



दिल्ली प्रौद्योगिकी विश्वविद्यालय
DELHI TECHNOLOGICAL UNIVERSITY
(Formerly Delhi College of Engineering)

(Estd. By Govt. of NCT of Delhi vide Act 6 of 2009)



SCHEME OF TEACHING AND EXAMINATIONS
BACHELOR OF TECHNOLOGY
BIOTECHNOLOGY

W.E.F 2015

DEPARTMENT OF BIOTECHNOLOGY

Scheme of Teaching and Examinations B. Tech. (BIOTECHNOLOGY) W.E.F. 2015



DELHI TECHNOLOGICAL UNIVERSITY
(Formerly Delhi College of Engineering)

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Delhi Technological University

(Formerly Delhi College of Engineering)

Shahbad Daultapur, Bawana Road, Delhi – 110 042

VISION

To be a world class university through education, innovation and research for the service of humanity.

MISSION

1. To establish centres of excellence in emerging areas of science, engineering, technology, management and allied areas.
2. To foster an ecosystem for incubation, product development, transfer of technology and entrepreneurship.
3. To create environment of collaboration, experimentation, imagination and creativity.
4. To develop human potential with analytical abilities, ethics and integrity.
5. To provide environment friendly, reasonable and sustainable solutions for local & global needs.

DEPARTMENT OF BIOTECHNOLOGY

VISION

To nurture Biotechnology department into a premier world class department through innovation, invention and dissemination knowledge for better health and environment.

MISSION

1. To establish excellence in biotechnology application oriented research and innovation.
2. To train students in different domains of biotechnology including incubation, product development, transfer of technology and entrepreneurship.
3. To create environment of collaborative research and creativity in bioengineering skills.
4. To nurture ethical values among the professionals.
5. To develop industrial interactions to cope up with latest technologies.

PROGRAM EDUCATIONAL OBJECTIVES(PEOS)

- PEO 1 :** Attain in-depth knowledge about biological sciences and inculcate research aptitude.
- PEO 2:** Function professionally in an increasingly international and rapidly changing world due to the advances in technologies and concepts.
- PEO 3:** Exercise excellent leadership qualities, at levels appropriate to their experience, which addresses issues in a responsive, ethical, and innovative manner.
- PEO 4:** Contribute to excel in careers by being a part of success and growth of an organization with which they are associated.
- PEO 5:** To impart state-of-the-art technology and practical training incommensurate with industrial need.

DEPARTMENT OF BIOTECHNOLOGY
BACHELOR OF TECHNOLOGY (BIOTECHNOLOGY)

I Year: Odd Semester

Teaching Scheme					Contact Hours/Week			Exam Duration (h)		Relative Weights (%)				
S. No.	Subject Code	Course Title	Subject Area	Credit	L	T	P	Theory	Practical	CWS	PRS	MTE	ETE	PRE
Group A														
1	MA101	Mathematics - I	ASC	4	3	1	0	3	0	25	-	25	50	-
2	AP101	Physics – I	ASC	4	3	0	2	3	0	15	15	30	40	-
3	AC101	Chemistry	ASC	4	3	0	2	3	0	15	15	30	40	-
4	ME101	Basic Mechanical Engineering	AEC	4	4	0	0	3	0	25	-	25	50	-
5	ME103	Workshop Practice	AEC	2	0	0	3	0	3	-	50	-	-	50
6	HU101	Communication Skills	HMC	3	3	0	0	3	0	25	-	25	50	-
Total				21	16	1	7							
Group B														
1	MA101	Mathematics - I	ASC	4	3	1	0	3	0	25	-	25	50	-
2	AP101	Physics – I	ASC	4	3	0	2	3	0	15	15	30	40	-
3	EE101	Basic Electrical Engineering	AEC	4	3	0	2	3	0	15	15	30	40	-
4	CO101	Programming Fundamentals	AEC	4	3	0	2	3	0	15	15	30	40	-
5	ME105	Engineering Graphics	AEC	2	0	0	3	0	3	-	50	-	-	50
6	EN101	Introduction to Environmental Science	AEC	3	3	0	0	3	0	25	-	25	50	-
Total				21	15	1	9							

I Year: Even Semester

Teaching Scheme					Contact Hours/Week			Exam Duration		Relative Weights (%)				
S. No.	Subject Code	Course Title	Subject Area	Credit	L	T	P	Theory	Practical	CWS	PRS	MTE	ETE	PRE
Group A														
1	MA102	Mathematics - II	ASC	4	3	1	0	3	0	25	-	25	50	-
2	AP102	Physics – II	ASC	4	3	0	2	3	0	15	15	30	40	-
3	EE102	Basic Electrical Engineering	AEC	4	3	0	2	3	0	15	15	30	40	-
4	CO102	Programming Fundamentals	AEC	4	3	0	2	3	0	15	15	30	40	-
5	ME102	Engineering Graphics	AEC	2	0	0	3	0	3	-	50	-	-	50
6	EN102	Introduction to Environmental Science	AEC	3	3	0	0	3	0	25	-	25	50	-
Total				21	15	1	9							
Group B														
1	MA102	Mathematics – II	ASC	4	3	1	0	3	0	25	-	25	50	-
2	AP102	Physics – II	ASC	4	3	0	2	3	0	15	15	30	40	-
3	AC102	Chemistry	ASC	4	3	0	2	3	0	15	15	30	40	-
4	ME104	Basic Mechanical Engineering	AEC	4	4	0	0	3	0	25	-	25	50	-
5	ME106	Workshop Practice	AEC	2	0	0	3	0	3	-	50	-	-	50
6	HU102	Communication Skills	HMC	3	3	0	0	3	0	25	-	25	50	-
Total				21	16	1	7							

II Year: Odd Semester

S.No.	Code	Title	Area	Cr	L	T	P	TH	PH	CWS	PRS	MTE	ETE	PRE
1.	MC251	Applied Mathematics	AEC	4	3	1	0	3	0	25	-	25	50	-
2.	BT201	Introduction to Biotechnology	DCC	4	3	1	0	3	0	25	-	25	50	-
3.	BT203	Biochemistry	DCC	4	3	0	2	3	0	15	25	20	40	-
4.	BT205	Biochemical Engineering Principles	DCC	4	3	0	2	0	3	15	25	20	40	-
5.	BT207	Engineering Analysis and Design	DCC	4	3	0	2	3	0	15	25	20	40	-
6.	HU201	Engineering Economics	HMC	3	3	0	0	3	0	25	-	25	50	-
		Total		23										

II Year: Even Semester

S.No.	Code	Title	Area	Cr	L	T	P	TH	PH	CWS	PRS	MTE	ETE	PRE
1.	CO252	Data Structure and Algorithm	AEC	4	3	0	2	3	0	15	25	20	40	
2.	BT202	Molecular Biology	DCC	4	3	0	2	3	0	15	25	20	40	-
3.	BT204	Genetics	DCC	4	3	1	0	3	0	25	-	25	50	-
4.	BT206	Microbiology	DCC	4	3	0	2	3	0	15	25	20	40	-
5.	BT208	Structural Biology	DCC	4	3	0	2	3	0	15	25	20	40	-
6.	MG202	Fundamentals of Management	HMC	3	3	0	0	3	0	25	-	25	50	-
		Total		23										

III Year: Odd Semester

S.No.	Code	Title	Area	Cr	L	T	P	TH	PH	CWS	PRS	MTE	ETE	PRE
1.	BT 301	Immunology and Immuno-Technology	DCC	4	3	0	2	3	0	15	25	20	40	-
2.	BT 303	Genetic Engineering	DCC	4	3	0	2	3	0	15	25	20	40	-
3.	BT 3xx	Departmental Elective Course- 1	DEC/ GEC	4	3	0/1	2/0	3	0	15/ 25	25/-	20 /25	40/ 50	-
4.	BT3xx	Departmental Elective Course- 2	DEC/ GEC	4	3	0/1	2/0	3	0	15/ 25	25/-	20 /25	40/ 50	-
5.	UExxx	Open Elective Course	OEC	3	3	0	0	3	0	25	-	25	50	-
6.	HU301	Professional Ethics and Human Values	HMC	2	2	0	0	3	0	25	-	25	50	-
		Total		21										

III Year: Even Semester

S.No.	Code	Title	Area	Cr	L	T	P	TH	PH	CWS	PRS	MTE	ETE	PRE
1.	BT302	Plant Biotechnology	DCC	4	3	0	2	3	0	15	25	20	40	-
2.	BT304	Animal Biotechnology	DCC	4	3	0	2	3	0	15	25	20	40	-
3.	BT306	Genomics and Proteomics	DCC	4	3	0	2	3	0	15	25	20	40	-
4.	BT3xx	Departmental Elective Course- 3	DEC/ GEC	4	3	0/1	2/0	3	0	15/ 25	25/-	20 /25	40/ 50	-
5.	BT3xx	Departmental Elective Course- 4	DEC/ GEC	4	3	0/1	2/0	3	0	15/ 25	25/-	20 /25	40/ 50	-
6.	HU302	Technical Communication	HMC	2	2	0	0	3	0	25		25	50	-
		Total		22										

IV Year: Odd Semester

S.No.	Code	Title	Area	Cr	L	T	P	TH	PH	CWS	PRS	MTE	ETE	PRE
1.	BT 401	B.Tech Project-I	DCC	4										
2.	BT 403	Training Seminar	DCC	2										
3.	BT 405	Fundamental of Computational Biology	DCC	4	3	0	2	3	0	15	25	20	40	-
4.	BT 407	Bioprocess Tech & Downstream Process	DCC	4	3	0	2	3	0	15	25	20	40	-
5.	BT4xx	Departmental Elective Course- 5	DEC/ GEC	4	3	0/1	2/0	3	0	15/ 25	25/-	20/ 25	40/ 50	-
6.	BT4xx	Departmental Elective Course- 6	DEC/ GEC	4	3	0/1	2/0	3	0	15/ 25	25/-	20/ 25	40/ 50	-
		Total		22										

IV Year: Even Semester

S.No.	Code	Title	Area	Cr	L	T	P	TH	PH	CWS	PRS	MTE	ETE	PRE
1.	BT402	B.Tech Project-II	DCC	8										
2.	BT404	Advances in Computational Biology	DCC	4	3	0	2	3	0	15	25	20	40	-
3.	BT4xx	Departmental Elective Course- 7	DEC/ GEC	4	3	0/1	2/0	3	0	15/ 25	25/-	20/ 25	40/ 50	-
4.	BT4xx	Departmental Elective Course- 8	DEC/ GEC	4	3	0/1	2/0	3	0	15/ 25	25/-	20/ 25	40/ 50	-
		Total		20										

List of Departmental Elective Courses

S. No.	Elective Code	Title of Elective	Elective no.
1.	BT-305	Instrumentation in Biotechnology	DEC 1 & 2
2.	BT-307	Food Biotechnology	
3.	BT-309	Object oriented Programing	
4.	BT-311	Introduction to Biomedical Engineering	
5.	BT-313	Thermodynamics of Biological System	
6.	BT-315	Current topics in Biotechnology	
7.	BT-317	Enzymology and Enzyme Technology	
8.	BT-319	Drug Design and Delivery	
9.	BT-321	Bioprocess Plant Design	
10.	BT-323	Population Genetics	
11.	BT-325	Cell Biology	
12.	BT-308	Stem Cells and Regenerative Medicine	DEC 3 & 4
13.	BT-310	Biopolymers	
14.	BT-312	Metabolic Engineering	
15.	BT-314	Ecology and Evolution	
16.	BT-316	Transgenic Technology	
17.	BT-318	Bioenergy and Biofuels	
18.	BT-320	Genomics in Medicine	
19.	BT-322	Protein Engineering	
20.	BT-324	Biodiversity and Bioresource Planning	
21.	BT-326	Medical Microbiology	
22.	BT-328	Bioinformatics approaches in Complex disorders	

23.	BT-409	Concepts in Neurobiology	DEC 5 & 6
24.	BT-411	Industrial Biotechnology	
25.	BT-413	Nanobiotechnology	
26.	BT-415	Medical Physics	
27.	BT-417	Plant Bioinformatics	
28.	BT-419	Cancer Biology	
29.	BT-421	Pharmacogenomics and Personalized Medicine	
30.	BT-423	Technological Application in Food Technology	
31.	BT-425	Biomaterials	
32.	BT-427	Pharmaceutical Sciences	
33.	BT-406	Agriculture Microbiology	
34.	BT-408	Bioethics and Intellectual Property Rights	
35.	BT-410	System Biology	
36.	BT-412	Advanced Bioanalytical Techniques	
37.	BT-414	Clinical Biotechnology	
38.	BT-416	Plant Metabolic Engineering	
39.	BT-418	Crop protection and Pest management	
40.	BT-420	Biosensor	
41.	BT-422	Green Energy Technology	
42.	BT-424	Neutraceuticals	
43.	BT-426	Environmental Biotechnology	

List of Open Elective Courses

S.No.	SUBJECT CODE	SUBJECTS
1.	CO351	Enterprise & Java Programming
2.	CO353	E-commerce & ERP
3.	CO355	Cryptography & Information Security
4.	CO357	Operating System
5.	CO359	Intellectual Property Rights & Cyber Laws
6.	CO361	Database Management System
7.	EC351	Mechatronics
8.	EC353	Computer Vision
9.	EC355	Embedded System
10.	EC 357	Digital Image Processing
11.	EC359	VLSI Design
12.	EE351	Power Electronics Systems
13.	EE353	Electrical Machines and Power Systems
14.	EE355	Instrumentation Systems
15.	EE357	Utilization of Electrical Energy
16.	EE359	Non-conventional Energy Systems
17.	EE361	Embedded Systems
18.	EN351	Environmental Pollution & E- Waste Management
19.	EN353	Occupational Health & Safety Management
20.	EN355	GIS & Remote Sensing
21.	EP351	Physics of Engineering Materials
22.	EP353	Nuclear Security
23.	HU351	Econometrics

24.	MA351	History Culture & Excitement of Mathematics
25.	ME351	Power Plant Engineering
26.	ME353	Renewable Sources of Energy
27.	ME355	Combustion Generated Pollution
28.	ME357	Thermal System
29.	ME359	Refrigeration & Air Conditioning
30.	ME361	Industrial Engineering
31.	ME363	Product Design & Simulation
32.	ME365	Computational fluid dynamics
33.	ME367	Finite Element Methods
34.	ME369	Total Life Cycle Management
35.	ME371	Value Engineering
36.	MG351	Fundamentals of Financial Accounting and Analysis
37.	MG353	Fundamentals of Marketing
38.	MG355	Human Resource Management
39.	MG357	Knowledge and Technology Management
40.	PE351	Advance Machining Process
41.	PE 353	Supply Chain Management
42.	PE355	Work Study Design
43.	PE357	Product Design & Simulation
44.	PE359	Total Life Cycle Management
45.	PE361	Total Quality Management
46.	PT361	High Performance Polymers
47.	PT363	Separation Technology
48.	PT365	Non-Conventional Energy
49.	PT367	Polymer Waste Management

50.	PT369	Nanotechnology in Polymers
51.	PT371	Applications of Polymer Blends and Composite
52.	IT 351	Artificial Intelligence and Machine Learning
53.	IT 353	Data Structures and Algorithms
54.	IT 355	Communication and Computing Technology
55.	IT 357	Internet and Web Programming
56.	IT 359	Java Programming
57.	CE351	Geoinformatics and its Applications

SYLLABUS

1. Subject Code: **ME 101/104** : Course Title: **Basic Mechanical Engineering**
2. Contact Hours : L: 04 T: 00 P: 00
3. Examination Duration (Hrs.) : Theory: 3 Practical: 00
4. Relative Weight : CWS: 25 PRS: 00 MTE: 25 ETE: 50 PRE: 00
5. Credits : 04
6. Semester : I / II
7. Subject Area : AEC
8. Pre-requisite : NIL
9. Objective : To familiarize the students with the concepts of thermodynamics, fluid mechanics, power plants, engineering materials, manufacturing processes and metrology.
10. Details of Course :

S. No.	Contents	Contact Hours
PART A		
1	Introduction: Introduction to Thermodynamics, Concepts of systems, control volume, state, properties, equilibrium, quasi-static process, reversible & irreversible process, cyclic process. Zeroth Law and Temperature, Ideal Gas. Heat and Work.	05
2	First Law of Thermodynamics for closed & open systems. Non Flow Energy Equation. Steady State, Steady Flow Energy Equation. Second Law of Thermodynamics-Kelvin and Planck's Statements, Clausius inequality, Definition of Heat Engines, Heat pumps, Refrigerators. Concept of Energy and availability. Carnot Cycle; Carnot efficiency, Otto, Diesel, Dual cycle and their efficiencies.	12
3	Principles of power production, basic introduction about thermal power plant, hydroelectric power plant and nuclear power plant.	04

4	Properties & Classification of Fluids, Ideal & real fluids, Newton's law of viscosity, Pressure at a point, Pascal's law, Pressure variation in a static fluid, General description of fluid motion, stream lines, continuity equation, Bernoulli's equation, Steady and unsteady flow.	07
PART B		
5	Introduction to engineering materials for mechanical construction. Composition, mechanical and fabricating characteristics and applications of various types of cast irons, plain carbon and alloy steels, copper, aluminum and their alloys like duralumin, brasses and bronzes cutting tool materials, super alloys thermoplastics, thermosets and composite materials.	12
6	Introduction to Manufacturing processes for various machine elements. Introduction to Casting & Welding processes. Sheet metal and its operations. Introduction to machining processes – turning, milling, shaping, drilling and boring operations. Fabrication of large and small assemblies – examples nuts and bolts, turbine rotors etc.	12
7	Introduction to quality measurement for manufacturing processes; standards of measurements, line standards, end standards, precision measuring instruments and gauges: vernier calliper, height gauges, micrometer, comparators, dial indicator, and limit gauges.	04
Total		56

11. Suggested Books:

S. No.	Name of Authors /Books / Publishers	Year of Publication/ Reprint
TEXT BOOKS:		
1	Engineering Thermodynamics, P. K. Nag, Tata McGrawa-Hill	2005
2	Fundamentals of Classical Thermodynamics, G. J. Van Wylen and R. E. Santag.	1994
3	Manufacturing Processes, Kalpakjian	2013
4.	Basic Mechanical Engineering,1/e, Pravin Kumar, Pearson Education, Delhi	2013

REFERENCE BOOKS:		
1	Introduction to Fluid Mechanics and Fluid Machines, S. K. Som and G. Biswas	2013
2	Fluid Mechanics and Hydraulic Machines, R. K. Bansal	2010
3	Workshop Practices, K. Hazara Chowdhary	2007
4	Workshop Technology, W. A. J. Chapman	1972
5	Production Engineering, R. K. Jain, Khanna Publishers	2001

1. Subject Code: **AC 101/102** : Course Title: **Chemistry**
2. Contact Hours : L: 03 T: 00 P: 02
3. Examination Duration (Hrs.) : Theory: 03 Practical: 00
4. Relative Weight : CWS: 15 PRS: 15 MTE: 30 ETE: 40 PRE: 00
5. Credits : 04
6. Semester : I / II
7. Subject Area : ASC
8. Pre-requisite : NIL
9. Objective : To familiarize the students with the concepts of Engineering Chemistry, Material characterization and green Chemistry.
10. Details of Course :

S. No.	Contents	Contact Hours
1.	Conventional Analysis: Volumetric Analysis, Types of Titrations, Theory of Indicators.	06
2.	Spectral Methods of Analysis: UV-visible, IR, NMR & MS: Principles and Applications.	08

3.	Thermal Methods of Analysis: Thermo-gravimetry, Differential thermal analysis and Differential Scanning Calorimetry: Principles and Applications.	04
4.	Polymers & Plastics: Functionality and Degree of Polymerization, Mechanism of Polymerization, Molecular Weights of Polymers, Methods of polymerization, Functional Polymers, Industrial applications of Polymers.	06
5.	Electrochemistry: Electrochemical cells, components, characteristics of batteries. Primary and Secondary battery systems, Zinc-Carbon cells, Lead storage and lithium batteries. Fuel Cells, Electro-deposition, Electrical and chemical requirements. Electroplating bath and linings. Agitation, Circulation and filtration equipment.	08
6.	Phase Equilibrium: Definitions of Phase, component and degree of freedom, Gibb's phase rule. One component systems: Water and sulphur. Two component systems: Pb-Ag and Cu-Ni.	06
7.	Green Chemistry: Principles of Green Chemistry, Examples of Green Methods of Synthesis, Reagents and Reactions, Evaluation of feedstocks, Future trends in Green Chemistry.	04
Total		42

11. Suggested Books:

S. No.	Name of Books/Authors/Publisher	Year of Publication/ Reprint
1	Introduction to Thermal Analysis/ Michael E. Brown/ Springer Netherlands	2001
2	Vogel's Quantitative Chemical Analysis/ J. Mendham, R.C. Denney, J. D. Barnes, M.J.K. Thomas / Prentice Hall/6 edition	2000
3	Green Chemistry: Theory & Practice/P.T. Anastas & J.C. Warner/ Oxford Univ Press	2000
4	Polymer Science and Technology/ Fried Joel R./ PHI; 2 edition	2005
5	Electrochemistry/ Philip H. Rieger / Springer	2009

1. Subject Code: **AP 101** : Course Title: **Physics – I**
2. Contact Hours : L: 03 T: 00 P: 02
3. Examination Duration (Hrs.) : Theory:03 Practical: 00
4. Relative Weight : CWS: 15 PRS: 15 MTE: 30 ETE: 40 PRE: 00
5. Credits : 04
6. Semester : I
7. Subject Area : ASC
8. Pre-requisite : NIL
9. Objective : To impart knowledge of basic concepts in applied physics and make the students familiar with topics like interference, diffraction, polarization, fiber optics, lasers, wave mechanics, etc. This course is also aimed at enhancing the analytical capability of the engineering students.
10. Details of Course :

S. No.	Contents	Contact Hours
1.	RELATIVITY: Review of concepts of frames of reference and Galilean transformation equation, Michelson – Morley experiment and its implications, Einstein’s special theory of relativity, Lorentz transformation equations, Law of addition of velocities, Mass variation with velocity, Concept of energy and momentum, Mass energy relation.	08
2.	OSCILLATIONS & WAVES: Damped and forced oscillations, Resonance (amplitude and power), Q – factor, Sharpness of resonance. Equations of longitudinal and transverse waves and their solutions, Impedance, Reflection and transmission of waves at a boundary, Impedance matching between two medium.	07

3.	PHYSICAL OPTICS: Interference by division of wave front and amplitude, Multiple beam interference and Fabry-Perot interferometer, Fresnel diffraction through a straight edge, Zone plate, Fraunhofer diffraction, single slit and N-slit / grating, Resolving power of telescope, prism and grating. Polarization by reflection and by transmission, Brewster's law, Double refraction, elliptically and circularly polarized light, Nicol prism, Quarter and half wave plates.	12
4.	OPTICAL INSTRUMENTS: Cardinal points of co-axial lens systems, spherical and chromatic aberrations and their removal, Huygens and Ramsden's eyepiece.	05
5.	Lasers: Coherence and coherent properties of laser beams, Brief working principle of lasers, Spontaneous and stimulated Emission, Einstein's co-efficient, Ruby laser, He-Ne laser.	06
6.	Optical Fiber: Classification of optical fibers, Refractive index profile, Core-cladding refractive index difference, Numerical aperture of optical fiber, Pulse dispersion in optical fiber (ray theory).	04
Total		42

11. Suggested Books:

S.No.	Name of Books/Authors	Year of Publication/ Reprint
1.	Physics of Vibrations and Waves, by H.J. Pain.	2005/ John Wiley & Sons Ltd
2.	Vibrations and Waves, by A.P. French.	1971/CRC Press
3.	Perspective of Modern Physics, by Arthur Beiser	1981/ McGraw-Hill
4.	Optics, by A. Ghatak.	2006/Tata McGraw-Hill
5.	Berkley Physics Course Vol – 1.	2009/ Tata McGraw-Hill

1. Subject Code: **AP 102** : Course Title: **Applied Physics-II**
2. Contact Hours : L: 03 T: 00 P: 02
3. Examination Duration (Hrs.) : Theory: 03 Practical: 00
4. Relative Weight : CWS: 15 PRS: 15 MTE: 30 ETE: 40 PRE: 00
5. Credits : 04

6. Semester : II
7. Subject Area : ASC
8. Pre-requisite : NIL
9. Objective : This course gives a balance account of the fundamentals of Physics as well as some of recent developments in this area best suited to the Engineering applications in different branches and to provide the knowledge and methodology necessary for solving problems in the field of engineering.
10. Details of Course :

S.No.	Contents	Contact Hours
1.	Quantum Physics : Failure of classical physics ,Compton effect , Pair production, de-broglie relation, wave function, Probability density, Schrodinger wave equation, operators, expectation values and eigen-value equation, particle in a box, simple harmonic oscillator problem, concept of degeneracy.	10
2.	Classical Statistics: Microscopic-macroscopic systems, concept of phase space, basic postulates of statistical mechanics, Maxwell—Boltzmann distribution law.	05
3.	Quantum Statistics: Fermi—Dirac and Bose—Einstein Distribution, Fermi- Dirac probability function, Fermi energy level.	05
4.	Nuclear Physics: Nuclear properties, constituent of the nucleus, binding energy, stable nuclei, radioactive decay law (alpha and beta spectrum), Q-value of nuclear reaction , nuclear models: liquid drop and shell model, nuclear fission and fusion, elementary ideas of nuclear reactors.	06
5.	Electrodynamics: Maxwell's equations, concept of displacement current, Derivation of wave equation for plane electromagnetic wave, Poynting vector. Poynting theorem, Energy density, wave equation in dielectric & conducting media.	09

6	Semiconductor Physics: Concept of intrinsic and extrinsic semiconductors, Fermi level, characteristics of PN Junction, static and dynamic resistance, zener diode and LED, diode as a rectifier, transistor (PNP and NPN) characteristics, current and voltage gain.	07
Total		42

11. Suggested Books:

S.No.	Name of Books/Authors	Year of Publication/ Reprint
1.	Nuclear Physics, by Erwin Kaplan	2002/Narosa
2.	Concept of Nuclear Physics, by Bernard Cohen	2001/ McGraw-Hill
3.	Perspective of Modern Physics, by Arthur Beiser	1969/ McGraw-Hill US
4.	Electrodynamics, by Griffith	2012/PHI Learning
5.	Electricity & magnetism, by Rangawala& Mahajan.	2012/ McGraw-Hill

1. Subject Code: **EE-101/102** : Course Title: **Basic Electrical Engineering**
2. Contact Hours : L: 03 T: 00 P: 02
3. Examination Duration (Hrs.) : Theory: 03 Practical: 00
4. Relative Weight : CWS: 15 PRS: 15 MTE: 30 ETE: 40 PRE: 00
5. Credits : 04
6. Semester : I / II
7. Subject Area : AEC
8. Pre-requisite : NIL
9. Objective : To familiarize the students with the concepts of electrical circuits, magnetic circuits, transformer and measuring instruments.

