SRM UNIVERSITY
(Under section 3 of UGC Act 1956)

B.Tech. (Full Time) - Bioinformatics
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. Bioinformatics
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
LE1002	G	VALUE EDUCATION	1	0	0	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
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
LE1001	G	ENGLISH	1	2	0	2
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
BT1003	B	CELL BIOLOGY	3	0	0	3
BT1004	B	BIOCHEMISTRY	3	0	0	3
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
ME1004	E	WORKSHOP	0	0	3	2
ME1005	E	ENGINEERING GRAPHICS	0	1	4	3
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 I / FRENCH LANGUAGE PHASE I/JAPANESE LANGUAGE PHASE I / KOREAN LANGUAGE PHASE I/ CHINESE LANGUAGE PHASE I	2	0	0	2
PD1003	G	APTITUDE I	1	0	1	1
MA1043	B	NUMERICAL METHODS FOR BIOINFORMATICS	4	0	0	4
BT1008	P	MICROBIOLOGY	3	0	0	3
BT1010	P	IMMUNOLOGY	3	0	0	3
BI1001	P	COMPUTATIONAL BIOLOGY	3	0	0	3
BI1002	P	BIOINFORMATICS ALGORITHMS	3	2	0	4
BI1003	P	COMPUTATIONAL BIOLOGY LAB	0	0	3	2
BI1004	P	BASIC BIOTECHNOLOGY LABORATORY	0	0	4	2
Total			**19**	**2**	**8**	**24**
Total Contact Hours			**29**			

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
MA1034	B	BIOSTATISTICS	4	0	0	4
BI1005	P	MOLECULAR BIOLOGY & GENETICS	3	0	0	3
BI1006	P	BIOPHYSICS	3	0	0	3
BI1007	P	DATABASE MANAGEMENT SYSTEMS	3	0	0	3
BI1008	P	PROGRAMMING IN C & C++	3	0	0	3
BI1009	P	DATABASE MANAGEMENT SYSTEMS LAB	0	0	2	1
BI1010	P	PROGRAMMING IN C & C++ LAB	0	0	2	1
	P	**Dep. Elective I**	3	0	0	3
Total			**22**	**0**	**5**	**24**
Total Contact Hours			**27**			

SEMESTER V						
Course Code	**Category**	**Course Name**	**L**	**T**	**P**	**C**
PD1005	G	APTITUDE III	1	0	1	1
BI1011	P	RECOMBINANT DNA TECHNOLOGY	3	0	0	3
BI1012	P	GENOMICS AND TRANSCRIPTOMICS	3	0	0	3
BI1013	P	MOLECULAR PHYLOGENY AND EVOLUTION	3	0	0	3
BI1014	P	PERL PROGRAMMING & BIOPERL	3	0	0	3
BI1015	P	RECOMBINANT DNA TECHNOLOGY LAB	0	0	4	2
BI1016	P	GENOMICS LAB	0	0	2	1
BI1017	P	PERL LAB	0	0	2	1
BI1047	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			**19**	**0**	**10**	**24**
Total Contact hours			**29**			

SEMESTER VI						
Course Code	**Category**	**Course Name**	**L**	**T**	**P**	**C**
PD1006	G	APTITUDE IV	1	0	1	1
BI1018	P	IMMUNOINFORMATICS	3	0	0	3
BI1019	P	PROTEOMICS	3	0	0	3
BI1020	P	JAVA PROGRAMMING	3	0	0	3
BI1021	P	IMMUNOINFORMATICS LAB	0	0	2	1
BI1022	P	PROTEOMICS LAB	0	0	2	1
BI1023	P	JAVA PROGRAMMING LAB	0	0	2	1
BI1049	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			**19**	**0**	**9**	**23**
Total Contact Hours			**28**			

SEMESTER VII						
Course Code	**Category**	**Course Name**	**L**	**T**	**P**	**C**
BI1024	P	CHEMOINFORMATICS & DRUG DESIGNING	3	0	0	3
BI1025	P	INTERNET PROGRAMMING	2	0	0	2
BI1026	P	MOLECULAR DYNAMICS	3	0	0	3
BI1027	P	PYTHON	3	0	0	3
BI1028	P	CADD LAB	0	0	4	2
BI1029	P	INTERNET PROGRAMMING LAB	0	0	2	1
BI1030	P	MOLECULAR DYNAMICS LAB	0	0	3	2
BT1032	P	ETHICAL ISSUES, RESEARCH METHODOLOGY AND INTELLECTUAL PROPERTY RIGHTS	1	0	0	1
BI1048	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			**18**	**0**	**10**	**24**
Total Contact Hours			**28**			

SEMESTER VIII						
Course Code	**Category**	**Course Name**	**L**	**T**	**P**	**C**
BI1050	P	MAJOR PROJECT / PRACTICE SCHOOL	0	0	24	12
Total			**0**	**0**	**24**	**12**
Total Contact Hours			**24**			

Department Electives						
Course Code	**Category**	**Course Name**	**L**	**T**	**P**	**C**
BI1101	P	METABOLOMICS AND METABOLIC ENGINEERING	3	0	0	3
BI1102	P	DATA STRUCTURES	3	0	0	3
BI1103	P	STRUCTURAL CHEMISTRY	3	0	0	3
BI1104	P	PHARMACOGENOMICS AND PHARMACOGENETICS	3	0	0	3
BI1105	P	GENETIC ALGORITHMS	3	0	0	3
BI1106	P	ACHIVEMENTS IN BIOTECHNOLOGY & BIOINFORMATICS	3	0	0	3
BI1107	P	BIOSPECTROSCOPY	3	0	0	3
BI1108	P	MEDICAL INFORMATICS	3	0	0	3
BI1109	P	COMPUTATIONAL NEUROSCIENCE	3	0	0	3
BI1110	P	PROTEIN ENGINEERING	3	0	0	3
BI1111	P	MICROARRAY – TECHNIQUES AND APPLICATIONS	3	0	0	3
BI1112	P	NEURAL NETWORKS	3	0	0	3
BI1113	P	CANCER BIOLOGY	3	0	0	3
BI1114	P	SYSTEMS BIOLOGY	3	0	0	3
BI1115	P	ARTIFICIAL INTELLIGENCE	3	0	0	3
BI1116	P	GENE THERAPY	3	0	0	3

Summary of Credits										
Category	**I**	**II**	**III**	**IV**	**V**	**VI**	**VII**	**VIII**	**Total**	**%**
G (Excluding open and departmental electives)	6	2	3	3	1	1			16	8.88
B (Excluding open and departmental electives)	12	15	4	4					35	19.44
E (Excluding open and departmental electives)	7	6							13	7.22
P (Excluding open and departmental electives)			18	14	17	13	18	12	92	51.11
Open Elective					3	6			9	5.0
Dep. Elective				3	3	3	6		15	8.33
Total	25	23	25	24	24	23	24	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. Thomas 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										

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										

MA1011	**MATRICES AND CALCULUS**	**L**	**T**	**P**	**C**
	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. K.Ganesan, Sundarammal Kesavan, K.S.Ganapathy Subramanian & V.Srinivasan, 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 Delih,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.

PY1001 PHYSICS												
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
2.	Mapping of instructional objectives with student outcome	1		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										

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. R.K.Shukla and Anchal Srivastava, "*Practical Physics*", 1st Edition, New Age International (P) Ltd, New Delhi, 2006.

REFERENCES

1. G.L.Souires, "*Practical Physics:*", 4th Edition, Cambridge University, UK, 2001.
2. D. Chattopadhyay, P. C. Rakshit and B. Saha, "*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										

CE1001	**BASIC CIVIL ENGINEERING**	**L**	**T**	**P**	**C**
	Prerequisite	**2**	**0**	**0**	**2**
	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 **(6hours)**

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 (6hours)

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 (6hours)

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 (6hours)

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 (6hours)

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 Material"s*, Charotar Publishing House, Anand, 2012.

REFERENCES

1. Ramesh Babu, "*Civil Engineering"* , VRB Publishers, Chennai, 2000.
2. National Building Code of India, Part V, "*Building Material"s*, 2005

3. Surendra Singh, "*Building Material"s*, 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.

REFERENCES

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										

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										

MA 1012	MULTIPLE INTEGRALS AND DIFFERENTIAL EQUATIONS	L	T	P	C
	Total No. of Contact Hours - 75 Hours	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. K.Ganesan, Sundarammal Kesavan, K.S.Ganapathy Subramanian & V.Srinivasan, *"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. F. Silver and C. Dillion, "*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. G. Cao, "*Nanostructures and Nanomaterials: Synthesis, Properties and Applications*", Imperial College Press, 2004.
8. T.Pradeep, "*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										

BT1003	CELL BIOLOGY	L	T	P	C
	Total contact hours - 45	3	0	0	3
	Prerequisite				
	Nil				

PURPOSE

The course is aimed to make the student understand the basic concept of cell structure, membrane, cellular functions of different types of cell, modes of cellular signaling and signal amplification.

INSTRUCTIONAL OBJECTIVES

1.	To study cell structure and functions of organelle functions 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 V - 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*", Orient Blackswan, 2010.
2. Rastogi SC, "*Cell biology*", New Age International**,** 2005.
3. Cecie Starr, Ralph Taggart "*Biology: The Unity and Diversity of life*", Brooks/Cole, 11TH EDITION, 2006.

BT1003 CELL BIOLOGY												
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
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										

BT1004	BIOCHEMISTRY	L	T	P	C
	Total 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 the structural and functional properties of carbohydrates, proteins, lipids and nucleic acids
2.	To emphasize the role on biomolecules by providing basic information on specific metabolic diseases and their 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 phosphorylation, Chemiosmotic theory - Shuttle

pathways – Glycerol phosphate Shuttle, Malate aspartate Shuttle –Shunt pathways.

TEXT BOOKS

1. Jain, J L, Jain, Nitin, Sunjay Jain, S. Chand Group "*Fundamentals of Biochemistry" (M. E.), ISBN: 8121924537.*

REFERENCES

1. Satyanarayana & U. Chakrapani, *"Biochemistry"* Books And Allied (p) Ltd., UISBN: 8187134801.
2. David L. Nelson, Albert Lester Lehninger, Michael M. Cox *"Lehninger Principles of Biochemistry"*, Edition 5, illustrated, W. H. Freeman, 2008.
3. Jeremy M. Berg, John L. Tymoczko, Lubert Stryer, *"Biochemistry"* Edition 7, W. H. Freeman, 2012.

BT1004 BIOCHEMISTRY														
Course designed by		Department of Biotechnology												
1.	Student outcome	a	b	c	d	e	f	g	h	i	j	k	L	m
		x			x									
2.	Mapping of instructional objectives with student outcome													
3.	Category	General (G)			Basic Sciences (B)			Engineering Sciences & 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. R.K.Bansal, A.K.Goel, M.K.Sharma, "*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. Prabhu, T. 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 earthing

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. S.S.Dash,C.Subramani,K.Vijayakumar,"BasicElectrical Engineering", First edition, Vijay Nicole Imprints Pvt.Ltd,2013

REFERENCES

1. Smarajt Ghosh, "*Fundamentals of Electrical & Electronics Engineering*", Second edition, PHI Learning, 2007.
2. V.K.Metha, 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. S. K. Bhattacharya, "*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. T. Thyagarajan, K.P. SendurChelvi, T.R. Rangaswamy, *"Engineering Basics: Electrical, Electronics and Computer Engineering"*, New Age International, Third Edition, 2007.
2. B. Somanathan Nair, S.R. Deepa, "*Basic Electronics",* I.K. International Pvt. Ltd., 2009.

REFERENCES

1. Thomas L. Floyd, *"Electronic Devices",* Pearson Education, 9th Edition, 2011.
2. R.K. Rajput, *"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>
<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>2.</td><td>Mapping of instructional objectives with student outcome</td><td>1,2,3</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td rowspan="2">3.</td><td rowspan="2">Category</td><td colspan="2">General (G)</td><td colspan="3">Basic Sciences (B)</td><td colspan="3">Engineering Sciences & Technical Arts (E)</td><td colspan="3">Professional Subjects (P)</td></tr>
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<tr><td rowspan="2">4.</td><td rowspan="2">Broad Area</td><td colspan="2">Electrical Machines</td><td colspan="2">Circuits & Systems</td><td colspan="2">Electronics</td><td colspan="2">Power Systems</td><td colspan="3">Intelligent Systems</td></tr>
<tr><td colspan="2">--</td><td colspan="2">--</td><td colspan="2">--</td><td colspan="2">--</td><td colspan="3">--</td></tr>
<tr><td>5.</td><td>Approval</td><td colspan="11">23rd meeting of Academic Council, May 2013</td></tr>
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<table>
<tr><td rowspan="4">ME1004</td><td>WORKSHOP PRACTICE</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>Total contact hours - 45</td><td>0</td><td>0</td><td>3</td><td>2</td></tr>
<tr><td>Prerequisite</td><td></td><td></td><td></td><td></td></tr>
<tr><td>Nil</td><td></td><td></td><td></td><td></td></tr>
<tr><td colspan="6">PURPOSE</td></tr>
<tr><td colspan="6">To provide the students with hands on experience on different trades of engineering like fitting, carpentry, smithy, welding and sheet metal.</td></tr>
</table>

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 BOOKS

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
			X	X				X				
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										

ME1005	ENGINEERING GRAPHICS	L	T	P	C
	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										

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 PRACTITIONERS**											
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

<table>
<tr><td colspan="13">LE1003 GERMAN LANGUAGE PHASE I</td></tr>
<tr><td colspan="2">Course designed by</td><td colspan="11">Department of English and Foreign Languages</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></td><td></td><td></td><td></td><td></td><td></td><td>x</td><td></td><td></td><td></td><td></td></tr>
<tr><td>2.</td><td>Mapping of instructional objectives with student outcome</td><td></td><td></td><td></td><td></td><td></td><td></td><td>1-5</td><td></td><td></td><td></td><td></td></tr>
<tr><td rowspan="2">3.</td><td rowspan="2">Category</td><td colspan="2">General (G)</td><td colspan="2">Basic Sciences (B)</td><td colspan="4">Engineering Sciences and Technical Arts (E)</td><td colspan="3">Professional Subjects (P)</td></tr>
<tr><td colspan="2">x</td><td colspan="2">--</td><td colspan="4">--</td><td colspan="3">--</td></tr>
<tr><td>4.</td><td>Approval</td><td colspan="11">23rd meeting of Academic Council, May 2013</td></tr>
</table>

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)**

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

UNIT - IV **(5 hours)**

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

UNIT - V **(4hours)**

Kanji – hidari, migi, kuchi
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.

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*,* 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										

MA1043	NUMERICAL METHODS FOR BIO INFORMATICS	L	T	P	C
	Total contact hours = 60 hours	4	0	0	4
	Prerequisite				
	Nil				

PURPOSE

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

INSTRUCTIONAL OBJECTIVES

1.	To familiarise with numerical solution of equations
2.	To get exposed to finite differences and interpolation
3.	To be thorough with the numerical Differentiation and integration
4.	To find numerical solutions of ordinary differential equations
5.	To find numerical solutions of partial differential equations

UNIT – I CURVE FITTING AND NUMERICAL SOLUTION OF EQUATIONS **(12 hours)**

Method of Least Squares – Fitting a straight line – Fitting a parabola – Fitting an exponential curve – Fitting a curve of the form $y = ax^b$ – Calculation of the sum of the squares of the residuals.- Newton-Raphson method – Gauss Elimination method – Gauss Jacobi method – Gauss Seidel method.

UNIT II - FINITE DIFFERENCES AND INTERPOLATION (12 hours)

First and higher order differences – Forward differences and backward differences and Central Differences – Differences of a polynomial – Properties of operators – Factorial polynomials – Shifting operator E – Relations between the operators. Interpolation – Newton-Gregory Forward and Backward Interpolation formulae - Divided differences – Newton's Divided difference formula – Lagrange's Interpolation formula – Inverse interpolation.

UNIT III - NUMERICAL DIFFERENTIATION AND INTEGRATION (12 hours)

Newton's forward and backward differences formulae to compute first and higher order derivatives – The Trapezoidal rule – Simpson's one third rule and three eighth rule.

UNIT IV - NUMERICAL SOLUTIONS OF ORDINARY DIFFERENTIAL EQUATIONS (12 hours)

Solution by Taylor's series – Euler's method – Improved and modified Euler method – Runge-Kutta methods of fourth order (No proof) – Milne's Method - Adam's Bashforth method.

UNIT V - NUMERICAL SOLUTIONS OF PARTIAL DIFFERENTIAL EQUATIONS (12 hours)

Classification of Partial differential equations of the second order - Difference quotients – Laplace's equation and its solution by Liebmann's process – Solution of Poisson's equation – Solutions of Parabolic and Hyperbolic equations.

TEXT BOOKS

1. B.S. Grewal, Numerical Methods in engineering and science, Khanna Publishers, 42nd edition, 2012.

REFERENCES

1. Dr. M.K. Venkataraman, Numerical Methods in Science and Engineering, National Publishing Co., 2005.
2. S.S. Sastry, Introductory Methods of Numerical Analysis, 4th edition, 2005.
3. E. Balagurusamy, Computer Oriented Statistical and Numerical Methods – Tata McGraw Hill., 2000.
4. M.K.Jain, SRK Iyengar and R.L.Jain, Numerical Methods for Scientific and Engineering Computation, Wiley Eastern Ltd., 4th edition,2003.

5. M.K.Jain, Numerical Solution of Differential Equations, 2nd edition (Reprint), 2002.
6. Dr.P.Kandasamy etal., Numerical Methods, S.Chand & Co., New Delhi, 2003.

