SRM UNIVERSITY
(Under section 3 of UGC Act 1956)

B.TECH. (FULL-TIME) - BIOTECHNOLOGY
CURRICULUM & SYLLABUS
2013 – 2014

Volume – I
(all courses except open electives)

FACULTY OF ENGINEERING AND TECHNOLOGY
SRM UNIVERSITY
SRM NAGAR, KATTANKULATHUR – 603 203

STUDENT OUTCOMES

The curriculum and syllabus for B.Tech programs (2013) conform to outcome based teaching learning process. In general, **ELEVEN STUDENT OUTCOMES** (a-k) have been identified and the curriculum and syllabus have been structured in such a way that each of the courses meets one or more of these outcomes. Student outcomes describe what students are expected to know and be able to do by the time of graduation. These relate to the skills, knowledge, and behaviors that students acquire as they progress through the program. Further each course in the program spells out clear instructional objectives which are mapped to the Student outcomes.

The Student outcomes are

(a) An ability to apply knowledge of mathematics, science, and engineering

(b) An ability to design and conduct experiments, as well as to analyze and interpret data

(c) An ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability

(d) An ability to function on multidisciplinary teams

(e) An ability to identify, formulate, and solve engineering problems

(f) An understanding of professional and ethical responsibility

(g) An ability to communicate effectively

(h) The broad education necessary to understand the impact of engineering solutions in global, economic, environmental, and societal context

(i) A recognition of the need for, and an ability to engage in life-long learning

(j) A knowledge of contemporary issues

(k) An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

B.Tech. Bio-Technology
Curriculum – 2013
(Applicable for students admitted from the academic year 2013-14 onwards)

SEMESTER I						
Course Code	**Category**	**Course Name**	**L**	**T**	**P**	**C**
PD1001	G	SOFT SKILLS I	1	0	1	1
MA1011	B	MATRICES AND CALCULUS	3	2	0	4
PY1001	B	PHYSICS	3	0	0	3
PY1002	B	PHYSICS LAB	0	0	2	1
CY1001	B	CHEMISTRY	3	0	0	3
CY1002	B	CHEMISTRY LAB	0	0	2	1
LE1002	G	VALUE EDUCATION	1	0	0	1
CE1001	E	BASIC CIVIL ENGINEERING	2	0	0	2
Courses from Table I						
Student shall register for minimum 20 credits in I semester and minimum 20 credits in II semester. However student shall have registered for all the courses enlisted under Semester I and II as well the courses in Table I by the time the registration process is complete in II semester. Keeping this in mind student shall register for the courses in I and II semesters.						

Legend:

L - Number of lecture hours per week
T - Number of tutorial hours per week
P - Number of practical hours per week
C - Number of credits for the course

Category of courses:
G - General
B - Basic Sciences
E - Engineering Sciences and Technical Arts
P - Professional Subjects

SEMESTER II						
Course Code	**Category**	**Course Name**	**L**	**T**	**P**	**C**
PD1002	G	SOFT SKILLS II	1	0	1	1
MA1012	B	MULTIPLE INTEGRALS AND DIFFERENTIAL EQUATIONS	3	2	0	4
PY1003	B	MATERIAL SCIENCE	2	0	2	3
CY1003	B	PRINCIPLES OF ENVIRONMENTAL SCIENCE	2	0	0	2
BT1002	P	HUMAN PHYSIOLOGY AND HEALTH	2	0	0	2
BT1003	P	CELL BIOLOGY	3	0	0	3
BT1004	P	BIOCHEMISTRY	3	0	0	3
BT1005	P	BIOCHEMISTRY LABORATORY	0	0	4	2
LE1001	G	ENGLISH	1	2	0	2
Courses from Table I						
Student shall register for minimum 20 credits in I semester and minimum 20 credits in II semester. However student shall have registered for all the courses enlisted under Semester I and II as well the courses in Table I by the time the registration process is complete in II semester. Keeping this in mind student shall register for the courses in I and II semesters.						

TABLE I

COURSES WHICH CAN BE REGISTERED FOR EITHER IN I OR II SEMESTER

SEMESTER I / II						
Course Code	**Category**	**Course Name**	**L**	**T**	**P**	**C**
CS1001	G	PROGRAMMING USING MATLAB	0	1	2	2
ME1001	E	BASIC MECHANICAL ENGINEERING	2	0	0	2
EE1001	E	BASIC ELECTRICAL ENGINEERING	2	0	0	2
EC1001	E	BASIC ELECTRONICS ENGINEERING	2	0	0	2
ME1005	E	ENGINEERING GRAPHICS	0	1	4	3
ME1004	E	WORKSHOP PRACTICE	0	0	4	2
NC1001/NS1001/ SP1001/YG1001	G	*NCC/NSS/NSO/YOGA	0	0	1	1

*NCC-National Cadet Corps
NSS-National Service Scheme
NSO-National Sports Organization (India)

SEMESTER III						
Course Code	**Category**	**Course Name**	**L**	**T**	**P**	**C**
LE1003/ LE1004/ LE1005/ LE1006/ LE1007	G	GERMAN LANGUAGE PHASE II / FRENCH LANGUAGE PHASE II/ JAPANESE LANGUAGE PHASE II / KOREAN LANGUAGE PHASE II / CHINESE LANGUAGE PHASE II	2	0	0	2
PD1003	G	APTITUDE I	1	0	1	1
CH1051	E	CHEMICAL AND BIOCHEMICAL PROCESS CALCULATION	3	0	0	3
BT1006	P	LAB SAFETY AND ANALYTICAL TECHNIQUES	2	0	0	2
BT1008	P	MICROBIOLOGY	3	0	0	3
BT1010	P	IMMUNOLOGY	3	0	0	3
BT1012	P	GENETICS AND CYTOGENETICS	3	0	0	3
BT1007	P	LAB SAFETY AND ANALYTICAL TECHNIQUES LAB	0	0	2	1
BT1009	P	MICROBIOLOGY LAB	0	0	4	2
BT1011	P	IMMUNOLOGY LAB	0	0	4	2
BT1013	P	CELL BIOLOGY LAB	0	0	4	2
TOTAL			**17**	**0**	**15**	**24**
Total No. of Contact Hours			**32**			

SEMESTER IV						
Course Code	**Category**	**Course Name**	**L**	**T**	**P**	**C**
LE1008/ LE1009/ LE1010/ LE1011/ LE1012	G	GERMAN LANGUAGE PHASE II / FRENCH LANGUAGE PHASE II/ JAPANESE LANGUAGE PHASE II / KOREAN LANGUAGE PHASE II / CHINESE LANGUAGE PHASE II	2	0	0	2
PD1004	G	APTITUDE II	1	0	1	1

SEMESTER IV						
Course Code	**Category**	**Course Name**	**L**	**T**	**P**	**C**
MA1034	B	BIO-STATISTICS	4	0	0	4
CH1052	E	CHEMICAL ENGINEERING PRINCIPLES I – MECHANICAL OPERATIONS AND MOMENTUM TRANSFER	3	0	0	3
CH1054	E	CHEMICAL AND BIOCHEMICAL ENGINEERING THERMODYNAMICS	3	0	0	3
BT1014	P	MOLECULAR BIOLOGY	3	0	0	3
BT1016	P	ENZYME ENGINEERING AND TECHNOLOGY	3	0	0	3
BT1017	P	BIOPROCESS PRINCIPLES	3	0	0	3
CH1053	E	CHEMICAL ENGINEERING PRINCIPLES LAB	0	0	2	1
BT1015	P	MOLECULAR BIOLOGY LABORATORY	0	0	4	2
BT1018	P	BIOPROCESS AND ENZYME TECHNOLOGY LABORATORY	0	0	2	1
	P	Dep. Elective –I	3	0	0	3
TOTAL			**25**	**0**	**9**	**29**
Total No. of Contact Hours			**34**			

SEMESTER V						
Course Code	**Category**	**Course Name**	**L**	**T**	**P**	**C**
PD1005	G	APTITUDE III	1	0	1	1
CH1055	E	CHEMICAL ENGINEERING PRINCIPLES II -HEAT AND MASS TRANSFER	3	0	0	3
CH1056	E	CHEMICAL ENGINEERING PRINCIPLES II -HEAT AND MASS TRANSFER LAB	0	0	2	1
BT1019	P	VECTOR BIOLOGY AND GENE	3	0	0	3

SEMESTER V						
Course Code	**Category**	**Course Name**	**L**	**T**	**P**	**C**
		MANIPULATION				
BT1021	P	ANIMAL BIOTECHNOLOGY	3	0	0	3
BT1022	P	PLANT BIOTECHNOLOGY	3	0	0	3
BT1024	P	ENVIRONMENTAL BIOTECHNOLOGY	3	0	0	3
BT1020	P	VECTOR BIOLOGY AND GENE MANIPULATION LABORATORY	0	0	4	2
BT1023	P	PLANT BIOTECHNOLOGY LABORATORY	0	0	4	2
BT1047	P	INDUSTRIAL TRAINING I (Training to be undergone after IV semester)	0	0	1	1
	P	Dep. Elective -II	3	0	0	3
		Open Elective I	3	0	0	3
TOTAL			**22**	**0**	**12**	**28**
Total No. of Contact Hours			**34**			

SEMESTER VI						
Course Code	**Category**	**Course Name**	**L**	**T**	**P**	**C**
PD1006	G	APTITUDE IV	1	0	1	1
BT1026	P	PHARMACEUTICAL BIOTECHNOLOGY	3	0	0	3
BT1027	P	BIOPROCESS ENGINEERING	3	0	0	3
BT1025	P	ANIMAL BIOTECHNOLOGY LAB	0	0	4	2
BT1028	P	BIOPROCESS ENGINEERING LABORATORY	0	0	2	1
BT1049	P	MINOR PROJECT	0	0	2	1
	P	Dep. Elective III	3	0	0	3
		Open Elective II	3	0	0	3
		Open Elective III	3	0	0	3
TOTAL			**16**	**0**	**9**	**20**
Total No. of Contact Hours			**25**			

SEMESTER VII						
Course Code	**Category**	**Course Name**	**L**	**T**	**P**	**C**
BT1029	P	PROTEIN ENGINEERING AND PROTEOMICS	3	0	0	3
BT1030	P	BIOSEPARATION TECHNOLOGY	3	0	0	3
BT1032	P	ETHICAL ISSUES, RESEARCH METHODOLOGY, AND INTELLECTUAL PROPERTY RIGHTS	1	0	0	1
BT1031	P	BIOSEPARATION TECHNOLOGY LAB	0	0	2	1
BT1048	P	INDUSTRIAL TRAINING II (Training to be undergone after VI semester)	0	0	1	1
	P	Dep. Elective IV	3	0	0	3
	P	Dep. Elective V	3	0	0	3
TOTAL			**13**	**0**	**3**	**15**
Total No. of Contact Hours			**16**			

SEMESTER VIII						
Course Code	**Category**	**Course Name**	**L**	**T**	**P**	**C**
BT1050	P	MAJOR PROJECT / PRACTICE SCHOOL	0	0	24	12
TOTAL			**0**	**0**	**24**	**12**
Total No. of Contact Hours			**24**			

DEPARTMENT ELECTIVES						
Course Code	**Category**	**Course Name**	**L**	**T**	**P**	**C**
BT1051	P	CANCER BIOLOGY	3	0	0	3
BT1052	P	STEM CELL BIOLOGY	3	0	0	3
BT1053	P	DRUG AND PHARMACEUTICAL BIOTECHNOLOGY	3	0	0	3
BT1054	P	COMPUTER SIMULATION AND DRUG DESIGNING	3	0	0	3
BT1055	P	INDUSTRIAL FERMENTATION TECHNOLOGY	3	0	0	3
BT1056	P	BIOREACTOR DESIGN	3	0	0	3
BT1057	P	FOOD AND BEVERAGE FERMENTATION TECHNOLOGY	3	0	0	3
BT1058	P	BIOCHEMICAL REACTION ENGINEERING	3	0	0	3
BT1059	P	BIOREMEDIATION TECHNOLOGY	3	0	0	3
BT1060	P	METAGENOMICS	3	0	0	3
BT1061	P	BIOENERGY	3	0	0	3
BT1062	P	ENVIRONMENTAL MICROBIOLOGY	3	0	0	3
BT1063	P	ANIMAL THERAPEUTICS	3	0	0	3
BT1064	P	TRANSGENIC ANIMALS	3	0	0	3
BT1065	P	VACCINE BIOTECHNOLOGY	3	0	0	3
BT1066	P	MARINE BIOTECHNOLOGY	3	0	0	3
BT1067	P	PHYTOCHEMICAL TECHNIQUES	3	0	0	3
BT1068	P	PLANT HORMONES AND SIGNAL TRANSDUCTION	3	0	0	3
BT1069	P	PATHOGENESIS-RELATED PROTEINS IN PLANTS	3	0	0	3
BT1070	P	REGULATION OF GENE EXPRESSION IN PLANTS	3	0	0	3
BT1071	P	BIOBUSINESS	3	0	0	3

SUMMARY OF CREDITS

SEMESTERS										
Category	**I**	**II**	**III**	**IV**	**V**	**VI**	**VII**	**VIII**	**Total**	**%**
G (Excluding open and departmental electives)	6	2	3	3	1	1			**16**	
B (Excluding open and departmental electives)	12	9	-	4					**25**	13.89
E (Excluding open and departmental electives)	7	6	3	7	4				**27**	15.00
P (Excluding open and departmental electives)		10	18	12	17	10	09	12	**88**	48.89
Open Elective					3	6			**9**	5.00
Dept. Elective				3	3	3	6		**15**	8.33
Total	**25**	**27**	**24**	**29**	**28**	**20**	**15**	**12**	**180**	100

SEMESTER – I

PD1001	**SOFT SKILLS-I**	**L**	**T**	**P**	**C**
	Total Contact Hours - 30	**1**	**0**	**1**	**1**
	Prerequisite				
	Nil				

PURPOSE

To enhance holistic development of students and improve their employability skills.

INSTRUCTIONAL OBJECTIVES

1.	To develop inter personal skills and be an effective goal oriented team player.
2.	To develop professionals with idealistic, practical and moral values.
3.	To develop communication and problem solving skills.
4.	To re-engineer attitude and understand its influence on behavior.

UNIT I - SELF ANALYSIS **(4 hours)**

SWOT Analysis, Who am I, Attributes, Importance of Self Confidence, Self Esteem

UNIT II - ATTITUDE **(4 hours)**

Factors influencing Attitude, Challenges and lessons from Attitude.

Change Management

Exploring Challenges, Risking Comfort Zone, Managing Change

UNIT III - MOTIVATION **(6 hours)**

Factors of motivation, Self talk, Intrinsic & Extrinsic Motivators.

UNIT IV - GOAL SETTING **(6 hours)**

Wish List, SMART Goals, Blue print for success, Short Term, Long Term, Life Time Goals.

Time Management

Value of time, Diagnosing Time Management, Weekly Planner To do list, Prioritizing work.

UNIT V - CREATIVITY **(10 hours)**

Out of box thinking, Lateral Thinking

Presentation

ASSESSMENT

1. A practical and activity oriented course which has continuous assessment for 75 marks based on class room interaction, activities etc.
2. Presentation – 25 marks

TEXT BOOK

1. INSIGHT, 2012, Career Development Centre, SRM Publications.

REFERENCES

1. Covey Sean, "*Seven Habits of Highly Effective Teens"*, New York, Fireside Publishers, 1998.
2. Carnegie Dale, "*How to win Friends and Influence People"*, New York: Simon & Schuster, 1998.
3. homas A Harris, "*I am ok, You are ok"* , New York-Harper and Row, 1972
4. Daniel Coleman, "*Emotional Intelligence"*, Bantam Book, 2006

PD1001 - SOFT SKILLS-I												
Course Designed by		**Career Development Centre**										
1.	Student outcome	a	b	c	d	e	f	g	h	i	j	k
					x		x	x		x		
2.	Mapping of instructional objectives with student outcome				1		2	3		4		
3.	Category	General(G)		Basic Sciences (B)			Engineering Sciences and Technical Arts (E)			Professional Subjects (P)		
		x										
4.	Approval	23rd Meeting of Academic Council, May 2013										

	MATRICES AND CALCULUS	L	T	P	C
MA1011	Total No. of Contact Hours = 75 Hours	3	2	0	4
	(Common to BT, BI, BME, BP, GE, FPE)				
	Prerequisite				
	Nil				

PURPOSE

To impart analytical ability in solving mathematical problems as applied to the respective branches of Engineering.

INSTRUCTIONAL OBJECTIVES

1.	To apply advanced matrix knowledge to Engineering problems.
2.	To improve their ability in trigonometry.
3.	To equip themselves familiar with the concepts of Differential calculus
4.	To expose to the concept of integral calculus
5.	To familiarize with the applications of differential and integral calculus

UNIT I - MATRICES **(12 hours)**

Review types of matrices, properties. Inverse matrix Cramer's rule for solving a system of linear equations. – Rank of Matrix – Consistency and Inconsistency of a system of m linear equations in 'n' unknowns –Cayley Hamilton theorem – Eigen values and Eigen vectors of a real matrix.

UNIT II - TRIGONOMETRY **(12 hours)**

Review of complex numbers. De Moiver's theorem and its applications. Expansion of $\sin n\theta$, $\cos n\theta$ in terms of $\sin\theta$ and $\cos\theta$. Expansion of $\tan n\theta$ in terms of $\tan\theta$. Expansion of $\sin^n\theta$ and $\cos^n\theta$ in terms of sines and cosines of multiples of θ. Hyperbolic functions and inverse hyperbolic functions.

UNIT III - DIFFERENTIAL CALCULUS **(12 hours)**

Differentiation and Derivatives of simple functions – Successive Differentiation – Various forms of Algebraic and Trigonometric functions – Problems.

UNIT IV - INTEGRAL CALCULUS **(12 hours)**

Methods of integration – Definite integrals and its properties-Reduction formula for $e^{ax}x^n$, $\sin^n x$, $\cos^n x$, $\sin^n x\cos^m x$ (without proof)-Problems.

UNIT V - APPLICATIONS OF DIFFERENTIAL CALCULUS & INTEGRAL CALCULUS **(12 hours)**

Applications of differential calculus & integral calculus. Tangent & Normal-Radius of curvature – Velocity and acceleration. Integral calculus – Length & Area.

TEXT BOOKS

1. Kreyszig.E, "*Advanced Engineering Mathematics",* 10th edition, John Wiley & Sons. Singapore, 2012.
2. Ganesan.K, Sundarammal Kesavan, Ganapathy Subramanian.K.S, & Srinivasan.V, "*Engineering Mathematics"*, Gamma publications, Revised Edition, 2013.

REFERENCES

1. Grewal.B.S, "*Higher Engg Maths"*, Khanna Publications, 42nd Edition, 2012.
2. Veerajan.T, "*Engineering Mathematics I"*, Tata McGraw Hill Publishing Co., New Delhi, 5th edition, 2006.
3. Kandasamy.P, etal. "*Engineering Mathematics"*, Vol.I (4th revised edition), S.Chand &Co., New Delhi, 2000.
4. Narayanan.S, Manicavachagom Pillay.T.K, Ramanaiah.G, "*Advanced Mathematics for Engineering students",* Volume I (2nd edition), S.Viswanathan Printers and Publishers, 1992.
5. Venkataraman.M.K, "*Engineering Mathematics"* – First Year (2nd edition), National Publishing Co., Chennai, 2000.

MA 1011 MATRICES AND CALCULUS													
Course Designed by		Department of Mathematics											
1.	Student outcome	a	b	c	d	E	f	g	h	i	j	k	
		x				x							
2.	Mapping of instructional objectives with student outcomes	1-5				1-5							
3.	Category	General(G)		Basic Sciences (B)			Engg. Sci.& Tech. Arts (E)			Professional Subjects(P)			
				x									
4.	Approval	23rd Meeting of Academic Council, May 2013											

PY1001	PHYSICS	L	T	P	C
	Total Contact Hours-45	3	0	0	3
	Prerequisite				
	Nil				

PURPOSE

The purpose of this course is to provide an understanding of physical concepts and underlying various engineering and technological applications. In addition, the course is expected to develop scientific temperament and analytical skill in students, to enable them logically tackle complex engineering problems in their chosen area of application.

INSTRUCTIONAL OBJECTIVES

1.	To understand the general scientific concepts required for technology
2.	To apply the Physics concepts in solving engineering problems
3.	To educate scientifically the new developments in engineering and technology
4.	To emphasize the significance of Green technology through Physics principles

UNIT I - MECHANICAL PROPERTIES OF SOLIDS AND ACOUSTICS (9 hours)

Mechanical properties of solids: Stress-strain relationship – Hooke's law – Torsional Pendulum – Young's modulus by cantilever – Uniform and non-uniform bending –– Stress-strain diagram for various engineering materials – Ductile and brittle materials – Mechanical properties of Engineering materials (Tensile strength, Hardness, Fatigue, Impact strength, Creep) – Fracture – Types of fracture (Elementary ideas).

Acoustics: Intensity – Loudness – Absorption coefficient and its determination – Reverberation – Reverberation time – Factors affecting acoustics of buildings and their remedies – Sources and impacts of noise – Sound level meter – Strategies on controlling noise pollution – Ultrasonic waves and properties – Methods of Ultrasonic production (Magnetostriction and Piezoelectric) – Applications of Ultrasonics in Engineering and medicine.

UNIT II - ELECTROMAGNETIC WAVES, CIRCUITS AND APPLICATIONS (9 hours)

Del operator – grad, div, curl and their physical significances - displacement current –Maxwell's equations (derivation) – Wave equation for electromagnetic waves – Propagation in free space – Poynting theorem – Characteristic of Transverse electric and magnetic waves – Skin depth – Rectangular and circular waveguides – High powered vacuum-based cavity magnetrons – Applications including radars, microwave oven and lighting systems.

UNIT III - LASERS AND FIBER OPTICS (9 hours)

Lasers: Characteristics of Lasers – Einstein's coefficients and their relations – Lasing action – Working principle and components of CO_2 Laser, Nd-YAG Laser, Semiconductor diode Laser, Excimer Laser and Free electron Laser – Applications in Remote sensing, holography and optical switching – Mechanism of Laser cooling and trapping.

Fiber Optics: Principle of Optical fiber – Acceptance angle and acceptance cone – Numerical aperture – V-number – Types of optical fibers (Material, Refractive index and mode) – Photonic crystal fibers – Fiber optic communication – Fiber optic sensors.

UNIT IV - QUANTUM MECHANICS AND CRYSTAL PHYSICS (9 hours)

Quantum mechanics: Inadequacies of Classical Mechanics – Duality nature of electromagnetic radiation – De Broglie hypothesis for matter waves – Heisenberg's uncertainty principle –Schrödinger's wave equation – Particle confinement in 1D box (Infinite Square well potential). **Crystal Physics:** Crystal directions – Planes and Miller indices – Symmetry elements – Quasi crystals – Diamond and HCP crystal structure – Packing factor – Reciprocal lattice – Diffraction of X-rays by crystal planes – Laue method and powder method – Imperfections in crystals.

UNIT V - GREEN ENERGY PHYSICS (9 hours)

Introduction to Green energy – **Solar energy:** Energy conversion by photovoltaic principle – Solar cells – **Wind energy:** Basic components and principle of wind energy conversion systems – **Ocean energy:** Wave energy – Wave energy conversion devices – Tidal energy – single and double basin tidal power plants – Ocean Thermal Electric Conversion (OTEC) – **Geothermal energy:** Geothermal sources (hydrothermal, geo-pressurized hot dry rocks, magma) – **Biomass:** Biomass and bio-fuels – bio-energies from wastages – **Fuel cells**: H_2O_2 – **Futuristic Energy:** Hydrogen – Methane Hydrates – Carbon capture and storage (CCS).

* One problem sheet consisting of 10 to 15 problems is to be prepared for each unit and discussed in the class.
* Few problems based on design considerations related to appropriate branches of engineering can be incorporated in each problem sheet.

TEXT BOOKS

1. Thiruvadigal.J.D, Ponnusamy.S, Sudha.D. and Krishnamohan. M, "*Physics for Technologists"*, Vibrant Publication, Chennai, 2013
2. Dattu R.Joshi, "*Engineering Physics*", Tata McGraw- Hill, New Delhi, 2010.

REFERENCES

1. Wole Soboyejo, "*Mechanical Properties of Engineered Materials*", Marcel Dekker Inc., 2003.
2. Frank Fahy, "*Foundations of Engineering Acoustics*", Elsevier Academic Press, 2005.
3. Alberto Sona, "*Lasers and their applications*", Gordon and Breach Science Publishers Ltd., 1976.
4. David J. Griffiths, "*Introduction to electrodynamics*", 3rd ed., Prentice Hall, 1999.
5. Leonard. I. Schiff, "*Quantum Mechanics"*, Third Edition, Tata McGraw Hill, 2010.
6. Charles Kittel, "*Introduction to Solid State Physics*", Wiley India Pvt. Ltd, 7th ed., 2007.
7. Godfrey Boyle, "*Renewable Energy: Power sustainable future*", 2nd edition, Oxford University Press, UK, 2004.

<table>
<tr><td colspan="14">PY1001 PHYSICS</td></tr>
<tr><td colspan="2">Course Designed by</td><td colspan="12">Department of Physics and Nanotechnology</td></tr>
<tr><td rowspan="2">1.</td><td rowspan="2">Student outcome</td><td>a</td><td>b</td><td>c</td><td>d</td><td>e</td><td>f</td><td>G</td><td>h</td><td>i</td><td>j</td><td>k</td></tr>
<tr><td>x</td><td></td><td>x</td><td></td><td>x</td><td></td><td></td><td></td><td></td><td></td><td>x</td></tr>
<tr><td>2.</td><td>Mapping of instructional objectives with student outcome</td><td>1</td><td></td><td>4</td><td></td><td>2</td><td></td><td></td><td></td><td></td><td></td><td>3</td></tr>
<tr><td rowspan="2">3.</td><td rowspan="2">Category</td><td colspan="3">General (G)</td><td colspan="3">Basic Sciences (B)</td><td colspan="4">Engineering Sciences and Technical Arts (E)</td><td colspan="2">Professional Subjects(P)</td></tr>
<tr><td colspan="3">--</td><td colspan="3">x</td><td colspan="4">--</td><td colspan="2">--</td></tr>
<tr><td>4.</td><td>Approval</td><td colspan="12">23rd Meeting of Academic Council, May 2013</td></tr>
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PY1002	PHYSICS LABORATORY	L	T	P	C
	Total Contact Hours – 30	0	0	2	1
	Prerequisite				
	Nil				

PURPOSE

The purpose of this course is to develop scientific temper in experimental techniques and to reinforce the physics concepts among the engineering students

INSTRUCTIONAL OBJECTIVES

1.	To gain knowledge in the scientific methods and learn the process of measuring different Physical variables
2.	Develop the skills in arranging and handling different measuring instruments
3.	Get familiarized with experimental errors in various physical measurements and to plan / suggest on how the contributions could be made of the same order, so as to minimize the errors.

LIST OF EXPERIMENTS

1. Determination of Young's modulus of a given material – Uniform / Non-uniform bending methods.
2. Determination of Rigidity modulus of a given material – Torsion pendulum
3. Determination of dispersive power of a prism – Spectrometer
4. Determination of laser parameters – divergence and wavelength for a given laser source –laser grating/ Particle size determination using laser
5. Study of attenuation and propagation characteristics of optical fiber cable
6. Calibration of voltmeter / ammeter using potentiometer
7. Construction and study of IC regulation properties of a given power supply
8. Study of electrical characteristics of a solar cell
9. Mini Project – Concept based Demonstration

TEXT BOOKS

1. Thiruvadigal.J.D, Ponnusamy.S, Sudha.D. and Krishnamohan.M, "*Physics for Technologists"*, Vibrant Publication, Chennai, 2013
2. Shukla R.K. and Anchal Srivastava, "*Practical Physics*", 1st Edition, New Age International (P) Ltd, New Delhi, 2006.

REFERENCES

1. Souires.G.L, "*Practical Physics:*" 4th Edition, Cambridge University, UK, 2001.
2. Chattopadhyay.D, Rakshit P. C. and Saha.B, "*An Advanced Course in Practical Physics*", 2nd ed., Books & Allied Ltd., Calcutta, 1990.

PY1002 PHYSICS LABORATORY												
Course Designed by		Department of Physics and Nanotechnology										
1.	Student outcome	a	b	c	d	e	f	g	H	i	j	k
		x	x			x						
2.	Mapping of instructional objectives with student outcome	1	3			2						
3.	Category	General(G)		Basic Sciences(B)		Engineering Sciences and Technical Arts (E)				Professional Subjects (P)		
		--		x		--				--		
4.	Approval	23rd Meeting of Academic Council, May 2013										

CY1001	CHEMISTRY	L	T	P	C
	Total Contact Hours – 45	3	0	0	3
	Prerequisite				
	Nil				

PURPOSE

To enable the students to acquire knowledge in the principles of chemistry for engineering applications

INSTRUCTIONAL OBJECTIVES

1.	The quality of water and its treatment methods for domestic and industrial applications.
2.	The classification of polymers, different types of polymerizations, preparation, properties and applications of important polymers and FRPs.
3.	The phase rule and its application to one and two component systems.
4.	The principle, types and mechanism of corrosion and protective coatings.
5.	The classification and selection of lubricants and their applications.
6.	The basic principles, instrumentation and applications of analytical techniques

UNIT I - WATER TREATMENT **(9 hours)**

Water quality parameters: Physical, Chemical & Biological significance - Hardness of water - estimation of hardness (EDTA method) - Dissolved oxygen – determination (Winkler's method), Alkalinity - determination - disadvantages of using hard water in boilers: Scale, sludge formation - disadvantages - prevention - treatment: Internal conditioning - phosphate, carbon and carbonate conditioning methods - External: Zeolite, ion exchange methods - desalination - reverse osmosis and electrodialysis - domestic water treatment.

UNIT II - POLYMERS AND REINFORCED PLASTICS (9 hours)

Classification of polymers - types of polymerization reactions - mechanism of addition polymerization: free radical, ionic and Ziegler - Natta - effect of structure on the properties of polymers - strength, plastic deformation, elasticity and crystallinity -Preparation and properties of important resins: Polyethylene, PVC, PMMA, Polyester, Teflon, Bakelite and Epoxy resins - compounding of plastics - moulding methods - injection, extrusion, compression and calendaring - reinforced plastics - FRP – Carbon and Glass- applications.

UNIT III - PHASE EQUILIBRIA, LUBRICANTS AND ADHESIVES (9 hours)

Phase rule: Statement - explanation of the terms involved - one component system (water system only). Condensed phase rule - thermal analysis - two component systems: simple eutectic, Pb-Ag; compound formation, Zn-Mg.

Lubricants: Classification –solid, semi solid, liquid, emulsion- properties – selection of lubricants for different purposes, Adhesives: classification-natural, synthetic, inorganic- Adhesive action - applications.

UNIT IV - CORROSION AND ITS CONTROL (9 hours)

Corrosion: Basic concepts - mechanism of chemical, electrochemical corrosion - Pilling Bedworth rule – Types of Electrochemical corrosion - galvanic corrosion - differential aeration corrosion - pitting corrosion - stress corrosion – Measurement of corrosion (wt. loss method only) - factors influencing corrosion. Corrosion control: Cathodic protection - sacrificial anodic method - corrosion inhibitors. Protective coatings: surface preparation for metallic coatings - electro plating (copper plating) and electroless plating (Nickel plating) - chemical conversion coatings - anodizing, phosphating & chromate coating.

UNIT V - INSTRUMENTAL METHODS OF ANALYSIS (9 hours)

Basic principles, instrumentation and applications of potentiometry, UV - visible spectroscopy, infrared spectroscopy, atomic absorption spectroscopy and flame photometry.

TEXT BOOKS

1. Kamaraj.P & Arthanareeswari.M, "*Applied Chemistry", 9th Edition*, Sudhandhira Publications, 2012.
2. Dara.S.S, "*A Text book of Engineering Chemistry"*, 10th Edition, S.Chand & Company Ltd., New Delhi, 2003

REFERENCES

1. Jain.P.C and Monika Jain, "*Engineering Chemistry*", Danpat Rai publishing company (P) Ltd, New Delhi, 2010.
2. Helen P Kavitha, "*Engineering Chemistry – I", Scitech* Publications, 2nd edition, 2008.

CY1001 CHEMISTRY												
Course Designed by		Department of Chemistry										
1.	Student outcome	a	b	c	d	e	f	g	H	i	j	k
		x	x	x		x						x
2.	Mapping of instructional objective with student outcome	1-6	1,5	3		2						4
3.	Category	General(G)		Basic Sciences(B)			Engineering Sciences and Technical Arts (E)			Professional Subjects (P)		
		--		x			--			--		
4.	Approval	23rd Meeting of Academic Council, May 2013										

CY1002	CHEMISTRY LABORATORY	L	T	P	C
	Total Contact Hours – 30	0	0	2	1
	Prerequisite				
	Nil				

PURPOSE

To apply the concepts of chemistry and develop analytical skills for applications in engineering.

INSTRUCTIONAL OBJECTIVES

1.	To enable the students to understand the basic concepts involved in the analyses.

LIST OF EXPERIMENTS

1. Preparation of standard solutions
2. Estimation of total, permanent and temporary hardness by EDTA method
3. Conductometric titration - determination of strength of an acid
4. Estimation of iron by potentiometry.
5. Determination of molecular weight of polymer by viscosity average method
6. Determination of dissolved oxygen in a water sample by Winkler's method

7. Determination of Na / K in water sample by Flame photometry (Demonstration)
8. Estimation of Copper in ore
9. Estimation of nickel in steel
10. Determination of total alkalinity and acidity of a water sample
11. Determination of rate of corrosion by weight loss method.

REFERENCES

1. Kamaraj & Arthanareeswari, Sudhandhira Publications "*Practical Chemistry*" (work book), 2011.
2. Helen P. Kavitha "*Chemistry Laboratory Manual*", Scitech Publications, 2008.

CY1002 CHEMISTRY LABORATORY												
Course Designed by		**Department of Chemistry**										
1.	Student outcome	a	b	c	d	e	f	g	h	i	j	k
		x	x									x
2.	Mapping of instructional objective with student outcome	1	1									1
3.	Category	General (G)		Basic Sciences(B)			Engineering Sciences and Technical Arts(E)			Professional Subjects(P)		
		--		x			--			--		
4.	Approval	23rd Meeting of Academic Council, May 2013										

LE1002	**VALUE EDUCATION**	**L**	**T**	**P**	**C**
	Total Contact Hours- 15	**1**	**0**	**0**	**1**
	Prerequisite				
	Nil				

PURPOSE

To provide guiding principles and tools for the development of the whole person recognizing that the individual is comprised of Physical, Intellectual, Emotional and Spiritual dimensions.

INSTRUCTIONAL OBJECTIVES

1.	To help individuals think about and reflect on different values.
2.	To deepen understanding, motivation and responsibility with regard to making personal and social choices and the practical implications of expressing them in relation to themselves, others, the community and the world at large.
3.	To inspire individuals to choose their own personal, social, moral and spiritual values and be aware of practical methods for developing and deepening.

UNIT I - INTRODUCTION **(3 hours)**

Definition, Relevance, Types of values, changing concepts of values

UNIT II - INDIVIDUAL AND GROUP BEHAVIOUR **(3 hours)**

Personal values – Self – Strengths (self-confidence, self-assessment, self-reliance, self-discipline, determination, self-restraint, contentment, humility, sympathy and compassion, gratitude, forgiveness) Weaknesses (Influences -- Peer pressure, familial and societal expectations, media)

UNIT III - SOCIETIES IN PROGRESS **(3 hours)**

Definition of society; Units of society; Communities – ancient and modern – Agents of change – Sense of survival, security, desire for comfort and ease sense of belonging, social consciousness and responsibility

UNIT IV - ENGINEERING ETHICS **(3 hours)**

Definition - Societies for engineers – Code of Ethics – Ethical Issues involved in cross border research -- Ethical and Unethical practices – case studies – situational decision making

UNIT V - SPIRITUAL VALUES **(3 hours)**

What is religion? -- Role of religion – Misinterpretation of religion – moral policing – Consequences -- Religion as spiritual quest – Aesthetics and religion

TEXT BOOK

1. Department of English and Foreign Languages SRM University, "*Rhythm of Life",* SRM Publications, 2013.

REFERENCE

1. Values (Collection of Essays). Published by: Sri Ramakrishna Math, Chennai-4. 1996.

LE1002 VALUE EDUCATION													
Course Designed by		**Department of English and Foreign Languages**											
1.	Student outcome	a	b	c	d	e	F	g	h	i	J	k
							x			x		
2.	Mapping of instructional objectives with student outcome						1-3			1-3		
3.	Category	General (G)		Basic Sciences (B)			Engineering Sciences and Technical Arts (E)			Professional Subjects (P)		
		x		--			--			--		
4.	Approval	23rd Meeting of Academic Council, May 2013											

CE1001	BASIC CIVIL ENGINEERING	L	T	P	C
	Total Contact Hours=30	2	0	0	2
	Prerequisite				
	Nil				

PURPOSE

To get exposed to the glimpses of Civil Engineering topics that is essential for an Engineer.

INSTRUCTIONAL OBJECTIVES

1.	To know about different materials and their properties
2.	To know about engineering aspects related to buildings
3.	To know about importance of surveying and the transportation systems
4.	To get exposed to the rudiments of engineering related to dams, water supply, and sewage disposal

UNIT I - BUILDING MATERILAS (6 hours)

Introduction – Civil Engineering – Materials: Bricks – composition – classifications – properties –uses. Stone – classification of rocks – quarrying – dressing – properties –uses. Timber - properties –uses –ply wood. Cement – grades –types – properties –uses. Steel – types – mild steel – medium steel – hard steel – properties – uses – market forms. Concrete – grade designation – properties – uses.

UNIT II - MATERIAL PROPERTIES (6 hours)

Stress – strain – types – Hook's law – three moduli of elasticity – poisons ratio – relationship – factor of safety. Centroid - center of gravity – problems in symmetrical sections only (I, T and channel sections). Moment of inertia, parallel, perpendicular axis theorems and radius of gyration (definitions only).

UNIT III - BUILDING COMPONENTS (6 hours)

Building – selection of site – classification – components. Foundations –functions – classifications – bearing capacity. Flooring – requirements – selection – types – cement concrete marble – terrazzo floorings. Roof – types and requirements.

UNIT IV - SURVEYING AND TRANSPORTATION (6 hours)

Surveying – objectives – classification – principles of survey. Transportation – classification – cross section and components of road – classification of roads. Railway – cross section and components of permanent way –functions. Water way – docks and harbor – classifications – components. Bridge – components of bridge.

UNIT V - WATER SUPPLY AND SEWAGE DISPOSAL (6 hours)

Dams – purpose – selection of site – types –gravity dam (cross section only). Water supply – objective – quantity of water – sources – standards of drinking water – distribution system. Sewage – classification – technical terms – septic tank – components and functions.

TEXT BOOKS

1. Raju.K.V.B, Ravichandran.P.T, "*Basics of Civil Engineering"*, Ayyappa Publications, Chennai, 2012.
2. Rangwala,S.C, "*Engineering Materials"*, Charotar Publishing House, Anand, 2012.