10. Details of Course

:

S. No.	Contents	Contact Hours
1	Introduction: Role and importance of circuits in Engineering, concept of fields, charge, current, voltage, energy and their interrelationships. V- I characteristics of ideal voltage and ideal current sources, various types of controlled sources, passive circuit components, V-I characteristics and ratings of different types of R, L, C elements. DC Network: Series and parallel circuits, power and energy, Kirchhoff's Laws, delta-star transformation, superposition theorem, Thevenin's theorem, Norton's theorem, maximum power transfer theorem, Tellegen's theorem.	10
2	Single Phase AC Circuits: Single phase emf generation, average and effective values of sinusoids, complex representation of impedance, series and parallel circuits, concept of phasor, phasor diagram, power factor, complex power, real power, reactive power and apparent power, resonance in series and parallel circuits, Q-factor, bandwidth and their relationship, half power points.	10
3	Three-Phase AC Circuits: Three phase emf generation, delta and star connection, line and phase quantities, solution of three phase circuits: balanced supply and balanced load, phasor diagram, three phase power measurement by two wattmeter method.	05
4	Magnetic Circuits and Transformers: Amperes circuital law, B-H curve, concept of reluctance, flux and mmf, analogies between electrical and magnetic quantities, solution of magnetic circuits, hysteresis and eddy current losses, mutual inductance and dot convention, single phase transformer – construction and principle of working, auto transformer and their applications.	12
5	Measuring Instruments: Analog indicating instruments, PMMC ammeters and voltmeters, damping in indicating instruments, shunt and multipliers, moving iron ammeter and voltmeters, dynamometer type instruments, multimeters, AC watt-hour meters. digital voltmeters, ammeters and watt meters.	05
Total		42

11. Suggested Books:

S. No.	Name of Authors /Books / Publishers	Year of Publication/ Reprint
1	Basic Electrical Engineering, A.E. Fitzgerald , David Higginbotham , Arvin Gabel, Tata McGraw-Hill Publishing Company; 5 th Edition.	2009
2	Electrical and Electronic Technology, Edward Hughes, Ian Mckenzie Smith, John Hiley, Pearson Education, 10 th edition.	2010
3	Linear Circuit Analysis: Time, Domain, Phasor and Laplace Transform Approaches Raymond A. De Carlo, Pen-Min Lin, Oxford University Press, 2 nd Edition.	2001
4	Hayt, Kemmerly & Durbin, "Engineering Circuit Analysis", Tata McGraw Hill Publishing Company Ltd.	2007
5	Electrical Engineering Fundamental V. Del Toro, Prentice-Hall, 2 nd Edition.	1989
6	Basic Electrical Engineering, C.L. Wadhwa, New Age International Pvt Ltd Publishers	2007
7	Introduction to Electrical Engineering, Mulukutla S. Sarma, Oxford University Press Inc.	2001

1. Subject Code: **ME-102/105** : Course Title: **Engineering Graphics**
2. Contact Hours : L: 00 T: 00 P: 03
3. Examination Duration (Hrs.) : Theory: 0 Practical: 03
4. Relative Weight : CWS: 00 PRS: 50 MTE: 00 ETE: 00 PRE: 50
5. Credits : 02
6. Semester : I / II
7. Subject Area : AEC
8. Pre-requisite : NIL
9. Objective : To familiarize the students with drafting and

engineering drawing practices.

10. Details of Course :

S. No.	Contents	Contact Hours
PART A		
1	General: Importance, Significance and scope of engineering drawing Lettering, Dimensioning, Scales, Sense of Proportioning, Different types of Projections, B.I.S. Specification, line symbols, rules of printing.	03
2	Projections of Points and Lines: Introduction of planes of projection, Reference and auxiliary planes, projections of points and lines in different quadrants, traces, inclinations, and true lengths of the lines, projections on auxiliary planes, shortest distance, intersecting and non-intersecting lines.	03
3	Planes Other than the Reference Planes: Introduction of other planes (perpendicular and oblique), their traces, inclinations etc., projections of points lines in the planes, conversion of oblique plane into auxiliary plane and solution of related problems.	03
4	Projections of Plane Figures: Different cases of plane figure (of different shapes) making different angles with one or both reference planes and lines lying in the plane figures making different given angles (with one or both reference planes). Obtaining true shape of the plane figure by projection.	03
5	Projection of Solids: Simple cases when solid is placed in different positions, Axis, faces and lines lying in the faces of the solid making given angles.	03
6	Isometric and Orthographic Views: First and Third angle of system of projection, sketching of Orthographic views from pictorial views and vice –versa, Sectional views.	09
7	Principles of dimensioning.	03
8	Development of lateral surfaces of simple solids.	06
9	Introduction to available drafting softwares like AutoCAD	09
Total		42

11. Suggested Books:

S. No.	Name of Authors /Books / Publishers	Year of Publication/ Reprint
TEXT BOOKS:		
1	Engineering Graphics, Narayana, K.L. and Kannaiah, P, Tata McGraw Hill	2005
REFERENCE BOOKS:		
1	Engineering Graphics, Naveen Kumar and S C Sharma	2013
2	Engineering Graphics, Chandra, A.M. and Chandra Satish, CRC Press	2003

1. Subject Code: **EN-101/102** : Course Title: **Environmental Science**
2. Contact Hours : L: 03 T: 00 P: 00
3. Examination Duration (Hrs.) : Theory: 03 Practical: 0
4. Relative Weight : CWS: 25 PRS: 00 MTE: 25 ETE: 50 PRE: 00
5. Credits : 03
6. Semester : I / II
7. Subject Area : AEC
8. Pre-requisite : NIL
9. Objective : To introduce basic fundamentals of Environmental Science.

10. Details of Course :

S. No.	Contents	Contact Hours
1.	<p>Introduction to Environment Definition, Scope, and importance of environmental studies; need for public awareness; Segments of environment- lithosphere, hydrosphere, atmosphere, and biosphere; Environmental degradation; Role of individual in environmental conservation; sustainable lifestyle.</p>	06
2.	<p>Natural Resources Forest Resources : Deforestation, mining, dams and their effects on forest and tribal people; Water resources: over-utilization, floods, drought, conflicts over water, dams-benefits and problems; Mineral resources: Use and exploitation, environmental effects; Food resources : World food problems, changes caused by modern agriculture, fertilizer-pesticide problems, water logging, salinity; Energy resources : Growing energy needs, renewable and non renewable energy sources; Land resources : Land as a resource, land degradation, man induced landslides, soil erosion and desertification.</p>	09
3.	<p>Ecosystems and Biodiversity Concept of an ecosystem, Structure and function, Energy flow, Ecological succession, ecological pyramids; Types, characteristic features, structure and function of the Forest, Grassland, Desert, and Aquatic ecosystems Concept of Biodiversity, definition and types, Bio-geographical classification of India; Value of biodiversity; Biodiversity at global, national and local levels; India as a mega-diversity nation; Hot-spots of biodiversity; Threats to biodiversity, Endangered and endemic species of India, Conservation of biodiversity.</p>	09
4.	<p>Environmental Pollution Definition, Cause, effects and control measures of: Air pollution, Water pollution, Soil pollution, Marine pollution, Noise pollution, Thermal pollution, Nuclear hazards Solid waste Management: Causes, effects and control measures of urban and industrial wastes, Role of an individual in prevention of pollution, Pollution case studies, Disaster management: floods, earthquake, cyclone and landslides.</p>	09

5.	Social Issues and Environment Sustainable development, Urban problems related to energy, Water conservation, rain water harvesting, watershed management, Resettlement and rehabilitation of people; its problems and concerns. Environmental ethics: Issues and possible solutions. Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust. Wasteland reclamation, Consumerism and waste products, Environment Laws and Acts, Issues involved in enforcement of environmental legislation, Public awareness. Population growth, variation among nations, Family Welfare Programme.	09
Total		42

1. Subject Code: **MA-101** : Course Title: **Mathematics – I**
2. Contact Hours : L: 03 T: 01 P: 00
3. Examination Duration (Hrs.) : Theory: 03 Practical: 00
4. Relative Weight : CWS: 25 PRS: 00 MTE: 25 ETE: 50 PRE: 00
5. Credits : 04
6. Semester : I
7. Subject Area : ASC
8. Pre-requisite : NIL
9. Objective : To acquaint the students with the knowledge of series & sequence, single & multiple variable calculus, knowledge of vector calculus and their applications.

10. Details of Course

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S. No.	Contents	Contact Hours
1.	Infinite series: Tests for convergence of series (Comparison, Ratio, Root, Integral, Raabe's, logarithmic), Alternating series, Absolute convergence, Conditional convergence.	06
2.	Differential & Integral Calculus of single variable: Taylor's & MaClaurin's expansion, Radius of curvature, Tracing of some standard curves, Applications of definite integral to Area, Arc length, Surface area and volume (in cartesian, parametric and polar co-ordinates).	07
3.	Calculus of several variables: Partial differentiation, Euler's theorem, Total differential, Taylor's theorem, Maxima-Minima, Lagrange's method of multipliers, Application in estimation of error and approximation.	07
4.	Multiple Integrals: Double integral (Cartesian and polar co-ordinates), Change of order of integration, Triple integrals (Cartesian, cylindrical and spherical co-ordinates), Beta and Gamma functions, Applications of multiple integration in area and volume.	08
5.	Vector Differential Calculus: Continuity and differentiability of vector functions, Scalar and Vector point function, Gradient, Directional Derivative, Divergence, Curl and their applications.	07
6.	Vector Integral Calculus: Line integral, Surface integral and Volume integral, Applications to work done by the force, Applications of Green's, Stoke's and Gauss divergence theorems.	07
Total		42

11. Suggested Books:

S. No.	Name of Books/Authors Publishers	Year of Publication/ Reprint
1.	Advanced engineering mathematics: Kreyszig; Wiley-India. 9 th Edition ISBN : 978-81-265-3135-6	2011
2.	Advanced engineering mathematics: Jain/Iyenger; Narosa. 2 nd Edition. ISBN: 81-7319-541-2	2003

3.	Advanced engineering mathematics: Taneja; I K international ISBN: 978-93-82332-64-0	2014
4.	Advanced engineering mathematics: Alan Jeffery; Academic Press ISBN: 978-93-80501-50-5	2010
5.	Calculus and analytic geometry: Thomas/Finney; Narosa. ISBN : 978-81-85015-52-1	2013

1. Subject Code: **MA-102** : Course Title: **Mathematics – II**
2. Contact Hours : L: 03 T: 01 P: 00
3. Examination Duration (Hrs.) : Theory: 03 Practical: 00
4. Relative Weight : CWS: 25 PRS: 00 MTE: 25 ETE: 50 PRE: 00
5. Credits : 04
6. Semester : II
7. Subject Area : ASC
8. Pre-requisite : NIL
9. Objective : To impart knowledge of matrices and applications closed form and series solutions of Differential equations, Laplace Transform, Fourier series, Fourier Transform & their applications.
10. Details of Course :

S. No.	Contents	Contact Hours
1.	Matrices: Rank of a matrix, Inverse of a matrix using elementary transformations, Consistency of linear system of equations, Eigenvalues and Eigenvectors of a matrix, Cayley Hamilton theorem, Diagonalization of matrix.	07

2.	Ordinary differential equations: Second & higher order linear differential equations with constant coefficients, General solution of homogenous and non - homogenous equations, Method of variation of parameters, Euler-Cauchy equation, Simultaneous linear equations, Applications to simple harmonic motion.	08
3.	Special Functions: Power series method, Frobenius method, Legendre equation, Legendre polynomials, Bessel equation, Bessel functions of first kind, Orthogonal property.	08
4.	Laplace Transforms: Basic properties, Laplace transform of derivatives and integrals, Inverse Laplace transform, Differentiation and Integration of Laplace transform, Convolution theorem, Unit step function, Periodic function, Applications of Laplace transform to initial and boundary value problems.	08
5.	Fourier series : Fourier series, Fourier Series of functions of arbitrary period, Even and odd functions, half range series, Complex form of Fourier Series, Numerical Harmonic analysis.	06
6.	Fourier Transforms: Fourier Transforms, Transforms of derivatives and integrals, Applications to boundary value problem in ordinary differential equations (simple cases only).	05
Total		42

11. Suggested Books:

S. No.	Name of Books/Authors Publishers	Year of Publication/ Reprint
1.	Advanced engineering mathematics: Kreyszig; Wiley. ISBN : 978-81-265-3135-6	2011
2.	Advanced engineering mathematics: Jain/Iyenger; Narosa. ISBN: 81-7319-541-2	2003
3.	Advanced engineering mathematics: Taneja; I K international ISBN: 978-93-82332-64-0	2014
4.	Advanced engineering mathematics: Alan Jeffery; Academic Press ISBN: 978-93-80501-50-5	2010

5.	Advanced engineering mathematics: Peter V. O'Neil Cengage Learning. ISBN : 978-81-315-0310-2	2007
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1. Subject Code: **HU 101/102** : Course Title: **Communication Skills**
2. Contact Hours : L: 03 T: 00 P: 00
3. Examination Duration (Hrs.) : Theory: 03 Practical: 00
4. Relative Weight : CWS: 25 PRS: 00 MTE: 25 ETE: 50 PRE: 00
5. Credits : 03
6. Semester : I / II
7. Subject Area : HMC
8. Pre-requisite : NIL
9. Objective : To impart essential skills required for effective communication in English language.
10. Details of Course :

Sl. No.	Contents	Contact Hours
1	Communication Communication: Process, Features, Barriers Language, Technology and Communication	02
2	Unit II: Grammar and Usage Vocabulary-Words/Word Formation, Confusing Word Pairs Sentence Construction, Sentence Types, Direct/Indirect Speech Punctuation, Error Spotting, Idioms and Phrases	06
3	Unit III: Oral Communication Phonetics of English, Vowels, Consonants, syllables, transcription of words and simple sentences using IPA: Speech Sounds and their articulation; phonemes, Syllable, Stress, Transcription of words and Simple Sentences Language Lab Practice for Oral Communication: Project Presentations, Group Discussions, Debates, Interviews etc.	12

4	Unit IV: Written Technical Communication Composition- Descriptive, Explanatory, Analytical and Argumentative Writing Paragraphs (Essay, Summary, Abstract) Reading and Comprehension, Providing working mechanism of instruments, appliances, description of processes, their operations and descriptions; Drawing Inferences from graphs, charts, Diagrams etc.	12
5	Unit V: Texts for Appreciation and Analysis Improve your Writing by V. N. Arora and Lakshmi Chandra (OUP) Vijay Seshadri. <i>3 Sections</i> (2014) or <i>Gestures: Poetry from SAARC Countries</i> Ed. K. Satchidanandan. Sahitya Akademi: New Delhi ISBN- 81-260-0019-8 Ursula K. Leguin. <i>The Telling</i> , Harcourt Inc. 2000 or <i>Animal Farm</i> by George Orwell (1945) ISBN: 9781502492791 or <i>Frankenstein</i> by Mary Shelley (1818) Harper Collins India Ltd.: NOIDA ISBN: 9780007350964	10
Total		42

Text Books:

Sl.No.	Name of Books, Authors, Publishers	Year of Publication/ Reprint
1.	<i>Improve your Writing</i> by V.N.Arora and Lakshmi Chandra OUP: Delhi ISBN 13: 978-0-19-809608-5	1981, 2013 (Revised Edition)
2.	<i>Technical Communication: Principles and Practice</i> by Meenakshi Raman and Sangeeta Sharma OUP: Delhi. ISBN-13: 9780-19-806529-6	2011, Reprinted in 2014
3.	<i>English Phonetics and Phonology: A Practical Course.</i> By Peter Roach. Cambridge: Cambridge University Press. (Fourth Edition) ISBN: 978-0-521-14921-1	2009, 2014 (Reprinted)
4.	Vijay Seshadri. <i>3 Sections</i> , Harper Collins India Ltd.: India. ISBN: 9789351367734. or <i>Gestures: Poetry from SAARC Countries</i> Ed. K. Satchidanandan. Sahitya Akademi: New Delhi ISBN- 81-260-0019-8	2014 1996, Reprint 2007

5.	Ursula K. Leguin. <i>The Telling</i> , Harcourt Inc. 2000 or <i>Animal Farm</i> by George Orwell (1945) ISBN: 9781502492791 or <i>Frankenstein</i> by Mary Shelley (1818) Harper Collins India Ltd.: Noida ISBN: 9780007350964	2000 1945/ 2014 Reprint 1818/ Latest Reprint 2012
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11. Suggested Books

Sl.No.	Name of Books, Authors, Publishers	Year of Publication / Reprint
1.	Maison, Margaret M. <i>Examine Your English</i> . Orient Blackswan: Delhi,	2009
2.	Sharma, Sangeeta & Binod Sharma. <i>Communication Skills for Engineers & Scientists</i> , PHI.	2012
3.	Swan, Michael, Catherine Walter. <i>Oxford English Grammar Course</i> . OUP: Delhi,	2011
4.	Kumar, E Suresh & P Sreehari <i>A Handbook for English Language Laboratories</i> , 2 nd Edition, Cambridge University Press, Foundation Books,	2014
5.	Dutt, P Kiranmai, Geetha Rajeevan & CLN Prakash <i>A Course in Communication Skills</i> . Cambridge University Press (Foundation Books).	2013
6.	Mitra, Barun K. <i>Personality Development and Soft Skills</i> . OUP: Delhi.	2011
7.	Apps for Phonetics- Advanced English Dictionary for Windows phone & OALD for Android phone	Latest

1. Subject Code: **CO 101/102** : Course Title: **Programming Fundamentals**
2. Contact Hours : L: 03 T: 00 P: 02
3. Examination Duration (Hrs.) : Theory : 3 Practical : 00
4. Relative Weight : CWS: 15 PRS: 15 MTE: 30 ETE: 40 PRE: 00
5. Credits : 04

6. Semester : I / II
7. Subject Area : AEC
8. Pre-requisite : NIL
9. Objective : To introduce fundamentals of Programming using C and C++, concepts of program development and object Oriented Programming.
10. Details of Course :

S.No.	Contents	Contact Hours
1.	Introduction: Concepts of algorithm, flow chart, Introduction to different Programming Languages like C, C++, Java etc. Elementary Programming in C: Data types, assignment statements, Arithmetic, unary, logical, bit-wise, assignment and conditional operators, conditional statements and input/output statements.	06
2.	Iterative programs using loops- While, do-while, for statements, nested loops, if else, switch, break, Continue, and goto statements, comma operators. Concept of subprograms.	06
3.	Array representation, Operations on array elements, using arrays, multidimensional arrays. Structures & Unions: Declaration and usage of structures and Unions. Defining and operations on strings.	06
4.	Pointers: Pointer and address arithmetic, pointer operations and declarations, using pointers as function argument. File: Declaration of files, different types of files. File input/ output and usage-, File operation: creation, copy, delete, update, text file, binary file..	08
5.	Concept of macros and pre-processor commands in C, Storage types: Automatic, external, register and static variables. Sorting and searching algorithms: selection sort, bubble sort, insertion sort, merge sort, quick sort and binary search.	08
6.	Introduction to Object Oriented Programming: OOPS concepts: class, encapsulation, inheritance, polymorphism, overloading etc. C++ introduction, Concept of class, methods, constructors, destructors, inheritance.	08
Total		42

11. Suggested Books

S.No.	Name of Books / Authors/ Publishers	Year of Publication/ Reprint
1.	The C Programming Language, 2nd Edition, Brian W. Kernighan, Dennis M. Ritchie, PHI, (ISBN-978-8120305960)	1988
2.	Let Us C, 13 th Edition, YashavantKanetkar, BPB Publications, (ISBN: 978-8183331630)	2013
3.	Mastering C, Venugopal K R, Sudeep R Prasad, Edition 1, McGraw Hill Education. (ISBN- 9780070616677)	2006
4.	Programming in ANSI C , Sixth Edition, McGraw Hill Education (India) Private Limited E Balagurusamy (ISBN: 978-1259004612)	2012
5.	Object Oriented Programming with C++, Sixth edition , E. Balagurusamy, McGraw Hill Education (India) Private Limited (ISBN: 978-1259029936)	2013

1. Subject Code: **ME 103/106** : Course Title: **Workshop Practice**
2. Contact Hours : L: 00 T: 00 P: 03
3. Examination Duration (Hrs.) : Theory : 00 Practical : 03
4. Relative Weight : CWS: 00 PRS: 50 MTE: 00 ETE: 00 PRE: 50
5. Credits : 02
6. Semester : I / II
7. Subject Area : AEC
8. Pre-requisite : NIL
9. Objective : To familiarize the students with manufacturing shops like Carpentry, Foundry, Welding, Machining, Fitting and Smithy.

10. Details of Course

:

Sl. No.	Shop	Description	Contact Hours
1.	Carpentry	Study of Different Carpentry Tools and Pattern Making of a given job (pulley/screw jack body)	03
2.	Foundry	Study of Different Foundry Tools and Furnaces Making a green sand mould of a given pattern (pulley/screw jack body) and its casting	06
3.	Welding	Arc welding of butt joint, T-joint and lap joint Study of other welding/ joining Techniques	09
4.	Machining	Study of lathe, milling, drilling machine, shaper, planer and grinding machine. Demonstration of a job on lathe	09
5.	Fitting	Study of various fitting hand tools, marking and measuring devices Preparation of a given job (box / funnel)	09
6.	Smithy	Study of different forming tools and power press Preparation of a given job (bolt / chisel)	06
Total			42

1. Subject Code: **MC251** Course Title: **Applied Mathematics**
2. Contact Hours : L: 3 T: 1 P:0
3. Examination Duration (Hrs.) : Theory 3 Practical 0
4. Relative Weightage : CWS 25 PRS - MTE 25 ETE 50 PRE-
5. Credits : 4
6. Semester : III
- 7 Subject Area : AEC
8. Pre-requisite : Nil
9. Objective : Learning mathematical tools applicable in Biotechnology.
10. Details of Course :

S. No.	Contents	Contact Hours
1.	Descriptive Statistics & Probability: Graphical methods for data representation. Measure of central tendency. Measure of dispersion. Moments, Skewness, and Kurtosis. Mathematical and Statistical concepts. Axiomatic concepts. Addition rule of probability. Conditional probability. Multiplication rule of probability. Baye's rule.	08
2.	Random variable and Expectation: random variable and distribution function. Jointly distributed random variables. Mathematical expectation. Statistical parameters. Moment generating function.	08
3.	Probability Distributions: Binomial distribution. Geometric distribution. Poisson distribution. Normal distribution. Normal distribution as limiting case of Binomial distribution. Exponential distribution.	10
4.	Solution of Algebraic and Transcendental Equations: Bisection method, Regula Falsi method, Secant methods, Newton-Raphson method, Fixed-point iteration method.	08
5.	System of Linear Algebraic Equations: Gauss elimination method, Crout's method, Gauss-Seidel and Gauss Jacobi methods.	08
Total		42

11.Suggested Books:

S. No.	Name of Books/Authors/Publishers, Year of Publication/Reprint
1.	Probability and Statistics for Engineers and Scientists by Ross, S.M. , 3rd ed. Publisher: Academic Press, (2005).
2.	Numerical Methods for Scientific and Engg.. Computations: M.K.Jain, S.R.K. Iyenger and R.K. Jain., New Age International (1993)
3.	Advanced Engineering Mathematics , Erwin Kreyszig, 10 th , 2010, Wiley edition

1. Subject Code: **BT-201** Course Title: **Introduction to Biotechnology**
2. Contact Hours : L: 3 T: 1 P:0
3. Examination Duration (Hrs.) : Theory 3 Practical 0
4. Relative Weightage : CWS 25 PRS - MTE 25 ETE 50 PRE -
5. Credits : 4
6. Semester : III
7. Subject Area : DCC
8. Pre-requisite : Nil
9. Objective : Introduction to Biotechnology integrates the fundamental concepts of life and physical sciences together with the basic laboratory skills necessary in the biological sciences. It provides foundational concepts in a broad spectrum of disciplines such as biochemistry, genetic engineering, biophysics, microbiology, molecular and cell biology.

10. Details of Course :

S. No.	Contents	Contact Hours
1.	Introduction, Scope and Applications of Biotechnology: Definition, historical perspectives, scope, applications of Biotechnology.	8

2.	Engineering Perspective to Biology: Characteristics of living organisms; Hierarchy of organization; Cellular architecture of prokaryotic and eukaryotic cells.	8
3.	Fundamentals of Biochemistry and Microbiology: Definition, classification and functions of Biomolecules; General characteristics, nomenclature and classification of enzymes; Types and important characteristics of microbes.	9
4.	Basic Concepts of Molecular Biology and Genetic Engineering: Evidence of nucleic acids as genetic material; Gene structure, function and organization, Central Dogma of molecular biology; Concept of recombinant DNA technology.	9
5.	Basics of Biophysical Methods and Techniques: Basic principles, procedures and types of Electrophoresis; Centrifugation; Chromatography.	8
Total		42

11.Suggested Books:

S.No.	Name of Authors /Books / Publishers, Year of Publication/Reprint
1.	Concepts in Biotechnology by D. Balasubramanian, C.F.A. Bryce, K. Jayaraman, J. Green and K. Dharmalingam. Publisher: Universities Press (2004)
2.	Microbiology by M.J. Pelczar, E.C.S. Chan and N.R. Krieg. Fifth edition. Publisher: McGraw Hill (2005)
3.	Lehninger's Principle of Biochemistry by D.L. Nelson and M.M. Cox. Fifth edition. Publisher: W.H. Freeman & Co. (2008)
4.	Physical Biochemistry: Applications to Biochemistry & Molecular Biology by D.M. Friefelder. Publisher: W.H. Freeman & Co (1982)
5.	Genes IX by B. Lewin. Publisher: Pearson Education (2007)
6.	Gene Cloning & DNA Analysis: An Introduction by T.A. Brown. Publisher: Blackwell (2010)

1. Subject Code: **BT-203** Course Title: **Biochemistry**
2. Contact Hours : L: 3 T: 0 P:2

3. Examination Duration (Hrs.) : Theory 3 Practical 0
4. Relative Weightage : CWS 15 PRS 25 MTE 20 ETE 40 PRE -
5. Credits : 4
6. Semester : III
- 7 Subject Area : DCC
8. Pre-requisite : Nil
9. Objective : To impart basic knowledge of biochemistry and biochemical principles for cell metabolism and bioenergetics.

10. Details of Course:

S. No.	Contents	Contact Hours
1.	Chemical Foundations of Biology: Properties of water; biogenic properties of water, acids, bases and buffers, covalent bonds, Non-covalent interactions in biological systems.	7
2.	Introduction to Biomolecules: Carbohydrates, Lipids, Proteins, Nucleic acids-classification, structure and function, Vitamins and Coenzymes.	6
3.	Metabolism and Bioenergetics: First and second law, free energy and chemical equilibrium; Electron transport chain and oxidative photophosphorylation, phosphorylation and control of ATP production.	7
4.	Carbohydrate Metabolism: Glycolysis pathway and reactions, Glycogen breakdown and synthesis, Citric acid cycle – Overview, Metabolic sources of Acetyl Co-A,enzymes and regulation, the amphibolic nature of the Citric acid cycle.Gluconeogenesis, Pentose Phosphate Pathw	8
5.	Lipid Metabolism: Lipid digestion, absorption and transport, fatty acid oxidation,ketone bodies, fatty acid biosynthesis, regulation of fatty acid metabolism.Cholesterol metabolism.	8

6.	Amino acid and Nucleotide Metabolism: Amino acid deamination, urea cycle, amino acids as biosynthetic precursors, amino acid biosynthesis, metabolism of purines and pyrimidines, biosynthesis of nucleotide coenzymes	6
Total		42

11. Suggested Books:

S. No.	Name of Authors /Books / Publishers, Year of Publication/Reprint
1.	Principles of Biochemistry by A.L. Lehninger, D.L. Nelson, M.M. Cox. Publisher: Worth Publishing (2008)
2.	Biochemistry by L. Stryer. Publishers: W.H. Freeman and Company (2002)
3.	Biochemical Calculations by I.H. Segal. Publisher: John Wiley and Sons (1968)
4.	Harper's Biochemistry by K. Robert, M.D. Murray, D.K. Granner, P.A. Mayes and V.I. Rodwell. Publisher: McGraw-Hill/Appleton and Lange (2006).
5.	Principles of Physical Biochemistry by Kensal E. Van Holde, Curtis Johnson, K.E. Van Holde., W.Curtis Johnson and Pui Shing Ho. Publisher: Prentice Hall.(2005)
6.	Biochemistry by C.K. Mathews, K.E. Van Holde and K.G. Ahern. Publisher: Benjamin/Cummings (1999).

1. Subject Code: **BT-205** Course Title: **Biochemical Engineering principles**
2. Contact Hours : L : 3 T : 0 P : 2
3. Examination Duration (Hrs.) : Theory 0 Practical 3
4. Relative Weightage : CWS 15 PRS 25 MTE 20 ETE 40 PRE -
5. Credits : 4
6. Semester : III
7. Subject Area : DCC
8. Pre-requisite : Nil
9. Objective : To introduce the key aspects associated with biochemical

processes & to optimise these processes, B.Tech students will learn about the practicalities of these processes in terms of microbial growth, kinetics, metabolism: the relationship of cellular function to the formation of products and the performance of processes useful to mankind.

