse</i> energy bands in solids, <i>discuss</i> and <i>use</i> physics principles of latest technology using semiconductor devices.	Cognitive: Psychomotor: Affective:		Understand, Analyze Mechanism Receive	
CO5	<i>Develop</i> Knowledge on particle duality and <i>solve</i> Schrodinger equation for simple potential.	Cognitive:		Understand, Apply	
UNIT - I MECHANICS OF SOLIDS				9+3+9	
<p>Mechanics: Force - Newton's laws of motion - work and energy - impulse and momentum - torque - law of conservation of energy and momentum - Friction.</p> <p>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.</p>					
UNIT -II ELECTROMAGNETIC THEORY				9+3+3	
Laws of electrostatics - Electrostatic field and potential of a dipole; Dielectric Polarisation, Dielectric constant, internal field - Clausius Mossotti Equation - Laws of magnetism - Ampere's Faraday's law; Lenz's law - Maxwell's equation - Plane electromagnetic waves; their transverse nature - expression for plane, circularly and elliptically polarized light - quarter and half wave plates - production and detection of plane, circularly and elliptically polarized light.					
UNIT -III OPTICS, LASERS AND FIBRE OPTICS				9+3+12	
<p>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.</p> <p>LASER: Introduction - Population inversion -Pumping - Laser action - Nd-YAG laser - CO₂ laser -</p>					

Applications

Fibre Optics: Principle and propagation of light in optical fibre - Numerical aperture and acceptance angle - Types of optical fibre - Fibre optic communication system (Block diagram).

UNIT –IV SEMICONDUCTOR PHYSICS

9+3+6

Semiconductors: Energy bands in solids - Energy band diagram of good conductors, insulators and semiconductors - Concept of Fermi level - Intrinsic semiconductors - Concept of holes - doping - Extrinsic semiconductors - P type and N type semiconductors - Hall effect.

Diodes and Transistors: P-N junction diode - Forward bias and reverse bias - Rectification action of diode - Working of full wave rectifier using P N junction diodes - PNP and NPN transistors - Three different configurations - Advantages of common emitter configuration - working of NPN transistor as an amplifier in common emitter configuration.

UNIT –V QUANTUM PHYSICS

9+3+0

Introduction to quantum physics, black body radiation, Compton effect, de Broglie hypothesis, wave – particle duality, uncertainty principle, Schrodinger wave equation (Time dependent and Time independent), particle in a box, Extension to three dimension - Degeneracy.

TEXT BOOKS

1. Gaur R. K. and Gupta S. L., "Engineering Physics", Dhanpat Rai Publications, 2009.
2. Avadhanulu M. N. "Engineering Physics" (Volume I and II), S. Chand & Company Ltd., New Delhi, 2010.

REFERENCE BOOKS

1. Palanisamy P. K., "Engineering Physics", Scitech Publications (India) Pvt. Ltd, Chennai.
2. Arumugam M., "Engineering Physics" (Volume I and II), Anuradha Publishers, 2010.
3. Senthil Kumar G., " Engineering Physics", 2nd Enlarged Revised Edition, VRB Publishers, Chennai, 2011.
4. Mani P., "Engineering Physics", Dhanam Publications, Chennai, 2007.

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. | Meter Bridge - Determination of specific resistance of the material of the wire. |
| 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. Samir Kumar Ghosh, "A text book of Advanced Practical Physics", New Central Agency (P) Ltd, 2008.				
2. Arora C.L., "Practical Physics", S. Chand & Company Ltd., New Delhi, 2013.				
3. Umayal Sundari AR., "Applied Physics Laboratory Manual", PMU Press, Thanjavur, 2012.				
	LECTURE	TUTORIAL	PRACTICAL	TOTAL HOURS
Hours	45	15	30	90

Table 1: Mapping of CO's with PO:

	PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS1	PS2
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		
Scaled to 0,1,2,3 scale	3	2	2	2	1				1			1		

1 - 5 → 1, 6 - 10 → 2, 11 - 15 → 3

0-No Relation, 1- Low Relation, 2-Medium Relation, 3-High Rel

Course Code	XEG 105	L	T	P	C
Course Name	ENGINEERING GRAPHICS	0	0	3	3
PREREQUISITE: NIL					
COURSE OUTCOMES:					
Course outcomes:		Domain	Level		
CO1	<i>Apply</i> the national and international standards, <i>construct</i> and <i>practice</i> various curves	Cognitive, Psychomotor and Affective	Applying, Guided response and Responds to Phenomena		
CO2	<i>Interpret, construct</i> and <i>practice</i> orthographic projections of points, straight lines and planes.	Cognitive, Psychomotor and Affective	Understanding, Mechanism and Responds to Phenomena		
CO3	<i>Construct Sketch</i> and <i>Practice</i> projection of solids in various positions and true shape of sectioned solids.	Cognitive, Psychomotor and Affective	Applying, Complex Overt Response and Responds to Phenomena		
CO4	<i>Interpret, Sketch</i> and <i>Practice</i> the development of lateral surfaces of simple and truncated solids, intersection of solids.	Cognitive, Psychomotor and Affective	Understanding, Complex Overt Response and Responds to Phenomena		
CO5	<i>Construct sketch</i> and <i>practice</i> isometric and perspective views of simple and truncated solids.	Cognitive, Psychomotor and Affective	Applying, Complex Overt Response and Responds to Phenomena		
UNIT-I	INTRODUCTION, FREE HAND SKETCHING OF ENGG OBJECTS AND CONSTRUCTION OF PLANE CURVE			6+6	
<p>Importance of graphics in engineering applications – use of drafting instruments – BIS specifications and conventions as per SP 46-2003.</p> <p>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.</p> <p>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.</p>					
UNIT –II	PROJECTION OF POINTS, LINES AND PLANE SURFACES			6+6	
<p>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.</p>					

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.		
THEORY 30	PRACTICAL 30	TOTAL HRS 60
TEXT BOOKS		
<ol style="list-style-type: none"> 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		
<ol style="list-style-type: none"> 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		
<ol style="list-style-type: none"> 1. http://periyarnet/Econtent 2. http://nptel.ac.in/courses/112103019/ 		

Table 1: Mapping of CO's with PO'S:

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	P O 10	P O 11	P O 12	PS O 1	PS O 2
CO1	3	3	3	2	3	2	3	1	1	2	3	3	3	-
CO2	3	3	3	1	3	1	3	1	1	1	2	3	3	-
CO3	3	3	3	1	3	1	3	1	1	1	2	3	3	-
CO4	3	3	3	1	3	1	3	1	1	1	2	3	3	-
CO5	3	3	3	1	3	1	3	1	1	1	2	3	3	-
Total	15	15	15	6	15	6	15	5	5	6	11	3	3	-
Scale d	3	3	3	2	3	2	3	1	1	2	3	3	3	-

0 - No relation

1- Low relation

2- Medium relation

3- High relation

1-5 → 1, 6-10 → 2, 11-15 → 3

COURSE CODE			XMA201	L	T	P	C
COURSE NAME			CALCULUS, ORDINARY DIFFERENTIAL EQUATIONS AND COMPLEX VARIABLE	3	1	0	4
C	P	A		L	T	P	H
3	0.5	0.5		3	1	0	4
PREREQUISITE :Mathematics I (Calculus and Linear Algebra)							
COURSE OUTCOMES:							
Course outcomes:				Domain	Level		
CO1: Find double and triple integrals and to find line, surface and volume of an integral by Applying Greens, Gauss divergence and Stokes theorem.				Cognitive	Applying Remembering		
CO2: Solve first order differential equations of different types which are solvable for p, y, x and Clairaut's type.				Cognitive	Applying		
CO3:Solve Second order ordinary differential equations with variable coefficients using various methods.				Cognitive	Applying		
CO4:Use CR equations to verify analytic functions and to find harmonic functions and harmonic conjugate. Conformal mapping of translation and rotation. Mobius transformation.				Cognitive Psychomotor	Remembering Applying Response		
CO5:Apply Cauchy residue theorem to evaluate contour integrals involving sine and cosine function and to state Cauchy integral formula, Liouville's theorem. Taylor's series, zeros of analytic functions, singularities, Laurent's series.				Cognitive Affective	Applying Receiving		
Unit 1: Multivariable Calculus (Integration)							12
Multiple Integration: Double integrals (Cartesian) - change of order of integration in double integrals - Change of variables (Cartesian to polar) - Triple integrals (Cartesian), Scalar line integrals - vector line integrals - scalar surface integrals - vector surface integrals - Theorems of Green, Gauss and Stokes.							
Unit 2: First order ordinary differential equations							12
Exact - linear and Bernoulli's equations - Euler's equations - Equations not of first degree: equations solvable for p - equations solvable for y- equations solvable for x and Clairaut's type.							
Unit 3: Ordinary differential equations of higher orders							12
Second order linear differential equations with variable coefficients- method of variation of parameters - Cauchy-Euler equation- Power series solutions- Legendre polynomials- Bessel functions of the first kind and their properties.							
Unit 4: Complex Variable – Differentiation							12
Differentiation-Cauchy-Riemann equations- analytic functions-harmonic functions-finding harmonic conjugate- elementary analytic functions (exponential, trigonometric, logarithm) and their properties- Conformal mappings- Mobius transformations and their							

properties.		
Unit 5: Complex Variable – Integration		12
Contour integrals - Cauchy-Goursat theorem (without proof) - Cauchy Integral formula (without proof)-Liouville’s theorem (without proof)- Taylor’s series- zeros of analytic functions- singularities- Laurent’s series – Residues- Cauchy Residue theorem (without proof)- Evaluation of definite integral involving sine and cosine- Evaluation of certain improper integrals using the Bromwich contour.		
LECTURE	TUTORIAL	TOTAL
45	15	60
Text Book: 1.B.S. Grewal, “Higher Engineering Mathematics”, Khanna Publishers, 40 th Edition, 2008.		
Reference Books:		
1.G.B. Thomas and R.L. Finney, “Calculus and Analytic geometry”, 9 th Edition, Pearson, Reprint, 2002.		
2. Erwin kreyszig, “Advanced Engineering Mathematics”, 9 th Edition, John Wiley & Sons, 2006.		
3.W. E. Boyce and R. C. DiPrima, “Elementary Differential Equations and Boundary Value Problems”, 9 th Edn. Wiley India, 2009.		
4. S. L. Ross, “Differential Equations”, 3 rd Ed., Wiley India, 1984.		
5.E. A. Coddington, “An Introduction to Ordinary Differential Equations”, Prentice Hall India, 1995.		
6. E. L. Ince, “Ordinary Differential Equations”, Dover Publications, 1958.		
7.J. W. Brown and R. V. Churchill, “Complex Variables and Applications”, 7 th Ed., McGraw Hill, 2004.		
8. N.P. Bali and Manish Goyal, “A text book of Engineering Mathematics”, Laxmi Publications, Reprint, 2008.		