REFERENCES

1. Ramesh Babu, "*Civil Engineering",* VRB Publishers, Chennai, 2000.
2. National Building Code of India, Part V, "*Building Materials"*, 2005
3. Surendra Singh, "*Building Materials"*, Vikas Publishing Company, New Delhi, 1996.

CE1001 - BASIC CIVIL ENGINEERING												
Course Designed by		**Department of Civil Engineering**										
1.	Student outcome	a	b	c	d	e	f	g	h	i	j	k
		x				x						x
2.	Mapping of instructional objectives with student outcome	1-4				1-4						2-4
3.	Category	General (G)		Basic Sciences (B)			Engineering Sciences and Technical Arts (E)			Professional Subjects (P)		
							x					
4.	Approval	23rd meeting of academic council , May 2013										

SEMESTER – II

PD1002	**SOFT SKILLS-II**	**L**	**T**	**P**	**C**
	Total Contact Hours – 30	**1**	**0**	**1**	**1**
	Prerequisite				
	Nil				

PURPOSE	
To enhance holistic development of students and improve their employability skills.	
INSTRUCTIONAL OBJECTIVES	
1.	To develop inter personal skills and be an effective goal oriented team player.
2.	To develop professionals with idealistic, practical and moral values.
3.	To develop communication and problem solving skills.
4.	To re-engineer attitude and understand its influence on behavior.

UNIT I - INTERPERSONAL SKILLS **(6 hours)**

Understanding the relationship between Leadership Networking & Team work, Realizing Ones Skills in Leadership, Networking & Team Work, and Assessing Interpersonal Skills Situation description of Interpersonal Skill.

Team Work

Necessity of Team Work Personally, Socially and Educationally

UNIT II - LEADERSHIP **(4 hours)**

Skills for a good Leader, Assessment of Leadership Skills

Change Management

Exploring Challenges, Risking Comfort Zone, Managing Change

UNIT III - STRESS MANAGEMENT **(6 hours)**

Causes of Stress and its impact, how to manage & distress, Understanding the circle of control, Stress Busters.

Emotional Intelligence

What is Emotional Intelligence, emotional quotient why Emotional Intelligence matters, Emotion Scales. Managing Emotions.

UNIT IV - CONFLICT RESOLUTION **(4 hours)**

Conflicts in Human Relations – Reasons Case Studies, Approaches to conflict resolution.

UNIT V - DECISION MAKING **(10 hours)**

Importance and necessity of Decision Making, process of Decision Making, Practical way of Decision Making, Weighing Positives & Negatives.

Presentation

ASSESSMENT

1. A practical and activity oriented course which has a continuous assessment for 75 marks based on class room interaction, activities etc.,
2. Presentation - 25 marks

TEXT BOOK

1. INSIGHT, 2009. Career Development Centre, SRM Publications.

REFERENCE

1. Covey Sean, "*Seven Habit of Highly Effective Teens"*, New York, Fireside Publishers, 1998.
2. Carnegie Dale, "*How to win Friends and Influence People"*, New York: Simon & Schuster, 1998.
3. Thomas A Harris, "*I am ok, You are ok*", New York-Harper and Row, 1972
4. Daniel Coleman, "*Emotional Intelligence"*, Bantam Book, 2006

PD1002 - SOFT SKILLS-II												
Course Designed by		**Career Development Centre**										
1.	Student outcome	a	b	c	d	e	f	g	h	i	j	k
					x		x	x		x		
2.	Mapping of instructional objectives with student outcome				1		2	3		4		
3.	Category	General(G)		Basic Sciences(B)			Engineering Sciences and Technical Arts(E)			Professional Subjects(P)		
		x										
4.	Approval	23rd Meeting of Academic Council, May 2013										

	MULTIPLE INTEGRALS AND DIFFERENTIAL EQUATIONS	L	T	P	C
MA 1012	Total No. of Contact Hours - 75	3	2	0	4
	(Common to Bio group)				
	Prerequisite				
	Nil				

PURPOSE

To impart analytical ability in solving mathematical problems as applied to the respective branches of Engineering.

INSTRUCTIONAL OBJECTIVES

1.	To understand maxima and minima of two and three variables.
2.	To expose to the concepts of Differential equations
3.	To expose to the concepts of Multiple integrals.
4.	To expose to the concept of vector calculus
5.	To expose to the concept of three dimensional analytical geometry.

UNIT I - FUNCTIONS OF SEVERAL VARIABLES (12 hours)

Functions of two variables – partial derivatives – total differentiation – Taylor's expansion – maxima and minima of functions of two and three variables - Jacobians.

UNIT II - DIFFERENTIAL EQUATIONS (12 hours)

Differential equations of first order–Linear equations of second order with constant coefficients and variable coefficients – method of variation of parameters.

UNIT III - MULTIPLE INTEGRALS (12 hours)

Double integration in Cartesian and polar coordinates – Change of order of integration –Triple integration in Cartesian coordinates.

UNIT IV - VECTOR CALCULUS (12 hours)

Review of Vector Algebra.Gradient, divergence and curl – solenoidal, and irrotational fields – directional derivatives – line integrals – surface integrals – volume integrals, Integral theorems (without proof) and its applications- cubes and parallelepipeds only

UNIT V - THREE DIMENSIONAL ANALYTICAL GEOMETRY (12 hours)

Direction cosines and direction ratios of a line – angle between two lines. Equation of a plane – equation of straight line – shortest distance between two skew lines – coplanar lines.

TEXT BOOKS

1. Kreyszig.E, *"Advanced Engineering Mathematics"*, 10th edition, John Wiley & Sons. Singapore, 2012.
2. Ganesan.K, Sundarammal Kesavan, Ganapathy Subramanian.K.S, & Srinivasan.V, *"Engineering Mathematics"*, Gamma publications, Revised Edition, 2013.

REFERENCES

1. Grewal B.S, Higher *"Engineering Mathematics"*, Khanna Publications, 42nd Edition , 2012.
2. Veerajan.T, *"Engineering Mathematics I"*, Tata McGraw Hill Publishing Co., New Delhi, 5th edition, 2006.
3. Kandasamy.P etal. "*Engineering Mathematics"*, Vol.I (4th revised edition), S.Chand &Co., New Delhi, 2000.
4. Narayanan.S, Manicavachagom Pillay.T.K, Ramanaiah.G, "*Advanced Mathematics for Engineering students"*, Volume I (2nd edition), S.Viswanathan Printers and Publishers, 1992.
5. Venkataraman.M.K, "*Engineering Mathematics"* – First Year (2nd edition), National Publishing Co., Chennai, 2000.

MA 1012 MULTIPLE INTEGRALS AND DIFFERENTIAL EQUATIONS												
Course Designed by		**Department of Mathematics**										
1.	Student outcome	a	b	c	D	E	f	g	h	i	j	k
		x				x						
2.	Mapping of instructional objectives with student outcomes	1-5				1-5						
3.	Category	General (G)			Basic Sciences (B)		Engg. Sci.& Tech. Arts (E)			Professional Subjects(P)		
					x							
4.	Approval	23rd Meeting of Academic Council, May 2013										

PY1003	MATERIALS SCIENCE	L	T	P	C
	Total Contact Hours - 60	2	0	2	3
	Prerequisite				
	Nil				

PURPOSE

The course introduces several advanced concepts and topics in the rapidly evolving field of material science. Students are expected to develop comprehension of the subject and to gain scientific understanding regarding the choice and manipulation of materials for desired engineering applications.

INSTRUCTIONAL OBJECTIVES

1.	To acquire basic understanding of advanced materials, their functions and properties for technological applications
2.	To emphasize the significance of materials selection in the design process
3.	To understand the principal classes of bio-materials and their functionalities in modern medical science
4.	To get familiarize with the new concepts of Nano Science and Technology
5.	To educate the students in the basics of instrumentation, measurement, data acquisition, interpretation and analysis

UNIT I - ELECTRONIC AND PHOTONIC MATERIALS (6 hours)

Electronic Materials: Fermi energy and Fermi–Dirac distribution function – Variation of Fermi level with temperature in intrinsic and extrinsic semiconductors – Hall effect – Dilute Magnetic Semiconductors (DMS) and their applications

Superconducting Materials: Normal and High temperature superconductivity – Applications.

Photonic Materials: LED – LCD – Photo conducting materials – Photo detectors – Photonic crystals and applications – Elementary ideas of Non-linear optical materials and their applications.

UNIT II - MAGNETIC AND DIELECTRIC MATERIALS (6 hours)

Magnetic Materials: Classification of magnetic materials based on spin – Hard and soft magnetic materials – Ferrites, garnets and magnetoplumbites – Magnetic bubbles and their applications – Magnetic thin films – Spintronics and devices (Giant magneto resistance, Tunnel magneto resistance and Colossal magneto resistance).

Dielectric Materials: Polarization mechanisms in dielectrics – Frequency and temperature dependence of polarization mechanism – Dielectric loss – Dielectric waveguide and dielectric resonator antenna – Piezoelectric, pyroelectric and ferroelectric materials and their applications.

UNIT III - MODERN ENGINEERING AND BIOMATERIALS (6 hours)

Modern Engineering Materials: Smart materials – Shape memory alloys – Chromic materials (Thermo, Photo and Electro) – Rheological fluids – Metallic glasses – Advanced ceramics – Composites.

Bio-materials: Classification of bio-materials (based on tissue response) – Comparison of properties of some common biomaterials – Metallic implant materials (stainless steel, cobalt-based and titanium-based alloys) – Polymeric implant materials (Polyamides, polypropylene, Acrylic resins and Hydrogels) – Tissue replacement implants – Soft and hard tissue replacements – Skin implants – Tissue engineering – Biomaterials for organ replacement (Bone substitutes) – Biosensor.

UNIT IV - INTRODUCTION TO NANOSCIENCE AND NANOTECHNOLOGY(6 hours)

Basic concepts of Nanoscience and Nanotechnology – Quantum wire – Quantum well – Quantum dot – fullerenes – Graphene – Carbon nanotubes – Material processing by chemical vapor deposition and physical vapor deposition – Principle of SEM, TEM, AFM, Scanning near-field optical microscopy (SNOM) – Scanning ion-conducting microscopy (SCIM) – Potential uses of nanomaterials in electronics, robotics, computers, sensors, sports equipment, mobile electronic devices, vehicles and transportation – Medical applications of nanomaterials.

UNIT V - MATERIALS CHARACTERIZATION (6 hours)

X-ray diffraction, Neutron diffraction and Electron diffraction– X-ray fluorescence spectroscopy – Fourier transform Infrared spectroscopy (FTIR) – Ultraviolet and visible spectroscopy (UV-Vis) – Thermogravimetric Analysis (TGA) – Differential Thermal Analysis (DTA) – Differential Scanning Calorimetry (DSC).

PRACTICAL EXPERIMENTS (30 hours)

1. Determination of resistivity and band gap for a semiconductor material – Four probe method / Post-office box
2. Determination of Hall coefficient for a semiconducting material
3. To study V-I characteristics of a light dependent resistor (LDR)
4. Determination of energy loss in a magnetic material – B-H curve
5. Determination of paramagnetic susceptibility – Quincke's method
6. Determination of dielectric constant for a given material
7. Calculation of lattice cell parameters – X-ray diffraction
8. Measurement of glucose concentration – Electrochemical sensor
9. Visit to Advanced Material Characterization Laboratory (Optional)

TEXT BOOKS

1. Thiruvadigal.J.D, Ponnusamy,S..Sudha.D and Krishnamohan.M, "*Materials Sciences"*, Vibrant Publication, Chennai, 2013
2. Rajendran.V, "*Materials Science*", Tata McGraw- Hill,New Delhi,2011

REFERENCES

1. Rolf E. Hummel, "*Electronic Properties of Materials"*, 4th ed., Springer, New York, 2011.
2. Dennis W. Prather, "*Photonic Crystals: Theory, Applications, and Fabrication"*, John Wiley & Sons, Hoboken, 2009.
3. James R. Janesick, "*Scientific Charge-Coupled Devices",* Published by SPIE - The International Society for Optical Engineering, Bellingham, Washington, 2001.
4. David M. Pozar, "*Microwave Engineering*", 3rd ed., John Wiley & Sons, 2005.
5. Silver.F. and Dillion.C, "*Biocompatibility: Interactions of Biological and Implantable Materials*", VCH Publishers, New York, 1989.
6. Severial Dumitriu, "*Polymeric Biomaterials*" Marcel Dekker Inc, CRC Press, Canada 2001.
7. Cao.G, "*Nanostructures and Nanomaterials: Synthesis, Properties and Applications*", Imperial College Press, 2004.
8. Pradeep.T, "*A Text Book of Nanoscience and Nanotechnology*", Tata McGraw Hill, New Delhi, 2012.
9. Sam Zhang, "*Materials Characterization Techniques*", CRC Press, 2008.

PY1003 MATERIALS SCIENCE												
Course Designed by		**Department of Physics and Nanotechnology**										
1.	Student outcome	a	b	c	d	e	f	g	H	i	j	k
		x	x		x	x						x
2.	Mapping of instructional objectives with student outcome	1	5		4	2						3
3.	Category	General(G)		Basic Sciences (B)			Engineering Sciences and Technical Arts (E)				Professional Subjects(P)	
		--		x			--				--	
4.	Approval	23rd Meeting of Academic Council, May 2013										

CY1003	**PRINCIPLES OF ENVIRONMENTAL SCIENCE**	**L**	**T**	**P**	**C**
	Total Contact Hours - 30	**2**	**0**	**0**	**2**
	Prerequisite				
	Nil				

PURPOSE

The course provides a comprehensive knowledge in environmental science, environmental issues and the management.

INSTRUCTIONAL OBJECTIVES

To enable the students

1.	To gain knowledge on the importance of environmental education and ecosystem.
2.	To acquire knowledge about environmental pollution- sources, effects and control measures of environmental pollution.
3.	To understand the treatment of wastewater and solid waste management.
4.	To acquire knowledge with respect to biodiversity, its threats and its conservation and appreciate the concept of interdependence.
5.	To be aware of the national and international concern for environment for protecting the environment.

UNIT I - ENVIRONMENTAL EDUCATION AND ECOSYSTEMS (6 hours)

Environmental education: Definition and objective. Structure and function of an ecosystem – ecological succession –primary and secondary succession - ecological pyramids – pyramid of number, pyramid of energy and pyramid of biomass.

UNIT II - ENVIRONMENTAL POLLUTION (6 hours)

Environmental segments – structure and composition of atmosphere - Pollution – Air, water, soil , thermal and radiation – Effects – acid rain, ozone layer depletion and green house effect – control measures – determination of BOD, COD, TDS and trace metals.

UNIT III- WASTE MANAGEMENT (6 hours)

Waste water treatment (general) – primary, secondary and tertiary stages. Solid waste management: sources and effects of municipal waste, bio medical waste - process of waste management.

UNIT IV- BIODIVERSITY AND ITS CONSERVATION (6 hours)

Introduction: definition - genetic, species and ecosystem diversity – bio diversity hot spots - values of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values - threats to biodiversity: habitat loss, poaching of wildlife – endangered and endemic species of India, Conservation of biodiversity: in-situ and ex-situ conservations.

UNIT V- ENVIRONMENTAL PROTECTION (6 hours)

National concern for environment: Important environmental protection acts in India – water, air (prevention and control of pollution) act, wild life conservation and forest act – functions of central and state pollution control boards - international effort – key initiatives of Rio declaration, Vienna convention, Kyoto protocol and Johannesburg summit.

TEXT BOOKS

1. Kamaraj.P & Arthanareeswari.M, "*Environmental Science – Challenges and Changes"*, 4th Edition, Sudhandhira Publications, 2010.
2. Sharma.B.K. and Kaur, "*Environmental Chemistry",* Goel Publishing House, Meerut, 1994.

REFERENCES

1. De.A.K, "*Environmental Chemistry"*, New Age International, New Delhi, 1996.
2. Helen P Kavitha, "*Principles of Environmental Science*", Sci tech Publications, 2nd Edition, 2008.

CY1003 – PRINCIPLES OF ENVIRONMENTAL SCIENCE												
Course Designed by		**Department of Chemistry**										
1.	Student outcome	a	b	c	d	e	f	g	h	i	j	k
				x		x	x		x	x	x	
2.	Mapping of instructional objective with student outcome			5		2	4		1,3	3	2, 5	
3.	Category	General(G)		Basic Sciences(B)		Engineering Sciences and Technical Arts (E)				Professional Subjects(P)		
				x		--				--		
4.	Approval	23rd Meeting of Academic Council, May 2013										

BT1002	HUMAN PHYSIOLOGY AND HEALTH	L	T	P	C
	Total No. of Contact Hours - 30	2	0	0	2
	Prerequisite				
	Nil				

PURPOSE

To provide a basic understanding of human physiological systems for a better comprehension of the problems faced by human.

INSTRUCTIONAL OBJECTIVES

1.	To familiarize the students with the basic organization of organisms and subsequent development to an organ system, and provide students with an understanding of the function and regulation of the human body and physiological integration of the organ systems to maintain homeostasis.
2.	The functional aspects of various organ systems will helpful for further understanding of the cellular and molecular mechanisms of action in health and disease.

UNIT I - PHYSIOLOGY OF CELLS AND MOLECULES (5 hours)

Functional organization of cell-Physiology of membranes- Signal transduction-Regulation of gene expression- Action potential- Cellular physiology of skeletal, cardiac and smooth muscle

UNIT II - CELLULAR PHYSIOLOGY OF THE NERVOUS SYSTEM (5 hours)

Organization and physiology of neurons-Circuits of the central nervous system-Autonomic nervous system-Neuronal microenvironment

UNIT III - CARDIOVASCULAR AND RESPIRATORY SYSTEMS (7 hours)

Organization of the cardiovascular system-Arteries and veins-Cardiac electrophysiology-Heart as a pump-Organization of respiratory system-Mechanics of respiration-Acid/base physiology-Gas exchange in lungs

UNIT IV - GASTROINTESTINAL AND RENAL SYSTEMS (7 hours)

Organization of the GI system-Gastric function-Pancreas and salivary glands-Hepatobiliary function-Organization of the urinary system-Glomerular filtration and Renal blood flow-Integration of salt and water balance

UNIT V - ENDOCRINE AND REPRODUCTIVE SYSTEMS (6 hours)

Organization of the endocrine control-Endorine glands-Regulation of endocrine glands-Male and female reproductive system-Fertilization, pregnancy, and lactation

TEXT BOOKS

1. Boron.W.F. and Boulpaep.E.L,"*Medical physiology*,", Elsevier, 2005.
2. Khurana, "*Essentials of Medical Physiology*," Elsevier India, 2008.

REFERENCE

1. Bruce M. Koeppen and Bruce A. Stanton, "*Berne & Levy Physiology*,"6th Updated Edition, Mosby, 2009.

BT1002 HUMAN PHYSIOLOGY AND HEALTH												
Course Designed by		**Department of Biotechnology**										
1.	Student outcomes	a	b	c	d	e	f	G	h	i	j	k
		x			x							
2.	Mapping of instructional objectives with student outcomes	1			2							
3.	Category	General(G)		Basic Sciences (B)			Engg. Sci. & Tech. Arts (E)		Professional Subjects (P)			
									x			
4.	Broad Area	Bio-technology		Bioprocess Engineering					Chemical Engineering			
		x		--					--			
5.	Approval	23rd Meeting of Academic Council, May 2013										

BT1003	**CELL BIOLOGY**	**L**	**T**	**P**	**C**
	Total No. of Contact Hours – 45	**3**	**0**	**0**	**3**
	Prerequisite				
	Nil				

PURPOSE

To provide a basic understanding of human physiological systems for a better comprehension of the problems faced by humans.

INSTRUCTIONAL OBJECTIVES

1.	To study cell structure and functions of organelles and understand the mechanism of cellular transport within and outside the cell membrane
2.	To focus on different receptors and model of signaling and introduce the concept of cell signaling and their role in diseases

UNIT I - AN OVERVIEW OF CELLS AND CELL RESEARCH (9 hours)

Origin and evolution of cells, cells as experimental models, tools of cell biology – chemistry of cells – molecular composition of cells, central role of enzymes, metabolic energy, biosynthesis of cell constituents, cell membrane.

UNIT II - CELL STRUCTURE AND FUNCTION – I (9 hours)

Nucleus, Endoplasmic reticulum, Golgi apparatus and Lysosomes, Bioenergetics and Metabolism – Mitochondria, Chloroplasts, Peroxisomes.

UNIT III - CELL STRUCTURE AND FUNCTION – II (9 hours)

The cytoskeleton and cell movement, cell surface – transport of small molecules, Endocytosis, cell –cell interactions-Adhesion junctions-Tight junctions-Gap junctions- Plasmodesmata

UNIT IV - CELL SIGNALING – CELL REGULATION (9 hours)

Signaling molecules and their receptors, functions, pathways of intracellular signal transduction – the Cell Cycle –Mitosis and Meiosis –Cell death and cell renewal-Programmed cell death-Stem cells- Embryonic stem cells and therapeutic cloning.

UNIT X - DISEASES OF CELLS (9 hours)

Epithelial cells and Cancer – Neurobiology and Neurodegenerative diseases

TEXT BOOK

1. Geoffrey M. Cooper and Robert E. Hausman**,** *"The Cell: A Molecular Approach,"* Fifth Edition, ASM Press and Sinauer Associates, 2009.

REFERENCES

1. Channarayappa, "*Cell biology*," Universities Press, 2010.
2. Rastogi.S.C, "*Cell biology*," New Age International publishers, 2005.
3. Cecie Starr, "*Biology: Concepts and applications*," Sixth edition, Thomson, 2006.

BT1003 CELL BIOLOGY												
Course Designed by		**Department of Biotechnology**										
1.	Student outcomes	a	b	c	d	e	f	G	h	I	j	k
		x			x							
2.	Mapping of instructional objectives with student outcomes	1			2							
3.	Category	General(G)			Basic Sciences(B)			Engg. Sci. & Tech. Arts (E)			Professional Subjects (P)	
											x	
4.	Broad Area	Bio-technology			Bioprocess Engineering			Chemical Engineering				
		x			--			--			--	
5.	Approval	23rd Meeting of Academic Council, May 2013										

BT1004	BIOCHEMISTRY	L	T	P	C
	Total No. of Contact Hours – 45	3	0	0	3
	Prerequisite				
	Nil				

PURPOSE

To provide an understanding of the functions of various biomolecules and their metabolism.

INSTRUCTIONAL OBJECTIVES

1.	To study structural and functional properties of carbohydrates, proteins, lipids and nucleic acids
2.	To emphasize the role of biomolecules by providing basic information on specific metabolic diseases and disorders

UNIT I - INTRODUCTION TO BIOCHEMISTRY (12 hours)

Introduction-Chemical bonds-pH-Buffers-Carbohydrates-Lipids-Proteins

UNIT II - METABOLISM OF CARBOHYDRATES (8 hours)

Introduction to Metabolism-Glycolysis-Citric acid cycle-Gluconeogenesis-Glycogen metabolism-Glycogenesis-Glycogenolysis-Biochemical aspects of Diabetes Mellitus

UNIT III - PROTEIN METABOLISM (9 hours)

Introduction-Metabolism of amino acids-Transamination-Deamination-Metabolism of ammonia-Urea cycle-Biosynthesis of amino acids-Disorders of tyrosine (phenylalanine) metabolism

UNIT IV - FATTY ACID METABOLISM AND NUCLEIC ACID METABOLISM (8 hours)

Introduction-Fatty acid oxidation-Ketone bodies & Ketogenesis-Biosynthesis of Fatty acids-Eicosanoids-Cholesterol Biosynthesis-Lipoproteins-Disorders of Lipid metabolism-Nucleic acids: Biosynthesis of Purine and Pyrimidines-Degradation of purine nucleotides and pyrimidine nucleotides-Disorders of Purine and pyrimidine metabolism

UNIT V - OXIDATIVE PHOSPHORYLATION (8 hours)

Introduction-Bioenergetics, High energy compounds, Biological oxidation-Electron transport chain, Oxidative phospholyration, Chemiosmotic theory-Shuttle pathway – Glycerol phosphate Shuttle, Malate aspartate Shuttle –Shunt pathways

TEXT BOOKS

1. Jain, J L, Jain, Nitin, Sunjay Jain, "*Fundamentals of Biochemistry"*, S. Chand Group, ISBN: 8121924537.
2. Satyanarayana.U & U. Chakrapani, "*Biochemistry"*,Books and Allied (p) Ltd., ISBN: 8187134801.

REFERENCES

1. David L. Nelson, Albert Lester Lehninger, Michael M. Cox, "*Lehninger Principles of Biochemistry",* Edition 5, illustrated, W. H. Freeman, 2008.
2. Jeremy M. Berg, John L. Tymoczko, Lubert Stryer, "*Biochemistry"*, Ed. 7, W. H. Freeman, 2012.

BT1004 BIOCHEMISTRY												
Course Designed by		**Department of Biotechnology**										
1.	Student outcomes	a	b	c	d	e	f	G	h	i	j	k
		x			x							
2.	Mapping of instructional objectives with student outcomes	1			2							
3.	Category	General (G)		Basic Sciences(B)		Engg. Sci. & Tech. Arts (E)			Professional Subjects (P)			
									x			
4.	Broad Area	Bio-technology		Bioprocess Engineering		Chemical Engineering						
		x		--		--			--			
5.	Approval	23rd Meeting of Academic Council, May 2013										

BT1005	BIOCHEMISTRY LABORATORY	L	T	P	C
	Total No. of Contact Hours – 60	0	0	4	2
	Prerequisite				
	BT 1004				

PURPOSE

To establish the basics of practical biochemistry and to provide a platform for understanding and analyzing the biomolecules

INSTRUCTIONAL OBJECTIVES

1.	To teach laboratory safety and standard operating procedures of common laboratory equipment's
2.	To impart skills in preparation of solutions and biological buffers
3.	To extend knowledge in analysis, estimation and comparison of biomolecules in normal and diseased conditions
4.	To offer exposure on modern separation techniques for biomolecules

LIST OF EXPERIMENTS

1. Introduction to commonly used instruments (pH meter, Spectrophotometer, Centrifuge, Microscopes etc..) and laboratory safety
2. pH measurements and preparation of buffers
3. Qualitative analysis of carbohydrates (Monosaccharide – Hexo, Pentose, Aldo, Keto sugars, Disaccharides – Reducing and non-reducing sugars, Polysaccharides)
4. Estimation of blood glucose and comparison of normal and diabetes mellitus samples
5. Estimation of blood plasma proteins
6. Separation of amino acids on Thin layer chromatography
7. Quantification of cholesterol and triglycerides from blood
8. Biochemical estimation of nucleic acid using spectrophotometer
9. HPLC determination of caffeine in urine – Demo
10. Purification of biomolecules using FPLC - Demo

REFERENCE

1. Laboratory Manual

<table>
<tr><th colspan="13">BT1005 BIOCHEMISTRY LABORATORY</th></tr>
<tr><th colspan="2">Course Designed by</th><th colspan="11">Department of Biotechnology</th></tr>
<tr><td rowspan="2">1.</td><td rowspan="2">Student outcomes</td><td>a</td><td>b</td><td>c</td><td>d</td><td>e</td><td>f</td><td>g</td><td></td><td>i</td><td>j</td><td>k</td></tr>
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<tr><td rowspan="2">4.</td><td rowspan="2">Broad area</td><td colspan="3">Bio-technology</td><td colspan="3">Bioprocess Engineering</td><td colspan="6">ChemicalEngineering</td></tr>
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<tr><td>5.</td><td>Approval</td><td colspan="12">23rd Meeting of Academic Council, May 2013</td></tr>
</table>

LE1001	ENGLISH	L	T	P	C
	Total Contact Hours-45	1	2	0	2
	Prerequisite				
	Nil				

PURPOSE

To help students achieve proficiency in English and develop their professional communication skills to meet the demand in the field of global communication to enable them to acquire placement anywhere with ease and confidence.

INSTRUCTIONAL OBJECTIVES

1.	To enable students improve their lexical, grammatical and communicative competence.
2.	To enhance their communicative skills in real life situations.
3	To assist students understand the role of thinking in all forms of communication.
4.	To equip students with oral and appropriate written communication skills.
5.	To assist students with employability and job search skills.

UNIT I - INVENTIONS **(9 hours)**

1. Grammar and Vocabulary – Tense and Concord:
2. Listening and Speaking – Common errors in Pronunciation (Individual sounds); Process description (Describing the working of a machine, and the manufacturing process)
3. Writing – Interpretation of data (Flow chart, Bar chart)
4. Reading -- (Reading Comprehension -- Answering questions)

UNIT II - ECOLOGY **(9 hours)**

1. Grammar and Vocabulary – Error Analysis – Synonyms and Antonyms, Parallelisms
2. Listening and Speaking - Conducting Meetings
3. Writing – Notice, Agenda, Minutes , letters to the editor via email : Email etiquette
4. D Reading Comprehension – Summarizing and Note-making

UNIT III - SPACE **(9 hours)**

1. Grammar and Vocabulary – tense and concord; word formation
2. Listening and Speaking – Distinction between native and Indian English (Speeches by TED and Kalam) – accent, use of vocabulary and rendering;
3. Writing – Definitions and Essay writing
4. Reading Comprehension – Predicting the content

UNIT IV - CAREERS **(9 hours)**

1. Grammar and Vocabulary –Homonyms and Homophones
2. Listening and Speaking – – Group Discussion
3. Writing Applying for job, cover letter and resume
4. Reading, etymology (roots; idioms and phrases), Appreciation of creative writing.

UNIT V - RESEARCH **(9 hours)**

1. Grammar and Vocabulary – Using technical terms, Analogies
2. Listening and Speaking -- Presentation techniques (Speech by the learner)
3. Writing – Project Proposal
4. Reading Comprehension -- Referencing Skills for Academic Report Writing (Research Methodology – Various methods of collecting data) Writing a report based on MLA Handbook

TEXTBOOK

1. Department of English and Foreign Languages. "*English for Engineers*", SRM University Publications, 2013.

REFERENCES

1. Dhanavel.S.P, "*English and Communication Skills for Students of Science and Engineering*"**,** Orient Blackswan Ltd., 2009.
2. Meenakshi Raman and Sangeetha Sharma**.** "*Technical Communication-Principles and Practice*", Oxford University Press, 2009.
3. Day.R.A, Scientific English: "*A Guide for Scientists and Other Professionals*", 2nd ed. Hyderabad: Universities Press, 2000.

LE1001 ENGLISH												
Course Designed by		Department of English and Foreign Languages										
1.	Student outcome	a	b	c	d	e	f	G	h	i	j	k
					x		x	x		x		
2.	Mapping of instructional objectives with student outcome				1-5		1-5	1-5		1-5		
3.	Category	General (G)		Basic Sciences (B)			Engineering Sciences and Technical Arts (E)			Professional Subjects (P)		
		x		--			--			--		
4.	Approval	23rd Meeting of Academic Council, May 2013										

SEMESTER I/II

CS1001	PROGRAMMING USING MATLAB	L	T	P	C
	Total Contact Hours - 45	0	1	2	2
	Prerequisite				
	Nil				

PURPOSE

This Lab Course will enable the students to understand the fundamentals and programming knowledge in MATLAB.

INSTRUCTIONAL OBJECTIVES

1.	To learn the MATLAB environment and its programming fundamentals
2.	Ability to write Programs using commands and functions
3.	Able to handle polynomials, and use 2D Graphic commands

LIST OF EXPERIMENTS

1. Practicing MATLAB environment with simple exercises to familiarize Command Window, History, Workspace, Current Directory, Figure window, Edit window, Shortcuts, Help files.
2. Data types, Constants and Variables, Character constants, operators, Assignment statements.
3. Control Structures: For loops, While, If control structures, Switch, Break, Continue statements.
4. Input-Output functions, Reading and Storing Data.
5. Vectors and Matrices, commands to operate on vectors and matrices, matrix Manipulations.
6. Arithmetic operations on Matrices, Relational operations on Matrices, Logical operations on Matrices.
7. Polynomial Evaluation, Roots of Polynomial, Arithmetic operations on Polynomials.
8. Graphics: 2D plots, Printing labels, Grid & Axes box, Text in plot, Bar and Pie chart.

TEXT BOOK

1. Bansal.R.K, Goel.A.K, Sharma.M.K, "*MATLAB and its Applications in Engineering*", Pearson Education, 2012.

REFERENCES

1. Amos Gilat, *"MATLAB-An Introduction with Applications"*, Wiley India, 2009.
2. Stephen.J.Chapman, *"Programming in MATLAB for Engineers"*, Cengage Learning, 2011.

CS1001 PROGRAMMING USING MATLAB												
Course Designed by		Department of Computer Science and Engineering										
1.	Student outcome	a	b	c	d	e	f	g	h	i	j	k
		x	x									x
2.	Mapping of instructional objective with student outcome	2,3	1-3									1
3.	Category	General(G)		Basic Sciences(B)		Engineering Sciences and Technical Arts (E)				Professional Subjects(P)		
		x		--		--				--		
4.	Approval	23rd Meeting of Academic Council, May 2013										

ME1001	BASIC MECHANICAL ENGINEERING	L	T	P	C
	Total Contact Hours - 30	2	0	0	2
	Prerequisite				
	Nil				

PURPOSE

To familiarize the students with the basics of Mechanical Engineering.

INSTRUCTIONAL OBJECTIVES

1.	To familiarize with the basic machine elements
2.	To familiarize with the Sources of Energy and Power Generation
3.	To familiarize with the various manufacturing processes

UNIT I - MACHINE ELEMENTS– I (5 hours)

Springs: Helical and leaf springs – Springs in series and parallel. **Cams:** Types of cams and followers – Cam profile.

UNIT II - MACHINE ELEMENTS– II (5 hours)

Power Transmission: Gears (terminology, spur, helical and bevel gears, gear trains). Belt drives (types). Chain drives. Simple Problems.

UNIT III - ENERGY (10 hours)

Sources: Renewable and non-renewable (various types, characteristics, advantages/disadvantages). **Power Generation:** External and internal combustion engines – Hydro, thermal and nuclear power plants (layouts, element/component description, advantages, disadvantages, applications). Simple Problems.

UNIT IV - MANUFACTURING PROCESSES - I (5 hours)

Sheet Metal Work: Introduction – Equipments – Tools and accessories – Various processes (applications, advantages / disadvantages). **Welding:** Types – Equipments – Tools and accessories – Techniques employed -applications, advantages / disadvantages – Gas cutting – Brazing and soldering.

UNIT V - MANUFACTURING PROCESSES– II (5 hours)

Lathe Practice: Types - Description of main components – Cutting tools – Work holding devices – Basic operations. Simple Problems. **Drilling Practice:** Introduction – Types – Description – Tools. Simple Problems.

TEXT BOOKS

1. Kumar.T, Leenus Jesu Martin and Murali.G, *"Basic Mechanical Engineering"*, Suma Publications, Chennai, 2007.
2. PrabhuT.J, Jai Ganesh.V and Jebaraj.S, *"Basic Mechanical Engineering"*, Scitech Publications, Chennai, 2000.

REFERENCES

1. Hajra Choudhary.S.K and HajraChoudhary.A.K, "*Elements of Workshop Technology", Vols. I & II*, Indian Book Distributing Company Calcutta, 2007.
2. Nag.P.K, "*Power Plant Engineering"*, Tata McGraw-Hill, New Delhi, 2008.
3. Rattan.S.S, "*Theory of Machines"*, Tata McGraw-Hill, New Delhi, 2010.

ME1001 BASIC MECHANICAL ENGINEERING												
Course Designed by		**Department of Mechanical Engineering**										
1.	Student outcome	a	b	c	d	e	f	g	h	i	j	k
		x				x						
2.	Mapping of instructional objectives with student outcome	1- 3				1- 3						
3.	Category	General (G)		Basic sciences(B)			Engineering sciences and technical art (E)				Professional subjects (P)	
		--		--			x				--	
4.	Approval	23rd Meeting of the Academic Council , May 2013										

EE1001	BASIC ELECTRICAL ENGINEERING	L	T	P	C
	Total Contact Hours - 30	2	0	0	2
	Prerequisite				
	Nil				

PURPOSE

This course provides comprehensive idea about circuit analysis, working principles of machines and common measuring instruments.

INSTRUCTIONAL OBJECTIVES

1.	Understand the basic concepts of magnetic circuits, AC & DC circuits.
2.	Explain the working principle, construction, applications of DC & AC machines and measuring instruments.
3.	Gain knowledge about the fundamentals of wiring and earthling

UNIT I - FUNDAMENTALS OF DC CIRCUITS (6 hours)

Introduction to DC and AC circuits, Active and passive two terminal elements, Ohms law, Voltage-Current relations for resistor, inductor, capacitor , Kirchhoff's laws, Mesh analysis, Nodal analysis, Ideal sources –equivalent resistor, current division, voltage division

UNIT II - MAGNETIC CIRCUITS (6 hours)

Introduction to magnetic circuits-Simple magnetic circuits-Faraday's laws, induced emfs and inductances

UNIT III - AC CIRCUITS (6 hours)

Sinusoids, Generation of AC, Average and RMS values, Form and peak factors, concept of phasor representation, J operator. Analysis of R-L, R-C, R-L-C circuits. Introduction to three phase systems - types of connections, relationship between line and phase values.

UNIT IV - ELECTRICAL MACHINES & MEASURING INSTRUMENTS (6 hours)

Working principle, construction and applications of DC machines and AC machines (1 - phase transformers, single phase induction motors: split phase, capacitor start and capacitor start & run motors). Basic principles and classification of instruments -Moving coil and moving iron instruments.

UNIT V - ELECTRICAL SAFETY, WIRING &INTRODUCTION TO POWER SYSTEM (6 hours)

Safety measures in electrical system- types of wiring- wiring accessories-staircase, fluorescent lamps & corridor wiring- Basic principles of earthing-Types of earthing- Simple layout of generation, transmission & distribution of power.

TEXT BOOK

1. Dash.S.S, Subramani.C, Vijayakumar.K, "*Basic Electrical Engineering*", First edition, Vijay Nicole Imprints Pvt.Ltd,2013

REFERENCES

1. Smarajt Ghosh, "*Fundamentals of Electrical & Electronics Engineering*", Second edition, PHI Learning, 2007.
2. Metha V.K, Rohit Metha, "*Basic Electrical Engineering*", Fifth edition, S.Chand & Co, 2012.
3. Kothari. D. P and Nagrath.IJ, "*Basic Electrical Engineering*", Second edition, Tata McGraw - Hill, 2009
4. Bhattacharya.S.K, "*Basic Electrical and Electronics Engineering"*, First edition, Pearson Education, 2011

EE1001 - BASIC ELECTRICAL ENGINEERING												
Course Designed by		**Department of Electrical and Electronics Engineering**										
1.	Student outcomes	a	b	c	d	e	f	g	h	i	j	k
		x				x						
2.	Mapping of instructional objectives with student outcome	1-3				1						
3.	Category	General(G)		Basic Sciences(B)			Engineering Sciences and Technical Arts(E)				Professional Subjects(P)	
		--		--			x				--	
4.	Approval	23rd Meeting of Academic Council, May 2013										

EC1001	BASIC ELECTRONICS ENGINEERING	L	T	P	C
	Total Contact Hours – 30	2	0	0	2
	Prerequisite				
	Nil				

PURPOSE

This course provides comprehensive idea about working principle, operation and characteristics of electronic devices, transducers, Digital Electronics and Communication Systems.