10. Details of Course:

S.No.	Contents	Contact Hours
1.	Microbial Process Principles: Microbial growth, Synchronous culture, Biomass yield; Energetics of the cells.	8
2.	Kinetics of Microbial Growth, Substrate Utilization and Product Formation: Mathematical modeling of microbial growth. Substrate utilization, Product formation & Plasmid Instability kinetics.	8
3.	Sterilization: Principles and mechanism of media sterilization. Thermal death kinetics. Air sterilization – Principles and design.	9
4.	Bioreactor Design, Analysis and Transport processes: Bioreactor configuration, Bioreactor design and optimum operations, Basic concept of scale-up of bioreactors. Introduction to design of homogeneous & heterogeneous reacting system. Mass transfer & Heat transfer operations.	9
5.	Instrumentation and Control: Biochemical process variables and their measurements, Control principles and their application in bioreactors.	8
Total		42

11. Suggested Books:

S.No.	Name of Authors /Books / Publish
1.	Biochemical Engineering Fundamentals by J.E. Baily and D.F. Ollis. Publisher: McGraw Hill. (1986)
2.	Bioprocess Engineering Basic Concepts by M.L. Shuler and F. Kargi. Publisher: Prentice Hall (1987)
3.	Bioprocess Engineering - Kinetics, Mass transport, reactors and gene expression by W.R. Veith. Publisher: John Wiley and Sons Inc. (1994)

4.	Bioprocess Engineering Principles by P. Doran. Publisher- Academic Press (1995)
5.	Transport Phenomena by R. B. Bird et al., 2nd Edition, Wiley (2006)
6.	Introduction to Biochemical Engineering by D. G. Rao. Publisher: Tata McGraw-Hill (2006)

1. Subject Code: **BT-207** Course Title: **Engineering Analysis and Design**
2. Contact Hours : L: 3 T: 0 P: 2
3. Examination Duration (Hrs.) : Theory 3 Practical 0
4. Relative Weightage : CWS 15 PRS 25 MTE 20 ETE 40 PRE 0
5. Credits : 4
6. Semester : III
7. Subject Area : DCC
8. Pre-requisite : Nil
9. Objective : Students specializing in biotechnology engineering integrate analysis and design with applied biology to solve problems in the production of energy from renewable biological resources, in transferring laboratory developments to large-scale biotechnical production, and in the development of biosensors and biomaterials.

10. Details of Course :

S. No.	Contents	Contact Hours
1.	Mechanisms and processes for the sustainable production and use of energy from renewable biological sources, challenges in scaling up the production of genetically altered plants, plant materials and food products, production, packaging, and application of biocontrol agents for plant pests and diseases. Basics of animal cell biotechnology, diseases and vaccine production.	8

2.	Bioprocess principles: microbial production of biological products, tissue culture, Protein engineering: design of new enzymes or proteins with new or desirable functions and bioremediation.	8
3.	Design and Development: biosensors for the detection of microorganisms or specific substances, Biomaterials- on the development of products based on biological processes and materials.	8
4.	Analytical tools in biotechnical engineering, Optical techniques: Basics of Microscopy and cell imaging, Spectroscopy and diffraction techniques, Centrifugation, Electrophoresis and chromatographic methods, Immunological methods.	9
5.	Process Design and Life cycle analysis (LCA): definition and scope-data specificity, collection methods and data presentation, life cycle inventory (LCI), life cycle impact assessment (LCIA)- process diagrams, data collection, and evaluation of the data, final report-include significant data, data evaluation and interpretation, final conclusions, and recommendations.	9
Total		42

11. Suggested Books:

S. No.	Name of Authors /Books / Publishers
1.	Biotechnology: An Introduction by S.R. Barnum. Publisher: Wadsworth Publishing Company, (1987)
2.	Doran, Pauline M. "Bioprocess engineering principles" 2 nd edition, I Academic Press publications, Elsevier,(2013)
3.	Ireneusz Zbicinski, John Stavenuiter, Barbara Kozlowska, and Hennie van de Coevering, Product Design and Life Cycle Assessment,Baltic University Press, (2007)
4.	Keith Wilson and John Walker, " <i>Principles and Techniques of Practical Biochemistry</i> ", 5th Edition, Cambridge University Press(2000)
5.	Freifelder D., Physical Biochemistry, " <i>Application to Biochemistry and Molecular Biology</i> ", 2nd Edition, W.H. Freeman & Company, San Fransisco. (1982)

1. Subject Code: **HU201** Course Title: **Engineering Economics**
2. Contact Hours : L: 3 T: 0 P: 0
3. Examination Duration (Hrs.) : Theory: 3 Practical: 0
4. Relative Weight : CWS: 25 PRS: 0 MTE: 25 ETE: 50 PRE: 0
5. Credits : 3
6. Semester : III
7. Subject Area : HMC
8. Pre-requisite : NIL
9. Objective : To enable the students to understand the economic theories which may be applied to maximize return and economic environment in which they have to operate.
10. Details of Course :

S.No.	Contents	Contact Hours
1.	Introduction: Nature and significance of economics, Goods and Utility, Basic Concept of Demand and Supply, Elasticity of Demand-Price elasticity of Demand, Cross elasticity of Demand, Production - Production Function, Production Process and Factors of Production, Market – Introduction to Monopoly, Perfect Competition, Oligopoly and Monopolistic Competition, Cost Concepts- Opportunity Cost, Total Cost, Average Cost; Marginal Cost; Life Cycle cost, Sunk Cost; Preparation of Cost Sheet Profit Maximisation- numerical problem.	10
2.	Money- its evaluation and function, Bank- Commercial Bank and Central Bank and brief idea about function of banking system: Tax and Subsidy, Type of Tax- Direct and Indirect, Monetary and fiscal policy, Inflation and Business cycle, International trade, terms of Trade, Gain from International Trade, Free Trade vs. Protection, Dumping, Balance of Payment.	10

3.	Role of Science, Engineering and Technology in Economic Development: Seven salient Feature of the Indian Economy; Inclusive Growth; relevance for the Indian Economy; Globalisation & opening up of the Indian Economy; GDP- definition and Its measurement; How knowledge of engineering and technology may be used to improve life at slum; Green Revolution and White revolution. Reasons for their success and can we replicate them. Appropriate Technology & Sustainable Development. Entrepreneurship: Macro environment for promotion of entrepreneurship: How environment has changed after advent of IT and Globalisation.	12
4.	Elementary Economic Analysis: Interest formulas and their Applications; Calculations of economic equivalence, Bases for Comparison of Alternatives: Present Worth Method, Future worth method, Annual equivalent, Internal Rate of Return; Business Risk; Factors which should be taken care while deciding price of the product in the market.	10
TOTAL		42

11. Suggested Books And References:

S.No.	Name of Books / Authors/ Publishers
1.	G.J. Thuesen, & W.J. Fabrycky, Engineering Economy, Pearson Education, 2007, ISBN 013028128X
2.	William G. Sullivan, Elin M. Wicks, C. Patrick Koelling, Engineering Economy, Prentice Hall,(First Indian reprint). 2009, ISBN 0131486497
3.	Donald G. Newman, Jerome P. Lavelle & Ted G. Eschenbach, Engineering Economic Analysis, Oxford University Press, USA , 2004, ISBN 0195168070
4.	Seema Singh, Economics for Engineering Students, IK International Publishing House Pvt. Ltd, 2014, ISBN 8190777041

- Subject Code: **CO252** Course Title: **Data structure and Algorithm**
- Contact Hours : L: 3 T: 0 P: 2
- Examination Duration (Hrs.) : Theory 3 Practical 0
- Relative Weightage : CWS 15 PRS 25 MTE 20 ETE 40 PRE -

5. Credits : 4
6. Semester : IV
7. Subject Area : AEC
8. Pre-requisite : Nil
9. Objective : The course aims to introduce a no. of popular data structures and algorithm, along with the basic technique in algorithm analysis.

10. Details of Course:

S. No.	Contents	Contact Hours
1.	<p>Introduction: Introduction to Algorithmic, Complexity- Time-Space Trade off.Introduction to abstract data types, design, implementation and applications.Introduction to List data structure.</p> <p>Arrays and Strings: Representation of Arrays in Memory: one dimensional, Twodimensional and Multidimensional, Accessing of elements of array, performingoperations like Insertion, Deletion and Searching. Sorting elements of arrays. Stringsand String Operations.</p> <p>Stacks and Queues: Introduction to data structures like Stacks and Queues.Operations on Stacks and Queues, Array representation of Stacks , Applications ofStacks : recursion, Polish expression and their compilation conversion of infixexpression to prefix and postfix expression, Operations of Queues,Representations of Queues Applications of Queues, Priority que</p>	8
2.	<p>Linked Lists: Singly linked lists, Representation of linked list, Operations of Linkedlist such as Traversing, Insertion and Deletion, Searching, Applications of Linked List.Concepts of Circular linked list and Doubly linked list and their Applications. Stacksand Queues as linked list.</p>	8
3.	<p>Trees: Basic Terminology, Binary Trees and their representation, binary search trees, various operations on Binary search trees like traversing, searching, Insertion and Deletion, Applications of Binary search Trees, Complete Binary trees, Extended binary trees. General trees, AVL trees, Threaded trees, B- trees.</p>	6

4.	Sorting: Insertion Sort, Quick sort, Merge sort, Heap sort, sorting on different keys, External sorting.	7
5.	Graphs: Terminology and Representations, Graphs & Multi-graphs, Directed Graphs, Representation of graphs and their Transversal, Spanning trees, shortest path and Transitive Closure, Activity Networks, Topological Sort and Critical Paths.	6
6.	File Structure: File Organization, Indexing & Hashing, Hashing Functions, Collision Resolution Techniques.	7
TOTAL		42

11. Suggested books:

S. No.	Name of Authors /Books / Publishers
1.	Ellis Horowitz and Sartaz Sahni. Fundamentals of Data structures. Galgotia Publications, New Delhi (1984).
2.	Tanenbaum, "Data Structures using C and C++", PHI (1997).
3.	Data Structures through C by Yashavant Kanetkar, Bpb publications (2008)
4.	J. Tremblay and P.G. Sorensen. "An Introduction to Data Structures and Application", McGraw Hill College Division (1998)
5.	Data Structures and Algorithms by A.V. Aho, J.E. Hopcroft and J. Ullman. Publisher: Addison-Wesley Publishing (1983)
6.	Data Structures (Schaum's Outline series) by Lipschutz S. Publisher: McGraw-Hill (2007)
7.	R.L. Kruse, B.P. Leary, C.L. Tondo, "Data structure and program design in C", PHI.

1. Subject Code: **BT-202** Course Title: **Molecular Biology**
2. Contact Hours : L: 3 T: 0 P: 2
3. Examination Duration (Hrs.) : Theory 3 Practical 0
4. Relative Weightage : CWS 15 PRS 25 MTE 20 ETE 40 PRE -
5. Credits : 4

6. Semester : IV
7. Subject Area : DCC
8. Pre-requisite : Knowledge of structure of nucleic acids
9. Objective : To give a detailed perspective of the Central Dogma of Molecular Biology and some basic molecular biology techniques.

10. Details of Course:

S.No.	Contents	Contact Hours
1.	DNA replication: Prokaryotic and eukaryotic DNA replication; Mechanism of DNA replication; Telomeres	8
2.	Transcription and Post transcriptional processing of RNA: Transcription in prokaryotes and eukaryotes; Transcription factors; RNA polymerase; Regulatory elements; Post transcriptional processing of precursor mRNA, rRNA and tRNA	8
3.	Translation and Post translational modifications: Genetic code; mRNA transport; Prokaryotic and eukaryotic translation; Post translational modifications of proteins	9
4.	Regulation of gene expression: Concept of operon; Transcriptional and post transcriptional gene silencing; Ubiquitination; Application of antisense RNA, RNAi, ribozyme	9
5.	Techniques in Molecular Biology: DNA sequencing; Basics of PCR; Basics of DNA cloning; Southern and Northern hybridization	8
TOTAL		42

11. Suggested Books:

S. No.	Name of Authors /Books / Publishers, Year of Publication/Reprint
1	Molecular Biology of the Gene by J.D. Watson et al. 7 th ed. Pearson Education, 2013
2	Biochemistry by D. Voet and J.G. Voet. 4 th ed. John Wiley & Sons, 2010

3	Lewin's Gene XI by J.E. Krebs et al. Jones & Bartlett Learning, 2013
4	Genomes by T.A. Brown. 2 nd ed. John Wiley and Sons Inc., 2003
5	Essentials of Molecular Biology by Malacinski. 4 th ed. Jones and Barlett Publ.,2005
6	Essential Molecular Biology (Practical Approach Series). Volume 1 & 2 by T. Brown. Oxford University Press,2001
7	Molecular Biology LabFax by T.A. Brown. Wiley Blackwell,1991
8	Molecular Cloning: A Laboratory Manual (3 Volume Set) by J. Sambrook and David W. Russel. Third edition. Cold Spring Harbor Laboratory Press, 2001
9	Introduction to Practical Molecular Biology by P.D. Dabre. John Wiley and Sons Inc, 988

1. Subject Code: **BT-204** Course Title: **Genetics**
2. Contact Hours : L: 3 T: 1 P: 0
3. Examination Duration (Hrs.) : Theory 3 Practical 0
4. Relative Weightage : CWS 25 PRS - MTE 25 ETE 50 PRE -
5. Credits : 4
6. Semester : IV
7. Subject Area : DCC
8. Pre-requisite : Nil
9. Objective : To impart basic knowledge of cell and its mechanistic features as well as genetics and chromosomal organization

10. Details of Course:

S. No.	Contents	Contact Hours
1.	The Science of Genetics: Organization of genes; Genetic advances in agriculture and medicine; Classical and Molecular Genetics; Mendelian principles of Genetics; Population Genetics: Hardy-Weinberg Law and deviations	10
2.	Chromosome structure and organization: Chromosome structure; Heterochromatin and euchromatin; Nucleosome and higher order organization of chromosomes; Organization of extranuclear genomes	08
3.	Quantitative inheritance and chromosomal basis of inheritance and linkage: Quantitative changes; Polygenic inheritance; The chromosomal theory of inheritance; Extrachromosomal inheritance in microbial systems; Sex linked inheritance in humans; Genetic linkage; Genetic and physical mapping; Gene interactions; Epistasis	10
4.	Mechanism of genetic change: Mutation and mutagenesis; DNA repair mechanism; Variations in chromosome number and structure; Plasmids; Transposable elements; Recombination; Gene transfer in bacteria: Conjugation, Transformation, Transduction	08
5.	Techniques used in Genetics: Fluorescence <i>in situ</i> hybridization; Spectral karyotyping; Molecular markers: RFLP, RAPD, AFLP, STR	06
Total		42

11. Suggested Books:

S. No.	Name of Authors / Books / Publishers, Year of Publication / Reprint
1.	Principles of Genetics by E.J. Gardner, M.J. Simmons and D.P. Snustad. Publisher: John Wiley and Sons Inc,2001
3.	Genetics by M.W. Strickberger. Prentice Hall College Division,2008
4.	Concepts of Genetics by W.S. Klug et al. Pearson Education Inc,2012
5.	Principles of Genetics by S. Snustad and M.J. Summons. John Wiley & Sons Inc,2003

6.	Genetics by S. Snustad and M.J. Summons. Wiley John & Sons Inc,2012
7.	Genetics by P.J. Russel. Benjamin Cumming Comp. Inc, 2006
8.	Molecular Biology of the Gene by J.D. Watson et al. Pearson Education, 2004
9	Introduction to Genetic Analysis by A.J.F. Griffiths, J.H. Miller, D.T. Suzuki, R.C. Lewontin and W.M. Gelbart. W.H. Freeman and Company, 2000
10	Modern Genetic Analysis by A.J. F. Griffiths, W.M. Gelbart, J.H. Miller and R.C. Lewontin. W.H. Freeman and Company,1999
11	Basic Genetics by G.S. Miglani. Narosa Publishing House,2000
12	Genetics: Analysis and Principles by R.J. Brooker. Addison Wesley Longman Inc.,1999
13.	Essentials of Genetics by D.L. Hartl. Jones and Bartlett Publishers, 2012

1. Subject Code: **BT-206** Course Title: **Microbiology**
2. Contact Hours : L: 3 T: 0 P:2
3. Examination Duration (Hrs.) : Theory 3 Practical 0
4. Relative Weightage : CWS 15 PRS 25 MTE 20 ETE 40 PRE -
5. Credits : 4
6. Semester : IV
7. Subject Area : DCC
8. Pre-requisite : Nil
9. Objective : To impart basic knowledge of all classes of micro-organisms namely, bacteria, viruses, algae, fungi and protozoa and also methods of sterilization and culturing of microbes. The course also aims to give a broad overview of the applications of microbiology in our present world.

10. Details of Course:

S. No.	Contents	Contact Hours
1.	Introduction and Methods in Microbiology: Discovery of the microbial world, controversy over spontaneous generation, principles of microbial nutrition, Culture media, Theory and practice of sterilization, pure culture techniques, Enrichment culture techniques for isolation of different microorganism, culture collection and maintenance of cultures..	7
2.	Prokaryotic Structure and Function: functional anatomy of bacteria: cell envelope, cell wall, cytoplasmic membrane, capsule, surface appendages, cytoplasm and cytoplasmic inclusions.	6
3.	Microbial Nutrition and Growth: The definition of growth, mathematical expression of growth, growth curve, measurement of growth and growth yields, synchronous growth, continuous culture, growth as affected by environmental factors like temperature, acidity, alkalinity, water availability and oxygen, Chemolithotrophy; nitrate and sulfate reduction; methanogenesis and acetogenesis. Fermentations diversity, syntrophy, role of anoxic decompositions. Nitrogen metabolism; nitrogen fixation; antimicrobial agents, sulfa drugs, antibiotics – penicillins and cephalosporins, broad spectrum antibiotics.	9
4.	Microbial Taxonomy: New approaches to bacterial taxonomy, classification including ribotyping, ribosomal RNA sequencing, characteristics of primary domains, taxonomy, nomenclature and Bergey's manual	7
5.	Host-parasite Relationship: Normal microflora of skin, oral cavity, gastrointestinal tract; entry of pathogens into the host, colonization factors predisposing to infections, types of toxins (exo-, endo-, entero-) and their structure, mode of actions, vigilance and pathogenesis. Plant – Microbe Interactions Microbial Pathogenesis: Disease reservoirs; Epidemiological terminologies; Infectious disease transmission; Respiratory infections caused by bacteria and viruses, Tuberculosis; Sexually transmitted disease including AIDS, Disease transmitted by animals (rabies and plague) and insects and ticks (rickettsias and malaria); Food and waterborne diseases; pathogenic fungi, emerging and resurgent infectious diseases; Viruses, viroids, and prions; Microbial control of pathogenesis.	7

6.	Control of Undesirable Microorganisms in Biosystems: Introduction, Methods of Controlling Undesirable Microorganisms, Disinfectant Decay and Bacterial Inactivation Kinetics	6
Total		42

11.Suggested Books:

S. No.	Name of Authors /Books / Publishers, Year of Publication / Reprint
1.	Text books: 1. Microbiology by M.J. Pelczar, E.C.S. Chan and N.R. Kreig. Publisher: Tata McGraw Hill , 2005
2.	Microbiology by Bernard D. Davis, Renato Dulbecco, Herman N.Eisen and Harold S. Ginsberg. Publisher: Lippincott Williams & Wilkins,1990
3.	Brock Biology of Microorganisms by M.T. Madigan, J.M. Martinko and J. Parker. Publisher: Prentice-Hall, Inc, 1997
4.	General microbiology by R.Y. Stanier, J.L. Ingraham, M.L. Wheelis and P.R. Painter. Publisher: Macmillan ,1987
5.	Microbial genetics by S.R. Maloy, J.E. Cronan and J.D. Freifelder. Publisher: Bartlett Publishers , 1994
6.	Microbiology – A Laboratory Manual by J.G. Cappuccino and N. Sherman. Publisher: Addison-Wesley, 2007
7.	Microbiology Applications – (A Laboratory Manual in General Microbiology) by H.J. Benson. Publisher: Wm C Brown Publishers, 2001
8.	Microbiology by Prescott Harley and Kliein. Publisher: Mc Graw Hill, 2007

1. Subject Code: **BT-208** Course Title: **Structural Biology**
2. Contact Hours : L: 3 T: 0 P: 2
3. Examination Duration (Hrs.) : Theory 3 Practical 0
4. Relative Weightage : CWS 15 PRS 25 MTE 20 ETE 40 PRE 0
5. Credits : 4
6. Semester : IV

7. Subject Area : DCC
8. Pre-requisite : Nil
9. Objective : To understand the structures of proteins and DNA and their interactions with other biomolecules and drugs

10. Details of Course:

S. No.	Contents	Contact Hours
1.	Protein Structures: Primary, Secondary and Tertiary structures of proteins; Chemistry of amino acids; Classification of proteins; Structure and function of an antibody, hemoglobin and myoglobin; Sequence and structural motifs in proteins; Unstructured proteins	10
2.	Protein-ligand Interactions: Lock and key versus handshake mechanism of substrate recognition; Structural basis of recognition; Forces governing protein-protein interactions; Reaction mechanisms of enzymes; G-Protein coupled receptors; Enzyme-linked receptors	08
3.	Protein Solubility and Stability: Salting in and salting out; Mutations increasing stability; Helix capping; Native, partially denatured and fully denatured proteins; Protein denaturation and renaturation; $Cot_{1/2}$ value; Physical and chemical denaturants; Refolding	08
4.	DNA Structure: Covalent structure of DNA; Watson Crick model of double helical DNA; Crystal structure of B-DNA; DNA melting and annealing; Major and minor grooves; Propeller twist; A and Z- DNA	08
5.	Secondary Structures of DNA and Interactions: Triple stranded DNA; Telomeric sequences and structure; G-quartets; Palindromic and tandem sequences; Base pair flipping; DNA bulges, DNA methylation; Protein-DNA interactions; drug-DNA interactions	08
Total		42

11. Suggested Books:

S. No.	Name of Authors /Books / Publishers
1.	Freifelder's Essentials of Molecular Biology by G.M. Malacinski, D. Freifelder. 4th Ed. Jones and Bartlett Publications. 2008

2.	Biochemistry by D. Voet, J.G. Voet. 4th ed. John Wiley & Sons,2010
3.	Metzler Biochemistry: The Chemical Reactions of Living Cells by Metzler, David E.; Metzler, Carol M.; Sauke, David J. Academic Press,2003
4.	Lewin's Gene XI by J.E. Krebs's et al. Jones & Bartlett Learning,2013
5.	Introduction to Protein Architecture: The Structural Biology of Proteins by A.M. Lesk. Oxford University Press, 2001
6.	Introduction to Protein Structure by C. Branden, J. Tooze. Garland Publishing Company, 1999
7.	Molecular Cloning: A Laboratory Manual (3 Volume Set) by J. Sambrook, David W. Russel. Third edition. Cold Spring Harbor Laboratory Press, 2001
8.	Principles of Biochemistry, D. L. Nelson, M.M. Cox, Lehninger. 4th Ed. W.H. Freeman, 2004
9.	Principles of Physical Biochemistry K.E van Holde, C.Johnson, P. Shing Ho. 2nd Ed. Prentice Hall, 2005

1. Subject Code:**MG-202** Course Title: **Fundamentals of Management**
2. Contact Hours : L: 3 T: 0 P: 0
3. Examination Duration (Hrs.) : Theory 3 Practical 0
4. Relative Weightage : CWS 25 PRS 0 MTE 25 ETE 50 PRE -
5. Credits : 3
6. Semester : IV
7. Subject Area : HMC
8. Pre-requisite : Nil
9. Objective : The basic objective of this paper is to acquaint the students with the basic concepts of management necessary to deal with emerging business environment besides sensitizing them about societal challenges.

10. Details of Course:

S.NO	Detail Contents	Contact Hrs.
1	Definition of management, importance of management, management principals, managerial roles, managerial ethos, management vs administration, managerial functions, task and responsibilities, organizational structure, motivation: meaning, theories and techniques	8
2	Concept of business environment, corporate social responsibility and corporate governance, managerial values and ethics	8
3	Objectives and importance of financial management, basics of capital budgeting, cost of capital, emerging sources of funds for new projects, introduction to stock market	9
4	Functions of marketing, marketing vs sales, interface of marketing with other departments, customer life time value, new product development, unethical issues in marketing	8
5	Introduction to knowledge management, knowledge society, knowledge economy, building knowledge assets, sources of knowledge, technology innovation process, E-governance: definition, objectives and significance; challenges in Indian context, Digital India programme	9
Total		42

11.Suggested Books

S. No.	Name of Books / Authors/ Publishers
1	Fundamental of Management, Stephen P. Robbins, David A. De Cenzo and Mary Coulter, Pearson Education, ISBN- 978-0273755869, 2011
2	Financial Accounting, 4 ed, S.N. Maheshwari and S.K. Maheshwari, Vikas Pulication, ISBN- 8125918523, 2005
3.	Management, James A F Stonner, Pearson Education, ISBN - 9788131707043 , 2010
4.	Marketing Management, 14 th ed., Philip Kotler , Kevin Lane Keller, Abraham Koshy and Mithileswar Jha, Pearson Education, New Delhi, (ISBN-10: 9788131767160), 2013
5	Knowledge Management in Organizations: A Critical Introduction, Donald Hislop, Oxford University Press, ISBN: 9780199691937,2013

1. Subject Code: **BT-301** Course Title: **Immunology & Immunotechnology**
2. Contact Hours : L: 3 T: 0 P: 2
3. Examination Duration (Hrs.) : Theory 3 Practical 0
4. Relative Weightage : CWS 15 PRS 25 MTE 20 ETE 40 PRE -
5. Credits : 4
6. Semester : V
7. Subject Area : DCC
8. Pre-requisite : Nil
9. Objective : To give an overview of the basic concepts and the principles of immune system and techniques for developing diagnostics and therapeutics.

10. Details of Course:

S. No.	Contents	Contact Hours
1.	Introduction Innate and acquired immunity, active and passive immunization, clonal selection theory, Humoral and Cellular Immunity	10
2.	Cellular Responses Cellular responses, activation and function of T and B cells, Cytokines and Major Histocompatibility Complex (MHC), Antibody and TCR gene rearrangement, Complement cascade, ADCC	15
3.	Applied Immunology Infection and immunity, Transplantation, graft vs host rejection Tumor Immunology, Tumor antigen, categories of tumor antigen, tumor immunoprophylaxis	5
4.	Immunological Tolerance and Autoimmunity : Autoimmune hemolytic anemia, myasthenia gravis, systemic lupus erythematosus, multiple sclerosis, rheumatoid arthritis.	5

5.	Diagnostics Applied immunology, antigen and antibody interactions, affinity and avidity, agglutination and precipitation reactions, immunoassays, immunofluorescence, fluorescence activated cell sorting analysis, microarrays to assess gene expression.	7
Total		42

11. Suggested Books:

S. No.	Name of Authors /Books / Publishers
1.	Roitt, I. and Male, B., "Immunology", Mosby Publ, 2002
2.	Kuby, J., "Immunology", W.H. Freeman & Co,2000
3.	Basic Immunology by A.K. Abbas and A.H. Lichtman. Third edition. Publisher: Saunders W.B. Company ,2010
4.	Immunobiology by Charles Janeway, Paul Travers, Mark Walport and Mark J. Shlomchik 2001 Publisher: Garland Science, New York.

1. Subject Code: **BT-303** Course Title: **Genetic Engineering**
2. Contact Hours : L: 3 T: 0 P: 2
3. Examination Duration (Hrs.) : Theory 3 Practical 0
4. Relative Weightage : CWS 15 PRS 25 MTE 20 ETE 40 PRE -
5. Credits : 4
6. Semester : V
7. Subject Area : DCC
8. Pre-requisite : Nil
9. Objective : Basic understanding of genetic engineering tools, gene, manipulation, gene delivery rDNA Technology and Library construction.