MA1043 NUMERICAL METHODS FOR BIO INFORMATICS												
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 outcome	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										

BT1008	MICROBIOLOGY	L	T	P	C
	Total 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, metabolic pathways, and effects of microbe. 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-** Penicillinsand 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** asplant-microbe interaction& animal-microbe interaction

TEXT BOOKS

1. Michael J. Pelczar, S. Chan, and Noel R. Krieg *"Microbiology",* McGraw Hill, 7thEdition, 2011.
2. Michael T. Madigan, John M. Martinko, Paul V. Dunlap, and David P. Clark *"Brock Biology of microorganisms",* Prentice Hall, 12thEdition, 2008.

3. Davis D. Bernard, Dulbecco Renato, Ginsberg S. Harold,and Eisen N. Herman *"Microbiology",* Lippincott Williams,4th Edition, 1990.
4. Joklik et al, "Zinsser microbiology"- Appleton & Lange, 20th edition, 1997.
5. Stanier Y. Roger,Adelberg A. Edward,and Ingraham John *"General Microbiology",* Prentice Hall,5th Edition, 1986.

REFERENCES

1. Geo Brooks, Karen C. Carroll, Janet Butel, and Stephen Morse"*Medical Microbiology",* McGraw-Hill Medical, 26th Edition, 2012.
2. Lansing M. Prescott,Donald A. Klein, and John P.Harley,*"Microbiology",* McGraw Hill,11th Edition, 2011.

BT1008 MICROBIOLOGY													
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											

BT1010	IMMUNOLOGY	L	T	P	C
	Total 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 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 cultureandExperimental 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*", Orient Blackswan, 2013.
2. Thomas J. Kindt , Barbara A. Osborne , Richard A. Goldsby , " *Kuby Immunology*", WH Freeman, Sixth Edition, 2006.

<table>
<tr><th colspan="14">BT1010 IMMUNOLOGY</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>
<tr><td>X</td><td></td><td></td><td>X</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
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<tr><td colspan="3"></td><td colspan="2"></td><td colspan="3"></td><td colspan="3">X</td></tr>
<tr><td rowspan="2">4.</td><td rowspan="2">Broad Area</td><td colspan="3">Biotechnology</td><td colspan="2">Bioprocess Engineering</td><td colspan="3">Chemical Engineering</td><td colspan="3"></td></tr>
<tr><td colspan="3">X</td><td colspan="2">--</td><td colspan="3">--</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>
</table>

BI1001	COMPUTATIONAL BIOLOGY	L	T	P	C
	Total contact hours - 45	3	0	0	3
	Prerequisite				
	Nil				

PURPOSE

Aims at providing an elementary knowledge in Bioinformatics and Biological Information on the web.

INSTRUCTIONAL OBJECTIVES

1.	To enable the students to understand scope of Bioinformatics
2.	Understanding of popular bioinformatics database
3.	Learn Fundamentals of Databases and Sequence alignment
4.	Approaches to drug discovery using bioinformatics techniques

UNIT I - HISTORY, SCOPE AND IMPORTANCE (9 hours)

Important contributions - aims and tasks of Bioinformatics - applications of Bioinformatics - challenges and opportunities - internet basics- HTML - introduction to NCBI data model- Various file formats for biological sequences

UNIT II - DATABASES - TOOLS AND THEIR USES (9 hours)

Importance of databases - Biological databases-primary sequence databases- Composite sequence databases- Secondary databases- nucleic acid sequence databases - Protein sequence data bases - structure databases - bibliographic databases - specialized genomic resources- analysis packages

UNIT III - SEQUENCE ALIGNMENT METHODS (10 hours)

Sequence analysis of biological data-Significance of sequence alignment-pairwise sequence alignment methods- Use of scoring matrices and gap penalties in sequence alignments- multiple sequence alignment methods - Tools and application of multiple sequence alignment.

UNIT IV - PREDICTIVE METHODS USING DNA AND PROTEIN SEQUENCES (9 hours)

Gene predictions strategies - protein prediction strategies - molecular visualization tools-phylogenetic analysis: Concept of trees- phylogenetic trees and multiple alignments.

UNIT V - DRUG DISCOVERY PROCESS (8 hours)

Discovering a drug - target identification and validation - identifying the lead compound - optimization of lead compound - chemical libraries.

TEXT BOOKS

1. S.C. Rastogi & others, "*Bioinformatics- Concepts, Skills, and Applications*", CBS Publishing, 2003.
2. Andreas D Baxevanis & B F Francis, "*Bioinformatics- A practical guide to analysis of Genes & Proteins*", John Wiley, 2000.
3. T K Attwood, D J parry-Smith," *Introduction to Bioinformatics*", Pearson Education, 1st Edition, 11th Reprint 2005.

REFERENCES

1. C S V Murthy," *Bioinformatics*", Himalaya Publishing House, 1st Edition 2003
2. David W.Mount "*Bioinformatics sequence and genome analysis",* Cold spring harbor laboratory press, 2004.
3. S. Ignacimuthu, S.J., "*Basic Bioinformatics'*, Narosa Publishing House, 1995.

BI1001 COMPUTATIONAL BIOLOGY												
Course designed by		**Department of Bioinformatics**										
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	3,4								
3.	Category	General (G)			Basic Sciences (B)		Engineering Sciences and Technical Arts (E)			Professional Subjects (P)		
										X		
4.	Broad Area	Biotechnology			Information Technology		Bioinformation Technology			Allied Bioinformatics		
		--			--		X			--		
5.	Approval	23rd meeting of Academic Council, May 2013										

BI1002	BIOINFORMATICS ALGORITHMS	L	T	P	C
	Total contact hours - 75	3	2	0	4
	Prerequisite				
	Nil				

PURPOSE

To provide an overview of algorithms used in Bioinformatics.

INSTRUCTIONAL OBJECTIVES

1.	Introduce the concept of Algorithms and their applications in Biology.
2.	Overview of different types of algorithms
3	Description and applications of Greedy algorithms, Dynamic Programming
4	Description and applications of Graph algorithms, Clustering algorithms.

UNIT I - INTRODUCTION (10 hours)

Algorithms and Complexity- Biological algorithms versus computer algorithms - The 'Change problem' - Recursive Algorithms - Iterative versus Recursive Algorithms - Big-O Notations – Algorithm design techniques and the different types of algorithms.

UNIT II - GREEDY ALGORITHMS (10 hours)

Molecular Biology Primer - Exhaustive Search: Mapping Algorithms – Motif Finding problem - Search Trees - Finding a Median String. Greedy Algorithms: Genome Rearrangements - Sorting by Reversals - Approximation Algorithms - A Greedy Approach to Motif Finding.

UNIT III - DYNAMIC PROGRAMMING ALGORITHMS (8 hours)

DNA Sequence comparison - Manhattan Tourist Problem - Edit Distance and Alignments - Longest Commons Subsequences - Global Sequence Alignment - Scoring Alignment - Local Sequence Alignment - Alignment with Gap Penalties - Multiple Alignment.

UNIT IV - GRAPH ALGORITHMS (8 hours)

Graphs - Graphs and Genetics - DNA Sequencing - Shortest Superstring Problem - DNA arrays as an alternative sequencing techniques - Sequencing by Hybridization - Path Problems - Fragment assembly in DNA Sequencing - Protein Sequencing and Identification - The Peptide Sequencing Problem – Spectrum Graphs.

UNIT V - CLUSTERING AND TREES **(9 hours)**

Gene expression analysis - Hierarchical clustering-k-means clustering - Clustering and corrupted Cliques - Evolutionary Trees - Distance-based tree reconstruction - Reconstruction trees from additive matrices - Evolutionary trees and hierarchical clustering - Character-based tree reconstruction - Small and large Parsimony Problem - Hidden Markov Models.

TEXT BOOKS

1. Neil C. Jones and Pavel A. Pevzner, "*An Introduction to Bioinformatics Algorithms*", MIT Press, First Indian Reprint 2005

REFERENCES

1. Gary Benson Roderic, "*Algorithms in Bioinformatics*", Springer International Edition, First Indian Reprint, 2004.
2. Gusfields G, "*Algorithms on strings, trees and sequences- Computer Science and Computational Biology*", Cambridge University Press, 1997.
3. Steffen Schulze-Kremer, "*Molecular Bioinformatics: Algorithms and Applications*", Walter de Gruyter, 1996.

<table>
<tr><th colspan="14">BI1002 BIOINFORMATICS ALGORITHMS</th></tr>
<tr><th colspan="2">Course designed by</th><th colspan="12">Department of Bioinformatics</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>
<tr><td>X</td><td></td><td>X</td><td></td><td></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>2</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>3,4,0</td></tr>
<tr><td rowspan="2">3.</td><td rowspan="2">Category</td><td colspan="2">General (G)</td><td colspan="2">Basic Sciences (B)</td><td colspan="4">Engineering Sciences and Technical Arts (E)</td><td colspan="3">Professional Subjects (P)</td></tr>
<tr><td colspan="2"></td><td colspan="2"></td><td colspan="4"></td><td colspan="3">X</td></tr>
<tr><td rowspan="2">4.</td><td rowspan="2">Broad Area (for ‘P’category)</td><td colspan="2">Biotechno -logy</td><td colspan="2">Information Technology</td><td colspan="4">Bioinformation Technology</td><td colspan="3">Allied Bioinformatics</td></tr>
<tr><td colspan="2"></td><td colspan="2"></td><td colspan="4">X</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>
</table>

BI1003	COMPUTATIONAL BIOLOGY LAB	L	T	P	C
	Total contact hours – 45	0	0	3	2
	Prerequisite				
	Nil				

PURPOSE

The main aim of this bioinformatics laboratory course is to explore the bioinformatics Resources. Provides an opportunity to practically verify the theoretical concepts. It also helps the student to be familiar with the various Bioinformatics tools.

INSTRUCTIONAL OBJECTIVES

1.	Understand the basic features of databases
2.	Analyze the importance of sequence similarity
3.	Apply concepts for biological research

LIST OF EXPERIMENTS

- Knowledge of different biological database
  - Protein and gene sequence data bases (NCBI, DDBJ, EMBL, SWISS PROT, PIR)
  - Structure databases (MMDB, PDB, FSSP, CATH, SCOP)
  - Pathway Databases (KEGG, BRENDA, METACYC, ECOCYC)
  - Bibliographic database (PUBMED, MEDLINE)
- Sequence retrieval from biological database
- Analysis of protein sequence using Expasy
- Sequence similarity searching of nucleotide and protein sequences
- Finding homologous sequences
- Multiple sequence alignment
- Dynamic programming method- local and global alignment
- Gene prediction methods

REFERENCE

1. Departmental Lab reference manual

BI1003 COMPUTATIONAL BIOLOGY LAB												
Course designed by		Department of Bioinformatics										
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		Information Technology			Bioinformation Technology			Allied Bioinformatics		
		--		--			X			--		
5.	Approval	23rd meeting of Academic Council, May 2013										

BI1004	BASIC BIOTECHNOLOGY LABORATORY	L	T	P	C
	Total contact hours - 30	0	0	4	2
	Prerequisite				
	Nil				

PURPOSE

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

INSTRUCTIONAL OBJECTIVES

1. Develop their skills in the preparation, identification and quantification of microorganisms
2. Immunological methods like antigen antibody reactions

LIST OF EXPERIMENTS

1. Sterilization techniques
2. Media preparation
3. Microscopy and Micrometry
4. Isolation, enumeration and purification of microbes from a given sample
5. Staining Techniques (Simple, Gram staining, spore staining and Hanging drop technique)
6. Blood grouping
7. Leucocyte count
8. Widal and VDRL

9. Immunodiffusion, Immunoelectrophoresis
10. ELISA-DOT and plate ELISA
11. pH measurements and preparation of buffers.
12. Estimation of sugars.
13. Estimation of proteins by Lowry's method.
14. Separation of sugars - Paper chromatography
15. Biochemical estimation of DNA /RNA using Spectrophotometer

REFERENCE

1. Departmental Lab reference manual.

BI1004 BASIC BIOTECHNOLOGY LABORATORY													
Course designed by		**Department of Bioinformatics**											
1.	Student Outcome	a	b	c	d	e	f	g	h	i	j	k
		X				X						
2.	Mapping of instructional objectives with student outcome	2				1						
3.	Category	General (G)		Basic Sciences (B)			Engineering Sciences and Technical Arts (E)			Professional Subjects (P)		
										X		
4.	Broad Area	Biotechnology		Information Technology			Bioinformation Technology			Allied Bioinformatics		
		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/wollen wir”—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

1. 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

A) Greetings

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

New words: 你ˆyouˇ 好ˆgood 'well ˇ
工作ˆwork 'jobˇ人员ˆpersonnel 'staff memberˇ 请问ˆMay I ask…ˇ 贵ˆexpensive 'valuableˇ 姓ˆone's family name is ˇ

B) 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 'homeˇ 有ˆhaveˇ 几ˆseveralˇ
爸爸 (fatherˇ 妈妈 (mother) 哥哥 (elderly brotherˇ

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ˆguest,visitorˇ这儿ˆhereˇ中文ˆChineseˇ 对ˆright, correctˇ
学生ˆstudentˇ 多ˆmany, a lotˇ

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. 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

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.

PD1004 - APTITUDE-II												
Course designed by		**Career Development Centre**										
1.	Student Outcome	a	b	c	d	e	f	g	h	i	j	k
								X				
2.	Mapping of instructional objectives with student outcome							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										

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

REFERENCES

1. S.C.Gupta & V.K.Kapoor, "*Fundamentals of Applied Statistics"*, Sultan Chand and Sons, New Delhi, 2003.
2. W. Ewans & G.Grant, "*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										

BI1005	MOLECULAR BIOLOGY AND GENETICS	L	T	P	C
	Total contact hours – 45	3	0	0	3
	Prerequisite				
	Nil				

PURPOSE

The course is aimed to make the student understand the fundamental concepts and basic principles such as structure of DNA / RNA, transcription, translation, gene regulation, RNA splicing and the Mendelian genetics.

INSTRUCTIONAL OBJECTIVES

1.	To provide an understanding of on basic concept in molecular biology and genetics
2.	To teach the use of proper terminology and notation in basic and applied molecular biology
3.	To reinforce and expand on basic concepts in molecular biology along with experiments that led to those concepts

UNIT I - STRUCTURE OF NUCLEIC ACID (8 hours)

Structure of DNA - Different forms of DNA and RNA - Identification of DNA as genetic material by Griffith –Avery, McLeod and McCarty - Frankel and Singer - Hershey and Chase - Messelson and Stahl experiment.

UNIT II - DNA REPLICATION AND MUTATION (10 hours)

Semi-Conservative replication - replication of DNA in Eukaryotes - molecular basis of Mutation - classification of mutation.

UNIT III - GENE EXPRESSION AND REGULATION (9 hours)

Genetic code – transcription - prokaryotes and Eukaryotes - Post transcriptional modification - Translation in prokaryotes and Eukaryotes - Post translational modification - Gene Regulation - Lac operon model

UNIT IV - MENDELIAN GENETICS (9 hours)

Mendel's laws - monohybrid - dihybrid inheritance - multiple alleles - structure and organization of chromosome in prokaryote and Eukaryotes.

UNIT V - CROSSING OVER AND LINKAGE (9 hours)

Linkage - types of linkage -crossing over and their types- Recombination mapping by two point and three point text cross mapping in bacteria.

TEXT BOOKS

1. Brown T.A., "*Genetics- A molecular approach"*, Chapman & Hall, Third edition, 1999
2. Gardener, Simmons and Snustad, "*Principles of Genetics"*, John Wiley & sons, 1991.

REFERENCES

1. Benjamin Lewin," *Gene VII"*, Oxford University Press, 2000-.
2. Jain H.K.," *Genetics – Principles, Concepts, and Implications*", Oxford, 1999.
3. Powar C.B, "*Genetics – VOL 1 & 2"*, Himalaya Publishing House, 2003.
4. John Ringo, *"Fundamental Genetics"*, Cambridge, 2004.

BI1005 MOLECULAR BIOLOGY AND GENETICS													
Course designed by		**Department of Bioinformatics**											
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					1,3			
3.	Category	General (G)			Basic Sciences (B)		Engineering Sciences and Technical Arts (E)			Professional Subjects (P)			
										X			
4.	Broad Area (for 'P'category)	Biotechnology			Information Technology		Bioinformation Technology			Allied Bioinformatics			
		X											
5.	Approval	23rd meeting of Academic Council, May 2013											

BI1006	BIOPHYSICS	L	T	P	C
	Total contact hours - 45	3	0	0	3
	Prerequisite				
	Nil				

PURPOSE

To provide an understanding about the various mechanisms taking place in a biological environment with special emphasis to macromolecules, their structural and thermo-dynamical properties, a necessity for drug designing.

INSTRUCTIONAL OBJECTIVES

1.	To provide biophysics knowledge to the students this will pave a way for further excellent application of the concepts.

UNIT I - ELEMENTARY BIOPHYSICS (11 hours)

Definition of atom and its properties, size and charge of electron, nucleus, protons & neutrons. Types of interaction between atoms: Bond distance, Bond angle, Torsion Angle, H-bonding, VdW interactions, Hydrophobic interactions, Electrostatics interactions. Classical Mechanics: Newton's laws of motion, Law of conservation of mass and energy. Thermodynamics: Laws, Enthalpy, Entropy, Free Energy, Gibbs & Helmholtz free energy, Internal energy, Boltzmann constant. Difference between classical and quantum mechanics. Legrange's equation, Uncertinity principle, Schrodinger equation: time dependent and time independent with its applications; Hamilton's equation with its applications.