Cos Versus GA mapping

Table 1: Mapping of Cos with GAs:

	GA1	GA2	GA3	GA4	GA5	GA6	GA7	GA8	GA9	GA10	GA11	GA12
CO 1	3	2			2					1		2
CO 2	3	1								1		1
CO 3	3	1								1		1
CO 4	3	2								1		1
CO 5	3	2			1					1		2
	15	8	0	0	3	0	0	0	0	5	0	7
Scaled Value	3	2			1					1		

1 – 5 → 1, 6 – 10 → 2, 11 – 15 → 3, 0 - No Relation, 1 - Low Relation, 2- Medium Relation, 3- High

COURSE CODE		XCP202		L	T	P	C
COURSE NAME		PROGRAMMING FOR PROBLEM SOLVING		3	0	2	5
II							
Course outcome				Domain		Levels	
CO1	<i>Define</i> programming fundamentals and <i>Solve</i> simple programs using I/O statements			Cognitive Psychomotor	Remember Understand Apply		
CO2	<i>Define</i> syntax and <i>write simple programs</i> using control structures and arrays			Cognitive Psychomotor	Remember Understand, Apply		
CO3	<i>Explain</i> and <i>write simple programs</i> using functions and pointers			Cognitive Psychomotor	Understand Apply		
CO4	<i>Explain</i> and <i>write simple programs</i> using structures and unions			Cognitive Psychomotor	Understand Apply, Analyze		
CO5	<i>Explain</i> and <i>write simple programs</i> using files and <i>Build</i> simple projects			Cognitive Psychomotor	Remember Understand Create		
COURSE CONTENT							Hours
UNIT I	PROGRAMMING FUNDAMENTALS AND INPUT /OUTPUT STATEMENTS						9 + 6
	<p>Theory: Introduction to components of a computer system, Program – Flowchart – Pseudo code – Software – Introduction to C language – Character set – Tokens: Identifiers, Keywords, Constants, and Operators – sample program structure – Header files – Data Types-Variables - Output statements – Input statements.</p> <p>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.</p>						

UNIT II	CONTROL STRUCTURE AND ARRAYS	9 + 6
	<p>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.</p> <p>Practical</p> <ol style="list-style-type: none"> 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. 5. Performing basic sorting algorithms 	
UNIT III	FUNCTIONS AND POINTERS	9 + 6
	<p>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 - Use of Pointers in self-referential structures-Notion of linked list(no implementation).</p> <p>Practical: Program to find factorial of a given number using four function types.</p> <ol style="list-style-type: none"> 1. Programs using Recursion such as Finding Factorial, Fibonacci series, Ackerman function etc. Quick sort or Merge sort 2. Programs using Pointers 	
UNIT IV	STRUCTURES AND UNIONS	9 + 6
	<p>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.</p> <p>Practical:Program to read and display student mark sheet Structures with variables</p> <ol style="list-style-type: none"> 1. Program to read and display student marks of a class using Structures with arrays 2. 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: Program for copying contents of one file to another file.	
TEXT BOOKS /REFERENCE BOOKS		
1. Byron Gottfried, "Programming with C", III Edition, (Indian Adapted Edition), TMH publications, 2010 2. Yeshwant Kanethker, “Let us C”, BPB Publications, 2008 3. Brian W. Kernighan and Dennis M. Ritchie, "The C Programming Language", Pearson Education Inc. 2005 4. Behrouz A. Forouzan and Richard. F. Gilberg, "A Structured Programming Approach Using C", II Edition, Brooks–Cole Thomson Learning Publications, 2001 5. Johnson baugh R. and Kalin M., “Applications Programming in ANSI C”, III Edition, Pearson Education India, 2003		

Table 1: COs Versus POs Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2			3						2	3	2	
CO2	3	2			2						2	3	2	
CO3	2	2	1	2	2						2	2	2	
CO4	2	2	1	2	2						2	2	2	
CO5	2	2	1		2			1		2	2	2	2	
Total	12	10	3	4	11			1		2	10	12	10	
Scaled Value	3	2	1	1	3			1		1	2	3	2	

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

COURSE CODE	XGS 203	L	T	P	SS	C
COURSE NAME	ENGLISH	2	0	1	0	3
Pre-requisites (if any)		L	T	P	SS	H
C: P: A	2.6:0.4:0	2	0	2	0	4
COURSE OUTCOMES:		Domain		Level		
CO1	<i>Ability</i> to recall the meaning for proper usage	Cognitive		Remember		
CO2	<i>Apply</i> the techniques in sentence patterns	Cognitive		Apply		
CO3	<i>Identify</i> the common errors in sentences	Cognitive		Remember		
CO4	<i>Construct</i> the Nature and Style of sensible Writing	Cognitive		Create		
CO5	<i>Practicing</i> the writing skills	Psychomotor		Guided Response		
CO6	<i>Grasping</i> the techniques in learning sounds and etiquettes	Psychomotor		Adapting		
UNIT I - Vocabulary Building						9
1.1 The concept of Word Formation						
1.2 Root words from foreign languages and their use in English						
1.3 Acquaintance with prefixes and suffixes from foreign languages in English to form derivatives.						
1.4 Synonyms, antonyms, and standard abbreviations.						
UNIT II - Basic Writing Skills						9
2.1 Sentence Structures						
2.2 Use of phrases and clauses in sentences						
2.3 Importance of proper punctuation						
2.4 Creating coherence						
2.5 Organizing principles of paragraphs in documents						
2.6 Techniques for writing precisely						
UNIT III - Identifying Common Errors in Writing						9
3.1 Subject-verb agreement						
3.2 Noun-pronoun agreement						
3.3 Misplaced modifiers						
3.4 Articles						
3.5 Prepositions						
3.6 Redundancies						
3.7 Clichés						
UNIT IV - Nature and Style of sensible Writing						9
4.1 Describing						
4.2 Defining						
4.3 Classifying						
4.4 Providing examples or evidence						
4.5 Writing introduction and conclusion						
UNIT V - Writing Practices						9
5.1 Comprehension						
5.2 Précis Writing						
5.3 Essay Writing						
Unit VI - Oral Communication						
(This unit involves interactive practice sessions in Language Lab)						
<input type="checkbox"/> Listening Comprehension						

- Pronunciation, Intonation, Stress and Rhythm
- Common Everyday Situations: Conversations and Dialogues
- Communication at Workplace
- Interviews
- Formal Presentations

Suggested Readings:

- (i) Practical English Usage. Michael Swan. OUP. 1995
- (ii) Remedial English Grammar. F.T. Wood. Macmillan.2007
- (iii) On Writing Well. William Zinsser. Harper Resource Book. 2001
- (iv) Study Writing. Liz Hamp-Lyons and Ben Heasley. Cambridge University Press. 2006
- (v) Communication Skills. Sanjay Kumar and PushpLata. Oxford University Press. 2011
- (vi) Exercises in Spoken English. Parts. I-III. CIEFL, Hyderabad. Oxford University Press

Table 1: Mapping of Cos with POs:

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2
CO1	2	0	0	0	0	0	2	0	1	0	0	0	0	0
CO2	2	0	0	0	0	0	2	0	1	0	0	0	0	0
CO3	1	0	0	0	0	0	1	0	1	0	0	0	0	0
CO4	2	0	0	0	0	0	1	0	1	0	0	0	0	0
CO5	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	7	0	0	0	0	0	6	0	4	0	0	0	0	0
Scale d Value	2	0	0	0	0	0	2	0	1	0	0	0	0	0
	1	0	0	0	0	0	1	0	1	0	0	0	0	0

1-5= 1, 6-10 = 2, 11-15= 3 , 0-No Relation, 1- Low Relation, 2 – Medium Relation, 3- High