10. Details of Course:

S. No.	Contents	Contact Hours
1	Gene cloning vectors: Isolation and purification of DNA, Plasmids, bacteriophages, phagemids, cosmids, cloning vectors for eukaryotes, cloning vectors for higher plants, cloning vectors for animals.	8
2	DNA manipulation: Restriction endonuclease, mechanism of action, restriction mapping and map construction, DNA methylase, Other DNA, manipulative enzymes: Nuclease, Polymerase, Ligase, Topoisomerases.	8
3	Gene Delivery: Transformation, Transfection, Calcium phosphate method, gene gun, Liposome mediated, viral mediated, electroporation, magnetofection, and microinjection. An overview of PCR and variations.	9
4	Library Construction and Identification of Recombinant Clones: Genomic and cDNA library construction; Selection & screening of recombinants clones, Reporter gene expression, RNA interference, Site directed mutagenesis	9
5	Expression System: Yeast, E. coli, Insects, mammals, plants; Studying gene expression and function, Production and scale-up operations of recombinant cells (bacteria and yeast).	8
Total		42

11. Suggested Books:

S. No.	Name of Authors /Books / Publishers
1	Gene Cloning & DNA Analysis: An Introduction by T.A. Brown. Blackwell Publisher, 2001
2	Principles of Gene Manipulation & Genomics by Primrose & Twyman. Seventh edition, 2006
3	Molecular Cloning: A Laboratory Manual (3 Volume Set) by J. Sambrook and David W. Russel. Third edition Publisher: Cold Spring Harbor Laboratory Press, 2001
4	Molecular Biotechnology: Principles and Applications of Recombinant DNA by B.R. Glick and J.J. Pasternak. Publisher: ASM Press, 2003
5	Genetic Engineering by S. Rastogi and N. Pathak. Publisher: Oxford University Press, 2009

6	Recombinant DNA by J.D. Watson et al. Publisher: W.H. Freeman and company, 2007
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1. Subject Code: **HU301** Course Title: **Professional Ethics and Human Values**
2. Contact Hours : L: 2 T: 0 P: 0
3. Examination Duration (Hrs.) : Theory: 3 Practical: 0
4. Relative Weight : CWS: 25 PRS:0 MTE: 25 ETE: 50 PRE: 0
5. Credits : 2
6. Semester : V
7. Subject Area : HMC
8. Pre-requisite : NIL
9. Objective Processes : To make students aware of the ethics and codes of conduct required by Engineers and Professionals.
10. Details of the Course:

SI No.	Name of Books, Authors, Publishers	Contact Hours
1	Human Values and Ethics: Morals, Values, Ethics and Integrity, Need for Value Education for Engineers, Happiness, Prosperity, Harmony.	6
2	Code of Ethics and Professionalism: Professionalism and the Code of Ethics, Technical Education, Human Values and Coexistence, Universal Human Order, Natural acceptance.	6
3	Professional Ethics and Technology :Science, Technology and Professional EthicsEngineering Ethics, Environmental Ethics, Safety, Responsibility and Rights	8
4	Case Studies: Holistic Technologies, Eco-friendly production systems, The role of responsible engineers and technologists, Global Issues concerning Engineers	8
Total		28

11. Suggested Books and Reference:

Sl.No.	Name of Books, Authors, Publishers
1	Professional Ethics, Subramanian, R, Oxford University Press, 2011 ISBN13: 978-0-19-808634-5
2	Professional Ethics and Human Values, Govindarajan, M. S. Natarajan, V.S. Senthilkumar PHI, 2013 ISBN: 978-81-203-4816-5
3	Constitution of India and Professional Ethics, Reddy, G.B. and Mohd. Suhaib, IK International Publishing House. 2006 ISBN: 81-89866-01-X
4	Introduction to Engineering Ethics (2nd Ed.) Martin, Mike W. and Roland Schingzinger McGraw-Hill, 2010 ISBN 978-0-07-248311-6

1. Subject Code: **BT-302** Course Title: **Plant Biotechnology**
2. Contact Hours : L: 3 T: 0 P: 2
3. Examination Duration (Hrs.) : Theory 3 Practical 0
4. Relative Weightage : CWS 15 PRS 25 MTE 20 ETE 40 PRE -
5. Credits : 4
6. Semester : VI
7. Subject Area : DCC
8. Pre-requisite : Nil
9. Objective : To provide students with expert information on current and potential future developments in the area of plant biotechnology and to provide information on national and international norms and regulations in biotechnology

10. Details of Course:

S.No	Content	Contact hours
1	Introduction to plant biotechnology and culture techniques : Historical perspectives, sterilization techniques, nutrient media, role of phytohormones; Callus, cell and protoplast cultures; Micropropagation; Organogenesis and somatic embryogenesis; Ovule culture; Anther culture; Production of haploids; Protoplast isolation and fusion; Selection systems for somatic hybrids / cybrids; Somaclonal variation; Preservation of germplasm.	8
2	Formation of Secondary Metabolites in Tissue Culture: Production of pharmaceuticals by tissue culture; Biotransformation using plant cell cultures; Bioreactor system and models for mass cultivation of plant cells, hairy root culture	8
3	Plant Genetic Engineering Techniques: Gene transfer techniques (vector mediated and vectorless gene transfer), transgenic plants, <i>trans</i> gene integration and expression, <i>trans</i> gene silencing, protein targeting, chloroplast transformation, targeted gene transfer.	9
4	Applications of Transgenic Techniques: Transgenic crops with new traits – herbicide tolerance, insect and disease resistance, pathogen free plants, nutrient quality, post harvest quality traits, fruit ripening, edible vaccines, Molecular farming for therapeutic protein	9
5	Regulation of Plant Genetic Engineering: National Regulatory Mechanism; Public Concerns Related to Plant Genetic Engineering	8
Total		42

11. Suggested Books:

S.No	Name of Author /book/publisher
1	Introduction to Plant Biotechnology by H. S. Chawla Publisher: Oxford and IBH Publishing, 2009
2	An Introduction to Plant Tissue Culture by M.K. Razdan. Publisher: Oxford and IBH Publishing, 2010
3	Gene Cloning and DNA Analysis by T A Brown. Blackwell Publishing, 2008

1. Subject Code: **BT-304** Course Title: **Animal Biotechnology**
2. Contact Hours : L: 3 T: 0 P: 2
3. Examination Duration (Hrs.) : Theory 3 Practical 0
4. Relative Weightage : CWS 15 PRS 25 MTE 20 ETE 40 PRE -
5. Credits : 4
6. Semester : VI
7. Subject Area : DCC
8. Pre-requisite : nil
9. Objective : To impart the knowledge of the most recent techniques used in animal biotechnology and their application to animal husbandry and biomedical field.

10. Details of Course:

S. No.	Contents	Contact Hours
1.	Animal cell culture, basic principles, serum free and serum based media, scaling-up, characterization and preservation of cell lines, cytotoxicity and viability assays.	10
2.	Animal diseases, diagnosis, therapy, variations of diseases, modes of transmission of diseases, control and management of disease spreading	8
3.	Stem cells, micromanipulation of embryos, generation of modified stem cells.	7
4.	Transgenic animals, retroviruses and DNA microinjection method, knock in and knock out animals.	7
5.	Monoclonal antibody and hybridoma technology, application of mAb in diagnostics and therapeutics, vaccinology	10
Total		42

11.Suggested Books:

S. No.	Name of Authors /Books / Publishers
1.	Gene cloning & DNA Analysis: An introduction by T A Brown, Fourth edition, 2001
2.	Animal Cell Biotechnology, Methods and Protocols Publisher: Humana Press, 2007
3.	Pinkart, C.A., "Transgenic Animal Technology", Academic Press Inc, 1998
4.	Sasidhara, R., "Animal Biotechnology", MJP Publishers, 2006

1. Subject Code: **BT-306** Course Title: **Genomics & Proteomics**
2. Contact Hours : L: 3 T: 0 P: 2
3. Examination Duration (Hrs.) : Theory 3 Practical 0
4. Relative Weightage : CWS 15 PRS 25 MTE 20 ETE 40 PRE 0
5. Credits : 4
6. Semester : VI
7. Subject Area : DCC
8. Pre-requisite : Nil
9. Objective : To give sufficient knowledge of basic techniques in genomics and proteomics and information about gene and protein interactions

10. Details of Course:

S. No.	Contents	Contact Hours
1.	Introduction to Genomics: Genome complexity; Origin of genomes; Acquisition of new genes; DNA sequencing; Automated DNA sequencers; Genome sequencing; Sequence assembly; Human Genome Project; DNA fingerprinting	08

2.	Comparative and functional genomics: Sequence alignment; Databases; Phylogeny; Synteny; Cluster of orthologous groups; Genome annotation; Metabolic reconstruction; Global gene expression profiling: Expressed sequence tags, Serial analysis of gene expression, Total gene expression analysis, DNA microarray technology, Digital Northern; Single nucleotide polymorphisms; Gene inactivation: <i>Arabidopsis</i> knockout strategies	10
3.	Introduction to Proteomics: Overview of protein structure; Relationship between protein structure and function; Protein sequencing; Automated amino acid analyzer; Identification and analysis of proteins by 2D gel electrophoresis, Mass spectrometry (MALDI-TOF); Multidimensional liquid chromatography	06
4.	DNA-protein interactions: DNA binding motifs; Methods for detecting DNA-protein interactions: Chromatin immunoprecipitation assay (ChIP), Gel retardation assay, DNase I footprinting, Modification interference assay, DNA pull-down assay, Microplate capture and detection assay, Reporter assays	06
5.	Protein interactomics: Protein motifs and domains; Methods for detecting protein-protein interactions: Coimmunoprecipitation, Yeast two-hybrid system and variants, Phage display, GFP tagging, TAP tagging, Protein chips, Synthetic lethal screens, Intein and protein splicing for interaction analysis; Yeast genome-wide interaction studies; Protein-protein interaction network	12
Total		42

11. Suggested Books:

S. No.	Name of Authors / Books / Publishers, Year of Publication / Reprint
1.	Introduction to Genomics by A. Lesk. 2 nd ed. Oxford University Press, Inc, 2012
2.	Discovering Genomics, Proteomics and Bioinformatics by A.M. Campbell and L.J. Heyer. 2 nd ed. Benjamin Cummings, 2006
3.	Functional Genomics: A Practical Approach by S.P. Hunt and R. Livesey. Oxford University Press, 2000
4.	Principles of Gene Manipulation and Genomics by S. Primrose and R. Twyman. 7 th ed. Wiley Blackwell, 2006

5.	Introduction to Proteomics: Tools for the New Biology by D. Liebler. Humana Press, 2002
6.	Principles of Proteomics by R.M. Twyman. 2 nd ed. Garland Science, 2013
7.	Proteomics: From Protein Sequence to Function by S. Pennington and M.J. Dunn. 1 st ed. Springer Verlag, 2001
8.	Essentials of Genomics and Bioinformatics by C.W. Sensen. John Wiley and Sons Inc, 2002
9.	Bioinformatics: Sequence and Genome Analysis by D.W. Mount. CBS,2003
10.	Bioinformatics and Functional Genomics by J. Pevsner. John Wiley & Sons, Inc, 2003
11.	A Practical Approach To Microarray Data Analysis by D.P. Berrar et al. Kluwer Academic Publisher, 2003
12.	Introducing Proteomics: From Concepts to Sample Separation, Mass Spectroscopy and Data Analysis by J. Lovric. John Willey and Sons Ltd,2011

1. Subject Code:**HU302** Course Title: **Technical Communication**
2. Contact Hours : L: 2 T: 0 P: 0
3. Examination Duration (Hrs.) : Theory: 3 Practical: 0
4. Relative Weight : CWS: 25 PRS: 0 MTE: 25 ETE: 50 PRE: 0
5. Credits : 2
6. Semester : VI
7. Subject Area : HMC
8. Pre-requisite : NIL
9. Objective : To train students for business communication to enhance employability skills with special emphasis on placement interviews and public speaking.

10. Details of Course:

Sl. No.	Contents	Contact Hours
1.	English for Professional Purposes: Technical Communication- Methods, Strategies and Skills Communication in Global Contexts- Social, Cultural, Political and Technical, especially in formal set up	1 2
2.	Communication at the Workplace: Oral and Written: Written Communication- Letters, Orders (Sale/Purchase) Report Writing, Technical proposals Resume, SOP, Memo, Notice, Agenda, Minutes, Note Taking/Making, Oral Communication: Seminars, Conferences, Meetings, Office Etiquettes/ Netiquettes, Presenting Written Material Negotiation, Demonstration, Group Discussion, Interview	6 6
3.	Group Discussion and Report Writing: Group Discussion (Continuous assessment through the semester) Minor Report Writing(to be submitted before Mid- Semester Examination) Major Report writing (To be submitted before End Semester Examination)	13
Total		28

11.Suggested References:

Sl.No.	Name of Books, Authors, Publishers
1	Technical Communication: Principles and Practice Raman, Meenakshi and Sangeeta Sharma, Oxford University Press, 2014, ISBN-13: 978-0-19-806529-6
2	Writing to Get Results, (3rd Ed) Blicq, Ron S., Lisa A. Moretto, John Wiley and Sons, Inc.,2001, ISBN 0-7803-6020-6
3	Effective Technical Communication: A Guide for Scientists and Engineers , Mitra, Barun K. OUP: Delhi, 2006, ISBN-13: 978-0-19-568291-5
4	Personality Development and Soft Skills, Mitra, Barun K. New Delhi: Oxford University Press.,2014, ISBN-9780198060017
5	The Essence of Effective Communication, Ludlow, Ron and Fergus Panton. Prentice Hall: PHI.,1996, ISBN-81-203-0909-X

6	Advanced Technical Communication, Gupta, Ruby. Foundation Books,2011, CUP. ISBN 978-81-7596-733-5
8	Soft Skills: Enhancing Employability, Rao, M.S. Connecting Campus with Corporate, 2011, ISBN: 978-93-80578-38-5
9	Developing Communication Skills (2nd Ed), Mohan, Krishna and Meera Banerji, Macmillan Publishers India Ltd.,2009 ISBN 13: 978=0230-63843-3

1. Subject Code: **BT401** Course Title: **B.Tech Project-I**
2. Contact Hours : L:0 T:0 P:0
3. Examination Duration (Hrs.) : Theory: 0 Practical: 0
4. Relative Weight : CWS: 0 PRS: 0 MTE: 0 ETE: 0 PRE: 0
5. Credits : 4
6. Semester : VII
7. Subject Area : DCC
8. Pre-requisite : NIL
9. Objective : To familiarize the students to work in group and develop an independent understanding of engineering and analysis of engineering systems. He should also be able to write and present the work done during the course.

1. Subject Code: **BT403** Course Title: **Training Seminar**
2. Contact Hours : L: 0 T:0 P:0
3. Examination Duration (Hrs.) : Theory: 0 Practical: 0
4. Relative Weight : CWS: 0 PRS: 0 MTE: 0 ETE: 0 PRE: 0
5. Credits : 2
6. Semester : VII

7. Subject Area : DCC
8. Pre-requisite : NIL
9. Objective : To familiarize the students to work in industry and working culture of the industrial system. He should also be able to write and present the work done during the course.

1. Subject Code: **BT-405** Course Title: **Fundamentals of Computational Biology**

2. Contact Hours : L: 3 T: 0 P: 2

3. Examination Duration (Hrs.) : Theory 3 Practical 0

4. Relative Weightage : CWS 15 PRS 25 MTE 20 ETE 40 PRE -

5. Credits : 4

6. Semester : VII

7. Subject Area : DCC

8. Pre-requisite : Nil

9. Objective : The objective of the course is to introduce students to the current bioinformatics algorithm concepts and their implementation.

10. Details of Course:

S. No.	Contents	Contact Hours
1.	Introduction to Biological Databases: Types, Overview of Biological Databases and Retrieve Nucleic acid databases: NCBI: Pubmed, Entrez, Blast, OMIM, Books, Taxonomy, Structure, Locuslink. Protein Databases- Primary, Functional, Composite, Secondary, Structural classification database, Sequence Formats & storage, Sequence submission to sequence Database.	8

2.	Genomics: Structure of DNA, Polymorphisms in DNA Sequence, Human Genome Project, Complete Genome Sequences, Functional Annotation	8
3.	Perl Programming: Introduction and Installation, Arithmetic and Logical operators, Conditionals and Loops, List and Arrays, Working with files, Regular Expression and Pattern Matching.	8
4.	Pairwise Sequence Alignment: Local alignment, Global alignment, Scoring matrices- PAM, BLOSUM, Gaps, Dot Plots. Dynamic programming Approach: Needleman and Wunsch Algorithm, Smith and waterman Algorithm, Heuristic Approach: BLAST, FASTA.	9
5.	Multiple Sequence Alignment: global and local alignments, scoring matrices and gap penalties, filtering, position specific scoring matrices, internet resources, uses of multiple sequence alignment, programs and methods for multiple sequence alignment, representation, structural inference.	9
Total		42

11. Suggested books:

S. No.	Name of Authors /Books / Publishers, Year of Publication/Reprint
1.	Introduction to Bioinformatics – Teresa Atwood and David J.Parry, PearsonSmith publication 1st edition ,2003.
2.	Fundamental Concepts of Bioinformatics - Dan E. Krane, Michael L. Raymer, Pearson education First edition ,2004.
3.	Sequence structure and Database – Des Higgins, Willice Taylor, oxford press 1 st edition, 2003
4.	Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins, by Andreas, 2005
5.	D. Baxevanis, B. F. Francis Ouellette, Wiley-Interscience, 3rd Edition.,2004
6.	Sequence and Genome Analysis by David W. Mount - Cold Spring Harbor Laboratory 1st edition; 2004

1. Subject Code: **BT 407** Course Title: **Bioprocess Technology & Downstream Processing**
2. Contact Hours : L: 3 T: 0 P: 2
3. Examination Duration (Hrs.) : Theory 3 Practical 0
4. Relative Weightage : CWS 15 PRS 25 MTE 20 ETE 40 PRE -
5. Credits : 4
6. Semester : VII
7. Subject Area : DCC
8. Pre-requisite : Nil
9. Objective : Introduction of new technology necessitates innovation in process development scale-up and design. As a consequence, there is the need to design new, as well as to improve existing, processes. An integral and cost intensive part of these processes is associated with downstream processing for product isolation and purification.

10. Details of Course:

S. No.	Contents	Contact Hours
1.	Bioprocess vs. chemical processing: Cell culture techniques, media design, Inoculum development and aseptic transfer methods.	6
2.	Process technology: Production of primary & secondary metabolites, metabolites from plant and animal cell culture.	7
3.	Microbial Production of industrial enzymes, Biomass, Biofertilizers and Biopesticides	7
4.	Characteristic of bioproducts: Cell disruption methods, Mechanical methods of separation, Flocculation Sedimentation, Filtration and centrifugation.	7

5.	Downstream Processes: Solid liquid separation- Protein precipitation, aqueous two phase extraction, Membrane based separation; Electrophoresis	8
6.	Chromatography, Crystallization and drying: Chromatographic methods of separation based on size, charge, hydrophobic interaction and biological affinity	6
Total		41

11. Suggested Books:

S. No.	Name of Authors /Books / Publishers, Year of Publication/Reprint
1.	Industrial Microbiology by Casida. Publisher: New Age International, 2003
2.	Product Recovery in Bioprocess Technology, BIOTOL Series. Publisher: Butterworth Heinmann, 1992
3.	Separation processes in Biotechnology by J.M. Asenjo. Publisher: Marcel Dekker Inc., 2008
4.	Bioprocess Engineering Basic Concepts by M.L. Shuler and F. Kargi. Publisher: Prentice Hall, 2001
5.	Biochemical Engineering Fundamentals by J.E. Baily and D.F. Ollis. Publisher: McGraw Hill 2nd edition., 1986

1. Subject Code: **BT-402** Course Title: **B.Tech project-II**
2. Contact Hours : L:0 T:0 P:0
3. Examination Duration (Hrs.) : Theory:0 Practical: 0
4. Relative Weight : CWS: 0 PRS: 0 MTE: 0 ETE:0 PRE: 0
5. Credits : 8
6. Semester : VIII
7. Subject Area : DCC
8. Pre-requisite : NIL

9. Objective : To familiarize the students to work in group and develop an independent understanding of engineering and analysis of engineering systems. He should also be able to write and present the work done during the course.

1. Subject Code:**BT-404** Course Title: **Advances in Computational Biology**

2. Contact Hours : L: 3 T:0 P: 2

3. Examination Duration (Hrs.) : Theory 3 Practical 0

4. Relative Weightage : CWS 15 PRS 25 MTE 20 ETE 40 PRE -

5. Credits : 4

6. Semester : VIII

7. Subject Area : DCC

8. Pre-requisite : Nil

9. Objective : The course advances in computational biology integrates genetics and genetics with recent advancement in the field,including personalized medicine,soft computation in biological sciences .The course also also integrates laboratory skills necessary for implementation of research ideas.

10. Details of Course:

S. No.	Contents	Contact Hours
1.	Human Genetic Variation: Databases and Concepts: Introduction, Forms and mechanisms of genetic variation, Databases of human genetic variation, SNP databases, Mutation databases, Genetic marker and microsatellite databases, Nonnuclear and somatic mutation databases, Tools for SNP and mutation visualization.	8
2.	Structure Databases: PDB and MMDB, visualizing structural information	8

3.	Pharmacogenomics and Personalized Medicine: Introduction, Historical Perspectives and Current Status, Management of Pharmacogenomic Information:PharmGKB, DrugBank.	8
4.	Phylogenetic prediction: Types,Tree building methods and tree interpretation analysis	9
5.	Soft Computation: Machine learning, support vector machines, Neural Networks,fuzzy logic, genetic algorithms - applications to bioinformatics.	9
Total		42

11.Suggested Books:

S. No.	Name of Authors /Books / Publishers, Year of Publication/Reprint
1.	Algorithms on Strings, Trees, and Sequences: Computer Science andComputational Biology by D. Gusfield. Publisher: Cambridge University Press,1997
2.	Bioinformatics: APractical Guide to the Analysis of Genes and ProteinsADBaxevanis and B.F.F. Ouellette. Publisher: Wiley-Interscience ,2005
3.	Biocomputing hypertext course book at http://www.techfak.unibielefeld.de/dcd/curric/welcome.html/ .
4.	Bioinformatics: Sequence and Genome Analysis by D.W.Mount. Publisher:CBS ,2003
5.	Computational Modeling of Genetic and Biochemical Networks by J.M. Bower and H. Bolouri. Publisher: MIT Press ,2001
6.	Computational Molecular Biology: An Algorithmic Approach by P. A. Pevzner. Publisher: MIT Press ,2000

DEPARTMENTAL ELECTIVES

1. Subject Code: **BT-305** Course Title: **Instrumentation in Biotechnology**
2. Contact Hours : L: 3 T: 1 P: 0
3. Examination Duration (Hrs.) : Theory 3 Practical 0
4. Relative Weightage : CWS 25 PRS - MTE 25 ETE 50 PRE -
5. Credits : 4
6. Semester : V
7. Subject Area : DEC
8. Pre-requisite : Nil
9. Objective : To impart broad knowledge of commonly used instruments and their working principles
10. Details of Course :

S. No.	Contents	Contact Hours
1.	Hydrodynamic Techniques: Centrifugation: Viscosity and diffusion, Sedimentation equilibrium and sedimentation velocity methods, Analytical and Preparative centrifuges, application of density gradient and differential centrifugation; Cell disruption techniques.	7
2.	Electrophoretic Techniques: Paper and gel electrophoresis, Immuno electrophoresis, isoelectric focussing, two - dimensional electrophoresis, capillary electrophoresis.	6
3.	Chromatographic Methods: Paper, TLC gas chromatography, gel filtration, ionexchange chromatography, affinity chromatography and HPLC, FPLC, adsorption and desorption.	7
4.	Spectroscopic and Diffraction Techniques: UV and visible, spectrofluorimetry, Atomic absorption spectrophotometry, Mass Spectrometry, Infrared and Raman Spectroscopy, Mossbauer, MALDITOF, ORD and Circular Dichorism, Nuclear Magnetic Resonance and Electron Spin Resonance spectroscopy, X – Ray diffraction, Electron diffraction, Neutron Diffraction	8

5.	Optical Techniques: Microscopy: Optical and Electron Microscopy, Transmission and Scanning Electron Microscopy, Tunneling Electron Microscopy, Atomic Force Microscopy, Polarization and Fluorescence microscopy. Radioisotope Techniques: Radio tracers, GM Counter, Proportional and Scintillation Counters, autoradiography, radioimmunoassay (RIA).	8
6.	Chemosensors and Biosensors: Sensors and transducers; Electrochemical sensors; Semiconductor devices as chemical sensors; Optical chemical sensors; Piezoelectric sensors; Sensor signal processing; Chemistry of biomolecules and their immobilization for biosensors; Types of biosensors and their application -Environmental monitoring, process control, and clinical/biochemical analysis; Amperometric biosensors; Immunosensors.	6
Total		42

11. Suggested Books:

S. No.	Name of Authors /Books / Publishers, Year of Publication/Reprint
1.	Principles and Techniques of Practical Biochemistry by Keith Wilson and John Walker, Fifth edition, Cambridge University Press ,2000
2.	Biophysical Chemistry: The conformation of Biological Macromolecules by C.R.Cantor and P.R. Schimmel. Publisher: W.H. Freeman ,1980.
3.	Essentials of Biophysics by P. Narayanan. Publishers: New Age International Publishers ,2007
4.	Introduction to Spectroscopy by D.L. Pavia, G.M. Lampman and G. S. Kriz.and Vyvyan Publisher: Brooks Cole ,2009
5.	Principles of Physical Biochemistry by Kensal E. Van Holde, Curtis Johnson, K.E. Van Holde., W.Curtis Johnson and Pui Shing Ho. Publisher: Prentice Hall.,2005
6.	Process Biotechnology Fundamentals by S N Mukhopadhyay. Publisher: Viva Books Pvt. Ltd., New Delhi.,2010
7.	Microbiology by Bernard D. Davis, Renato Dulbecco, Herman N.Eisen and Harold S. Ginsberg. Publisher: Lippincott Williams & Wilkins ,1990

1. Subject Code:**BT-307** Course Title: **Food Biotechnology**
2. Contact Hours : L: 3 T: 1 P: 0
3. Examination Duration (Hrs.) : Theory 3 Practical 0
4. Relative Weightage : CWS 25 PRS - MTE 25 ETE 50 PRE -
5. Credits : 4
6. Semester : V
7. Subject Area : DEC
8. Pre-requisite : Nil
9. Objective : To impart broad understanding of food technology, industrial food production and product regulations.
10. Details of Course:

S. No.	Contents	Contact Hours
1.	Scope of Food Biotechnology (What is the difference between food technology and food biotechnology?) Tools of the Trade (How biotechnology techniques relate to food?)	8
2.	Recombinant Proteins (Production and applications in food), Biological Role of DNA in cell metabolism, Cell and tissue culture, Secondary metabolites synthesis .	8
3.	Plant biotechnology in foods (Application to food production, food industries, pharmaceuticals, and agriculture)	6
4.	Cell Culture and Food (Brewing, dairy biotechnology, food additives), Diagnostic Systems (How and Why and application in food)	7
5.	Biotechnological Approach for the exploitation of food and industrially important microorganism ,Bio Gas Plant	6
6.	Industrial Cell culture (Downstream processing Ethics and safety of food biotechnology products Regulations of food biotechnology	7
Total		42

11. Suggested Books:

S. No.	Name of Authors /Books / Publishers, Year of Publication/Reprint
1.	Advances in Biotechnology Vol.1, (Scientific and Engineering principles). Murray Moo-Young,C.W. gambell and C.Vezina
2.	Advances in biotechnology Vol-II, (Fuels, chemical.food and waste treatment) Murray Moo-Young,C.W. gambell and C.Vezina.
3.	Introduction to Plant Biotechnology, H. S. Chawla, 2004
4.	Fundamentals of Food Biotechnology By Byong H. Lee,wiley publications, 2015
5.	Food Biotechnology in Ethical Perspective edited by Julie Eckinger,second edition by Paul P Thompson., 2007

1. Subject Code:**BT-309** Course Title: **Object Oriented Programming**
2. Contact Hours : L: 3 T: 1 P: 0
3. Examination Duration (Hrs.) : Theory 3 Practical 0
4. Relative Weightage : CWS 25 PRS - MTE 25 ETE 50 PRE -
5. Credits : 4
6. Semester : V
7. Subject Area : DEC
8. Pre-requisite : Nil
9. Objective : Basics of programming language and application

10. Details of Course:

S. No.	Contents	Contact Hours
1.	Object oriented paradigm & C++ at a glance: Evolution of programming paradigm, structured versus object-oriented development, elements of object-oriented programming, Objects, classes, methods, popular OOP languages, software reuse.	7
2.	Classes and objects: Introduction, Class revisited, constant objects and constructor, static data members with constructors and destructors, constructor overloading, nested classes, objects as arguments, returning objects, friend functions and friend classes, constant parameters and member functions, static data and member functions.	6
3.	Dynamic objects: Introduction, pointers to objects, array of objects, pointers to object members, this pointer, self-referential classes	7
4.	Operator overloading and Inheritance: Overloading of new and delete operators, conversion between objects and basic types, conversion between objects of different classes, overloading with friend functions, abstract classes, inheritance types, virtual base classes, virtual functions, pointer to derived class objects, and base class objects, pure virtual functions, virtual destructors.	8
5.	Generic programming with templates: Introduction, function templates, overloaded function templates, class templates, inheritance of class template, class template containership, class template with overloaded operators.	8
6.	Introduction to byte code, security and portability, Data Types, variables, operators, arrays, type conversion and casting, type promotion, Control statements, standard input-output, Designing Classes, constructors, methods, access specifiers : public, private, protected, inheritance, packages and interfaces, Math, String, Vectors, and Array List classes, polymorphism: function and operator overloading, function overriding, abstract classes	6
Total		42

11. Suggested books:

S. No.	Name of Authors /Books / Publishers, Year of Publication/Reprint
1.	E Balaguruswamy, "Object Oriented Programming with C++", The McGraw Hill Companies ,2008
3.	Patrick Naughton, S. Herbert, "C++: The Complete Reference", Wiley Dream Tech,2005
4.	Jeri R.Hanly, Elliot B. Koffman, "Problem Solving and Program Design in C", Pearson Addison-Wesley ,2006
5.	Behrouz A. Forouzan, Richrad F. Gilberg "A structured Programming Approach Using C", Thomson Computer Science-3rd edition [India edition] ,2007
6.	Budd, "An Introduction to Object Oriented Programming", Addison Wesley,2002 K.R.Venugopal, Rajkumar Buyya, T.Ravishankar, "Mastering C++", TMH,2003 Lippman and Lajoie, "C++ Primer ", Addison Wesley ,1998

1. Subject Code: **BT-311** Course Title: **Introduction to Biomedical Engineering**
2. Contact Hours : L: 3 T: 1 P: 0
3. Examination Duration (Hrs.) : Theory 3 Practical 0
4. Relative Weightage : CWS 25 PRS - MTE 25 ETE 50 PRE -
5. Credits : 4
6. Semester : V
7. Subject Area : DEC
8. Pre-requisite : Nil
9. Objective : The main goal of subject is to introduce students to the application of engineering science to biomedical problems and to apply basic principles of science and engineering to study living functions and to understand the operation of biomedical instruments.