INSTRUCTIONAL OBJECTIVES

At the end of the course students will be able to gain knowledge about the

1.	Fundamentals of electronic components, devices, transducers
2.	Principles of digital electronics
3.	Principles of various communication systems

UNIT I - ELECTRONIC COMPONENTS (4 hours)

Passive components – resistors, capacitors & inductors (properties, common types, I-V relationship and uses).

UNIT II - SEMICONDUCTOR DEVICES (7 hours)

Semiconductor Devices - Overview of Semiconductors - basic principle, operation and characteristics of PN diode, zener diode, BJT, JFET, optoelectronic devices (LDR, photodiode, phototransistor, solar cell, optocouplers)

UNIT III - TRANSDUCERS (5 hours)

Transducers - Instrumentation – general aspects, classification of transducers, basic requirements of transducers, passive transducers - strain gauge, thermistor, Hall-Effect transducer, LVDT, and active transducers – piezoelectric and thermocouple.

UNIT IV - DIGITAL ELECTRONICS (7 hours)

Number systems – binary codes - logic gates - Boolean algebra, laws & theorems - simplification of Boolean expression - implementation of Boolean expressions using logic gates - standard forms of Boolean expression.

UNIT V - COMMUNICATION SYSTEMS (7 hours)

Block diagram of a basic communication system – frequency spectrum - need for modulation - methods of modulation - principles of AM, FM, pulse analog and pulse digital modulation – AM / FM transmitters & receivers (block diagram description only)

TEXT BOOKS

1. Thyagarajan.T, SendurChelvi.K.P, Rangaswamy.T.R, *"Engineering Basics: Electrical, Electronics and Computer Engineering"*, New Age International, Third Edition, 2007.
2. Somanathan Nair.B, Deepa.S.R, "*Basic Electronics",* I.K. International Pvt. Ltd., 2009.

REFERENCES

1. Thomas L. Floyd, *"Electronic Devices",* Pearson Education, 9th Edition, 2011.
2. Rajput.R.K, *"Basic Electrical and Electronics Engineering"*, Laxmi Publications, First Edition, 2007.

<table>
<tr><th colspan="13">EC1001 BASIC ELECTRONICS ENGINEERING</th></tr>
<tr><td colspan="2">Course Designed by</td><td colspan="11">Department of Electronics and Communication Engineering</td></tr>
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<tr><td>4.</td><td>Approval</td><td colspan="11">23rd Meeting of Academic Council, May 2013</td></tr>
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	ENGINEERING GRAPHICS	L	T	P	C
ME1005	Total Contact Hours - 75	0	1	4	3
	Prerequisite				
	Nil				
	First Angle Projection is to be followed - Practice with Computer Aided Drafting tools				

PURPOSE	
1.	To draw and interpret various projections of 1D, 2D and 3D objects.
2.	To prepare and interpret the drawings of buildings.
INSTRUCTIONAL OBJECTIVES	
1.	To familiarize with the construction of geometrical figures
2.	To familiarize with the projection of 1D, 2D and 3D elements
3.	To familiarize with the sectioning of solids and development of surfaces
4.	To familiarize with the Preparation and interpretation of building drawing

UNIT I - FUNDAMENTALS OF ENGINEERING GRAPHICS (2 hours)

Lettering – Two dimensional geometrical constructions – Conics – Representation of three-dimensional objects – Principles of projections – Standard codes – Projection of points.

UNIT II - PROJECTION OF LINES AND SOLIDS (4 hours)

Projection of straight lines – Projection of planes - Projection of solids – Auxiliary projections.

UNIT III - SECTIONS AND DEVELOPMENTS (3 hours)

Sections of solids and development of surfaces.

UNIT IV - PICTORIAL PROJECTIONS (4 hours)

Conversion of Projections: Orthographic projection – Isometric projection of regular solids and combination of solids.

UNIT V - BUILDING DRAWING (2 hours)

Plan, Elevation and section of single storied residential (or) office building with flat RCC roof and brick masonry walls having not more than 3 rooms (planning / designing is not expected in this course) with electrical wiring diagram.

PRACTICAL (60 hours)

TEXT BOOKS

1. Venugopal.K and Prabhu Raja.V, "*Engineering Graphics"*, Eighth Edition (Revised), New Age International Publishers, Chennai, 2007.
2. Natarajan.K.V, "*A Text Book of Engineering Graphics"*, 21st Edition, Dhanalakshmi Publishers, Chennai, 2012.
3. Jeyapoovan.T, "*Engineering Drawing and Graphics using AutoCAD"*, Vikas Publishing House Pvt. Ltd., New Delhi, 2010.

REFERENCES

1. Bethune.J.D, "*Engineering Graphics with AutoCAD 2013*", PHI Learning Private Limited, Delhi, 2013.
2. Bhatt.N.D, "*Elementary Engineering Drawing (First Angle Projection)"*, Charotar Publishing Co., Anand, 1999.
3. Narayanan.K.L and Kannaiah.P, "*Engineering Graphics"*, Scitech Publications, Chennai, 1999.
4. Shah.M.B and Rana.B.C, "*Engineering Drawing"*, Pearson Education (Singapore) Pvt. Ltd., New Delhi, 2005.

ME1005 ENGINEERING GRAPHICS												
Course Designed by		**Department of Mechanical Engineering**										
1.	Student outcome	a	b	c	d	e	f	g	h	i	j	k
			x	x				x				
2.	Mapping of instructional objectives with student outcome		1-4	1-4				1-4				
3.	Category	General(G)		Basic sciences(B)			Engineering sciences and technical art (E)				Professional subjects (P)	
		--		--			x				--	
4.	Approval	23rd meeting of the Academic Council , May 2013										

ME1004	WORKSHOP PRACTICE	L	T	P	C
	Total contact hours - 45	0	0	3	2
	Prerequisite				
	Nil				

PURPOSE

To provide the students with hands on experience on different trades of engineering like fitting, carpentry, smithy, welding and sheet metal.

INSTRUCTIONAL OBJECTIVES

1.	To familiarize with the basics of tools and equipments used in fitting, carpentry, sheet metal, welding and smithy
2.	To familiarize with the production of simple models in the above trades.

UNIT I - FITTING **(9 hours)**

Tools & Equipments – Practice in filing.
Making Vee Joints, Square, Dovetail joints and Key making - plumbing.
Mini project – Assembly of simple I.C. engines.

UNIT II - CARPENTRY **(9 hours)**

Tools and Equipments- Planning practice.
Making Half Lap, Dovetail, Mortise &Tenon joints.
Mini project - model of a single door window frame.

UNIT III - SHEET METAL **(9 hours)**

Tools and equipments– practice.
Making rectangular tray, hopper, scoop, etc.
Mini project - Fabrication of a small cabinet, dust bin, etc.

UNIT IV - WELDING **(9 hours)**

Tools and equipments -
Arc welding of butt joint, Lap joint, Tee fillet.
Demonstration of gas welding, TIG & MIG welding.

UNIT V - SMITHY **(9 hours)**

Tools and Equipments –
Making simple parts like hexagonal headed bolt, chisel.

TEXT BOOK

1. Gopal.T.V, Kumar.T and Murali.G, "*A first course on workshop practice – Theory, Practice and Work Book"*, Suma Publications, Chennai, 2005.

REFERENCES

1. Kannaiah.P and Narayanan.K.C, "*Manual on Workshop Practice"*, Scitech Publications, Chennai, 1999.
2. Venkatachalapathy.V.S, "*First year Engineering Workshop Practice"*, Ramalinga Publications, Madurai, 1999.
3. Laboratory Manual.

ME1004 - WORKSHOP PRACTICE												
Course Designed by		**Department of Mechanical Engineering**										
1.	Student outcome	a	B	c	d	e	f	g	h	i	j	k
			×	×				×				
2.	Mapping of instructional objectives with student outcome		1, 2	1, 2				1, 2				
3.	Category	General (G)		Basic Sciences(B)			Engineering Sciences and Technical Art(E)			Professional Subjects (P)		
							x					
4.	Approval	23rd meeting of the Academic Council , May 2013										

NC1001/ NS1001/ SP1001/ YG1001	**NATIONAL CADET CORPS (NCC)/ NATIONAL SERVICE SCHEME (NSS)/ NATIONAL SPORTS ORGANIZATION (NSO) / YOGA**	**L**	**T**	**P**	**C**
	Total Contact Hours – 15 (minimum, but may vary depending on the course)	**0**	**0**	**1**	**1**
	Prerequisite				
	Nil				

PURPOSE

To imbibe in the minds of students the concepts and benefits of NCC/NSS/NSO/YOGA and make them practice the same

INSTRUCTIONAL OBJECTIVES

1.	To enable the students to gain knowledge about NCC/NSS/NSO/YOGA and put the same into practice

NATIONAL CADET CORPS (NCC)

Any student enrolling as a member of National Cadet Core (NCC) will have to attend sixteen parades out of twenty parades each of four periods over a span of academic year.

Attending eight parades in first semester will qualify a student to earn the credits specified in the curriculum. Grading shall be done based on punctuality, regularity in attending the parades and the extent of active involvement.

NATIONAL SERVICE SCHEME (NSS)

A student enrolling as member of NSS will have to complete 60 hours of training / social service to be eligible to earn the credits specified in the curriculum.

Grading shall be done by the faculty member handling the course based on punctuality, regularity in attending the classes and the extent of active involvement.

NATIONAL SPORTS ORGANIZATION (NSO)

Each student must select one of the following games/sports events and practice for one hour per week. An attendance of 75% is compulsory to earn the credits specified in the curriculum. Grading shall be done by the faculty member handling the course based on punctuality, regularity in attending the classes and the extent of active involvement.

List of games/sports:

Basket Ball, Football, Volley Ball, Ball Badminton, Cricket, Throw-ball, Track events

Field events or any other game with the approval of faculty member.

YOGA

Benefits of Agnai Meditation -Meditation - Agnai, Asanas, Kiriyas, Bandas, Muthras

Benefits of santhi Meditation - Meditation Santhi Physical Exercises (I & II)

Lecture & Practice - Kayakalpa Yoga Asanas, Kiriyas, Bandas, Muthras

Analysis of Thought - Meditation Santhi Physical Exercises III & IV

Benefits of Thuriyam - Meditation Thuriyam Kayakalpa Asanas, Kiriyas, Bandas, Muthras

Attitude - Meditation Thuriyam Kayakalpa Asanas, Kiriyas, Bandas, Muthras

Importance of Arutkappy & Blessings - Meditation Thuriyam Kayakalpa Asanas, Kiriyas, Bandas, Muthras

Benefits of Blessings - Meditation Santhi Kayakalpa Asanas, Kiriyas, Bandas, Muthras

Assessment

An attendance of 75% is compulsory to earn the credits specified in the curriculum. Grading shall be done by the faculty member handling the course based on punctuality, regularity in attending the classes and the extent of active involvement.

REFERENCES

1. Yogiraj Vethathiri Maharishi, "*Yoga for Modern Age*", Vethathiri Publishers, 1989
2. Vethathiri Maharishi.T, "*Simplified Physical Exercises*", Vethathiri Publishers, 1987.

NC1001/ NS1001/ SP1001/ YG1001		**NATIONAL CADET CORPS (NCC)/ NATIONAL SERVICE SCHEME (NSS)/ NATIONAL SPORTS ORGANIZATION (NSO)/YOGA**										
Course Designed by		**NCC/ NSS/ NSO/YOGA UNITS**										
1.	Student outcome	a	b	C	d	e	f	g	h	i	j	k
2.	Mapping of instructional objectives with student outcome				X					X		
3.	Category	General (G)		Basic Sciences (B)		Engineering Sciences and Technical Arts (E)				Professional Subjects(P)		
		X										
4.	Approval	23rd Meeting of Academic Council, May 2013										

SEMESTER- III

LE1003	**GERMAN LANGUAGE PHASE I**	**L**	**T**	**P**	**C**
	Total Contact Hours – 30	**2**	**0**	**0**	**2**
	Prerequisite				
	Nil				

PURPOSE

Germany offers infinite opportunities for students of engineering for higher studies, research and employment in Germany. B.Tech Students are offered German Language during their second year. Knowledge of the language will be helpful for the students to adjust themselves when they go for higher studies.

INSTRUCTIONAL OBJECTIVES

1.	To introduce the language, phonetics and the special characters in German language
2.	To introduce German culture & traditions to the students.
3.	By the end of Phase – I, the students will be able to introduce themselves and initiate a conversation.
4.	We endeavor to develop the ability among the students to read and understand small texts written in German
5.	To enable the students to elementary conversational skills.

UNIT I (**6 hours)**

Wichtige Sprachhandlungen: Phonetics – Sich begrüßen - Sich und andere vorstellen formell / informell - Zahlen von 1 bis 1 Milliarde - verstehen & sprechen **Grammatik:** regelmäßige Verben im Präsens - "sein" und haben im Präsens - Personalpronomen im Nominativ

UNIT II **(6 hours)**

Wichtige Sprachhandlungen Telefon Nummern verstehen und sprechen Uhrzeiten verstehen und sagen Verneinung "nicht und kein" (formell und informell) **Grammatik** : Wortstellung – Aussagesatz – W-Frage und Satzfrage (Ja/Nein Frage) Nomen buchstabieren und notieren bestimmter und unbestimmter Artikel und Negativartikel im Nom. & Akkusativ

UNIT III **(6 hours)**

Wichtige Sprachhandlungen Tageszeiten verstehen und über Termine sprechen -Verabredungen verstehen - Aufgaben im Haushalt verstehen **Grammatik** Personalpronomen im Akkusativ und Dativ - W-Fragen "wie, wer, wohin,wo, was usw.- Genitiv bei Personennamen - Modalverben im Präsens "können, müssen, möchten"

UNIT IV **(6 hours)**

Wichtige Sprachhandlungen Sich austauschen, was man kann, muss – Bezeichnungen Lebensmittel – Mengenangaben verstehen – Preise verstehen und Einkaufzettel schreiben

Grammatik Wortstellung in Sätzen mit Modalverben – Konnektor "und" – "noch"-kein-------mehr – "wie viel, wie viele, wie alt, wie lange" –Possessivartikel im Nominativ.

UNIT V **(6 hours)**

Wichtige Sprachhandlungen Freizeitanzeigen verstehen – Hobbys und Sportarten Anzeigen für Freizeitpartner schreiben bzw. darauf antworten – Vorlieben und Abneigungen ausdrucken

Grammatik Verben mit Vokalwechsel im Präsens – Modalverben im Präsens dürfen, wollen und mögen- "haben und sein" im Präteritum – regelmäßige Verben im Perfekt – Konnektoren "denn, oder, aber

TEXT BOOK

1. Studio d A1. Deutsch als Fremdsprache with CD.(Kursbuch und Sprach training).

REFERENCES

1. German for Dummies
2. Schulz Griesbach

LE1003 GERMAN LANGUAGE PHASE I												
Course Designed by		**Department of English and Foreign Languages**										
1.	Student outcome	a	b	c	d	e	f	g	h	i	j	k
								x				
2.	Mapping of instructional objectives with student outcome							1-5				
3.	Category	General (G)		Basic Sciences (B)			Engineering Sciences and Technical Arts (E)			Professional Subjects (P)		
		x		--			--			--		
4.	Approval	23rd Meeting of Academic Council, May 2013										

LE1004	FRENCH LANGUAGE PHASE I	L	T	P	C
	Total Contact Hours - 30	2	0	0	2
	Prerequisite				
	Nil				

PURPOSE

To enable the student learners acquire a basic knowledge of the French language and concepts of general French for everyday interactions and technical French at the beginner's level and also to get to know the culture of France.

INSTRUCTIONAL OBJECTIVES

1.	To enable students improve their grammatical competence.
2.	To enhance their listening skills.
3	To assist students in reading and speaking the language.
4.	To enhance their lexical and technical competence.
5.	To help the students introduce themselves and focus on their communication skills.

UNIT I **(6 hours)**

1. Grammar and Vocabulary: Usage of the French verb "se presenter", a verb of self- introduction and how to greet a person- "saluer"
2. Listening and Speaking – The authentic sounds of the letters of the French alphabet and the accents that play a vital role in the pronunciation of the words.
3. Writing – correct spellings of French scientific and technical vocabulary.
4. Reading -- Reading of the text and comprehension – answering questions.

UNIT II **(6 hours)**

1. Grammar and Vocabulary – Definite articles , "prepositions de lieu" subject pron ouns
2. Listening and Speaking – pronunciation of words like Isabelle, presentez and la liaison – vous etes, vous appelez and role play of introducing each other – group activity
3. Writing – particulars in filling an enrollment / registration form
4. Reading Comprehension – reading a text of a famous scientist and answering questions.

UNIT III **(6 hours)**

1. Grammar and Vocabulary – verb of possession "avoir' and 1st group verbs "er", possessive adjectives and pronouns of insistence- moi, lui..and numbers from 0 to 20
2. Listening and Speaking –nasal sounds of the words like feminine, ceinture , parfum and how to ask simple questions on one's name, age, nationality, address mail id and telephone number.
3. Writing –conjugations of first group verbs and paragraph writing on self – introduction and introducing a third person.
4. Reading Comprehension – reading a text that speaks of one's profile and answering questions

UNIT IV **(6 hours)**

1. Grammar and Vocabulary –negative sentences, numbers from 20 to 69, verb "aimer"and seasons of the year and leisure activities.
2. Listening and Speaking – To express one's likes and dislikes and to talk of one's pastime activities (sports activities), je fais du ping-pong and nasal sounds of words – janvier, champagne
3. Writing- conjugations of the irregular verbs – faire and savoir and their usage. Paragraph writing on one's leisure activity- (passé temps favori)
4. Reading- a text on seasons and leisure activities – answering questions.

UNIT V **(6 hours)**

1. Grammar and Vocabulary – les verbes de direction- to ask one's way and to give directions, verbes- pouvoir and vouloir and 2nd group verbs , a droite, la premiere a gauche and vocabulary relating to accommodation.
2. Listening and Speaking – to read and understand the metro map and hence to give one directions – dialogue between two people.
3. Writing –paragraph writing describing the accommodation using the different prepositions like en face de, derriere- to locate .
4. Reading Comprehension -- a text / a dialogue between two on location and directions- ou est la poste/ la pharmacie, la bibliotheque?.....

TEXT BOOK

1. Tech French

REFERENCES

1. French for Dummies.
2. French made easy-Goyal publishers
3. Panorama

LE1004 FRENCH LANGUAGE PHASE I												
Course Designed by		**Department of English and Foreign Languages**										
1.	Student outcome	a	b	c	d	e	f	g	h	i	j	k
								x				
2.	Mapping of instructional objectives with student outcome							1-5				
3.	Category	General (G)	Basic Sciences (B)			Engineering Sciences and Technical Arts (E)				Professional Subjects (P)		
		x	--			--				--		
4.	Approval	23rd Meeting of Academic Council, May 2013										

LE 1005	JAPANESE LANGUAGE PHASE I	L	T	P	C
	Total Contact Hours- 30	2	0	0	2
	Prerequisite				
	Nil				

PURPOSE

To enable students achieve a basic exposure on Japan, Japanese language and culture. To acquire basic conversational skill in the language.

INSTRUCTIONAL OBJECTIVES

1.	To help students learn the Japanese scripts viz. hiragana and a few basic kanji.
2.	To make the students acquire basic conversational skill.
3.	To enable students to know about Japan and Japanese culture.
4.	To create an advantageous situation for the students to have better opportunity for employability by companies who have association with Japan.

UNIT I **(8 hours)**

1. Introduction to Japanese language. Hiragana Chart 1 - vowels and consonants and related vocabulary.
2. Self introduction
3. Grammar – usage of particles wa, no, mo and ka and exercises
4. Numbers (1-100)
5. Kanji – introduction and basic kanjis – naka, ue, shita, kawa and yama
6. Greetings, seasons, days of the week and months of the year
7. Conversation – audio
8. Japan – Land and culture

UNIT II **(8 hours)**

1. Hiragana Chart 1 (contd.) and related vocabulary
2. Grammar – usage of kore, sore, are, kono, sono, ano, arimasu and imasu. Particles – ni (location) and ga. Donata and dare.
3. Numbers (up to 99,999)
4. Kanji – numbers (1-10, 100, 1000, 10,000 and yen)
5. Family relationships and colours.
6. Conversation – audio
7. Festivals of Japan

UNIT III **(5 hours)**

1. Hiragana Charts 2&3, double consonants, vowel elongation and related vocabulary
2. Lesson 3
3. Grammar - particles ni (time), kara, made and ne. Koko, soko, asoko and doko.
4. Time expressions (today, tomorrow, yesterday, day before, day after)
5. Kanji – person, man, woman, child, tree and book
6. Directions – north, south, east and west

UNIT IV **(5 hours)**

1. Grammar - directions,-kochira, sochira, achira and dochira. Associated vocabulary (mae, ushiro, ue, shita, tonari, soba, etc.)
2. Conversation – audio
3. Japanese art and culture like ikebana, origami, etc.

UNIT V **(4 hours)**

1. Kanji – hidari, migi, kuchi
2. Japanese sports and martial arts

TEXT BOOK

1. First lessons in Japanese, ALC Japan

REFERENCES

1. Japanese for dummies. Wiley publishing co. Inc., USA.
2. Kana workbook, Japan foundation

LE1005 JAPANESE LANGUAGE PHASE I												
Course Designed by		**Department of English and Foreign Languages**										
1.	Student outcome	a	b	c	d	e	f	G	h	i	j	k
								X				
2.	Mapping of instructional objectives with student outcome							1- 4				
3.	Category	General (G)		Basic Sciences (B)		Engineering Sciences and Technical Arts (E)				Professional Subjects (P)		
		x		--		--				--		
4.	Approval	23rd Meeting of Academic Council, May 2013										

LE1006	KOREAN LANGUAGE PHASE I	L	T	P	C
	Total Contact Hours-30	**2**	**0**	**0**	**2**
	Prerequisite				
	Nil				

PURPOSE

To enable students achieve a basic exposure on Korea, Korean language and culture. To acquire basic conversational skill in the language.

INSTRUCTIONAL OBJECTIVES

1.	To help students learn the scripts.
2.	To make the students acquire basic conversational skill.
3	To enable students to know about Korean culture.
4.	To create an advantageous situation for the students to have better opportunity for employability by companies who have association with Korea.

UNIT I **(6 hours)**

Lesson 1 < Introduction to Korean Language >, Lesson2 < Consonants and Vowels >, <Basic Conversation, Vocabularies and Listening >

UNIT II **(10 hours)**

Lesson 3 < Usage of "To be" >, Lesson 4 < Informal form of "to be" >, Lesson 5 <Informal interrogative form of "to be" >, Lesson 6 < To be, to have, to stay >, < Basic Conversation, Vocabularies and Listening >

UNIT III (**10 hours)**

Lesson 7 < Interrogative practice and Negation >, < Basic Conversation, Vocabularies and Listening >

UNIT IV **(4 hours)**

Lesson 8 < Korean Culture and Business Etiquette >, < Basic Conversation, Vocabularies and Listening

TEXT BOOK

1. Korean through English 1 (Basic Korean Grammar and Conversation).

REFERENCES

1. Bharati Korean (Intermediate Korean Grammar).
2. Hand-outs.
3. Various visual mediums such Movie CD, Audio CD.
4. Collection of vocabularies for engineering field.

LE1006 KOREAN LANGUAGE PHASE I												
Course Designed by		**Department of English and Foreign Languages**										
1.	Student outcome	a	b	c	d	e	f	g	h	i	j	k
								x				
2.	Mapping of instructional objectives with student outcome							1-4				
3.	Category	General (G)		Basic Sciences (B)		Engineering Sciences and Technical Arts (E)				Professional Subjects (P)		
		x		--		--				--		
4.	Approval	23rd Meeting of Academic Council, May 2013										

LE1007	**CHINESE LANGUAGE PHASE I**	**L**	**T**	**P**	**C**
	Total contact hours- 30	**2**	**0**	**0**	**2**
	Prerequisite				
	Nil				

PURPOSE

To enable students achieve a basic exposure on China, Chinese language and culture. To acquire basic conversational skill in the language.

INSTRUCTIONAL OBJECTIVES	
1.	To help students learn the Chinese scripts.
2.	To make the students acquire basic conversational skill.
3	To enable students to know about China and Chinese culture.
4.	To create an advantageous situation for the students to have better opportunity for employability by companies who have association with china.

UNIT I

Introduction of Chinese Language

UNIT II

Phonetics and Notes on pronunciation

a) 21 Initials:

b p m f d t n l g k h j q x z c s zh ch sh r

b) 37 Finals:

a	o	e	i	u	ü
ai	ou	ei	ia	ua	üe
an	ong	en	ian	uai	üan
ang		eng	iang	uan	ün
ao		er	iao	uang	
		ie	uei(ui)		
		in	uen(un)		
		ing	ueng		
		iong	uo		
		iou(iu)			

c) The combination of Initials and Finals - Pinyin

UNIT III

Introduction of Syllables and tones

a) syllable=initial+final+tone

b) There are four tones in Chinese: the high-and-level tone, the rising tone, the falling-and-rising tone, and the falling tone. And the markers of the different tones.

UNIT IV

a) **Tones practice**

b) **The Strokes of Characters**

1. Introduction of Chinese Characters
2. The eight basic strokes of characters

UNIT V

1. **Learn to read and write the Characters:**
   八(eight) 不(not) 马(horse) 米(rice) 木(wood).
2. **classes are organized according to several Mini-dialogues.**

TEXT BOOK

1. A New Chinese Course 1- Beijing Language and Culture University Press.

REFERENCES

1. New Practical Chinese Reader Textbook (1) – Beijing Language and Culture University Press.
2. 40 Lessons For Basic Chinese Course I – Shanghai Translation Press.
3. My Chinese Classroom - East China Normal University Press.

LE1007 CHINESE LANGUAGE PHASE I												
Course Designed by		**Department of English and Foreign Languages**										
1.	Student outcome	a	b	c	d	e	f	g	h	i	j	k
								x				
2.	Mapping of instructional objectives with student outcome							1 - 4				
3.	Category	General (G)		Basic Sciences (B)		Engineering Sciences and Technical Arts (E)				Professional Subjects (P)		
		x		--		--				--		
4.	Approval	23rd Meeting of Academic Council, May 2013										

PD1003	**APTITUDE-I**	**L**	**T**	**P**	**C**
	Total Contact Hours - 30	**1**	**0**	**1**	**1**
	Prerequisite				
	Nil				
PURPOSE					
To enhance holistic development of students and improve their employability skills.					
INSTRUCTIONAL OBJECTIVES					
1.	To improve aptitude, problem solving skills and reasoning ability of the student.				
2.	To collectively solve problems in teams & group.				

UNIT I - NUMBERS **(6 hours)**

Types and Properties of Numbers, LCM, GCD, Fractions and decimals, Surds

UNIT II - ARITHMETIC – I **(6 hours)**

Percentages, Profit & Loss, Simple Interest & Compound Interest, , Clocks & calendars

UNIT III - ALGEBRA – I **(6 hours)**

Logarithms, Problems on ages

UNIT IV - MODERN MATHEMATICS - I **(6 hours)**

Permutations, Combinations, Probability

UNIT V - REASONING **(6 hours)**

Logical Reasoning, Analytical Reasoning

ASSESSMENT

1. Objective type – Paper based / Online – Time based test

REFERENCE

1. Agarwal.R.S, *"Quantitative Aptitude for Competitive Examinations",* S.Chand Limited 2011
2. Abhijit Guha*, "Quantitative Aptitude for Competitive Examinations",* Tata McGraw Hill, 3rd Edition*,* 2011
3. Edgar Thrope, *"Test Of Reasoning for Competitive Examinations",* Tata McGraw Hill, 4th Edition, 2012
4. *"Other material related to quantitative aptitude"*

PD1003 – APTITUDE-I												
Course Designed by		**Career Development centre**										
1.	Student outcome	a	b	c	d	e	f	g	h	i	j	k
		x			x							
2.	Mapping of instructional objectives with Student outcome	1			2							
3.	Category	General(G)		Basic Sciences(B)		Engineering Sciences and Technical Arts(E)				Professional Subjects(P)		
		x										
4.	Approval	23rd Meeting of Academic Council, May 2013										

	CHEMICAL AND BIOCHEMICAL PROCESS CALCULATION	L	T	P	C
CH1051	Total No. of Contact Hours - 45	**3**	**0**	**0**	**3**
	Prerequisite				
	Nil				

PURPOSE

This course prepares the students to formulate and solve material and energy balances on chemical and biochemical process systems.

INSTRUCTIONAL OBJECTIVES

To familiarize

1. Basic principles of process calculations
2. Material and Energy balance calculations
3. Biochemical calculations

UNIT I - INTRODUCTION (9 hours)

Units and dimensions: the mole unit- mole fraction (or percent) and mass fraction (or percent)- analyses of a mixture- concentrations- **Basis of calculations:** predicting P-V-T properties of gases using the following equations of state: ideal gas law- Van der Waals equation- Redlich-Kwong equation- calculation of density.

UNIT II - CHEMICAL EQUATION AND MATERIAL BALANCES (9 hours)

Basics of chemical equation and stoichiometry: limiting reactant- excess reactant- conversion- selectivity- yield. **Basic concepts involved in material balance calculations**: material balance problems without chemical reactions: membrane separation- mixing- drying- crystallization. Basic concepts of recycle-bypass and purge streams.

UNIT III - COMBUSTION, PARTIAL SATURATION AND HUMIDITY (9 hours)

Introduction to combustion: flue gas- Orsat analysis- theoretical air- excess air- determination of products of combustion of solid- liquid and gaseous fuels- calculation of excess air. **Humidity calculations:** Saturated gas- partial saturation- dew point- molal humidity- humidity- saturation molal humidity- saturation humidity- percentage humidity- relative humidity. Material balances involved in the following processes: dehydration- humidification- condensation

UNIT IV - ENERGY BALANCES (9 hours)

Thermodynamics: Heat capacity of gases- empirical equations for heat capacities- mean heat capacities of gases- Kopp's rule- latent heats- calculation of enthalpy from thermophysical properties.-**Thermochemistry:** Standard heat of reaction- heat of formation- law of Hess- standard heat of combustion- heats of formation calculated from heats of combustion- calculation of the standard heat of reaction from heats of formation or combustion- effect of temperature on heat of reaction- enthalpy changes in reactions with different temperatures- calculation of theoretical flame temperature.

UNIT V - MATERIAL & ELEMENTAL BALANCES FOR BIOCHEMICAL PROCESSES (9 hours)

Growth of stoichiometry and elemental balances: Energy balance for continuous ethanol fermentation- Mass balance for production of penicillin -**Conservation of mass principle:** Acetic acid fermentation process -Xanthan gum production- Stoichiometric coefficient for cell growth -Embden–Meyerhoff–Parnas pathway.

TEXT BOOKS

1. David M. Himmelblau, "*Basic Principles and Calculations in Chemical Engineering*", 6th Edn., Prentice-Hall of India, New Delhi, 1998.
2. Hougen.O.A, Watsen.K.M and Ragartz. R.A, "*Chemical Process Principles*", Part-I, John Wiley and Asia Publishing Co., 1976.

REFERENCES

1. Najafpour.G.D, "*Biochemical Engineering and Biotechnology*", Elsevier, 2007.
2. Richard M. Felder, Ronald W. Rousseau, "*Elementary Principles of Chemical Processes*", 3rd Edition by John Wiley & Sons, Inc. Singapore, 2000.
3. Bhatt.B.I and Vora.S.M, "*Stoichiometry*", 3rd Edn., Tata McGraw-Hill Publishing Company, New Delhi, 1996.

CH1051 CHEMICAL AND BIOCHEMICAL PROCESS CALCULATION												
Course Designed by		Department of Chemical Engineering										
1.	Student outcomes	a	b	c	d	e	f	g	h	i	j	k
		x			x	x						
2.	Mapping of instructional objectives with student outcomes	1			3	2						
3.	Category	General(G)		Basic Sciences (B)			Engg. Sci. & Tech. Arts (E)			Professional Subjects (P)		
							x					
4.	Approval	23rd Meeting of Academic Council, May 2013										

BT1006	LAB SAFETY AND ANALYTICAL TECHNIQUES	L	T	P	C
	Total No. of Contact Hours – 30	2	0	0	2
	Prerequisite				
	Nil				

PURPOSE

The purpose of this course is to provide an understanding of fundamental concepts and underlying principles in the instruments used in biotechnology. In addition, the course is expected to develop the analytical skill to enable them to interpret the experimental data.

INSTRUCTIONAL OBJECTIVES

1.	To provide the basic knowledge in the safety aspects and ethics
2.	To impart sufficient scientific understanding of the basic concepts in instrumentation used in Biotechnology.
3.	To provide experience in various bioanalytical techniques.
4.	To apply the concepts in the interpretation of the data.

UNIT I - LABORATORY SAFETY (3 hours)

General rules - personal precautions – lab safety- good laboratory practices-lab maintenance. Apparatus, Materials and reagents, test systems, test and REFERENCE substances and standard operating procedures.

UNIT II - BIOSAFETY AND ETHICS IN THE LABORATORY (5 hours)

Biosafety levels-containment levels-risk assessment – guidelines - Regulations specific o the biotechnology labs- Hazardous materials used in biotechnology-disposal of chemical and hazardous chemicals- controlling the exposure of hazardous chemicals-biological agents –handling and disposal-ethical issues.

UNIT III - BASIC INSTRUMENTS (5 hours)

Theory, instrumentation and applications of pH meter, colorimetry and calorimetry.Electrophoresis- General principles- electrophoresis, PCR Machines-handling and maintenance.

UNIT IV - MICROSCOPY & SPECTROSCOPY (9 hours)

Principle, working and applications of Microscopy- Dark-field, Phase contrast, Fluorescence, Confocal, Polarization microscopy; Electron microscopy: TEM & SEM.

Spectroscopy techniques-Measurement of transmittance and absorbance – Beer and Lambert's law – spectrophotometer analysis – qualitative and quantitative absorption measurements - General Principles, instrumentation, applications of spectrometers – UV – visible, fluorescence, Infrared Spectroscopy- Atomic absorption and Mass spectrometry.

UNIT V - CHROMATOGRAPHY (8 hours)

Chromatographic methods- General principles, instrumentation, applications, classification of chromatographic techniques - Ion exchange, Gel filtration, Affinity, Gas chromatography techniques and High Performance Liquid Chromatography (HPLC).

TEXT BOOKS

1. Weinberg.S, "*Good Laboratory Practice Regulation*" Drugs and Pharm. Sci. Series,Vol. 124, 2nd Ed., Maracel Dekker Inc., N.Y.
2. Willard.H.H, Merrit.L.L, Dean.J.A, Settle.P.A, "*Instrumental Methods of Analysis*", Van Nostrand, C B S Publishers &Distributors (1986).
3. Skoog.D.A, Heller.F.J, Nieman.T.A, "*Principles of Instrumental Analysis*", WB Saunders

REFERENCES

1. Sharma.P. P, "*How to practice GLP*" Vandana Publication.
2. Day.R.A and Underwood.A.L, "*Quantitative Analysis*", 6th ed., Prentice Hall of India Pvt. Ltd,(1993).
3. Hunson.J.W, "*Pharmaceutical Analysis*", Modern Methods, part A & B, Marcel Dekker.
4. Schirmer.R.E, "*Modern Methods of Pharmaceutical Analysis*", Vols 1, 2. Boca Raton F.L., CRC Press.
5. Mann.C.K, et al., "*Instrumental Analysis* "Harper & Row.
6. Eving.G.W, "*Instrumental Methods of Chemical Analysis"*, 5th ed., Mc-Graw Hill Book Company (1985)
7. Silverstein, "*Spectrometric identification of Organic Compounds"*, 6th Ed., John Wiley& Sons, Inc., 1996.
8. Vogel.A.I, "*Textbook of Quantitative Chemical Analysis"*, 5th ed., Addison Wesley Longman Singapore (1999).

BT1006 LAB SAFETY AND ANALYTICAL TECHNIQUES												
Course Designed by		Department of Biotechnology										
1.	Student outcomes	a	b	c	d	e	f	g	h	i	j	k
		x	x	x	x							x
2.	Mapping of instructional objectives with student outcomes		1	2	3							4
3.	Category	General (G)		Basic Sciences B)		Engg. Sci. & Tech. Arts (E)		Professional Subjects (P)				
								x				
4.	Broad Area	Biotechnology		Bioprocess		Chemical Engineering						
		x		--		--		--				
5.	Approval	23rd Meeting of Academic Council, May 2013										

BT1008	MICROBIOLOGY	L	T	P	C
	Total No. of Contact Hours – 45	3	0	0	3
	Prerequisite				
	Nil				

PURPOSE

Introducing the fundamentals of microbiology through the study of the characteristics of microorganisms, multiplication, growth in different media and various metabolic pathways. Knowledge of these principles will enable students to understand how they react under different conditions and how they cause different diseases and their control

INSTRUCTIONAL OBJECTIVES

1.	To highlight the roles and characteristics of microorganisms
2.	To study in detail the growth of microorganisms and impact of environment on their growth
3.	To evaluate explicitly, the metabolic pathways, role of microbes in public health; insight into the physical and chemical control of microorganisms

UNIT I - INTRODUCTION TO MICROBIOLOGY (9 hours)

Basic of microbial existence: History of Microbiology, classification, and nomenclature of microorganisms. **Microscopy**: Light and Electron microscopy. **Microscopic examination of microorganisms-morphology and fine structure of bacteria**

UNIT II - MICROBIAL NUTRITION, GROWTH AND METABOLISM (9 hours)

Nutritional requirements of bacteria: Growth curve and Different methods to quantitative bacterial growth.**Aerobic and anaerobic bioenergetics**- utilization of energy. **Biosynthesis of important molecules**

UNIT III - MICROBIAL PHYSIOLOGY AND GENETICS (9 hours)

Fungi-Importance, characteristics, morphology, reproduction, physiology cultivation,and Classification of fungi.**Molds and repair association with other organisms**.**Bacteriophages**- General characteristics, Morphology and structure.**Classification and Nomenclature**-Bacteriophages of *E.coli.***Replication-** Viruses of plants, animals,Structure, and Replication

UNIT IV - MICROBIAL INFECTIONS, TRANSMISSION, AND THEIR MODE OF ACTION (9 hours)

Sources of infection: Portals of entry and Exit of microbes. **Epidemiological terminologies-Infectious diseases caused by Vibrio cholerae, Basidiomycetes, and Sexually transmitted diseases- AIDS.Antimicrobial agents**: **Antibiotics-** Penicillins and Cephalosporins.**Broad spectrum antibiotics:** Antibiotics from Prokaryotes. **Antibacterial, Antifungal, and Antiviral agents- Mode of action. Lantibiotics**

UNIT V - APPLIED MICROBIOLOGY (9 hours)

Microbial metabolites: Microbial applications in agricultural, biotechnological, pharmaceutical, and environmental applications. **Physical, chemical, and biological control of microorganisms**. **Host-microbe interactions such** as plant-microbe interaction& animal-microbe interaction

TEXT BOOKS

1. Pelczar *et al*., *"Microbiology"*, 7th ed., Mc Graw Hill, 2011.
2. Madigan *et al*., *"Brock Biology of microorganisms",* 12th ed., Prentice Hall, 2008.
3. Davis *et al., "Microbiology",* 6th ed., Lippincott Williams and Wilkins, 2010.
4. Joklik *et al*., *"Zinsser's Microbiology",* 11th ed., Mc Graw-Hill Professional, 2010.
5. Stainer Ry *et al*., *"General Microbiology",* 5th ed., Prentice Hall 1986.