UNIT II - DNA BIOPHYSICS (9 hours)

Structure of A, B & Z forms of DNA with special emphasize to formation of phosphodiester bond, hydrogen bonding between the two strands of DNA, Helical parameters, DNA Backbone torsion angles, sugar backbone torsion angles, pseudorotation, sugar puckering. Comparison of various parameters of A, B & Z forms of DNA.

UNIT III - PROTEIN BIOPHYSICS (9 hours)

Amino acids, peptide bond, phi, psi & omega angles with distance, Zwitterion formation of amino acids, Levels of protein structure, Significance of Ramachandran Plot, Protein – DNA, drug, carbohydrate, small molecule interactions. Energetics of lipid bilayer. Molecular Mechanics & Dynamics protocol.

UNIT IV - CARBOHYDRATE BIOPHYSICS (9 hours)

Structure of D-glucose & D-fructose; formation of glucosides & the cyclic structure of D- glucose; D-ribose & D-deoxyribose; Structure and conformation of disacharides and polysaccharides- cellulose, amylose, amylopectin & glycogen, Chitin, carbohydrate conjugates.

UNIT V - TECHNIQUES IN BIOPHYICS (7 hours)

X-ray crystallography, NMR, IR, Raman, AAS, UV, CD, Cosy, Noesy, spectroscopy, Mass spectrometry, Maldi TOF for protein prediction.

REFERENCES

1. Carl Branden & John Tooze (1999), "*Introduction to Protein Structure*" Garland Publishing, New York & London.
2. Wolfram Saenger (1983), "*Principles of nucleic acid structure*" Springer-Verlag, New York.
3. Andrew R. Leach (2000), "*Molecular Modelling Principles and Applications*" Prentice Hall.
4. Puri B.R. , L.R. Sharma, M.S. Pathania (2008), "*Principles of Physical Chemistry*" VISHAL PUBLISHING Company.
5. Murugesan R. (2004), "*Modern Physics*" S. Chand & Co.
6. Vasantha Pattabhi & Gautham (2002), "*Biophysics*" Narosa Publishing.

<table>
<tr><th colspan="14">BI1006 BIOPHYSICS</th></tr>
<tr><th colspan="2">Course designed by</th><th colspan="12">Department of Bioinformatics</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="2">Biotechnology</td><td colspan="2">Information Technology</td><td colspan="4">Bioinformation Technology</td><td colspan="3">Allied Bioinformatics</td></tr>
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<tr><td>5.</td><td>Approval</td><td colspan="12">23rd meeting of academic council held on May 2013.</td></tr>
</table>

BI1007	DATABASE MANAGEMENT SYSTEMS	L	T	P	C
	Total contact hours - 45	3	0	0	3
	Prerequisite				
	Nil				

PURPOSE

To make the students aware of different database management systems (DBMS) available and impart the knowledge of developing and managing databases to them.

INSTRUCTIONAL OBJECTIVES

1.	Introduce the basics, models and applications of different DBMS.
2.	Describe the database designing concepts and the languages used.
3	Describe the widely used relational database model and biological sequence databases.

UNIT I - INTRODUCTION (9 hours)

Database -System Applications- Purpose of Database Systems, View of Data, Database Languages, introduction to Relational Databases, Database Design, Data Storage and Querying, Transaction Management, Database Architecture, Database Users and Administrators, History of Database Systems.

UNIT II - DATABASE DESIGN AND THE E-R MODEL (9 hours)

Overview of the Design Process, The Entity-Relationship Model, Constraints, Removing Redundant Attributes in Entity Sets, Entity-Relationship Diagrams, Reduction to Relational Schemas, Entity-Relationship Design Issues, Extended E-R Features, Alternative Notations for Modeling Data, Other Aspects of Database Design.

UNIT III - RELATIONAL MODEL AND ITS DESIGN TECHNIQUE (9 hours)

Introduction to the Relational model: Structure of Relational Databases, Database Schema, Keys, Schema Diagrams, Relational Query Languages, Relational Operations. Relational Database Design: Features of Good Relational Designs, Atomic Domains and First Normal Form, Decomposition Using Functional Dependencies, Functional-Dependency Theory, Algorithms for Decomposition, Decomposition Using Multivalued Dependencies, More Normal Forms, Database-Design Process, Modeling Temporal Data.

UNIT IV - STRUCTURED QUERY LANGUAGE (9 hours)

Overview of the SQL Query Language, SQL Data Definition, Basic Structure of SQL Queries, Additional Basic Operations, Set Operations, Null Values, Aggregate Functions, Nested Subqueries, Modification of the Database.

UNIT V - BIOLOGICAL DATABASE MANAGEMENT (9 hours)

Introduction to Biological Data Integration - specifications. -Challenges Faced in the Integration of Biological Information: -Nature of Biological data,- Data sources in Life Sciences, -Challenges in information integration-. Data management in Bioinformatics, Dimensions -Describing the Space of Integration Solutions.

TEXT BOOK

1. Abraham Silberschatz, Henry F. Korth, S. Sudarshan, "*Database System Concepts*", McGraw-Hill, 6th Edition, 2011.

REFERENCES

1. Raghu Ramakrishnan, Johannes Gehrke, "*Database Management System*", McGraw Hill, 3rd Edition 2003
2. Elmashri & Navathe, "*Fundamentals of Database System*", Addison-Wesley Publishing, 3rd Edition, 2000
3. Date C.J, "*An Introduction to Database*", Addison-Wesley Pub Co, 7th Edition, 2001
4. Jeffrey D. Ullman, Jennifer Widom, "*A First Course in Database System*", Prentice Hall, AWL 1st Edition, 2001
5. Peter Rob, Carlos Coronel, "*Database Systems - Design, Implementation, and Management*", 4th Edition, Thomson Learning, 2001.
6. Zoe Lacroix, Terence Critchlow," *Bioinformatics:Managing Scientific Data*", Morgan Kaufmann Publishers (Elsevier Science), 2003 (for the V unit)

BI1007 DATABASE MANAGEMENT SYSTEMS												
Course designed by		**Department of Bioinformatics**										
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		

BI1007 DATABASE MANAGEMENT SYSTEMS					
Course designed by		Department of Bioinformatics			
4.	Broad Area	Biotechnology	Information Technology	Bioinformation Technology	Allied Bioinformatics
			X		
5.	Approval	23rd meeting of academic council held on May 2013.			

BI1008	PROGRAMMING IN C &C++	L	T	P	C
	Total contact hours – 45	3	0	0	3
	Prerequisite				
	Nil				

PURPOSE

To introduce programming languages C and C++ as tools to solve general and biological problems and to provide hands on training.

INSTRUCTIONAL OBJECTIVES

1.	Understand the program development life cycle Design algorithms to solve simple problems using computers Convert algorithms into C and C++ programs and execute
2.	Application of the programs in sequence analysis

UNIT I - INTRODUCTION TO C PROGRAMMING –I (9 hours)

Program structure, Algorithm/Pseudocode, Flowcharts, data types, variables, operators , keywords, data modifiers types, storage classes; Input/ Output functions.

Decision making statements: if/else, switch/case statements; Loop control statements - for, while, do/while.

UNIT II - INTRODUCTION TO C PROGRAMMING –II (9 hours)

Single and multi-dimensional Array operations –matrix operation, push, pop etc . Function handling- scope of variables, call by value and call by reference, function overwriting and overloading. Data structures

UNIT III - OOP CONCEPTS AND C++ -I (9 hours)

classes and objects, data hiding, constructor and destructor, Inheritance: single, multiple, multilevel. Overloading - Function overloading, Operator overloading. Polymorphism, Abstraction, Encapsulation, interfaces and multi threading;

UNIT IV - C++ - II **(9 hours)**

Files and streams, Data structures. Exception handling, Dynamic memory, Namespaces, Templates, Preprocessor, signal handling, multithreading and web programming.

UNIT V - APPLICATION IN BIOINFORMATICS **(9 hours)**

Program development for DNA/Protein sequence analysis.- Dynamic programming.

Sequence retrieval from databases, Motif finding in sequences. Phylogentic Tree traversal and other tool development applications.

TEXT BOOKS

1. Balagurusamy . "*Object Oriented Programming With C Plus Plus*", Tata McGraw-Hill Education, 2008.
2. Bjarne Stroustrup," *The C++ Programming Language*", Third Edition, Imprint of Addison Wesley Longman, Inc., 2003.

REFERENCES

1. Scott Meyers, "*Effective C++"*,Third edition, Addison Wesley Longman,2005.
2. Brian W. Kernighan, Dennis M. Ritchie, "*The C Programming Language*" , second edition, Prentice hall, 1988.

<table>
<tr><th colspan="13">BI1008 PROGRAMMING IN C &C++</th></tr>
<tr><th colspan="2">Course designed by</th><th colspan="11">Department of Bioinformatics</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>5.</td><td>Approval</td><td colspan="11">23rd meeting of academic council held on May 2013.</td></tr>
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BI1009	DATABASE MANAGEMENT SYSTEMS LAB	L	T	P	C
	Total contact hours -30	0	0	2	1
	Prerequisite				
	Nil				

PURPOSE

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

INSTRUCTIONAL OBJECTIVES

1.	The students should be able to develop their skills
2.	To create simple databases
3.	Describe the widely used relational database model and biological sequence databases.

LIST OF EXPERIMENTS

1. Simple Queries
2. Built-in-functions
3. Group Functions
4. Multiple sub-queries
5. SQL Views & Triggers
6. Simple PL/SQL (or MySQL) Procedures
7. PL/SQL Procedures (or MySQL) accessing Databases
8. Mini Project

REFERENCES

1. Departmental Lab reference manual

BI1009 DATABASE MANAGEMENT SYSTEMS LAB												
Course designed by		Department of Bioinformatics										
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				1						2
3.	Category	General (G)		Basic Sciences (B)			Engineering Sciences and Technical Arts (E)			Professional Subjects (P)		
										X		
4.	Broad Area	Biotechnology		Information Technology			Bioinformation technology			Allied Bioinformatics		
		--		X			--			--		
5	Approval	23rd meeting of Academic Council, May 2013										

BI1010	PROGRAMMING IN C &C++ LAB	L	T	P	C
	Total contact hours -30	0	0	2	1
	Prerequisite				
	Nil				

PURPOSE

To introduce programming languages C and C++ as tools to solve general and biological problems and to provide hands on training.

INSTRUCTIONAL OBJECTIVES

1. Design algorithms to solve simple problems using computers Convert algorithms into C and C++ programs and execute
2. Application of the programs in bioinformatics

Note to the Instructors: Design exercise problems to demonstrate the use of C and C++ in Bioinformatics

LIST OF EXERCISES

1. Programs using conditional statements
2. Programs to count total nucleotide count of DNA
3. Alignment of two sequences
4. Programs to implement functions
5. Programs to illustrate recursion
6. Program to create classes and objects using C++
7. Program to implement Constructor and Destructor in C++
8. Program to implement single inheritance in C++
9. Program to implement Function overloading in C++
10. Program to implement Operator overloading in C++

REFERENCE

1. Departmental Lab reference manual.

BI1010 PROGRAMMING IN C &C++ LAB												
Course designed by		Department of Bioinformatics										
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		Information Technology			Bioinformation Technology			Allied Bioinformatics		
		--		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

REFERENCES

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										

BI1011	RECOMBINANT DNA TECHNOLOGY	L	T	P	C
	Total Contact Hours – 45	3	0	0	3
	Prerequisite				
	BI1002 Molecular Biology and Genetics				

PURPOSE

The subject deals with different strategies of gene cloning and construction of genomic and cDNA library and applications of recombinant DNA technology

INSTRUCTIONAL OBJECTIVES

1.	To provide an understanding of on basic concept in Gene cloning
2.	To teach the use various components and techniques in designing experiments
3.	To use basic concepts and technical knowledge in applications

UNIT I - VECTORS AND INSERT (9 hours)

Vehicles for gene cloning - Biology of plasmids, Plasmid based vectors, Bacteriophage ,Phage vectors, Cosmids, Phasmids, BAC and YAC vectors; Insert preparation- Restriction Digestion-Restriction enzymes, Polymerase chain reaction –Polymerase, Creation of restriction site by PCR

UNIT II - CLONING TECHNIQUE (9 hours)

Ligation –Ligase, cohesive , Blunt end ligation; Other Modification enzymes – Nucleases, Phasphatase, Kinase; Transformation-Preparation of competent cell, chemical and electrical transformation; Transfection; Recombinant selection and screening -Blotting technique

UNIT III - CONSTRUCTION OF GENE LIBRARIES (9 hours)

Construction of cDNA library- construction subtractive cDNA library – construction of genomic DNA library – BAC library – YAC library

UNIT IV - EXPRESSION OF RECOMBINANT PROTEIN IN E.COLI (9 hours)

Plasmid expression vectors-general features, promoters used in expression vectors -cloning of genes in correct reading frame in expression vector-purification of recombinant protein using Histidine tag, GST tag, chitin

UNIT V - APPLICATION OF RECOMBINANT DNA TECHNOLOGY (9 hours)

Applications of rDNA technology in Diagnostics- HIV diagnosis; Therapeutic proteins-Vaccines, Human Insulin, Growth hormone; Agriculture - Golden rice, Insect resistant plant; Genetic diversity

TEXT BOOK

1. Sandy B. Primrose, Richard M. Twyman, "*Principles of gene manipulation"*, 7th edition ., Blackwell Publishing, 2006

REFERENCES

1. T A Brown Gene cloning and DNA analysis 6th edition, Blackwell Publishing, 2010.
2. Jerney D. Wale and Malcolm Von Schants, "*From Genes to Genomes: Concepts and Applications of DNA Technology",* John Wiley & Sons, 2002.

BI1011 RECOMBINANT DNA TECHNOLOGY												
Course designed by		Department of Bioinformatics										
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					1,3		

BI1011 RECOMBINANT DNA TECHNOLOGY					
Course designed by		Department of Bioinformatics			
3.	Category	General (G)	Basic Sciences (B)	Engineering Sciences and Technical Arts (E)	Professional Subjects (P)
					X
4.	Broad Area	Biotechnology	Information Technology	Bioinformation Technology	Allied Bioinformatics
		X			
5.	Approval	23rd meeting of Academic Council, May 2013			

BI1012	GENOMICS AND TRANSCRIPTOMICS	L	T	P	C
	Total Contact Hours – 45	3	0	0	3
	Prerequisite				
	Nil				

PURPOSE

The students will be aware of the structure and functions of the genomes together with the computational approaches to analyze the genomes.

INSTRUCTIONAL OBJECTIVES

1. It gives emphasize on Structure and organization of genomes, Computational approaches to analyze the genomes, Microarray, Functional and comparative genomics, Basics of Transcriptomics.

UNIT I - GENOMES AND THEIR ORGANIZATION (9 hours)

Prokaryotic and eukaryotic genomes- structure- organization-Genomics: Genome Sequencing- Fragment Assembly- Genome Assembly- Human Genome Project- Aims- goals and achievements. General principles of Gene Therapy

UNIT II - GENE EXPRESSION PROFILING (10 hours)

Aligning Whole Genome Alignment (WGA) - prediction of coding regions - gene structure - conserved motifs, comparative genomics, methods of gene discovery - Prediction of gene function - methods - annotation, Coding and non coding genes and RNA, Gene expression - regulatory mechanism, Expression profiling - Northern, RT-PCR, DD-RT-PCR, EST library - cDNA library, cDNA AFLP – SAGE- Mechanical methods of delivery- Example: Duchenne myotrophy- Liposomal methods of delivery- Cystic fibrosis.

UNIT III - GENE REGULATORY NETWORK AND MICROARRAY (8 hours)

Gene regulatory network and the models- DNA micro array and the analysis of data using clustering methods.

UNIT IV - FUNCTIONAL AND COMPARATIVE GENOMICS (9 hours)

Introduction to functional and comparative genomics- Methods to perform comparative genomics

UNIT V - TRANSCRIPTOMICS (9 hours)

Features of RNA secondary structure- Basics of RNA structure prediction- Limitations of prediction- Development of RNA prediction methods- Methods - Self- complementary regions in RNA- minimum free energy method- MFOLD- Sequence covariation method

TEXT BOOKS

1. T.A. Brown, *"Genome"*, John Wiley & sons, 2006.
2. David W. Mount, "*Bioinformatics: Sequence and Genome Analysis*", Cold Spring Harbor Laboratory Press, I edition, 2001.
3. Stekel Dov*, "Microarray Bioinformatics"*, Cambridge University Press, 2003.

REFERENCES

1. Issac S Kohane, *"Microarrays for an integrative genomics"*, The MIT Press, 2002.
2. Benjamin Lewin, *"Gene VII"*, Oxford University Press, 2000.

BI1012 GENOMICS AND TRANSCRIPTOMICS												
Course designed by		**Department of Bioinformatics**										
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			1						1	
3	Category	General (G)		Basic Sciences (B)			Engineering Sciences and Technical Arts (E)			Professional Subjects (P)		
										X		
4	Broad Area	Biotechnology		Information Technology			Bioinformation technology			Allied Bioinformatics		
				--			X					
5	Approval	23rd meeting of Academic Council, May 2013										

BI1013	MOLECULAR PHYLOGENY AND EVOLUTION	L	T	P	C
	Total Contact Hours – 45	3	0	0	3
	Prerequisite				
	Nil				

PURPOSE

This course provides the basic concept of Phylogenetics and evolution at molecular level.

INSTRUCTIONAL OBJECTIVES

1.	To understand the various methods of phylogenetic tree construction
2.	Accuracies and statistical methods of optimization
3.	Molecular evolution

UNIT I - PHYLOGENETIC TREES **(9 hours)**

Types- topological differences- tree building methods- Distance methods- UPGMA- LS methods- minimum evaluation methods- NJ methods- phylogenetic reconstruction.