10. Details of Course:

S. No.	Contents	Contact Hours
1.	Introduction to Biomedical Engineering, Roles Played by Biomedical Engineers, Professional Status of Biomedical Engineering. Introduction: Anatomy and Physiology, Cellular Organization, Tissues, Major Organ Systems and Homeostasis	8
2.	Introduction: Rehabilitation Engineering and Assistive Technology, Principles of Rehabilitation Engineering, Introduction of Biomaterials in Medicine: From Prosthetics to Regeneration, Tissue-Biomaterial Interactions, Tissue Engineering	8
3.	Introduction to basic Bioinstrumentation System, Bioinstrumentation Design, Introduction to Biomedical Sensors, Basic Biophysics, Equivalent Circuit Model for the Cell Membrane Hodgkin–Huxley Model of the Action Potential. Introduction to Origin, Characteristics and Acquisition of Biosignals,	9
4.	Instrumentation and Imaging Devices, Radiographic Imaging Systems, Introduction of Diagnostic Ultrasound Imaging, Magnetic Resonance Imaging (MRI), Biomedical Optical Imaging, Fundamentals of Light Propagation in Biological Tissue, Physical Interaction of Light and Physical Sensing, Biochemical Measurement Techniques Using Light, Fundamentals of Therapeutic Effects of Lasers	9
5.	Biomedical Morality and Ethics: A Definition of Terms, Regulation of Medical Device Innovation Marketing Medical Devices, The Role of the Biomedical Engineer in the FDA Process.	8
Total		42

11. Suggested Books:

S. No.	Name of Authors /Books / Publishers, Year of Publication/Reprint
1.	R. S. Khandpur, Handbook of Bio-Medical Instrumentation, Tata McGraw Hill, India, 2005
2.	L.a. Geddes, L.e. Baker, Principles of Applied Biomedical Instrumentation, 3rd edn., Wiley India Pvt. Ltd, New Delhi, 2008

3.	J. D. Bronzino, Biomedical Engineering & Instrumentation, CRC Publication, Boca Raton, FL, 2006
4.	A. C. Guyton and E. Hall, Textbook of Medical Physiology, 11th edn., Elsevier, 2005

1. Subject Code: **BT-313** Course Title: **Thermodynamics of Biological Systems**
2. Contact Hours : L: 3 T: 1 P: 0
3. Examination Duration (Hrs.) : Theory 3 Practical 0
4. Relative Weightage : CWS 25 PRS - MTE 25 ETE 50 PRE -
5. Credits : 4
6. Semester : V
7. Subject Area : DEC
8. Pre-requisite : Nil
9. Objective : To gain insight into the concepts of nonbiological and biological thermodynamic systems, how are membrane transport and various metabolic processes facilitated?

10. Details of Course:

S. No.	Contents	Contact Hours
1.	Introduction to Thermodynamic Systems: Energetic process in the biosphere: The Ecosystem; Equilibrium, activity coefficients and phase equilibrium functions of state, cyclic processes, work, energy and metabolic heat; Mechanical equivalent of heat, energy as a function of state. Carnot cycle; Reverse Carnot cycle; use of heat transfer in biological processes	9
2.	The Laws of Thermodynamics: Free energy; Entropy: Ideality and Molecular Cohesion, Probabilistic nature of Entropy, Order and Disorder	8

3.	Chemical Potential: Visualization of the potential; Steady velocity and steady flow; Fick's law and diffusion; Local Equilibria and Steady State: Energy vs. Power; Transducers in biological states; Prigogine's principle; Spontaneous coupling and entropy production	9
4.	Non-equilibrium Thermodynamics: Reversible work; Exact differentials and function of state; First and second law; The electrochemical potential; External forces and steady state; Fick's Law; Chemical reactions in the steady state; internal entropy production; Cells as non-equilibrium stationary states; Diffusion and membrane transport	8
5.	Thermodynamics of Biological Systems: Biological Systems as open, non-equilibrium systems; Thermodynamic analysis of oxidative photophosphorylation; Stability of non-equilibrium stationary states; Ordering in time and space far from equilibrium; Glycolytic oscillations; Biological clocks	8
Total		42

11. Suggested Books:

S. No.	Name of Authors /Books / Publishers, Year of Publication/Reprint
1.	Bioenergetics by A.L. Lehninger. W.A. Benjamin Inc., 1971
2.	Biological Thermodynamics by D.T. Haynie. Cambridge University Press, 2008
3.	Biophysical Chemistry by CR. Cantor and P.R. Schimmel. W.H. Freeman
4.	Thermodynamics and Kinetics for the Biological Sciences by G.G. Hammes. John Wiley and Sons Inc., 2000
5.	Bioenergetics by Alexander Lowen. Penguin Books, 1994
6.	Bioenergetics by David G. Nicholls and Stuart Ferguson. Elsevier Ltd. 2013
7.	Principles of Bioenergetics by V. Skulachev, A.V. Bogachev, F.O. Kasparinsky. Springer-Verlag Berlin Heidelberg, 2013
8.	Thermal Biophysics of Membranes by T. Heimburg. Wiley-VCH, 2007

1. Subject Code: **BT-315** Course Title: **Current Topics in Biotechnology**

2. Contact Hours : L: 3 T: 1 P: 0

3. Examination Duration (Hrs.) : Theory 3 Practical 0

4. Relative Weightage : CWS 25 PRS - MTE 25 ETE 50 PRE -
5. Credits : 4
6. Semester : V
7. Subject Area : DEC
8. Pre-requisite : Nil
9. Objective : To make the students aware of the thrust research areas in Biotechnology

10. Details of Course:

S. No.	Contents	Contact Hours
1.	Stem cell research: Stem cell: characteristics, types, preparation, applications, ethical concerns; Therapeutic and reproductive cloning; Regenerative medicine; Functional tissue engineering	8
2.	Molecular and Nuclear medicine: Gene mutations; SNPs; Allele specific oligonucleotides; ARMS-PCR; Disease diagnostics using genetic markers; Molecular targeting of cancer cells; Radiotracers; PET/CT; MRI	8
3.	Nanobiotechnology: Concepts; Applications; Molecular machines for biotechnology and medicine	9
4.	Transgenic technology: Genetically modified organisms (GMOs); Legal requirements in the production of GMOs; Case study: Bt cotton; Current trends and consumer acceptance	9
5.	Pharmacogenetics and translational research: Drug responses; Adverse drug reactions; Role in drug discovery and drug development; Conventional medicine versus personalized medicine; Clinical trial formulations; Advances in translational research	8
Total		42

11.Suggested books:

S. No.	Name of Authors / Books / Publishers, Year of Publication / Reprint
1.	Essentials of Stem Cell Biology by R. Lanza et al. 2 nd ed. Elsevier Academic Press,2009
2.	Textbook of Molecular Medicine by J.L. Jameson. Blackwell Science Inc.,1997
3.	Molecular Medicine: Genomics to Personalized Healthcare by R.J. Trent. Academic Press,2012
4.	Molecular Medicine: An Introductory Text by R.J. Trent. Academic Press,2005
5.	Nuclear Medicine and PET/CT: Technology and Techniques by P.E. Christian and K.M. Waterstram-Rich. 7 th ed. Mosby,2011
6.	Essentials of Nuclear Medicine Imaging by F.A. Mettler Jr. and M.J. Guiberteau. 6 th ed. Saunders,2012
7.	Nanotechnology: Science, Innovations and Opportunity by L. Foster. Prentice Hall,2005
8.	Genetic Engineering by S. Rastogi and N. Pathak. Oxford University Press,2015
9.	Pharmacogenomics: Social, Ethical and Clinical Dimensions by M.A. Rothstein. Wiley-Liss,2003
10.	Pharmacogenomics in Drug Discovery & Development by Q. Yan. Humana Press,2008
11.	Pharmacogenomics Methods and Protocols by F. Innocenti. Humana Press,2005

1. Subject Code: **BT-317** Course Title: **Enzymology & Enzyme Technology**
2. Contact Hours : L: 3 T: 1 P: 0
3. Examination Duration (Hrs.) : Theory 3 Practical 0
4. Relative Weightage : CWS 25 PRS 0 MTE 25 ETE 50 PRE 0
5. Credits : 4
6. Semester : V
7. Subject Area : DEC

8. Pre-requisite : Nil
9. Objective : To integrate the practical aspects of enzymology with the kinetic theories to provide a mechanistic overview of enzyme activity and regulation in cells.

10. Details of Course :

S.No.	Contents	Contact Hours
1.	Enzyme: Introduction, Nomenclature & Classification of enzymes, Applications of enzyme in various fields, Enzyme catalyzed reactions in micro-aqueous medium, catalytic antibodies and Ribozyme.	7
2.	Enzyme Mechanism, Regulation & Kinetics: Mechanism & Regulation of enzyme action, Kinetics of enzymatic reaction, Single and multiple substrate systems, Biocatalysis using cofactor linked enzymes, Inhibition kinetics.	8
3.	Immobilization of Enzyme: Methods of immobilization& its kinetics, External and diffusional mass transfer limitation.	7
4.	Enzyme Reactor: Types of reactors for enzymatic processing, Steady state analysis of mass transfer and biochemical reaction in enzyme reactors.	7
5.	Bioprocess Design: Physical parameters, reactors operational stability; immobilized cells.	7
6.	Case studies on enzyme based industrial bioprocesses	6
Total		42

11.Suggested Books:

S. No.	Name of Authors /Books / Publishers, Year of Publication/Reprint
1.	Fundamentals of Enzymology by Price and Stevens. Publisher: Oxford University Press., 2002
2.	Introduction to Biocatalysis using Enzymes and Microorganisms by S.M. Roberts, N.J. Turner and A. J. Willetts. Publisher: Cambridge University Press, 1995
3.	Enzyme Kinetics: Behavior and Analysis of Rapid Equilibrium and Steady - State Enzyme Systems by I.H. Segel. Publisher: Wiley-Interscience., 1993

4.	Enzyme Technology by M.F. Chaplin and C. Bucke. Publisher: Cambridge University Press, 1990
5.	Enzymes: A Practical Introduction to Structure, Mechanism, and Data Analysis by R.A. Copeland .Publisher: John Wiley and Sons Inc, 1996
6.	Enzymes: biochemistry, biotechnology and clinical chemistry by Trevor Palmer: Horwood Publishing Series, 2001

1. Subject Code: **BT-319** Course Title: **Drug Design and Delivery**
2. Contact Hours : L: 3 T: 1 P: 0
3. Examination Duration (Hrs.) : Theory 3 Practical 0
4. Relative Weightage : CWS 25 PRS - MTE 25 ETE 50 PRE -
5. Credits : 4
6. Semester : V
7. Subject Area : DEC
8. Pre-requisite : Nil
9. Objective : To familiarize B.Tech students with concepts in Drug Design and Development with emphasis on the role of Bioinformatics in lead identification and lead optimization. Students are also being given in depth knowledge of the regulations involved in translation of 'bench to bedside' of a new drug and its IPR regulations.

10. Details of Course:

S. No.	Contents	Contact Hours
1.	Drug Discovery and development overview, Source of drugs, molecular screening strategies, traditional drug development	5
2.	'Bench to Bedside' translation of drugs, Preclinical drug development, Phases of Clinical Trials	5

3.	IPR regulations in drug development, Biosafety regulations	4
4.	Enzyme kinetics, Enzyme inhibition, Allosteric modulators, Enzymes as drug targets, Receptor Theory, Agonist and antagonist, Peptidomimetics	12
	Epitope mapping, synthetic vaccine design, concept of lead identification, Lead optimization, Rational drug design	8
5.	Computational drug design, Docking, QSAR, Pharmacophore modeling, Recent advances in drug development.	8
Total		42

11.Suggested Books:

S. No.	Name of Authors /Books / Publishers, Year of/Publication
1.	Comprehensive Medicinal Chemistry ,C.Hansh 9Ed.);(vol I-VI), 1990
2.	Design of Enzyme Inhibitors as Drugs,M.Sandler and H.J.Smith,Oxford University, 1989
3.	Drug Discovery and Design:Medical Aspects,J.Matsoukas and T.Mavromoustakos,IOS Press, 2002
4.	Drug Design Cutting Edge Approaches,Darren R Flower ,The royal society of Chemistry,Cambridge, 2002
5.	Protein folding and Drug Design ,R.A Broglia and L.Serrano,IOS Press, 2007

1. Subject Code: **BT 321** Course Title: **Bioprocess Plant Design**
2. Contact Hours : L: 3 T:1 P: 0
3. Examination Duration (Hrs.) : Theory 3 Practical 0
4. Relative Weightage : CWS 25 PRS - MTE 25 ETE 50 PRE -
5. Credits : 4
6. Semester : V
7. Subject Area : DEC

8. Pre-requisite : Nil
9. Objective : Subject deals with engineering principles for design of systems for processing biological materials into desired products.

10. Details of Course:

S. No.	Contents	Contact Hours
1.	Introduction, general design information; Mass and energy balance.	6
2.	Materials of construction for bioprocess plants; Mechanical design of process equipment; Vessels for biotechnology application.	9
3.	Design of fermenters; Design considerations for maintaining sterility of processing equipment; Piping and instrumentation; Penicillin case study.	9
4.	Selection and specification of equipment for handling fluids and solids; Design of heat and mass transfer equipment; Design of facilities for cleaning of process equipment; Utilities for biotechnology.	9
5.	Production plants; Process economics; Bioprocess validation; Safety considerations. Case studies.	9
Total		42

11. Suggested Books:

S. No.	Name of Authors /Books / Publishers, Year of Publication/Reprint
1.	Chemical Engineering by R.K. Sinnott, J.M. Coulson and J.F. Richardsons. Publisher: Butterworth-Heinemann. Vol-6, Butterworth Heinemann III edition, 2002
2.	Applied Process Design for Chemical and Petrochemical Plants by E.E. Ludwig. Publisher: Butterworth-Heinemann, 2001
3.	Chemical Engineers Handbook by RH. Perry and D.W. Green. Publisher McGraw-Hill 8th edition, 2008
4.	Process Biotechnology Fundamentals by S.N. Mukhopadhyay. Publisher: Viva Books , 2010

5.	Plant Design and Economics for Chemical Engineers by M. Peters and K. Timmerhaus. Publisher: McGraw-Hill, 2002
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1. Subject Code: **BT-323** Course Title: **Population Genetics**
2. Contact Hours : L: 3 T: 1 P: 0
3. Examination Duration (Hrs.) : Theory 3 Practical 0
4. Relative Weightage : CWS 25 PRS - MTE 25 ETE 50 PRE -
5. Credits : 4
6. Semester : V
7. Subject Area : DEC
8. Pre-requisite : Nil
9. Objective : Introduction to population genetics and evolutionary analysis
10. Details of Course:

S. No.	Contents	Contact Hours
1.	Introduction: Scope & Premises of Population Genetics, Genetic and Phenotypic Variation Random Mating, Loci and alleles, Mutations and Polymorphisms, Genotype and Allele Frequencies, Effect of Mutations on Fitness, Rate of Spontaneous Mutation	6

2.	Population Structure: The Hardy-Weinberg Principle, Testing for Hardy-Weinberg Equilibrium, Extensions of the Hardy-Weinberg Principle, Linkage and Linkage Disequilibrium, Genetic Drift, The Wright-Fisher Model of Random Genetic Drift, Effective Population Size, Gene Trees and Coalescence, Mutation, The Neutral Theory, Recombination, Migration, Inbreeding and Heterosis, Darwinian Selection, Selection in Haploid Organisms, Selection in Diploid Organisms Overdominance, More Complex Types of Selection Molecular Population Genetics, Molecular Polymorphisms, Patterns of Change in Nucleotide and Amino Acid Sequences, Polymorphism and Divergence, Molecular Phylogenetics, Transposable Elements, mtDNA, Y-DNA: Separating History from Gene Flow	8
3.	Population Genomics and proteomics: Genome-Wide Patterns of Polymorphism, Human Population Genetics, Human Polymorphism , Population Genetic Inferences from Human SNPs , Population Structure Inferred from Human Polymorphism, Mendelian Disease and Population Genetics, Genetic Basis for Variation in Risk of Complex Disease, Human Origins	8
4.	Evolutionary Analysis: Quantitative Genetics, Quantitative Genetics of Natural Populations, Quantitative Trait Loci (QTLs), Types of Quantitative Traits, Genes That Affect Quantitative Traits, the Number of Genes Affecting Quantitative Traits, Methods for Mapping QTLs	7
5.	UniSelection: Measures of Fitness & Constant Fitness Models, Nonrandom Mating: Identity by descent, Inbreeding; Selection on Quantitative Traits, Pleiotropy and Developmental Constraints, Interactions of selection with other evolutionary forces, The Shifting Balance Theory, The Unit of Selection, Meiotic and Molecular Drive, Sexual, Frequency & Density Dependent Selection.	6
6.	Genetic Variability in Natural Populations: Introduction, Measures of Genetic Variation, Gene Diversity within Populations- Enzyme and Protein Loci, Blood Groups and other loci; Genetic Diversity in Subdivided Populations, Mechanisms of Maintenance of Protein Polymorphisms: Overdominance hypothesis, Other types of Balancing Selection, Neutral Mutations, Transient Polymorphisms due to selection.	7
Total		42

11. Suggested books:

S. No.	Name of Authors /Books / Publishers, Year of Publication/Reprint
1.	Evolutionary Analysis, Scott Freeman, John C. Hendon, Fourth Edition Pearson Education.
2.	Molecular Genetic Analysis of Populations, Hoelzel, 2nd Edition, Oxford University,.1998
3.	Genetics -Principles and Analysis Hartl and Jones, 5th edition Jones and Barlet., 2001.
4.	Genetics of Populations P W Hedrick, 2nd Edition, Jones & Bartlett ,2000
5.	Principles of Population Genetics Hartl & Clark, Third Edition, Sinauer Associates Inc.,1997

1. Subject Code: **BT-325** Course Title: **Cell Biology**
2. Contact Hours : L: 3 T: 1 P: 0
3. Examination Duration (Hrs.) : Theory 3 Practical 0
4. Relative Weightage : CWS 25 PRS - MTE 25 ETE 50 PRE 0
5. Credits : 4
6. Semester : V
7. Subject Area : DEC
8. Pre-requisite : Nil
9. Objective : To impart basic knowledge of cell and its mechanistic features for better understanding of other subjects

10. Details of Course:

S. No.	Contents	Contact Hours
1.	Cell organelles and motility: Prokaryotic and eukaryotic cell; Cellular organelles: organization, structure and function; Cytoskeletal elements; Cell motility	10

2.	Cell Cycle and Apoptosis: Molecular events and regulation; Cell division: Mitosis and Meiosis, Apoptosis	08
3.	Cell-cell interactions and signal transduction: Cell junctions, cell adhesion and extracellular matrix; Signal transduction: cell to cell signaling and intracellular signaling; Transport across membranes; Endocytosis	10
4.	Protein sorting: Extracellular and intracellular signalling; Cell surface receptors; Secondary messengers; Vesicular trafficking in the cell	08
5.	Cancer: General concepts, causes, prevention, treatment; Roles of oncogenes and tumor suppressor genes	06
Total		42

11. Suggested Books:

S. No.	Name of Authors / Books / Publishers, Year of Publication / Reprint
1.	Molecular Biology of the Cell by B. Alberts et al. 6 th ed. Garland Science, 2015
2.	Cell and Molecular Biology: Concepts and Experiments by G. Karp. John Wiley & Sons, Inc., 2002
3.	Molecular Cell Biology by H. Lodish et al. 7 th ed. W.H. Freeman and Company, 2012
4.	Essential Cell Biology by B. Alberts et al. Garland Publishing, 2009
5.	The Cell: A Molecular Approach by G.M. Cooper and R.E. Hausmann. 6 th ed. Sinauer Associates, Inc., 2013
6.	Cell Biology by S.R. Bolsover et al. 2 nd ed. Wiley Liss, 2004
7.	Cell Biology by De Robertis et al. Saunders Publication, 2001
8.	Cell and Molecular Biology by P. Sheeler and D.E. Bianchi. 3 rd ed. Wiley India Private Limited., 2009
9.	Cell and Molecular Biology by De Robertis and De Robertis. Sunders Publications, 2009

1. Subject Code: **BT-308** Course Title: **Stem Cells and Regenerative Medicines**
2. Contact Hours : L: 3 T: 1 P: 0

3. Examination Duration (Hrs.) : Theory 3 Practical 0
4. Relative Weightage : CWS 25 PRS - MTE 25 ETE 50 PRE -
5. Credits : 4
6. Semester : VI
7. Subject Area : DEC
8. Pre-requisite : Nil
9. Objective : Introduction to stem cell technology and application
10. Details of Course:

S. No.	Contents	Contact Hours
1.	Basic elements of stem cells and tissue engineering Definition of stem cells, historical perspectives and various types of stem cells in use. Stem Cells – Basics, Properties and Classification, • Stem Cells in Gastrointestinal , Liver, Pancreas, Kidney, Heart, Spinal Cord and Lung Regeneration • Stem Cells in Eye Diseases and Disorders	7
2.	Regenerative Medicine: from Bench to Bedside The repair and regeneration of tissues for therapeutic purposes, such as replacing bone marrow in leukemia, cartilage in osteoarthritis or cells of the heart after a heart attack.	6
3.	Molecularly Targeted Therapies in Blood Disorders and Malignancy The discoveries of several novel regenerative treatments; Gene therapy, the potential of drugs based on RNA interference and the reprogramming of somatic cells into stem cells for regenerative medicine.	7
4.	Developmental and molecular biology of regeneration, pluripotent stem cells and genome engineering for modeling human diseases	8
5.	Principles and Practice of Tissue Engineering: Health Sciences and Technology	8

6.	Stem Cells: A Cure or Disease? Recent developments in stem cell science, underlying biology behind the idea of using stem cells to treat disease, specifically analyzing the mechanisms that enable a single genome to encode multiple cell states ranging from neurons to fibroblasts to T cells.	6
Total		42

11. Suggested Books:

S. No.	Name of Authors /Books / Publishers, Year of Publication/Reprint
1.	Stem Cells and Regenerative Medicine, Walter C Low, Catherine M Verfaillie ISBN: 978-981-4, 2008
2	Stem Cell Repair and Regeneration; Nagy Habib, Nataša Y Levičar, Myrtle Gordon, Long Jiao, Nicholas Fisk Volume 2, 2008
3	Developmental Biology, 6th Edition, Scott F. Gilbert, 2000
4	Hematology, William J. Williams, Ernest Beutler, Allan JU. Erslev, Marshall A. Lichtman, 2007
5	Stem Cell Biology by Marshak, Cold Spring Harbar Symposium Publication., 2001

1. Subject Code: **BT-310** Course Title: **Biopolymers**
2. Contact Hours : L: 3 T:1 P:0
3. Examination Duration (Hrs.) : Theory 3 Practical 0
4. Relative Weightage : CWS 25 PRS - MTE 25 ETE 50 PRE -
5. Credits : 4
6. Semester : VI
7. Subject Area : DEC
8. Pre-requisite : Nil
9. Objective : Brief overview of Biopolymers and bioplastics

10. Details of Course:

S. No.	Contents	Contact Hours
1.	Introduction: Definition of Biopolymers and types of biopolymers, definition of bioplastics, Types of bioplastics, such as starch based, cellulose based plastics and some aliphatic polyesters (PLA, PHB), polyamides, Bio-Based Composites from Soybean Oil and Chicken Feathers, bio-derived polyethylene and genetically modified bioplastics. Environmental impact such as Bioplastics and biodegradation.	8
2.	Biodegradable polymer: Classes, Natural biodegradable polymer, Synthetic biodegradable polymer and modified naturally biodegradable polymer. Non-biological and biological degradable polymer. Measuring of biodegradation of polymers- Enzyme assays, Plate test, Respiratory test, Natural environment, Field trial, Gas evolution test (CO ₂ & CH ₄)	8
3.	Composite implant materials: Mechanics of improvement of properties by incorporating different elements. Composite theory of fiber reinforcement (short and long fibers, fibers pull out). Polymers filled with estrogenic fillers (e.g. hydroxyapatite). Host tissue reactions.	9
4.	Bioplastics and Biocomposites processing and their applications: Introduction of bioplastics and biocomposites, processing of bioplastics and biocomposites, applications of bioplastics and their composites- civil engineering, biomedical, automotives applications	9
5.	Applications and manufacture of Bio Plastics: Use of Bio materials for manufacture of plastic films, various types of films and applications; usage of biological friendly plastics in homes, industry, etc. with specific applications. Mixing of biomaterials with plastics: equipment details, process details etc.	8
Total		42

11. Suggested Books:

S. No.	Name of Authors /Books / Publishers, Year of Publication/Reprint
1.	Handbook of Biopolymers and Biodegradable Plastics, 1st Edition Properties, Processing and Application, 2012
2.	Natural Polymers, Biopolymers, Biomaterials, and Their Composites, Blends, and IPNs, Sabu Thomas, Neethu Ninan, Sneha Mohan, Elizabeth Francis, 2012

3.	Biopolymers: Biomedical and Environmental Applications By Susheel Kalia, Luc Avérous wiley , 2011
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1. Subject Code: **BT-312** Course Title: **Metabolic Engineering**
2. Contact Hours : L: 3 T: 1 P: 0
3. Examination Duration (Hrs.) : Theory 3 Practical 0
4. Relative Weightage : CWS 25 PRS - MTE 25 ETE 50 PRE -
5. Credits : 4
6. Semester : VI
7. Subject Area : DEC
8. Pre-requisite : Nil
9. Objective : To impart basic knowledge of metabolic engineering, metabolic flux and applications of metabolic engineering
10. Details of Course:

S. No.	Contents	Contact Hours
1.	Basic concepts of metabolic engineering: Overview of cellular metabolism	8
2.	Synthesis of primary and secondary metabolites	10
3.	Bioconversions: Factors affecting bioconversions and Application	10
4.	Metabolic Flux: Integration of anabolism and catabolism, Regulation of Enzyme production	10
5.	Metabolic engineering and Bioinformatics	4
Total		42

11. Suggested Books:

S. No.	Name of Authors / Books / Publishers, Year of Publication / Reprint
1.	Wang.D.I.C Cooney C.L., Demain A.L., Dunnill.P. Humphrey A.E. Lilly M.D., Fermentation and Enzyme Technology, John Wiley and sons , 1980
2.	Stanbury P.F., and Whitaker A., Principles of Fermentation Technology,Pergamon Press, 1984
3.	Metabolic Engineering: Principles and Methodologies Gregory N. Stephanopoulos, Aristos A. Aristidou , Jens C. O. Nielsen , 1998
4.	Metabolic Engineering Sang Yup Lee, E. Terry Papoutsakis, 1999

1. Subject Code: **BT 314** Course Title: **Ecology and Evolution**
2. Contact Hours : L: 3 T: 1 P: 0
3. Examination Duration (Hrs.) : Theory 3 Practical 0
4. Relative Weightage : CWS 25 PRS - MTE 25 ETE 50 PRE -
5. Credits : 4
6. Semester : VI
7. Subject Area : DEC
8. Pre-requisite : Nil
9. Objective : Ecology develops an understanding of the differences in structure and function of different types of ecosystems and familiarize with the variety of ways that organisms interact with both the physical and the biological environment while Evolutionary explanations pervade all fields in biology and bring them together under one theoretical umbrella. It increases understanding of the causes, processes and consequences of evolution.