REFERENCES

1. Prescott *et al*., *"Microbiology",* 11th ed., Mc Graw Hill, 2011.
2. Brooks *et al*., "*Medical Microbiology",* 26th ed., Lange Med. 2012.

BT1008 MICROBIOLOGY												
Course Designed by		Department of Biotechnology										
1.	Student outcomes	a	b	c	d	e	F	g	h	i	j	K
		x		x					x			
2.	Mapping of instructional objectives with student outcomes	1		2					3			
3.	Category	General (G)		Basic Sciences(B)			Engg. Sci. & Tech. Arts (E)			Professional Subjects (P)		
										x		
4.	Broad Area	Biotechnology					Bioprocess Engineering			Chemical Engineering		
		x					--			--		
5.	Approval	23rd Meeting of Academic Council, May 2013										

BT1010	IMMUNOLOGY	L	T	P	C
	Total No. of Contact Hours - 45	3	0	0	3
	Prerequisite				
	Nil				

PURPOSE

Aimed at introducing the science of immunology and a detailed study of various types of immune systems and their classification, structure, and mechanism of immune activation.

INSTRUCTIONAL OBJECTIVES

To familiarize students with

1.	The immune system ,their structure and classification, genetic control of antibody production, cellular immunology, mechanism of activation in hypersensitive immune reaction
2.	The role of the immune molecules in infectious diseases, autoimmunity, and cancer will be discussed

UNIT I - OVERVIEW OF THE IMMUNE SYSTEM (10 hours)

Introduction: overview of the immune system-Lymphatic system, Lymphoid organs, Cells of the immune system and their functions-Immune system. **Innate and Acquired immunity**: Cells and processes of Innate immunity—Cells and organs of the Acquired immunity**-** Anatomical and Physiological barriers; Innate immune response and their recognition structures; Pathogen elimination. **Comparative immunity**. **Plant Immune system. Immunogens and Antigens**: Requirements for immunogenicity; major classes of antigens; antigen recognition by B and T lymphocytes

UNIT II - ANTIBODY STRUCTURE AND FUNCTIONS, B CELL FUNCTION (10 hours)

Immunoglobulins: Structure and function-- Monoclonal antibodies. **B Cell generation and differentiation**: BCR--Antibody diversity: Genetic basis—T-dependent activation of B cells-B-lymphocyte signal transduction. **Cytokines**.**Complement.**

UNIT III - ANTIGEN – ANTIBODY INTERACTIONS (8 hours)

Antigen- antibody interaction: antibody affinity and activity- Isolation of lymphoid cells from blood and lymphoid organs--precipitation reaction, agglutination reaction --Radioimmunoassay, ELISA, Western Blot, Immunoprecipitation-Immunofluoresence, flow cytometry. **Cell culture and experimental animal models. Analysis of gene expression**

UNIT IV - T CELL MATURATION, ACTIVATION, & DIFFERENTIATION (9 hours)

MHC, antigen processing and presentations: T-cell receptors--T-cell maturation, activation and differentiation-Cell mediated effector responses-Function of CD8+ T cells

UNIT V - IMMUNE SYSTEM IN HEALTH & DISEASE (8 hours)

Hypersensitive reactions--Immune responses to infectious diseases--Tumor Immunology-Vaccines-Autoimmunity

TEXT BOOKS

1. Richard Coico, Geoffrey Sunshine, "*Immunology: A short course*" 6th Edition. Wiley-Blackwell. 2009.
2. Kenneth Murphy, "*Janeway's Immunobiology*," 8th Edition, Garland, 2011.

REFERENCES

1. Sudha Gangal and Shubhangi Sontakke, "*Textbook of basic and clinical immunology*," Universities Press, 2013.
2. Thomas J. Kindt, Barbara A. Osborne, Richard A. Goldsby, "*Kuby Immunology,"* Sixth edition, W. H. Freeman and Company, 2006.

BT1010 IMMUNOLOGY												
Course Designed by		**Department of Biotechnology**										
1.	Student outcomes	a	b	c	d	e	f	g	h	i	j	k
		x			x							
2.	Mapping of instructional objectives with student outcomes	1			2							
3.	Category	General (G)		Basic Sciences(B)		Engg. Sci. & Tech. Arts (E)		Professional Subjects (P)				
								x				
4.	Broad Area	Biotechnology		Bioprocess Engineering		Chemical Engineering						
		x		--		--						
5.	Approval	23rd Meeting of Academic Council, May 2013										

BT1012	GENETICS AND CYTOGENETICS	L	T	P	C
	Total No. of Contact Hours - 45	**3**	**0**	**0**	**3**
	Prerequisite				
	Nil				

PURPOSE

This course introduces the fundamentals of genetics. It discusses the pattern of inheritance, chromosome structure, sex linked genes and inherited disorders, construction of linkage maps and population analysis.

INSTRUCTIONAL OBJECTIVES

1.	To provide knowledge on the basic laws governing the pattern of inheritance familiarize the students with the basic concepts and principles of nucleic acids in prokaryotic and eukaryotic organisms
2.	To understand the concepts and experiments in preparation of linkage map.
3	To provide knowledge on inherited disorders and population genetics.

UNIT I - MENDELIAN GENETICS **(10 hours)**

Mendel's experiments, Mendel's laws, Gene interaction - Allelic and non-allelic – epistasis, Multiple allelism – ABO and Rh factor inheritance, cytoplasmic inheritance, sex determination, pedigree analysis – autosomal, sex linked, cytoplasmic.

UNIT II - LINKAGE AND RECOMBINATION MAPPING (9 hours)

Chromosome structure and organization, giant chromosomes, Linkage and crossing over, cytological basis of crossing over – Sterns experiment, Mapping – two and three factor cross, preparation of linkage map, somatic cell hybridization, CGH.

UNIT III - MUTATION AND HUMAN CYTOGENETICS (10 hours)

Changes in chromosome and number, Non-disjunction, Aneuploids in humans – Autosomal - Downs, Patau and Edwards syndrome; Allosomes - Klinefelter and Turner syndrome, mosaics, position effect, chromosome preparation – leucocytes, bone marrow, amniotic fluid, chorionic villi, Banding, karyotype preparation and analysis, FISH, Prenatal diagnosis.

UNIT IV - RECOMBINATION AND MAPPINGIN BACTERIA (8 hours)

Mechanisms of recombination, Mapping – transformation, Transduction mapping – generalized and specialized transduction, conjugation – interrupted mating analysis, Fine structure in merozygotes.

UNIT V - POPULATION GENETICS (8 hours)

Hardy Weinberg equilibrium, calculating allelic frequency, Application of Hardy Weinberg equilibrium, Random genetic drift, founders effect, genetic equilibrium.

TEXT BOOK

1. Gardner, Simmons, Sunstad, "*Principles of Genetics,"* 8th edition – John Wiley and Sons, Inc., 2003.

REFERENCE

1. Monroe W. Strickberger, "*Genetics*," 3rd edition – Phi Learning, 2008.

BT1012 GENETICS AND CYTOGENETICS												
Course Designed by		**Department of Biotechnology**										
1.	Student outcomes	a	b	c	d	e	f	g	h	I	j	k
		x			x							
2.	Mapping of instructional objectives with student outcomes	1			2							
3.	Category	General (G)			Basic Sciences (B)			Engg. Sci. & Tech. Arts (E)			Professional Subjects (P)	
											x	
4.	Broad Area	Biotechnology			Bioprocess Engineering			Chemical Engineering				
		x			--			--				
5.	Approval	23rd Meeting of Academic Council, May 2013										

BT1007	LAB SAFETY AND ANALYTICAL TECHNIQUES LAB	L	T	P	C
	Total No. of Contact Hours – 30	0	0	2	1
	Prerequisite				
	BT1006				

PURPOSE

The PURPOSE of this course is to give a comprehensive understanding of the various techniques used in the analysis of compounds and drugs by different branches of biotechnology. The student will gain thorough information on the principles of the techniques.

INSTRUCTIONAL OBJECTIVES

1.	To impart knowledge about the working of the instruments
2.	To teach the application of techniques in biotechnology and related fields
3.	To apply the concepts in the interpretation of the data.

LISTOF EXPERIMENTS

1. Studies on pH titration curves of amino acids/ acetic acid and determination of pKavalues.
2. Separation of serum protein by horizontal submerged gel electrophoresis.
3. Determination of concentration of dye by Colorimetry
4. Study of UV absorption spectra of macromolecules (protein, nucleic acid, bacterial pigments).
5. Determination of functional groups of protein by FT-IR
6. Separation of bacterial lipids/amino acids/sugars/organic acids by TLC or Paper Chromatography.
7. HPLC –Demonstration
8. FPLC-Demonstration
9. LC-MS Demonstration
10. Principles of Microscopy-SEM and TEM-Demonstration
11. Atomic Adsorption Spectroscopy – Demonstration

REFERENCE

1. Lab Manual

BT1007 LAB SAFETY AND ANALYTICAL TECHNIQUES LAB												
Course Designed by		**Department of Biotechnology**										
1.	Student outcomes	a	b	c	d	e	f	g	h	i	j	k
			x			x						x
2.	Mapping of instructional objectives with student outcomes		1			2						3
3.	Category	General(G)		Basic Sciences(B)			Engg. Sci. & Tech Arts (E)			Professional Subjects (P)		
										x		
4.	Broad Area	Biotechnology		Bioprocess Engineering			Chemical Engineering					
		x		--			--					
5.	Approval	23rd Meeting of Academic Council, May 2013										

BT1009	**MICROBIOLOGY LABORATORY**	**L**	**T**	**P**	**C**
	Total No. of Contact Hours – 60	**0**	**0**	**4**	**2**
	Prerequisite				
	BT1008				

PURPOSE

Provides an opportunity to experimentally verify the theoretical concepts studied. It also helps in understanding the theoretical principles in a more explicit and concentrated manner.

INSTRUCTIONAL OBJECTIVES

1.	To enable the students to understand the basic concepts involved in the isolation, identification and characterization of different kinds of microorganisms
2.	To impart the proper handling experience of microorganisms
3.	To provide the complete practical experience on microbiological methods and getting useful microbial products.

LIST OF EXPERIMENTS

1. Aseptic technique and Media preparation
2. Culturing of microorganisms– in broth and in plates (pour plates, streak plates, isolation, and preservation of bacterial cultures)
3. Growth Kinetics (Bacterial Growth Curve)
4. Isolation, enumeration and purification of microbes from a given sample

5. Staining Techniques (Simple, Gram staining, and spore staining)
6. Motility test by Hanging drop method
7. Biochemical Characterization of Bacteria
    a. Oxidation/Fermentation Test
    b. Catalase, Oxidase, and Urease Tests
    c. IMViC test
    d. Hydrogen Sulfide Test and Nitrate Reduction Test
    e. Casein and Starch Hydrolysis
8. Identification of bacteria using 16s-rRNA method
9. Kirby-Bauer assay
10. Screening and characterization of bioactive molecules from bacteria

REFERENCES

1. Russell Bey, *"Microbiology Laboratory Manual",* Thomson Learning, 2000.
2. Tabo.N,*"Laboratory Manual in Microbiology",* Rex Bookstore, Inc 2004.

BT1009 MICROBIOLOGY LABORATORY												
Course Designed by		**Department of Biotechnology**										
1.	Student outcomes	a	b	c	d	e	f	g	h	i	J	k
			x	x		x						x
2.	Mapping of instructional objective with student outcomes		1	2		3						1
3.	Category	General (G)			Basic Sciences(B)			Engg. Sci. & Tech. Arts (E)			Professional Subjects (P)	
											x	
4.	Broad Area	Biotechnology			Bioprocess Engineering			Chemical Engineering				
		x			--			--				
5.	Approval	23rd Meeting of Academic Council, May 2013										

BT1011	**IMMUNOLOGY LABORATORY**	**L**	**T**	**P**	**C**
	Total No. of Contact Hours - 60	**0**	**0**	**4**	**2**
	Prerequisite				
	BT1010				

PURPOSE

A laboratory course with an opportunity to experimentally verify the theoretical concepts already studied.

INSTRUCTIONAL OBJECTIVES	
1.	To enable the students to understand the theoretical concepts in Immunology.
2.	To provide students with some experience in methods used in immunology, particularly the use of specific antibody in biomolecular applications.
3.	To understand various methods and their applications, and interpretation of results

LIST OF EXPERIMENTS

1. Blood grouping
2. Leukocyte counting – Total leukocyte and differential leukocyte
3. Isolation of peripheral blood mononuclear cells (PBMC)
4. Antigen-antibody reaction -Haemagglutination,
5. Precipitation reaction-Widal and VDRL
6. Immunodiffusion – Single Radial Immuno Diffusion (SRID)
7. Immunodiffusion – Double Immuno Diffusion (DID)
8. Immunoelectrophoresis – Rocket Immunoelectrophoresis
9. Immunoelectrophoresis – Counter Current Immunoelectrophoresis
10. ELISA
11. Immunoprecipitation
12. Western blotting
13. Flow cytometry

REFERENCES

1. Immunology Laboratory manual.
2. Arti Nigam,Archana Ayyagari, *"Lab Manual in Biochemistry, Immunology and Biotechnology",* Mc Graw Hill Education, India, 2007.

BT1011 IMMUNOLOGY LABORATORY												
Course Designed by		Department of Biotechnology										
1.	Student outcomes	a	b	c	d	e	f	g	h	i	j	k
		x	x									x
2.	Mapping of instructional objective with student outcomes	1	3									2
3.	Category	General (G)		Basic Sciences (B)			Engg. Sci. & Tech. Arts (E)			Professional Subjects (P)		
										x		
4.	Broad area	Biotechnology					Bioprocess Engineering			Chemical Engineering		
		x					--			--		
5.	Approval	23rd Meeting of Academic Council, May 2013										

BT1013	CELL BIOLOGY LABORATORY	L	T	P	C
	Total No. of Contact Hours - 60	0	0	4	2
	Prerequisite				
	BT1003				

PURPOSE

Provides an opportunity to experimentally verify the theoretical concepts. It also helps in understanding the theoretical principles in a more explicit and concentrated manner.

INSTRUCTIONAL OBJECTIVES

1.	To impart practical knowledge about cell growth and cell differentiation
2.	To develop skill in isolation and identification of cell organelles using advanced tools
3.	To learn about cancer cell culture and to check the cell toxicity of different products
4.	To provide practical skill in handling molecular techniques like PCR and western blotting

LIST OF EXPERIMENTS

1. **Cell cycle** – Mitosis and Meiosis
2. **Cell organelles** – Isolation of mitochondria, chloroplast and lysosome
3. **Cell morphology** – Staining of hepatocytes, adipocytes and osteocytes
4. **Cell toxicity** – Quantification of mitochondrial dehydrogenase and plasma membrane lactate dehydrogenase
5. **Cancer cells** – Culture of tumor cells and transformed cell lines
6. **Mutation** – Isolation of genetic variants
7. **Mendelian principles** – Genetic crosses in fruit fly
8. **Chromosome preparation** - Karyotyping
9. **Nucleus** – Isolation of nuclear proteins by western blotting
10. **Heterochromatin** – Polytene and lampbrush chromosome

REFERENCES

1. John Davey, Mike Lord, *"Essential Cell Biology: A Practical Approach"*, Oxford University Press, 2003.
2. Robin Harris, John Graham, David Rickwood, "*Cell Biology Protocols*", John Wiley & Sons, 2006.
3. Thomas Robert Mertens, Robert L Hammersmith, "*Genetics Laboratory Investigations",* Benjamin Cummings, 2006.

BT1013 - CELL BIOLOGY LABORATORY												
Course Designed by		**Department of Biotechnology**										
1.	Student outcome	a	b	c	d	e	f	g	h	i	j	k
		x										x
2.	Mapping of instructional objectives with student outcome	1										1
3.	Category	General (G)		Basic Sciences(B)		Engineering Sciences and Technical Arts (E)					Professional Subjects(P)	
											x	
4.	Broad Area	Biotechnology				Bioprocess Engineering					Chemical Engineering	
		x				-					-	
5.	Approval	23rd Meeting of Academic Council, May 2013										

SEMESTER – IV

LE1008	**GERMAN LANGUAGE PHASE II**	**L**	**T**	**P**	**C**
	Total Contact Hours- 30	**2**	**0**	**0**	**2**
	Prerequisite				
	LE1003-German Language Phase I				

PURPOSE

Familiarity in German language will be helpful for the students in preparing their resumes in German. Proficiency in the language will be an added asset for the students to have an edge in the present day highly competitive and global job market.

INSTRUCTIONAL OBJECTIVES

1.	To enable the students to speak and understand about most of the activities in the day to day life.
2.	The students will be able to narrate their experiences in Past Tense.
3.	The students will be able to understand and communicate even with German Nationals.
4.	By the end of Phase – II the students will have a reasonable level of conversational skills.

UNIT I **(6 hours)**

Wichtige Sprachhandlungen: Zimmersuche, Möbel

Grammatik: Verben mit trennbaren Vorsilben im Präsens und Perfekt. Verben mit trennbaren Vorsilben und Modalverben imPräsens. Verben mit untrennbaren Vorsilben im Perfekt. Unregelmäßige und gemischte Verben im Perfekt.

UNIT II **(6 hours)**

Wichtige Sprachhandlungen: Kleidung ,Farben , Materialien.

Grammatik : formelle Imperativsätze mit “Sie” informelle Imperativsätze Vorschläge mit “wir” – “sollen/wollenwir”—Soll ich? Modalpartikeln “doch” “mal” “doch mal.

UNIT III **(6 hours)**

Wichtige Sprachhandlungen : Sehenswürdigkeite (Prater, Brandenburger Tör,Kolossium, Eifeltürm)

Grammatik : Ortsangaben mit Akk. und Dativ “alle”,”man” Indefinitepronomen “etwas”, “nichts”,

UNIT IV **(6 hours)**

Wichtige Sprachhandlungen : Wegbeschreibung/ Einladung interkulturelle Erfahrung.

Grammatik : Verwendung von Präsens für zukünftigen Zeitpunkt.

UNIT V **(6 hours)**

Wichtige Sprachhandlungen: Essen und Trinken im Restaurant , Partyvorbereitung und Feier

Grammatik: Nomen aus Adjektiven nach "etwas"und "nichts" Nomen aus dem Infinitiv von Verben, zusammegesetzte Nomen und ihre Artikel. Adjektive im Nom. und Akk. nach unbestimmten Artikel, Negativartikel und Possessivartikel.

TEXT BOOK

Studio d A1. Deutsch als Fremdsprache with CD.(Kursbuch und Sprachtraining).

REFERENCES

1. German for Dummies
2. Schulz Griesbach

LE01008 GERMAN LANGUAGE PHASE II												
Course Designed by		**Department of English and Foreign Languages**										
1.	Student outcome	a	b	c	d	e	f	g	h	i	j	k
								x				
2.	Mapping of instructional objectives with student outcome							1-4				
3.	Category	General (G)		Basic Sciences (B)			Engineering Sciences and Technical Arts (E)				Professional Subjects (P)	
		x		--			--				--	
4.	Approval	23rd Meeting of Academic Council, May 2013										

LE1009	**FRENCH LANGUAGE PHASE II**	**L**	**T**	**P**	**C**
	Total Contact Hours- 30	**2**	**0**	**0**	**2**
	Prerequisite				
	LE1004- French Language Phase I				

PURPOSE

To enable the students communicate effectively with any French speaker and have a competitive edge in the international market.

INSTRUCTIONAL OBJECTIVES

1.	To enable students access information on the internet
2.	To receive and send e mails
3.	To assist students in gaining a certain level of proficiency to enable them to give the level 1 exam conducted by Alliance Française de Madras.
4.	To enhance their lexical and technical competence.

UNIT I **(6 hours)**

1. Grammar and Vocabulary: The second group verbs: Finir, rougir, grossir, grandir . "Les preposition de temps": à, en, le, de 7h à 8h, jusqu' à, vers.
2. Listening and Speaking – the semi- vowels: Voilà, pollutant. Writing –the days of the week. Months, technical subjects, time, "les spécialités scientifiques et l' année universitaire, paragraph writing about time table.
3. Reading -- Reading of the text and comprehension – answering questions

UNIT II **(6 hours)**

Grammar and Vocabulary – The adjectives, the nationality, feminine & masculine noun forms "les métiers scientifiques".

Listening and Speaking – Vowels: soirée, année, près de, très.

Writing – Countries name, nationality, "les métiers scientifiques", numbers from: 69 to infitive and some measures of unit.

Reading Comprehension – reading a text.

UNIT III **(6 hours)**

Grammar and Vocabulary – near future, The demonstrative adjectives, Express the aim by using the verb, Listening and Speaking –"La liaison interdite – en haut". Writing – some scientific terms, French expressions to accept an invitation. Sentence framing. Reading Comprehension – reading a text.

UNIT IV **(6 hours)**

Grammar and Vocabulary –the verbs: manger, boire , the partitive articles
Listening and Speaking – "le 'e' caduc Writing- the food, the ingredients, fruits, vegetables, expression of quantity, paragraph writing about food habits. Reading – reading a text.

UNIT V **(6 hours)**

Grammar and Vocabulary – " les prepositions de lieu": au à la, à l', chez, the reflexives verbs, verbs to nouns. Listening and Speaking – "le 'e' sans accents ne se prononce pas. C'est un "e" caduc. Ex: quatre, octobre. " les sons (s) et (z)- salut , besoin. Writing –paragraph writing about one's everyday life, French culture. Reading Comprehension -- reading a text or a song.

TEXT BOOK

1. Tech French

REFERENCES

1. French for Dummies
2. French made easy: Goyal publishers
3. Panorama

LE1009 FRENCH LANGUAGE PHASE II												
Course Designed by		**Department of English and Foreign Languages**										
1.	Student outcome	a	b	c	d	e	f	g	h	i	j	k
								x				
2.	Mapping of instructional objectives with student outcome							1-4				
3.	Category	General (G)		Basic Sciences (B)			Engineering Sciences and Technical Arts (E)				Professional Subjects (P)	
		x		--			--				--	
4.	Approval	23rd Meeting of Academic Council, May 2013										

LE 1010	JAPANESE LANGUAGE PHASE II	L	T	P	C
	Total Contact Hours- 30	2	0	0	2
	Prerequisite				
	LE1005- Japanese Language Phase I				

PURPOSE

To enable students to learn a little advanced grammar in order to improve their conversational ability in Japanese.

INSTRUCTIONAL OBJECTIVES

1.	To help students learn Katakana script (used to write foreign words)
2.	To improve their conversational skill.
3	To enable students to know about Japan and Japanese culture.
4.	To improve their employability by companies who are associated with Japan.

UNIT I **(8 hours)**

Introduction to Verbs; Ikimasu, okimasu, nemasu, tabemasu etc.
Grammar – usage of particles de, o, to, ga(but) and exercises
Common daily expressions and profession.
Katakana script and related vocabulary.
Religious beliefs, Japanese housing and living style.
Conversation – audio

UNIT II **(8 hours)**

Grammar :Verbs –Past tense, negative - ~mashita, ~masen deshita..
i-ending and na-ending adjectives - introduction
Food and transport (vocabulary)
Japanese food, transport and Japanese tea ceremony.
Kanji Seven elements of nature (Days of the week)
Conversation – audio

UNIT III **(6 hours)**

Grammar - ~masen ka, mashou
Adjectives (present/past – affirmative and negative)
Conversation – audio

UNIT IV **(4 hours)**

Grammar – ~te form
Kanji – 4 directions
Parts of the body
Japanese political system and economy
Conversation – audio

UNIT V **(4 hours)**

Stationery, fruits and vegetables

Counters – general, people, floor and pairs

TEXT BOOK

1. First lessons in Japanese, ALC Japan

REFERENCES

1. Japanese for dummies. Wiley publishing co. Inc., USA.
2. Kana workbook, Japan foundation

LE1010 JAPANESE LANGUAGE PHASE II												
Course Designed by		**Department of English and Foreign Languages**										
1.	Student outcome	a	b	c	d	e	f	g	h	i	j	k
								x				
2.	Mapping of instructional objectives with student outcome							1-4				
3.	Category	General (G)		Basic Sciences (B)		Engineering Sciences and Technical Arts (E)				Professional Subjects (P)		
		x		--		--				--		
4.	Approval	23rd Meeting of Academic Council, May 2013										

LE1011	**KOREAN LANGUAGE PHASE II**	**L**	**T**	**P**	**C**
	Total Contact Hours-30	**2**	**0**	**0**	**2**
	Prerequisite				
	LE1006-Korean Language Phase I				

PURPOSE

To enable students achieve a basic exposure on Korea, Korean language and culture. To acquire basic conversational skill in the language.

INSTRUCTIONAL OBJECTIVES

1.	To help students learn the scripts.
2.	To make the students acquire basic conversational skill.
3	To enable students to know about Korean culture.
4.	To create an advantageous situation for the students to have better opportunity for employability by companies who have association with Korea.

UNIT I (**9 hours)**

Lesson 1 <Review of Vowels and Consonants>, Lesson2 < Various Usages of "To be">, Lesson3 < Informal form of "to be"> <Basic Conversation, Vocabularies and Listening>

UNIT II (**9 hours)**

Lesson 4 < Informal interrogative form of "to be">, Lesson 5 < To be, to have, to stay>, Lesson 5 < Advanced Interrogative practice>, Lesson 6 < Types of Negation>, <Basic Conversation, Vocabularies and Listening>

UNIT III (**9 hours)**

Lesson 7 < Honorific forms of noun and verb2>, Lesson8 < Formal Declarative2>, Lesson 9 < Korean Business Etiquette>, <Basic Conversation, Vocabularies and Listening>

UNIT IV (**3 hours)**

Lesson 10 <Field Korean as an Engineer1>, <Field Korean as an Engineer2> <Basic Conversation, Vocabularies and Listening>

TEXT BOOK

1. Korean through English 2 (Basic Korean Grammar and Conversation)

REFERENCES

1. Bharati Korean (Intermediate Korean Grammar)
2. Hand-outs
3. Various visual media such Movie CD, Audio CD, and music
4. Collection of vocabularies for engineering field.

LE1011 KOREAN LANGUAGE PHASE II												
Course Designed by		**Department of English and Foreign Languages**										
1.	Student outcome	a	b	c	d	e	f	g	h	i	j	k
								x				
2.	Mapping of instructional objectives with student outcome							1-4				
3.	Category	General (G)		Basic Sciences(B)		Engineering Sciences and Technical Arts (E)				Professional Subjects (P)		
		x		--		--				--		
4.	Approval	23rd Meeting of Academic Council, May 2013										

LE1012	CHINESE LANGUAGE PHASE II	L	T	P	C
	Total Contact Hours-30	2	0	0	2
	Prerequisite				
	LE1007-Chinese Language Phase I				

PURPOSE

To enable students achieve a basic exposure on China, Chinese language and culture. To acquire basic conversational skill in the language.

INSTRUCTIONAL OBJECTIVES

1.	To help students learn the Chinese scripts.
2.	To make the students acquire basic conversational skill.
3	To enable students to know about China and Chinese culture.
4.	To create an advantageous situation for the students to have better opportunity for employability by companies who have association with china.

UNIT I

1. Greetings
Questions and answers about names
Introducing oneself
Receiving a guest
Making corrections

New words: 你ˆyou˘ 好ˆgood 'well˘
工作ˆwork 'job˘ 人员ˆpersonnel 'staff member˘ 请问ˆMay I ask…˘ 贵ˆexpensive 'valuable˘ 姓ˆone's family name is ˘

2. Questions and answers about the number of people in a family
Expressing affirmation/negation
Questions and answers about the identity of a person same or not.

New words: 家ˆfamily 'home˘ 有ˆhave˘ 几ˆseveral˘
爸爸 (father˘ 妈妈 (mother) 哥哥 (elderly brother˘

UNIT II

A. About places
B. About numbers
C. if one knows a certain person
D. Expressing apology
E. Expressing affirmation/negation
F. Expressing thanks.

New Words:
客人﹀guest,visitor﹀这儿﹀here﹀中文﹀Chinese﹀ 对﹀right, correct﹀
学生﹀student﹀ 多﹀many, a lot﹀
Grammar: Sentences with a verbal predicate

UNIT III
Introducing people to each other
A. Exchanging amenities
B. Making/Negating conjectures
C. Questions and answers about nationality
Grammar: Sentences with an adjectival predicate

UNIT IV
A) About places to go
Indicating where to go and what to do
Referring to hearsay.
Saying good-bye
B) Making a request
Questions and answers about postcodes and telephone numbers
Reading dates postcodes and telephone numbers
Counting Renmibi
Grammar: Sentences with a subject-verb construction as its predicate
Sentences with a nominal predicate

UNIT V
A. Asking and answering if someone is free at a particular time
B. Making proposals
C. Questions about answers about time
D. Making an appointment
E. Telling the time
F. Making estimations

TEXT BOOK
1. New Chinese Course 1- Beijing Language and Culture University Press

REFERENCES
1. New Practical Chinese Reader Textbook (1) – Beijing Language and Culture University Press
2. 40 Lessons For Basic Chinese Course I – Shanghai Translation Press
3. My Chinese Classroom - East China Normal University Press

LE1012 CHINESE LANGUAGE PHASE II												
Course Designed by		**Department of English and Foreign Languages**										
1.	Student outcome	a	b	c	d	e	f	g	h	i	j	k
								x				
2.	Mapping of instructional objectives with student outcome							1 - 4				
3.	Category	General (G)		Basic Sciences (B)			Engineering Sciences and Technical Arts (E)			Professional Subjects (P)		
		x		--			--			--		
4.	Approval	23rd Meeting of Academic Council, May 2013										

PD1004	APTITUDE-II	L	T	P	C
	Total Contact Hours - 30	1	0	1	1
	Prerequisite				
	Nil				

PURPOSE

To enhance holistic development of students and improve their employability skills.

INSTRUCTIONAL OBJECTIVES

1.	To improve verbal aptitude, vocabulary enhancement and reasoning ability of the student.

UNIT I **(6 hours)**

Critical Reasoning – Essay Writing

UNIT II **(6 hours)**

Synonyms – Antonyms - Odd Word - Idioms & Phrases

UNIT III **(6 hours)**

Word Analogy - Sentence Completion

UNIT IV **(6 hours)**

Spotting Errors - Error Correction - Sentence Correction

UNIT V **(6 hours)**

Sentence Anagram - Paragraph Anagram - Reading Comprehension

ASSESSMENT

1. Objective type – Paper based /Online – Time based test

TEXT BOOK

1. Personality Development -Verbal Work Book, Career Development Centre, SRM Publications

REFERENCES

1. Green Sharon Weiner.M.A & Wolf Ira K.*Barron's New GRE*, *19th Edition*. Barron's Educational Series, Inc, 2011.
2. Lewis Norman, *Word Power Made Easy*, Published by W.R.Goyal Pub, 2011.
3. Thorpe Edgar and Thorpe Showich, *Objective English.* Pearson Education 2012.
4. Murphy Raymond, *Intermediate English Grammar*, (Second Edition), Cambridge University Press, 2012.

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<tr><td>4.</td><td>Approval</td><td colspan="11">23rd Meeting of Academic Council, May 2013</td></tr>
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MA1034	BIOSTATISTICS	L	T	P	C
	Total No. of Contact Hours =60 Hours	4	0	0	4
	Prerequisite				
	Nil				

PURPOSE

To develop an understanding of the methods of probability andstatistics which are used to model engineering problems.

INSTRUCTIONAL OBJECTIVES	
1.	To gain knowledge in measures of central tendency and dispersion.
2.	To appropriately choose, define and/or derive probability distributions such as the Binomial, Poisson and normal distribution to solve engineering problems.
3.	To learn how to formulate and test the hypotheses about means, proportions and standard deviation to draw conclusions based on the results of statistical tests in large sample.
4.	To learn how to formulate and test the hypotheses about means, variances for small samples using t and F test for small sample and have knowledge on ANOVA.
5.	To understand the fundamentals of quality control and the methods used to control systems and processes.

UNIT I - INTRODUCTION TO BIO-STATISTICS (NUMERICAL PROBLEMS ONLY) (12 hours)

Handling univariate and bivariate data - Measures of central tendency - Measures of dispersion -Skewness & Kurtosis - Correlation and Regression.

UNIT II - PROBABILITY & THEORETICAL DISTRIBUTIONS (12 hours)

Probability concepts - conditional probability - Baye's theorem - one - dimensional random variables - expectation, variance, moments. Theoretical distributions : Binomial, Poisson, Normal (Problems only).

UNIT III - TESTING OF HYPOTHESIS (12 hours)

Introduction - Large sample tests based on normal distribution - Test for single mean, difference between means - proportion, difference between proportion - standard deviation, difference between standard deviation -Chi-square test for goodness of fit - Independence of attributes.

UNIT IV - ANALYSIS OF VARIANCE (12 hours)

Small sample tests based on t and F distribution - Test for, single mean, difference between means, Paired t-test, test for equality of variances. ANOVA-one -way classification, Two-way classification.

UNIT V - STATISTICAL QUALITY CONTROL (12 hours)

Introduction - Process control - control charts for variables - X and R, X and s charts control charts for attributes: p chart, np chart, c chart.

TEXT BOOK

1. Gupta.S.C and Kapoor.V.K, "*Fundamentals of Mathematical Statistics, 11th extensively revised edition"*, Sultan Chand & Sons, 2007.

REFERENCES

1. Gupta.S.C & Kapoor.V.K, "*Fundamentals of Applied Statistics"*, Sultan Chand and Sons, New Delhi, 2003.
2. Ewans.W & Grant.G, "*Statistical Methods in Bio informatics - An Introduction"*, Springer, 2nd edition,2005.

MA 1034 - BIOSTATISTICS												
Course Designed by		Department of Mathematics										
1.	Student outcome	a	b	c	d	e	f	g	h	i	j	k
		x				x						
2.	Mapping of instructional objectives with student outcomes	1-5				1-5						
3.	Category	General (G)		Basic Sciences (B)			Engg. Sci.& Tech. Arts (E)			Professional Subjects(P)		
				x								
4.	Approval	23rd Meeting of Academic Council, May 2013										

CH1052	CHEMICAL ENGINEERING PRINCIPLES I - MECHANICAL OPERATIONS AND MOMENTUM TRANSFER	L	T	P	C
	Total No. of Contact Hours - 45	**3**	**0**	**0**	**3**
	Prerequisite				
	Nil				

PURPOSE

This course is concerned with filtration and agitation operations and behavior of fluids

INSTRUCTIONAL OBJECTIVES

1.	o understand the basic concepts of filtration and agitation and mixing
2.	To study the nature of fluids and flow characteristics.
3.	To teach knowledge about the fluid transportation and metering devices.

UNIT I - FILTRATION **(9 hours)**

Introduction: cake filters- **Discontinuous pressure filter:** principle and working of filter press- **Continuous vacuum filter:** principle and working of rotary drum

filters- **Centrifugal Filter:** principle and working of suspended batch centrifuges- filter media- filter aids- principles of cake filtration- pressure drop through filter cake- compressible and incompressible filter cakes- filter-medium resistance- constant pressure filtration- continuous filtration- constant rate filtration- working principle of centrifugal filters.

UNIT II - AGITATION AND MIXING OF LIQUIDS (9 hours)

Dimensional analysis: Buckingham's Π theorem. -**Principles of agitation**: agitation equipment- flow patterns: prevention of swirling- draft tubes. Standard turbine design- power consumption- power correlation- significance of dimensionless groups- effect of system geometry- calculation of power consumption in Newtonian liquids.**Blending and mixing:** blending of miscible liquids- blending in process vessels- stratified blending in storage tanks- jet mixers- motionless mixers- mixer selection.

UNIT III - FLUID FLOW PHENOMENA (9 hours)

Nature of fluids: incompressible and compressible- hydrostatic equilibrium- manometers- potential flow- boundary layer- the velocity field- laminar flow- **Newtonian and non-Newtonian fluids**: Newton's-law of viscosity- turbulence- Reynolds number and transition from laminar to turbulent flow- Eddy viscosity- **Flow in boundary layers:** laminar and turbulent flow in boundary layers- boundary-layer formation in straight tubes.

UNIT IV - KINEMATICS OF FLOW & FLOW PAST IMMERSED BODIES (9 hours)

Streamlines and stream tubes: equation of continuity- Bernoulli equation- pump work in Bernoulli equation. **Flow of incompressible fluids in conduits and thin layers-** Hagen-Poiseuille equation- von Karman equation- roughness parameter- friction losses in Bernoulli equation- couette flow. Drag coefficients- drag coefficients of typical shapes- Ergun equation- terminal settling velocity- **Free and hindered settlings:** Stokes' law- Newton's law- criterion for settling regime- **Fluidization:** conditions for fluidization- minimum fluidization velocity.

UNIT V - TRANSPORTATION & METERING OF FLUIDS (9 hours)

Introduction to pipe and tubing: joint and fittings- stuffing boxes- mechanical seals- gate valves and globe valves- plug cocks and ball valves- check valves.- **Classification and selection of pumps**: Reciprocating and rotary pumps – Centrifugal pump– Pump characteristics– Fans- blowers and compressors–Steam jet ejector.**Types of metering devices**: Application of Bernouli equation to venturi meter and orifice meter- flow rate calculations from the readings of venture meter- orifice meter and pitot tube.

TEXT BOOKS

1. Warren L. Mccabe, Julian C. Smith and peter Harriott, "*Unit Operations of Chemical Engineering*", 6th Edn., McGraw Hill International Edition, New York, 2001.
2. Coulson.J.M, Richardson.J.F, Backhurst.J.R and Harker.J.M, "*Coulson & Richardson's Chemical Engineering*", Vol. II, 4th Edn., Butter worth Heinemann, Oxford, 1996.

REFERENCES

1. Anup K Swain, Hemalata Patra , Roy.G.K, "*Mechanical operations*", Tata - McGraw Hill, 2010.
2. Noel de Nevers, "*Fluid Mechanics for Chemical Engineers*", 2nd Edn., McGraw Hill International Editions.
3. White.F.M, "*Fluid Mechanics*", 4th Edn, McGraw-Hill Inc, 1999.
4. Narayanan.C.L & Bhattacharya, "*Mechanical Operation for Chemical Engineering*", 1993.
5. Darby.R,"*Chemical Engineering Fluid Mechanics*", Marcel Dekker, 1998.

CH1052 CHEMICAL ENGINEERING PRINCIPLES I – MECHANICAL OPERATIONS AND MOMENTUM TRANSFER												
Course Designed by		**Department of Chemical Engineering**										
1.	Student outcomes	a	b	c	d	e	f	g	h	I	j	k
		x	x	x								
2.	Mapping of instructional objectives with student outcomes	1	2	3								
3.	Category	General (G)			Basic Sciences (B)			Engg. Sci. & Tech. Arts (E)			Professional Subjects(P)	
								x				
4.	Broad Area	Biotechnology			Bioprocess Engineering			Chemical Engineering				
		--			--			--				
5.	Approval	23rd Meeting of Academic Council, May 2013										

	CHEMICAL AND BIOCHEMICAL ENGINEERING THERMODYNAMICS	L	T	P	C
CH1054	Total No. of Contact Hours - 45	3	0	0	3
	Prerequisite				
	Nil				

PURPOSE

This course helps the students to obtain a proficiency in applying thermodynamic principles to the solution of a variety of energy flow and equilibrium problems in chemical and biochemical processes.