UNIT II – METHODS **(9 hours)**

Maximum parsimony methods- Strategies of searching for MP trees- consensus trees- branch length estimation - weighted parsimony- MP methods for protein data- Maximum likelihood methods

UNIT III - STATISTICAL APPROACH **(9 hours)**

Optimization principle and topological errors- interior branch tests- bootstrap tests- Tests of topological differences- advantages and disadvantages- molecular clocks and linearized trees

UNIT IV - ANCESTRAL SEQUENCES **(9 hours)**

Inferences of ancestral sequences- parsimony and Bayesian approaches- synonymous and non-synonymous substitutions- convergent and parallel evolution

UNIT V – EVOLUTION **(9 hours)**

Molecular basis of evolution- synonymous and non- synonymous mutations- genetic polymorphism and evolution- Population trees from genetic markers

TEXT BOOKS

1. Masatoshi Nei, "*Molecular Evolution and Phylogenetics"*, Oxford University Press, 2000.
2. David W Mount, "*Bioinformatics- Sequence and genome analysis"*, Cold Spring Harbor Laboratory Press, second edition, 2004.

REFERENCES

1. Bruce S. Lieberman,"*Phylogenetics: Theory and Practice of Phylogenetic Systematics",* Wiley-Blackwell, second edtion, 2011.
2. Roderick D.M. Page, Dr Edward C. Holmes, "*Molecular Evolution: A Phylogenetic Approach"*, well Publishing, 1998.
3. Jin Xiong, "*Essential Bioinformatics"*, Cambridge University Press, 2006.

BI1013 MOLECULAR PHYLOGENY AND EVOLUTION												
Course designed by		**Department of Bioinformatics**										
1	Student outcome	a	b	c	d	e	f	G	h	i	j	k
		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 (for 'P' category)	Biotechnology			Information Technology		Bioinformation Technology			Allied Bioinformatics		
							X					
5	Approval	23rd meeting of Academic Council, May 2013										

BI1014	**PERL PROGRAMMING & BIOPERL**	**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 application of Perl programming in general as well as in biological problem solving in addition to the basic Linux working environment.

INSTRUCTIONAL OBJECTIVES

1.	To understand the basic Linux commands

2.	To understand the basic Perl – control structures , subroutines and modules.
3.	To apply Perl in biological problems

UNIT I - INTRODUCTION TO LINUX **(8 hours)**

Linux OS-Working Environment- editors-Navigation commands, File handling - creating and manipulating sequence files-text processing, System administration commands, Archival commands, process management networking and advanced commands.

UNIT II - INTRODUCTION TO PERL **(8 hours)**

Data types, variables, operators, formatting of input/output, Array operations, Hashes, @ARGV, control structures and file handling, Debugging

UNIT III-PERL SUBROUTINES AND REGULAR EXPRESSIONS **(10 hours)**

Builtin functions, subroutines, scoping of variables, Regular expressions-metacharacters and special operators, translation and substitution operators, pattern matching

UNIT IV - PERL MODULES **(10 hours)**

OOP concepts in Perl, Packages, libraries and modules- basic modules - getopt::long, LWP,CWD, file::basename.

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

Bioperl installation and applications, Bioperl modules- Databases, sequence retrieval & alignment, phylogentic tree construction, restriction enzyme analysis, mutation studies.

TEXT BOOK

1. James Tisdall, "*Mastering Perl for Bioinformatics*", O'Reilly, 2010.

REFERENCES

1. Harshawardhan P Bal, "*Perl Programming for Bioinformatics*", Tata McGraw Hill, 2003.
2. James Lee, "*Beginning Perl*", Apress, 2004.
3. D. Curtis Jamison, "*Perl Programming for Bioinformatics & Biologists*", John Wiley & Sons, INC., 2004.
4. Michael Moorhouse, Paul Barry, "*Bioinformatics Biocomputing and Perl*", Wiley, 2004.

BI1014 PERL PROGRAMMING & BIOPERL													
Course designed by		Department of Bioinformatics											
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.	Broad Area	Biotechnology		Information Technology		Bioinformation Technology				Allied Bioinformatics			
		--		X		--				--			
5.	Approval	23rd meeting of Academic Council, May 2013											

BI1015	RECOMBINANT DNA TECHNOLOGY LAB	L	T	P	C
	Total Contact Hours – 60 hours	0	0	4	2
	Prerequisite				
	Basic Biotechnology Laboratory				

PURPOSE

To provide hands on training the basic techniques that is essential for genetic engineering and recombinant DNA technology

INSTRUCTIONAL OBJECTIVES

1.	To teach the designing of cloning experiments
2.	To teach the handling og macromolecules (DNA and RNA)
3.	To perform the cloning experiments

LIST OF EXPERIMENTS

1. Partial digestion of bacterial genomic DNA
2. Restriction enzyme digestion of pUC 18/19 and Alkaline Phosphatase treatment.
3. Purification of digested DNA
4. Ligation of DNA fragment with plasmid DNA
5. Preparation of competent cells
6. Transformation in *E. coli*
7. Isolation of recombinants plasmid and confirmation of insert DNA in plasmid.

8. PCR and RT-PCR
9. Colony Hybridization
10. Southern Hybridization
11. Northern hybridization

REFERENCE

1. Laboratory Manual Sambrook and Russell, *"Molecular Cloning – A Laboratory Manual"*, CSHL Press, 2002

BI1015 RECOMBINANT DNA TECHNOLOGY LAB												
Course designed by		**Department of Bioinformatics**										
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			Information Technology		Bioinformation technology			Allied Bioinformatics		
		X										
5.	Approval	23rd meeting of Academic Council, May 2013										

BI1016	GENOMICS LAB	L	T	P	C
	Total Contact hours - 30	0	0	2	1
	Prerequisite				
	Nil				

PURPOSE

Provide an opportunity to practice different genome analysis tools.

INSTRUCTIONAL OBJECTIVES

1. The students will be able to get exposure on various bioinformatics tools available for analyzing genes and genomes

LIST OF EXPERIMENTS

1. Genome comparison
2. Genome rearrangements

3. Phylogenetic Reconstruction
4. Gene prediction
5. Translation the sequences and ORF finding
6. Splice site junction prediction
7. Comparative genome analysis

REFERENCES

1. Lab Manual and software manuals.

BI1016 GENOMICS LAB												
Course designed by		Department of Bioinformatics										
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			1						1	
3.	Category	General (G)			Basic Sciences (B)		Engineering Sciences and Technical Arts (E)			Professional Subjects (P)		
										X		
4.	Broad Area	Biotechnology			Information Technology		Bioinformation Technology			Allied Bioinformatics		
					--		X					
5.	Approval	23rd meeting of Academic Council, May 2013										

BI1017	PERL LAB	L	T	P	C
	Total Contact Hours -30 hours	0	0	2	1
	Prerequisite				
	Nil				

PURPOSE

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

INSTRUCTIONAL OBJECTIVES

1.	To understand and develop the concept of analyzing scientific problems using perl.
2.	To apply Perl in sequence analysis, new tool development.
3.	To apply Linux environment for Perl programming

LIST OF EXPERIMENTS

1. Linux commands
2. Working with editors
3. Simple programs using Control Structures, Arrays and hashes- push , pop
4. Simple programs using Subroutines –
5. Programs on getopt long, cwd, CGI modules
6. Simple programs using File Functions,
7. Creating a static HTML page for pairwise sequence alignment using Perl Program
8. Simple bioperl program for running blast

REFERENCES

1. Lab Manual
2. Curtis Jamison, "*Perl Programming for Bioinformatics" & Biologists*, John Wiley & Sons, INC., 2004

BI1017 PERL LAB												
Course designed by		**Department of Bioinformatics**										
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				1						2
3.	Category	General (G)		Basic Sciences (B)		Engineering Sciences and Technical Arts(E)				Professional Subjects (P)		
										X		
4.	Broad Area	Biotechnology		Information Technology		Bioinformation technology				Allied Bioinformatics		
		--		X		--				--		
5.	Approval	23rd meeting of Academic Council, May 2013										

BI1047	**INDUSTRIAL TRAINING I (Training to be undergone after IV semester)**	**L**	**T**	**P**	**C**
	2 week practical training in industry	**0**	**0**	**1**	**1**
	Prerequisite				
	Nil				

PURPOSE

To provide hands-on experience by working in bioinformatics or 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 bioinformatics 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.

BI1047 INDUSTRIAL TRAINING I												
Course designed by		Department of Bioinformatics										
1.	Student Outcome	a	b	c	d	e	f	g	h	i	j	k
					X		X	X	X	X	X	
2.	Mapping of instructional objectives with student outcome				1	1	1	1	1	1	1	
3.	Category	General (G)		Basic Sciences (B)		Engineering Sciences & Technical Arts (E)				Professional Subjects (P)		
										X		
4.	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										

BI1018	IMMUNOINFORMATICS	L	T	P	C
	Total contact hours - 45	3	0	0	3
	Prerequisite				
	Immunology				

PURPOSE

To provide adequate information to gain fundamental knowledge in immunoinformatics and its applications

INSTRUCTIONAL OBJECTIVES

1.	To provide information about the methods used in Immunological Bioinformatics
2.	To provide knowledge about various prediction methods used in Immunoinformatics

UNIT I - SEQUENCE ANALYSIS (7 hours)

Alignments- DNA alignments- Molecular evolution and phylogeny- viral evolution and escape- prediction of functions

UNIT II - METHODS (10 hours)

Methods applied in Immunological Bioinformatics- starting from sequence weighing methods to cluster analysis- Gibbs Sampling- HMM- Neural network- microarray and its applications

UNIT III - MHC- I PREDICTION **(9 hours)**

Prediction of Cytotoxic T Cell (MHC Class I) Epitopes- Antigen Processing in the MHC Class I Pathway

UNIT IV - MHC-II PREDICTION **(9 hours)**

Prediction of Helper T Cell (MHC Class II) Epitopes- Processing of MHC Class II Epitopes

UNIT V - B CELL EPITOPE PREDICTION AND WEB SOURCES **(10 hours)**

Recognition of Antigen by B Cells- vaccine design- Web-Based Tools for Vaccine Design

TEXT BOOKS

1. Ole Lund, "*Immunological Bioinformatics"*, MIT press, September 2005.
2. Darren Flower, " *In Silico Immunology"*, Springer, 2006.

REFERENCES

1. Darren R Flower, "*Immunoinformatics: Predicting Immunogenicity in Silico"*, Humana Press, 2007.
2. Rammensee, *"Immunoinformatics- Bioinformatics Strategies for Better Understanding of Immune Function"*, Wiley, 2003.

BI1018 IMMUNOINFORMATICS												
Course designed by		**Department of Bioinformatics**										
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		Information Technology			Bioinformation technology			Allied Bioinformatics		
		--		--			X			--		
5.	Approval	23rd meeting of Academic Council, May 2013										

BI1019	PROTEOMICS	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 concepts and underlying various techniques of proteomics.

INSTRUCTIONAL OBJECTIVES

1.	Principles of electrophoretic and chromatographic techniques
2.	Protein identification and Quantitation methods
3.	Protein-Protein Interaction analysis
4.	Protein Chips

UNIT I - AN OVERVIEW OF PROTEOMICS (9 hours)

Proteomics- Need, scope and challenges of proteomics, how proteomics is applied in real-life scientific research, Protein structures, Making the extract, Clarification- Centrifugation, filtration and ultra-filtration, precipitation, dialyze, batch binding

UNIT II - STRATEGIES FOR PROTEIN SEPARATION (9 hours)

2D gel electrophoresis- principle and applications, **Liquid chromatography**- principle and applications, multidimensional liquid chromatography **Mass Spectrometry** - principles, instrumentation and applications in proteomics.

UNIT III - STRATEGIES FOR PROTEIN IDENTIFICATION QUANTITATION(9 hours)

Protein Identification with antibodies, protein sequence determination by chemical degradation, Edman's degradation, Short-gun proteomics for proteome profile, **Quantitative proteomics** with standard 2D gels, multiplexed proteomics, quantitative with mass spectrometry, Computational tools- advanced tools for data analysis.

UNIT IV - STRUCTURAL PROTEOMICS (9 hours)

Protein-Protein interactions- principles and methods to study proteins, Proteomic analysis of Post-translational Modification- Phosphorylation, ubiquitination, and glycosylation.

UNIT V - PROTEIN CHIPS **(9 hours)**

Protein Chips and Functional Proteomics- different types of protein chip-detecting and quantifying, Applications of Proteomics, Proteome database

TEXT BOOK

1. R.M. Twyman, "*Principles of Proteomics (Advanced Text Series*)", Bios Scientific, 2004.
2. Daniel C. Liebler *," Introduction to Proteomics: Tools for the New Biology"*, Humana Press Inc., 2002.

REFERENCES

1. Ian M. Rosenberg , "*Protein Analysis and Purification: Benchtop Techniques "- ,* Springer, 2005
2. Philip L.R. Bonner*, "Protein Purification"*, Taylor & Francis, 2007
3. David W Mount, "*Bioinformatics- Sequence and genome analysis"*, Cold Spring Harbor Laboratory Press, second edition, 2004.
4. S. R. Pennington, M. J. Dunn, "*Proteomics: from Protein Sequence to Function"*, Springer publications, first edition, 2001.
5. Timothy Palzkill, "*Proteomics",* Springer, 2002.

BI1019 PROTEOMICS												
Course designed by		**Department of Bioinformatics**										
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	2		3						4
3.	Category	General (G)		Basic Sciences (B)			Engineering Sciences and Technical Arts (E)			Professional Subjects (P)		
										X		
4.	Broad Area	Biotechnology		Information Technology			Bioinformation technology			Allied Bioinformatics		
		--		--			X			--		
5.	Approval	23rd meeting of Academic Council, May 2013										

BI1020	JAVA PROGRAMMING	L	T	P	C
	Total Contact Hours - 45	3	0	0	3
	Prerequisite				
	Nil				

PURPOSE

The purpose of this course is to learn the fundamentals of Java Programming in order to apply it in Bioinformatics.

INSTRUCTIONAL OBJECTIVES

1.	To understand the operators of Java and its applications
2.	To learn the control statements, classes and methods of Java
3.	To learn packages, applets and string handling in Java
4.	To learn event handling and AWT controls in Java
5.	Using Java in Bioinformatics

UNIT I - INTRODUCTION TO JAVA (9 hours)

An Overview of Java- Object Oriented Programming, A Simple JAVA Program. Data Types - Variables, and Arrays, Operators:– Arithmetic Operators, Bitwise Operators, Relational Operators and Logical Operators

UNIT II - CONTROL STATEMENTS, CLASSES, METHODS AND INHERITANCE (9 hours)

Control Statements:- Selection statements, Iteration statements, Jump statements. Classes and Methods:- Introducing Classes, fundamentals, declaring objects, Introducing Methods, constructors, keywords. Inheritance:- Basics, '*super*', hierarchy, method overriding, abstract and object class.

UNIT III - PACKAGES, APPLETS AND STRING HANDLING (9 hours)

Packages and Interfaces. Exception Handling:- fundamentals, types, '*try and catch*', '*throw*', '*finally'*, built-in exceptions. I/O Applets- the Applet class, String handling:- string constructors, operations, character extraction, string comparison, modifications and string buffer.

UNIT IV - EVENT HANDLINGS AND AWT CONTROLS (9 hours)

Event Handling-Key event class-Mouse event class- Text event Class- Event listener interfaces-Programs for handling mouse and keyboard events- Using AWT controls-Labels- Text field-Buttons-Check boxes- Choice controls and Scroll bars- Layout Managers and Menus.

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

Applications of Java in Bioinformatics: BioJAVA-Java based software used for Bioinformatics analysis (Pattern Hunter)-Java code examples.

TEXT BOOK

1. Herbert Schildt, "*The Complete Reference JAVA 2*" Fifth Edition, Tata McGraw Hill, 2005.

REFERENCES

1. Harvey M. Deitel, Paul J. Deitel, *"Java: How to Program: with an Introduction to Visual J++"*, Prentice Hall, 1997.
2. Kim B. Bruce, Thomas P. Murtagh, Andrea Pohoreckyj Danyluk*, "Java: An Eventful Approach*", Prentice Hall College, 2006.
3. Joseph P. Russell, *"Java Programming for the Absolute Beginner",* Thomson Course Technology, 2001.

BI1020 JAVA PROGRAMMING												
Course designed by		Department of Bioinformatics										
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		5								2,3,4
3.	Category	General (G)		Basic Sciences (B)			Engineering Sciences and Technical Arts (E)			Professional Subjects (P)		
										X		
4.	Broad Area	Biotechnology		Information Technology			Bioinformation Technology			Allied Bioinformatics		
		--		X			--			--		
5.	Approval	23rd meeting of Academic Council, May 2013										

BI1021	IMMUNOINFORMATICS LAB	L	T	P	C
	Total Contact Hours - 30	0	0	2	1
	Prerequisite				
	Nil				

PURPOSE

The purpose of this course is to provide an understanding of concepts and underlying various aspects of *insilico* vaccine development

INSTRUCTIONAL OBJECTIVES

1.	To provide tools for Immunoinformatics based vaccine candidates

LIST OF EXPERIMENTS

1. Identification of Target
2. Prediction of MHC-I binding peptides using SYFPEITHI database
3. Prediction of MHC-I binding peptides using BIMAS database
4. Proteasomal cleavage prediction using PAProC
5. Proteasomal cleavage prediction using NetChop
6. Prediction of MHC-II binding peptides
7. Prediction of B-Cell Sequential epitopes
8. Prediction of B-Cell Conformational epitopes
9. Antigen- Antibody Interaction study

REFERENCE

1. Lab Manual

BI1021 IMMUNOINFORMATICS LAB												
Course designed by		Department of Bioinformatics										
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.	Broad Area	Biotechnology		Information Technology		Bioinformation Technology				Allied Bioinformatics		
		--		--		X				--		
5.	Approval	23rd meeting of Academic Council, May 2013										

BI1022	PROTEOMICS LAB	L	T	P	C
	Total Contact Hours - 30	0	0	2	1
	Prerequisite				
	Nil				

PURPOSE

The purpose of this course is to provide an understanding of concepts and underlying various techniques of proteomics.