COURSE CODE	XAC 204	L	T	P	C
COURSE NAME	APPLIED CHEMISTRY FOR ENGINEERS	3	1	1	5
PREREQUISITES	Nil	L	T	P	H
C:P:A	3.5:1.0:0.5	3	1	3	7
COURSE OUTCOMES		DOMAIN		LEVEL	
CO1	<i>Identify</i> the periodic properties such as ionization energy, electron affinity, oxidation states and electro negativity. <i>Describe</i> the various water quality parameters like hardness and alkalinity.	Cognitive Psychomotor		Remember Perception	
CO2	<i>Interpret</i> bulk properties and processes using thermodynamic and kinetic considerations.	Cognitive Psychomotor		Understand Set	
CO3	<i>Explain and Measure</i> microscopic chemistry in terms of atomic, molecular orbitals and intermolecular forces.	Cognitive Psychomotor Affective		Apply Mechanism Receive	
CO4	<i>Describe, Illustrate and Discuss</i> the chemical reactions that are used in the synthesis of molecules.	Cognitive Psychomotor Affective		Remember Analyze Perception Respond	
CO5	<i>Apply, Measure and Distinguish</i> the ranges of the electromagnetic spectrum used for exciting different molecular energy levels in various spectroscopic techniques	Cognitive Psychomotor		Remember Apply Mechanism	
Theory Part					
UNIT – I	PERIODIC PROPERTIES AND WATER CHEMISTRY	8+3+6			
Effective nuclear charge, penetration of orbitals, variations of s, p, d and f orbital energies of atoms in the periodic table, electronic configurations, atomic and ionic sizes, ionization energies, electron affinity, electronegativity, polarizability and oxidation states. Water Chemistry -Water quality parameters-Definition and explanation of hardness, determination of hardness by EDTA method-Introduction to alkalinity.					
UNIT-II	USE OF FREE ENERGY IN CHEMICAL EQUILIBRIA	12+3+6			
Thermodynamic functions: energy, entropy and free energy. Estimations of entropy and free energies. Free energy and emf. Cell potentials, the Nernst equation and applications. Acid base, oxidation reduction and solubility equilibria. Corrosion-Types, factors affecting corrosion rate and Control methods. Use of free energy considerations in metallurgy through Ellingham diagrams. Advantages of electroless plating, electroless plating of nickel and copper on Printed Circuit Board (PCB).					
UNIT-III	ATOMIC AND MOLECULAR STRUCTURE	10+3+6			
Schrodinger equation. Particle in a box solution and their applications for conjugated molecules and nanoparticles.. Molecular orbitals of diatomic molecules and plots of the multicenter orbitals. Equations for atomic and molecular orbitals. Energy level diagrams of diatomic molecules. Crystal field theory and the energy level diagrams for transition metal ions and their magnetic properties. Band structure of solids and the role of doping on band structures. Intermolecular forces and potential energy surfaces Ionic, dipolar and Vander waals interactions. Equations of state of real gases and critical phenomena. Potential energy surfaces of H ₃ , H ₂ F and HCN and trajectories on these surfaces.					
UNIT-IV	SPECTROSCOPIC TECHNIQUES AND APPLICATIONS	7+3+6			

Principles of spectroscopy and selection rules. Electronic spectroscopy-chromophore, auxochromes, types of electronic transition and application. Fluorescence and its applications in medicine. Vibrational spectroscopy-types of vibrations, Instrumentation and applications. Rotational spectroscopy of diatomic molecules. Nuclear magnetic resonance spectroscopy-concept of chemical shift and applications-magnetic resonance imaging. Diffraction and scattering.				
UNIT-V	STEREOCHEMISTRY AND ORGANIC REACTIONS			8+3+6
Representations of 3 dimensional structures, structural isomers and stereoisomers, configurations and symmetry and chirality, enantiomers, diastereomers, optical activity, absolute configurations and conformational analysis. Isomerism in transitional metal compounds <i>Organic reactions and synthesis of a drug molecule</i> Introduction to reactions involving substitution, addition, elimination, oxidation, reduction, cyclization reactions and ring opening reactions. Synthesis of a commonly used drug molecule-Aspirin and paracetamol.				
	LECTURE	TUTORIAL	PRACTICAL	TOTAL HOURS
Hours	45	15	30	90
TEXT BOOKS				
<ol style="list-style-type: none"> 1. Puri B.R. Sharma, L.R., Kalia K.K. Principles of Inorganic Chemistry, (23rd edition), New Delhi, Shoban Lal Nagin Chand & Co., 1993 2. Lee. J.D. Concise Inorganic Chemistry, UK, Black well science, 2006. 3. Trapp. C, Cady, M. Giunta. C, Atkins's Physical Chemistry, 10th Edition, Oxford publishers, 2014. 4. Glasstone S., Lewis D., Elements of Physical Chemistry, London, Mac Millan & Co. Ltd, 1983. 5. Morrison R.T. and Boyd R.N. Organic Chemistry (6th edition), New York, Allyn & Bacon Ltd., 1976. 6. Banwell. C.N, Fundamentals of Molecular Spectroscopy, (3th Edition), McGraw-Hill Book Company, Europe 1983. 7. Bahl B.S. and Arun Bahl, Advanced Organic Chemistry, (4th edition), S./ Chand & Company Ltd. New Delhi, 1977. 8. P. S. Kalsi, Stereochemistry: Conformation and mechanism, (9th Edition), New Age International Publishers, 2017. 				
REFERENCE BOOKS				
<ol style="list-style-type: none"> 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:				
<ol style="list-style-type: none"> 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

Experiments :				
1. Determination of chloride ion present in the water sample by Argentometric method.	CO1			
2. Determination of total, temporary and permanent hardness of water sample by EDTA	CO1			
3. Determination of cell constant and conductance of solutions.	CO2			
4. Potentiometry - determination of redox potentials and emfs.	CO2			
5. Determination of surface tension and viscosity.	CO3			
6. Adsorption of acetic acid by charcoal.	CO3			
7. Determination of the rate constant of a reaction.	CO4			
8. Estimation of iron by colorimetric method.	CO4			
9. Synthesis of a polymer/drug.	CO5			
10. Saponification/acid value of an oil.	CO5			
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.				
E Resources - MOOCs:				
3. http://freevideolectures.com/Course/2380/Chemistry-Laboratory-Techniques				
4. http://freevideolectures.com/Course/2941/Chemistry-1A-General-Chemistry-Fall-2011				
5. http://ocw.mit.edu/courses/chemistry/5-301-chemistry-laboratory-techniques				
	LECTURE	TUTORIAL	PRACTICAL	TOTAL HOURS
HOURS	45	15	45	105

Table 1 : Mapping of CO's with GA's:

	GA1	GA 2	GA 3	GA 4	GA 5	GA 6	GA 7	GA 8	GA 9	GA 10	GA 11	GA 12
CO1	3	2	1	2	2	1	1	0	2	0	1	1
CO2	3	2	1	3	1	1	1	0	2	0	1	0
CO3	3	3	1	3	2	0	1	0	2	0	1	0
CO4	3	2	1	2	3	1	1	0	1	0	1	1
CO5	2	2	1	2	1	0	1	0	1	0	1	0

1 – 5 → 1, 6 – 10 → 2, 11 – 15 → 3, 0-No Relation, 1- Low, 2-Medium , 3-High

SUB CODE		XWP205			L	T	P	C	
SUB NAME		WORKSHOP/ MANUFACTURING PRACTICES			1	0	2	3	
C	P	A				L	T	P	H
1	3	0				2	0	4	6
PREREQUISITE:									
Course outcomes:					Domain		Level		
CO1:	<i>Summarize</i> the machining methods and <i>Practice</i> machining operation.				Cognitive Psychomotor		Understanding Guided response		
CO2:	<i>Defining</i> metal casting process, moulding methods and relates Casting and Smithy applications.				Cognitive Psychomotor		Remembering Perception		
CO3:	<i>Plan</i> basic carpentry and fitting operation and <i>Practice</i> carpentry and fitting operations.				Cognitive Psychomotor		Applying Guided response		
CO4:	<i>Summarize</i> metal joining operation and <i>Practice</i> welding operation.				Cognitive Psychomotor		Understanding Guided response		
CO5:	<i>Illustrate</i> the, electrical and electronics basics and <i>Makes</i> appropriate connections.				Cognitive Psychomotor		Understanding Origination		
COURSE CONTENT									
EXP.NO		TITLE						CO RELATION	
1		INTRODUCTION TO MACHINING PROCESS						CO1	
2		PLAIN TURNING USING LATHE OPERATION						CO1	
3		INTRODUCTION TO CNC						CO1	
4		DEMONSTRATION OF PLAIN TURNING USING CNC						CO1	
5		STUDY OF METAL CASTING OPERATION						CO2	
6		DEMONSTRATION OF MOULDING PROCESS						CO2	
7		STUDY OF SMITHY OPERATION						CO2	
8		Study of carpentry tools						CO3	
9		Half lap joint – Carpentry						CO3	
10		Mortise and Tenon joint – Carpentry						CO3	
11		Study of fitting tools						CO3	
12		Square fitting						CO3	
13		Triangular fitting						CO3	
14		STUDY OF WELDING TOOLS						CO4	
15		Square butt joint - welding						CO4	
16		Tee joint – Welding						CO4	
17		Introduction to house wiring						CO5	
18		One lamp controlled by one switch						CO5	
19		Two lamps controlled by single switch						CO5	
20		Staircase wiring						CO5	
TEXT BOOKS									
1. Workshop Technology I,II,III, by S K Hajra, Choudhary and A K Chaoudhary. Media Promoters and Publishers Pvt. Ltd., Bombay									

2. Workshop Technology by Manchanda Vol. I,II,III India Publishing House, Jalandhar.

REFERENCES

1. Manual on Workshop Practice by K Venkata Reddy, KL Narayana et al; MacMillan India Ltd.
2. Basic Workshop Practice Manual by T Jeyapoovan; Vikas Publishing House (P) Ltd.,New Delhi
3. Workshop Technology by B.S. Raghuwanshi, Dhanpat Rai and Co., New Delhi.
4. Workshop Technology by HS Bawa, Tata McGraw Hill Publishers, New Delhi.