INSTRUCTIONAL OBJECTIVES

1.	To understand the basics of First and second laws of thermodynamics
2.	To familiarize the concept of volumetric properties of pure fluids and vapor/liquid equilibrium
3.	To learn the concept of biochemical thermodynamics and applications

UNIT I - FIRST AND SECOND LAWS OF THERMODYNAMICS (9 hours)

Basic concepts: work, energy, internal energy- **First law of thermodynamics**: energy balance for closed systems- equilibrium- the reversible process- constant-v and constant-p processes- enthalpy- heat capacity- energy balances for steady-state flow processes. **Second law of thermodynamics:** statements- heat engines- Carnot's theorem- ideal-gas temperature scale; Carnot's equations- concept of entropy- entropy changes of an ideal gas undergoing a mechanically reversible process in a closed system- mathematical statement of the second law.

UNIT II - VOLUMETRIC PROPERTIES OF PURE FLUIDS (9 hours)

PVT behavior of pure substances- virial equations of state- the ideal gas- **Equations for process calculations:** isothermal process- isobaric process- isochoric process- adiabatic process- and polytropic process. Application of the virial equations- **Introduction to cubic equations of state:** van der Waals equation- Redlich/Kwong equation- theorem of corresponding states.

UNIT III - VAPOR/LIQUID AND CHEMICAL REACTION EQUILIBRIA (9 hours)

The nature of equilibrium- phase rule: Duhem's theorem- Pxy and Txy diagrams- simple models for VLE- Raoult's law- Dewpoint and bubblepoint calculations with Raoult's law for binary mixtures- Henry's law- VLE by modified Raoult's law- VLE from K-value correlations**- Flash calculations**. Reaction coordinate- application of equilibrium criteria to chemical reactions- Standard Gibbs-energy change and the equilibrium constant- **Relation of equilibrium constants to composition:** gas-phase reactions- liquid-phase reactions- **Equilibrium conversions for single reactions:** single- phase reactions.

UNIT IV - BIOCHEMICAL THERMODYNAMICS (9 hours)

Bioenergetics: energetics of metabolic pathways- energy coupling (ATP & NADH)- **Stoichiometry and energetic analysis of cell growth and product formation:** i.) elemental balances - degree of reduction concepts- available electron balances- ii) yield coefficients- iii) oxygen consumption and heat evolution in aerobic culture- iv) Thermodynamic efficiency of growth.- **Thermodynamics of oxidation**:-reduction reactions- **Energetics of protein folding :** enzyme -ligand binding.

UNIT V - BIOCHEMICAL APPLICATIONS OF THERMODYNAMICS (9 hours)

Acidity of solutions- Ionization of biochemicals- solubilities of weak acids- bases and pharmaceuticals as function of pH- Protein concentration in an ultracentrifuge- Thermodynamic analysis of fermenters and other bioreactors.

TEXT BOOKS

1. Smith.J.M, Van Ness.H.C and Abbott.M.M, "*Introduction to Engineering Thermodynamics*", 6th Edn., McGraw Hill International Edition, Singapore 2001.
2. Rao.Y.V.C, "*Chemical Engineering Thermodynamics*", University Press, 1997.

REFERENCES

1. Stanley I. Sandler, "*Chemical and Engineering Thermodynamics*", 4th Edn., John Wiley & Sons, USA, 2006.
2. Kyle.B.G, "*Chemical Process Thermodynamics*", 2nd Edn., Prentice Hall of India Pvt. Ltd., New Delhi, 2000.

CH1054 CHEMICAL AND BIOCHEMICAL ENGINEERING THERMODYNAMICS												
Course Designed by		**Department of Chemical Engineering**										
1.	Student outcomes	a	b	c	d	e	f	g	h	i	j	k
				x					x			x
2.	Mapping of instructional objectives with student outcomes			2					1			3
3.	Category	General(G)		Basic Sciences (B)		Engg. Sci. & Tech. Arts (E)		Professional Subjects (P)				
						x						
4.	Approval	23rd Meeting of Academic Council, May 2013										

BT1014	MOLECULAR BIOLOGY	L	T	P	C
	Total No. of Contact Hours - 45	3	0	0	3
	Prerequisite				
	Nil				

PURPOSE

To provide the fundamental mechanisms of gene expression and regulation at molecular level

INSTRUCTIONAL OBJECTIVES

1.	To familiarize the students with the basic concepts and principles of nucleic acids in prokaryotic and eukaryotic organisms
2.	To understand the structure and machinery of nuclear functions responsible for cell functioning

UNIT I - INTRODUCTION TO MOLECULAR BIOLOGY– DNA AND RNA (9 hours)

Scope and history -Structure of DNA: Nucleoside – Nucleotide - Base pairing - Base stacking - Double helix - Features of Watson and crick model - Major and minor groove - Supercoiling – Twist - Writhe and linking number - Forms of DNA - A, B, Z - **Structure and function of** RNAs – mRNA rRNA – tRNA - Secondary structures in RNA.

UNIT II - REPLICATION AND REPAIR (9 hours)

Replication in prokaryote and eukaryote: Types and function of DNA polymerases - Proof reading activity - 5′- 3′ exonuclease activity - Topoisomerase activity - **Telomeric DNA replication and Plasmid replication** - Theta model - Strand replacement model - Rolling circle model - **DNA repair:** Nucleotide excision repair - Mismatch repair - Photo-reactivation - Recombination repair - SOS repair.

UNIT III - TRANSCRIPTION AND POST TRANSCRIPTIONAL MODIFICATIONS (9 hours)

Fine structure of prokaryotic and eukaryotic genes: Structure and function of the promoters in mRNA, rRNA, tRNA genes - RNA polymerases in prokaryote and eukaryote - Types and function of mRNA, rRNA and tRNA genes in prokaryote and eukaryote - **Post transcriptional processing of mRNA:** 5' capping - Splicing (including different types) - Polyadenylation.

UNIT IV - TRANSLATION AND POST TRANSLATIONAL MODIFICATIONS (9 hours)

Genetic code and wobble hypothesis-Translation in prokaryote and eukaryote - **Post translational modifications:** Principles - Protein sorting - Targeting into endoplasmic reticulum – Mitochondria - Chloroplast and Nucleus.

UNIT V - GENE REGULATION **(9 hours)**

Principles of gene regulation - Transcriptional and post transcriptional gene regulation: Activators – Co-activators – Suppressors – Co-suppressors – Moderators – Silencers – Enhancers – **Operons**: *lac* operon - *trp* operon - *ara*operon - *gal* operon.

TEXTBOOK

1. James D Watson, "*Molecular Biology of Gene*,"Pearson Education, 2011.

REFERENCE

1. Robert Weaver, "*Molecular Biology*", McGraw-Hill, 2011.

BT1014 MOLECULAR BIOLOGY												
Course Designed by		Department of Biotechnology										
1.	Student outcomes	a	b	c	d	e	f	g	h	i	j	K
		x			x							
2.	Mapping of instructional objectives with student outcomes	1			2							
3.	Category	General (G)		Basic Sciences (B)			Engg. Sci. &Tech. Arts (E)			Professional Subjects (P)		
										x		
4.	Broad Area	Biotechnology					Bioprocess Engineering			Chemical Engineering		
		x					--			--		
5.	Approval	23rd Meeting of Academic Council, May 2013										

BT1016	ENZYME ENGINEERING AND TECHNOLOGY	L	T	P	C
	Total No. of Contact Hours - 45	**3**	**0**	**0**	**3**
	Prerequisite				
	Nil				

PURPOSE

The purpose of this course is to provide an opportunity to understand the theoretical concepts of enzyme technology principles and applications.

INSTRUCTIONAL OBJECTIVES

1.	To understand the basics and mechanisms of enzyme catalysis
2.	To impart knowledge on reaction kinetics of free and immobilized enzymes
3.	To study about the sources, production and industrial applications of enzymes

UNIT I - INTRODUCTION TO ENZYMES (8 hours)

Classification of enzymes- Characteristics of enzymes - **Structural Components of Enzymes**: Role of Coenzymes and Cofactors- specificity of enzyme action, **Factors affecting enzyme activity**: pH- temperature, **Enzyme substrate complex formation models**: lock and key- induced fit- Various m**echanisms of enzyme catalysis**: acid base- covalent bonding- proximity

UNIT II – ENZYME KINETICS I (10 hours)

Kinetics of single substrate reactions: Michaelis–Menten Kinetics – Evaluation of Michaelis –Menten parameters- Line Weaver Burk plot- Eadie Hofstee plot - Hanes woolf plot - Eisenthal and Cornish Bowdon plot - turnover number, **Kinetics of multi-substrate reactions**: Ternary-complex mechanisms- Ping–pong mechanisms.

UNIT III - ENZYME KINETICS II (10 hours)

Kinetics of Enzyme Inhibition: Reversible and irreversible enzyme inhibition - competitive, uncompetitive and non competitive enzyme inhibition – substrate and feedback inhibition, **Allosteric enzymes**: MCW model and KNF model, **Methods of immobilization of enzymes**, **Kinetics of immobilized enzymes**: Effects of external mass transfer and intra - particle diffusion, Enzyme Deactivation kinetics.

UNIT IV - PRODUCTION, PURIFICATION AND CHARACTERIZAION OF ENZYMES (9 hours)

Enzyme sources: Extraction from plant, animal and microbial sources - **Production and purification of intracellular and extracellular industrial enzymes** – **Comprehensive flow sheet for enzyme purification**: bioseparation techniques, Analysis of yield, purity and activity of enzymes -**Determination of molecular weight of enzymes:** ultracentrifugation, gel filtration, electrophoresis, MALDI-TOF methods

UNIT V - INDUSTRIAL APPLICATIONS OF ENZYMES (9 hours)

Enzyme reactors- Application of enzymes in food industries: brewing, baking- **Food processing:** High fructose corn syrup production- Detergent industry- Textile industry – leather - pulp and paper industry - **Medical and diagnostic applications of enzymes**: Biosensors.

TEXT BOOKS

1. Trevor Palmer and Philip L Bonner. "*Enzymes: Biochemistry, Biotechnology, Clinical Chemistry*", East- West Press, 2004.
2. Shuler, M.L. and F. Kargi, "*Bioprocess Engineering: Basic Concepts*" 2nd Edn, Pearson, 2002.

REFERENCES

1. Blanch.H.W and Clark.D.S, "*Biochemical Engineering*". Marcel & Dekker, Inc., 1997.
2. Bailey.J.E and Ollis.D.F, "*Biochemical Engineering Fundamentals*", 2nd Edition,McGraw-Hill, 1986.
3. Nicholas.C, Price and Lewis Stevens, "*Fundamentals of Enzymology*", Oxford University Press, 1982.
4. Alan Wiseman, "*Handbook of Enzyme Biotechnology*", 3rd Ed, Ellis Harwood Publications, 1999.

BT1016 ENZYME ENGINEERING AND TECHNOLOGY												
Course Designed by		**Department of Biotechnology**										
1.	Student outcomes	a	b	c	d	e	f	g	h	i	j	k
			x	x					x			
2.	Mapping of instructional objectives with student outcomes		2	3					1			
3.	Category	General (G)		Basic Sciences (B)			Engg. Sci. &Tech. Arts (E)			Professional Subjects (P)		
										x		
4.	Broad Area	Biotechnology					Bioprocess Engineering			Chemical Engineering		
		--					x			--		
5.	Approval	23rd Meeting of Academic Council, May 2013										

BT1017	**BIOPROCESS PRINCIPLES**	**L**	**T**	**P**	**C**
	Total No. of Contact Hours - 45	**3**	**0**	**0**	**3**
	Prerequisite				
	Nil				

PURPOSE

This subject emphasizes on the basic engineering principles of bioprocess. It also highlights the modern application of biotechnological process and the role of biotechnology industry.

INSTRUCTIONAL OBJECTIVES

1.	To study the historical development of bio process technology , design of fermenter and types of fermentation process
2.	To gain knowledge about formulation of medium and principles of sterilization
3.	To study the stoichiometry and energetics of cell growth and product formation
4.	To evaluate the kinetics and mechanism of microbial growth

UNIT I - INTRODUCTION TO BIOPROCESS (8 hours)

Historical development of bioprocess technologies **-** role of bioprocess engineer in the biotechnology industry, **Outline of an integrated bioprocess**: upstream and downstream, unit operations involved in bioprocesses, generalized process flow sheets - A brief survey of organisms **-** processes and products, **Process economics**: market analysis relating to modern industrial biotechnology-economics of citric acid manufacture.

UNIT II - FERMENTER & FERMENTATION PROCESS (9 hours)

Basic design and construction of fermenter and ancillaries: Tasks of fermenter **-General requirements of fermentation processes**: Isolation - preservation and improvement of industrially important microorganisms - inoculum development for industrial fermentations. **Types of fermentation**: An overview of aerobic and anaerobic fermentation processes and their application in the biotechnology industry - submerged and solid-state fermentation and its applications.

UNIT III - MEDIA DESIGN AND STERILIZATION KINETICS (9 hours)

Formulation of media for fermentation processes: Types of media- design and usage of various commercial media for industrial fermentations, **Media optimization:** Plackett Burman screening method- Response surface methodology (RSM), **Sterilization**: Thermal death kinetics of micro organisms - batch and continuous heat sterilization of liquid media - filter sterilization of liquid media and air.

UNIT IV - METABOLIC STOICHIOMETRY AND ENERGETICS (9 hours)

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

UNIT V - MICROBIAL GROWTH AND PRODUCT FORMATION KINETICS (10 hours)

Phases of cell growth in batch cultures - **Simple unstructured kinetic models for microbial growth**: Monod model, growth of filamentous organisms. **Growth associated (primary) and non-growth associated (secondary) product formation kinetics:** Leudking - Piret models - substrate and product inhibition on cell growth and product formation.

TEXT BOOKS

1. Pauline.M.Doran, "*Bioprocess Engineering Principles*", Academic press, 2012.
2. Stanbury.P.F, Whitaker.A and Hall.S.J, "*Principles of Fermentation Technology*", 2nd Edition, Butterworth– Heinemann, 1995.

REFERENCES

1. Najafpour.G.D, "*Biochemical Engineering and Biotechnology*", Elsevier, 2007.
2. Shuler.M.L and Kargi.F, "*Bioprocess Engineering: Basic Concepts*" 2nd Edition, Pearson, 2002.
3. Bailey.J.E and Ollis.D.F, "*Biochemical Engineering Fundamentals*", 2nd Edition, McGraw-Hill, 1986.
4. Blanch.H.W and Clark.D.S, "*Biochemical Engineering*". Marcel & Dekker, Inc., 1997.

BT1017 BIOPROCESS PRINCIPLES												
Course Designed by		**Department of Biotechnology**										
1.	Student outcomes	a	b	c	d	e	f	g	h	i	j	k
		x		x		x			x			
2.	Mapping of instructional objectives with student outcomes	3		2		4			1			
3.	Category	General (G)		Basic Sciences (B)			Engg. Sci. & Tech. Arts (E)			Professional Subjects (P)		
										x		
4.	Broad Area	Biotechnology		Bioprocess Engineering						Chemical Engineering		
		--		x						--		
5.	Approval	23rd Meeting of Academic Council, May 2013										

CH1053	CHEMICAL ENGINEERING PRINCIPLES-I – MECHANICAL OPERATIONS AND MOMENTUM TRANSFER LABORATORY	L	T	P	C
	Total No. of Contact Hours - 30	0	0	2	1
	Prerequisite				

PURPOSE

This course helps the students to experimentally verify the theoretical concepts they learnt in the course: Chemical Engineering Principles –I

INSTRUCTIONAL OBJECTIVES

1. To make the students to experimentally evaluate the concepts of unit operations and momentum transfer.

LIST OF EXPERIMENTS

1. Screening Efficiency
2. Size reduction using Jaw Crusher
3. Leaf Filtration
4. Pressure Filtration
5. Size reduction using Ball Mill
6. Rotary Vacuum Filtration
7. Sink and Float Separation
8. Flow measurement using Orifice Meter
9. Flow measurement using Venturi Meter
10. Performance characteristics of single stage Centrifugal pump
11. Pressure drop study in fluidized bed
12. Drag study

REFERENCE

1. Laboratory manual

CH1053 CHEMICAL ENGINEERING PRINCIPLES-I – MECHANICAL OPERATIONS AND MOMENTUM TRANSFER LABORATORY												
Course Designed by		**Department of Chemical Engineering**										
1.	Student outcomes	a	B	c	d	e	f	g	h	i	j	k
		x	x									x
2.	Mapping of instructional objective with student outcomes	1	1									1
3.	Category	General(G)		Basic Sciences (B)			Engg. Sci. & Tech. Arts (E)			Professional Subjects (P)		
							x					
4.	Approval	23rd Meeting of Academic Council, May 2013										

BT1015	MOLECULAR BIOLOGY LABORATORY	L	T	P	C
	Total No. of Contact Hours - 60	0	0	4	2
	Prerequisite				
	BT1014				

PURPOSE

To provide an opportunity to experimentally verify the theoretical concepts of nucleic acids

INSTRUCTIONAL OBJECTIVE

1. The students will perform various experiments to understand the role of nucleic acids through different techniques.

LIST OF EXPERIMENTS

1. Isolation of genomic DNA from bacteria
2. Plasmid DNA isolation
3. Agarose gel electrophoresis of DNA
4. Polyacrylamide gel electrophoresis of DNA
5. Isolation of RNA
6. Formaldehyde gel electrophoresis of RNA
7. Quantitative analysis of DNA and RNA
8. Restriction digestion of Plasmid DNA
9. Ligation of digested DNA
10. UV mutation

REFERENCE

1. Sambrook et al., "*Molecular Cloning*" A Laboratory Manual.

BT1015 MOLECULAR BIOLOGY LABORATORY												
Course Designed by		**Department of Biotechnology**										
1.	Student outcomes	a	b	c	d	e	f	g	h	i	j	k
		x			x							
2.	Mapping of instructional objectives with student outcomes	1			2							
3.	Category	General (G)		Basic Sciences (B)			Engg. Sci. & Tech. Arts (E)			Professional Subjects (P)		
										x		
4.	Broad Area	Bio-technology		Bioprocess Engineering						Chemical Engineering		
		x		--						--		
5.	Approval	23rd Meeting of Academic Council, May 2013										

BT1018	BIOPROCESS AND ENZYME TECHNOLOGY LABORATORY	L	T	P	C
	Total No. of Contact Hours - 30	**0**	**0**	**2**	**1**
	Prerequisite				
	BT1017				

PURPOSE

Enables the student to develop their skills in the field of bioprocess to understand the basic principles using biocatalysts, optimization of parameters for maximum enzyme activity, kinetic studies, inhibition studies, enzyme immobilization and microbial fermentation for production of industrial products

INSTRUCTIONAL OBJECTIVES

1.	To develop practical skills in enzyme kinetics and immobilization techniques.
2	To produce various marketable bio products through microbial fermentation

LIST OF EXPERIMENTS

1. Isolation and screening of microorganisms for industrial enzymes
2. Enzyme Kinetics - Batch Study
3. Effect of pH on enzyme activity
4. Effect of temperature on enzyme activity
5. Effect of inhibitors on enzyme activity
6. Immobilization of enzymes – Entrapment Method
7. Comparison of free and immobilized enzyme kinetics

8. Bioreactor operation – Demonstration
9. Batch Experiment for production of viable bio products
10. Ethanol fermentation in an immobilized cell reactor using *Saccharomyces cerevisiae*
11. Production of Citric acid by *Aspergillus niger* by Solid Substrate Fermentation

REFERENCE

1. Laboratory Manual

BT1018 BIOPROCESS AND ENZYME TECHNOLOGY LABORATORY												
Course Designed by		**Department of Biotechnology**										
1.	Student outcomes	a	b	c	d	e	f	g	h	i	j	k
			x									x
2.	Mapping of instructional objective with student outcomes		1									2
3.	Category	General (G)		Basic Sciences (B)		Engg. Sci. &Tech. Arts (E)		Professional Subjects (P)				
								x				
4.	Broad area	Biotechnology		Bioprocess Engineering		Chemical Engineering						
		--		x		--						
5.	Approval	23rd Meeting of Academic Council, May 2013										

SEMESTER - V

PD1005	**APTITUDE-III**	**L**	**T**	**P**	**C**
	Total Contact Hours - 30	**1**	**0**	**1**	**1**
	Prerequisite				
	Nil				

PURPOSE

To enhance holistic development of students and improve their employability skills.

INSTRUCTIONAL OBJECTIVES

1.	Understand the importance of effective communication in the workplace.
2.	Enhance presentation skills – Technical or general in nature.
3.	Improve employability scope through Mock GD, Interview

UNIT I **(6 hours)**

Video Profile

UNIT II **(6 hours)**

Tech Talk / Area of Interest / Extempore / Company Profile

UNIT III **(6 hours)**

Curriculum Vitae

UNIT IV **(6 hours)**

Mock Interview

UNIT V **(6 hours)**

Group Discussion / Case Study

ASSESSMENT

1. Objective type – Paper based / Online – Time based test
2. 50% marks based on test, 50 % based on Continuous Communication assessment

REFERENCE

1. Bovee Courtland and Throill John, *Business Communication Essentials: A skills-Based Approach to Vital Business English*. Pearson Education Inc., 2011
2. Dhanavel.S.P, *English & Communication Skills for Students of Science and Engineering*. Orient Black Swan, 2009
3. Rizvi M. Ashraf *Effective Technical Communication*, Tata McGraw-Hill Publishing Company Limited, 2006.

PD1005 – APTITUDE-III												
Course Designed by		**Career Development Centre**										
1.	Student outcome	a	b	c	d	e	f	g	h	i	j	k
								x		x	x	
2.	Mapping of instructional objectives with student outcome							1,2,3		1,2		2,3
3.	Category	General(G)		Basic Sciences(B)			Engineering Sciences and Technical Arts(E)			Professional Subjects(P)		
		x										
4.	Approval	23rd Meeting of Academic Council, May 2013										

	CHEMICAL ENGINEERING PRINCIPLES II - HEAT AND MASS TRANSFER	L	T	P	C
CH1055	Total No. of Contact Hours - 45	**3**	**0**	**0**	**3**
	Prerequisite				
	Nil				

PURPOSE

This course explains the fundamentals of heat and mass transfer operations.

INSTRUCTIONAL OBJECTIVES

1.	To understand the basic concepts of conductive and convective heat transfer and heat exchange equipment's.
2.	To familiarize the mass transfer operations like diffusion, drying and distillation
3.	To understand the principles extraction and adsorption processes involved in industries.

UNIT I - CONDUCTIVE & CONVECTIVE HEAT TRANSFER (9 hours)

Introduction to various modes of heat transfer: Fourier's law of heat conduction, effect of temperature on thermal conductivity- steady-state conduction- compound resistances in series- heat flow through a cylinder. **Concept of heat transfer by convection**: natural and forced convection- application of dimensional analysis for convection- heat transfer to fluids without phase change: heat transfer coefficient calculation for natural and forced convection- **Heat transfer to fluids with phase change**: heat transfer from condensing vapours- dropwise and film-type condensation- **Heat transfer coefficients calculation for film**:-type condensation.

UNIT II - HEAT-EXCHANGE EQUIPMENTS (8 hours)

Typical heat exchange equipment: counter current and parallel-current flows- **Enthalpy balances**: heat exchanges- total condensers. -Double pipe exchanger- single-pass 1-1 exchanger- 1-2 parallel-counterflow exchanger- 2-4 exchanger- heat-transfer coefficients in shell-and-tube exchanger- coefficients for crossflow- correction of LMTD for crossflow.-**Condensers:** shell-and-tube condensers- kettle-type boilers- Calculation of number of tubes in heat exchangers.

UNIT III - DIFFUSION (8 hours)

Molecular diffusion: steady state molecular diffusion in fluids at rest and in laminar flow- molecular diffusion in gases-steady state diffusion: of A through non diffusing B- equimolal counter diffusion- in multicomponent mixtures. Molecular diffusion in liquids-steady state diffusion: of A through nondiffusing B- equimolal counter diffusion. **Effect of temperature and pressure on diffusivity**.

UNIT IV - DRYING & DISTILLATION (10 hours)

Importance of drying in processes: principles of drying- critical moisture content and falling-rate period- porous solids and flow by capillarity- calculation of drying time under constant drying conditions.-**Classification of dryers**: solids handling in dryers- **Equipments for batch and continuous drying processes**: working principle of tray driers- tower driers- rotary driers- spray driers. Concept of freeze drying. -**Basic concepts of various methods of distillation:** batch- continuous- flash- steam- azeotropic and vacuum distillations- Design calculations by McCabe-Thiele and Ponchon-Savarit methods.

UNIT V - EXTRACTION & ADSORPTION (10 hours)

Extraction-basics:working principle of extraction equipments: mixersettlers- spray and packed extraction towers- agitated tower extractors. **General principles of leaching**: working principle of moving-bed leaching equipments: Bollman extractor- Hildebrandt extractor. Percentage extraction calculation for single stage and multistage crosscurrent operations when liquids are insoluble.Minimum solvent rate and number of theoretical stages for continuous countercurrent- multistage extraction operation when liquids are insoluble.**Introduction to adsorption**: adsorbents and adsorption processes- adsorption equipment: fixed- bed adsorbers- gas-drying equipment. Pressure-swing adsorption- adsorption from liquids- adsorption isotherms.

TEXT BOOKS

1. Warren L. Mccabe, Julian C. Smith and Peter Harriott, "*Unit Operations of Chemical Engineering*", 6th Edn., McGraw Hill, New York, 2001.
2. Robert E. Treybal, "*Mass-Transfer Operations*",3rd Edn., McGraw Hill International Ed., Singapore, 1980.

REFERENCES

1. Coulson.J.M, Richardson. J.F, Backhurst.J.R and Harker.J.M, "*Coulson & Richardson's Chemical Engineering*", Vol. I, 6th Edn., Butter worth Heinemann,1999.
2. Binay K.Dutta "*Heat Transfer Principles and Applications*", Prentice Hall of India, 2001.
3. Kern.D.Q, "*Process Heat Transfer*", McGraw-Hill, 1999.

CH1055 CHEMICAL ENGINEERING PRINCIPLES II - HEAT AND MASS TRANSFER												
Course Designed by		**Department of Chemical Engineering**										
1.	Student outcomes	a	b	c	d	e	f	G	h	I	j	k
			x	x					x			
2.	Mapping of instructional objectives with student outcomes		3	2					1			
3.	Category	General(G)		Basic Sciences (B)			Engg. Sci. & Tech. Arts (E)			Professional Subjects (P)		
							x					
4.	Approval	23rd Meeting of Academic Council, May 2013										

	CHEMICAL ENGINEERING PRINCIPLES -II HEAT AND MASS TRANSFER LABORATORY	L	T	P	C
CH1056	Total No. of Contact Hours - 30	**0**	**0**	**2**	**1**
	Prerequisite				
	Nil				

PURPOSE

This course helps the students to experimentally verify the theoretical concepts they learnt in the course: Chemical Engineering Principles –II

INSTRUCTIONAL OBJECTIVES

1.	To make the students to experimentally evaluate the concepts of hear transfer process and mass transfer operations

LIST OF EXPERIMENTS

1. Natural and forced convection heat transfer
2. Heat transfer in a jacketed kettle
3. Study of single effect evaporator
4. Study of shell and tube heat exchanger
5. Heat transfer in agitated vessel
6. Extraction
7. Leaching
8. Batch adsorption
9. Diffusion
10. Air drying

REFERENCE

1. Laboratory manual

CH1056 CHEMICAL ENGINEERING PRINCIPLES-II – HEAT AND MASS TRANSFER LABORATORY												
Course Designed by		**Department of Chemical Engineering**										
1.	Student outcomes	a	b	c	d	E	f	g	h	i	j	k
		x	x									x
2.	Mapping of instructional objective with student outcomes	1	1									1
3.	Category	General(G)		Basic Sciences (B)			Engg. Sci. & Tech. Arts (E)			Professional Subjects (P)		
							x					
4.	Approval	23rd Meeting of Academic Council, May 2013										

BT1019	VECTOR BIOLOGY AND GENE MANIPULATION	L	T	P	C
	Total No. of Contact Hours - 45	3	0	0	3
	Prerequisite				
	Nil				

PURPOSE

To provide the basic knowledge about genetic engineering for cloning and expression of proteins

INSTRUCTIONAL OBJECTIVES

1.	To familiarize the students with the basic concepts and principles of utilization of different expression vectors for cloning in prokaryotic and eukaryotic organisms
2.	To better understand the different strategies of gene cloning and construction of genomic and cDNA libraries for applications of recombinant DNA technology

UNIT I - INTRODUCTION TO CLONING (9 hours)

Overview of cloning: Cell based DNA cloning - Cell free DNA cloning - **Plasmid vectors**: Phage vectors – Cosmids – YAC- Expression vectors.

UNIT II - GENOMIC AND CDNA LIBRARIES (9 hours)

Genomic DNA library: Overlapping and non-overlapping DNA fragments - Choice of vectors - Evaluation of genomic DNA library - **cDNA library**: Purification and separation of RNAs - cDNA library construction - Screening libraries - **Polymerase chain reaction (PCR)**: Semi quantitative PCR - Real time PCR and Applications.

UNIT III - DNA SEQUENCING AND NUCLEIC ACIDS LABELING (9 hours)

Principles of DNA sequencing: Sanger's Dideoxy sequencing method - Maxam and Gilbert's chemical sequencing method - **Labeling of nucleic acids**: Random priming - Nick translation - End labeling - RNA labeling - Non-isotopic labeling methods.

UNIT IV - ANALYSIS AND MANIPULATION OF GENE EXPRESSION AND FUNCTION (9 hours)

Analysis of gene expression: Transcription and translation - **Analysis of gene function - Manipulation of gene expression: S**mall RNAs – siRNAs - MicroRNAs **- Expression in prokaryotic and eukaryotic host cells:***in vitro* mutagenesis.

UNIT V - APPLICATIONS OF CLONING **(9 hours)**

Medical applications: Vaccines - Human and genetic diseases - Embryonic stem cells - Over-expression - Gene knock-in - Gene knock-out.

TEXTBOOK

1. Jeremy W. Dale and Malcolm von Schantz, "*From Genes to Genomes*," John Willey and Sons Publications, 2002.

REFERENCE

1. Old.R.W and Primrose.S.B, "*Principles of Gene Manipulation, An Introduction to Genetic Engineering*," Blackwell Scientific Publications.

BT1019 VECTOR BIOLOGY AND GENE MANIPULATION												
Course Designed by		**Department of Biotechnology**										
1.	Student outcomes	a	b	c	d	e	f	g	h	i	J	k
		x			x							
2.	Mapping of instructional objectives with student outcomes	1			2							
3.	Category	General (G)		Basic Sciences (B)			Engg. Sci. &Tech. Arts (E)			Professional Subjects (P)		
										x		
4.	Broad Area	Bio-technology		Bioprocess Engineering						Chemical Engineering		
		x		--						--		
5.	Approval	23rd Meeting of Academic Council, May 2013										

BT1021	**ANIMAL BIOTECHNOLOGY**	**L**	**T**	**P**	**C**
	Total No. of Contact Hours - 45	**3**	**0**	**0**	**3**
	Prerequisite				
	Nil				
PURPOSE					
To provide a basic understanding of animal biotechnology and its applications					
INSTRUCTIONAL OBJECTIVES					
1.	To impart knowledge on production of transgenic animals and how to improve the meat and milk production.				
2.	To inculcate the understanding of cell culture technique, significance of its cultivation and its application in the production of valuable products.				
3	To develop an understanding on basic pattern of animal breeding, controlling characters and disorders.				

UNIT I - ANIMAL BREEDS (7 hours)

Introduction: Breed: Species-different types of breeding, upgrading, **Economic traits**- Genetic characterization of live stock breeds - Quantitative trait loci- Marker assisted selection. **Genetic disorders** - Chromosomal aberrations in farm animals.

UNIT II - EMBRYO TRANSFER AND TRANSGENIC ANIMALS (8 hours)

Embryo transfer: Artificial insemination, Superovulation, Embryo transfer, In vitro fertilization - Pregnancy diagnosis - Sexing of embryos, Embryo splitting; Cryopreservation of embryo; **Cloning for conservation of endangered species** - **Transgenic animals**: Therapeutic protein expression using transgenic animals - Transgenic fish - Animal as bioreactors.

UNIT III - ANIMAL CELL CULTURE (12 hours)

Principles of sterile techniques and cell propagation; **Primary cell culture, secondary cell culture, continuous cell lines, suspension cultures - Chemically defined and serum free media for cell culture - Scaling up of animal cell cultures**; **Contamination** : sources, types and eradication -**Preservation of animal cells - organotypic culture - Application of animal cell culture for *in vitro* testing of drugs**: Cytotoxicity and viability assays - **Cell culture as source of valuable products** - Protein production by genetically engineered mammalian cell lines.

UNIT IV - RECOMBINANT VACCINES FOR ANIMAL HEALTH (8 hours)

Common viral, bacterial and parasitic diseases affecting animals- Types of Vaccines - Live vaccines, killed vaccines- Conjugate vaccines – Anti-Idiotypic vaccine - Subunit vaccines- Recombinant vaccines - DNA vaccines.

UNIT V - BIOTECHNOLOGY IN ANIMAL PRODUCTION (10 hours)

Manipulation of Growth hormone -somatotropic hormone-Thyroid hormone; **Probiotics as growth promoters** - Ideal characteristics of probiotics, Mode of action-uses of probiotics-**Manipulation of lactation** – Lactogenesis-galactopoiesis - **Manipulation of wool growth-Manipulation of rumen microbial digestive system**.

TEXTBOOKS

1. Freshney.R.I, "*Culture of Animal cells: A manual of basic technique*", Fifth edition, Wiley Publishers, 2010.
2. Ramadass.P, "*Animal Biotechnology: Recent concepts and Developments*", MJP Publications, India, 2008.

REFERENCES

1. Leach.C.K, *"In vitro cultivation of Animal cells"*, Butterworth and Heinnmamm Ltd., 1994.
2. Renaville.R and Burny.A, "Biotechnology in Animal husbandry", Kluwer Academic Publishers, 2001.

BT1021 ANIMAL BIOTECHNOLOGY												
Course Designed by		**Department of Biotechnology**										
1.	Student outcomes	a	b	C	d	e	f	g	h	i	J	k
				x			x			x	x	
2.	Mapping of instructional objectives with student outcomes			1,3			3			2	2	
3.	Category	General (G)		Basic Sciences (B)			Engg. Sci. &Tech. Arts (E)			Professional Subjects (P)		
										x		
4.	Broad Area	Bio-technology		Bioprocess Engineering						Chemical Engineering		
		x		--						--		
5.	Approval	23rd Meeting of Academic Council, May 2013										

BT1022	**PLANT BIOTECHNOLOGY**	**L**	**T**	**P**	**C**
	Total No. of Contact Hours - 45	**3**	**0**	**0**	**3**
	Prerequisite				
	Cell Biology, Biochemistry, Molecular Biology				

PURPOSE

The course is tailored to provide an understanding of the basic concepts and state of art techniques and methods underlying plant biotechnology research including the genetic basis of several important plant properties and the molecular basis of plant breeding. The students will gain an understanding of theoretical principles enabling them to employ the knowledge to solve problems related to plant production and protection through biotechnological approaches.

INSTRUCTIONAL OBJECTIVES	
1.	To explore the structural complexity and diversity of plants
2.	To present an overview of plant tissue culture and genetic manipulation of plants
3.	To impart knowledge in principles underlying plant metabolism
4.	To understand the modern technologies underlying plant breeding and plant protection
5.	To appreciate the utility of plants as production systems

UNIT I - FROM CELLS TO PLANTS (9 hours)

Evolution of plant diversity - variation in plant populations and species –speciation origins of reproductive isolating mechanisms -species concepts -morphology anatomy and embryology - overview of plant phylogeny -phylogenetic relationships of angiosperms- molecular systematics

UNIT II - TECHNIQUES FOR GENETIC MANIPULATION OF PLANTS (9 hours)

Introduction- *Agrobacterium* mediated gene transfer –Ti-plasmid-process of T-DNA transfer and integration, transformation in plant, Direct gene transfer methods. Binary vectors- basic features of vectors-optimization-clean gene technology.

UNIT III - METABOLIC PLANT PHYSIOLOGY (9 hours)

Overview of photosynthesis.- Light absorption and energy conversion; the reaction center complex; the photosystem - Carbon reactions in C_3 plants – Photorespiration - Variations in mechanisms of CO_2 fixation- Carbohydrate metabolism- sucrose and starch- cell wall polysaccharides- non-starch storage polysaccharides Nitrogen and sulphur metabolism- Transport processes

UNIT IV - PLANT BREEDING AND PLANT PROTECTION (9 hours)

Plant reproductive systems- germplasm - variation- types and origin - Plant genetic resources for plant breeding- Sexual hybridization and wide crosses- Mutagenesis - Polyploidy- selected breeding objectives- Cultivar release and commercial seed production. Biotic stress factors- plant-pathogen interactions- natural disease resistance pathways- abiotic stress factors - tolerance mechanisms

UNIT V - PLANTS AS PRODUCTION SYSTEMS (9 hours)

Plant tissue culture-plasticity and totipotency, culture environment, growth regulators, media regulators, culture types, plant regeneration - Hairy root cultures - production of secondary metabolites-carbohydrate and lipid production-molecular pharming of proteins - emerging applications for producing fine chemicals, drugs, and alternative fuels.

TEXT BOOKS

1. Taiz. L and Zeigler.E, "*Plant Physiology*," . Panima Publishing Corporation, New Delhi, Third edition. 2003.
2. Salisbury. F.B and Ross.C.W, "*Plant Physiology*", Wadsworth Publishing Company Fourth edition 1992.
3. Slater. A, Scott.N.W and Fowler.M.R, "*Plant Biotechnology - The genetic manipulation of plants*", Oxford University press 2008.
4. Robert Wayne Allard John, "*Principles of Plant Breeding*", Wiley & Sons Second edition 1999.

REFERENCES

1. Murray.D.R, "*Advanced methods in plant breeding and biotechnology*" CAB International 1991.
2. Stephanopolous.G.N, Aristidou. A.A and Neilsen.J, "*Metabolic engineering-Principles and Methodologies*," Academic Press 1998.
3. Smolke.C, "*The metabolic pathway engineering- Tools and applications*" - CRC Press 2009.

<table>
<tr><th colspan="14">BT1022 PLANT BIOTECHNOLOGY</th></tr>
<tr><td colspan="2">Course Designed by</td><td colspan="12">Department of Biotechnology</td></tr>
<tr><td rowspan="2">1.</td><td rowspan="2">Student outcomes</td><td>a</td><td>b</td><td>c</td><td>d</td><td>E</td><td>f</td><td>g</td><td>h</td><td>i</td><td>j</td><td>k</td></tr>
<tr><td>x</td><td></td><td>x</td><td></td><td>x</td><td></td><td></td><td>x</td><td></td><td></td><td>x</td></tr>
<tr><td>2.</td><td>Mapping of instructional objectives with student outcomes</td><td>1-5</td><td></td><td>1-5</td><td></td><td>1-5</td><td></td><td></td><td>1-5</td><td></td><td></td><td>1-5</td></tr>
<tr><td rowspan="2">3.</td><td rowspan="2">Category</td><td colspan="3">General Subjects (G)</td><td colspan="3">Basic Sciences(B)</td><td colspan="3">Engg. Sci. & Tech. Arts(E)</td><td colspan="2">Professional Subjects(P)</td></tr>
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<tr><td>5.</td><td>Approval</td><td colspan="12">23rd Meeting of Academic Council, May 2013</td></tr>
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BT1024	ENVIRONMENTAL BIOTECHNOLOGY	L	T	P	C
	Total No. of Contact Hours – 45	3	0	0	3
	Prerequisite				
	Nil				

PURPOSE

The purpose of this course is to provide an understanding of fundamental concepts and underlying principles in the Environmental sciences. In addition, the course covers the application of biology-based technologies for bioenergy and bio-remediation.