INSTRUCTIONAL OBJECTIVES

1. To apply the information gained from the theory about the methods used in proteomics and identify the strategies for electrophoretic and chromatographic techniques
2. *In silico* Protein identification and Quantitation methods
3. *In silico* Protein-Protein Interaction analysis

LIST OF EXPERIMENTS

1. Practice on the separation of proteins by one and two-dimensional gel electrophoresis,
2. Chromatography techniques
3. Analyzing mass spectrometry data using Bioinformatics tools.
4. peptide structural characterization by Bioinformatics tools
5. Peptide mapping and sequence analysis of Gel-resolved proteins
6. Proteomics method for Phosphorylated site mapping
7. Protein identification using computational tools.
8. Protein Identification and Analysis Tools on the ExPASy Server

REFERENCES

1. Departmental Lab reference manual.

BI1022 PROTEOMICS LAB												
Course designed by		Department of Bioinformatics										
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	2	3							
3.	Category	General (G)			Basic Sciences (B)		Engineering Sciences and Technical Arts (E)			Professional Subjects (P)		
										X		

BI1022 PROTEOMICS LAB					
Course designed by		Department of Bioinformatics			
4.	Broad Area	Biotechnology	Information Technology	Bioinformation Technology	Allied Bioinformatics
		X	--	X	--
5.	Approval	23rd meeting of Academic Council, May 2013			

BI1023	JAVA PROGRAMMING LAB	L	T	P	C
	Total Contact hours - 30	0	0	2	1
	Prerequisite				
	Nil				

PURPOSE

To practically apply the concepts and methods learnt in Java Programming.

INSTRUCTIONAL OBJECTIVES

1. The students should be able to; Write example codes for each concept in Java, Learn the applications of Java in Bioinformatics

LIST OF EXPERIMENTS

1. Programs to implement the following Java Programming Techniques.
2. Arrays
3. Inheritance
4. Polymorphism
5. Package and Interface
6. Exception Handling
7. String handling
8. AWT, Event Handling & I/O
9. Applets

REFERENCE

1. Departmental Lab reference manual.

BI1023 JAVA PROGRAMMING LAB												
Course designed by		Department of Bioinformatics										
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

BI1023 JAVA PROGRAMMING LAB					
Course designed by		Department of Bioinformatics			
3	Category	General (G)	Basic Sciences (B)	Engineering Sciences and Technical Arts (E)	Professional Subjects (P)
					X
4.	Broad Area	Biotechnology	Information Technology	Bioinformation Technology	Allied Bioinformatics
			X	--	--
5.	Approval	23rd meeting of Academic Council, May 2013			

BI1049	MINOR PROJECT	L	T	P	C
	Prerequisite	0	0	2	1
	Nil				

PURPOSE

To practically apply the concepts and methods to solve a minor biological problem

INSTRUCTIONAL OBJECTIVES

1.	The students will be able to apply the concepts and techniques studied in earlier semesters

Students have to undergo minor project in Bio-informatics related titles of their choice but with the approval of the department. At the end of the project 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 external examiner. Marks will be awarded out of 100 and appropriate grades assigned as per the regulations.

BI1049 MINOR PROJECT												
Course designed by		**Department of Bioinformatics**										
1.	Student outcome	a	b	c	d	e	f	g	h	i	j	K
		X	X			X						X
2.	Mapping of instructional objective with student outcome	1	1			1						1
3.	Category	General (G)			Basic Sciences (B)		Engineering Sciences and Technical Arts (E)			Professional Subjects (P)		
										X		
4.	Broad Area	Biotechnology			Information Technology		Bioinformation technology			Allied Bioinformatics		
		--			--		X			--		
5.	Approval	23rd meeting of Academic Council, May 2013										

SEMESTER VII

BI1024	**CHEMOINFORMATICS & DRUG DESIGNING**	**L**	**T**	**P**	**C**
	Total Contact Hours – 45	**3**	**0**	**0**	**3**
	Prerequisite				
	Nil				

PURPOSE

This subject portraits the fundamentals of chemo informatics and applications of computer aided drug designing.

INSTRUCTIONAL OBJECTIVES

1.	Study the basic concepts of molecular modeling
2.	Understand the drug discovery and development process
3.	Study the representation of structures and descriptors.
4.	Predict the biological activities through QSAR analysis
5.	Emphasize the significance of chemical libraries

UNIT I - MOLECULAR MODELING IN DRUG DESIGN (8 hours)

Molecular modeling in drug discovery- Molecular docking- *De-novo* ligand designing- and structure-based methods

UNIT II - DRUG DISCOVERY AND DEVELOPMENT (10 hours)

Drug discovery: targets and receptors- target identification and validation- drug interactions- small molecule drugs- Pharmacodynamics- Pharmacokinetics- toxicology- animal tests- formulations and delivery systems

UNIT III - REPRESENTATION OF STRUCTURES AND MOLECULAR DESCRIPTORS (9 hours)

Representation and Manipulation of 2D Molecular Structures- Representation and Manipulation of 3D Molecular Structures. - Descriptors Calculated from the 2D Structure- Descriptors Based on 3D Representations

UNIT IV - SIMILARITY AND QSAR METHODS (9 hours)

Similarity Methods- Similarity Based on 2D Fingerprints- Similarity Coefficients- 2D Descriptor Methods- 3D Similarity- Selecting Diverse Sets Of Compounds- Introduction- deriving a QSAR Equation- Simple and Multiple Linear Regression- Designing a QSAR "Experiment"- Principal Components Regression- Partial Least Squares- Molecular Field Analysis

UNIT V - HIGH THROUGHPUT AND VIRTUAL SCREENING (9 hours)

Analysis of High-Throughput Screening Data- Data Visualization- Data Mining Methods- Virtual Screening- Drug-Likeness and Compound Filters- Structure-Based Virtual Screening- chemical libraries.

TEXT BOOK

1. Andrew R Leach, Valerie J Gillet, "*An Introduction to Chemoinformatics*", Kluwer academic publishers, 2003.
2. Rick NG, "*Drugs: from Discovery to Approval*", John Wiley & sons, 2004.
3. Andrew R Leach, "*Molecular Modelling- Principles and applications*", Prentice Hall, II edition, 1996.

REFERENCES

1. Johann Gasteiger, Thomas Engel, "*Chemoinformatics- A Textbook*", Wiley-VCH, 2003.
2. Jürgen Bajorath, "*Chemoinformatics: Concepts, Methods, and Tools for Drug Discovery*", Humana press, 2004.
3. Garland R Marshall, *"Chemoinformatics in Drug Discovery*" ,John Wiley & Sons, 2006.

<table>
<tr><th colspan="14">BI1024 CHEMOINFORMATICS & DRUG DESIGNING</th></tr>
<tr><th colspan="2">Course designed by</th><th colspan="12">Department of Bioinformatics</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>2.</td><td>Mapping of instructional objectives with student outcome</td><td>1</td><td>2,3</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>4,5</td></tr>
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<tr><td colspan="3">--</td><td colspan="2">--</td><td colspan="3">X</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>
</table>

BI1025	INTERNET PROGRAMMING	L	T	P	C
	Total Contact Hours - 30	2	0	0	2
	Prerequisite				
	Nil				

PURPOSE

The purpose of this course is to learn the fundamentals of various programming methods employed in the internet.

INSTRUCTIONAL OBJECTIVES

1.	To introduce the basics of internet and HTML
2.	To make the students understand the scripting languages
3.	To introduce the markup languages XML and XHTML
4.	To give the students an understanding of server side programming
5.	To make the students understand the fundamentals and applications of ASP.NET

UNIT I - INTERNET BASICS, HTML (9 hours)

Basic internet concepts - web server, client – Apache server – Internet Information Services (IIS)- Markup Language- Introduction to HTML and Cascading Style Sheets (CSS)- Internet applications- Email – chat – search engines – news groups.

UNIT II - SCRIPTING LANGUAGES (9 hours)

Java Scripting - VB scripting- Object model and event model- Document Object Model (DOM) – Common Gateway Interface (CGI) & data base connectivity- Introduction to PHP and Perl scripting.

UNIT III - XML AND XHTML (9 hours)

Introduction to XML – Document Type Definitions - XML schemas – XML Database creation. Introduction to XHTML and XHTML elements.

UNIT IV - SERVER SIDE PROGRAMMING (9 hours)

Multi tier application- Introduction to Java servlets- HTTP GET & POST request- JDBC principles- cookies session tracking;

UNIT V - ASP.NET **(9 hours)**

Introduction to ASP.NET- using objects- data types- data access objects- connection object- command object. CASE STUDY- Developing a web based tool for sequence analysis.

TEXT BOOKS

1. Steven M. Schafer, "*HTML, XHTML, and CSS Bible*", Fifth Edition, Wiley Publishing, Inc. 2010.
2. Deital and Deital, Goldberg, "*Internet & World Wide Web, How To Program*", third edition, Pearson Education, 2004.

REFERENCES

1. Paul Wilton and Jeremy McPeak, "*Beginning JavaScript*", Wrox, 4th edition, 2009.
2. Cerami Ethan, "*XML for Bioinformatics*", Springer, 2005.
3. Adrian Kingsley-Hughes, Kathie Kingsley-Hughes, Daniel Read, "*VBScript Programmer's Reference*", 3rd Edition, Wrox, 2007.
4. Vivek Chopra, Jon Eaves, Rupert Jones, Sing Li, John T. Bell, "*Beginning JavaServer Pages*", Wrox, 2005.
5. Macdonald Mathew, "*Asp.Net - The Complete Reference*", McGraw-Hill/ Osborne, 2002.

<table>
<tr><th colspan="14">BI1025 INTERNET PROGRAMMING</th></tr>
<tr><td colspan="2">Course designed by</td><td colspan="12">Department of Bioinformatics</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></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>5</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>2,3,4</td></tr>
<tr><td rowspan="2">3.</td><td rowspan="2">Category</td><td colspan="3">General (G)</td><td colspan="2">Basic Sciences (B)</td><td colspan="3">Engineering Sciences and Technical Arts (E)</td><td colspan="3">Professional Subjects (P)</td></tr>
<tr><td colspan="3"></td><td colspan="2"></td><td colspan="3"></td><td colspan="3">X</td></tr>
<tr><td rowspan="2">4.</td><td rowspan="2">Broad Area</td><td colspan="3">Biotechnology</td><td colspan="2">Information Technology</td><td colspan="3">Bioinformation Technology</td><td colspan="3">Allied Bioinformatics</td></tr>
<tr><td colspan="3">--</td><td colspan="2">X</td><td colspan="3">--</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>
</table>

BI1026	MOLECULAR DYNAMICS	L	T	P	C
	Total Contact Hours – 45	3	0	0	3
	Prerequisite				
	Nil				

PURPOSE

The purpose of this course is to provide detail information to understand structural and dynamic properties of biomolecules. The course is expected to develop the scientific interest in students, to facilitate the value of efficient sampling methods.

INSTRUCTIONAL OBJECTIVES

1.	To understand molecular dynamics concepts of temperature, ensemble, and periodic boundaries.
2.	Understanding the structural properties and energy minimization in folding process
3.	To set up free energy calculations
4.	To understand the modeling of molecules including hard potentials, soft potentials, torsion and bend potential

UNIT I - BASICS (10 hours)

Introduction of molecular dynamics – Statistical mechanics- Entropy and temperature, Classical Statistical Mechanics, ergodicity- Monte Carlo Simulations- Sampling Method, Algorithm, applications- Molecular dynamics simulations: the Idea

UNIT II - ALGORITHMS (8 hours)

Introduction- Periodic boundary conditions, Constraint algorithm- Shake, Lincs, Simulated Annealing, Stochastic Dynamics, Brownian Dynamics- Energy minimization- Steepest Descent- Conjugate Gradient.

UNIT III - FORCE FIELD AND INTERACTION FUNCTIONS (8 hours)

Non-bonded interactions- Lennard-Jones interaction- Coulomb interaction- Bonded interactions- Bond stretching, Morse potential bond stretching- Cubic bond stretching- Torsional angles- Force field- GROMOS87, OPLS, AMBER, CHARMM

UNIT IV - MOLECULAR DYNAMICS (9 hours)

Molecular dynamics simulations- the Idea, Initialization, force calculation, integrating equations of motions- Higher order schemes- Liouville formulation of time reversible algorithm- Computer experiment: Diffusion, Order-n Algorithm to measure correlations- Applications

UNIT V - MONTE CARLO AND MOLECULAR DYNAMICS IN VARIOUS ENSEMBLES (10 hours)

Monte Carlo Simulations- General approach, Canonical ensemble, Microcanonical Monte Carlo, Isobaric-isothermal ensemble, applications- Molecular dynamics: The Andersen Thermostat, Nose-Hoover Thermostat, MD at constant pressure.

TEXT BOOKS

1. Daan Frenkel, Berend Smit, "*Understanding Molecular Simulation: Algorithms to applications*", Academic Press, 2001.
2. Andrew R. Leach, "*Molecular Modelling- Principles and applications*", Prentice hall, 1996.

REFERENCES

1. Carl Branden and John Tooze, "*Introduction to protein structures*", Garland publishing Inc., 1999.
2. Heerman .D.W., "*Computer Simulation Methods*", Springer- Verlag, 1990.

BI1026 MOLECULAR DYNAMICS												
Course designed by		**Department of Bioinformatics**										
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		4		2						3
3	Category	General (G)		Basic Sciences (B)			Engineering Sciences and Technical Arts (E)			Professional Subjects (P)		
										X		
4	Broad Area	Biotechnology		Information Technology			Bioinformation Technology			Allied Bioinformatics		
		--		--			X			--		
5	Approval	23rd meeting of Academic Council, May 2013										

BI1027	PYTHON	L	T	P	C
	Total Contact Hours - 45	3	0	0	3
	Prerequisite				
	Nil				

PURPOSE

The purpose of this course is to introduce biopython and its applications in bioinformatics

INSTRUCTIONAL OBJECTIVES

1.	To understand the basics of Python as prelude for Biopython.
2.	To learn the control statements and file parsing methods in Python
3.	To learn sequence handling using python
4.	To learn how to use python for handling the biological databases.
5.	To get familiarized with some of the advanced options in Biopython.

UNIT I - INTRODUCTION TO PYTHON (9 hours)

Simple values, expressions, operators. Names, functions and modules. Collections:- Sequences, mappings, streams, and expression features.

UNIT II - CONTROL STATEMENTS, FILE PARSING (9 hours)

Conditional statements:- loops, iterations, exception handlers. Extended examples - Extracting Information from an HTML File, Bioinformatics File Parser, Parsing GenBank Files, Translating RNA Sequences, Constructing a Table from a Text File.

UNIT III - SEQUENCES AND BIOPYTHON (9 hours)

Introduction to Biopython, sequence objects, sequence record objects. Sequence input and output:- parsing sequences, parsing sequences from the net, sequence files as dictionaries, writing sequence files. Multiple Sequence Alignment objects.

UNIT IV - DATABASE SEARCH USING BIOPYTHON (9 hours)

BLAST using Biopython:- running BLAST, parsing BLAST output, PSI-BLAST and RPS-BLAST. Accessing NCBI's Entrez databases. Swiss-Prot and ExPASy.

UNIT V - ADVANCED MODULES IN BIOPYTHON (9 hours)

PDB module, phylogenetics, sequence motif analysis and cluster analysis.

TEXT BOOK

1. Jeff Chang, Brad Chapman, Iddo Friedberg, Thomas Hamelryck, *Biopython Tutorial and Cookbook*", http://biopython.org/DIST/docs/tutorial/Tutorial.html, 2013.

REFERENCES

1. Mitchell L Model, "*Bioinformatics Programming Using Python*", O'Reilly media, Cambridge, 2010.

BI1027 PYTHON												
Course designed by		Department of Bioinformatics										
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, 4,5
3.	Category	General (G)			Basic Sciences (B)		Engineering Sciences and Technical Arts (E)			Professional Subjects (P)		
										X		
4.	Broad Area	Biotechnology			Information Technology		Bioinformation Technology			Allied Bioinformatics		
		--			X					--		
5.	Approval	23rd meeting of Academic Council, May 2013										

BI1028	CADD LAB	L	T	P	C
	Total Contact hours - 60	0	0	4	2
	Prerequisite				
	Nil				

PURPOSE

Provides an opportunity to experimentally verify the theoretical concepts

INSTRUCTIONAL OBJECTIVES

1. To enable the students to understand the basic concepts involved in the analyses of proteins
2. To be able to use various Bioinformatics tools to visualize and build small molecules

LIST OF EXPERIMENTS

1. Target - Ligand from PDB Sum
2. Knowledge about different chemical data bases
3. Different chemical file formats
4. Molecule Visualization Tools
5. Small molecule building, using ISIS Draw and CHEM SKETCH
6. Analysis of 2D and 3D structures of proteins
7. Finding the active sites in a receptor
8. Homology Modeling
9. Docking

REFERENCE

1. Laboratory Manual

BI1028 CADD LAB												
Course designed by		**Department of Bioinformatics**										
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			Information Technology		Bioinformation Technology			Allied Bioinformatics		
		--			--		X			--		
5.	Approval	23rd meeting of Academic Council, May 2013										

BI1029	**INTERNET PROGRAMMING LAB**	**L**	**T**	**P**	**C**
	Total Contact hours 30	**0**	**0**	**2**	**1**
	Prerequisite				
	Nil				

PURPOSE

To practically apply the concepts and methods learnt in Internet Programming.