E RESOURCES

1. <http://nptel.ac.in/courses/112107145/>

Mapping of CO's with PO'S:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	2	2	1			1	1		1	2
CO2	2	1	2	2	1			1	1		1	2
CO3	2	1	2	2	1			1	1		1	2
CO4	2	1	2	2	1			1	1		1	2
CO5	2	1	2	2	1			1	1		1	2
Total												

0- No relation

1- Low relation

2- Medium relation

3- High relation

SEMESTER	COURSE NAME	COURSE CODE	L	T	P	C
3	PROBABILITY AND STATISTICS	XMA 301	3	0	0	3
PREREQUISITE: Basic concepts of Probability theory , Differentiation and Integration						
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.		Cog	Remembering			
CO2: Explain the joint distribution and Marginal distribution and to Find the correlation and regression.		Cog	Remembering Understanding			
CO3: Define null and alternate hypothesis, Apply test statistic.		Cog	Remembering Apply			
CO4: Explain the concept of analysis of variance and to Compare between one and two factor analysis of variance tests.		Cog	Understanding			
CO5. Explain the purpose, function and basic methods of statistical process control and to Apply the statistical techniques to measure the quality of a product, service, or process.		Cog	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	PRACTICAL	TOTAL
45	0	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 1. Advanced Engineering Mathematics Prof. Somesh Kumar Department of Mathematics, Indian Institute of Technology, Kharagpur.			

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1
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

SEMESTER	COURSE NAME	COURSE CODE	L	T	P	C
3	BIOCHEMISTRY -I	XBT302	3	0	0	3
PREREQUISITE: XAP 104 Applied Physics, XAC 204 Applied Chemistry						
COURSE OUTCOMES:						
Course Outcomes			Domain		Level	
<i>On the successful completion of the course, students will be able to</i>						
CO1: Recognize and Understand biochemical molecules structure and functions in the cell.			Cog Psy		Remembering Receiving	
CO2: Discuss and Remember amino acids structure and properties & fundamentals of Ramachandran Plot			Cog Psy		Recalling Origination	
CO 3: Discuss and apply enzyme properties and metabolic pathways (Glycolysis, TCA cycle)			Cog Psy		Create Guided Response	
CO4: Relate and follow biosynthesis and catabolism of fatty acids.			Cog Psy		Create Guided response	
CO5: Measures and Analyze biosynthesis of nucleotide and structure of DNA and relate diseases to DNA sequence and metabolic pathways.			Cog Psy Aff		Create Guided response Perception	
CO 1	FOUNDATION OF BIOCHEMISTRY					9
Cellular Foundations, Chemical Foundations, Physical Foundations, Genetic Foundations, Evolutionary Foundations, Water, Weak Interactions in Aqueous Systems, Ionization of Water, Weak Acids, and Weak Bases, Buffering against pH changes in biological systems. Water as a reactant.						
CO 2	AMINO ACIDS, PROTEINS AND PEPTIDES					9
Amino acids, structures of 20 common acids and properties, Peptides, Proteins, working with proteins – Electrophoresis. Structure of Proteins- Primary, Secondary, Tertiary structure and Quaternary Structures – Fibrous Proteins. Methods for determining the three-dimensional structure of protein (XRD and NMR). Protein denaturation and Folding – Protein Diseases- Ramachandran Plot.						
CO 3	ENZYMES AND CARBOHYDRATES METABOLISM					9
Enzymes- Fundamentals – Enzyme Kinetics and approach to understand mechanism – Two-Step-reaction catalyzed by enolase. Carbohydrates and Glycobiology, Monosaccharides-Disaccharides-Blood glucose measurement in diagnosis and treatment of diabetes. Working with carbohydrates. Introduction to metabolism, Glycolysis, Gluconeogenesis, Pentose Phosphate pathway. TCA cycle.						
CO 4	BIOSYNTHESIS OF FATTY ACIDS AND CATABOLISM					9

Biosynthesis of fatty acids, Oxidation of fatty acid – beta oxidation and omega oxidation. Biosynthesis of Cholesterol, Biosynthesis of phospholipids and glycolipids, Metabolic disorders of carbohydrate metabolism (pathophysiology, clinical symptoms and treatment)			
CO 5	BIOSYNTHESIS OF AMINO ACIDS AND NUCLEOTIDES		9
Overview of Nitrogen Metabolism, Biosynthesis of amino acids, biosynthesis and degradation of nucleotides – De Novo Purine Nucleotide synthesis – Purine Nucleotide Biosynthesis – Pyrimidine Nucleotide-Nucleotide Monophosphates-Ribosomal – Purine and Pyrimidine bases are restricted by Salvage Pathways.			
	LECTURE	PRACTICAL	TOTAL
	45	0	45
A. TEXT BOOK			
1. Lehninger Principles of Biochemistry, David L. Nelson and Michael M. Cox, W. H. Freeman; 6th edition (13 February 2013), 1158 pages ISBN-10: 1464109621, ISBN-13: 978-1464109621.			
2. Biochemistry , <u>Donald Voet, Judith G. Voet</u> 4th Edition, 2011, 1520 pages ISBN : 978-0-470-91410-6.			
3. Branden C. and Tooze J., “Introduction to Protein Structured, Second Edition”, Garland Publishing, NY, USA, 1999.			
B. REFERENCES:			
1. Introduction to Protein structure, 2nd Ed by Carl Branden and John Tooze, Garland Press, 1999.			
2. Structure and Mechanism in Protein Science, Alan Fersht, Freeman, 1999.			
3. Protein engineering in Industrial biotechnology, Ed. Lilia Alberghina, Harwood Academic Publishers, 2002.			
4. Creighton T.E. Proteins, Freeman WH, Second Edition, 1993.			

Table 1: COs Vs. Pos

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO 1	1	1	2	0	1	0	0	1	1	1	1
CO 2	1	1	2	0	1	0	0	1	1	1	1
CO 3	1	1	2	0	1	0	0	1	1	1	1
CO 4	1	1	2	0	1	0	0	1	1	1	1
CO 5	1	1	2	0	1	0	0	1	1	1	1
Total	5	5	10	0	5	0	0	5	5	5	5

Semester	Course name	Course Code	L	T	P	C
3	UNIT OPERATIONS	XBT303	2	1	2	5
Course outcome			Domain		Level	
CO1	Interprets and analyze the dimensional homogeneity of unit operations	Cognitive		Remembering, Understanding		
CO2	Distinguishes types of fluids and fluid flow Explain the energy balances across fluid moving systems	Cognitive Psychomotor Affective	Understanding Guided Response Receiving			
CO3	Demonstrates the agitation, mixing, centrifugation and filtration operations	Cognitive Psychomotor Affective	Understanding Guided Response Receiving			
CO4	Analyse the mechanism of conduction and convection mode of heat transfer	Cognitive Psychomotor Affective	Understanding Guided Response Receiving			
CO5	Outlines the modes of mass transfer operations and describes the basic principles in distillation, extraction and drying	Cognitive Psychomotor Affective	Understanding Guided Response Receiving			
COURSE CONTENT						Hours
UNIT I	DIMENSIONAL ANALYSIS					11
	Units and Dimensions, dimensional homogeneity and dimensionless numbers and similitude					
UNIT II	FLUID MECHANICS					13
	Definition and classification, types of fluids, types of flow. Equations for flow, Continuity equation, Bernoulli equation, Hagen-Poiseuille equation. Flow over particles and through stagnant fluids, settling and sedimentation. Fluid flow measuring devices, pumps, energy calculations and characteristic of pumps.					
UNIT III	MECHANICAL OPERATIONS					12
	Agitation and Mixing - power consumption in mixing. Fluid solid interactions, Centrifugation, membrane filtration and filtration equipment's.					
UNIT IV	HEAT TRANSFER					12
	Heat conduction, conduction through single and multi-layers walls, insulations. Convective heat transfer, forced and natural convection, condensation. Design of heat exchangers. Sterilization operations.					
UNIT V	MASS TRANSFER					12
	Basics, modes of mass transfer, Fick's law of Diffusion, mass transfer correlations. Mass transfer operations: Distillation, extraction and drying.					
	LIST OF EXPERIMENTS					15
	1. Identification of fluid types and flow					

	<ol style="list-style-type: none"> 2. Flow measurements by flow meters 3. Centrifugal pump characteristics 4. Settling and sedimentation 5. Centrifugation 6. Rotary drum filter 7. Mixing power consumption 8. Heat transfer by Conduction 9. Heat transfer by Convection 10. Heat exchangers 11. Mass correlations for K_{La} determination 12. Extraction 13. Drying 			
	LECTURE	TUTORIAL	PRACTICAL	TOTAL
	45	15	15	75
EXT BOOKS				
<ol style="list-style-type: none"> 1. McCabe, Warren L., Julian C. Smith, and Peter Harriott , Unit Operations of Chemical Engineering, McGraw-Hill, 2010. 2. Warren, L. M., C. S. Julian, and H. Peter, Unit operations of chemical engineering, McGraw Hill Book Company, 2005. 3. Geankoplis, Christie John, Allen H. Hersel, and Daniel H. Lepek, Transport processes and separation process principles, Prentice hall, 2018. 4. Welty J, Rorrer GL, Foster DG., Fundamentals of Momentum, Heat, and Mass Transfer,. Wiley, Revised 6th Edition; 2014. 				
REFERENCE BOOKS				
<ol style="list-style-type: none"> 1. Benitez, Jaime, Principles and modern applications of mass transfer operations, John Wiley & Sons, 2016. 2. Ravi, R., R. Vinu, and Sathyanarayana N. Gummadi, eds. Coulson and Richardson's Chemical Engineering: Volume 3A: Chemical and Biochemical Reactors and Reaction Engineering, Butterworth-Heinemann, 2017. 				
E- REFERENCES				
<ol style="list-style-type: none"> 1. http://ce-iitb.vlabs.ac.in/List%20of%20experiments.html?domain=Chemical%20Engineering 2. http://uorepc-nitk.vlabs.ac.in/# 3. http://iitg.vlab.co.in/?sub=58 				