INSTRUCTIONAL OBJECTIVES

1.	To understand the role of various environmental pollutants and its effects.
2.	To focus the involvement of microbes in waste water treatments.
3.	To focus the role of microorganisms involved in toxic compound degradations.
4.	To focus the role of environmental enzymes in environmental applications
5.	To focus the status of solid waste management's.

UNIT I - WASTE & POLLUTANTS (9 hours)

Source of Waste and Pollutants; Hazardous from Waste and Pollutants; Waste Treatment- Biofilters, Treatment of Liquid wastes, Treatment of Solid wastes, Contributions of Biotechnology to waste treatment and Environmental Managements.

UNIT II - WASTE WATER BIOTREATMENT (9 hours)

Characteristics of Waste Waters; Aerobic and Anaerobic waste water treatment: Activated Sludge Process and Natural Treatment Systems; Stoichiometry and Bioenergetics ; Anaerobic Digestion; Nitrogen Removal and Anammox; Phosphorus Removal and EBPR.

UNIT III - BIODEGRADATIONOF XENOBIOTIC COMPOUNDS (9 hours)

Xenobiotic compounds: Types of Recalcitrant xenobiotic compounds. Biodegradation of Xenobiotics. Hydrocarbons and their derivatives: Aliphatic, Aromatic, Polycyclic compounds. Methods of biodegradation of xenobiotics. Reductive/oxidative/hydrolytic.

UNIT IV - ENVIRONMENTAL ENZYMES AND BIOCATALYSTS (9 hours)

Biocatalyst Discovery: Sources and Techniques: Isolated Enzymes versus whole cell systems; Biocatalyst Engineering, Industrial applications of enzyme based

biocatalysis. Classification of enzymes: Oxidoreductases, Transferases, Hydrolases, Lyases, Isomerases, Ligases. Advantages and Disadvantages of Biocatalysis vs. Chemical Catalysis;

UNIT V - SOLID WASTE MANAGEMENT (9 hours)

Definition of solid wastes –– types of domestic solid wastes – collection – transportation – characteristics of solid waste–segregation – types of disposal methods – sanitary land fill – incineration – composting – Vermicompost – recovery of energy from solid wastes. Biocontrol agents- Bioherbicides & Biopesticides, Biofertilizers.

TEXT BOOKS

1. Bruce E. Rittmann, Perry L. McCarty, "*Environmental Biotechnology: Principles and Applications*" McGraw-Hill, 2001.
2. Michael D. LaGrega,Phillip L. Buckingham, Jeffrey C. Evans, "*Hazardous Waste Management*," Waveland Pr Inc; Reissue edition, 2010.
3. Chatterjee.A.K, "*Introducton to Environmental Biotechnology*," Prentice-Hall of India, 2004.
4. Jogdand.S.N, "*Environmental biotechnology: industrial pollution management*," Himalaya Publishing, 2005.

REFERENCE

1. Leslie Grady Jr C. P., Glen T. Daigger, Nancy G. Love, Carlos D. M. Filipe, "*Biological Wastewater Treatment*," Third Edition, CRC Press, 2011.

BT1024 ENVIRONMENTAL BIOTECHNOLOGY												
Course Designed by		**Department of Biotechnology**										
1.	Student outcomes	a	b	c	d	e	f	g	h	i	J	k
			x									x
2.	Mapping of instructional objectives with student outcomes	1		4		2						
3.	Category	General Subjects (G)		Basic Sciences B)			Engg. Sci. & Tech. Arts (E)				Professional Subjects (P)	
											x	
4.	Broad Area	Biotechnology		Bioprocess Engineering			Chemical Engineering					
		x		--			--					
5.	Approval	23rd Meeting of Academic Council, May 2013										

BT1020	**VECTOR BIOLOGY AND GENE MANIPULATION LABORATORY**	**L**	**T**	**P**	**C**
	Total No. of Contact Hours - 60	**0**	**0**	**4**	**2**
	Prerequisite				
	BT1019				

PURPOSE

To provide an opportunity to experimentally verify the theoretical concepts of gene cloning and protein expression

INSTRUCTIONAL OBJECTIVE

1.	The students will perform various experiments on gene cloning and protein expression through different techniques.

LIST OF EXPERIMENTS

1. Preparation of DNA fragments by PCR
2. Restriction enzyme digestion of vector DNA
3. Purification of DNA fragments/digested vector DNA by column purification
4. Preparation of target DNA by linker/adapters/alkaline phosphatase treatment for cloning
5. Ligation of DNA fragment with cloning vector
6. Preparation of *E. coli* competent cells
7. Bacterial transformation with recombinant vector
8. Preparation of recombinant and non-recombinant vector DNAs
9. Confirmation of insert DNA in recombinant vector
10. Mammalian cell transfection
11. Polyacrylamide gel electrophoresis for protein
12. Western blot analysis

REFERENCE

1. Sambrook et al., '*Molecular Cloning*' A Laboratory Manual'

BT1020 VECTOR BIOLOGY AND GENE MANIPULATION LABORATORY												
Course Designed by		**Department of Biotechnology**										
1.	Student outcome	a	b	c	d	e	f	g	h	i	j	k
2.	Mapping of instructional objectives with student outcome		x		x	x	x					
3.	Category	General(G)		Basic Sciences(B)			Engineering Sciences and Technical Arts (E)				Professional Subjects(P)	
											x	
4.	Broad Area	Biotechnology		Bioprocess Engineering			Chemical Engineering					
		x		--			--					
5.	Approval	23rd Meeting of Academic Council, May 2013										

BT1023	PLANT BIOTECHNOLOGY LABORATORY	L	T	P	C
	Total No. of Contact Hours – 60	**0**	**0**	**4**	**2**
	Prerequisite				
	BT1022				

PURPOSE

To facilitate understanding of the practical use of and theory behind the emerging techniques in the field of plant biotechnology enabling practice of the gained knowledge to solve problems related to plant production through biotechnological approaches.

INSTRUCTIONAL OBJECTIVES

1.	To give students hands-on experience and training in representative plant tissue culture techniques and an insight to explore the applications.
2.	To develop strategies and models to solve problems relating to plant biotechnology by using fundamental principles in plant biotechnology.
3.	To give a practical hand-on experience related to advanced techniques and equipment used in plant biotechnology.
4.	To employ advanced technologies in plant biotechnology such as genetic modification and molecular genetics.
5.	To put into perspective and discuss the potential applications of plant biotechnology.

LIST OF EXPERIMENTS

1. Preparation of tissue culture medium and callus induction
2. Demonstration of direct and indirect organogenesis
3. *In vitro* and *in vivo* embryogenesis
4. Protoplas isolation, electrofusion and regeneration
5. *Agrobacterium* mediated transformation
6. Demonstration of electroporation
7. Extraction and detection of nucleic acids from plants
8. 2-D Gel electrophoresis for separation of plant proteins and peptides
9. Understanding plant pathogen interactions using confocal microscopy
10. Production of secondary metabolites in suspension cultures
11. Purification and quantitation of secondary metabolites using TLC and HPLC
12. SNP based multiplex PCR

REFERENCES

1. Plant Biotechnology Laboratory Manual.
2. Protocols in Plant Biotechnology.

BT1023 PLANT BIOTECHNOLOGY LABORATORY												
Course Designed by		**Department of Biotechnology**										
1.	Student outcomes	a	b	c	d	e	F	G	h	i	j	k
2.	Mapping of instructional objective with Student outcomes	1	1									1
3.	Category	General Subjects (G)			Basic Sciences (B)			Engg. Sci. & Tech. Arts(E)		Professional Subjects (P)		
										x		
4.	Broad area	Biotechnology			Bioprocess Engineering			Chemical Engineering				
		x						--				
5.	Approval	23rd Meeting of Academic Council, May 2013										

	INDUSTRIAL TRAINING I (Training to be undergone after IV semester)	L	T	P	C
BT1047	2 weeks practical training in industry	**0**	**0**	**1**	**1**
	Prerequisite				
	Nil				

PURPOSE

To provide hands-on experience by working in biotechnology related industries

INSTRUCTIONAL OBJECTIVES

1.	Students have to undergo practical training in bioengineering industries or training institutes so that they become aware of the practical application of theoretical concepts studied in the class rooms

Students have to undergo two-weeks practical training in biotechnology related project of their choice but with the approval of the department. At the end of the training student will submit a report as per the prescribed format to the department.

Assessment process

This course is mandatory and the student has to pass the course to become eligible for the award of degree. The student shall make a presentation before a committee constituted by the department which will assess the student based on the report submitted and the presentation made. Marks will be awarded out of 100 and appropriate grades assigned as per the regulations.

BT1047 INDUSTRIAL TRAINING I												
Course Designed by		**Department of Biotechnology**										
1.	Student outcome	a	b	c	d	e	f	g	h	i	j	k
					x		x	x	x	x	x	
2.	Mapping of instructional objective with student outcome				1		1	1	1	1	1	
3.	Category	General Subjects (G)			Basic Sciences (B)			Engg. Sci. & Tech. Arts(E)		Professional Subjects (P)		
										x		
4.	Broad area	Biotechnology			Bioprocess Engineering			Chemical Engineering				
		x						--				
5.	Approval	23rd Meeting of Academic Council, May 2013										

SEMESTER - VI

PD1006	**APTITUDE-IV**	**L**	**T**	**P**	**C**
	Total Contact Hours - 30	**1**	**0**	**1**	**1**
	Prerequisite				
	Nil				

PURPOSE

To enhance holistic development of students and improve their employability skills.

INSTRUCTIONAL OBJECTIVES

1.	To improve aptitude, problem solving skills and reasoning ability of the student.
2.	To collectively solve problems in teams & group.

UNIT I - ARITHMETIC - II **(6 hours)**

Ratios & Proportions, Averages, Mixtures & Solutions

UNIT II - ARITHMETIC – III **(6 hours)**

Time, Speed & Distance, Time & Work

UNIT III - ALGEBRA – II **(6 hours)**

Quadratic Equations, Linear equations & inequalities

UNIT IV - GEOMETRY **(6 hours)**

2D Geometry, Trigonometry, Mensuration

UNIT V - MODERN MATHEMATICS – II **(6 hours)**

Sets & Functions, Sequences & Series, Data Interpretation, Data Sufficiency

ASSESSMENT

1. Objective type – Paper based / Online – Time based test

REFERENCES

1. Agarwal.R.S *, "Quantitative Aptitude for Competitive Examinations",* S Chand Limited 2011
2. Abhijit Guha*, "Quantitative Aptitude for Competitive Examinations",* Tata Mcgraw Hill, 3rd Edition
3. Edgar Thrope*, "Test Of Reasoning For Competitive Examinations",* Tata Mcgraw Hill, 4th Edition
4. *"Other material related to quantitative aptitude"*

PD1006 - APTITUDE-IV												
Course Designed by		**Career Development Centre**										
1.	Student outcome	a	b	c	d	e	f	g	h	i	j	k
		x			x							
2.	Mapping of instructional objectives with student outcome	1			2							
3.	Category	General(G)		Basic Sciences(B)		Engineering Sciences and Technical Arts(E)				Professional Subjects(P)		
		x										
4.	Approval	23rd Meeting of Academic Council, May 2013										

BT1026	PHARMACEUTICAL BIOTECHNOLOGY	L	T	P	C
	Total No. of Contact Hours – 45	3	0	0	3
	Prerequisite				
	Nil				

PURPOSE

The PURPOSE of this course is to provide basic concepts of pharmacology and the role of biotechnological products in pharmaceutical industries. The course ensures to impart brief knowledge on current technologies, requirements and futuristic demand in pharmaceutical sector.

INSTRUCTIONAL OBJECTIVES

1.	To highlight the parameters considered for drug action and drug discovery process.
2.	To understand the current procedures for the manufacture of various chemicals, biological and pharmaceutical products.
3.	To realize the potential avenues and requirements from the biotechnologists in pharmaceutical industries.

UNIT I - GENERAL PHARMACOLOGY (9 hours)

Introduction, Pharmacokinetics – Absorption, Distribution, Metabolism, Excretion and Toxicology. Pharmacodynamics – signal transduction, GPCR's, Ion channels, Steroid receptors and peptide receptors. Efficacy vs Potency, therapeutic window and dosage calculation.

UNIT II - INDUSTRIALLY RELEVANT MICROBIAL METABOLITES (8 hours)

Process technology for the production of both primary and secondary metabolites; organic solvent – alcohol, acid – lactic acid and citric acid, amino acids – glutamic acid and lysine, vitamins – riboflavin and vit. B12, nucleotides – cAMP and cGMP.

UNIT III - CHEMOTHERAPEUTICS (9 hours)

Structure, Mechanism of Action and production of antibiotics – Penicillin and Cephalosporins (beta lactam antibiotics), Griseofulvin, Streptomycin, Rifampicin, Amphotericin B and Mitomycin C.

UNIT IV - GENETICALLY ENGINEERED BIOPHARMACEUTICALS (9 hours)

Industrial production of **(A)** interferon, interleukins (regulatory proteins) **(B)** Erythropoietin (blood products) **(C)** Hepatitis B vaccine **(D)** insulin hormone. Various routes of administration, controlled and targeted drug delivery of therapeutic proteins and peptides.

UNIT V - IMMUNOBIOTECHNOLOGY (8 hours)

Hybridoma technology – selection, screening and fusion methods for myeloma cells and B lymphocytes. Production, purification and application of monoclonal antibodies.Introduction to second generation antibodies and lymphokines.

TEXTBOOKS

1. Tripathi.C.P, "*Essentials of Medical Pharmacology*," 6th Edition, Jaypee publications, 2008.
2. Hugo..W.B and Russel.A.D, "*Pharmaceutical Microbiology*", 6th Edition, Blackwell Science, 2003.
3. Crommelin.D.J.A, Robert D. Sindela, Bernd Meibohm "*Pharmaceutical Biotechnology: fundamentals and applications*", Informa Healthcare, 2008.

REFERENCES

1. Gary Walsh, "*Pharmaceutical Biotechnology-Concepts and Applications*," Wiley, 2007.
2. Stanbury.P.F, Whitaker.A and Hall.S.J, "*Principles of Fermentation Technology*", 2nd Edition, Aditya Books (P) Ltd, 1995.

BT1026 PHARMACEUTICAL BIOTECHNOLOGY												
Course Designed by		**Department of Biotechnology**										
1.	Student outcomes	a	b	c	d	e	f	g	h	i	J	k
		x			x							x
2.	Mapping of instructional objectives with Student outcomes	1			2							3
3.	Category	General Subjects (G)			Basic Sciences B)			Engg. Sci. & Tech. Arts (E)			Professional Subjects (P)	
											x	
4.	Broad Area	Biotechnology			Bioprocess Engineering						Chemical Engineering	
		x			--						--	
5.	Approval	23rd Meeting of Academic Council, May 2013										

BT1027	BIOPROCESS ENGINEERING	L	T	P	C
	Total No. of Contact Hours - 45	3	0	0	3
	Prerequisite				
	BT1017				

PURPOSE

This subject deals with the design, analysis monitoring , modeling and simulation aspect of bioreactors

INSTRUCTIONAL OBJECTIVES

1.	To strengthen the knowledge on design, performance and stability of bioreactors
2.	To understand the mass transfer process and bioreactor scale up
3.	To learn about the methods of on line and off line monitoring of bio process
4.	To acquire knowledge about the fundamentals of modeling and simulations of bio process

UNIT I - DESIGN AND ANALYSIS OF BIOREACTORS (9 hours)

Introduction to ideal reactors: performance equations, **Non-ideal reactors**: Tanks-in-series and Dispersion models-applications to design of continuous sterilizers, **Design and operation of novel bioreactors:**Air-lift loop reactors; Fluidized bed bioreactors, **Stability analysis of bioreactors**.

UNIT II - BIOREACTOR SCALE-UP (10 hours)

Transport phenomena in Bioprocess systems: Oxygen transfer in fermentation broth, Rheological effects, **Regime analysis of bioreactor processes**, Correlations for oxygen transfer; **Scale-up**: Criteria for bioreactors based on oxygen transfer and power consumption.

UNIT III - MONITORING OF BIOPROCESSES (9 hours)

On-line data analysis for measurement of physico-chemical and biochemical parameters: Methods of on-line and off-line biomass estimation; microbial calorimetry, Flow injection analysis for measurement of substrates, products and other metabolites; **State and parameter estimation**: Observer, Kalman filters, ANN, **Computer-based data acquisition**: monitoring and control-LABVIEW Software.

UNIT IV - RECOMBINANT CELL CULTIVATION (8 hours)

Recombinant cell culture processes: Guidelines for choosing host-vector systems, plasmid stability and instability model, limits to over expression, **Modeling of recombinant bacterial cultures**; Bioreactor strategies for maximizing product formation. **Bioreactor configurations for cultivation of animal and plant cells**: Secondary metabolites from plant and animal cell cultures.

UNIT V - MODELLING AND SIMULATION OF BIOPROCESSES (9 hours)

Formulation of model: Study of Structured Models – Willam's two compartment model- Ramakrishna model- Metabolic model- Single cell model. **Simulation software packages**: Model simulation using MATLAB, SIMULINK and ISIM, **Dynamic simulation studies**: Batch, continuous and fed batch fermentation process.

TEXT BOOKS

1. Shuler.M.L and Kargi. F, "*Bioprocess Engineering : Basic Concepts*" 2nd Edition. Pearson, 2002.
2. Blanch.H.W and Clark.D.S. "*Biochemical Engineering*". Marcal & Dekker, Inc., 1997.

REFERENCES

1. Najaf pour.G.D, "*Biochemical Engineering and Biotechnology*", Elsevier, 2007.
2. James M Lee. "*Biochemical Engineering*", Prentice – Hall, 1992.
3. Bailey.J.E and Ollis.D.F, "*Biochemical Engineering Fundamentals*", 2nd Edition, McGraw-Hill, 1986.
4. Pauline.M.Doran, "*Bioprocess Engineering Principles*"; Academic press, 1995.
5. Alan.H.Scragg, "*Bioreactors in Biotechnology- A Practical approach",* Ellis Harwood, 1991.
6. Aiba.S, Humphrey.E and Milli.N.R, "*Biochemical Engineering*" Academic Press, 1973.

BT1027 BIOPROCESS ENGINEERING												
Course Designed by		**Department of Biotechnology**										
1.	Student outcomes	a	b	c	d	e	f	g	h	i	j	k
			x	x		x						x
2.	Mapping of instructional objectives with student outcomes		1	2		4						3
3.	Category	General Subjects (G)		Basic Sciences (B)			Engg. Sci. & Tech. Arts (E)			Professional Subjects (P)		
										x		
4.	Broad Area	Biotechnology		Bioprocess Engineering						Chemical Engineering		
		--		x						--		
5.	Approval	23rd Meeting of Academic Council, May 2013										

BT1025	ANIMAL BIOTECHNOLOGY LABORATORY	L	T	P	C
	Total No. of Contact Hours - 60	0	0	4	2
	Prerequisite				
	BT1021				

PURPOSE

Provides an opportunity to experimentally verify the theoretical concepts on animal cell culture.

INSTRUCTIONAL OBJECTIVES

1.	To enable the students to understand the theoretical concepts in animal biotechnology.
2.	To gain hands on experience on cell culture techniques
3.	To understand the significance of cultivation of the cells *in vitro.*

LIST OF EXPERIMENTS

1. Preparation of culture media and sterilization
2. Primary cell culture - Culture of chick embryo fibroblast cells
3. Culturing of spleen/liver cells
4. Passaging of cell lines
5. Maintenance of adherent and suspension cell cultures
6. Cryopreservation of cells
7. Cell revival
8. Live cell counting – Determining cell density of culture using haemocytometer
9. Determining the differentiation of monolayer cells using fluorescence staining technique.
10. Determining cell toxicity using MTT assay

REFERENCES

1. Freshney.R.I, "*Culture of Animal cells*", Fifth edition, Wiley Publishers, 2010.
2. Leach.C.K, *"In vitro cultivation of Animal cells"*, Butterworth and Heinnmamm Ltd., 1994.

BT1025 ANIMAL BIOTECHNOLOGY LABORATORY												
Course Designed by		**Department of Biotechnology**										
1.	Student outcomes	a	b	c	d	e	f	g	h	i	J	k
			x	x								
2.	Mapping of instructional objective with student outcomes		2	2								
3.	Category	General Subjects (G)		Basic Sciences (B)			Engg. Sci. & Tech. Arts (E)			Professional Subjects (P)		
										x		
4.	Broad area	Biotechnology					Bioprocess Engineering			Chemical Engineering		
		x					--			--		
5.	Approval	23rd Meeting of Academic Council, May 2013										

BT1028	**BIOPROCESS ENGINEERING LABORATORY**	**L**	**T**	**P**	**C**
	Total No. of Contact Hours - 30	**0**	**0**	**2**	**1**
	Prerequisite				
	BT1027				

PURPOSE

Provides an opportunity to experimentally verify the theoretical concepts studied in Bioprocess Engineering. It also helps in understanding the theoretical principles in a more explicit and concentrated manner.

INSTRUCTIONAL OBJECTIVE

1.	To enable the students to understand the basic concepts involved in the bioprocess engineering such as sterilization kinetics, groeth kinetics and effect of mass transfer in fermentation process.

LIST OF EXPERIMENTS

1. Sterilization kinetics- determination of holding time
2. Temperature effect on growth-estimation of energy of activation and Arrhenius constant for microorganisms.
3. Growth kinetics of bacteria- evaluation of specific growth rate, yield coefficient and doubling time

4. Growth kinetics of yeast- evaluation of specific growth rate, yield coefficient and doubling time
5. Screening of Medium composition – Plackett -Burman design
6. Estimation of Monod parameters
7. K_La determination by sulphite oxidation method
8. K_La determination by dynamic gassing method
9. Power correlation analysis
10. K_La determination by power correlation analysis
11. Study of rheology of fermentation broth

REFERENCE

1. Laboratory Manual

BT1028 BIOPROCESS ENGINEERING LABORATORY												
Course Designed by		**Department of Biotechnology Engineering**										
1.	Student outcomes	a	b	c	d	e	f	g	h	i	j	k
		x	x									x
2.	Mapping of instructional objective with Student outcomes	1	1									1
3.	Category	General (G)		Basic Sciences (B)		Engg. Sci. & Tech. Arts (E)		Professional Subjects (P)				
								x				
4.	Broad area	Biotechnology		Bioprocess Engineering		Chemical Engineering		--				
		--		x		--		--				
5.	Approval	23rd Meeting of Academic Council, May 2013										

BT1049	**MINOR PROJECT**	**L**	**T**	**P**	**C**
	Total Contact Hours - 30	**0**	**0**	**2**	**1**
	Prerequisite				
	Nil				

PURPOSE

To carry out a design project in one of the specializations of the program with substantial multidisciplinary component

INSTRUCTIONAL OBJECTIVES

1. To guide the students in such a way so that they carry out a work on a topic as a forerunner to the full fledged project work to be taken subsequently in VIII semester. The project work shall consist of substantial multidisciplinary component

The students will carry out a project in one of the specializations of program under study with substantial multidisciplinary component

Student groups will be formed and a faculty member will be allocated to guide them. Assessment will be based on internal reviews. Based on the reviews marks will be allotted out of 100.

BT1049 MINOR PROJECT												
Course Designed by		**Department of Biotechnology Engineering**										
1.	Student outcome	a	b	c	d	e	f	g	h	i	j	k
		x	x	x	x	x	x	x	x	x	x	x
2.	Mapping of instructional objectives with student outcome	1	1	1	1	1	1	1	1	1	1	1
3.	Approval	23rd Meeting of Academic Council, May 2013										

SEMESTER - VII

BT1029	**PROTEIN ENGINEERING AND PROTEOMICS**	**L**	**T**	**P**	**C**
	Total No. of Contact Hours – 45	**3**	**0**	**0**	**3**
	Prerequisite				
	Nil				

PURPOSE

The course aims at imparting knowledge on proteins through a detailed study of protein structure, its characteristics property and significance in biological systems with strategies for modifying the structures for desirable properties in industry. It briefs about the different analytical techniques for elucidation of protein structure.

INSTRUCTIONAL OBJECTIVES

1.	To appreciate the structure function correlation and the prediction of properties of protein based on its sequence.
2.	To observe the similarities in structure at basal level in a group of having similar function, thereby predicting the strategies to modify and design novel proteins.
3.	To emphasize the role of analytical methods to determine protein structure and protein – protein interactions

UNIT I - STRUCTURE FUNCTION DYNAMICS CORRELATION (9 hours)

Basic structural concepts – Primary, secondary, tertiary and quaternary structures. Ramachandran plot, super secondary structures – motif and domain. Protein folding and mechanisms.

UNIT II - STRUCTURE FUNCTION ENGINEERING (10 hours)

The correlation of structure and function in – transcription factors, serine proteinases, membrane proteins, signal transduction proteins and recognition in immune system.

UNIT III - PREDICTION AND DESIGN OF PROTEINS (10 hours)

Examples of designed proteins (enzymes) with enhanced stability and efficiency, playing a significant role in industries. A case study for – introduction of disulfide bonds (T4 lysozyme), reduction of free sulfhydryl groups, removal of metal requirements in certain proteins, streptokinase, introduction of complementary determining region in antibodies and to increase enzyme activity.

UNIT IV - PROTEIN STRUCTURE CHARACTERIZATION (8 hours)

Proteomes, Analytical proteomics, Protein digestion and separation techniques. Role of Mass spectrometry in protein identification – peptide mass fingerprinting, Tandem MS and SALSA.

UNIT V - PROTEOMICS APPLICATION (8 hours)

Mining proteomes, protein expression profiling, identifying protein – protein Interactions and protein complexes, mapping- protein identification, new directions in proteomics.

TEXTBOOKS

1. Carl Brandon & John Tooze, "*Introduction to Protein Structure*," "2nd Edition" Garland Publishing, 1999
2. Daniel C. Liebler, "*Introduction to Proteomics – Tools for the New Biology*," Humana Press, 2001

REFERENCES

1. Paul R. Carey, "*Protein Engineering and Design*," Academic Press, 1996.
2. Engelbert Buxbaum, "*Fundamentals of Protein Structure and Function*," Springer, 2007.
3. Amit Kessel & Nir Ben-Tal, "*Introduction to Proteins: Structure, Function and Motions*," CRC press, 2010.
4. Malcolm Campbell & Laurie J. Heyer, "*Discovering Genomics, Proteomics & Bioinformatics*," 2nd Edition by 2006.

BT1029 PROTEIN ENGINEERING AND PROTEOMICS												
Course Designed by		Department of Biotechnology										
1.	Student outcomes	a	b	c	d	e	f	g	h	i	j	k
		x	x								x	x
2.	Mapping of instructional objectives with student outcomes	1	2								3	3
3.	Category	General(G)		Basic Sciences (B)		Engg. Sci. & Tech. Arts (E)		Professional Subjects (P)				
								x				
4.	Broad Area	Biotechnology				Bioprocess Engineering		Chemical Engineering				
		x				--		--				
5.	Approval	23rd Meeting of Academic Council, May 2013										

BT1030	BIOSEPARATION TECHNOLOGY	L	T	P	C
	Total No. of Contact Hours - 45	3	0	0	3
	Prerequisite				
	BT1027				

PURPOSE

The course provides an opportunity to understand the importance of the Bioseparation process, economics and process design of bioproducts.

INSTRUCTIONAL OBJECTIVES

1.	To understand the importance of bioseparation processes and solid- liquid separation processes
2.	To gain knowledge about isolation of desired product and purification strategies
3.	To learn about the unit operations involved in product finishing process

UNIT I - INTRODUCTION TO BIOSEPARATION PROCESS (9 hours)

Role and importance of bioseparation in biotechnological processes: RIPP scheme, Problems and requirements of bioproducts purification - Properties of Biomolecules - Characteristics of fermentation broth - Biological activity, Analysis of purity-**Process economics**: Capital and operating cost analysis.

UNIT II - REMOVAL OF INSOUBLES (9 hours)

Cell disruption methods for intracellular products: Physical, chemical and mechanical - **Removal of insolubles:** Biomass and particulate debris separation techniques - flocculation - sedimentation - centrifugation and filtration methods.

UNIT III - ISOLATION OF PRODUCTS (9 hours)

Adsorption: Principles - Langumir- Freundlich isotherms - **Extraction**:Basics-Batch and continuous, aqueous two-phase extraction - supercritical extraction - *in situ* product removal - **Precipitation:** Methods of precipitation with salts - organic solvents and polymers - **Membrane based separations**: Micro and ultra filtration - theory - design and configuration of membrane separation equipment - applications.

UNIT IV - PURIFICATION OF BIOPRODUCT (9 hours)

Basic principles of Chromatographic separations: GC - HPLC - gel permeation - ion-exchange - affinity - reverse phase and hydrophobic interaction chromatography - **Electrophoretic separation techniques**: capillary - isoelectric focusing - 2D gel electrophoresis - Hybrid **separation technologies**: GC-MS and LC-MS.

UNIT V - PRODUCT POLISHING **(9 hours)**

Crystallization: Principles-Nucleation-Crystal growth-Kinetics-**Batch crystallizers**: Scale-up and design, **Drying**: Principles-Water in biological solids-Heat and mass transfer-**Drying equipments:** description and operation-Vacuum shelf - rotary dryer-Freeze dryer-Spray dryer.

TEXT BOOKS

1. Roger G. Harrison, Paul Todd, Scott R. Rudge, Demetri P. Petrides, "*Bio separation Science and Engineering*" Oxford University press, 2003.
2. Belter PA and Cussler E, "*Bioseparations*", Wiley, 1985.

REFERENCES

1. Raja Ghosh, "*Principles of Bioseparations Engineering"*, World Scientific Publishing, 2006.
2. Ladisch.M.R, "*Bioseparation Engineering: Principles, Practice and Economics*", John Wiley & sons, New York, 2001.
3. Asenjo.J.M, "*Separation processes in Biotechnology*" Marcel Dekker Inc.1993.

BT1030 BIOSEPARATION TECHNOLOGY												
Course Designed by		**Department of Biotechnology**										
1.	Student outcomes	a	b	c	d	e	f	g	h	i	j	k
				x		x						x
2.	Mapping of instructional objectives with student outcomes			2		1						3
3.	Category	General(G)			Basic Sciences (B)			Engg. Sci. & Tech. Arts E)			Professional Subjects (P)	
											x	
4.	Broad Area	Biotechnology			Bioprocess Engineering			Chemical Engineering			--	
		--			x			x			--	
5.	Approval	23rd Meeting of Academic Council, May 2013										

BT1032	ETHICAL ISSUES, RESEARCH METHODOLOGY AND INTELLECTUAL PROPERTY RIGHTS	L	T	P	C
	Total No. of Contact Hours - 15	1	0	0	1
	Prerequisite				
	Nil				

PURPOSE

The course is designed to outline the methodology for research in biotechnology and provides an understanding of the ethical issues underlying biotechnology research and innovation in addition to protection of the acquired intellectual property. The student will gain an understanding research methodology, the ethical issues underlying biotechnology research and the importance of protection of intellectual property.

INSTRUCTIONAL OBJECTIVES

1.	To caution the nature of hazards related to biotechnology and the importance of biosafety in research.
2.	To debate on ethical issues related to biotechnology research.
3.	To give an overview of the methods used in scientific research and to emphasize on the importance of statistical concepts.
4.	To provides guidelines on accessing scientific literature, and preparing scientific papers and presentation.
5.	To impart knowledge on the importance of intellectual property and its protection under the constitution.

UNIT I - BIOSAFETY AND GMOs IN INDIA (6 hours)

Regulatory framework in India governing GMOs-Recombinant DNA Advisory Committee (RDAC) - Institutional Biosafety Committee (IBSC) - Review Committee on Genetic Manipulation, Genetic Engineering Approval Committee (GEAC) - State Biosafety Coordination Committee (SBCC) - District Level Committee (DLC). Recombinant DNA Guidelines (1990) -Revised Guidelines for Research in Transgenic Plants (1998) - Prevention Food Adulteration Act (1986) - The Food Safety and Standards Bill (2005)

UNIT II - BIOSAFETY-REGULATORY FRAMEWORK FOR GMOS (6 hours)

Rules for the manufacture, use/import/export and storage of hazardous microorganisms/genetically engineered organisms or cells (Ministry of Environment and Forests Notification (1989) - Plant Quarantine Order (2003), Regulation for Import of GM Products Under Foreign Trade Policy (2006-2007) National Environment Policy (2006) - Convention of Biological Diversity (1992) -

Cartagena Protocol on Biosafety - Objectives and salient features of Cartagena Protocol - Advanced Information Agreement (AIA) procedure - procedures for GMOs intended for direct use-risk assessment- risk management-handling, transport, packaging and identification of GMOs - Biosafety Clearing House-unintentional transboundary movement of GMOs

UNIT III - BIOETHICS (6 hours)

The legal and socioeconomic impacts of biotechnology-Public education of the process of biotechnology involved in generating new forms of life for informed decision making ethical concerns of biotechnology research and innovation.

UNIT IV - RESEARCH METHODOLOGY (6 hours)

Introduction to the design, analysis, and presentation of scientific projects - methods used in scientific research - hypothesis testing - the measurement of functional relationships - and observational research-important features of experimental design,- control of errors- instrument calibration - data analysis

UNIT V - INTELLECTUAL PROPERTY RIGHTS (6 hours)

Intellectual property rights - patents and methods of application of patents - legal implications- objectives of the patent system - basic principles and general requirements of patent law-biotechnological inventions and patent law - patentable subjects and protection in biotechnology- TRIPs – GATT - Biodiversity and Plant variety protection and farmer rights - Seed Policy (2002)

TEXT BOOKS

1. Sasson.A *, "Biotechnologies and Development"*, UNESCO Publications.
2. Singh.K, *"Intellectual Property rights in Biotechnology",* , BCIL, New Delhi.
3. *"Regulatory Framework for GMOs in India"* Ministry of Environment and Forest, Government of India,New Delhi, (2006).
4. *"Cartagena Protocol on Biosafety"* Ministry of Environment and Forest, Government of India, New Delhi, (2006).
5. Michael P. Marder "*Research methods for Science"* Cambridge University Press.

BT1032 ETHICAL ISSUES, RESEARCH METHODOLOGY AND INTELLECTUAL PROPERTY RIGHTS												
Course Designed by		Department of Biotechnology										
1.	Student outcomes	a	b	c	d	e	f	g	h	i	j	k
		x	x	x	x				x		x	
2.	Mapping of instructional objectives with student outcomes	1-5	1-5	1-5	1-5				1-5		1-5	
3.	Category	General Subjects(G)		Basic Sciences(B)		Engg. Sci. & Tech. Arts (E)			Professional Subjects (P)			
									x			
4.	Broad Area	Biotechnology		Bioproc.Engg.		Chemical Engineering						
		x										
5.	Approval	23rd Meeting of Academic Council, May 2013										

BT1031	BIOSEPARATION TECHNOLOGY LABORATORY	L	T	P	C
	Total No. of Contact Hours - 30	0	0	2	1
	Prerequisite				
	BT1030				

PURPOSE

Provides an opportunity to experimentally check the theoretical concepts related to Bioseparation Technology. It also helps in understanding the theoretical principles

INSTRUCTIONAL OBJECTIVE

1.	The students will be exposed to various Bioseparation process such as cell disruption, Product isolation and purification methods

LIST OF EXPERIMENTS

1. Mechanical cell disruption – Ultrasonication
2. Mechanical cell disruption – High pressure homogeneizer
3. Enzymatic cell disruption by lysozyme
4. Separation of insolubles by batch sedimentation- determination of thickener area
5. Flocculation
6. Separation of insolubles by filtration –determination of specific cake resistance
7. Aqueous two phase extraction
8. Ammonium sulphate precipitation and dialysis
9. Ultra and microfiltration
10. Gas chromatography
11. Lyophilization

REFERENCE

1. Scopes AK, "*Protein Purification*", IRL Press, 1993.

BT1031 BIOSEPARATION TECHNOLOGY LABORATORY												
Course Designed by		Department of Biotechnology										
1.	Student outcomes	a	b	c	d	e	f	g	h	i	j	k
		x	x									x
2.	Mapping of instructional objective with student outcomes	1	1									1
3.	Category	General(G)		Basic Sciences (B)			Engg. Sci. & Tech. Arts (E)			Professional Subjects(P)		
										x		
4.	Broad area	Biotechnology		Bioprocess Engineering						Chemical Engineering		
		--		x						x		
5.	Approval	23rd Meeting of Academic Council, May 2013										

BT1048	INDUSTRIAL TRAINING II (Training to be undergone after VI semester)	L	T	P	C
	2 weeks practical training in industry	0	0	1	1
	Prerequisite				
	Nil				

PURPOSE

To provide hands-on experience by working in biotechnology related industries

INSTRUCTIONAL OBJECTIVES

1. Students have to undergo practical training in bioengineering industries or training institutes so that they become aware of the practical application of theoretical concepts studied in the class rooms

Students have to undergo two-week practical training in biotechnology related project of their choice but with the approval of the department. At the end of the training student will submit a report as per the prescribed format to the department.

Assessment process

This course is mandatory and the student has to pass the course to become eligible for the award of degree. The student shall make a presentation before a committee constituted by the department which will assess the student based on the report submitted and the presentation made. Marks will be awarded out of 100 and appropriate grades assigned as per the regulations.

BT1048 INDUSTRIAL TRAINING II												
Course Designed by		**Department of Biotechnology**										
1.	Student outcome	a	b	c	d	e	f	g	h	i	j	k
					x		x	x	x	x	x	
2.	Mapping of instructional objective with student outcome				1		1	1	1	1	1	
3.	Category	General Subjects (G)			Basic Sciences (B)			Engg. Sci. & Tech. Arts (E)			Professional Subjects (P)	
											x	
4.	Broad area	Biotechnology			Bioprocess Engineering						Chemical Engineering	
		x									--	
5.	Approval	23rd Meeting of Academic Council, May 2013										

SEMESTER - VIII

BT1050	MAJOR PROJECT / PRACTICE SCHOOL	L	T	P	C
	Total Contact Hours - 360	0	0	24	12
	Prerequisite				
	Nil				

PURPOSE

To simulate real life situations related to the program and impart adequate training so that confidence to face and tackle any problem in the field is developed in the college itself.

INSTRUCTIONAL OBJECTIVES

1. To guide the students such a way that the they carry out a comprehensive work on the chosen topic which will stand them in good stead as they face real life situations. The project work so chosen by the student shall culminate in gaining of major design experience in the related area of specialization.