INSTRUCTIONAL OBJECTIVES	
1.	The students should be able to; Write example codes for Internet using markup, scripting and server side programming methods.

LIST OF EXPERIMENTS

1. Exercises on creating HTML pages
2. Implementation of Package Bio-Data
3. Shapes Class Hierarchy
4. Animation using Java Applets
5. MS-FrontPage
6. Implementation of simple TCP/IP Client and server
7. Operations on Employee table using JDBC
8. Constructing a simple database using XML
9. An interactive Web application in JSP
10. Using cookies to track users in browsers from the web servers
11. Constructing a secured FTP client - server application

REFERENCE

1. Departmental Lab reference manual.

BI1029 INTERNET PROGRAMMING LAB												
Course designed by		Department of Bioinformatics										
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.	Broad Area	Biotechnology			Information Technology		Bioinformation Technology			Allied Bioinformatics		
		--			X		--			--		
5.	Approval	23rd meeting of Academic Council, May 2013										

BI1030	MOLECULAR DYNAMICS LAB	L	T	P	C
	Total Contact hours -45	0	0	3	2
	Prerequisite				
	Nil				

PURPOSE

To practically apply the concepts and methods learnt in Molecular Dynamics

INSTRUCTIONAL OBJECTIVES

1. The students should be able to; dynamically analyse trajectories and infer behaviour of proteins and small molecules

LIST OF EXPERIMENTS

1. Molecular energy surfaces: torsions and H-bonds
2. Normal mode analysis : water
3. Conformational search : energy minimization
4. Conformational search : molecular dynamics
5. MD simulation of a small protein in vacuum
6. MD simulation of a solvated peptide
7. Individual student-generated projects

REFERENCES

1. Departmental Lab reference manual.

BI1030 MOLECULAR DYNAMICS LAB												
Course designed by		Department of Bioinformatics										
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.	Broad Area	Biotechnology			Information Technology		Bioinformation technology			Allied Bioinformatics		
		--			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										

BI1048	INDUSTRIAL TRAINING II (Training to be undergone after VI semester)	L	T	P	C
	2 week practical training in industry	0	0	1	1
	Prerequisite				
	Nil				

PURPOSE

To provide hands-on experience by working in bioinformatics or 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 Bioinformatics projects of their choice with the approval of the department. At the end of the training student will submit a report in the prescribed format.

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.

BI1048 INDUSTRIAL TRAINING II												
Course designed by		**Department of Bioinformatics**										
1.	Student Outcome	a	b	c	d	e	f	g	h	i	j	k
					X		X	X	X	X	X	
2.	Mapping of instructional objectives with student outcome				1	1	1	1	1	1	1	
3.	Category	General (G)		Basic Sciences (B)		Engineering Sciences & Technical Arts (E)				Professional Subjects (P)		
										X		
4.	Approval	23rd meeting of Academic Council, May 2013										

SEMESTER VIII

BI1050	MAJOR PROJECT	L	T	P	C
	Prerequisite	0	0	24	12
	Minor project				

PURPOSE

To practically apply the concepts and methods to solve a biological problem

INSTRUCTIONAL OBJECTIVES

1. The students will be able to apply the concepts and techniques studied in earlier semesters

Students have to undergo one semester project in Bioinformatics related titles of their choice but with the approval of the department. At the end of the project 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 external examiner. Marks will be awarded out of 100 and appropriate grades assigned as per the regulations.

BI1050 MAJOR PROJECT												
Course designed by		Department of Bioinformatics										
1.	Student outcome	a	b	c	d	e	f	G	h	i	j	K
		X	X			X						X
2.	Mapping of instructional objective with student outcome	1	1			1						1
3.	Category	General (G)			Basic Sciences (B)		Engineering Sciences and Technical Arts (E)			Professional Subjects (P)		
										X		
4.	Broad Area	Biotechnology			Information Technology		Bioinformation technology			Allied Bioinformatics		
		--			--		X			--		
5.	Approval	23rd meeting of Academic Council, May 2013										

DEPARTMENT ELECTIVES

BI1101	**METABOLOMICS AND METABOLIC ENGINEERING**	**L**	**T**	**P**	**C**
	Total Contact Hours - 45	**3**	**0**	**0**	**3**
	Prerequisite				
	BIOCHEMISTRY				

PURPOSE

This course offers fundamental applications of bioinformatics techniques to analyze and manage metabolites using metabolomics and metabolic engineering model.

INSTRUCTIONAL OBJECTIVES

1.	To expose the different technologies associated with metabolome study
2.	To apply bioinformatics tools to metabolome analysis
3.	To provide metabolic engineering fundamentals related to flux.
4.	To provide examples of metabolic engineering

UNIT I - INTRODUCTION TO METABOLOMICS (10 hours)

Role of metabolomics in systems biology –application of metabolomics- Analytical methods in metabolomics – Data standards– Databases for Chemical, Spectral and Biological Data –Reconstruction of dynamic metabolic network model- examples- study of metabolome of a simple organism like *E.Coli.*

UNIT II - BIOINFORMATICS IN METABOLOMICS (10 hours)

Online databases and pipelines for metabolomics – GC-MS based metabolomics – Computational methods to compute and integrate metabolic data-software for metabolomics- metabolomics and medical sciences

UNIT III - INTRODUCTION TO METABOLIC ENGINEERING (7 hours)

Importance of metabolic engineering-comprehensive models for cellular reactions-material balances & data consistency- metabolic pathway synthesis.

UNIT IV - METABOLIC FLUX ANALYSIS AND ITS APPLICATION (9 hours)

Theory-determination of flux by isotope labeling-Metabolic control analysis-(control coefficients and summation theorems, FCC determination)-Grouping of reactions (gFCC, identification of independent pathways).

UNIT V - METABOLIC NETWORKS **(9 hours)**

Kinetic model of metabolic networks-Systems metabolic engineering of E.coli-bottom up and top down approaches of network analysis.

TEXT BOOKS

1. Jens Hřiriis Nielsen, Michael C. Jewett, "*Metabolomics: A Powerful Tool in Systems Biology*", Springer, 2007.
2. Dr. Christoph Wittmann, Sang Yup. Lee, "*Systems Metabolic Engineering*", Springer 2012.
3. Gregory N. Stephanopoulos, "*Metabolic Engineering- Principles and Methodologies*", Academic press, First Edition, 1998.

REFERENCES

1. Ute Roessner, "*Metabolomics*", InTech, 2012.
2. Silas G. Villas-Boas, Jens Nielsen, Jorn Smedsgaard, Michael A. E. Hansen, Ute Roessner-Tunali, "*Metabolome Analysis: An Introduction*", John Wiley & Sons, 2007.
3. Wolfram Weckwerth, "*Metabolomics: Methods And Protocols*", Humana Press, 2007.
4. Cortassa S. "*An Introduction to Metabolic and Cellular Engineering*", World scientific public company Ltd., 2002.

BI1101 METABOLOMICS AND METABOLIC ENGINEERING												
Course designed by		**Department of Bioinformatics**										
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								4		1,2
3.	Category	General (G)			Basic Sciences (B)		Engineering Sciences and Technical Arts (E)			Professional Subjects (P)		
										X		
4.	Broad Area	Biotechnology			Information Technology		Bioinformation Technology			Allied Bioinformatics		
		--			--		X			--		
5.	Approval	23rd meeting of Academic Council, May 2013										

BI1102	DATA STRUCTURES	L	T	P	C
	Total Contact Hours - 45	3	0	0	3
	Prerequisite				
	Nil				

PURPOSE

The purpose of this subject is to study about the basic fundamentals of data structures and their applications in 'C' & 'C++'

INSTRUCTIONAL OBJECTIVES

1.	To understand the basic fundamentals and stack, queue Implementation
2.	To understand the basic concepts of trees and their applications.
3.	To understand various types of sorting methods
4.	To understand the application of various search and graph techniqiues

UNIT I - LINEAR DATA STRUCTURES (9 hours)

Algorithm Analysis - Mathematical background, Model - Running Time Calculations - Linear Data Structure - List ADT Array and Cursor Implementations - Stack ADT - Queue ADT Array and List Implementation and Applications.

UNIT II - NON-LINEAR DATA STRUCTURES (9 hours)

Trees- Binary trees - Binary Tree Representations, Tree Traversals, AVL Trees- Single and Double Rotation, Splay trees- B-Trees- Priority Queue- Binary Heap, Applications and variations of Priority Queue.

UNIT III - SORTING METHODS (9 hours)

Sorting- Exchange sorts- Selection and Tree sorting- Insertion Sort- Heap Sort- Merge Sort- Quick Sort- Bucket Sort.

UNIT IV - GRAPH ALGORITHMS (9 hours)

Definition and Representation of graphs- Topological sort- Shortest-Path Algorithms- Network flow problems- Minimum Spanning Tree- Application of Depth-First Search.

UNIT V - SEARCHING (9 hours)

Basic Search Techniques- Tree Searching- General Search Trees- Hashing.

TEXT BOOKS

1. Jeffrey Esakov, Tom Weiss, "*Data Structures An Advanced Approach using C*", PHI, 1989.
2. Mark Allen Weiss, "*Data Structures and Algorithm Analysis in C*", Addison Wesley Publications, 2007.

REFERENCES

1. Aaron M. Tanenbaum, Yedidyah Langsam, Moshe J. Augensten, "*Data Structures Using C*", PHI, 1990.Chapters-5, 6, 7
2. Alfred V. Aho, John E. Hopcroft, Jeffrey D. Ullman, "*Data Structures and Algorithms*", Pearson Education, 10th Reprint, 2004.
3. Jean-Paul Tremblay, Paul G. Sorenson, "*An Introduction to Data Structures with Applications*", 2nd Edition, Tata McGraw-Hill Edition, 1976.

BI1102 DATA STRUCTURES												
Course designed by		**Department of Bioinformatics**										
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				3			2			4
3.	Category	General (G)			Basic Sciences (B)		Engineering Sciences and Technical Arts(E)			Professional Subjects (P)		
										X		
4.	Broad Area	Biotechnology			Information Technology		Bioinformation Technology			Allied Bioinformatics		
		--			X		--			--		
5.	Approval	23rd meeting of Academic Council, May 2013										

BI1103	**STRUCTURAL CHEMISTRY**	**L**	**T**	**P**	**C**
	Total Contact Hours - 45	**3**	**0**	**0**	**3**
	Prerequisite				
	Nil				

PURPOSE

Introduce the theories and concepts of structure of chemical compounds that are considered important in chemoinformatics.

INSTRUCTIONAL OBJECTIVES	
1.	To have acquired a thorough and comprehensive understanding of various types of chemical bonding
2.	To have good exposure to stereochemistry and conformational analysis
3.	To Have knowledge on principles of spectroscopy for structural elucidation.

UNIT I - CHEMICAL BONDING (9 hours)

Introduction- chemical bonding: ionic bond, covalent bond, coordination bond and hydrogen bond – their characteristics- Factors affecting covalent bond – Inductive effect – applications – strength of acids, bases – electromeric effect – applications. Conjugation – mesomerism and resonance: applications, hyper conjugation – intra molecular interaction - hydrogen bond – application.

UNIT II - THEORY OF CHEMICAL BONDING (9 hours)

The valence bond approach – Sigma and pi bonds - Hybridization – Bond length – Bond angle – Bond energy – Dipole moment interaction – Modification of VB Theory – VSEPR theory – Shapes of simple molecules –concepts of Molecular orbital theory- applications to simple molecule like H^2, H^{2+}, N_2, O_2, & CO.

UNIT III - CHEMISTRY OF CARBOHYDRATE, PROTEINS (9 hours)

Carbohydrates – Classification – D and L – Sugars- relative configuration of sugars: Glucose, Lactose, Maltose, fructose, starch – Structures and chemical properties an elementary account (Elucidation of Structure not necessary)- Amino acids: classification, stereochemistry, chemical properties peptides- Proteins – classification, structure and chemical properties.

UNIT IV - STEREO CHEMISTRY (9 hours)

Isomerism- Types – structural – stereoisomerism – optical isomerism – elements of symmetry & chirality – Resolution – Racemisation – Asymmetric synthesis – Walden inversion – Stereo specific and stereo selective synthesis – Tautomerism – Difference between Tautomerism and resonance.

UNIT V - CONFORMATIONAL ANALYSIS (9 hours)

Conformation and Configuration – conformational isomers – various notations- New Mann, sawhorse, Fisher –representations, inter conversion –

stereoisomerism. Conformations of cyclohexane – Geometrical isomerism – Nomenclature of E and Z system – Optical activity – Symmetry elements and chirality - Optical isomerism – Optical isomers of lactic acid, Malic acid and tartaric acid – Specification of configuration – D & L notation, R & S notation – Sequence rules - specification of configuration of compounds with more than one chiral carbons.

TEXT BOOKS

1. Soni. P.L, "*Text book of Organic Chemistry*", 20th Edition, Sultan Chand and Sons, New Delhi.
2. Eliel .E.L. & Wilen .S.H, "*Stereo Chemistry*", John Wiley & Sons, 1994.

REFERENCES

1. Tewari .K.S. Vishonoi N.K. "*A Text book of organic chemistry*", Vikhyas publishing house, 1998.
2. Nasipur D. "*Stereo Chemistry of Organic Chemistry*", 2nd Edition, Wiley Easkera Ltd, 1991.
3. Finar I.L. *"Organic Chemistry*", Vol. I, Vol. II, Addisan – Wesly Longman, 1973.
4. Morrison R.T. Boyd R.W "*Organic chemistry*", Prentice Hall, 2002.

<table>
<tr><th colspan="14">BI1103 STRUCTURAL CHEMISTRY</th></tr>
<tr><td colspan="2">Course designed by</td><td colspan="12">Department of Bioinformatics</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>
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<tr><td>2.</td><td>Mapping of instructional objectives with student outcome</td><td>1,2</td><td></td><td></td><td>3</td><td></td><td></td><td></td><td></td><td></td><td></td><td></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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BI1104	PHARMACOGENOMICS & PHARMACOGENETICS	L	T	P	C
	Total Contact Hours - 45	3	0	0	3
	Prerequisite				
	Nil				

PURPOSE

To introduce the in-depth knowledge on Pharmacogenomics advances and Pharmacogenetics technologies

INSTRUCTIONAL OBJECTIVES

1.	To be able to understand the potentials of Pharmacogenomics
2.	To have knowledge in technologies associated with pharmacogenetics

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

Historical aspects of Pharmacogenetics- Pharmacogenomics- Biomarkers- and the promise of personalized medicine

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

Pharmacogenetics of drug metabolism- receptors- drug transporters

UNIT III - DRUG RESPONSE **(9 hours)**

Inter ethnic drug response- clinical viewpoints- technologies and challenges

UNIT IV - SINGLE NUCLEOTIDE POLYMORPHISM **(9 hours)**

Introduction- technologies for the analysis of SNPs- molecular diagnostics

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

Serial Analysis of Gene Expression (SAGE) - functional biology- mapping of disease loci

TEXT BOOKS

1. Zdanowicz M, "*Concepts in Pharmacogenomics*", ASHP, 2010.
2. Werner Kalow, Rachel F Tyndale, Urs A Meyer, "*Pharmacogenomics*", Marcel Dekker Inc., 2001.

REFERENCES

1. Adam Hedgecoe, "*The Politics of Personalized Medicine- Pharmacogenetics in the Clinic*", Cambridge University Press, first edition, 2004.

2. Licinio J. Ma-LiWong, "*Pharmacogenomics: The Search for Individualized Therapies*", Wiley-VCH, 2002.

BI1104 PHARMACOGENOMICS & PHARMACOGENETICS												
Course designed by		Department of Bioinformatics										
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			Information Technology		Bioinformation Technology			Allied Bioinformatics		
							X					
5.	Approval	23rd meeting of Academic Council, May 2013										

BI1105	GENETIC ALGORITHMS	L	T	P	C
	Total Contact Hours - 45	3	0	0	3
	Prerequisite				
	Nil				

PURPOSE

Introduce the in-depth knowledge complete understanding of the concepts of Genetic algorithm.

INSTRUCTIONAL OBJECTIVES

1.	Mathematical foundations for Genetic algorithm, operators
2.	Applications of Genetic Algorithms
3.	Genetic based machine learning and its applications

UNIT I - INTRODUCTION TO GENETIC ALGORITHM (9 hours)

Introduction to Genetic Algorithm – Robustness of Traditional Optimization and Search methods – Goals of optimization-GA versus Traditional methods – Simple GA – GA at work –Similarity templates (Schemata) – Learning the lingo -

Mathematical foundations- The fundamental theorem - Schema processing at work. – The 2-armed & k-armed Bandit problem. –The building Block Hypothesis. – Minimal deceptive problem.

UNIT II - GA OPERATORS (9 hours)

Data structures – Reproduction- Roulette-wheel Selection – Boltzman Selection – Tournament Selection-Rank Selection – Steady –state selection –Crossover mutation –A time to reproduce, a time to cross. – Get with the Main program. – How well does it work. – Mapping objective functions to fitness forum. – Fitness scaling. Coding – A Multi parameter, Mapped, Fixed – point coding – Discretization – constraints.

UNIT III-APPLICATIONS OF GA (9 hours)

The rise of GA – GA application of Historical Interaction. – Dejung & Function optimization – Current applications of GA - Advanced operators & techniques in genetic search- Dominance, Diploidy & abeyance – Inversion & other reordering operators. – Other mine-operators – Niche & Speciation – Multi objective optimization – Knowledge-Based Techniques. – GA & parallel processes – Real life problem.