10. Details of Course:

S. No.	Contents	Contact Hours
1.	Introduction to Ecology: Relevance of studying ecology, its history, autecology, synecology, Species (Sympatric and Allopatric).	8
2.	Ecosystem, Biome, Biosphere and Ecosphere: Abiotic Factors, Laws of limiting factors- Liebig's law of minimum and Shelford's law of tolerance.	8
3.	Population & its growth: Ecosystem, Community, Sustainable development, Biodiversity, Trophic levels, Nutrient cycles.	8
4.	Introduction to Evolution: Lamarckism, Darwinism, Neo-Darwinism, An overview (chemogeny, biogeny, the RNA World).	10
5.	Process and products of evolutionary change: (Population genetics, Natural selection, Species concept and modes of speciation.	8
Total		42

11. Suggested Books:

S. No.	Name of Authors /Books / Publishers, Year of Publication/Reprint
1.	Environmental studies Benny Joseph-Tata McGrawHill , 2005
2.	Rana. S.V.S., —Essentials of Ecology & Environment Science, PHI Publications., 2013
3.	Ridley, M. Evolution. III Edition. Blackwell Publishing, 2004
4.	Barton, N. H., Briggs, D.E.G., Eisen, J. A., Goldstein, D. B. and Patel, N. H. Evolution. Cold Spring Harbour Laboratory Press, 2007
5.	Hall, B.K. and Hallgrimsson, B. Evolution. IV Edition. Jones and Bartlett Publishers, 2008

1. Subject Code: **BT-316**

2. Contact Hours : L: 3 T: 1 P:

3. Examination Duration (Hrs.) : Theory 3 Practical

4. Relative Weightage : CWS 25 PRS - MTE 25 ETE 50 PRE -
5. Credits : 4
6. Semester : VI
7. Subject Area : DEC
8. Pre-requisite : Nil
9. Objective : This course describes the methodology for generation of transformants and applications of transgenics.

10. Details of Course:

S. No.	Contents	Contact Hours
1.	Basics of Recombinant DNA Technology: Bacterial, plant and animal vectors; Methods of bacterial, plant and animal transformation	08
2.	Techniques Related to Generation and Applications of Transgenics: Nuclear transfer technologies; Reproductive and therapeutic cloning; Gene therapy; Gene targeting; Gene editing; Use of recombinase in transgenic construction; Application of Cre recombinase, Flippase, Zinc finger nucleases and Transcription activator-like effector nuclease; Recombinase mediated gene stacking; Design of vectors for optimizing transgene expression; Analysis of phenotype and transgene expression; Databases	10
3.	Recombinant Microorganisms: Production of recombinant biopharmaceuticals, restriction enzymes, antibiotics, Small molecules, biopolymers, recombinant vaccines; Biopesticides; Improved production of alcohol, fructose, glycerol; Improved conversion of glucose to fructose; Efficient utilization of cellulose; Plant growth promotion; Bioremediation, Superbug	08
4.	Plant and Animal Transgenics: Plant transgenics: Applications of transgenic technology in agriculture; Development of plants with improved quality attributes; Phytoremediation; Bioenergy plants; Plants as bioreactors; Edible vaccines; Animal transgenics: Application as basic research models and bioreactors; Application in molecular pharming, DNA vaccines, human gene medicines; stem cell therapy	08

5.	Regulation and Public Concerns: Recombinant DNA biosafety guidelines; National regulatory mechanism for implementation of biosafety guidelines for handling GMOs; Commercialization; Public acceptance; Risk factors related to transgenic plants and animals – health, environmental, ecological, socio-economical safety and ethical issues; Bt cotton case study; Concerns and regulations related to stem cell research and human cloning	08
Total		42

11. Suggested Books:

S. No.	Name of Authors / Books / Publishers, Year of Publication / Reprint
1.	Molecular Biotechnology by Glick, B.R. and Pasternak, ASM Press, USA, 2010
2.	Molecular Cloning: A Laboratory Manual (3 Volume Set) by J. Sambrook and David W. Russel. Third edition. Cold Spring Harbor Laboratory Press, 2001
3.	Genetic Engineering by Rastogi, S. and Pathak, N. Oxford University Press, 2015
4.	Principles of Gene Manipulation and Genomics Primrose, S.B. and Twymann, R., 2006
5.	Understanding DNA and Gene Cloning: A Guide for the Curious by Drlica, K. 4TH Ed. Wiley, 2006
6.	Transgenic Animal Technology - A Laboratory Handbook by Pinkert, C.A. 3 rd Ed. Elsevier Publ., 2014
7.	Transgenic Plants - Advances and Limitations by Yelda, O.C. InTech.,v
8.	Advances in Transgenic Technology by Devasahayam, M. Power Publ., 2012

1. Subject Code: **BT-318** Course Title: **Bioenergy and Biofuels**
2. Contact Hours : L: 3 T: 1 P: 0
3. Examination Duration (Hrs.) : Theory 3 Practical 0
4. Relative Weightage : CWS 25 PRS - MTE 25 ETE 50 PRE -
5. Credits : 4
6. Semester : VI

7. Subject Area : DEC
8. Pre-requisite : Nil
9. Objective : To impart basic understanding of renewable energy resources

10. Details of Course

S.No	Content	Contact hours
1	Introduction to Biofuels: Global energy outlook,,Biofuel Production Process and technology, ; Importance of biofuel feed stocks; Cellulose, starch, sugar, Lignocellulosic, Agro and Industrial by-products, Current status of research in India.	8
2	Production of Bio-ethanol: Process Technology for Bioethanol production using Sugar; Starch and Lignocellulosic. Selection of micro-organisms and raw materials; Unit Operations in Alcohol production.	8
3	Production of Biodiesel: Lipids as a source of biodiesel; Methods of Biodiesel Production, Quality Control Aspects. Biodiesel production from microalgae and future prospects	9
4	Production of Biohydrogen: Biohydrogen Production by anaerobic bacteria and photosynthetic algae, Enzymes involved in biohydrogen production, Factors affecting biohydrogen production, Detection and Quantification of biohydrogen.	9
5	Microbial Fuel Cells: Introduction and biochemical basis, History of microbial fuel cell development, Microbes used in microbial fuel cells Design of microbial fuel cells; MFC components, Two and Single MFC systems, Performances of microbial fuel cells.	8
Total		42

11.Suggested Books:

S.No	Name of Author /book/publisher, Year of publication/Reprint
1	Caye M. Drapcho, N.P. Nguan and T. H. Walker, Biofuels Engineering Process Technology , Mc Graw Hill Publishers, New York, 2008
2	Jonathan R.M, Biofuels – Methods and Protocols (Methods in Molecular Biology Series), Humana Press, New York, 2009
3	Lisbeth Olsson (Ed.), Biofuels (Advances in Biochemical Engineering/Biotechnology Series, Springer-Verlag Publishers, Berlin, 2007

1. Subject Code: **BT-320** Course Title: **Genomics in medicine**
2. Contact Hours : L: 3 T: 1 P: 0
3. Examination Duration (Hrs.) : Theory 3 Practical 0
4. Relative Weightage : CWS 25 PRS - MTE 25 ETE 50 PRE -
5. Credits : 4
6. Semester : VI
7. Subject Area : DEC
8. Pre-requisite : Nil
9. Objective : To understand the role of genomics for treatment of ailments

10. Details of Course:

S. No.	Contents	Contact Hours
1.	Biotechnology and Genomics in Medicine: Gene Medicine, Disease Models, Impact of Genomics on Medicine, Molecular Medicines	7
2.	Genomics: Human Genome Project Breakthroughs, Functional Genomics: Comparative Genomics, Transcriptomics, Proteomics, Mutational Genomics	6

3.	Genomics Applications in Infectious Diseases: Identification of causative microbes, molecular epidemiology, host resistance to infection, pathogenicity, combating infectious diseases	7
4.	Genomics Applications in Genetic Diseases: Genetic Disorders, detection and treatment of single gene disorders, analysis of polygenic disorders: linkage analysis, Linkage disequilibrium mapping, haplotypes, MHC, pharmacogenomics	8
5.	Genomics Applications in Cancer: Molecular basis of cancer, impact of genomics on cancer research, methods for the diagnosis of cancer, approaches to cancer therapy	8
6.	Case Study: Cardiovascular Disorders: Cardiovascular Single Gene Disorders, Cardiovascular Polygenic Disorders, Therapies and Applications	6
Total		42

11. Suggested books:

S. No.	Name of Authors /Books / Publishers, Year of Publication/Reprint
1.	Human Molecular Genetics, Third Edition T. Strachan and A.P. Read, Garland Science Publication. 2003
2.	Molecular Cell Biology, Sixth Edition (2007) H. Lodish, A. Berk, and C.A. Kaiser, W. H. Freeman & Co Ltd. 2007
3.	Cardiovascular Genetics and Genomics for the Cardiologist Victor J. Dzau and Choong-Chin Liew, Blackwell Publishing. 1999
4.	Genomics: The Science of Technology Behind the Human Genome Project Charles R. Cantor and Cassandra L. Smith, John Wiley & Sons, Inc. 1999
5.	A Century of Mendelism in Human Genetics Milo Keynes, A.W.F. Edwards and Robert Peel, CRC Press. 2005

1. Subject Code: **BT-322** Course Title: **Protein Engineering**
2. Contact Hours : L: 3 T: 1 P: 0
3. Examination Duration (Hrs.) : Theory 3 Practical 0

4. Relative Weightage : CWS 25 PRS - MTE 25 ETE 50 PRE -
5. Credits : 4
6. Semester : VI
7. Subject Area : DEC
8. Pre-requisite : Nil
9. Objective : To impart advance knowledge on how to engineer proteins through a detailed study of protein structure, its characteristic properties and its significance in biological systems

10. Details of Course:

S. No	Content	Contact hours
1	Bonds and Energies in protein: Covalent, Ionic, Hydrogen, Coordinate, hydrophobic and Vander walls interactions in protein structure.	8
2	Amino acids and their characteristics: Amino acids- structure with three and single letter codes, molecular properties (size, solubility, charge, pKa), Chemical reactivity in relation to post-translational modification.	8
3	Protein architecture: Primary structure- peptide mapping, peptide sequencing, Secondary structure- methods to determine Super-secondary structure, Tertiary structure-overview of methods to determine 3D structures.	10
4	Structure-function relationship: DNA binding proteins- Prokaryotic transcription factors, Eukaryotic transcription factors, Membrane proteins	8
5	Identification and analysis of proteins: Identification and analysis of proteins by 2D analysis, Mass spectrometry- ion source (MALDI, spray sources), analyser and detector	8
Total		42

11. Suggested Books:

S.No	Name of Author /book/publisher, Year of publication/Reprint
1	Moody P.C.E. and Wilkinson A.J. Protein Engineering, IRL Press, Oxford, UK. 1990
2	Branden C. and Tooze J. Introduction to Protein Structured, Second Edition, Garland Publishing, NY, USA. 1999
3	Creighton T.E. Proteins, Freeman WH, Second Edition. 1993
4	Sheldon J. Park, Jennifer R. Cochran. Protein Engineering and Design, CRC Press. 2009
5	Stefan Lutz, Uwe T. Bornscheuer. Protein Engineering Handbook, Volume 1 & Volume 2, willey publication, 2011

1. Subject Code: **BT-324** Course Title: **Biodiversity and Bio-resource Planning**
2. Contact Hours : L: 3 T: 0 P: 2
3. Examination Duration (Hrs.) : Theory 3 Practical 0
4. Relative Weightage : CWS 15 PRS 25 MTE 20 ETE 40 PRE -
5. Credits : 4
6. Semester : VI
7. Subject Area : DEC
8. Pre-requisite : Nil
9. Objective : The curriculum gives holistic coverage to the extremely valuable field of Biodiversity. Biodiversity—the variety of genes, species, and ecosystems—is the basis for long-term ecosystem health and stability. The world’s biodiversity is diminishing and dwindling before our eyes at an alarming rate day by day. Half of the world’s wetlands have been lost in the past century; 80 percent of grasslands are suffering from soil degradation; and 20 percent of drylands are in danger of becoming deserts. Every minute of the day, 28 hectares of forest are lost the world over. Wetlands and forests are being cleared for

urban and industrial development and encroached upon by local people. Because of the irreversibility of species extinction and habitat loss, this rampant depletion of our biodiversity exerts a terrible toll on both the natural and economic world, affecting both current and future generations. It is the need of the hour to preserve and conserve biological diversity of all wetlands, forests and other ecosystems of the world. Seeing the importance of this, the United Nations designated the years 2011–2020 as the “United Nations Decade on Biodiversity.”

10. Details of Course:

S. No.	Contents	Contact Hours
1.	<p>INTRODUCTION TO BIODIVERSITY Man – nature interactions, Role of bioresources in shaping human culture. Agriculture and Animal Husbandry- Origin, Spread, Changes, Challenges; Resource Use Patterns – Diversity, Specificity, Sustainable utilization of bioresources; Biodiversity, components, scope, and constraints of biodiversity, genetic diversity, species diversity, ecosystem diversity – aquatic biodiversity, agro-biodiversity, urban-peri-urban biodiversity, forest biodiversity; Wealth of India: Flora & Fauna with respect to western Ghats, Himalayan and sub-Himalayan regions, Freshwater and marine water biodiversity in India; biodiversity indices, Role of biodiversity in ecology and natural balance, threats to biodiversity. Factors affecting biodiversity changes.</p>	8
2.	<p>RESOURCES FROM PLANT, ANIMAL & MICROBES Role of plants, animals and microbes in natural ecosystems and life support systems (terrestrial, freshwater and marine), wild and domesticated gene-pool; Importance of traditional cultivars and wild species in agriculture, Value of plants, animals and microbes in scientific research and technological inventions, Traditional healthcare, modern lifestyle and economy.</p>	8
3.	<p>STRATEGIES FOR CONSERVATION OF BIODIVERSITY Management of agro-biodiversity, Human Animal Conflict, Human impact on distribution, consequences, Approaches to conservation of plants and animals (in situ and ex situ)</p>	6

4.	APPLICATIONS OF BIODIVERSITY IN BIOTECHNOLOGY Uses of bio resources- animal uses; food animals (terrestrial and aquatic), non-food uses of animals, domestic livestock. Primary and Secondary metabolites from plants, animals and microbes, Fatty acids, Alkaloids, Steroids, Flavonoids, Essential oils, Bioactive molecules (antimicrobials)	6
5.	LAWS, ACTS AND POLICIES International conventions and treaties for conservation of bio-resources, National Laws, policies and action plans for conservation of forests, wildlife, biodiversity, marine resources; National Biodiversity Authority, Role of NGOs in conservation of bio-resources and people's participation in such efforts at global, national and grassroot level.	6
Total		34

11. Suggested Books:

S. No.	Name of Authors /Books / Publishers, Year of Publication/Reprint
1	Krishnamurthy, K.V. 2003. Textbook of Biodiversity. Science Publications.
2	Mittermeier, R. A., N. Meyers, P.R. Gil and C. G. Mittermeier 2000. Hotspots: Earth's Biologically richest and most endangered Terrestrial Ecoregions. Cemex/ Conservation International, USA.
3	Gaston, K. J. 1996. Biodiversity: Biology of numbers and Difference. Blackwell.

Reference books

David Lindenmayer, Saul Cunningham, Andrew Young (Editors). Land Use Intensification: Effects on Agriculture, Biodiversity, and Ecological Processes. 2012, CRC Press. ISBN 9781466517141

David Lindenmayer, Philip Barton, Jennifer Pierson (Editors). Indicators and Surrogates of Biodiversity and Environmental Change. 2015, CRC Press. ISBN 9781498748704

Guy R. Larocque (Editor). Ecological Forest Management Handbook. 2015, CRC Press. ISBN 9781482247855

M. K. Rai, Geoffrey A. Cordell, Jose L. Martinez, Mariela Marinoff, Luca Rastrelli. Medicinal Plants: Biodiversity and Drugs. 2012, Science Publishers, CRC Press. ISBN 9781578087938

1. Subject Code: **BT-326** Course Title: **Medical Microbiology**
2. Contact Hours : L: 3 T: 1 P: 0
3. Examination Duration (Hrs.) : Theory 3 Practical 0
4. Relative Weightage : CWS 25 PRS - MTE 25 ETE 50 PRE -
5. Credits : 4
6. Semester : VI
7. Subject Area : DEC
8. Pre-requisite : Nil
9. Objective : To impart basic understanding of human pathogens and medical microbiology
10. Details of Course:

S. No.	Contents	Contact Hours
1.	Systemic Bacteriology: Study of - Staphylococcus, Streptococcus, Pneumococcus, Neisseria gonorrhoea, Neisseria meningitis, Corynebacterium diphtheriae, Mycobacterium, Clostridium, E.coli, H. pylori, Klebsiella, Salmonella, Proteus, Pseudomonas, Vibrio & Spirochaetes	8
2.	Parasitology: Protozoa : Intestinal Amoebae a. E. Histolytica, Flagellates of intestine/genitalia a. Giardia lamblia, Trichomonas vaginalis , Malarial Parasite, Plasmodium vivax, P. malaria, P. falciparum & P.ovale, Nematodes: Life cycle, Morphology, disease & lab diagnosis	8
3.	Virology: Viral pathogens Morphology, disease & lab diagnosis	9
4.	Mycology: Morphology and structure of fungi. - Classification of fungi. - Nutrition and cultivation of fungus. - Cutaneous & Sub cutaneous and Systemic Mycosis. 14 - Lab diagnosis of fungal Infections. - Opportunistic fungal infections.	9
5.	Applied Medical Microbiology: Urinary tract infections , Nosocomial infections , Pyrexia of unknown origin , Immunization, Automation - Introduction, meaning, advantages, history	8
Total		42

11.Suggested Books:

S. No.	Name of Authors / Books / Publishers, Year of Publication/ Reprint
1	Medical Microbiology 7 th ed Murray, Rosenthal, Pfaller, 2015
2	Medical Microbiology, 4th edition ISBN-10: 0-9631172-1-1, 1996
3	Polymicrobial Diseases. Brogden KA, Guthmiller JM Washington (DC): ASM Press, 2002
4	Prescott's Microbiology 9 th ed. Joanne Willey, Linda Sherwood and Christopher J. Woolverton, 2015
5	Topley and Wilson's Microbiology and microbial infections, 10 th ed, 2015
6	Sherris Medical Microbiology 6 th ed Kenneth Ryan, C. George Ray, Nafees Ahmad, W. Lawrence Drew, Michael Lagunoff, Paul Pottinger, L. Barth Reller and Charles R. Sterling, 2015

1. Subject code: **BT-328** Course Title: **Bioinformatics approaches in Complex disorders**
2. Contact hours: 34 L: 3 T: 1 P: 0
3. Examination Duration : Theory : 3 Practical: 0
4. Relate Weightage : CWS: 25 PRS: 0 MTE:25 ETE:50 PRE: 0
5. Credits : 4
6. Semester : VI
7. Subject area : DEC
8. Pre-requisite : Nil
9. Objective : This course focuses on analyses, chemistry, processing, bioavailability, and health benefits of bioactive food components. Objective of the course is to understand fundamental concepts and knowledge related to functional food and to reveal to students the importance of food in the promotion of our health.

10. Details of Course:

S. No.	Contents	Contact Hours
1.	Unit 1 Introduction: Monogenic and complex disorders; Interplay of genetic and environmental Factors; Integration of clinical and molecular data; Understanding the factors influencing disease susceptibility.	6
2.	Unit 2 Genome wide sequence extraction: Genomic sequences; Genome analysis; Extraction of information related to length of the sequence, organism specificity, evolutionary origin, etc	5
3.	Unit 3 Genotype-Phenotype Mapping: Relationship between genotypes and phenotypes; Genetic programming and its influence on phenotypes; Genotype–phenotype map; Importance in evolutionary studies.	5
4.	Unit 4 Database Creation: Database system; Construction of database; 5.Database interface; Data collection and retrieval; Database Management Systems; Importance of databases and database management systems.	6
5.	Unit 5 Sequence based and Structure based analysis: Sequence alignment and assembly; Profile comparison of sequences; Similarity search and conserved domains; Identification of intrinsic features of the sequence and its variations, Identification of molecular structure; Structure induced functional analysis; Exploring genetic diversity.	6
6.	Unit 6 Development of a Predicted Tool: Features of predicte tools and why need them; Data utility; Statistical algorithms; Machine learning techniques; Types of predicte tools.	6
Total		34

11. Suggested Books:

S. No.	Name of Authors /Books / Publishers, Year of Publication/Reprint
1	Shui Qing Ye 2015: Big Data Analysis for Bioinformatics and Biomedical Discoveries by Chapman and Hall/CRC , 2015
2	Eija Korpelainen, Jarno Tuimala, Panu Somervuo, Mikael Huss, Garry Wong 2014: RNA-seq Data Analysis: A Practical Approach by Chapman & Hall/CRC Mathematical and Computational Biology , 2014
3	Robert Gentleman: 2008 R Programming for Bioinformatics by Chapman and Hall/ CRC , 2008
4	Bentley DR, Balasubramanian S, Swerdlow HP, et al. Accurate whole human genome sequencing using reversible terminator chemistry. Nature. 2008; 456:53-59, 2008

1. Subject Code: **BT-409** Course Title: **Concepts in Neurobiology**
2. Contact Hours : L: 3 T: 1 P: 0
3. Examination Duration (Hrs.) : Theory 3 Practical 0
4. Relative Weightage : CWS 25 PRS - MTE 25 ETE 50 PRE -
5. Credits : 4
6. Semester : VII
7. Subject Area : DEC
8. Pre-requisite : Nil
9. Objective : To impart understanding of neuroscience

10. Details of Course:

S. No.	Contents	Contact Hours
1.	Introduction to neuroscience Introduction to Nervous system-Neurons and glia-Membrane potential - Action potential -Development of nervous system-Neurogenesis	7
2.	Neurochemicals and sensory nervous system Divisions of the nervous system—Central and peripheral nervous systems-Neurotransmitters-Amino acids-Neuropeptides—Sensation and perception-Vision-Hearing and equilibrium-Taste and Smell-Body senses	6
3.	Neural control of movement, memory, and learning Movement—Anatomy and physiology of the neuromuscular junction—Nervous system control of movement—Basal Ganglia—Cerebellum—Motor neurons— Spinal reflexes-Learning and Memory	7
4.	Neuroendocrine-immune network and homeostasis Emotions and reward systems—Neuroanatomy of emotions—Reward mechanisms—Neuroendocrine and Immune network—Hypothalamus and endocrine system	8
5.	Neurodegenerative diseases Sleep and wakefulness—Arousal and wakefulness—Types and stages of sleep-sleep and memory—Diseases of injuries of the nervous system—Neuromuscular disorders-Basal ganglia disorders—Spinal cord injury—Traumatic brain injury—Stroke—Dementia	8
6.	New approaches in neurosciences	6
Total		42

11.Suggested books:

S. No.	Name of Authors /Books / Publishers, Year of Publication/Reprint
1.	Handbook of Neurology Minoru Oishi, v
2.	Eric R. Kandel, James H. Schwartz, Thomas M. Jessell, "Principles of Neural Science," McGraw-Hill, 5th Edition,2012
3.	Robert Ader, "Psychoneuroimmunology," Academic Press; 4th edition,2006

4.	Memory Mechanisms in Health and Disease Mechanistic Basis of Memory Karl Peter Giese,2012
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1. Subject Code: **BT 411** Course Title: **Industrial Biotechnology**
2. Contact Hours : L: 3 T:1 P:0
3. Examination Duration (Hrs.) : Theory 3 Practical 0
4. Relative Weightage : CWS 25 PRS - MTE 25 ETE 50 PRE -
5. Credits : 4
6. Semester : VII
7. Subject Area : DEC
8. Pre-requisite : Nil
9. Objective : The objective is to develop biotechnology approaches with the exploitation of enzymes, microorganisms, and plants that will yield 'green' industrial processes that are cost effective and sustainable.

10. Details of Course:

S. No.	Contents	Contact Hours
1.	Introduction to industrial bioprocess: Fermentation, Basic concepts of Upstream and Downstream processes	9
2.	Production of primary metabolites: Organic acids, Amino acids and alcohols.	8
3.	Production of secondary metabolites: Antibiotics, Vitamins and Steroids	8
4.	Production of enzymes and other bioproducts: Production of Industrial Enzymes, Biopesticides, Biofertilizers, Biopreservatives, Biopolymers Biodiesel. Cheese, Beer, SCP & Mushroom culture, Bioremediation.	9

5.	Production of modern biotechnology products: Production of recombinant proteins, vaccines.	8
Total		42

11.Suggested Books:

S. No.	Name of Authors /Books / Publishers, Year of Publication/Reprint
1.	Satyanarayana, U. "Biotechnology" Books & Allied (P) Ltd., 2005
2.	Balasubramanian, D. etal., "Concepts in Biotechnology" Universities Press Pvt. Ltd., 2004
3.	Ratledge, Colin and Bjorn Kristiansen "Basic Biotechnology" 2 nd Edition Cambridge University Press., 2001
4.	Dubey, R.C. "A Textbook of Biotechnology" S.Chand & Co. Ltd., 2006
5.	Kumar, H.D. "A Textbook on Biotechnology" 2 nd Edition. Affiliated East West Press Pvt. Ltd., 1998

1. Subject Code: **BT413** Course Title: **Nanobiotechnology**
2. Contact Hours : L: 3 T: 1 P: 0
3. Examination Duration (Hrs.) : Theory 3 Practical 0
4. Relative Weightage : CWS 25 PRS - MTE 25 ETE 50 PRE - CWS
5. Credits : 4
6. Semester : VII
7. Subject Area : DEC
8. Pre-requisite : Nil
9. Objective : The objective of this course is to impart interdisciplinary education in nanoscience and nanobiotechnology. The aim of this advanced course is to provide understanding for various nanobiotechnological applications

10. Details of Course:

S. No.	Contents	Contact Hours
1	Introduction: Introduction to nanotechnology and overview of nanoscale materials, effect of length scale on properties, introduction to bionanotechnology, challenges and opportunities associated with biology on the nanoscale, biological and medical applications of bionanomaterials.	8
2	Nanomaterials: Introduction to nanomaterials, General surface and colloid chemistry; Characteristics of nanoparticles, Unique functional properties of natural and synthetic biomolecular-sized (nanometer-scale) constructs such as quantum dots, carbon nanotubes, nanostructured surfaces, liposomes, artificial membranes, and molecular machines for biotechnology and medicine, Environmental behavior of nanoparticles, biological activity of nanomaterials.	8
3	Biosensors: Introduction to biosensors, the biological component, the sensor surface, Immobilization of the sensor molecule, Applications of molecular recognition elements in nanosensing of different analytes, Application of various transducing elements as part of nanobiosensors	9
4	Biophotonics and Bioimaging: Overview of imaging biological systems, from the cellular level through to whole-body medical imaging, Fluorescence spectroscopy. Miniaturized devices in nanobiotechnology - types and applications, MEMS, Lab on a chip concept	9
5	Nanotoxicology: Principles of toxicology; toxicology models, experimental toxicology studies; activation and detoxification mechanisms. Applications, Risks and Precautions: In vivo diagnosis, in vitro diagnosis, therapy, cosmetics; Environmental and Risk Prevention; Risks and Ethical considerations.	8
Total		42

11. Suggested Books:

S. No.	Name of Authors /Books / Publishers, Year of Publication/Reprint
1	Nanobiotechnology: Concepts, Applications and Perspectives, Christof M.Niemeyer (Editor), Chad A. Mirkin (Editor), Wiley VCH., 2004

2	Nanobiotechnology - II more concepts and applications, Chad A Mirkin and Christof M. Niemeyer (Eds), Wiley VCH., 2007
3	Nanotechnology in Biology and Medicine: Methods, Devices, and Applications., 2006
4	D.S. Goodsell, Bionanotechnology: Lessons from Nature, Wiley Press, 2004
5	G. Ozin, A. Arsenault, Nanochemistry. A Chemical Approach to Nanomaterials, RSC, London, 2005

1. Subject Code: **BT-415** Course Title: **Medical Physics**
2. Contact Hours : L: 3 T: 1 P: 0
3. Examination Duration (Hrs.) : Theory 3 Practical 0
4. Relative Weightage : CWS 25 PRS - MTE 25 ETE 50 PRE -
5. Credits : 4
6. Semester : VII
7. Subject Area : DEC
8. Pre-requisite : Nil
9. Objective : To impart knowledge on application of physics is in explaining various physiological phenomena and its significance in biological systems. Also, this course imparts detailed aspects of biochemistry and its applications.