MAPPING OF COURSE OUTCOMES WITH PROGRAM OUTCOMES

	PROGRAM OUTCOMES												
	1	2	3	4	5	6	7	8	9	10	11	PSO1	PSO2
CO1	3	3	1	2	1	0	2	0	0	0	1	1	1
CO2	2	2	1	2	1	0	2	0	0	0	1	1	1
CO3	2	3	1	2	1	0	2	0	0	0	1	1	1
CO4	3	2	1	1	1	0	2	0	0	0	1	1	1
CO5	1	3	1	2	1	0	2	0	0	0	1	1	1
	11	13	5	9	5	0	10	0	0	0	5	5	5

Semester	Course name	Course Code	L	T	P	C
3	MASS AND ENERGY BALANCE COMPUTATIONS	XBT304	2	1	0	3
Course Outcome:				Domain	Level	
CO1	<i>Interpret</i> different unit systems and <i>Express</i> the composition gas liquid and solid systems			Cognitive Affective	Receiving Analyzing	
CO2	<i>Compute</i> the material balances across different unit operations			Cognitive Affective	Understanding Receiving	
CO3	<i>Compute</i> the material balances across chemical reactors			Cognitive Affective	Understanding Perception Mechanism	
CO4	<i>Explain</i> the energy balance calculations for systems with and without chemical reactions			Cognitive Affective	Understanding Perception Mechanism	
CO5	<i>Describe</i> the humidification operations			Cognitive Affective	Understanding Mechanism	
COURSE CONTENT					Hours	
UNIT I	STOICHIOMETRIC PRINCIPLES AND BASIC CALCULATIONS					8
	Introductory concepts of units, physical quantities in chemical engineering, dimensionless groups, “basis” of calculations - Methods of expression, compositions of mixture and solutions. Gases, Vapors and Liquids: Equations of state, Vapor pressure, Clausius-Clapeyron equation, Cox chart, Duhring’s plot, Raoult’s law.					
UNIT -II	MATERIAL BALANCES FOR UNIT OPERATIONS					7
	Material balances to different unit operations - recycle - bypass and purging. Distillation, extraction, mixing, drying, crystallization, evaporation, adsorption and absorption.					
UNIT -III	MATERIAL BALANCES FOR UNIT PROCESSES					7
	Material balances with chemical reaction - Limiting and excess reactants – Combustion – Yield, conversion and selectivity calculations					
UNIT -IV	ENERGY BALANCES					7
	Heat capacity of solids, liquids, gases and solutions, use of mean heat capacity in heat calculations, problems involving sensible heat and latent heats					
UNIT -V	ENERGY BALANCES FOR CHEMICAL SYSTEMS					8
	Energy balances with chemical reaction: Heat of reaction, Heat of combustion - Evaluation of enthalpy. Standard heat of reaction, heats of formation, combustion, solution, mixing etc., calculation of standard heat of reaction.					
UNIT - VI	HUMIDIFICATION					8
	Humidity and Saturation, humid heat, humid volume, dew point, humidity chart and its use.					
LECTURE		TUTORIAL		PRACTICAL		TOTAL
30		15		0		45
TEXT BOOKS						
1. K.V.Narayanan and Lakshmikutty, <i>Chemical Process Calculations</i> , Prentice Hall, 2004.						

2. D. M. Himmelblau and J. B. Riggs, *Basic Principles and Calculations in Chemical Engineering*, Pearson India Education Services, 8th Edition, 2015.
3. B. I. Bhatt and S.M. Vora, *Stoichiometry*, Tata McGraw Hill Publishing Company Ltd, 4th Edition, 2004.
4. Richard M. Felder and Ronald W. Rousseau, *Elementary Principles of Chemical Processes*, John Wiley & Sons, INC. 3rd Edition, 2000.

REFERENCE BOOKS

1. V. Venkataramani, N. Anantharaman, and Begum, K. M. Meera Sheriffa, *Process Calculations*, Prentice Hall of India, 2nd Edition.
2. D. C. Sikdar, *Chemical Process Calculations*, Prentice Hall of India.

E- REFERENCES

1. <http://nptel.ac.in/syllabus/103106076/>

MAPPING OF COURSE OUTCOMES WITH PROGRAM OUTCOMES

	PROGRAM OUTCOMES											PSO1	PSO2
	1	2	3	4	5	6	7	8	9	10	11		
CO1	3	3	2	1	0	0	1	0	0	0	0	0	0
CO2	3	3	2	2	0	0	1	0	0	0	0	0	0
CO3	3	3	2	1	0	0	1	0	0	0	0	0	0
CO4	3	3	2	2	0	0	1	0	0	0	0	1	0
CO5	3	3	3	1	0	0	1	0	0	0	0	0	0
CO6	3	3	2	1	0	0	1	0	0	0	0	0	0
	18	18	13	8	0	0	6	0	0	0	0	1	0

Semester	Course name	Course Code	L	T	P	C
3	CELL BIOLOGY AND MICROBIOLOGY	XBT305	3	0	2	5
PREREQUISITE: Nil						
Course Outcomes			Domain		Level	
After the completion of the course, students will be able to						
CO1	<i>Comprehend</i> knowledge about historical perspective of microbiology and its developments. <i>Perform</i> staining techniques to observe microorganisms	Cognitive Psychomotor		Understanding Remembering Applying Guided response		
CO2	<i>Demonstrate</i> the microbial nutritional requirements for bacterial growth and control. <i>Perform</i> culturing techniques to isolate microorganisms	Cognitive Psychomotor		Understanding Remembering Applying Guided response		
CO3	<i>Recognize</i> the fundamental concepts in the structure and functioning of a cell. <i>Perform</i> cell counting using haemocytometer	Cognitive Psychomotor		Understanding Remembering Guided response		
CO4	<i>Acquire</i> knowledge about cell cycles mitosis and meiosis. <i>Perform</i> experiment to observe mitosis division in cells	Cognitive Psychomotor		Understanding Remembering Guided response		
CO5	<i>Acquire</i> knowledge on cellular signalling and membrane receptors present inside the cell.	Cognitive		Understanding Remembering		
I	INTRODUCTION TO MICROBIOLOGY				7 + 9	
History and Scope of Microbiology – Study of microbial structure: Microscopy (light, dark-field, phase contrast, electron), Specimen preparation, Staining techniques (simple and differential) – Overview of Prokaryotic cell structure: Cell membrane, Cytoplasmic matrix, Cell wall.						
Lab: 1 Handling and examining the microbial cultures						
Lab: 2 Staining and identification of microbes using simple staining						
Lab: 3 Staining and identification of microbes using differential staining						
II	MICROBIAL NUTRITION, GROWTH AND CONTROL				11 + 12	
Nutritional types of microorganisms: Autotrophs, Heterotrophs, Phototrophs, Chemotrophs, Lithotrophs,						

<p>Organotrophs, Culture media (defined, complex) – Microbial Growth: Growth curve (lag, exponential, stationary, death phase), Measurement (cell number, cell mass), Factors influencing growth (water activity, pH, temperature, oxygen, pressure, radiation) – Microbial Control: Use of physical methods (moist heat, dry heat, radiation), Use of chemical agents (phenols, alcohols, gases).</p> <p>Lab: 4 Isolation of microbes from soil using spread plate method Lab: 5 Isolation of microbes from milk using streak plate method Lab: 6 Isolation of microbes from water using pour plate method Lab: 7 Microbial growth control by chemical agents using Kirby-Bauer method</p>			
III	CELLULAR ORGANIZATION AND MEMBRANE TRANSPORT		11 + 6
<p>Overview of Eukaryotic cell structure: Cytoplasmic matrix, Endoplasmic Reticulum, Golgi complex, Mitochondria, Chloroplast, Nucleus – Functions of cell organelles – Membrane Transport: Passive and Active transport – Sodium/potassium pumps, Ca²⁺, ATPase pumps</p> <p>Lab: 8 Isolation of chloroplast from plant leaves Lab: 9 Performance of cell counting using haemocytometer</p>			
IV	CELL DIVISION		9 + 3
<p>The cell cycle – General description and different stages of mitosis and meiosis (Interphase, Prophase, Metaphase, Anaphase, Telophase) – Consequences of meiosis – difference between mitosis and meiosis.</p> <p>Lab: 10 Staining and observation of mitosis division in onion root tip cells</p>			
V	CELL SIGNALING		7
<p>Cellular junctions – Cell Signaling: Types of Cell Signaling, General Principles of Cell Signaling, Calcium signaling – Receptors in Signaling: Types of Receptors, Signaling via G-Protein-linked Cell Surface Receptors, Signaling via Enzyme-linked Cell-Surface Receptors.</p>			
LECTURE	TUTORIAL	PRACTICAL	TOTAL
45	0	30	75
TEXT BOOKS:			
<ol style="list-style-type: none"> 1. Prescott, L. M., Harley, J. P., and Klein, D. A. <i>Microbiology</i>. 5th. McGraw Hill Higher Education, 2005. 2. Bolsover, S. R., Shephard, E. A., White, H. A., and Hyams, J. S. <i>Cell biology: a short course</i>. John Wiley & Sons, 2011. 			