UNIT IV - INTRODUCTION TO GENETICS-BASED MACHINE LEARNING (9 hours)

genetics – Based Machine learning – Classifier system – Rule & Message system – Apportionment of credit-The bucket brigade – Genetic Algorithm – A simple classifier system in Pascal. – Results using the simple classifier system.

UNIT V - APPLICATIONS OF GENETICS-BASED MACHINE LEARNING (9 hours)

The Rise of GBMC – Development of CS-1, the first classifier system. – Smitch's Poker player. – Other Early GBMC efforts. –Current Applications.

TEXT BOOKS

1. David E. Gold Berg, "*Genetic Algorithms in Search*", Optimization & Machine Learning, Pearson Education, 2001.
2. Rajasekaran.S, Vijayalakshmi Pai .G.A. , "*Neural Networks, Fuzzy Logic and Genetic Algorithms*", PHI,003. (Chapters 8 and 9).

REFERENCES

1. Kalyanmoy Deb, "*Optimization for Engineering Design, algorithms and examples*", PHI 1995.

2. Melanie Mitchell, "*An Introduction to Genetic Algorithms*", The MIT Press, 1996.

BI1105 GENETIC ALGORITHMS												
Course designed by		**Department of Bioinformatics**										
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
3.	Category	General (G)			Basic Sciences (B)		Engineering Sciences and Technical Arts (E)			Professional Subjects (P)		
										X		
4.	Broad Area	Biotechnology			Information Technology		Bioinformation Technology			Allied Bioinformatics		
		--			X		--					
5.	Approval	23rd meeting of Academic Council, May 2013										

BI1106	ACHIEVEMENTS IN BIOTECHNOLOGY AND BIOINFORMATICS	L	T	P	C
	Total Contact Hours - 45	**3**	**0**	**0**	**3**
	Prerequisite				
	Nil				

PURPOSE

To make aware the different achievements in the field of bioinformatics and biotechnology in the industry

INSTRUCTIONAL OBJECTIVES

1. The students is made aware of the current techniques used in rDNA technology
2. Advances in agriculture and environmental biotechnology
3. The role of bioinformatics in food and medical biotechnology

UNIT I - INTRODUCTION TO NEW HORIZONS IN BIOTECHNOLOGY AND BIOINFORMATICS. (9 hours)

Current achievents and innovation prospects in bioindustry and bioeconomy- Recombinant DNA technology ; gene therapy; biopharmaceuticals; pharmacogenomics- genetic testing- Artificial Chromosome assembly.

UNIT II - PLANT AND AGRICULTURE BIOTECHNOLOGY (9 hours)

Plant as factories for vaccines, antibodies, and pharmaceutical proteins- Bioengineering of low molecular weight essential nutrients, health-promoting phytochemicals volatiles and aroma- bioenergy from plants- microbial control of postharvest diseases of fruits, vegitables, roots and tubers.

UNIT III - INDUSTRIAL, FOOD AND MEDICAL BIOTECHNOLOGY (9 hours)

Industrial production of enzymes for feed industry, solid state fermentation- esterase and lipase production by thermophilic fungi- prebleaching of kraft pulps for paper manufacture- beverage and coffee industry- Screening of mushrooms- kefir yeast technology- ELISa and IFAT techniques for canine cutaneous Leishmaniasis

UNIT IV - ENVIRONMENTAL BIOTECHNOLGY, BIOAUGMENTATION, BIOSTIMULATION (9 hours)

Bioremediation and biobeneficiation of metals- enhanced biological phosphorus removal- role of membrane bioreactors in environmental engineering applications- detoxification strategy- organic soil as a biofilter- plant growth promoting Rhizosphere microorganisms, biofertilizer and pulse prodiction- agro-food and beverage industry effluents- composting of lignocellulosic waste material for soil amendment- InSitu soil remediation- Biodegradation of Oil Hydrocarbons

UNIT V - CURRENT STATE OF GENETICALLY MODIFIED ORGANISM (GMO) (9 hours)

Microbial, Plant, Mammalian GMOs- Health impact- Biosafety and Ethical issues- consumer acceptance of GM food- Intellectual property rights of biotechnologically improved plants- regulatory issues of genetically modified food plants- commercialization of GM products

TEXT BOOKS

1. Roussos .S, Soccol.C.R., Pandey.A and Augur .C "*New Horizons in Biotechnology",* Springer, 2003.

REFERENCES

1. Sarad R. Parekh "*The GMO Handbooks, Genetically modified animals, Microbes and Plants in Biotechnology"*, Humana Press, 2010.
2. Krylov. I.A., Zaikov .G.E., "*Industrial application of Biotechnology*", Nova Publishers, 2006.

3. Albert Sasson., *"Medical Biotechnolgy, Achievements, prospects and perceptions"*, United Nations University Press, 2005.
4. Ajay Singh, Nagina Parmar and Remesh C. Kuhad, *"Bioaugmentation, Biostimulation and Biocontro*l", Spinger press,2011.
5. Arie Altman and Paul Michael Hasegawa., *"Plant Biotechnolgy and Agriculture prospects for the 21st century*", Academic Press, 2012.

BI1106 ACHIEVEMENTS IN BIOTECHNOLOGY AND BIOINFORMATICS													
Course designed by		Department of Bioinformatics											
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	
3.	Category	General (G)			Basic Sciences (B)		Engineering Sciences and Technical Arts (E)			Professional Subjects (P)			
										X			
4.	Broad Area	Biotechnology			Information Technology		Bioinformation Technology			Allied Bioinformatics			
		X			--		X						
5.	Approval	23rd meeting of Academic Council, May 2013											

BI1107	BIOSPECTROSCOPY	L	T	P	C
	Total Contact Hours - 45	3	0	0	3
	Prerequisite				
	Nil				

PURPOSE

To introduce the in-depth knowledge in spectroscopy methods employed in biological sciences which plays a major role in structural and functional bioinformatics

INSTRUCTIONAL OBJECTIVES

1.	To introduce spectroscopy technologies
2.	To expose the concepts of NMR and Mass Spectroscopy in elucidating macromolecules

UNIT I - FUNDAMENTALS OF SPECTROSCOPY (7 hours)

Quantum mechanics- Particle in a box-Wave properties

UNIT II - X-RAY CRYSTALLOGRAPHY (10 hours)

Introduction-Scattering of X Rays by a Crystal-Structure Determination-Neutron Diffraction-Nucleic Acid Structure-Protein Structure-Enzyme Catalysis.

ELECTRONIC SPECTRA-Introduction-Absorption Spectra-Ultraviolet Spectra of Proteins-Nucleic Acid Spectra-Prosthetic Groups-Difference Spectroscopy-X-Ray Absorption Spectroscopy-Fluorescence and Phosphorescence-RecBCD: Helicase Activity Monitored by Fluorescence-Fluorescence Energy Transfer: A Molecular Ruler-Application of Energy Transfer to Biological Systems-Dihydrofolate reductase.

UNIT III - CIRCULAR DICHROISM, OPTICAL ROTARY DISPERSION, AND FLUORESCENCE POLARIZATION (10 hours)

Introduction-Optical Rotary Dispersion-Circular Dichroism-Optical Rotary Dispersion and Circular Dichroism of Proteins-Optical Rotation and Circular Dichroism of Nucleic Acids-Small Molecule Binding to DNA-Protein Folding-Interaction of DNA with Zinc Finger Proteins-Fluorescence Polarization

VIBRATIONS IN MACROMOLECULES-Introduction-Infrared Spectroscopy-Raman Spectroscopy-Structure Determination with Vibrational Spectroscopy Resonance Raman Spectroscopy-Structure of Enzyme-Substrate Complexes.

UNIT IV - PRINCIPLES OF NUCLEAR MAGNETIC RESONANCE AND ELECTRON SPIN RESONANCE (9 hours)

NMR Spectrometers-Chemical Shifts-Spin-Spin Splitting-Relaxation Times-Multidimensional NMR-Magnetic Resonance Imaging-Electron Spin Resonance - Applications Of Magnetic Resonance to biology

UNIT V - MASS SPECTROMETRY (7 hours)

Mass Analysis-Tandem Mass Spectrometry (MS/MS)-Ion Detectors-Ionization of the Sample. Sample Preparation/Analysis-Proteins and Peptides-Protein Folding.

TEXT BOOKS

1. Gordon G. Hammes, "*Spectroscopy for the Biological Sciences*", John Wiley & Sons, 2005.

REFERENCES

1. Pedro Carmona, Raquel Navarro, Antonio Hernanz, "*Spectroscopy of Biological Molecules: Modern Trends*", Springer, 1997.

BI1107 BIOSPECTROSCOPY												
Course designed by		**Department of Bioinformatics**										
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 (for courses under 'P' only)	Biotechnology			Information Technology		Bioinformation Technology			Allied Bioinformatics		
		--			X		--			--		
5.	Approval	23rd meeting of Academic Council, May 2013										

BI1108	MEDICAL INFORMATICS	L	T	P	C
	Total contact hours - 45	**3**	**0**	**0**	**3**
	Prerequisite				
	Nil				

PURPOSE

To provide adequate information to gain knowledge in applying information technology in medical field.

INSTRUCTIONAL OBJECTIVES

1. To provide information about the systems applied in medical Bioinformatics
2. To provide knowledge about various techniques used Medical informatics

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

Introduction- Hospital management and information system: functional area- pre-requisites- integrated hospital information systems- health information system- and disaster management plan

UNIT II - KNOWLEDGE – BASED AND EXPERT SYSTEMS **(9 hours)**

Artificial intelligence- expert systems- materials and methods- computer based patient Records- computer assisted medical education.

UNIT III - MODULES (11 hours)

Hospital Management and Information systems- structure and functions- computer assisted patient education- computer assisted patient surgery

UNIT IV - COMPUTER ASSISTED SURGICAL TECHNIQUES (10 hours)

Three-dimensional imaging: limitations of endoscopy and imaging- benefits of virtual endoscopy- materials and methods- limitations- applications- merits and demerits- surgical simulation- virtual environment

UNIT V-TELECOMMUNICATIONS BASED SYSTEMS (9 hours)

Tele-medicine- needs- materials and methods- Internet tele-medicine- controversial issues- reliability- cost- analysis- applications- tele-surgery- the Internet

TEXT BOOKS

1. Mohan Bansal, "*Medical Informatics- a primer*", Tata McGraw-Hill, 2003.
2. De Dombal. F. T., "*Medical Informatics: The Essentials",* Butterworth-Heinemann, 1996.

REFERENCES

1. Charles P. Friedman, Jeremy C. (EDT) Wyatt, "Evaluation Methods in Medical Informatics- Springer Verlag", 1997.
2. Hsinnchun Chen, "*Medical Informatics: Knowledge Management And Data Mining in Biomedicine"*, Springer, 2005.

<table>
<tr><th colspan="14">BI1108 MEDICAL INFORMATICS</th></tr>
<tr><th colspan="2">Course designed by</th><th colspan="12">Department of Bioinformatics</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="3">Biotechnology</td><td colspan="2">Information Technology</td><td colspan="3">Bioinformation Technology</td><td colspan="3">Allied Bioinformatics</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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BI1109	COMPUTATIONAL NEUROSCIENCE	L	T	P	C
	Total Contact Hours – 45	3	0	0	3
	Prerequisite				
	Nil				

PURPOSE

This course enables the students to understand the computational neuroscience from the basics.

INSTRUCTIONAL OBJECTIVES

1.	Neurons, Population dynamics
2.	Perceptions, models of neuroscience
3.	Supervised Learning and Rewards Systems

UNIT I - INTRODUCTION (9 hours)

Definition- Domains in Computational Neuroscience- Brain metaphors-computer and brain- basic neuroscience- Basic synaptic mechanisms and the generation of action potentials- Nernst Potential, Hodgkin-Huxley equations, the propagation of action potentials.

UNIT II - SPIKING NEURONS AND RESPONSE VARIABILITY (9 hours)

Spiking neurons- concept neurons- the neural code- spike trains- cable theory- Spike time variability- post synaptic potential(PSP)- firing threshold and action potential- Neurons in a Network- Population Dynamics- rate code- Information in spike trains- Population coding and decoding- single neuron models, Hodgkin-Huxley Model, spiking neuron models- integrate and firing model- noise in spiking neuron models- compartmental modeling.

UNIT III - FEED-FORWARD MAPPING NETWORKS (9 hours)

From artificial neural network to realistic neural networks-Perception, function representation, and look-up tables- The sigma node as perception- Multi-layer mapping networks- Learning, generalization and biological interpretations- Self-organizing network architectures and genetic algorithms- Mapping networks with context units- Probabilistic mapping networks- Associators and synaptic plasticity, Associative memory and Hebbian learning, Hebbian plasticity- features of associators and Hebbian learning.

UNIT IV - AUTO-ASSOCIATIVE MEMORY AND NETWORK DYNAMICS (9 hours)

Associative memory networks- Short-term memory and reverberating network activity, Long-term memory and auto-associators- Point attractor networks- The Grossberg-Hopfield model- sparse attractor neural networks- Chaotic networks-

biologically more realistic variations of attractor networks- Continuous attractor and competitive networks.

UNIT V - SUPERVISED LEARNING AND REWARDS SYSTEMS (9 hours)

Motor learning and control- supervised learning-the delta rule and back propagation- generalized delta rules- plasticity and coding- Reward learning- System level organization and coupled networks- System level anatomy of the brain- Modular mapping networks- Coupled attractor networks- working memory- Attentive vision- an interconnecting workspace hypothesis.

CASE STUDY

Introduction to the MATLAB programming environment- A MATLAB guide to computational neuroscience- Spiking neurons and numerical integration in MATLAB.

TEXT BOOKS

1. Thomas Trappenberg, "*Fundamentals of Computational Neuroscience*", oxford University Press, January 2010 (Edition 2) & June 2002 (Edition1)
2. Steven J. Schiff, "*Neural Control Engineering: The Emerging Intersection between Control Theory and Neuroscience*", The MIT Press, 2012.

REFERENCES

1. Lytton, William W, "*From Computer to Brain - Foundations of Computational Neuroscience*", Springer publications, 2002.
2. Gerstner and Kistler, "*Spiking Neuron Models. Single Neurons, Populations, Plasticity"* Cambridge University Press, 2002.
3. Eric L. Schwartz, "*Computational Neuroscience*", MIT Press, 1993.

BI1109 COMPUTATIONAL NEUROSCIENCE												
Course designed by		**Department of Bioinformatics**										
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
3.	Category	General (G)			Basic Sciences (B)		Engineering Sciences and Technical Arts (E)			Professional Subjects (P)		
										X		
4.	Broad area	Biotechnology			Information Technology		Bioinformation Technology			Allied Bioinformatics		
							X					
5.	Approval	23rd meeting of Academic Council, May 2013										

BI1110	PROTEIN ENGINEERING	L	T	P	C
	Total contact hours – 45	3	0	0	3
	Prerequisite				
	BT1002 Cell Biology				

PURPOSE

The course imparts advanced knowledge on proteins through a detailed study of protein Structure, its characteristics property and significance in biological systems

INSTRUCTIONAL OBJECTIVES

1.	To advance the knowledge on primary, secondary and tertiary structure of protein
2.	To teach the basic knowledge of protein engineering and protein design
3.	To expand the knowledge of data analysis

UNIT I - PRIMARY AND SECONDARY STRUCTURE (9 hours)

Primary structure and its determination secondary structure prediction and determination of super secondary structures- proteins folding pathways.

UNIT II - RECEPTORS (9 hours)

Membrane proteins and receptors- bacteriohodopsin- photosynthetic centres- epidermal growth factor- Insulin and PDGF receptors and their interaction with effectors- protein phosphorylation- immunoglobulins- Nucleotide and binding proteins- enzymes serine proteases- ribonuclease- lysozyme

UNIT III - ENGINEERING OF MACROMOLECULES (9 hours)

Basic outline- Rational and steps involved in protein engineering- Protein design principles and examples

UNIT IV - DATA ANALYSIS METHODS (9 hours)

Protein database analysis methods- to alter primary structure of proteins- Theory- Interactive graphics programme- perturbation

UNIT V - METHODS OF PROTEIN ENGINEERING (9 hours)

Methods of Proteins engineering- Immunotoxins- Drug Designing.

TEXT BOOK

1. Moody PCE and Wilkinson AJ , "*Protein Engineerin*g",IRL press oxford 1990.

REFERENCES

1. Creighton T.E., "*Proteins- structures and molecular properties*", Freeman WH Second Ed 1993.
2. Branden .C, Tooze .R, "*Introduction of Protein structure*", Garland 1999.
3. Jeffrey L. Cleland, Charles S. Craik, "*Protein Engineering: Principles and Practice*", Wiley-Liss, 1996.

BI1110 PROTEIN ENGINEERING												
Course designed by		**Department of Bioinformatics**										
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					1,3		
3.	Category	General (G)			Basic Sciences (B)		Engineering Sciences and Technical Arts (E)			Professional Subjects (P)		
										X		
4.	Broad area	Biotechnology			Information Technology		Bioinformation Technology			Allied Bioinformatics		
		X										
5.	Approval	23rd meeting of Academic Council, May 2013										

	MICROARRAY- TECHNIQUES AND APPLICATIONS	**L**	**T**	**P**	**C**
BI1111	Total Contact Hours - 45	**3**	**0**	**0**	**3**
	Prerequisite				
	Nil				

PURPOSE

This course provides knowledge in whole genome analysis using miniaturization technology and computational interpretation

INSTRUCTIONAL OBJECTIVES

1.	To provide insight into microarray applications and potentials
2.	To make aware different technologies and tools for analysis of microarray data
3.	To put forward methods and standards to design and conduct microarray experiments.

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

Microarray- making and using microarrays- types of Microarray- sequence databases for microarrays.