10. Details of Course:

S. No	Content	Contact hours
1	Functions of various cellular constituents: Action potential and its measurements – Hodgkin–Huxley model, Functioning of skeletal muscles, Blood and lymph circulation,	6

2	Physics of the Lungs and Breathing: The airways- Blood and Lung interaction, Measurement of Lung Volumes, Pressure, Physics of the Alveoli, Breathing mechanism, Airway resistance	8
3	Physics of the Cardiovascular system and Cardiovascular instrumentation: Major Components of the Cardiovascular System, Oxygen and Carbon di-oxide exchange in the Capillary System, Bernoulli's Principle applied to Cardiovascular system, Laminar and Turbulent Blood Flow	8
4	Bio – Chemistry (I): Bio molecules – Carbohydrate - Structure and properties of mono, di oligo and polysaccharides, Classification of lipids - physical and chemical properties of fats and oils, phospholipids, fatty acids, prostaglandin	10
5	Bio – Chemistry (II): Structure and properties of amino acids, proteins, nucleic acids, vitamins and minerals	10
Total		42

11.Suggested Books:

S.No	Name of Author /book/publisher, Year of publication/Reprint
1	Voet D. and Voet G., "Biochemistry", Third Edn. John Wiley and Sons, 2001
2	Medical Physics by J.R.Cameron and J.G.Skofronide (). , 1978
3	Lehninger Principles of Biochemistry by David . L. Nelson, Micheal . M. Cox, Fourth Edition, Macmillan Worth publishers, 2006

1. Subject Code: **BT-417** Course Title: **Plant Bioinformatics**
2. Contact Hours : L: 3 T: 1 P: 0
3. Examination Duration (Hrs.) : Theory 3 Practical 0
4. Relative Weightage : CWS 25 PRS - MTE 25 ETE 50 PRE -
5. Credits : 4
6. Semester : VII
7. Subject Area : DEC

8. Pre-requisite : Nil
9. Objective : Plant Bioinformatics studies pave the way to understand plant evolution, and use this knowledge to improve crops. Plant Bioinformatics carries benefits for plant researchers. It can aid in plant breeding and genetic engineering, and allow plant scientists to produce better crops for the future.

10. Details of Course:

S.No	Content	Contact Hours
1	Introduction to Plant Bioinformatics: Importance of plant bioinformatics, biological databases , Protein and Gene Information Resources – PIR, SWISSPROT, PDB, genebank.	8
2	Plant specific Genomic Data and Resources: HarvEST, TARI Database, Legume Resources, GrainGenes, Maize GDB, Gramene	8
3	Phylogenetic data and phylogenies Software used to discover phylogenies, use and status of specimen data, species distribution, Current priorities in biodiversity informatics, challenges and future prospect	9
4	KEGG Bioinformatic Resource for Plant Genomic Research: KEGG tools and Resources, Germplasm Data Management Arlet Portugal, Ranjan Balachand	9
5	Gene Structure Annotation at Plant GDB: PlantGDB Resources, Gene Ontology Annotation, Manual Annotations, Computational Annotation Methods	8
Total		42

11.Suggested Books:

S.No	Name of Author /book/publisher, Year of publication/Reprint
1	Plant Genomics: Methods and Protocols, Daryl J. Somers, Peter Langridge and J. Perry Gustafson, Humana Press, 2009.

2	Plant Genomics and Proteomics, CHRISTOPHER A. CULLIS, John Wiley & Sons, Inc. 2004
3	Plant Bioinformatics: Methods and Protocols, David Edwards, Humana Press, 2007.

1. Subject Code: **BT-419** Course Title: **Cancer Biology**
2. Contact Hours : L: 3 T: 1 P: 0
3. Examination Duration (Hrs.) : Theory 3 Practical 0
4. Relative Weightage : CWS 25 PRS - MTE 25 ETE 50 PRE -
5. Credits : 4
6. Semester : VII
7. Subject Area : DEC
8. Pre-requisite : Nil
9. Objective : To give an understanding of the principles of cancer biology by studying the molecular and cellular basis of cancer
10. Details of Course:

S.No	Content	Contact hours
1	Introduction to cancer: Nature of Cancer, Tumor Viruses, Discovery of oncogenes, Mutagens, Carcinogens, and Mutations.	8
2	Avoiding Genomic Instability: DNA Replication, the Cell Cycle, and Cancer The process of DNA replication , Mechanisms of oncogene activation , Role of growth factors and receptors in carcinogenesis	8
3	p53 & Apoptosis: Master Guardian and Executioner Cell cycle control and the pRb tumor suppressor, Apoptosis and the p53 tumor suppressor	8

4	Cell Immortalization, Tumorigenesis, & Cancer Development Cellular senescence, Telomeres, cellular immortalization, and tumorigenesis, Tumor-promoting stimuli, Cancer stem cells, DNA repair defects and their relationship to cancer.	9
5	Treatments for cancer Traditional chemotherapies, Immunotherapy -targeted therapy, New genomic and proteomic technologies, Applications of new technologies in prevention, assessing risk, diagnostics, and treatment.	9
Total		42

11. Suggested books:

S. No.	Name of Authors /Books / Publishers, Year of Publication/Reprint
1	The Biology of Cancer, Volume 1 Robert A. Weinberg Garland Science,2010
2.	Dunmock N.J And Primrose S.B., "Introduction to Modern Virology", Blackwell, Scientific Publications, Oxford, 1988
3.	"An Introduction Top Cellular And Molecular Biology of Cancer", j Oxford MedicalPublications,1991

- Subject Code: **BT-421** Course Title: **Pharmacogenomics and personalized medicine**
- Contact Hours : L: 3 T:1 P:0
- Examination Duration (Hrs.) : Theory 3 Practical 0
- Relative Weightage : CWS 25 PRS - MTE 25 ETE 50 PRE -
- Credits : 4
- Semester : VII
- Subject Area : DEC
- Pre-requisite : Nil
- Objective : The course incorporates the basics of Pharmacogenomics and its applications in personalized medicine

10. Details of Course:

S. No.	Contents	Contact Hours
1.	Introduction to Pharmacogenomics: The roots of pharmacogenomics, Historical Perspectives and Current Status	7
2.	The Human genome: Computational genome analysis	6
3.	Functional Analysis of Gene Variation & Genotyping Techniques: Aspects influencing method of selection, SNP Genotyping, TaqMan Genotyping.	7
4.	Pharmacogenomics in drug discovery: The need of protein structure information, protein structure and variation in drug targets-the scale of problem, Mutation of drug targets leading to change in the ligand binding pocket.	8
5.	Case Studies	8
Total		42

11. Suggested books:

S. No.	Name of Authors /Books / Publishers, Year of Publication/Reprint
1.	Pharmacogenomics: The Search for the Individualized Therapies”, Licinio, julio and Ma-Li Wong, Wiley-VCH, 2002
2.	Pharmacogenomics: An Approach to New Drugs Development, Chakrabarthy, Chiranjib and Bhattacharyya, Atane, 2004.
3.	Pharmacogenomics: Social, Ethical and Clinical Dimensions, Rothstein, Mark, A.Wiley-Liss, 2003.

1. Subject Code:**BT-423** Course Title: **Technological advancements in Food Technology**
2. Contact Hours : L: 3 T: 1 P:0
3. Examination Duration (Hrs.) : Theory 3 Practical 0
4. Relative Weightage : CWS 25 PRS - MTE 25 ETE 50 PRE -

5. Credits : 4
6. Semester : VII
7. Subject Area : DEC
8. Pre-requisite : Nil
9. Objective : Introduction to Biotechnology integrates the fundamental concepts of life and physical sciences together with the basic laboratory skills necessary in the biological sciences. It provides foundational concepts in a broad spectrum of disciplines such as biochemistry, genetic engineering, biophysics, microbiology, molecular and cell biology.

10. Details of Course:

S. No.	Contents	Contact Hours
1.	Material science and food technology -Properties of Crystals and Solids : Classification of Engineering materials –Crystal geometry– Structure determination by X-ray Diffraction- Crystalline and Non-crystalline states – Inorganic solids – Metals and Alloys - Imperfection in Crystals and Phase diagram – Iron-Iron carbide systems and applications – Fick’s second law of diffusion and its importance in alloy manufacture – Phase transformations and its applications – Manufacture and properties of different types of steel – Basics of SS Fabrication – Deformations – Creep, Fatigue, and Fracture – Oxidation and Corrosion and methods of protection	3
2.	Agitation and mixing agitated vessels, mixing and blending of miscible liquids, mixing index and effectiveness of mixing. Types of evaporators, single and multiple effect evaporators. Evaporator capacity, multiple effect evaporator – methods of feeding. Moisture and its measurements. Drying rate – Mechanical Drying. Types fixed – and Fluidized Bed. Filtration – types of filtration, constant pressure filtration and constant volume filtration and filtration aids. Principles of comminution. Energy and power requirements. Size reduction equipments.	3

3.	Chromatography principles. High performance liquid chromatography, Gas chromatograph - column efficiency, types of detectors – FID, TCD, ECD, MSD. FTIR Spectroscopy. Atomic Absorption Spectroscopy and Atomic Emission Spectrometry (AES). ICP – Mass spectrometry - Atomic Fluorescence Spectrometry (AFS). The NMR Phenomenon – Types of information provided by NMR spectra – Instrumental and Experimental Considerations – Solid state NMR – application of NMR to Food analysis. Application of GC/MS, LC/MS / FAB/MS / MS/MS and linked scan techniques for food analyze.	3
4.	Technology of Rice, Pulse milling and Wheat milling-Oil extraction-Methods of manufacture of bread-Fruits and vegetable processing - Preservation treatments-Basics of Canning, Minimal processing and Hurdle technology. Processing of fruit juices. Dairy processing-manufacture of milk and milk products - Meat, poultry and fish processing and their products- Processing of Plantation products -Processing of Tea, Coffee and Cocoa and chocolate Processing of spices-. Pepper, cardamom, ginger, vanilla and turmeric.	3
5.	Introduction to Food packaging, Effect of environmental factors in packaging, testing of packaging materials, Shelf Life Estimation, Vacuum Packaging, Manufacturing of Metal cans, glass containers, plastic containers and pouches, paper and paperboard. Properties of plastics, .Filling and sealing of Flexible plastic containers, Form fill Seal equipment: Printing on packages, Bar codes, Nutrition labeling and legislative requirements Extrusion – Retort pouch packaging, Active packaging, Moisture control, CO2 and Oxygen scavenging, Modified atmosphere packaging – principles, applications	3
6.	Structure, organization and practical operation of international intergovernmental food regulation bodies such as World Trade order - Codex Alimentarius -World Health Organization. Regulatory affairs - International Food Regulatory Affairs - Risk Analysis- Food and Health-Farm to Fork Regulation of the Food Chain- Regulating authority for food safety in India and its role - Food labelling –Standards at the world level for processed food, irradiated foods, genetically modified foods – EU & US approach to nutritional labelling and Health claims. General concepts of HACCP and ISO 22000. Safety aspects of drinking water and Indian regulations for bottled water.	3
Total		18

11. Suggested Books:

S. No.	Name of Authors /Books / Publishers, Year of Publication/Reprint
1.	Rajput R.K., Fundamentals of Materials Science, S.K. Kataria and Sons, Mittemeijer, Eric J., Fundamentals of Materials Science, 2011. Springer Publications, 2011.
2.	Singh and Heldman, "Introduction to Food Engineering" Academic Press, ISBN 9780123985309, 2013
3.	Coles, R., Dowell, D.M., Kirwan, J. "Food Packaging Technology", Wiley-Blackwell Publishing Ltd, ISBN-9781405147712, 2009.
4.	The History and Future of the World Trade Organization, WTO Publications, Craig Van Grastek, 2., ISBN-132013: 978-9287038715
5.	Guide to the Food Safety and Standards Act. Tax-mann allied Services Pvt. Ltd., ISBN – 10-8174968288 2006

1. Subject Code: **BT-425** Course Title: **Biomaterials**
2. Contact Hours : L: 3 T: 1 P: 0
3. Examination Duration (Hrs.) : Theory 3 Practical 0
4. Relative Weightage : CWS 25 PRS - MTE 25 ETE 50 PRE - CWS
5. Credits : 4
6. Semester : VII
7. Subject Area : DEC
8. Pre-requisite : Nil
9. Objective : To study the structure and characteristics of different types of biomaterials of natural and synthetic origin. This course will give an idea on the effective uses of these materials in medical science.

10. Details of Course:

S.No	Content	Contact hours
1	Introduction: Definition, requirements of biomaterials, Comparison of properties of some common biomaterials, effects of physiological fluid, biological responses, physical and surface properties.	10
2	Metallic implant materials: Stainless steel- Co-based alloys- Ti and Ti-based alloys, corrosion behaviour, Hard tissue and soft tissue replacement implant.	8
3	Ceramic and composite implant materials: Types of bioceramics, Importance of wear resistance, Composite implant materials- Mechanics of improvement of properties by incorporating different elements.	6
4	Polymeric implant materials: Classification, Viscoelastic behaviour, Biodegradable polymers for medical purposes, Synthetic polymeric membranes and their biological applications.	8
5	Testing of Biomaterials: Biocompatibility, blood compatibility Toxicity tests, <i>In-vitro</i> and <i>In-vivo</i> testing.	10
Total		42

11. Suggested Books:

S. No	Name of Author /book/publisher, Year of publication/Reprint
1	S. V. Bhat. Biomaterials, Springer., 2002
2	J.B. Parkand, JD Boonzino. Biomaterials: Principles and Application, CRC Press, 2002
3	J. Black. Biological Performance of materials, Taylor & Francis, 2006
4	J. B. Parkand, R. S. Lakes. An Introduction to Biomaterials, Springer, 2007
5	B. D. Ratner, F. J. Schoen, A. S. Hoffman, J. E. Lemons. Biomaterials Science: An introduction to Materials in medicine, Academic Press, 2004

1. Subject Code:**BT- 427** Course Title: **Pharmaceutical Sciences**

2. Contact Hours : L: 3 T: 1 P: 0

3. Examination Duration (Hrs.) : Theory 3 Practical 0
4. Relative Weightage : CWS 25 PRS - MTE 25 ETE 50 PRE -
5. Credits : 4
6. Semester : VII
7. Subject Area : DEC
8. Pre-requisite : Nil
9. Objective : Introduction to Biotechnology integrates the fundamental concepts of life and physical sciences together with the basic laboratory skills necessary in the biological sciences. It provides foundational concepts in a broad spectrum of disciplines such as biochemistry, genetic engineering, biophysics, microbiology, molecular and cell biology.

10. Details of Course :

S. No.	Contents	Contact Hours
1.	Introduction to and History of Pharmaceutical Chemistry: Classification and nomenclature of organic pharmaceutical compounds; Hyperconjugation, steric effects inductive effect and mesomeric effect.	8
2.	Physicochemical Properties in Relation to Biological Action: Effects of route of administration, Drug-receptor interactions, Steric features of drugs, The drug receptor, Structure-Activity Relationships	8
3.	Drug Metabolism: Oxidative Reductive, Hydrolytic, Conjugative	9
4.	Drug Toxicity, Tolerance, Dependence, Addiction: adverse drug reactions; Drug overdose; Drug-induced liver injury, Drug-drug interactions, Drug-disease interactions, Drug-food interactions; Intolerance to multiple drugs; Physical dependence, Psychological dependence, Cross dependence; Drug receptors; Learning, conditioning, and relapse.	9

5.	Survey of Various Drug Classes: Anesthetics (general, local), Analgesics, Neurotransmitters (adrenergic, cholinergic effects; psychopharmacology), CNS depressants (sedative/hypnotic, major/minor tranquilizers), CNS stimulants, Antibiotics (especially b-lactam), Steroids. Natural Products as Medicinal Compounds	8
Total		42

11. Suggested Books

S. No.	Name of Authors /Books / Publishers, Year of Publication/Reprint
1.	Medicinal Chemistry: An introduction by G. Thomas. Publisher: John Wiley and Sons Medicinal Chemistry: The Role of Organic Chemistry in Drug ,2000
2.	Research by C. R. Ganellin and S. M. Roberts. Publisher: Academic Press ,1993
3.	Ansel's Pharmaceutical Dosage Forms and Drug Delivery Systems by H.C. Ansel, L. V Allien, N.G. Popovich. Publisher: Lippincott Williams and Wilkins Publishers.,1999
4	Review of Organic Functional Groups: Introduction to Medicinal Organic Chemistry by TL. Lemke. Publisher: Lippincott Williams & Wilkins, 4 th edition ,2003

1. Subject Code: **BT-406** Course Title: **Agriculture Microbiology**
2. Contact Hours : L: 3 T: 1 P: 0
3. Examination Duration (Hrs.) : Theory 3 Practical 0
4. Relative Weightage : CWS 25 PRS - MTE 25 ETE 50 PRE -
5. Credits : 4
6. Semester : VIII
7. Subject Area : DEC
8. Pre-requisite : Nil
9. Objective : Introduction to Biotechnology integrates the fundamental concepts of life and physical sciences together with the basic laboratory skills necessary in the biological

sciences. It provides foundational concepts in a broad spectrum of disciplines such as biochemistry, genetic engineering, biophysics, microbiology, molecular and cell biology.

10. Details of Course:

S. No.	Contents	Contact Hours
1.	Introduction History of Microbiology: Spontaneous generation theory, Role of microbes in fermentation, Germ theory of disease, Plant Protection against infections	7
2.	Metabolism Metabolism in bacteria: ATP generation, chemoautotrophy, photo autotrophy, respiration, fermentation. Bacteriophages: structure and properties of Bacterial viruses—Lytic and Lysogenic cycles: viroids, prions.	6
3.	Microbial diversity Microbial groups in soil, microbial transformations of carbon, nitrogen, phosphorus and sulphur, Biological nitrogen fixation. Microflora of Rhizosphere and Phyllosphere microflora, microbes in composting.	7
4.	Food microbiology , Microbiology of food microbial spoilage and principles of food preservation.	8
5.	Microrganisms in agriculture Beneficial microorganisms in Agriculture: Biofertilizer (Bacterial Cyanobacterial and Fungal), microbial insecticides, Microbial agents for control of Plant diseases, Biodegradation, Biogas production, Biodegradable plastics.	8
6.	Plant– Microbe interactions Plant– Microbe interactions, calcium, nitric oxide and salicylic acid in plant development. Molecular strategies for imparting tolerance against biotic and abiotic stress.	6
Total		42

11. Suggested books:

S. No.	Name of Authors /Books / Publishers, Year of Publication/Reprint
1.	Agricultural Microbiology.. G. Rangaswani and D.J. Bagyraj. Prentice Hall of India.,New Delhi,1998
2.	Pelczar MJ Jr., Chan ECS and Kreig NR. Microbiology, 5thEdition, Tata McGraw Hill, 1993
3.	Maloy SR, Cronan JE Jr., and Freifelder D, Microbial Genetics, Jones Bartlett Publishers, Sudbury, Massachusetts, 2006
4.	Crueger and A Crueger, (English Ed., TDW Brock); Biotechnology: A textbook of Industrial Microbiology, Sinaeur Associates, 1990

1. Subject Code **BT-408** Course Title: **Bioethics and Intellectual Property Rights**
2. Contact Hours : L: 3 T: 1 P: 0
3. Examination Duration (Hrs.) : Theory 3 Practical 0
4. Relative Weightage : CWS 25 PRS - MTE 25 ETE 50 PRE -
5. Credits : 4
6. Semester : VIII
7. Subject Area : DEC
8. Pre-requisite : Nil
9. Objective : To discuss about various aspects of biosafety regulations, IPR and bioethic concerns arising from the commercialization of biotech products.

11. Details of Course:

S.No	Content	Contact hours
1	General Overview of Intellectual Property Rights: History and evolution of IPR like patent, design and copyright, WIPO, WTO, Trade related Intellectual Property Right International background of intellectual property	9
2	Patents: Requirement of patentable novelty, inventive step, prior art Classifying products as patentable and non-patentable Procedure for applying for patent Patent Infringement and related case studies Biological Patentability	8
3	Biosafety and risk assessment issues; Regulatory framework; National biosafety policies and law, The Cartagena protocol on biosafety, WTO and other international agreements related to biosafety, Cross border movement of germplasm; Risk management issues - containment.	9
4	IPR and Biotechnology: Biopiracy and Bioprospecting Farmers Rights and Plant breeders rights Biodiversity, Ecological aspects of GMOs and impact on biodiversity; Monitoring strategies and methods for detecting transgenics; Radiation safety and non-radio isotopic procedure; Benefits of transgenics to human health, society and the environment.	8
5	Bioethics: Bioethical issues related to Healthcare & medicine Food & agriculture Genetic engineering The Human Genome Project and Genetic Testing, Environmental problems	8
Total		42

11. Suggested Books:

S.No	Name of Author /book/publisher, Year of publication/Reprint
1	1. WTO-Trade-related Aspects of Intellectual Property Rights Edited by P.T. Stoll, J. Busche, K. Arend (2009).
2	2. Intellectual Property Rights in Agricultural Biotechnology by F.H. Erbisch and K.M. Maredia (2000).

1. Subject Code:**BT-410** Course Title: **System Biology**

2. Contact Hours : L: 3 T: 1 P: 0

3. Examination Duration (Hrs.) : Theory 3 Practical 0
4. Relative Weightage : CWS 25 PRS - MTE 25 ETE 50 PRE -
5. Credits : 4
6. Semester : VIII
7. Subject Area : DEC
8. Pre-requisite : Nil
9. Objective : To introduce the concept of systems biology an application in biomedicine

10. Details of Course:

S. No.	Contents	Contact Hours
1.	Introduction to Systems Biology Flux Balance Analysis, Metabolic Control Analysis, Metabolic Network Reconstruction, Network structure analysis, Visual Representations and Notations for Systems Biology,	8
2.	Experimental Methods in Systems Biology ,Scope and Overview, Biological Model Systems, Experimental Perturbations, Measuring Nucleic Acids and Proteins, Deep mRNA Sequencing, Mass Spectrometry-Based Proteomics, Flow and Mass Cytometry for Single Cell Protein Levels and Cell Fate	10
3.	Network Analysis in Systems Biology Introduction to Complex Systems, Topological and Network Evolution Models, Types of Biological Networks, Data Processing and Identifying Differentially Expressed Genes, Gene Set Enrichment and Network Analyses, Deep Sequencing Data Processing and Analysis, Principal Component Analysis, Self-Organizing Maps, Network-Based Clustering and Hierarchical Clustering, Resources for Data Integration	8
4.	Dynamical Modeling Methods for Systems Biology Introduction Computing with MATLAB, Introduction to Dynamical Systems, Bistability in Biochemical Signaling Models, Computational Modeling of the Cell Cycle	8

5.	Integrated Analysis in Systems Biology Experimental design, Issues of Reproducibility, Kinetic Modelling Approach for Drug Development	8
Total		42

11. Suggestedbooks:

S. No.	Name of Authors /Books / Publishers, Year of Pu blication/Reprint
1.	Fundamentals of Systems Biology: From Synthetic Circuits to Whole-cell Models Paperback – Import, 16 Feb by Markus W. Covert (Author), CRC Press,2015
2.	An Introduction to Systems Biology: Design Principles of Biological Circuits (Chapman & Hall/CRC Mathematical and Computational Biology), 7 Jul by Uri Alon,2006
3.	Systems Biology 1st Edition, June, Wiley-Blackwell by Edda Klipp, Wolfram Liebermeister, Christoph Wierling, Axel Kowald, Hans Lehrach, Ralf Herwig,2009
4.	Stochastic Modeling for Systems Biology, Chapman & Hall/CRC, by Wilkinson, D. J.,2006
5.	Handbook of Systems Biology, Concepts and Insights 1st Edition , Academic Press, 20 Nov by Walhout & Vidal & Dekker,2012
6.	Handbook of Systems Biology, Elsevier Inc, by Walhout, Marian,2012

1. Subject Code: **BT-412** Course Title: **Advance Bioanalytical Techniques**
2. Contact Hours : L: 3 T: 1 P:0
3. Examination Duration (Hrs.) : Theory 3 Practical 0
4. Relative Weightage : CWS 25 PRS - MTE 25 ETE 50 PRE -
5. Credits : 4
6. Semester : VIII
7. Subject Area : DEC
8. Pre-requisite : Nil

9. Objective : Providing insight into the development of advance bioanalytical techniques. Introducing students to select specific methods of bioanalytical techniques and to apply those in solving complex analytical problems in biotechnological research.

10. Details of Course:

S. No.	Contents	Contact Hours
1.	<p>Advanced Imaging Techniques In Microscopy Live cell imaging, Confocal microscopy and fluorescence microscopy - High content/throughput screening - Basics of SEM and TEM & Specimen preparations. Advanced EM techniques: Electron tomography and Serial block face imaging using SEM – CryoEM - Methods to study interactions: FRET, FCCS and BiFC - Atomic Force Microscopy - Dynamics methods: photobleaching and activation – STED - Structured Illumination Microscopy - Multiphoton microscopy and In vivo imaging.</p>	7
2.	<p>Spectroscopic techniques: UV – Visible Spectroscopy: Introduction; Electromagnetic Radiation and Spectrum; Interaction of Radiation with Matter; Lambert Law; Beer Law; Bear –Lambert Law; Absorption Instruments; Radiation Sources; Materials of Optical Components. Infrared Spectroscopy: Introduction; Near – Middle – Far IR range of Spectrum; Basic Components of IR Spectrophotometers: Optical Null and Ratio Recording Type Spectrophotometers; NMR: Theory and Principle of NMR - Multi nuclear NMR- Analysis of spectra and Interpretations. Mass Spectrometer: Principles of modern ionization methods and mass analyzers (TOF and FT-ICR), hybrid/tandem mass methods (MS-MS) and applications of MS in the analysis of drugs and macromolecules</p>	6
3.	<p>X Ray Spectrometers: Introduction, X-ray Spectrum, Block diagram of X-ray Spectroscopy Instrument, X-ray Generating Equipment, Collimators, Monochromators. Detectors: Photographic Emulsion, Ionization Chamber, 6The Geiger Muller Counter, Proportional Counter, Scintillation Counter. X-ray Diffrcatometer, X-ray Absorption Meter. X-ray Fluorescence Spectrometry Ion Detectors: Faraday Cup, Electron Multiplier, Micro Channel Plate.</p>	7

4.	Hybrid Techniques: Gas chromatography with mass spectrometric detection (GC-MS), liquid chromatography with mass spectrometric detection (LC-MS), inductively coupled plasma with mass spectrometric detection (ICP-MS). Analysis of data: HPLC chromatograms.	6
5.	Immunochemical methods: Immunoassay, Immunodiffusion, Rocket Immuno-electrophoresis. High-Throughput Next generation sequencing (HT-NGS) platforms.	8
6.	Flow Cytometer: Introduction to flow cytometry- Fluorochromes and fluorescence - Readings on flow cytometry data analysis. Isoelectric focusing and 2-Dimensional polyacrylamide gel electrophoresis and their uses.	8
Total		42

11.Suggested Books:

S. No.	Name of Authors /Books / Publishers, Year of Publication/Reprint
1.	Robert D. Braun, 'Introduction to Instrumental Analysis', McGraw Hill, Singapore, 1987
2.	G.W.Ewing, 'Instrumental Methods of Analysis', McGraw Hill, 1992
3.	Skoog, D.A., Crouch, S.R., and Holler, F.J. "Principles of Instrumental Analysis", 6th edition, Brooks/Cole, USA., 2006
4.	Keith Wilson and John Walker, "Principles and Techniques of Practical Biochemistry", 5th Edition, Cambridge University Press, 2000
5.	Freifelder D., Physical Biochemistry, "Application to Biochemistry and Molecular Biology", 2nd Edition, W.H. Freeman & Company, San Fransisco., 1982

1. Subject Code: **BT-414** Course Title: **Clinical Biotechnology**
2. Contact Hours : L: 3 T: 1 P: 0
3. Examination Duration (Hrs.) : Theory 3 Practical 0
4. Relative Weightage : CWS 25 PRS - MTE 25 ETE 50 PRE -
5. Credits : 4

6. Semester : VIII
7. Subject Area : DEC
8. Pre-requisite : Nil
9. Objective : Basic understanding of clinical biotechnology and diagnostics.