REFERENCES:		
<ol style="list-style-type: none"> 1. Sadava, D. E. <i>Cell biology: organelle structure and function</i>. Jones & Bartlett Learning, 1993. 2. Alberts, Bruce, Dennis Bray, Karen Hopkin, Alexander Johnson, Julian Lewis, Martin Raff, Keith Roberts, and Peter Walter. <i>Essential cell biology</i>. Garland Science, 2013. 3. Morcello, J. A., Mizer, H. E., & Granato, P. A. Laboratory manual and workbook in Microbiology: Application to patient care, 2003 4. Prescott, L. M., Harley, J. P., & Klein, D. A. Laboratory exercises in microbiology, 2002. 		
E-REFERENCES:		
<ol style="list-style-type: none"> 1. http://www.austincc.edu/rohde/noteref.htm 2. http://www.uwyo.edu/molb2210_lect/lecture/lectures.html 3. http://nptel.ac.in/courses/102103012/ 4. https://cellbiology.med.unsw.edu.au/cellbiology/index.php/Cell_Biology_Introduction 		

Table 1: Cos Vs POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO 2
CO 1	3	1	2	2	0	0	0	0	0	3	1	2	2
CO 2	2	3	1	2	1	0	0	0	0	2	2	2	2
CO 3	3	2	3	1	1	0	0	0	0	3	1	2	2
CO 4	2	3	2	1	2	0	0	0	0	2	3	2	2
CO 5	1	0	1	3	2	0	0	0	0	3	3	2	2
	11	9	9	9	6	0	0	10	0	13	10	10	10

No relation, 1-Low Relation, 2- Medium Relation, 3-High Relation

Semester	Course name	Course Code	L	T	P	C
3	ENTREPRENEURSHIP DEVELOPMENT	XEP306	3	0	0	3
Course Outcome:			Domain		Level	
CO1	<i>Recognise</i> and <i>describe</i> the personal traits of an entrepreneur.	Cognitive Affective	Understanding Receiving			
CO2	<i>Determine</i> the new venture ideas and <i>analyse</i> the feasibility report.	Cognitive	Understanding Analyzing			
CO3	<i>Develop</i> the business plan and <i>analyse</i> the plan as an individual or in team.	Cognitive Affective	Analyzing Receiving			
CO4	<i>Describe</i> various parameters to be taken into consideration for launching and managing small business.	Cognitive	Understanding			
CO5	<i>Describe</i> Technological management and Intellectual Property Rights	Cognitive	Understanding			
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 start-up 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	PRACTICAL	TOTAL			
45	0	0	45			
TEXT BOOKS						
1. Robert D. Hisrich, Michael P. Peters, Dean A. Shepherd, <i>Entrepreneurship</i> , Tata McGraw Hill, 6 th Edition, 2011.						
2. S.S.Khanka, <i>Entrepreneurial Development</i> , S.Chand and Company Limited, 2013.						

REFERENCE BOOKS

1. Mathew Manimala., *Entrepreneurship Theory at the Crossroads, Paradigms & Praxis*, Biztrantra, 2nd Edition, 2005.
2. Prasanna Chandra, *Projects – Planning, Analysis, Selection, Implementation and Reviews*, Tata McGraw-Hill, 2009.
3. Saravanavel P., *Entrepreneurial Development*, Ess Pee kay Publishing House, 1997.
4. Arya Kumar, *Entrepreneurship: Creating and Leading an Entrepreneurial Organization*, Pearson Education 2012.
5. Donald F.K., Rao T.V, *Entrepreneurship: A South Asian perspective*, Cengage Learning India, 2012.

E RESOURCES

1. Jeff Hawkins, “*Characteristics of a successful entrepreneur*”, ALISON Online entrepreneurship courses, “<https://alison.com/learn/entrepreneurial-skills>”
2. Jeff Cornwall, “*Entrepreneurship -- From Idea to Launch*”, UdeMy online Education, <https://www.udemy.com/entrepreneurship-from-idea-to-launch/>
3. Dinesh A., Raman J., Padmanand V., *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>

MAPPING OF COURSE OUTCOMES WITH PROGRAM OUTCOMES

	PROGRAM OUTCOMES											PSO1	PSO2
	1	2	3	4	5	6	7	8	9	10	11		
CO1	1	1	3	3	3	1	2	2	3	2	3	1	1
CO2	1	1	3	2	2	1	2	2	3	2	3	1	1
CO3	1	1	2	3	2	1	2	2	3	2	3	1	1
CO4	1	1	3	3	2	1	2	2	3	2	3	1	1
CO5	1	1	3	2	3	1	2	2	3	2	3	1	1
CO6	1	1	2	3	3	1	2	2	3	2	3	1	1
	6	6	16	16	15	6	12	12	18	12	18	6	6

Semester	Course name	Course Code	L	T	P	C
4	MATERIAL SCIENCE	XES 401	3	0	0	3
PREREQUISITE: Nil						
COURSE OUTCOMES:						
Course Outcomes			Domain	Level		
After the completion of the course, students will be able to						
CO1: Study the Basic Properties of Engineering Materials.			Cog	Understanding		
CO2: Analyze the heat treatment process and its applications.			Cog	Analyzing		
CO3: Analyze nonmetallic materials and application.			Cog	Analyzing		
CO4: Inspection of engineering materials (mechanical and metallurgical)			Cog	Analyzing		
CO5: List the properties and applications of modern engineering materials.			Cog	Remembering		
UNIT-I	BASIC PROPERTIES OF METALLIC MATERIALS					9 hrs
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 hrs
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 hrs
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 hrs
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 hrs
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			
<ol style="list-style-type: none"> 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			
<ol style="list-style-type: none"> 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 PO's:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1
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

Semester	Course name	Course Code	L	T	P	C
4	GENETICS AND MOLECULAR BIOLOGY	XBT402	3	0	0	3
Course outcome				Domain	Level	
CO1	Able to <i>Recall</i> and <i>Outline</i> the principles in genetics			Cognitive	Remember Perception	
CO2	<i>Distinguish</i> various types of linkages.			Cognitive	Apply	
CO3	<i>Interpret</i> the experimentations pertaining to DNA as genetic material and <i>Summarizes</i> genome structure.			Cognitive	Create Responding	
CO4	<i>Explain</i> and the process of transcription.			Cognitive Affective	Understanding Mechanism	
CO5	<i>Discuss</i> the process of translation			Cognitive Affective	Applying Responding	
CO6	<i>Categorizes</i> Mutations and <i>distinguishes</i> DNA Repair mechanisms.			Cognitive	Understanding	
COURSE CONTENT					Hours	
UNIT I	MODEL SYSTEMS IN GENETIC ANALYSIS				9	
	Bacteriophage, E. coli, Yeast, Arabidopsis, Maize, Drosophila, Homo sapiens - General outline of life cycle, importance in Genetic analysis. Laws of inheritance: Mendel's Laws, concept of dominance, segregation, independent assortment; Chromosome theory of inheritance.					
UNIT II	LINKAGE AND INHERITANCE				9	
	Concepts, recombination, gene mapping in prokaryotes and eukaryotes, fine structure mapping. Sex-linked inheritance: Conceptual basis, sex-influenced traits, mechanism of sex determination. Quantitative inheritance – Concept, Genes and Environment - heritability, penetrance and expressivity. Cytoplasmic inheritance – Basis and mechanism, role of organellar genes.					
UNIT III	NUCLEIC ACIDS AND GENOME REPLICATION				8	
	DNA as genetic material – Griffith; Hershey and Chase; Avery McLeod & McCarty experiments; DNA replication and control; Unit of replication, Enzymes in replication, Prokaryotic replication; Replication in eukaryotic chromosomes; Replication of telomeres in eukaryotes					
UNIT IV	TRANSCRIPTION				5	

	Prokaryotic and Eukaryotic transcription - RNA polymerase - Prokaryotic and Eukaryotes transcription factors - mechanism of transcription - Post Transcriptional modifications - Transcription in eukaryotes- enhancers- silencers. Export of mRNA - Si RNA- SnRNA.	
UNIT V	TRANSLATION AND GENE REGULATION	8
	Genetic code - Elucidation of Codons - mRNA- ribosomes - aminoacyl tRNA synthetase. Prokaryotic and eukaryotic translation. Translational control & gene expression- post – translational regulatory mechanisms. Regulation of gene expression - Operon concepts – Lactose – Constitutive - inducible and repressible gene expression. Operon systems – lactose operon – induction- catabolite repression. Tryptophan operon- Repression-attenuation. Arabinose operon - positive and negative controls	
UNIT VI	MUTATION AND DNA REPAIR	6
	Mutation – Genetic variability required for evolution. Mutation types – basic features of the process – Molecular basis of mutation – physical, chemical and biological. DNA Repair Mechanisms- Direct Reversal; Excision Repair; The SOS Response.	
Total		45
TEXT BOOKS		
<ol style="list-style-type: none"> 1. De Robertis and De Robertis, Cell and Molecular biology, Waverly Pvt. Ltd, 1998. 2. Rastogi S.C, Cell Biology, New Age International Publishers, New Delhi: 2nd Edition, 2004. 3. Snustad S., Principles of Genetics, John Willey & Sons Inc. Hoboken, 2003. 		
REFERENCE BOOKS		
<ol style="list-style-type: none"> 1. Harvey L., Arnold B., Zipursky S.L, Paul M., David B. and James D., Molecular Cell Biology, 4th Edition, New York: W.H Freeman and company,2002. 2. De Robertis E.D.P and De Robertis E.M.F., Cell and Molecular Biology, 8th Edition, New York: Lippincott Williams and Wilkins. 2001. 3. Friefelder D., Molecular Biology, 2nd Edition, Narosa Publishing House, New Delhi. 2009. 4. Lewin B., Genes IX, Jones and Bartlett, 2008. 5. Weaver R.F. Molecular Biology, 3rd Edition, McGraw Hill., 2005. 6. Alberts et al., Molecular Biology of The Cell, 6th Edition, Garland Science Publisher. 		
E- REFERENCES		
<ol style="list-style-type: none"> 1. NPTEL, Biotechnology, Prof. G.S. Randhawa, Department of Biotechnology, Indian Institute of Technology, Roorkee. 		