UNIT II - COMPUTER DESIGN OF OLIGONUCLEOTIDE PROBES **(9 hours)**

Introduction- filtering- cross-hybridization prediction- Image processing

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

Introduction- data cleaning and transformation-within array normalization-between array normalization-measuring and qualifying microarray variability

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

Analysis of differentially expressed genes- fundamental concepts and hypothesis rules-analysis of relationships between genes- tissues or treatments- classification of tissues and samples

UNIT V - EXPERIMENTAL DESIGN **(9 hours)**

Blocking- randomization and blinding- choice of technology-data standards-storage and sharing

TEXT BOOKS

1. Gary Hardiman, "*Microarray Innovations: Technology and Experimentation*", CRC Press, 2010.
2. Dov Stekel, "*Microarray Bioinformatics*", Cambridge University Press, 2003.
3. Helen C. Causton, John. Quackenbush, Alvis. Brazma, "*Microarray Gene Expression Data Analysis: A Beginner's Guide"*, Blackwell Publishing, 2003.

REFERENCES

1. Geoffrey McLachlan, Kim-Anh Do, Christophe Ambroise, "*Analyzing Microarray Gene Expression Data*", John Wiley & Sons, 2005.
2. David W Mount, "*Bioinformatics- Sequence and genome analysis*", Cold Spring Harbor Laboratory Press, second edition, 2004.
3. Uwe. R Müller, Dan V. Nicolau, "*Microarray Technology and Its Applications*", Springer, 2005.

BI1111 MICROARRAY –TECHNIQUES AND APPLICATIONS												
Course designed by		Department of Bioinformatics										
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
3.	Category	General (G)			Basic Sciences (B)		Engineering Sciences and Technical Arts (E)			Professional Subjects (P)		
										X		
4.	Broad Area	Biotechnology			Information Technology		Bioinformation technology			Allied Bioinformatics		
		--			--		X			--		
5.	Approval	23rd meeting of Academic Council, May 2013										

BI1112	NEURAL NETWORKS	L	T	P	C
	Total Contact Hours - 45	3	0	0	3
	Prerequisite				
	Nil				

PURPOSE

This course provides a way to study the Artificial Neural Networks and its applications..

INSTRUCTIONAL OBJECTIVES

1.	To learn the basics of ANN in comparison with Human brain
2.	To learn the various architectures of building an ANN and its applications
3.	To learn the advanced methods of representing information in ANN like self-organizing networks and competitive learning

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

Artificial Neural Networks- Architectures, Definition and Fundamental Concepts, A Brief Overview - Engineering Approaches to Neural Computing- The Mappings View point, The Structure Viewpoint, Learning Approaches- Mathematical Foundations for ANN Study- Vector and Matrix Fundamentals- Geometry for State-Space Visualization- Optimization.

UNIT II – PERCEPTRONS (9 hours)

Elementary ANN Building Blocks- Biological Neural Units, Artificial Unit Structures, Unit Net Activation to Output Characteristics- Artificial Unit Model Extensions- Single Unit Mappings and Perceptron - Introduction, Linear Separability, Techniques to Directly Obtain Linear Unit Parameters- Perceptrons and Adaline / Madaline Units and Networks- Multilayer Perceptrons- Gradient Descent Training using Sigmoidal Activation Functions.

UNIT III - PATTERN ASSOCIATORS & FEEDFORWARD NETWORKS (9 hours)

Introduction to Neural Mappings and Pattern Associator Applications- Neural Network based pattern associators- The Influence of Psychology on PA Design and Evaluation Linear Associative Mappings- Training and Examples- Hebbian or Correction based learning, Feed Forward Networks and Training- Multilayer Feedforward Network Structure- The Delta Rule- Architecture- Hidden Layer-Mapping Capability.

UNIT IV - EXTENSIONS AND ADVANCED TOPICS (9 hours)

Feedforward Pattern Associator Design - Weight Space - Error Surfaces and Search - Generalization - Output Error Norms - Higher Order Derivative Based Training - Stochastic Optimization for Weight Determination - Network Architecture Determination Problem - Genetic Algorithms for Network Training - Network Cascade Correlation - Minimization - Inversion.

UNIT V - COMPETITIVE AND SELF-ORGANISING NETWORKS (9 hours)

Introduction- Formal Characterization and General Clustering Procedures- Competitive Learning Architectures and Algorithms- Self-Organizing Feature Maps- Adaptive Resonance Architectures- RBF Networks and Time Delay Networks- ANN Hardware and Implementation.

TEXT BOOK

1. Simon Haykin, "*Neural Networks - A Comprehensive Foundation*", Pearson Education Asia. 2002.

REFERENCES

1. Yegnanarayana B. "*Artificial Neural Networks*", Prentice -Hall of India, 2004.
2. Robert J. Schalkoff, "*Artificial Neural Networks*", McGraw Hill International Ed, 1997.
3. James. A. Freeman and David. M. Skapura, "*Neural Networks Algorithms, Applications and programming Techniques*", Pearson Education, 2002.

BI1112 NEURAL NETWORKS												
Course designed by		Department of Bioinformatics										
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			Information Technology		Bioinformation Technology			Allied Bioinformatics		
		--			X		--			--		
5.	Approval	23rd meeting of Academic Council, May 2013										

BI1113	CANCER BIOLOGY	L	T	P	C
	Total Contact Hours - 45	3	0	0	3
	Prerequisite				
	Nil				

PURPOSE

To provide knowledge about biological aspects of cancer

INSTRUCTIONAL OBJECTIVES

1.	To impart basic concepts of cancer biology
2.	Various stages in carcinogenesis
3.	Molecular cell biology of cancer
4.	Cancer metastasis, and cancer therapy
5	Integrated Biology and Cancer

UNIT I - FUNDAMENTALS OF CANCER BIOLOGY (9 hours)

Regulation of Cell cycle- Mutations that cause changes in signal molecules- effects on receptor- signal switches tumour suppressor genes- Modulation of cell cycle-in cancer- Different forms of cancers- Diet and cancer.

UNIT II - PRINCIPLES OF CARCINOGENESIS (9 hours)

Chemical Carcinogenesis- Metabolism of Carcinogenesis- Natural History of Carcinogenesis- Targets of Chemical Carcinogenesis- Principles of Physical Carcinogenesis- X-Ray radiation - Mechanism of radiation Carcinogenesis.

UNIT III - PRINCIPLES OF MOLECULAR CELL BIOLOGY OF CANCER (9 hours)

Oncogenes- Identification of Oncogenes- Retroviruses and Oncogenes- detection of Oncogenes- Growth factor and Growth factor receptors that are Oncogenes- Oncogenes/ Proto Oncogenes activity- Growth factors related to transformations.

UNIT IV - PRINCIPLES OF CANCER METASTASIS (9 hours)

Clinical significances of invasion- heterogeneity of metastatic phenotype- Metastatic cascade- Basement membrane disruption- Three step theory of invasion- Proteinases and tumour cell invasion.

UNIT V - NEW MOLECULUS FOR CANCER THERAPY (9 hours)

Different forms of therapy- Chemotherapy- Radiation Therapy- Detection of Cancers- Prediction of aggressiveness of Cancer- Advances in Cancer detection.- Bioinformatics and Cancer.

TEXT BOOKS

1. King R.J.B., "*Cancer Biology*", Addision Wesley Longmann Ltd, U.K., 1996.
2. Ruddon.R.W., "*Cancer Biology*", Oxford University Press, Oxford, 1995.

REFERENCES

1. Maly B.W.J., *"Virology a practical approach*", IRL press, Oxford, 1987.
2. Dunmock.N.J and Primrose S.B., "*Introduction to modern Virology",* Well Scientific Publications, Oxford, 1988.

BI1113 CANCER BIOLOGY												
Course designed by		Department of Bioinformatics										
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	2	3					4			5
3.	Category	General (G)			Basic Sciences (B)		Engineering Sciences and Technical Arts(E)			Professional Subjects (P)		
										X		
4.	Broad Area	Biotechnology			Information		Bioinformation			Allied		

BI1113 CANCER BIOLOGY					
Course designed by		Department of Bioinformatics			
			Technology	Technology	Bioinformatics
		X	--	--	--
5.	Approval	23rd meeting of Academic Council, May 2013			

BI1114	SYSTEMS BIOLOGY	L	T	P	C
	Total Contact Hours - 45	3	0	0	3
	Prerequisite				
	Nil				

PURPOSE

The objective of the course is to impart knowledge on principles of systems biology with emphasis on Modeling and steps involved in modeling. The course aims at introducing various kinetic principles that govern biological system dynamics and their corresponding Kinetic models. The course outlines various Biological systems behaviors like oscillation, Hypercycles, Evolution, Ageing and their corresponding Dynamic models. The course provides various inputs on Tools and Data formats used in Modeling biological systems and provides insight on various challenges involved in modeling.

INSTRUCTIONAL OBJECTIVES

1.	Principles of Modeling and Steps involved in Modeling.
2.	Kinetic principles, Dynamic Models, Metabolism and Analysis.
3.	Signaling mechanism and Dynamic Models.
4.	Oscillations, Hypercycles, Evolution and Ageing and their corresponding Models
5.	Tools, data formats for modeling and simulation of Biological systems.

UNIT I - INTRODUCTION TO SYSTEMS BIOLOGY (9 hours)

Principles of Systems Biology-Reductionist Vs Holism approach --Principles of Modeling Biological systems-Standard steps involved in Modeling-Advantages of Modeling and Simulation of Biological systems. Experimental techniques:-Basic techniques and High throughput techniques overview-Proteomics Techniques 2Dgel Electrophoresis, MS and Microarray technologies.-Y2H system, RNAi.

UNIT II - METABOLISM IN SYSTEMS PERSPECTIVE (9 hours)

Standard Models and Approaches:-Kinetic law's for modeling Biochemical reactions-Principles of Thermodynamics for modeling Biological Systems-Metabolic Networks- Flux Balance Analysis-Metabolic Control Analysis.

UNIT III - BIOLOGICAL PROCESSES (9 hours)

Signal transduction- introduction, function and structures, interactions, structural components, signaling, selected biological processes

UNIT IV - OSCILLATION AND EVOLUTION (9 hours)

Biological Oscillations - Glycolytic Oscillations-The Higgins-Sel'kov Oscillator – cell cycle-Ageing. Evolution and Hyper cycles-Data integration.

UNIT V - APPLICATIONS AND TOOLS (9 hours)

Systems biology in various fields, databases and tools, modeling and simulation tools.

TEXT BOOK

1. Edda Klipp, Ralf Herwig, "*Systems Biology in Practice-Concepts, Implementation and Application*", Wiley VCH, II Edition, 2008.

REFERENCE

1. Edda Klipp, Wolfram Liebermeister, Christoph Wierling, Axel Kowald, Hans Lehrach, Ralf Herwig "*Systems Biology*" John Wiley & Sons, 2011.

BI1114 SYSTEMS BIOLOGY												
Course designed by		**Department of Bioinformatics**										
1.	Student Outcome	a	b	c	d	e	f	g	h	i	j	k
		X	X	X			X		X	X	X	X
2.	Mapping of instructional objectives with student outcome	1	2	3,4			4		5	4	5	5
3.	Category	General (G)			Basic Sciences (B)		Engineering Sciences and Technical Arts (E)			Professional Subjects (P)		
										X		
4.	Broad Area	Biotechnology			Information Technology		Bioinformation technology			Allied Bioinformatics		
		--			--		X					
5.	Approval	23rd meeting of Academic Council, May 2013										

BI1115	ARTIFICIAL INTELLIGENCE	L	T	P	C
	Total Contact Hours – 45	3	0	0	3
	Prerequisite				
	Nil				

PURPOSE

The purpose of this course is to give students an in-depth understanding of Artificial Intelligence methodologies, techniques, tools and results. Interactions between Artificial Intelligence and other disciplines will be explored

INSTRUCTIONAL OBJECTIVES

1.	Various searching techniques used in problem solving, deal with ignorance and vagueness.
2.	Planning agents and the algorithm used.

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

What Is AI- the Foundations of Artificial Intelligence- The History of Artificial Intelligence- Intelligent Agents-How Agents Should Act, Structure of Intelligent Agents, Environments

UNIT II - SEARCH METHOD **(9 hours)**

Solving Problems by Searching- Problem-Solving Agents, Formulating Problems, Search Strategies, Avoiding Repeated States, Constraint Satisfaction Search- Informed Search Methods- Best-First Search- Heuristic Functions- Memory Bounded Search- Iterative Improvement Algorithms- Game Playing- Introduction, Games As Search Problems, Perfect Decisions In Two-Person Games, Imperfect Decisions, Alpha-Beta Pruning, Games That Include An Element Of Chance.

UNIT III - LOGICAL REASONING SYSTEMS **(9 hours)**

First-Order Logic- Syntax and Semantics, Extensions and Notational variations, Using First Order Logic-Introduction to Logical Reasoning system Indexing, Retrieval and Unification- Logical Programming Systems- Theorem Provers- Forward-Chaining Production Systems- Frame Systems and Semantic Networks.

UNIT IV - REASONING UNDER UNCERTAINTY (9 hours)

Uncertainty- Acting under Uncertainty- Basic Probability Notation- The Axioms of Probability, Bayes' Rule and its Use- Probabilistic Reasoning Systems- Representing Knowledge in an Uncertain Domain- The Semantics of Belief Networks- Inference in Belief Networks, Inference in Multiply Connected Belief Networks- Non monotonic reasoning- Dealing with ignorance- Dempster Shafer theory- Dealing with vagueness- Fuzzy logic and fuzzy sets.

UNIT V - PLANNING AND LEARNING (9 hours)

Planning A Simple Planning Agent- From Problem Solving to Planning, Planning in Situation Calculus, Basic Representations for planning, A Partial-Order Planning Example, A Partial-Order Planning Algorithm- Learning- A General Model of Learning Agents, Inductive Learning, Learning Decision Trees- Neural Networks- Bayesian Methods for Learning Belief Networks- Genetic Algorithms and Evolutionary Programming- Knowledge in Learning- Explanation-Based Learning.

TEXT BOOKS

1. Stuart Russel and Peter Norvig, “Artificial Intelligence- A Modern Approach”, Prentice Hall, 1995.
2. George F Luger, “Artificial Intelligence”, Pearson Education, 4th Edition, 2001.

REFERENCES

1. Engene Charniak and Drew Mc Dermott, “Introduction to Artificial Intelligence”, Addison Wesley, 2000.
2. Nils J. Nilsson, “Principles of Artificial Intelligence”, Narosa Publishing House, 2000.
3. Dan W. Patterson, “Introduction to Artificial Intelligence and Expert systems”, Prentice Hall of India, 1992.
4. Robert J Schalkoff, “Artificial Intelligence- An Engineering Approach”, McGraw Hill, 1990.

BI1115 ARTIFICIAL INTELLIGENCE												
Course designed by		Department of Bioinformatics										
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								1,2
3.	Category	General (G)			Basic Sciences (B)		Engineering Sciences and Technical Arts (E)			Professional Subjects (P)		
										X		
4.	Broad Area	Biotechnology			Information Technology		Bioinformation technology			Allied Bioinformatics		
		--			--		X			--		
5.	Approval	23rd meeting of Academic Council, May 2013										

BI1116	GENE THERAPY	L	T	P	C
	Total Contact Hours – 45	3	0	0	3
	Prerequisite				
	Nil				

PURPOSE

The purpose of this course is to cover general principles of modern therapeutic approaches to treat inherited human diseases and cancer.

INSTRUCTIONAL OBJECTIVES

1. To impart basic knowledge on mechanisms and approaches in gene therapy, compilations of current clinical trial efforts, methods of gene delivery, immune therapeutics, oncolytic virus therapeutics, antisense therapeutics as well as ethical considerations in all these novel methods of therapy.

UNIT I - GENERAL PRINCIPLES OF GENE THERAPY (9 hours)

Diseases that could be treated by gene therapy- Clinical trials- Gene Delivery. Reporter genes and Transfer efficiency- Germline vs. somatic cells- In vivo and ex vivo gene therapy- Ex vivo and In vivo Gene Therapy.

UNIT II - DNA–BASED GENE THERAPY (9 hours)

Mechanical methods of delivery- Example: Duchenne myotrophy- Liposomal methods of delivery- Cystic fibrosis.

UNIT III-RETROVIRAL AND ADENOVIRAL VECTORS. **(9 hours)**

Safety of GT vectors- Gutted vectors- Helper viruses and Packaging cell lines- Examples: ornithine transcarbamylase deficiency (OTC) - Severe Combined Immunodeficiency (SCID). -Failures in the OTC and SCID GT trials.

UNIT IV - ADENO-ASSOCIATED VIRUS- BASED VECTORS **(9 hours)**

Hemophilia- Diabetes mellitus- Erythropoietin- How to target vector to the particular cell- Tissue specific promoters- Vectors as ligands for cellular receptors.

UNIT V - CANCER GENE THERAPY **(9 hours)**

Genetic Prodrug Activation Gene Therapy- GT methods to overcome chemotherapy resistance of tumors- Biological response modifiers- Oncolytic virus- based strategies of tumor treatment. DNA vaccines for cancer and infectious diseases- AIDS as a target for DNA vaccines- Antisense based methods of gene therapy.

TEXT BOOK

1. Peter J. Quesenberry, "*Stem cells biology and gene therapy*", Wiley-Liss, 1998.

REFERENCE

1. Keith Green berg, "*Gene therapy*", Blackbirch Pr Inc, 2003.

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<tr><th colspan="14">BI1116 GENE THERAPY</th></tr>
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<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>5.</td><td>Approval</td><td colspan="12">23rd meeting of Academic Council, May 2013</td></tr>
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