MAJOR PROJECT

Each project will cover all the aspects (to the extent possible) of real life application of concepts studied under the program. . Alternately, a few research problems also may be identified for investigation. The project shall be driven by realistic constraints like that related to economic, environmental, social, political, ethical, health & safety, manufacturability and sustainability. The outcomes to be attained by students by doing the project work shall be spelt out clearly. A project report is to be submitted on the topic which will be evaluated during the final review. Assessment procedure will be as spelt out in the regulations.

PRACTICE SCHOOL

Alternately, a student is encouraged to take an industrial project with reputed organizations or firms chosen by the institute. In such cases the student will stay with the firm and carry out the project. The project will be guided by the faculty member and the concerned officer in the industry. All the requirements spelt out under 'MAJOR PROJECT' above, shall be incorporated under this work also. However reviews will be conducted in the institute which the student shall attend.

BT1050 MAJOR PROJECT												
Course Designed by		Department of Biotechnology Engineering										
1.	Student outcome	a	b	c	d	e	f	g	h	i	j	k
		x	x	x	x	x	x	x	x	x	x	x
2.	Mapping of instructional objectives with student outcome	1	1	1	1	1	1	1	1	1	1	1
3.	Approval	23rd Meeting of Academic Council, May 2013										

DEPARTMENT ELECTIVES

BT1051	CANCER BIOLOGY	L	T	P	C
	Total No. of Contact Hours - 45	3	0	0	3
	Prerequisite				
	Cell biology, Biochemistry and Immunology				

PURPOSE

To provide knowledge about biological aspects of cancer.

INSTRUCTIONAL OBJECTIVE

1. To impart basic concepts of cancer biology, various stages in carcinogenesis, molecular cell biology of cancer, cancer metastasis, and cancer therapy.

UNIT I - CANCER CELL BIOLOGY (8 hours)

Introduction to Cancer --Cell cycle—pRb--Tumor suppressor genes--Knudson's two-hit hypothesis--p53--Myc oncoprotein--TGF-b --Cell cycle and cancer--Different forms of cancer--Diet and Cancer

UNIT II - CARCINOGENESIS (8 hours)

Stages of Carcinogenesis-Environment, Genetics, and Cancer—Causes of cancer—Classes and Types of Carcinogens—Ecogenetics and Cancer risk—Carcinogen Metabolism—Epigenetics--DNA repair, pathways, and Human Cancer

UNIT III - SIGNAL TRANSDUCTION: CELL DIVISION, DIFFERENTIATION, AND APOPTOSIS (12 hours)

Signal Transduction-Growth factor signaling-EGF signaling-Oncogenes—Wnt signaling--Immune system in cancer—B cell, T cell, and Cytokine signaling—Neuroendcrine system in cancer-Hormone and Neurotransmitter signaling—Apoptosis—Cancer stem cells

UNIT IV - METASTASIS AND ANGIOGENESIS (9 hours)

Tumor microenvironment in cancer progression—Invasion and Metastasis-Stages in metastasis and the factors involved in the invasive process—Angiogenesis-VEGF signaling

UNIT V - CANCER THERAPY, PREVENTION AND DIAGNOSIS (8 hours)

Current modalities of treatment-Radiation therapy-Surgery-Chemotherapy-Classification of properties of chemotherpeutic drugs—Biological therapy-Cancer prevention and early detection -Imaging and cancer

TEXT BOOK

1. Robert A. Weinberg, "*The Biology of Cancer*," Garland Science; 1 Cdr edition, 2010.

REFERENCE

1. Lauren Pecorino, *"Molecular Biology of cancer: Mechanisms, Targets, and Terapeutics*," Oxford University Press. 3rd edition, 2012.

BT1051 CANCER BIOLOGY												
Course Designed by		**Department of Biotechnology**										
1.	Student outcomes	a	b	c	d	e	f	g	h	i	j	k
		x		x	x				x	x	x	
2.	Mapping of instructional objectives with student outcomes				1					1		1
3.	Category	General(G)		Basic Sciences (B)			Engg. Sci. & Tech. Arts (E)			Professional Subjects (P)		
										x		
4.	Broad Area	Biotechnology					Bioprocess Engineering			Chemical Engineering		
		x					--			--		
5.	Approval	23rd Meeting of Academic Council, May 2013										

BT1052	**STEM CELL BIOLOGY**	**L**	**T**	**P**	**C**
	Total No. of Contact Hours - 45	**3**	**0**	**0**	**3**
	Prerequisite				
	BT1003,BT1004				

PURPOSE

The course aims at imparting basic and advanced topics in Stem Cell Biology and its clinical applications.

INSTRUCTIONAL OBJECTIVES

1.	To strengthen the knowledge of students on stem cell basics and thei applications for the benefit of mankind.
2.	To impart knowledge about stem cell culturing and stem cell signaling.

UNIT I - INTRODUCTION TO STEM CELLS (8 hours)

Stem Cells sources -Unique properties of stem cells- classification- Embryonic stem cells-adult stem cells-umbilical cord stem cells-similarities and differences between adult and embryonic stem cells.

UNIT II - EMBRYONIC STEM CELLS (10 hours)

Stem cells and their developmental potential. In vitro fertilization-culturing of embryos-blastocyst-inner cell mass-isolation and growing ES cells in lab-Identification and characterization of human ES cells-Cloning and controlled differentiation of human embryonic stem cells. Applications of Embryonic stem cells.

UNIT III - ADULT STEM CELLS (9 hours)

Somatic stem cells-test for identification of adult stem cells- adult stem cell differentiation-trans differentiation-plasticity-different types of adult stem cells-liver stem cells-skeletal muscle stem cells-bone marrow derived stem cells.

UNIT IV - STEM CELLS IN TISSUE ENGINEERING (10 hours)

Haematopoietic Stem Cells-Growth factors and the regulation of haematopoietic stem cells-clinical applications of haematopoietic stem cells.Mesenchymal stem cells and their role in bone tissue engineering-bone repair.Therapeutic applications-Parkinsons disease-diabetes. Stem cell based gene therapy and benefits to human.

UNIT V - STEM CELL SIGNALING (8 hours)

Tumor stem cells-common signaling pathways in cancer and embryonic stem cells-Notch signaling- pathway-wnt signaling in cancer and stem cell self renewal.

TEXTBOOKS

1. Potten.C S, "*Stem Cells*," Elsevier, 1996.
2. Robert Lanza, "*Essentials of Stem Cell Biology*," Academic Press, 2009.

REFERENCES

1. Ariff Bongso, Eng Hin Lee, "*Stem Cells: From Bench to Bedside*," World Scientific, 2011.
2. Daniel R. Marshak, "*Stem cell biology*," Cold Spring Harbor Laboratory Press, 2001.
3. Peter Quesenberry, "*Stem cell biology and Gene Therapy*," Wiley-Liss, 1998.

BT1052 STEM CELL BIOLOGY												
Course Designed by		Department of Biotechnology										
1.	Student outcomes	a	b	c	d	e	f	g	h	i	j	k
		x		x	x				x	x	x	
2.	Mapping of instructional objectives with student outcomes	1		2	2				1	2	1	
3.	Category	General(G)		Basic Sciences (B)		Engg. Sci. & Tech. Arts (E)		Professional Subjects (P)				
								x				
4.	Broad Area	Biotechnology		Bioprocess Engineering		Chemical engineering						
		x				--		--				
5.	Approval	23rd Meeting of Academic Council, May 2013										

BT1053	DRUG AND PHARMACEUTICAL BIOTECHNOLOGY	L	T	P	C
	Total No. of Contact Hours – 45	3	0	0	3
	Prerequisite				
	Nil				

PURPOSE

The course design is aimed at industrial production of various biopharmaceuticals for various disorders. The student also gains the fundamental science behind the manufacturing procedure of the drugs and vaccines, as well as, the Patho-physiology in humans.

INSTRUCTIONAL OBJECTIVES

1.	To understand the various dosage forms and the choice of dosage form based on the need.
2.	To gain in depth knowledge on normal physiology of nervous system and the effects of biopharmaceuticals on the system.
3.	To signify the role of biomaterials and biotechnological products in cardio vascular disorders.
4.	To impart the knowledge on industrial scale production of several important pharmaceutical products by biocatalytic routes.
5.	To highlight the current and futuristic trends in vaccine technology and its importance in health care.

UNIT I - DRUG DELIVERY SYSTEM (7 hours)

Various dosage forms, advantages and disadvantages. Controlled and Sustained drug delivery mechanism and the role of biopolymers. Futuristic perspective on

bio - watches for serological analysis, titration of dose and release of the medication.

UNIT II - DRUGS ACTING ON NERVOUS SYSTEM (10 hours)

Molecular mechanism of neuro-transmission – Action potential, Threshold potential, RMP, EPSP and IPSP.Various neurotransmitter and cross-talk.Effects of agonist and antagonist in adrenergic and cholinergic receptors.

UNIT III - BIOTECHNOLOGY IN CARDIO VASCULAR DISORDERS (10 hours)

Introduction to CVS disorders – pulmonary thrombo-embolism, valvular disorders, heart bloc, ischemia and myocardial infarction. Biopolymers – stents, artificial blood vessels and valves. Pace maker and artificial heart - lung machine. Rennin - angiotensin mechanism for blood pressure regulation. Dialyzer.

UNIT IV - BIOCATALYSIS (10 hours)

Prostaglandin synthesis, biocatalytic routes for the synthesis of – anti-inflammatory drugs, anticholesterol drugs, calcium channel blockers, potassium channel openers and anti-arrhythmic agents.Chiral compound (teratogenecity) synthesis (ACE inhibitors) with help of biocatalysis.

UNIT V - VACCINE TECHNOLOGY (8 hours)

Conventional vaccines, antiidiotype vaccine, naked DNA vaccine and ISCOM's. Vaccines against Hepatitis A, Malaria,Typhoid and HIV (in clinical trials).

TEXTBOOKS

1. Tripathi.K.D, "*Essentials of Medical Pharmacology,*" 6th Edition, Jaypee publications, 2008.
2. Crommelin.D.J.A, Robert D. Sindela, "*Pharmaceutical Biotechnology*," 2nd Edition - 2004.
3. Remington,"*The science and Practice of Pharmacy,"* by Vol. I and II, 20th Edition, 2007.

REFERENCES

1. *"Medicinal chemistry: A molecular and biochemical approach,"* 3rd Edition, OUP, 2005.
2. Gary Walsh, "*Pharmaceutical Biotechnology-Concepts and Applications*," Wiley, 2007.
3. Stanbury.P.F, Whitaker.A and Hall.S.J, "*Principles of Fermentation Technology*", 2nd Edition, Aditya Books (P) Ltd, 1995.
4. Hugo.W.B and Russel.A.D, "*Pharmaceutical Microbiology*", 6th Edition, Blackwell Science, 2003.

BT1053 DRUG AND PHARMACEUTICAL BIOTECHNOLOGY												
Course Designed by		**Department of Biotechnology**										
1.	Student outcomes	a	b	c	d	e	f	g	h	i	j	k
					x						x	x
2.	Mapping of instructional objectives with student outcomes				1						4	5
3.	Category	General(G)		Basic Sciences (B)			Engg. Sci. & Tech. Arts (E)			Professional Subjects (P)		
										x		
4.	Broad Area	Biotechnology					Bioprocess Engineering			Chemical engineering		
		x					--			--		
5.	Approval	23rd Meeting of Academic Council, May 2013										

	COMPUTER SIMULATION AND DRUG DESIGNING	L	T	P	C
BT1054	Total No. of Contact Hours – 45	**3**	**0**	**0**	**3**
	Prerequisite				
	Nil				

PURPOSE

The course is aimed at elaborating on the fundamental concepts of classical mechanics and quantum mechanics, thereby highlighting the role of computers in theoretical chemistry calculations. The student would also acquire brief knowledge on parameters considered for drug designing and the computational role in preclinical studies.

INSTRUCTIONAL OBJECTIVES

1.	To understand the black box calculation of parameters of biomolecules and its behavior.
2.	To highlight the different approaches for drug designing and the computer softwares used for it.
3.	To impart the knowledge on artificial intelligence in preclinical trials.

UNIT I - COMPUTER SIMULATION (10 hours)

Useful Concepts in Molecular Modeling: Coordinate Systems. Potential Energy Surfaces.Molecular Graphics.Surfaces.Computer Hardware and Software.Force Fields.Bond Stretching.Angle Bending.Introduction to Non-bonded Interactions.Electrostatic Interactions.Van der Waals Interactions.Hydrogen Bonding in Molecular Mechanics.Minimisation and Related Methods for Exploring the Energy Surface. Non-Derivative method, 1st and 2nd order minimisation methods. Computer Simulation Methods.

UNIT II - MODELING METHODS (10 hours)

Computer Simulation Methods.Simple Thermodynamic Properties and Phase Space.Boundaries. Free energies and solvation, electrostatic and non electrostatic contribution to free energies. Simulation analysis and Error Estimation.MO Theory.Empirical Methods.Geometric Optimization (Gaussian).Free Energy Perturbation.Global minimum problem.Simulated Annealing.Monte Carlo Simulation.

UNIT III - ANALOGUE BASED DRUG DESIGN (8 hours)

Quantitative Structure Activity Relationship and parameters considered. Hit and target – lead discovery strategies, multi target drugs, lead molecule identification and optimization, design of bioassay, optimizing target interactions, Combinatorial and parallel synthesis. Molecular modeling in drug discovery.

UNIT IV - STRUCTURE BASED DRUG DESIGN (10 hours)

Introduction to HIV protease inhibitor design strategy, 3D pharmacophores, molecular docking, De novo Ligand design, 3D data base and virtual screening, sources of data, molecular similarity and similarity searching. Rational drug design – reduction of toxicity, endogenous compounds as drugs.Preclinical and clinical trials.

UNIT V – ARTIFICIAL INTELLIGENCE IN DRUG DESIGN (7 hours)

The Castlemaine Project.Role of AI techniques in Castlemaine project. Computational tools for drug design. Expert Systems.Computer Languages for AI applications. Multivariate QSAR – role of AI.

TEXTBOOKS

1. Andrew Leach, "*Molecular Modeling: Principles and applications*," 2nd edition, Pearson Education.
2. Pandeya.S.N, "*An Introduction to Drug Design*," NewAge International (P) Ltd., Publishers, ISBN : 978-81-224-0943-7.

REFERENCES

1. Vinter.J.G, Mark Gardner, "*Molecular Modelling and Drug Design*," CRC presss, ISBN-13:978-0849377723
2. Graham L. Patrick, "*An Introduction to Medicinal Chemistry*"
3. Remington, "*The science and Practice of Pharmacy*," Vol. I and II, 20th Edition, 2007.
4. "*Medicinal chemistry: A molecular and biochemical approach*," 3rd Edition, OUP, 2005.

BT1054 COMPUTER SIMULATION AND DRUG DESIGNING												
Course Designed by		Department of Biotechnology										
1.	Student outcomes	a	b	c	d	e	f	g	h	i	j	k
		x	x		x							x
2.	Mapping of instructional objectives with student outcomes	1	2		3							3
3.	Category	General (G)		Basic Sciences (B)		Engg. Sci. & Tech. Arts (E)		Professional Subjects (P)				
								x				
4.	Broad Area	Biotechnology		Bioprocess Engineering		Chemical Engineering						
		x		--		--						
5.	Approval	23rd Meeting of Academic Council, May 2013										

BT1055	INDUSTRIAL FERMENTATION TECHNOLOGY	L	T	P	C
	Total No. of Contact Hours - 45	3	0	0	3
	Prerequisite				
	Nil				

PURPOSE

This course provides an opportunity to learn the importance of the industrial fermentation processes and production of various valuable bioproducts through fermentation.

INSTRUCTIONAL OBJECTIVES

1.	To understand the basics of industrial fermentation process.
2.	To gain the knowledge about the products of primary and secondary microbial metabolites
3.	To learn about the production process of beverages and pharmaceutically important bioproducts.

UNIT I - BASICS OF INDUSTRIAL FERMENTATI (6 hours)

Introduction to industrial fermentations: Types of fermentation process – **Microbial growth metabolism**: Microbial metabolites – screening – strain development, preservation methods – **Product development:** regulation and safety -use of Process flowcharts and block diagrams.

UNIT II - PRODUCTION OF PRIMARY METABOLITES (10 hours)

Production of primary metabolites: **Organic acids fermentation:**Citric acid – Acetic acid – Lactic acid – **Amino acids**:L-glutamic acid – L-lysine – L-tryptophan – **Solvents:**Acetone-Butanol – Ethanol.

UNIT III - PRODUCTION OF SECONDARY METABOLITES (10hours)

Antibiotic production: Classification-**Carbohydrate containing antibiotic**:Streptomycin – **Macro cyclic lactones:** Erythromycin – **Quiones**: Tetracycline – **Amino acid containing antibiotic**:Penicillin – **Peptide antibiotic**: Bacitracin – **Industrial Enzyme production**: α-amylase – cellulase – protease – lipase, **Vitamins**: Cyanaocobalamin – Riboflavin Fermentation.

UNIT IV - FOOD AND BEVERAGE FERMENTATION (10 hours)

Food fermentations: Cheese – yogurt – sauerkraut – soy sauce- **Food flavoring agents**: MSG – γ-decalactone – **Food preservative**: Nisin – **Food colorants:***Monascus* pigments fermentation – **Production of single cell protein**: Bel – symba – pekilo – pruteen processes - **Beverages**: Brewing process – Wine and Cider production.

UNIT V - PRODUCTION OF OTHER COMMERCIAL PRODUCT (9 hours)

Recombinant protein production: Insulin – interferon – **Production of nucleosides and nucleotides:** 5' IMP – 5' GMP – **Enzyme biotransformations**: Types- steriod – antibiotic transformations-**Biopolymers**: Xanthan gum – PHA – PHB – **Agrochemicals:** *Bacillus thuringenesis* insecticide production.

TEXT BOOK

1. Wulf Cruger and Anneleise Cruger, "*Biotechnology: A Textbook of Industrial Microbiology*", Panima Publishing ,2000

REFERENCES

1. Yuan Kun Lee, "*Microbial Biotechnology: Principles and Applications*", World Scientific Publishing 2006.
2. Michael J. Waites, "*Industrial Microbiology: An Introduction*", Blackwell Science, 2001.
3. Samuel Cate Prescott, Cecil Gordon Dunn, Gerald Reed, "*Prescott & Dunn's Industrial Microbiology*", CBS Publishers, 1983.
4. Patel.A.H, "*Industrial Microbiology*", MacMillan Publishers, 1985.
5. Ratledge, Colin and Bjorn Kristiansen "*Basic Biotechnology*" 2nd EdN, Cambridge University Press, 2001.
6. Henry J. Peppler, D. Perlman, "*Microbial Technology: Microbial processes*", Volume I, Academic Press, 1979.
7. L.E.Casida JR, "*Industrial Microbiology*", New Age international Publishing, 1968.

BT1055 INDUSTRIAL FERMENTATION TECHNOLOGY												
Course Designed by		Department of Biotechnology										
1.	Student outcomes	a	b	c	d	e	f	g	h	i	j	k
				x					x			x
2.	Mapping of instructional objectives with student outcomes			2					1			3
3.	Category	General(G)		Basic Sciences(B)		Engg. Sci. & Tech. Arts (E)		Professional Subjects (P)				
								x				
4.	Broad Area	Biotechnology		Bioprocess Engineering				Chemical Engineering				
		--		x				x				
5.	Approval	23rd Meeting of Academic Council, May 2013										

BT1056	BIOREACTOR DESIGN	L	T	P	C
	Total No. of Contact Hours - 45	3	0	0	3
	Prerequisite				
	BT1027				

PURPOSE

The course imparts advanced knowledge on bioreactor design for efficient utilization of the principles in bioprocess technology.

INSTRUCTIONAL OBJECTIVES

1.	To understand the basic concepts of bioreactor design
2.	To learn about the Air-driven bioreactors and bioreactors for plant and animal cell cultivation
3.	To study about the solid state bioreactors and instrumentation control of bioreactors

UNIT I - BIOREACTOR DESIGN (9 hours)

Types of Bioreactor: Stirred tank bioreactors – **Design equations**: Batch – CSTR – Fed Batch reactor, Monod model for a chemostat – Multistage fermenter.

UNIT II - AIR-DRIVEN BIOREACTORS (9 hours)

Airlift bioreactors: Design and construction of the airlift - loop reactor, Hydrodynamics – Three - phase flow – Mixing – Oxygen transfer, Design and construction of Bubble column fermenter: Design and operation of Fluidized bed bioreactor**.**

UNIT III - PLANT AND ANIMAL CELL BIOREACTORS (9 hours)

Design consideration for plant cell cultivation: Plant cell bioreactors- STR – ALR – BC – rotary drum – spin filter – process strategies – **Animal cell bioreactors**: Bubble Columns and Air-Lift Reactors – Fluidized Bed Bioreactors – **Membrane Bioreactor Design**: Cell Recycle Membrane Reactors.

UNITIV - SOLID STATE FERMENTATION BIOREACTORS (9hours)

Solid-State Bioreactor Fundamentals: Selection and design of SSF reactors – Heat and mass transfer in SSF reactors – **Types:**Unaerated and Unmixed, Forcefully-Aerated Bioreactors Without Mixing, Rotating-Drum and Stirred-Drum Bioreactors – Continuously-Mixed, Forcefully-Aerated Bioreactors – Intermittently-Mixed Forcefully-Aerated Bioreactors.

UNIT V - INSTRUMENTATION CONTROL OF BIOREACTORS (9 hours)

Bioreactor sensor characteristics: Temperature measurement control – principles of dissolved oxygen measurement and control – principles of pH / redox measurement and control – deduction and prevention of foam – **Determination of biomass and application of biosensors,Off –gas analysis**: Steady - state balancing – Derived quantities based on combined gas analysis and gas mass balancing techniques – Gas analyzers.

TEXT BOOKS

1. Scragg H., "*Bioreactors in Biotechnology*", Ellis Horwood series, 1991.
2. Klaas Van't Riet, Johannes Tramper, "*Basic Bioreactor Design*", 2nd ed., Marcel Dekker, Inc., New York, 1991

REFERENCES

1. Henry C. Vogel, "*Fermentation and biochemical engineering handbook: principles,process design, and equipment*", Noyes Publications, 1983.
2. David Mitchell, Nadia Krieger, Marin Berovic, "*Solid-State Fermentation Bioreactors :Fundamentals of Design and Operation*", Springer-Verlag Berlin Heidelberg ,2006.
3. Regine Eibl, Dieter Eibl, Ralf Pörtner, "*Cell and Tissue Reaction Engineering: Principles and Practice"*, Springer,2008.
4. Saurabh Chattopadhyay, Sunita Farkya, Ashok K. Srivastava, and Virendra S. Bisaria "*Bioprocess Considerations for Production of Secondary Metabolites by Plant Cell Suspension Cultures", Biotechnology and Bioprocess Engineering"*. 2002, 7: 138-149.

BT1056 BIOREACTOR DESIGN												
Course Designed by		Department of Biotechnology										
1.	Student outcomes	a	b	c	d	e	f	g	h	i	j	k
				x					x			x
2.	Mapping of instructional objectives with student outcomes			2					1			3
3.	Category	General(G)		Basic Sciences (B)			Engg. Sci. & Tech. Arts (E)			Professional Subjects(P)		
										x		
4.	Broad Area	Biotechnology		Bioprocess Engineering			Chemical Engineering					
		--		x			x					
5.	Approval	23r[d] Meeting of Academic Council, May 2013										

BT1057	FOOD AND BEVERAGE FERMENTATION TECHNOLOGY	L	T	P	C
	Total No. of Contact Hours - 45	3	0	0	3
	Prerequisite				
	Nil				

PURPOSE

To make the student to understand the science underpinning food fermentations, food preservation , technology of fermented beverages and fermented food products and food sanitation.

INSTRUCTIONAL OBJECTIVES

Students completing this course should be able

1.	To understand the role of food fermentation and preservation
2.	To list the major fermented food products and beverages
3.	To analyze methods used to control or destroy microorganism commonly found in food.

UNIT I - THE SCIENCE UNDERPINNING FOOD FERMENTATIONS (9 hours)

Microorganisms: microbial metabolism– nutritional needs – environmental impacts – metabolic events – **Fermenters:** Downstream processing – Some general issues for a number of food stuffs.

UNIT II - FOOD PRESERVATION (9 hours)

Preservation by Moist Heat: Heat Resistance of microorganisms and spores – Decimal reduction time (D values) – 12D concept – Thermal Death Time curves – Unit of lethality – determination of process lethality requirements – effective F values – **Preservation by low temperature**: The behavior of microorganisms under freezing and refrigeration environment – Growth and lethal effects of low temperature treatments on microorganisms in raw and processed foods. Preservation by drying, Chemicals and **ionizing irradiation**– Pulsed electric field (PEF) method.

UNIT III - TECHNOLOGY OF FERMENTED BEVERAGES (9 hours)

Fermented products: Beer – Wine – Cider – Distilled alcoholic beverages – Flavoured spirits and sake.

UNIT IV -TECHNOLOGY OF FERMENTED FOOD PRODUCTS (9 hours)

Fermented food products: Vinegar – cheese – yoghurt and other fermented milk products – bread – **Meat:** sausage, bologna, **Fermented vegetables:** Sauerkaurt – Kimchi – Soya sauce – Miso – Natto.

UNIT V- FOOD SANITATION (9 hours)

Basic principles of food plant sanitation: cleaning chemicals and sanitizers in the food industry – Indicator organism – coliform bacteria – **Hazard Analysis and Critical Control Point (HACCP) Program** – Good manufacturing Practices(GMP's)and microbiological standards.

TEXT BOOKS

1. Charles W.Bamforth, "*Food, fermentation and microorganisms*", Blackwell Publishing, 2005.
2. Frazier, W.C. and Dennis.D.Westhoff, "*Food Microbiology",* 3rd Edn*,* Tata McGraw Hill Publishing, 1978.

REFERENCES

1. Zeki Berk, "*Food Process Engineering and Technology*", Academic Press, 2009.
2. James.M.Jay, Martin.J.Loessner, David.A. Golden, "*Modern Food Microbiology*", 7th Edn, 2005.
3. Paul SinghR., Dennis R. Heldman, "*Introduction to Food Engineering*", 4th Edn, Academic Press, 2009.

BT1057 FOOD AND BEVERAGE FERMENTATION TECHNOLOGY												
Course Designed by		Department of Biotechnology										
1.	Student outcomes	a	b	c	d	e	f	g	h	i	j	k
				x					x			x
2.	Mapping of instructional objectives with student outcomes			2					1			3
3.	Category	General(G)		Basic Sciences(B)			Engg. Sci. & Tech. Arts (E)			Professional Subjects (P)		
										x		
4.	Broad Area	Biotechnology		Bioprocess Engineering			Chemical Engineering					
		--		x			--					
5.	Approval	23rd Meeting of Academic Council, May 2013										

BT1058	BIOCHEMICAL REACTION ENGINEERING	L	T	P	C
	Total No. of Contact Hours – 45	3	0	0	3
	Prerequisite				
	CH1051 and CH1054				

PURPOSE

This course helps the students to develop a clear understanding of the fundamentals of chemical and biochemical reaction engineering.

INSTRUCTIONAL OBJECTIVES

To familiarize

1.	Basic concepts of reaction kinetics and reactor types
2.	Various aspects of design for single, multiple reactions and Effects of temperature and pressure on conversion
3.	Kinetics of Biochemical reaction systems

UNIT I - REACTION KINETICS (9 hours)

Kinetics of homogeneous reactions: Law of mass action – Rate equation – concentration-dependent term of a rate equation – temperature- dependent term of a rate equation – predictability of reaction rate from theory – Elementary– non-elementary reactions and their mechanisms– **Interpretation of batch reactor data:** constant volume batch reactor – varying-volume batch reactor – temperature and reaction rate, Search for a rate equation.

UNIT II - IDEAL REACTORS (9 hours)

Introduction to reactor design – **Ideal reactors for a single reaction:** ideal batch reactors – Steady-state mixed flow reactors – steady-state plug flow reactors.

UNIT III - SINGLE AND MULTIPLE REACTIONS (9hours)

Design for single reactions: size comparison of single reactors – multiple-reactor systems – recycle reactor – **Design for parallel reactions:** Irreversible first-order reactions in series.

UNIT IV - TEMPERATURE AND PRESSURE EFFECTS (9 hours)

Single reactions: heats of reaction from thermodynamics – equilibrium constants from thermodynamics – optimum temperature progression – heat effects – adiabatic operations, non-adiabatic operations.

UNIT V - BIOCHEMICAL REACTION SYSTEMS (9 hours)

Enzyme fermentation – **Microbial fermentation**: substrate limiting microbial fermentation – product limiting microbial fermentation- Batch and mixed flow fermenters.

TEXT BOOKS

1. Octave Levenspiel, "*Chemical Reaction Engineering*", 3rd Edn, John Wiley & Sons , Singapore, 1999.
2. Scott Fogler H., "*Elements of Chemical Reaction Engineering*", 2nd Edn., Prentice Hall of India, New Delhi, 1995.

REFERENCES

1. Smith J.M., "*Chemical Engineering Kinetics*", 3rd Edn., McGraw Hill, New Delhi, 1981.
2. Ronald.W.Missen,Charles.A.Mions,Bradley.A.Saville, "*Introduction to Chemical Reaction operation and Kinetics*", John Wiley and Sons, Singapore, 1999.

BT1058 BIOCHEMICAL REACTION ENGINEERING												
Course Designed by		Department of Biotechnology										
1.	Student outcomes	a	b	c	d	e	f	g	h	i	j	k
				x		x			x			
2.	Mapping of instructional objectives with student outcomes			2		3			1			
3.	Category	General(G)		Basic Sciences (B)		Engg. Sci. & Tech. Arts(E)		Professional Subjects (P)				
								x				
4.	Broad Area	Biotechnology		Bioprocess Engineering		Chemical Engineering						
		x		--		--						
5.	Approval	23rd Meeting of Academic Council, May 2013										

BT1059	BIOREMEDIATION TECHNOLOGY	L	T	P	C
	Total No. of Contact Hours - 45	3	0	0	3
	Prerequisite				
	Nil				

PURPOSE

The PURPOSE of this course is to introduce the use of living organisms such as plants and microbes or their systems to the treat contaminants. In addition, the course is expected to develop an efficient, eco-friendly and economical novel alternative treatment technologies.

INSTRUCTIONAL OBJECTIVES

1.	To impart sufficient scientific understanding of the current environmental tribulations and global concern.
2.	To focus the process of bioremediation, mechanisms, types, success stories& monitoring strategies.
3.	To focus the advance molecular techniques to facilitate bioremediation technology.
4.	To focus on advanced nuclear remediation program.
5.	To apply the concepts of bioremediation technology to the real time problems.

UNIT I - BIOREMEDIATION (9 hours)

Introduction to Bioremediation: Types of Bioremediation, Factors affection Bioremediation .Bioremediation Mechanisms.Limitations of Bioremediations.**Microbes for Bioremediation** :Essential Chararcteristics of Microbes for Bioremediation, Microbial Adapadation for Adverse conditions. Microbes involved in Bioremediation. Metabolic process involved in bioremediation. **Bioremediation Techniques** : Insitu & Exsitu bioremediation techniques. Phytoremediation.

UNIT II - SPECIFIC BIOREMEDIATION TECHNOLOGIES (9 hours)

Application, specific advantages and disadvantages of specific **bioremediation technologies**- land farming, prepared beds, biopiles, composting, bioventing, biosparging, pump and treat method, constructed wet lands, use of bioreactors for bioremediation. **Phytoremediation,** restoration of coal mines a case study.

UNIT III - ENVIRONMENTAL GENOMICS & PROTEOMICS MOLECULAR TECHNIQUES (9 hours)

Environmental Metagenomics – Introduction Pure culture and in consortium ; Cultivable and Non-cultivable microbial analysis; Recombination DNA technology and DNA cloning; Types of vectors, applications of recombination DNA technology. Molecular fingerprinting techniques (RFLP, T-RFLP, ARISA, DGGE, rDNA library, and FISH) Stable isotope probing (SIP); Suppressive subtractive hybridization (SSH); Differential expression analysis (DEA).Microarrays & Metagenome sequencing. Next-generation sequencing approaches to metagenomics. Applications of Proteomics in Metagenomics Challenges with MS Analysis.

UNIT IV - NUCLEAR WASTE BIOREMEDIATION (9 hours)

Spent fuel characterisation, storage and disposal; Partitioning, transmutation and conditioning; Measurement of Radioactivity in the environment; Basic **actinide research.**

UNIT V - HEAVY METAL AND OIL SPILL BIOREMEDIATION (9 hours)

Heavy metal pollution & sources; Microbial interactions with heavy metals - resistance &tolerance ;**Microbial transformation**; Accumulation and concentration of metals. Biosorption of heavy metals by microbial biomass and secondary metabolites – **Biosurfactants.** Advantages of biosurfactants over chemical surfactants.; Biotechnology and oil spills; Improved oil recovery.

TEXT BOOKS

1. Bruce E. Rittmann, Perry L. McCarty, "*Environmental Biotechnology: Principles and Applications"* McGraw-Hill, 2001.
2. Phillip L. Buckingham, Jeffrey C. Evans," *Hazardous Waste Management"* Waveland Pr Inc; Reissue edition 1, 2010.
3. Agarwal S. K., *"Environmental Biotechnology*", APH Publishing, 2000.
4. Rajendran P., P. Guansekaran, "*Microbial Bioremediation*", Mjp Publishers, 2011.

REFERENCES

1. Agarwal S. K., *"Environmental Biotechnology*", APH Publishing, 2000.
2. Martin Alexander, "*Biodegradation & Bioremediation"*, Academic press, 1999.

BT1059 BIOREMEDIATION TECHNOLOGY												
Course Designed by		Department of Biotechnology										
1.	Student outcomes	a	b	c	d	e	f	g	h	i	j	k
			x									x
2.	Mapping of instructional objectives with student outcomes	1		4		2						
3.	Category	General(G)		Basic Sciences (B)		Engg. Sci. & Tech. Arts (E)		Professional Subjects (P)				
								x				
4.	Broad Area	Biotechnology		Bioprocess Engineering				Chemical Engineering				
		x		--				--				
5.	Approval	23rd Meeting of Academic Council, May 2013										

BT1060	METAGENOMICS	L	T	P	C
	Total No. of Contact Hours – 45	3	0	0	3
	Prerequisite				
	Nil				

PURPOSE

The purpose of this course is to provide focus on next generation DNA sequencing technology to describe the ecological roles of microbial communities in different environments. It also provides how the metabolic functions, taxonomic distribution, diversity, evenness and species richness of microbial communities varies across environment.

INSTRUCTIONAL OBJECTIVES

1.	To use metagenomic data to describe the taxonomic make-up, functional potential and ecological processes of microbial communities from a range of environments
2.	To apply next generation sequencing technology.
3.	To assemble and annotate genomes by identifying genes

UNIT I - ENVIRONMENTAL GENOMICS (9 hours)

Environmental Metagenomics – Introduction; Pure culture and in consortium ; Cultivable and Non-cultivable microbial analysis; Recombination DNA technology and DNA cloning; Types of vectors, applications of recombination DNA technology; Molecular fingerprinting techniques (RFLP, T-RFLP, ARISA, DGGE, rDNA library, and FISH); Stable isotope probing (SIP); Suppressive subtractive

hybridization (SSH); Differential expression analysis (DEA); Microarrays & Metagenome sequencing; Next-generation sequencing approaches to metagenomics

UNIT II - ENVIRONMENTAL PROTEOMICS (9 hours)

Protein separations before digestion; One-dimensional SDS-PAGE, Two-dimensional SDS-page, Problems with 2d-SDS-PAGE, Preparative IEF, High-performance liquid chromatography; **Protein separations after digestion**: Mass spectrometers for protein and peptide analysis, Instrumentation, MALDI-TOF-MS. The TOF mass analyzer, Pros and cons of MALDI, **Protein identification by peptide mass fingerprinting**, Peptide mass fingerprinting: analytical approach, Peptide mass fingerprinting: complications, Software tools for peptide mass fingerprinting, Finding the matches, Applications of Proteomics in Metagenomics; Challenges with Metagenomic Analysis

UNIT III - LIBRARY CONSTRUCTION & ANALYSIS OF METAGENOMIC LIBRARIES (9 hours)

Cataloging microbes: phylogenetic tree and construction - Construction of a metagenomic library; Analysis of Metagenomic Libraries; Sequence-based Metagenomics Analysis; Function-based Metagenomics Analysis; **Phylogenetic analysis** and Comparative genomics Softwares & Tools

UNIT IV - METAGENOMICS CASE STUDIES (9 hours)

Metagenomic analysis of soil microbial communities; Metagenomic analysis of marine microbial communities; **Metagenome of the Microbial Community in Acid Mine Drainage** ; **Metagenomic Analysis of Bacteriophage**; Metagenomics and Its Applications to the Study of the Human Microbiome; Archaeal Metagenomics: Bioprospecting Novel Genes and Exploring New Concepts.

UNIT V - METAGENOMICS IN ENVIRONMENTAL STUDIES (9 hours)

Application of Metagenomics to Bioremediation ; Applications of Metagenomics for Industrial Bioproducts; Escherichia coli host engineering for efficient metagenomic enzyme discovery; Next-generation sequencing approaches to metagenomics; Stable isotope probing: uses in metagenomics; DNA sequencing of uncultured microbes from single cells

TEXT BOOKS

1. Joanna R. Freeland, Heather Kirk, Stephen Petersen, "*Molecular Ecology*", Mc Graw Hill, 2nd Edition "2012.
2. Beebee T.J.C., D G. Rowe," *An Introduction to Molecular Ecology*", Mc Graw Hill, 2004.

REFERENCES

1. Diana Marco Universidad Nacional de Cordoba, Argentina, "*Metagenomics: Theory, Methods and Applications"*, Caister Academic Press, 2010.
2. Diana Marco Universidad Nacional de Cordoba, Argentina "*Metagenomics: Current Innovations and Future Trends"*, Caister Academic Press, 2011.

BT1060 METAGENOMICS												
	Course Designed by	**Department of Biotechnology**										
1.	Student outcomes	a	b	c	d	e	f	G	h	i	j	k
			x									x
2.	Mapping of instructional objectives with student outcomes	1		4		2						
3.	Category	General (G)		Basic Sciences(B)			Engg. Sci. & Tech. Arts (E)			Professional Subjects (P)		
										x		
4.	Broad Area	Biotechnology		Bioprocess Engineering			Chemical Engineering					
		x		--			--					
5.	Approval	23rd Meeting of Academic Council, May 2013										

BT1061	**BIOENERGY**	**L**	**T**	**P**	**C**
	Total No. of Contact Hours – 45	**3**	**0**	**0**	**3**
	Prerequisite				
	Nil				

PURPOSE

The purpose of this course is to provide an understanding of fundamental concepts in understanding biofuel/bioenergy; renewable feedstocks, their production, availability and attributes for biofuel/bioenergy production.

INSTRUCTIONAL OBJECTIVES

1.	To provide a thorough understanding of various renewable feedstocks of importance their availability and attributes for biofuels production.
2.	To provide a thorough understanding of the broad concept of second and third generationbiofuel production from biomass and other low-cost agri-residues and biowastes.
3.	To provide students with tools and knowledge necessary for biofuel facility operations.
4.	To teach our students to analyze and design processes for biofuel production.
5.	To teach Nanotechnology applications in bioenergy fields.