MAPPING OF COURSE OUTCOMES WITH PROGRAM OUTCOMES

	PROGRAM OUTCOMES												
	1	2	3	4	5	6	7	8	9	10	11	PSO1	PSO2
CO1	3	3	3	3	1	3	3	3	1	1	3	3	2
CO2	3	3	3	1	0	2	2	2	0	2	2	1	0
CO3	3	1	1	2	0	2	1	2	0	2	2	0	0
CO4	2	1	1	3	0	2	2	2	0	2	2	0	0
CO5	2	2	0	2	0	1	1	1	0	0	1	0	0
CO6	1	3	2	3	0	3	3	2	0	2	1	2	0
	14	13	10	15	1	13	12	12	1	9	11	6	2

Semester	Course name	Course Code	L	T	P	C
4	ANALYTICAL TECHNIQUES	XBT403	2	1	2	5
Course outcome				Domain	Level	
CO1	<i>Explain</i> the basics and fundamentals of analytical techniques and <i>describe</i> the various calibration techniques.			Cognitive Affective	Understanding Precision	
CO2	<i>Describe</i> the spectrophotometric methods and <i>perform</i> various electrometric and structural analysis.			Cognitive Affective	Remembering Precision	
CO3	<i>Understand</i> the electrophoresis techniques and <i>analyze</i> various types of electrophoresis			Cognitive	Analyzing	
CO4	<i>Know</i> the principle of instrumentation and <i>applications</i> of various centrifugal and sedimentation techniques.			Cognitive	Understanding Responding	
CO5	<i>Distinguish</i> the various Microscopic and chromatographic techniques			Cognitive	Understanding Precision	
CO6	<i>Explain</i> the techniques and instrumentation for various radio isotopic techniques.			Cognitive	Understanding	
COURSE CONTENT					Hours	
UNIT I	INTRODUCTION				6	
	Classification of instrumental methods; Concepts of accuracy, precision and limits of detection (LOD); Types of errors: random and systematic; Calibration of instrumental methods: Comparison with standards, external and internal standard addition methods; Introduction and significance of signal to noise ratio.					
UNIT II	SPECTROSCOPIC TECHNIQUES				6	
	Regions and properties of electromagnetic radiation, Absorption, transmittance and their relationship, Beer lamberts law and its limitations, Deviations (Real, chemical and instrumental); Principle, Instrumentation and applications of UV-Visible, IR & FTIR and Fluorescence Spectroscopy.					
UNIT III	MICROSCOPIC TECHNIQUES				5	
	Optical Microscopy: Principle, Numerical aperture, Instrumentation of bright field, phase contrast and fluorescence microscopy; Electron microscopy: Principle, Instrumentation of SEM, TEM and Atomic force microscopy.					
UNIT IV	ELECTRODES AND STRUCTURAL ANALYSIS				6	
	Basic concept of indicators, Principle of pH meter- hydrogen electrode and glass electrode, Ion selective electrodes - Mass spectrometry and MALDI – TOF Analysis – Crystalline structure analysis using XRD and NMR.					
UNIT V	CENTRIFUGAL ANALYSIS				5	
	Basic principles; relation between g and rpm, instrumentation, working and applications of preparative, analytical, differential and density gradient centrifugation.					

UNIT VI	ELECTROPHORETIC ANALYSIS			5
	Instrumentation, Theory and application of Polyacrylamide and Agarose gel electrophoresis; Capillary electrophoresis; 2D Electrophoresis; Isoelectric focusing			
UNIT VII	CHROMATOGRAPHIC ANALYSIS			6
	Chromatographic techniques: Classification, Basic principles: Elution, migration rates, band broadening and column efficiency, theory of band broadening, column resolution. HPLC and GC Analysis, Interpretation of chromatogram.			
UNIT VIII	RADIOISOTOPE			6
	Radioactive & stable isotopes: Pattern and rate of radioactive decay, Units of radioactivity; Measurement of radioactivity: Geiger-Muller counter, Solid & Liquid scintillation counters (Basic principle, instrumentation & technique); Autoradiography,			
	List of Experiments: <ol style="list-style-type: none"> 1. Preparation of standard graph with precision and accuracy using KMnO_4 through spectroscopic analysis 2. Analysis of sample size and surface through SEM and AFM analysis (Demonstration with instrument). 3. Isolation of pigments from leaf extract through column chromatography 4. Extraction of caffeine using HPLC and analysis of chromatogram. 5. Gas chromatography – Demonstration with instrument 6. Precision and validity in an experiment using absorption spectroscopy. 7. Absorption spectra for KMnO_4 8. UV spectra of nucleic acids, protein 9. Sample surface using SEM (practical) and topography measurement using AFM (demonstration with instrument) 10. Estimation of Chloride using conductivity meter 11. Analysis of given sample using TGA/DSC (demonstration with the instrument) 12. XRD results interpretation (analysis of results available in literature) 13. Finding the pKa of 4- nitrophenol using Absorption spectroscopy. 14. Raman spectrophotometer analysis of biological samples 15. Electrochemical measurements (Cyclic Voltammetry/lab on chip) 16. Analysis of amino acids using TLC (experiment) and ethanol using GC (demonstration) 			30
	LECTURE	TUTORIAL	PRACTICAL	TOTAL
	30	15	30	75

TEXT BOOKS
1. Hobart Hurd Willard, Lynne Merritt, John A. Dean., <i>Instrumental methods of analysis</i> , CBS Publisher, 7 th Edition, 2012. 2. Douglas A. Skoog, Donald M. West, F. James Holler, Stanley R. Crouch, <i>Fundamentals of Analytical Chemistry</i> , Mary finch publishers, 9 th Edition, 2014.
REFERENCE BOOKS
1. Vogel A.I, <i>Qualitative Inorganic analysis</i> , Dorling Kindersley (India) Pvt. Ltd., 7 th Edition, 2009. 2. Sharma B.K., <i>Instrumental Methods of chemical Analysis</i> , Goel publishing House, 24 th Edition, 2005.
E- REFERENCES
1. http://www.ncbi.nlm.nih.gov/books/NBK26851/

MAPPING OF COURSE OUTCOMES WITH PROGRAM OUTCOMES

	PROGRAM OUTCOMES												
	1	2	3	4	5	6	7	8	9	10	11	PSO1	PSO2
CO1	3	2	2	1	0	0	1	0	0	0	0	0	1
CO2	3	3	2	2	0	0	1	0	0	0	0	0	1
CO3	3	2	2	1	0	0	1	0	0	0	0	0	1
CO4	2	3	2	2	0	0	0	0	0	0	0	0	1
CO5	3	2	3	1	0	0	1	0	0	0	0	0	1
CO6	2	3	2	1	0	0	1	0	0	0	0	0	1
	16	15	13	8	0	0	5	0	0	0	0	0	6

Semester	Course name	Course Code	L	T	P	C
4	BIOCHEMISTRY -II	XBT404	3	0	2	5
Course Outcome				Domain		Level
CO1	State and explain Should be able to under going molecular mechanisms of biological processes			Cognitive Affective		Remembering Receiving
CO2	Interpret and analyze basic concept within kinetics of enzyme-catalysed one- and two-substrate reactions, simpler structure/function relationships in enzyme-catalysed reactions			Cognitive Affective		Recalling Origination
CO3	Know and estimate simpler structure/function relationships for the most common cofactors, regulatory principles of enzyme activity			Cognitive		Create Guided Response
CO4	Knows and calculate molecular genetic processes such as replication, transcription and translation and regulation			Cognitive		Create Guided Response Perception
CO5	Principles for energy transformation and biosynthesis in cellular systems and regulation			Cognitive		Guided Response Perception
CO6	Biochemical experiments including enzyme characterization with the most essential biochemical analysis and purification methods			Cognitive		Guided Response Perception
COURSE CONTENT						Hours
UNIT I	BASIC FUNCTION OF CELLULAR METABOLISM					9
	Chemical structure and molecular organisation of biological systems. Supramolecular complexes, organelles. Molecular dynamics in living cells: Bioenergetics and intermediary metabolism. Regulation of the metabolism on transcription and protein level. Photosynthesis.					
UNIT II	PROTEIN STRUCTURE					12
	The structure and evolution of proteins. Protein ligand and protein-protein interactions. Allosteric enzymes, cooperativity. Covalent modification, partial proteolysis. Signal substances, receptors, signal amplification. Biochemical toxicology. Enzyme kinetics. Enzyme mechanisms, cofactors. Definition of primary-, secondary- and tertiary structure. Functional domains and multienzyme complexes. Immunoglobulins and immunological analysis. Design of protein function.					
UNIT III	FUNCTIONS OF CELL MEMBRANE					5