UNIT I - ENERGY **(9 hours)**

Introduction; Resources: Renewable and non-renewable resources (Water, Minerals, and Energy; Use and overexploitation; **Classification and Sources of Energy**; Problems relating demand and supply of various energy sources; Coal, Petroleum etc.

UNIT II - BIOMASS & ENERGY CROPS **(9 hours)**

Energy Crops : wood(Lignocellulose) – Degradation by microorganisms and pathway studies. Sugar and Starch crops - Degradation by microorganisms and pathway studies. Oil seeds crops - **Degradation by microorganisms and pathway studies.**Hydrocarbon producing crops - Degradation by microorganisms and pathway studies.

UNIT III - BIOFUELS **(9 hours)**

First Generation Biofuels : Bioethanol , – Production meachnisms by microbes, **Second Generation Biofuels:** Methane and Hydrogen – Production mechanisms by microbes, Factors affecting Biogas yields. **Third Generation Biofuels** : Biobutanol. Biodesel from algae.

UNIT IV - CLEAN COAL TECHNOLOGY **(9 hours)**

Principles of Microbial Metal Leaching: Leaching Mechanisms: Models of Leaching Mechanisms. **Factors Influencing Bioleaching**.Bacterial Attachment on Mineral Surfaces Microbial Diversity in Bioleaching Environments.**Case Studies of Bioleaching Applications:** Commercial-Scale Copper Ore Bioleaching; Bacterial oxidation of Chalcophyire and pyrite; Reactor Bioleaching of Fly Ash; Shake Flask Bioleaching of Electronic Scrap; Bioremediation of Metal-Contaminated Sites.

UNIT V - SPECIAL TOPICS **(9 hours)**

From Microbes to Megawatts – **Microbial Fuel Cells** - Types of Biological fuel cells – Working Principle - Applications of Biological Fuel cells. **Biofilm -** Theory and Applications.**Biosensor -** Theory and Applications**. Environmental Nanobiotechnology** : Nano carbons, Nano catalysts, Nano aerosols & gels for waste water treatment.

TEXT BOOKS

1. Samir K. Khanal, "*Anaerobic Biotechnology for Bioenergy Production: Principles and Applications"*, Wiley-Blackwell Publishing, 2008.
2. David M. Mousdale, "*Biofuels: Biotechnology, Chemistry, and Sustainable Development "*CRC Press, 2008.
3. Gupta, Vijai Kumar; Tuohy, Maria G. (Eds.), "*Biofuel Technologies Recent Developments"*, Springer, 2013.

REFERENCES

1. Robert C. Brown, "*Biorenewable Resources: Engineering New Products from Agriculture"*, Wiley-Blackwell Publishing, 2003.
2. Pogaku, Ravindra; Sarbatly, Rosalam Hj. (Eds.), "*Advances in Biofuels*", Springer, 2013.

BT1061 BIOENERGY												
Course Designed by		**Department of Biotechnology**										
1.	Student outcomes	a	b	c	d	e	f	g	h	i	j	k
			x									x
2.	Mapping of instructional objectives with student outcomes	1		4		2						
3.	Category	General (G)		Basic Sciences(B)			Engg. Sci.& Tech Arts (E)			Professional Subjects (P)		
										x		
4.	Broad Area	Biotechnology		Bioprocess Engineering						Chemical Engineering		
		x		--						--		
5.	Approval	23rd Meeting of Academic Council, May 2013										

BT1062	**ENVIRONMENTAL MICROBIOLOGY**	**L**	**T**	**P**	**C**
	Total No. of Contact Hours - 45	**3**	**0**	**0**	**3**
	Prerequisite				
	Nil				

PURPOSE

The PURPOSE of this course is to provide an understanding of fundamental concepts and underlying principles in the Environmental Microbiology. In addition, the course is expected to develop identifying community members and determining their metabolic and ecological roles in the community.

INSTRUCTIONAL OBJECTIVES

1.	To impart sufficient scientific understanding of the basic concepts in ecological processes of microbial communities from a range of environments.
2.	To apply the concepts of extremophiles and its taxonomic make up.
3.	To focus the general understanding of the extremophiles and its uses in Biotechnology.
4.	To provide experience in various techniques to study extremophiles.

UNIT I - BIODIVERSITY **(9 hours)**

Introduction to microbial biodiversity – distribution, abundance, ecological niche.Types- Bacterial, Archael and Eucaryal. Characteristics and classification of Archaebacteria.Thermophiles: Classification, hyperthermophilic habitats and ecological aspects. Extremely Thermophilic Archaebacteria, Thermophily, commercial aspects of thermophiles.Applications of thermozymes. Methanogens: Classification, Habitats, applications.

UNIT II - ALKALOPHILES AND ACIDOPHILES **(9 hours)**

Classification, alkaline environment, soda lakes and deserts, calcium alkalophily Applications . Acidophiles: Classification, life at low pH, acidotolerence, applications.

UNIT III - HALOPHILES AND BAROPHILES **(9 hours)**

Classification, Dead Sea, discovery basin, cell walls and membranes – Purple membrane, compatible solutes.Osmoadaptation / halotolerence.Applications of halophiles and their extremozymes. Barophiles: Classification, high-pressure habitats, life under pressure, barophily, death under pressure.

UNIT IV - NITROGEN FIXING BACTERIA **(9 hours)**

Introduction to Nitrogen Fixation –biological fixation ; Nitrogenase enzyme and its activity & physiology ; Nod genes – nif genes – I; Nod genes – nif genes – II ; Regulation of nitrogen fixation genes;Process of nodulation- Bacteriods;Transfer of nif genes to microorganisms;National interests and Economic considerations;

UNIT V - SPACE MICROBIOLOGY **(9 hours)**

Aims and objectives of Space research. Life detection methods a] Evidence of metabolism (Gulliver) b] Evidence of photosynthesis (autotrophic and heterotrophic) c] ATP production d] Phosphate uptake e] Sulphur uptake .Martian environment (atmosphere, climate and other details).*Antartica as* a model for Mars. Search for life on Mars, Viking mission, Viking landers, and Biology box experiment. Gas exchange, Label release and pyrolytic release experiments .Monitoring of astronauts microbial flora: Alterations in the load of medically important microorganisms, changes in mycological autoflora, and changes in bacterial autoflora.

TEXT BOOKS

1. Christon J. Hurst, Ronald L. Crawford, Guy R. Knudsen, Michael J. McInerney, "*Manual of Environmental Microbiology*," 2nd edition, ASM Press. 2001.

2. Hans G. Schlegel, "*General Microbiology*," Seventh Edition, Cambridge University Press Publisher, 1993.
3. Lansing M Prescott, John P.Harley and Donald A. Klein, "*Microbiology*," Mc Graw Hill publication, Seventh edition, 2008
4. Michael J. Pelczar, "Microbiology," Tata McGraw-Hill,1993.

REFERENCES

1. Maier, R.M. Pepper, I.L and Gerba, "*Environmental Microbiology*," C.P. Academic press, 2000.
2. Joanne M Willey, Joanne Willey, "*Prescott's Microbiology*," 8th edition, 2009, ISBN:0077350138

BT1062 ENVIRONMENTAL MICROBIOLOGY												
Course Designed by		**Department of Biotechnology**										
1.	Student outcomes	a	b	c	d	e	f	g	h	i	j	k
			x									x
2.	Mapping of instructional objectives with student outcomes	1		4		2						
3.	Category	General (G)		Basic Sciences(B)			Engg. Sci.& Tech. Arts (E)			Professional Subjects (P)		
										x		
4.	Broad Area	Biotechnology		Bioprocess Engineering						Chemical Engineering		
		x		--						--		
5.	Approval	23rd Meeting of Academic Council, May 2013										

BT1063	**ANIMAL THERAPEUTICS**	**L**	**T**	**P**	**C**
	Total No. of Contact Hours - 45	**3**	**0**	**0**	**3**
	Prerequisite				
	Nil				

PURPOSE

To impart knowledge on various animal sources for the production of therapeutics.

INSTRUCTIONAL OBJECTIVES

1.	To provide guidelines for the product development and drug testing.
2.	To educate the students for the *in vitro* and *in vivo* source of drugs and their applications.
3.	To know the values of ethics in animal study.

UNIT I - HISTORY OF PRODUCT DEVELOPMENT (9 hours)

History of the product development for the human kind - guidelines for the product industry for the uses of animal and human cells.**Product development and drug testing** – Common product safety tests.

UNIT II - METHODS AND SOURCES OF PRODUCT STUDY (8 hours)

***In vitro* and *in vivo* method of products** – selection and culture of cell lines, types of human and animal cell lines. **History, assessment and types of animal models for the products**.

UNIT III - COMPARATIVE MEASUREMENT OF SOURCES (9 hours)

Methods of production of therapeutics -Comparative status of drugs from both natural and cell line or animal models.**Animal models and their applications** – Fruit fly and Zebra fish.

UNIT IV - PRODUCTS AND THEIR SPECIFIC SOURCES 10 hours)

Production of medicinally important products from *in vitro* sources– Hormones, blood clotting factors, interferons, plasminogen activator, erythropoietin and antitrypsin.

UNIT V - ETHICAL ISSUES AND PATENT APPROVAL (9 hours)

Fundamental issues for cell-line banks in biotechnology and regulatory affairs - Ethical issues on animal model research. **Patents in the drug industry**: Legal and Ethical Issues-**Drug Approval in the European Union and the United States**.

TEXT BOOKS

1. Allan B. Haberman, "*Animal Models for Therapeutic Strategies",* Cambridge Healthtech Institute, 2010.
2. Gary Walsh, "*Pharmaceutical Biotechnology: Concepts and Applications"*, John Wiley & Sons Ltd, 2007.

REFERENCES

1. Freshney R.I., "*Culture of Animal cells",* 5th Edition, Wiley Publications, 2010.
2. Jim E. Riviere and Mark G. Papich (Eds), "*Veterinary Pharmacology and Therapeutics*," Wiley-Blackwell, 9th Ed., 2009.

BT1063 ANIMAL THERAPEUTICS												
Course Designed by		Department of Biotechnology										
1.	Student outcome	a	b	c	d	e	f	g	h	i	j	k
							x				x	x
2.	Mapping of instructional objectives with student outcome						3				2	1
3.	Category	General(G)		Basic Sciences(B)			Engineering Sciences and Technical Arts(E)				Professional Subjects(P)	
											x	
4.	Broad Area			Biotechnology			Bioprocess Engineering				Chemical Engineering	
				x			-				-	
5.	Approval	23rd Meeting of Academic Council, May 2013										

BT1064	TRANSGENIC ANIMALS	L	T	P	C
	Total No. of Contact Hours - 45	3	0	0	3
	Prerequisite				
	Nil				

PURPOSE

This course explains the fundamentals of transgenic animals and their potential applications.

INSTRUCTIONAL OBJECTIVES

1.	To import knowledge on basic techniques for transgenic study and their issues.
2.	To understand about the sources for transgenic animals and the products.

UNIT I - HISTORICAL ASPECTS OF TRANSGENIC STUDY (9 hours)

History and Concepts of transgenic techniques of gene transfer, principles of animal cloning. **Social, ethical, religious, environmental and other regulatory issues related to transgenic animal technology**.

UNIT II - PROMOTORS AND VECTORS (8 hours)

Suitable promoters for expression of transgenes - eukaryotic expression vectors, detection of transgenes in the new born.

UNIT III - METHODS OF TRANSGENESIS (10 hours)

Methodology for production of transgenic animals - Retroviral vector method - DNA micro injection - Engineered embryonic stem cell method, Oocyte culture. **Transgenic animals** - Dolly, Cattle, Goat, Pigs and Rat.

UNIT IV - DEVELOPMENT OF ANIMAL MODELS (9 hours)

Knock out and knock in technology- Advances in development of animal models for human diseases using transgenic animal technology - cystic fibrosis, atherosclerosis, obesity.

UNIT V - PRODUCTS FROM TRANSGENIC SOURCES (9 hours)

Applications of transgenic animals for the production - therapeutic proteins - better nutrition, disease resistance, xenotransplantation. **Bioindicator-** transgenic Glofish.

TEXT BOOKS

1. Carl A. Pinkert (Eds.), "*Transgenic Animal Technology – A laboratory handbook"*, Academic press, USA, 2002.
2. Ranga, M.M., "*Transgenic Animals*", Riddhi International, India, 2006.
3. Louis-Marie Houdebine, "*Transgenic Animals- Generation and Use*", CRC Press, 1997.
4. Jose Cibelli, Robert P. Lanza, Keith H.S. Campbell and Michael D. West (Eds.), "*Principles of Cloning"*, Academic press, USA, 2002.

REFERENCES

1. Ralf Pörtner, "*Animal Cell Biotechnology: Methods and Protocols (Methods in Biotechnology)"*, Humana Press; 2nd edition (April 5, 2007).
2. Joseph Panno, "*Animal Cloning: The Science of Nuclear Transfer (New Biology)",* Facts on File Science Library, (October 2004).

BT1064 TRANSGENIC ANIMALS												
Course Designed by		Department of Biotechnology										
1.	Student outcome	a	b	c	d	e	f	g	h	i	j	k
									x			x
2.	Mapping of instructional objectives with student outcome								1			2
3.	Category	General (G)		Basic Sciences(B)		Engineering Sciences and Technical Arts (E)			Professional Subjects(P)			
									x			
4.	Broad Area	Biotechnology				Bioprocess Engineering			Chemical Engineering			
				x		-			-			
5.	Approval	23rd Meeting of Academic Council, May 2013										

BT1065	VACCINE BIOTECHNOLOGY	L	T	P	C
	Total No. of Contact Hours - 45	3	0	0	3
	Prerequisite				
	Nil				

PURPOSE

To understand the historical developments of vaccine production and to current methods and their management.

INSTRUCTIONAL OBJECTIVES

1.	To provide the knowledge on conventional to recent technology of vaccine production.
2.	To learn the types of vaccine, immunological effects and regulatory guidelines.

UNIT I - HISTORICAL DEVELOPMENTS OF VACCINE (9 hours)

History of vaccine development-Conventional strategies for vaccine improvement, live attenuated and killed vaccines, types of adjuvant, quality control, preservation and monitoring of microorganisms in seed lot systems.

UNIT II - BETTER PRODUCTION (9 hours)

Technology related to monitoring - temperature, sterilization, environment, quality assurance and related areas. **Production techniques-** growing the microorganisms in maximum titer, preservation techniques, freeze drying.

UNIT III - TYPES, METHODS AND APPLICATION (10 hours)

Types of vaccines- subunit vaccine, synthetic vaccines, DNA vaccines, virus like particles, recombinant vaccines and edible vaccines.**Uses of nanoparticles in vaccine application**.

UNIT IV - DELIVERY METHODS (8 hours)

Immunomodulators-Innovative methods of delivery of immunogens through liposomes, microsperes, **ISCOMS**.

UNIT V - GUIDELINES FOR THE MANAGEMENT (9 hours)

Regulatory issues- Environmental concerns with the use of recombinant vaccines- Disease security and biosecurity principles and OIE guidelines such as seed management- Method of manufacture- inprocess control, batch control, test on final products.

TEXT BOOKS

1. Ronald W. Ellis, "*New Vaccine Technologies"*, Landes Bioscience, 2001.
2. Cheryl Barton, "*Advances in Vaccine Technology and Delivery"*, Espicom Business Intelligence, 2009.

REFERENCES

1. Thomas J. Kindt, Richard A. Goldsby, Barbara A. Osborne and Janis Kuby, "*Kuby Immunology",* 6th edition W.H. Freeman and company, 2007.
2. Ramadass, P., "*Animal Biotechnology – Recent concepts and Developments"*, MJP Publications, India, 2008.

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<tr><th colspan="14">BT1065 VACCINE BIOTECHNOLOGY</th></tr>
<tr><th colspan="2">Course Designed by</th><th colspan="12">Department of Biotechnology</th></tr>
<tr><td rowspan="2">1.</td><td rowspan="2">Student outcome</td><td>a</td><td>b</td><td>c</td><td>d</td><td>e</td><td>f</td><td>g</td><td>h</td><td>i</td><td>j</td><td>k</td></tr>
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<tr><td rowspan="2">4.</td><td rowspan="2">Broad Area</td><td colspan="6">Biotechnology</td><td colspan="3">Bioprocess Engineering</td><td colspan="3">Chemical Engineering</td></tr>
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<tr><td>5.</td><td>Approval</td><td colspan="12">23rd Meeting of Academic Council, May 2013</td></tr>
</table>

BT1066	MARINE BIOTECHNOLOGY	L	T	P	C
	Total No. of Contact Hours - 45	3	0	0	3
	Prerequisite				
	Nil				

PURPOSE

To provide an adequate knowledge of the wealth of marine and aquaculture resources. In addition to know the techniques on the resource management.

INSTRUCTIONAL OBJECTIVES

1.	To understand the economically important marine animals and their potency as toxins and drugs.
2.	To learn the knowledge on the degradation process for discharged wastes.
3.	To know the diseases of aquaculture animals and its management.

UNIT I - ECONOMICAL IMPORTANCE OF MARINE RESOURCES (9 hours)

Wealth of the sea - Economically important marine animals – finfishes, shrimp, crab, edible oysters and pearl oysters.

UNIT II - TOXINS AND THEIR ACTION (9 hours)

Marine toxins from animals – sources and pharmacological potentials of tetrodotoxins, conotoxins and ciguateratoxins.

UNIT III - POTENTIAL BIOACTIVE COMPOUNDS (10 hours)

Bioactive compounds from the sea - source and benefits of antioxidants, collagen, gelatin, heparin, chitosan, omega 3 fatty acids and carotinoids.

UNIT IV - OIL AND SOLID WASTE DEGRADATION (8 hours)

Oil spillage – methods of degradation in coastal waters, **Algal blooms- Biodegradation of pesticides and heavy metals discharged coastal waters- Management of solid wastes disposed into coastal waters**.

UNIT V - DISEASE AND WATER QUALITY MANAGEMENT (9 hours)

Diseases associated with cultured shrimps and fishes-disease management - antibiotics, Immunostimulants, diagnostic kits. **Water quality management in hatcheries and grow out ponds**.

TEXT BOOKS

1. Milton Fingerman and Rachakonda Nagabhushanam, "*Recent Advances in Marine Biotechnology (Series) Biomaterials and Bioprocessing"*, Science Publishers, 2009.
2. Proksch and Werner E.G.Muller, *Frontiers in Marine Biotechnology*, Horizon Bioscience, 2006.
3. Le Gal, Y., Ulber, R, "*Marine Biotechnology I: Advances in Biochemical Engineering/Biotechnology",* (Series editor: T. Scheper) Springer-Verlag Berlin Heidelberg. Vol. 96, 2005.
4. Le Gal, Y., Ulber, R "*Marine Biotechnology II: Advances in Biochemical Engineering/Biotechnology",* (Series editor: T. Scheper) Springer-Verlag Berlin Heidelberg. Vol. 97, 2005.

REFERENCES

1. Attaway D.H. and Zaborsky O.R., (eds). "*Marine Biotechnology: Volume I, Pharmaceuticals and Bioactive Natural Products",* New York: Plenum. 1993.
2. Powers D.A., "*New frontiers in marine biotechnology: Opportunities for the 21st century", In: Marine Biotechnology in the Asian Pacific Region* (eds). C. G. Lundin and R. A. Zilinskas. The World Bank and SIDA. Stockholm. 1995.

BT1066 MARINE BIOTECHNOLOGY												
Course Designed by		**Department of Biotechnology**										
1.	Student outcome	a	b	c	d	e	f	g	h	I	j	k
							x		x			x
2.	Mapping of instructional objectives with student outcome						1		2			3
3.	Category	General(G)		Basic Sciences(B)			Engineering Sciences and Technical Arts(E)				Professional Subjects(P)	
											x	
4.	Broad Area			Biotechnology			Bioprocess Engineering				Chemical Engineering	
				x								
5.	Approval	23rd Meeting of Academic Council, May 2013										

BT1067	PHYTOCHEMICAL TECHNIQUES	L	T	P	C
	Total No. of Contact Hours - 45	3	0	0	3
	Prerequisite				
	Biochemistry				

PURPOSE

The course is designed to provide an understanding of the range of metabolites synthesized by plants and the varied applications of these metabolites. The student will gain an understanding of theoretical principles related to the metabolic pathways leading to the synthesis of these metabolites *in vivo* and various modern techniques for the purification and identification. The course would be relevant for students who wish introduction to the latest techniques and theory related to the range of industrially important compounds including pharmaceuticals, cosmetics, food-flavours, biofuels and oils to substitute unsustainable products.

INSTRUCTIONAL OBJECTIVES

1.	To explore the structural complexity and diversity of pharmaceutically relevant plant metabolites
2.	To impart knowledge in principles underlying plant secondary metabolism
3.	To present an overview of different classes of metabolites present in plants
4.	To understand the technologies underlying the isolation, purification, quantitation and identification of plant metabolites
5.	To appreciate the diversity of plant metabolites and their utility

UNIT I - OVERVIEW OF PLANT SECONDARY METABOLITES (9 hours)

Drugs from plants - Insecticides and rodenticides- Industrially important Plant products Essential Oils, Fatty Oils & Waxes, Fibers & Fiber Plants, Forest Products: Wood and Cork, Forest Resources, Gums & Resins, Rubber and Other Latex Products, Tanning, Dye & Processing Materials.

UNIT II - METABOLITES DERIVED FROM THE SHIKMATE CHORISMATE PATHWAY (9 hours)

Plant acids, fatty acids and lipids, alkanes and related hydrocarbons, polyacetylenes, sulphur compounds. nitrogen compounds-amino acids, amines, alkaloids, cyanogenic glycosides, inoles, purines, pyrimidines and cytokinins, chlorophylls.

UNIT III - METABOLITES DERIVED FROM THE MALONIC AND MEVALONIC ACID PATHWAYS (9 hours)

Phenols and phenolic acids, phenylpropanoids, flavonoid pigments, anthocyanins, flavaonols and flavones, tanins, quinones. essential oils, diterpenoids and gibberellins, triterpenoids, steroids and catotenoids.

UNIT IV - CONVENTIONAL METHODS IN PLANT ANALYSES (9 hours)

Introduction- selection of plants and plant parts - methods of extraction and isolation, methods of separation, methods of identification, analysis of results and application

UNIT V - ADVANCES IN PLANT ANALYTICAL TECHNIQUES (9 hours)

GC - HPLC- HPTLC-OPLC – NMR-MS Microarray- RT PCR- RNA SEQ – fluorescence and confocal microscopy - CHN analysis - X ray crystallography

TEXT BOOK

1. Harbone J. B., "*Phytochemical Method-- A guide to modern techniques of plant analysis*," Chapman and Hall Third edition. 2005.

REFERENCES

1. Sarker, S. D., Latif, Z. and Gray,A.I. "*Methods in Biotechnology -Natural Product Isolation*" Second Edition, Humana Press 2006
2. Raman N. "*Phytochemical Techniques*" – New India Publishing agency First Edition, 2006.

BT1067 PHYTOCHEMICAL TECHNIQUES												
Course Designed by		Department of Biotechnology										
1.	Student outcomes	a	b	c	d	e	f	g	h	i	j	K
		x		x		x			x			x
2.	Mapping of instructional objectives with student outcomes	1-5		1-5		1-5			1-5			1-5
3.	Category	General Subjects (G)			Basic Sciences(B)			Engg. Sci. & Tech. Arts (E)			Professional Subjects(P)	
											x	
4.	Broad Area	Biotechnology			Bioproc. Engg.			Chemical Engineering				
		x										
5.	Approval	23rd Meeting of Academic Council, May 2013										

	PLANT HORMONES AND SIGNAL TRANSDUCTION	L	T	P	C
BT1068	Total No. of Contact Hours - 45	**3**	**0**	**0**	**3**
	Prerequisite				
	BT1022				

PURPOSE

The course is designed to provide an understanding of the regulation of various physiological and metabolic processes by signalling growth regulating substances. The student will gain an understanding of theoretical principles related to transduction of signals between different plant parts which in turn regulate plant growth and development.

INSTRUCTIONAL OBJECTIVES

1.	To introduce basic concepts related to discovery and physiological effects of plant growth regulators
2.	To impart an understanding of control of various physiological and developmental mechanisms by hormones
3.	To give an insight into the cellular and molecular modes of action of phytohormones
4.	To explore the nature of signaling molecules and receptors involved in plant development
5.	To explore the prospects related to potential applications of principles underlying signal transduction mechanisms.

UNIT I - AUXINS **(9 hours)**

Introduction – The emergence of the auxin concept, biosynthesis and metabolism of auxin, auxin transport, physiological effects of auxin, developmental effects of auxin – auxin receptors and signal transduction pathways of auxin.

UNIT II - GIBBERELLINS **(9 hours)**

The discovery of the gibberellins, effects of gibberellin on growth and development, Biosynthesis and metabolism of gibberellin, physiological mechanisms of gibberellin-induced growth, signal transduction -cereal aleuronic layers.

UNIT III - CYTOKININS **(9 hours)**

The discovery, identification and properties, Biosynthesis, metabolism and transport of cytokinins, biological roles of cytokinins, cellular and molecular modes of cytokinin action

UNIT IV - ETHYLENE **(9 hours)**

Structure, biosynthesis and measurement of ethylene, developmental and physiological effects, cellular and molecular modes of ethylene action- Ethylene receptors

UNIT V - ABSCISIC ACID **(9 hours)**

Occurrence, chemical structure and measurement of ABA, developmental and physiological effects of ABA, ABA Receptors - cellular and molecular modes of ABA action

TEXT BOOKS

1. Lincoln Taiz and Eduardo Zeiger, "*Plant Physiology*", Third edition. Panima Publishing corporation, 2003.
2. Davies, P. J., "*Plant Hormones - Biosynthesis, Signal Transduction, Action*", Third Edition, Springer 2010.

REFERENCES

1. Perrot-Rechenmann, C. and Hagen, G.,"*Auxin Molecular Biology*" , Springer 2002.
2. Takahashi, N., Phinney, B., MacMillan, J., "*Gibberellins* " , Springer 1990.

BT1068 PLANT HORMONES AND SIGNAL TRANSDUCTION												
Course Designed by		**Department of Biotechnology**										
1.	Student outcomes	a	b	c	d	e	f	g	h	I	j	K
		x		x		x			x			x
2.	Mapping of instructional objectives with student outcomes	1-5		1-5		1-5			1-5			1-5
3.	Category	General Subjects (G)		Basic Sciences(B)		Engg. Sci. & Tech. Arts (E)			Professional Subjects(P)			
									x			
4.	Broad Area	Biotechnology		Bioprocess Engineering		Chemical Engineering						
		x										
5.	Approval	23rd Meeting of Academic Council, May 2013										

BT1069	**PATHOGENESIS RELATED PROTEINS IN PLANTS**	**L**	**T**	**P**	**C**
	Total No. of Contact Hours - 45	**3**	**0**	**0**	**3**
	Prerequisite				
	BT1014				

PURPOSE

The course is designed to provide an understanding of the up-regulation of various proteins during pathogen infection and other related abiotic stress conditions. The student will gain an understanding of theoretical principles related to mechanisms of resistance to pathogens at molecular level which can be applied for developing technologies to improve resistance in plants.

INSTRUCTIONAL OBJECTIVES

1.	To presents an overview of the expression of proteins during biotic and abiotic stress conditions
2.	To gain an understanding of mechanisms of disease resistance in plants
3.	To give an insight into principles related to plant insect interactions
4.	To project the application of the knowledge of PR proteins for genetic manipulation of plants

UNIT I - PR PROTEINS AND THEIR FUNCTIONS (9 hours)

Introduction- induction of PR proteins, occurrence and properties of PRs and PR like proteins, Functions of PR proteins

UNIT II - PR-1 AND PR-2 PROTIENS (9 hours)

PR-1-Introduction**-** Characterization-acidic, basic proteins, proteins from other organisms, functions Expression - pathogens/wounds, salicylic acid, ethylene and other hormones, UV light and developmental stimuli. PR-1 promoter analysis. PR-2- Introduction- Structural classes of β-1,3-Glucanases and PR-2 Nomenclature, Biological functions of β-1,3-Glucanases, Regulation of β-1,3-Glucanases expression.

UNIT III - PLANT CHITINASES AND PR-5 FAMILY (9 hours)

Introduction-PR-3, 4, 8, 11- Structure of proteins, catalytic mechanisms and specificities, structure and regulation of the genes, functions. PR-5-Occurrence, biological properties of TLPs, regulation of TLP expression, cDNAs and genes for TLPs

UNIT IV - PATHOGEN INDUCED PR GENE EXPRESSION AND RIP (9 hours)

Introduction – Signals and putative receptors that activate PR gene expression, PR gene activation by pathogens, transcriptional regulation and genetic studies of PR gene expression. Ribosome inactivating proteins – structure, function and engineering- Pathogen induced gene expression PR-6- Occurrence and structure of plant proteinase inhibitors, Plant microbe interaction, Plant insect interaction and its regulation.

UNIT V - PLANT DEFENSINS AND PR GENES IN TRANSGENIC PLANTS(9 hours)

Introduction – Protein structure, antimicrobial activities, structure activity relationships, mode of action, expression of plant defensin genes and its contribution for host defense. Transgenic plants – over expression of PR proteins – antifungal and insecticidal proteins, PR proteins in Rice.

TEXTBOOK

1. Swapan K. Datta and Muthukrishnan, "*Pathogenesis –Related Proteins in plants*", CRC Press, 1999.

BT1069 PATHOGENESIS-RELATED PROTEINS IN PLANTS												
Course Designed by		**Department of Biotechnology**										
1.	Student outcomes	a	b	c	d	e	f	g	h	i	j	K
		x		x		x			x			x
2.	Mapping of instructional objectives with student outcomes	1-4		1-4		1-4			1-4			1-4
3.	Category	General(G)		Basic Sciences(B)				Engg. Sci. & Tech. Arts (E)			Professional Subjects (P)	
											x	
4.	Broad Area	Biotechnology		Bioprocess Engineering				Chemical Engineering				
		x										
5.	Approval	23rd Meeting of Academic Council, May 2013										

BT1070	REGULATION OF GENE EXPRESSION IN PLANTS	L	T	P	C
	Total No. of Contact Hours - 45	3	0	0	3
	Prerequisite				
	BT1014				

PURPOSE

The course is designed to provide an understanding of the molecular concepts related to the control of plant growth and development. The student will gain an understanding of theoretical principles related to gene expression which in turn can be applied for genetic manipulation of plants. The course will be relevant for students who wish an insight of molecular switches that regulate plant growth and development and who wish to explore these principles for improvement of plant production.

INSTRUCTIONAL OBJECTIVES

1.	To explore the complexity of plant genome
2.	To appreciate the tolerance ranges in plants to abiotic stress factors and apply the principles for manipulation of plants to improve tolerance
3.	To understand and apply various strategies for increasing resistance in plants to biotic stress
4.	To explore applications of various chemical and environmental signals involved in plant development
5.	To understand the applications of various plant derived control systems for crop improvement

UNIT I - ORGANIZATION OF PLANT GENOME (9 hours)

Introduction-, genome size and organization - the chloroplast genome - organization, inheritance and expression. Mitochondria genome - organization - expression - male sterility - gene structure and gene expression - regulation, implication for plant transformation - protein targeting, heterologous promoters. Transposons - Ac and Ds transposable elements in maize, transposon tagging and retrotransposons- Arabidopsis

UNIT II- TRANSGENIC TECHNOLOGIES FOR COMBATING ABIOTIC (9 hours)

Herbicide resistance- Use of herbicides in modern agriculture- strategies for engineering herbicide resistance - environmental impact- abiotic stress-water deficit stress – ROS -various approaches for engineering tolerance.

UNIT III - TRANSGENIC TECHNOLOGIES FOR COMBATING BIOTIC STRESS (9 hours)

Pest resistance-nature and scale of insect / pest damage to crop - GM strategies - Bt approach to insect resistance-copy nature strategy - insect resistant crops and

food safety - plant-pathogen interactions - natural disease resistance pathways - biotechnological – Genetic manipulation based approaches to disease resistance - plant viruses - transgenic approach-PDR

UNIT IV - PROMOTER SYSTEMS BASED ON CHEMICAL AND ENVIRONMENTAL SIGNALS (9 hours)

Tn10 encoded Tet repressor - ecdysteroid agonist inducible control of gene expression in plants - regulatory mechanism of the GR, GVG system-construction, induction experiments, characteristics and prospects of steroid inducible system - Copper controllable expression system - basis and functioning, modifications to overcome background expression in roots, vectors for CC gene expression - tissue specific antisense experiments- conditional lethal genes and practical uses-organization and types of heat shock promoters- heat shock transcription factors, heat shock promoter in transgenic plants - examples- nitrate inducibility- gene expression using nitrite reductase gene promoter

UNIT IV - PROMOTER SYSTEMS BASED ON PLANT DEVELOPMENTAL PROCESSES (9 hours)

Wound inducible genes and hormone responsive elements- Introduction - Multiple phases of wound response, Mechanism of wound induction, Additional hormone factors. Hormone responsive elements- ocs/as-1 AuxRE, natural composite AuxREs, Synthetic composite and simple AuxREs - abscisic acid inducible promoters - developmental targeting of gene expression by senescence specific promoter.

TEXT BOOKS

1. Adrian Slater, Nigel W. Scott and Mark R.Fowler. "*Plant Biotechnology-The genetic manipulation of plants*", Oxford university press 2008.
2. Reynolds P. H. S. (ed.) "*Inducible Gene Expression in Plants*", CAB International First Edition 1999.

REFERENCES

1. Carole L. Bassett, "*Regulation of gene expression in plants - The role of transcript structure and processing*". Springer, First Edition 2007.
2. Filipowicz and Horn, "*Post transcriptional control of gene expression in plants*", Springer, First Edition 1996.
3. Balbas and Lorence "*Recombinant gene expression - Reviews and protocols*", Springer Second Edition 2004.

BT1070 REGULATION OF GENE EXPRESSION IN PLANTS												
Course Designed by		Department of Biotechnology										
1.	Student outcome	a	b	c	d	e	f	g	h	i	j	k
		x		x		x			x			x
2.	Mapping of instructional objectives with student outcome	1-5		1-5		1-5			1-5			1-5
3.	Category	General (G)		Basic Sciences(B)		Engineering Sciences and Technical Arts (E)					Professional Subjects(P)	
											x	
4.	Broad Area	Biotechnology				Bioprocess Engineering					Chemical Engineering	
				x								
5.	Approval	23rd Meeting of Academic Council, May 2013										

BT1071	BIOBUSINESS	L	T	P	C
	Total No. of Contact Hours - 45	3	0	0	3
	Prerequisite				
	Nil				

PURPOSE

The purpose of Biobusines course is to provide specialized knowledge from the Biotechnology sector for effective business education for tomorrow's industry leaders.

INSTRUCTIONAL OBJECTIVES

1.	To develop knowledge and skills to master the future challenges of the biotechnology industries.
2.	To understand the Life Cycle Process of Biotech R&D and Marketing
3.	To study and develop product launch and marketing strategies for a highly regulated industry.
4.	To Learn how to analyze and manage different stakeholder interests (Pharma & biotech, patients and physicians.

UNIT I - BIOTECHNOLOGY BUSINESS MANAGEMENT (9 hours)

Principles & Practices of Management & Communication Skills.Basics of Biotechnology and Bioinformatics – Business, Marketing, Materials, & Logistics Management.Biotechnology plant, Project & Production management. Intellectual property rights & technology transfer Innovation & knowledge management.

UNIT II - BIOTECHNOLOGY INDUSTRY & BUSINESS MANAGEMENT (9 hours)

Antibody Technologies; Antisense & RNAi Technology ; Biologics ; Biomarkers ; Biomaterials; Cell Culture ; DNA Sequencing ; Drug Development ; Emerging Technology ; Enzymes ; Gene Therapy ; Genetic Engineering ; Genomics ; Informatics ; Instrumentation & Equipment ; Microarray ; Molecular Biology ; Nanomedicine ; Personalized Medicine ; Proteomics ; Regenerative Medicine ; Stem Cell ; Tissue Engineering.

UNIT III - PHARMACEUTICAL BUSINESS INDUSTRY & MANAGEMENT (9 hours)

Pharmaceutical Industry: Issues, Structure & Dynamics; Legal, Regulatory, and Ethical Issues in the Pharmaceutical Industry; U.S Healthcare System & Pharmaceutical Managed Markets.Pharmaceutical Marketing: Pharmaceutical Marketing Research; Pharmaceutical Product Management; Managing the Pharmaceutical Sales Organization

UNIT IV - AGRICULTURE BUSINESS MANAGEMENT (9 hours)

Management of Agricultural Input Marketing; Fertilizer Technology & Management; Management of Agro Chemical Industry; Management of Agro Chemical Industry; Seed Production Technology & Management; Case studies : Banana; sugarcane, wheat, rice etc., Transgenic Seeds/Crops (Soybean, Corn, Cotton, & Others (Includes Canola, Wheat, Rice, and Potato among Others), and Biopesticides.

UNIT V - HEALTH CARE BUSINESS MANAGEMENT (9 hours)

Economics of Health Care and Policy, Managed Care and Market Structure, Financial Management of Health Institutions, Health Policy, Health Services Delivery: A Managerial Economic Approach, Legal Aspects of Health Care, Management of Care for the Elderly, Health Care Marketing, Comparative Health Care Systems, E-Health: Business Models and Impact, Health Care Entrepreneurship.

TEXT BOOKS

1. Mark J. Ahn, Michael A. Alvarez, Arlen D. Meyers, Anne S York, "*Building the Case for Biotechnology",* 1st edition, 2011.
2. Peter Kolchensky, "The *Entrepreneurship Guide to a Biotech startup*", Evelexa, 2011.
3. Maureen D. MacKelvey, Luigi Orsenigo, "*The Economics of Biotechnology*" Edward Elgar Pub; 1 edition, 2001.
4. Steven B. Kayne, "*Pharmacy Business Management*" ,Pharmaceutical Press, 2005.

REFERENCES

1. Damian Hine, John Kapeleris, "*Innovation and Entrepreneurship in Biotechnology", Concepts, Theories and Case",* Edward Elgar Publishing, 2008.
2. Yali Friedman, "*Best practices in biotechnology business Development*", Logos Press, 2008.

<table>
<tr><th colspan="14">BT1071 BIOBUSINESS</th></tr>
<tr><td colspan="2">Course Designed by</td><td colspan="12">Department of Biotechnology</td></tr>
<tr><td rowspan="2">1.</td><td rowspan="2">Student outcomes</td><td>a</td><td>b</td><td>c</td><td>d</td><td>e</td><td>f</td><td>g</td><td>h</td><td>i</td><td>j</td><td>k</td></tr>
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<tr><td>2.</td><td>Mapping of instructional objectives with student outcomes</td><td>1</td><td></td><td>2</td><td></td><td>3</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
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<tr><td rowspan="2">4.</td><td rowspan="2">Broad Area</td><td colspan="3">Biotechnology</td><td colspan="6">Bioprocess Engineering</td><td colspan="3">Chemical Engineering</td></tr>
<tr><td colspan="3">x</td><td colspan="6">--</td><td colspan="3">--</td></tr>
<tr><td>5.</td><td>Approval</td><td colspan="12">23rd Meeting of Academic Council, May 2013</td></tr>
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AMENDMENTS

S.No.	Details of Amendment	Effective from	Approval with date