	Membrane topology and membrane transport, chemiosmotic coupling. Oxidative phosphorylation, photo phosphorylation, electron transport			
UNIT IV	DNA STRUCTURE, TRANSLATION & TRANSCRIPTION			9
	DNA as major source of information. Gene structure. Expression of genetic information: Regulation of transcription, operons, induction, repression, transcription factors, protein-DNA interactions. Mutations, oncogenes, cancer. Biosynthesis of immunoglobulins, alternative splicing. Biosynthesis of proteins, ribosomes.			
UNIT V	DNA HYBRIDIZATION, PROTEIN SEPARATION COMPUTATIONAL MODELING			10
	Post-translational modification and intracellular distribution of proteins. Basic hybrid-DNA technique. Experimental methodology: Analytical and preparative separation methods Using computers for visualisation and modelling of macromolecules, experimental data analysis and bioinformatics are integrated in various parts of the course.			
	LIST OF EXPERIMENTS			30
	<ol style="list-style-type: none"> 1. Blood grouping 2. Estimation of blood glucose given blood sample 3. Determination of protein estimation in a broth (Bradford) 4. Quantitative analysis of proteins (Lowry) 5. Calculation of Rf for given amino acids and unknown sample by TLC 6. Determination of β-carotene, Flavonoid 7. Acid hydrolysis and action of salivary amylase on starch 8. Quantitative analysis of urea in serum 9. Quantitative analysis of serum bilirubin 10. Quantitative estimation of serum cholesterol by Zak's method 			
	LECTURE	TUTORIAL	PRACTICAL	TOTAL
	45	0	30	75
TEXT BOOKS				
<ol style="list-style-type: none"> 1. David L. Nelson and Michael M. Cox, <i>Lehninger Principles of Biochemistry</i>, W. H. Freeman Publisher, 7th Edition, 2017. 2. Donald Voet and Judith G. Voet, <i>Fundamentals of Biochemistry</i>, Blackwell, 6th Edition, 2012. 				
REFERENCE BOOKS				
<ol style="list-style-type: none"> 1. Jeremy M. Berg, Lubert Stryer, John L. Tymoczko and Gregory J. Gatto, <i>Biochemistry</i>, Macmillan Learning, 8th Edition, 2015. 2. Robert K. Murray, Daryl K. Granner, Peter A. Mayes and Victor W. Rodwell, <i>Harper's Illustrated Biochemistry</i>, The McGraw-Hill Companies Inc., 26th Edition, 2003. 3. Carl Branden and John tooze, <i>Introduction to protein structure</i>, Garland science publications, 2nd Edition, 1999. 				

4. Thomas E.Creighton, *Proteins: Structure and molecular properties*, W.H.Freeman publishers, 2nd Edition, 1993.

E- REFERENCES

1. <http://nptel.ac.in/courses/102102033/>
 2. <http://vlab.amrita.edu/?sub=3&brch=63>

MAPPING OF COURSE OUTCOMES WITH PROGRAM OUTCOMES

	PROGRAM OUTCOMES											PSO1	PSO2
	1	2	3	4	5	6	7	8	9	10	11		
CO1	3	3	2	1	0	0	1	0	0	0	0	0	0
CO2	3	3	2	2	0	0	1	0	0	0	0	0	0
CO3	3	3	2	1	0	0	1	0	0	0	0	0	0
CO4	3	3	2	2	0	0	1	0	0	0	0	1	0
CO5	3	3	3	1	0	0	1	0	0	0	0	0	0
CO6	3	3	2	1	0	0	1	0	0	0	0	0	0
	18	18	13	8	0	0	6	0	0	0	0	1	0

Semester	Course name	Course Code	L	T	P	C
4	CHEMICAL ENGINEERING THERMODYNAMICS	XBT405	3	1	0	4
PREREQUISITE: Engineering chemistry, Basic calculations						
Course Outcomes			Domain	Level		
After the completion of the course, students will be able to						
CO1: State the basic laws of thermodynamics and explain the fundamentals of thermodynamics.			Cog	Remembering Understanding		
CO2: Interpret and analyze the PVT relationship for various systems.			Cog	Interpretation, analyzing		
CO3: Know the thermodynamic relations and estimate the thermodynamic properties.			Cog	Remembering, Understanding		
CO4: Analyze and evaluate the phase equilibrium in various systems like miscible and immiscible systems.			Cog	Analyzing, evaluating		
CO5: Knows the chemical equilibrium for industrial reactions and will calculate required free energy.			Cog	Remembering, Applying		
UNIT-I	FUNDAMENTALS OF THERMODYNAMICS			9 + 3 hrs		
Fundamentals of Thermodynamics: Laws of thermodynamics as applied to open and closed system - reversible and irreversible processes - state and point function - Absolute entropy - Thermodynamic property changes for ideal gas.						
UNIT –II	PVT RELATIONSHIPS FOR GASES AND LIQUIDS			9 + 3 hrs		
PVT Relations: PVT relationships for gases and liquids - equations of state - Z charts - gas mixtures. Compression - expansion. Refrigeration: Principles and application.						
UNIT-III	THERMODYNAMIC RELATIONS			9 + 3 hrs		
Thermodynamic relations - Maxwell's relations – Jacobian algebra - estimation of thermodynamic properties.						
UNIT-IV	PHASE EQUILIBRIA			9 + 3 hrs		
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 - thermodynamic diagrams.						
UNIT-V	CHEMICAL EQUILIBRIA			9 + 3 hrs		
Chemical equilibria - heat effects, industrial reactions - Free energy calculations - Homogeneous and heterogeneous reactions - Industrial reactions like NH ₃ synthesis, SO ₃ production etc.,						
LECTURE	TUTORIAL	PRACTICAL	TOTAL			
45	15	0	60			
TEXT BOOKS:						

1. S.I.Sandler, Chemical, Biochemical and Engineering Thermodynamics, 4th Edition, Wiley India, 2006.
2. Narayanan K.V. A textbook of Chemical Engineering Thermodynamics'', PHI 2003.

REFERENCES:

- 1.Smith, J.M., Van Ness HC and Abbot MM.2001. Chemical Engineering Thermodynamics, 6th Edition, Mcgraw Hill.
- 2.Rao., Y.V.C., Chemical engineering Thermodynamics, University Press, Hyderabad, 2005.

COs Vs POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO 1	2		2	1					2		1
CO 2	3		3	3					2		2
CO 3	3		3	2					2		2
CO 4	2		3	3					2		2
CO 5	2		3	3					2		2
	12	0	14	12	0	0	0	0	10	0	9

Semester	Course name	Course Code	L	T	P	C
4	INDIAN CONSTITUTION	XMC 406	3*	0	0	0
PREREQUISITE:	NIL		L	T	P	H
C:P:A	3:0:0		3	0	0	3
COURSE OUTCOMES		Domain	Level			
CO1	<i>Understand</i> the Constitutional History	Cognitive	Understanding			
CO2	<i>Understand</i> the Powers and Functions	Cognitive	Understanding			
CO3	<i>Understand</i> the Legislature	Affective	Remembering			
CO4	<i>Understand</i> the Judiciary	Affective	Remembering			
CO5	<i>Understand</i> the Centre State relations	Cognitive	Understanding			
UNIT I					08	
Constitutional History- The Constitutional Rights- Preamble- Fundamental Rights- Fundamental Duties- Directive principles of State Policy.						
UNIT II					09	
The Union Executive- The President of India (powers and functions)- Vice-President of India-The Council of Ministers-Prime Minister- Powers and Functions.						
UNIT III					10	
Union Legislature- Structure and Functions of Lok Sabha- Structure and Functions of Rajya Sabha- Legislative Procedure in India- Important Committees of Lok Sabha- Speaker of the Lok Sabha.						
UNIT IV					09	
The Union Judiciary- Powers of the Supreme Court- Original Jurisdiction- Appellate jurisdictions- Advisory Jurisdiction- Judicial review.						
UNIT V					09	
Centre State relations- Political Parties- Role of governor, powers and functions of Chief Minister-Legislative Assembly- State Judiciary- Powers and Functions of the High Courts.						
LECTURE	TUTORIAL	PRACTICAL	TOTAL			
45	0	0	45			
REFERENCES						
<ol style="list-style-type: none"> 1. W.H.Morris Shores- Government and politics of India, NewDelhi,B.1.Publishers,1974. 2. M.V.Pylee- Constitutional Government in India, Bombay, Asia Publishing House, 1977. 3. R.Thanker- The Government and politics of India, London:Macmillon, 1995. 4. A.C.Kapur- Select Constitutions S,Chand & Co.,NewDelhi, 1995 5. V.D.Mahajan- Select Modern Governments,S,Chand &Co, NewDelhi,1995. 6. B.C.Rout- Democractic Constitution of India. 7. Gopal K.Puri- Constitution of India, India 2005. 						

Table 1: Mapping of COs with POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO 1	2			1					
CO 2	2			1					
CO 3	2			1					1
CO 4	2			1				1	1
CO 5	2	2		1				1	1
Total	10	2		5				2	3
Scaled to 0,1,2,3	2	1		1				1	1

1-5 →1, 6-10 →2, 11-15 →3

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