10. Details of Course:

S. No.	Contents	Contact Hours
1.	Basic Principles: Photometry and fluorometry, Water & Mineral Metabolism Distribution of fluids in the body,	7
2.	Liver Functions & their Assessment. Based on Carbohydrate metabolism, Protein metabolism, Lipid metabolism, Measurements of serum enzyme levels, Bile pigment metabolism, Jaundice, its types and their biochemical findings. Renal Function Tests,	6
3.	Immunodiffusion Techniques: Radioimmunoassay & ELISA Principles & Applications.	7
4.	Electrophoresis & PCR- Principle, Types & Applications	8
5.	Cardiac Profile - In brief Hypertension, Angina, Myocardial Infarction, Pattern of Cardiac Enzymes in heart diseases	8
6.	Different methods of Glucose and Cholesterol Estimation Principle advantage and disadvantage of different methods	6
Total		42

11. Suggested books :

S. No.	Name of Authors / Books / Publishers, Year of Publication / Reprint
1	Bailey and Scott's Diagnostic Microbiology, 13 th ed Patricia M. Tille, 2015
2	Clinical Biochemistry 5 th edition, Allan Gaw & Michael J. Murphy & Rajeev Srivastava & Robert A. Cowan & Denis St. J. O'Reilly, 2014

3	Fundamentals of Clinical Trials 4 th edition, Springer Lawrence Friedman, 2010
4	Molecular Biology of the Cell by B. Alberts et al. 6 th ed. Garland Science, 2015
5	Medical Microbiology, 4th edition,v

1. Subject Code:**BT- 416** Course Title: **Plant Metabolic Engineering**
2. Contact Hours : L: 3 T: 1 P: 0
3. Examination Duration (Hrs.) : Theory 3 Practical 0
4. Relative Weightage : CWS 25 PRS - MTE 25 ETE 50 PRE -
5. Credits : 4
6. Semester : VIII
7. Subject Area : DEC
8. Pre-requisite : Nil
9. Objective : Plant metabolic engineering principles
10. Details of Course:

S. No.	Contents	Contact Hours
1.	Carbohydrate metabolism : Classification, Synthesis and degradation of sucrose and starch. Diurnal fluctuations in plants and their regulation. Genetic engineering of sugars.	8
2.	Photosynthesis : Light absorption and energy conservation, pigment systems I and II and their structural organization, electron transport and ATP synthesis. Calvins cycle, Transcription, translation and regulation of plastid genes in chloroplast development. Genetic engineering of photosynthesis.	8
3.	Lipid metabolism : Synthesis and degradation of fats and fatty acids. α - and β -oxidation. Outlines of terpenoid and flavonoid pathways, signal transduction.	9

4.	Concept of secondary metabolites. Historical and current status. Importance of secondary metabolites in medicine and agriculture. Introduction to pathways and their networking. Transfer of entire pathways and completion of partial pathways through genetic engineering.	9
5.	Metabolic engineering: Pathway engineering for new products and new pathways, Redirecting metabolic flow – desensitization of feed back inhibition, elevating rate limiting enzymes.	8
Total		42

11. Suggested books:

S. No.	Name of Authors /Books / Publishers, Year of Publication/Reprint
1.	Lincoln, Tiaz and Eduardo Zeiga Plant Physiology, Paxima Publishing Co.,2003
2.	Buchanan, B.B. Gruinesson, W. and Jones R.S. (2). Biochemistry and Molecular Biology of Plants,2000
3.	Derris D.T., Turpa, D.H. Leferbure, D.D. and Layzell D.B.. Plant Metabolism. ,1987
4.	Lodish, H. Berk A, Zipursty S.C., Matudaira, P. Baltimore, D and Darell J. Molecular Biology, W.H. Freeman and Company.,2000

1. Subject Code: **BT- 418** Course Title: **Crop Protection and Pest Management**
2. Contact Hours : L: 3 T: 1 P: 0
3. Examination Duration (Hrs.) : Theory 3 Practical 0
4. Relative Weightage : CWS 25 PRS - MTE 25 ETE 50 PRE -
5. Credits : 4
6. Semester : VIII
7. Subject Area : DEC
8. Pre-requisite : Nil
9. Objective : To provide a basic knowledge of pest control and yield enhancement.

10. Details of Course:

S. No.	Contents	Contact Hours
1.	Introduction to crop protection: Losses in crops due to pests, Importance of plant diseases, Classification of plant diseases, Causes and symptoms of plant diseases, Disease epidemics, Prevention of epidemics	8
2.	Pathogenecity,: Genetics of pathogenocity, Pathotypes, Mechanism of disease resistance, breeding for disease and insect resistance	8
3.	Genetic engineering and stress resistance Genetic engineering for improvement of disease resistance, Genetic manipulation of Crops for insect resistance, herbicide resistance, abiotic stress resistance	9
4.	Chemical and Biological control- concepts and techniques, Bio-organism for pest Management, Bt based pesticides, Baculovirus pesticides, Mycopesticides, production and formulation technologies	9
5.	Integrated pest management: Principles of integrated Pest Management (IPM), IPM practices for important crops	8
Total		42

11. Suggested Books:

S. No.	Name of Authors /Books / Publishers, Year of Publication/Reprint
1.	Brock T.D. and Modigaa M.T. (Latest edition) Biology of Microorganisms, Prentice Hall, New Jersey Pelczar M.J; Chan E.C.S. and Kreig N.R. 1993.
2.	Microbiology, Tata Mc-Graw HTK Publishing Co., New Delhi. Stainer, R.Y; Ingram J; Wheelis, M.G. and Paintor, P.R. 1986
3.	The Microbial World-Prentice Hall-New Jersey Alexander M. 1985;.
4.	Introduction to soil Microbiology John Wileys & Sons, New York Rangaswamy. G and Bagyaraj, D.I. (1992)
5	Agricultural Microbiology, Asia Publishing House, New York. Subba Rao N.S. 1987 Advance in Agricultural Microbiology, Oxford & IBH.

1. Subject Code **BT-420** Course Title: **Biosensors**
2. Contact Hours : L: 3 T: 1 P: 0
3. Examination Duration (Hrs.) : Theory 3 Practical 0
4. Relative Weightage : CWS 25 PRS - MTE 25 ETE 50 PRE -
5. Credits : 4
6. Semester : VIII
7. Subject Area : DEC
8. Pre-requisite : Nil
9. Objective : This course will present an overview of the fundamental principles, technologies, methods and applications of biosensors. The objective of this course is to link engineering principles to understanding of biosystems in sensors and bioelectronic. Furthermore the application of fundamentals of measurement science to optical, electrochemical, mass and pressure signal transduction

10. Details of Course:

S. No.	Contents	Contact Hours
1.	Introduction: Biosensors: Definition, History, Properties of biosensors, Design features of biosensors, The biological component.	6
2.	Signal Transduction: Amperometric Biosensors, Potentiometric biosensors, Detection of H ⁺ cation, Detection of NH ₄ ⁺ cation, Detection of CN ⁻ anion; Calorimetric biosensors, Optical biosensors, Measuring the change in light reflectance, Measuring luminescence, Piezo-electric biosensors, Immunosensors.	12
3.	Biomedical Sensors: Sensors and transducers: an overview, measurement systems, Classification of biomedical sensors and transducers, Why do we need Biomedical sensors and transducers? Important design considerations and system calibration.	10

4.	Commercial Examples of Biosensors: Biosensors markets: Opportunities and obstacles. Miniaturized devices in nanobiotechnology - types and applications, MEMS, Lab on a chip concept	6
5.	The Future of Biosensors and Transducers: Sensing Layer: The importance of computers in sensor and transducer technology, Recent engineering solutions to health care using biosensors and transducers, Modern health care solutions.	8
Total		42

11.Suggested Books:

S. No.	Name of Authors /Books / Publishers, Year of Publication/Reprint
1	Affinity Biosensors: Techniques and Protocols by K.R. Rogers and A. Mulchandani. Publisher: Humana Press. 1998
2	Biosensors and their Applications by V.C. Yang and T.T. Ngo. Publisher: Springer. 2000
3	Chemical Sensors and Biosensors by B.R. Eggins. Publisher: John Wiley and Sons Inc. 2002
4	Sensors and Sensing in Biology and Engineering by F.G. Barth, et al. Publisher: Springer Verlag. 2003
5	Bioinstrumentation and Biosensors by D.L. Wise. Publisher: Marcel Dekker. 1991
6	Process Biotechnology Fundamentals by S N Mukhopadhyay. Publisher: Viva Books Pvt. Ltd., New Delhi. 2010

1. Subject Code: **BT-422** Course Title: **Green Energy Technology**
2. Contact Hours : L: 3 T: 1 P: 0
3. Examination Duration (Hrs.) : Theory 3 Practical 0
4. Relative Weightage : CWS 25 PRS - MTE 25 ETE 50 PRE -
5. Credits : 4
6. Semester : VIII

7. Subject Area : DEC
8. Pre-requisite : Nil
9. Objective : This paper exposes students to the renewable resources of energies and energy conversion processes. It teaches the uses of clean energy technologies and their importance in sustainable development

10. Details of Course:

S. No.	Contents	Contact Hours
1.	Energy Sources, Green Energy and Sustainable Development: Introduction to nexus between Energy, Environment and Sustainable Development; Classification of energy sources; Review of conventional energy resources; Fossil fuel reserves; Renewable resources; Global environment concerns: Global warming, Ozone layer depletion, Greenhouse gas emissions; Clean/green energy technologies; International agreements/conventions on energy and sustainability	8
2.	Solar Energy Utilization: Solar radiation: measurements and prediction; Earth and Sun relation; Solar thermal collectors; Thermal storage; Conversion of heat energy in to mechanical energy; Solar thermal power generation systems; Solar Photovoltaic; Types of solar cells; Solar photocatalysis; Solar energy based industrial processes and systems; Greenhouse technology	8
3.	Biomass Energy Utilization, Bioenergy and Biomethanation: Biomass generation and utilization; Properties of biomass; Agriculture crop and forestry residues used as fuels; Techniques for biomass assessment; Bio-based chemicals and materials; Biomass energy conversion processes; Biochemistry and process parameters of biomethanation; Importance of biogas technology; Biogas digester types; Aerobic and anaerobic bioconversion processes; Applications of biogas	8

4.	Wind, Ocean, Geothermal & Waste to Energy Conversion: Wind energy potential measurements; Principles of wind energy conversion Wind energy conversion systems; Wind electric generator; Ocean energy resources; Principle of ocean thermal energy conversion systems; Ocean thermal power plants; Principles of ocean wave energy and tidal energy conversion; Types of geothermal energy deposits; Geothermal power plants; Introduction to waste and waste processing; Types and composition of various types of wastes; Waste to energy conversion processes	8
5.	Green Management: Introduction to green chemistry, green nanotechnology	10
Total		42

11. Suggested Books:

S. No.	Name of Authors / Books / Publishers, Year of Publication / Reprint
1.	Renewable Resources and Renewable Energy- A Global Challenge by M. Graziani and P. Fornasiero. 2 nd Ed. CRC-Taylor and Francis, 2011
2.	Fundamentals of Renewable Energy Processes by Aldo da Rosa, Academic Press, 2012
3.	Municipal Solid Waste to Energy Conversion Processes: Economic, technical and Renewable Comparisons by Gary C. Young. John Wiley & Sons, 2010
4.	Biogas from waste and renewable resources by Dieter D. and Angelika S. Wiley-VCH Publication, 2010
5.	Energy and the Environment by Ristinen, Robert A. Kraushaar, Jack J. A Kraushaar, Jack P. Ristinen, Robert A., 2nd Ed. John Wiley, 2009
6.	Solar Photovoltaics: Fundamental Applications and Technologies by C. S. Solanki. Prentice Hall of India, 2009
7.	Solar Cell Device Physics by Stephen Fonash. Academic Press 2010
8.	Solar Energy Handbook, J F Kreider and Frank Kreith, McGraw Hill

1. Subject Code: **BT-424** Course Title: **Nutraceuticals**
2. Contact Hours : L: 3 T: 1 P: 0
3. Examination Duration (Hrs.) : Theory 3 Practical 0
4. Relative Weightage : CWS 25 PRS - MTE 25 ETE 50 PRE -
5. Credits : 4
6. Semester : VIII
7. Subject Area : DEC
8. Pre-requisite : Nil
9. Objective : This course will describe biochemistry, health benefits, development and regulation of nutraceuticals
10. Details of Course:

S. No.	Contents	Contact Hours
1.	Introduction: Definitions; Synonymous terms; Basis of claims for a compound as a nutraceutical; Properties, structure and functions of various nutraceuticals; Classification of nutraceuticals; Nutraceuticals of plant and animal origin; Microbial and algal nutraceuticals; Non-nutrient effects of specific nutrients; Antinutritional factors present in foods; Regulatory issues for nutraceuticals including CODEX	8
2.	Nutraceuticals and Disease Management: Concept of angiogenesis; Nutraceuticals for cardiovascular diseases, cancer, diabetes, cholesterol management, obesity, joint pain, immune enhancement, age-related macular degeneration	8
3.	Nutraceutical Development: Manufacturing of nutraceuticals (lycopene, isoflavonoids, prebiotics, probiotics, glucosamine, phytosterols); Formulation of functional foods containing nutraceuticals; Packaging and safety evaluation; Analytical techniques in nutraceutical industry	8

4.	Clinical Testing of Nutraceuticals: Interactions of prescription drugs and nutraceuticals; Adverse effects and toxicity of nutraceuticals	8
5.	Nutrigenomics: An introduction to nutrigenomics and its relation to nutraceuticals; Scope of genetic engineering in nutraceutical production; Production technology for recombinant therapeutic products using <i>E. coli</i> with examples like human insulin, growth hormones, interferons, erythropoietin; Biotechnology in phytonutraceuticals	10
Total		42

11. Suggested Books:

S. No.	Name of Authors / Books / Publishers, Year of Publication / Reprint
1.	Handbook of Nutraceuticals and Functional Foods by Robert E.C. 3 rd Ed. CRC Press, 2010
2.	Dietary supplements and functional foods by Geoffrey P. Webb. 2 nd Ed. Wiley Blackwell Publishing, 2011
3.	Anti-angiogenic functional and medicinal foods by Losso, JN. CRC Press, 2007
4.	Dietary supplements: Toxicology and Clinical Pharmacology by Cupp, J., Tracy, TS. Humana Press., 2003
5.	Functional Food Ingredients and Nutraceuticals: Processing Technologies by Shi, J. CRC Press 2006
6.	Nutritional Genomics: Impact on Health and Disease by Brigelius-Flohé, J., Joost, HG. Wiley-VCH, 2006
7.	Bioprocesses and Biotechnology for Functional Foods and Nutraceuticals by Neeser, JR., German, BJ. Marcel Dekker, 2004
8.	Nutritional Genomics: The Impact of Dietary Regulation of Gene Function on Human Disease by Wayne R. Bidlack, Raymond L. Rodriguez. CRC Press, 2011

1. Subject Code: **BT-426** Course Title: **Environmental Biotechnology**
2. Contact hours : L: 3 T: 1 P: 0
3. Examination Duration (H) : Theory: 3 Practical: 0
4. Relative weightage : CWS: 25 PRS:- MTE: 25 ETE: 50 PRE: -
5. Credits : 4
6. Semester : VIII
7. Subject Area : DEC
8. Pre-requisite : Nil
9. Objective : To impart knowledge about the environment structure and its balance, Pollution and its measurement. The strategies to reduce the pollutant concentrations in the biosphere.

10. Details of Course

S.No.	Contents	Contact Hours
1.	Environmental Pollution: Types of pollution, methods for the measurement of pollution; Methodology of environmental management the problem- solving approach, its limitations.	6
2.	Air Pollution and its Control through Biotechnology: Active trace gases in air, reactive odd nitrogen, carbon, sulfur and Halogen compounds in air, aerosols in air, direct and indirect effect on radioactive forcing, Bio-filtration	8
3.	Water Pollution and its Control: Water resource management, waste water collection, Measurement of water pollution, sources of water pollution, waste water treatment - physical, chemical and biological treatment processes. Activated sludge, oxidation ditches, trickling filter, towers, rotating discs, rotating drums, oxidation ponds. Anaerobic processes of biological treatment- Anaerobic digestion, anaerobic filters. Upflow anaerobic sludge blanket reactors; Treatment schemes for waste waters of dairy, distillery, tannery, sugar, antibiotic industries	8

4.	Microbiology of Degradation of Xenobiotics in Environment: Ecological considerations, decay behavior and degradative plasmids: Hydrocarbons, substituted hydrocarbons, oil pollution, surfactants, pesticides.	6
5.	Solid Wastes: Treatment and Management: Sources of solid waste and management (composting, Vermiculture and methane production) Bioremediation of contaminated soils and waste land, Biopesticides in integrated pest management.	8
6.	Global Environmental Problems: Ozone depletion, greenhouse effect and acid rain, their impact and biotechnological approaches for management.	6
Total		42

11. Suggested Books:

S. No.	Name of books/Authors/Publishers	Year of publication/ reprint
Text Books:		
1.	Comprehensive Biotechnology by M. Moo- Young. 4-volume set Publisher: Pergarmon Press	1985
2.	Environmental Chemistry AK. De. Publisher: New Age Publications (Academic) India)	2006
Reference books:		
1.	Introduction to Biodeterioration by D. Allsopp and K.J. Seal. Publisher ELBS/Edward Arnold.	1986
2.	Waste Water Engineering - Treatment and Reuse by Metcalf, Eddy and G. Tchobanoglous. Publisher: Tata McGraw Hill	2002
3.	Microbiology by Bernard D. Davis, Renato Dulbecco, Herman N. Eisen and Harold S. Ginsberg. Publisher:Lippincott Williams & Wilkins	1990
4.	Biochemical Engineering Fundamentals by J.E. Baily and D.F. Ollis. Publisher: McGraw Hill.	1986
5.	Process Biotechnology Fundamentals by S.N. Mukhopadhyay. Publisher: Viva Books	2010

OPEN ELECTIVE COURSES

CO351 ENTERPRISE & JAVA PROGRAMMING

1. Subject Code: **CO351** Course Title: **Enterprise & Java programming**
2. Contact Hours : L: 3 T: 0 P: 0
3. Examination Duration (ETE)(Hrs.) : Theory 3 Hrs Practical 0
4. Relative Weightage : CWS 25 PRS 0 MTE 25 ETE 50 PRE 0
5. Credits : 3
6. Semester : V
7. Subject Area : OEC
8. Pre-requisite : Nil
9. Objective : To introduce fundamentals of Enterprise Java Programming, concepts of program development using beans.
10. Details of Course :

Unit No.	Contents	Contact Hours
1.	Collections : Collection Interfaces, Concrete Collections, Collections Framework. Multithreading : Creating and running thread, Multiple thread synchronization, Thread communication, Thread group, Thread priorities, Daemon Thread, Life Cycle ofThread.	5

2.	<p>Fundamentals in Networking: Sockets in Java - Internet Addressing - DNS – Ipv4,IPv6- URL class - TCP/IP and Datagram. The interfaces and classes for networking :Interfaces and classes of java.net package; InetAddress class : IP address scope - Host name resolution - Methods of InetAddress class; Program to look up the IP addresses for a hostname - Factory methods - Creating and using Sockets : Socket class - constructors and methods of Socket class. Creating TCP servers & clients : TCP/IP server sockets - Constructors and methods of ServerSocket class - Program to create a TCP/IP server and client. Handling URL: URL class - constructors and methods of URL class -URLConnection class - fields of URLConnection class - methods of URLConnection class. Working with Datagrams: DatagramPacket - Constructors for DatagramPacket class - Methods of DatagramPacket class - creating Datagram server and client.</p>	6
3.	<p>JDBC Package :JDBC – JDBC versus ODBC – Types of JDBC drivers – Connection – Statement – PreparedStatement.ResultSet :Fields of ResultSet – Methods of ResultSet – Executing a query - ResultSetMetaData – DatabaseMetaData. Datatypes in JDBC : Basic datatypes in JDBC – Advanced datatypes in JDBC – fields of Statement – methods of Statement – CallableStatement Interface – BatchUpdates</p>	6
4.	<p>Servlets : Using Servlets - Servlet Package - Servlet lifecycle - init() method - service() method , doGet() method, doPost() method and destroy() method . Classes and interfaces of Servlet: Servlet - GenericServlet - ServletConfig - ServletContext - ServletException - ServletInputStream - ServletOutputStream - ServletRequest – ServletResponse. Classes and interfaces of HttpServlet: HttpServlet - HttpServletRequest - HttpServletResponse - Reading HTML form data from Servlets - Response Headers - Response Redirection. Handling Servlets : Servlet Chaining - HttpUtils - Database access with JDBC inside servlet. State and Session management : Cookies - HttpSession - Server Side includes - Request forwarding – RequestDispatcher.</p>	7

5.	Concepts of Java Beans: Java Beans - Advantage of Java Beans - Reflection and Introspection - Customizers – Persistence. Developing Java Beans : Bean Developer Kit (BDK) - Creating a Java Bean - Creating a Bean Manifest file - Creating a Bean JAR file. Controls and Properties of a Bean : Adding controls to Beans - Giving Bean Properties - BeanInfo interface - SimpleBeanInfo class. Types of Properties: Design pattern for Properties: Simple properties - Indexed Properties; Descriptor Classes - Giving Bean methods - Bound and Constrained Properties - Property Editors.	9
6.	Components of EnterpriseBeans : Distributed Multitiered Applications -J2EE components: J2EE clients, Web components, J2EE containers. Developing an Enterprise Bean : Packaging - Enterprise JavaBeans Technology - Enterprise Bean - Contents of an Enterprise Bean. Session Bean : Stateful session bean – life cycle of stateful session bean - Stateless session bean – life cycle of stateless session – ejbCreate methods – Business methods – Home interface – Remote interface – Running the session bean. Entity Bean :Persistence - Bean managed Persistence - Container Managed Persistence - Shared Access - Primary key – Relationships. Message Driven Bean :life cycle of message driven bean – onMessage method.	9
Total		42

11. Suggested Books

S. No.	Name of Books / Authors/ Publishers
Text Books	
1.	Java 2 Programming Black Book - Steven Holzner dreamTech Press(ISBN-9788177226553), 2005
2.	JavaBeans Programming from the GroundUp - Joseph O'Neil, TMGH, New Delhi(ISBN- 007463786X), 2001
Reference Books	

3.	Web Security: Security Issues on web, Importance of Firewall, components of Firewall, Transaction security, Emerging client server, Security Threats, Network Security, Factors to consider in Firewall design, Limitation of Firewalls.	6
4.	Electronic Payments: Overview, The SET protocol, Payment Gateway, certificate, digital Tokens, Smart card, credit card, magnetic strip card, E-Checks, Credit/Debit card based EPS, online Banking. EDI Application in business, E- Commerce Law, Forms of Agreement, Govt. policies and Agenda.	6
5.	ERP Introduction, Benefits, Origin, Evolution and Structure: Conceptual Model of ERP, The Evolution of ERP, The Structure of ERP. Business Process Reengineering, Data ware Housing, Data Mining, Online Analytic Processing(OLAP), Product Life Cycle Management(PLM), LAP, Supply chain Management.	8
6.	ERP Marketplace and Marketplace Dynamics: Market Overview, Marketplace Dynamics, The Changing ERP Market. ERP- Functional Modules: Introduction, Functional Modules of ERP Software, Integration of ERP, Supply chain and Customer Relationship Applications. ERP Implementation Basics, ERP Implementation Life Cycle, Role of SDLC/SSAD, Object Oriented Architecture, Consultants, Vendors and Employees, ERP & E-Commerce, Future Directives- in ERP, ERP and Internet.	8
Total		42

11. Suggested Books

S.No.	Name of Books / Authors/ Publishers
1.	Goel, Ritendra "E-commerce", New Age International, 2007
2.	Ravi Kalakota, Andrew Winston, "Frontiers of Electronic Commerce", Addison-Wesley. 1996
3.	Vinod Kumar Garg and Venkitakrishnan N K, "Enterprise Resource Planning – Concepts and Practice", PHI 2004
4.	Rahul V. Altekar "Enterprise Resource Planning", Tata McGraw Hill, 2004
5.	Alexis Leon, "ERP Demystified", Tata McGraw Hill, 2014

CO355 CRYPTOGRAPHY AND INFORMATION SECURITY

1. Subject Code: **CO355** Course Title: **Cryptography and Information Security**
2. Contact Hours : L: 3 T: 0 P: 0
3. Examination Duration (ETE)(Hrs.) : Theory 3 Hrs Practical 0
4. Relative Weightage : CWS 25 PRS 0 MTE 25 ETE 50 PRE 0
5. Credits : 3
6. Semester : V
7. Subject Area : OEC
8. Pre-requisite : NIL
9. Objective : To study various cryptographic techniques, mathematics related to cryptography and some network security protocols.
10. Details of Course

Unit No.	Contents	Contact Hours
1.	Introduction: Need for security, Introduction to security attacks, services and mechanism, introduction to cryptography, Conventional Encryption: Conventional encryption model, classical encryption techniques- substitution ciphers and transposition ciphers, cryptanalysis, stereography, stream and block ciphers, Intruders, Viruses and related threads.	6
2.	Modern Block Ciphers: Block ciphers principals, Shannon's theory of confusion and diffusion, Fiestal structure, data encryption standard(DES), strength of DES, crypt analysis of DES, block cipher modes of operations, triple DES, IDEA encryption and decryption, strength of IDEA, key distribution.	6

3.	Introduction to graph, ring and field, prime and relative prime numbers, modular arithmetic, Fermat's and Euler's theorem, primarily testing, Euclid's Algorithm, Chinese Remainder theorem, discrete logarithms, Principals of public key crypto systems, RSA algorithm, security of RSA, key management, Diffie-Hellman key exchange algorithm, introductory idea of Elliptic curve cryptography, Elganel encryption	8
4.	Message Authentication and Hash Function: Authentication requirements, authentication functions, message authentication code (MAC), hash functions, security of hash functions and MACS, MD5 message digest algorithm, Secure hash algorithm(SHA), Public Key Infrastructure(PKI): Digital Certificate, private key management, Digital Signatures: Digital Signatures, authentication protocols, digital signature standards (DSS), proof of digital signature algorithm.	6
5.	Authentication Applications: Kerberos and X.509, directory authentication service, password, challenge-response, biometric authentication, electronic mail security-pretty good privacy (PGP), S/ MIME.	8
6.	IP Security: Architecture, Authentication header, Encapsulating security payloads, combining security associations, key management. Web Security: Secure Socket Layer(SSL) and transport layer security, TSP, Secure Electronic Transaction (SET), Electronic money, WAP security, firewall design principals, Virtual Private Network (VPN) security.	8
Total		42

11. Suggested Books

S.No.	Name of Books / Authors/ Publishers
1.	William Stallings, "Cryptography and Network Security: Principals and Practice", Prentice Hall, New Jersey. 2016
2.	Atul Kahate, "Cryptography and Network Security", TMH. 2009
3.	Behrouz A. Forouzan, "Cryptography and Network Security", TMH.2007
4.	Johannes A. Buchmann, "Introduction to Cryptography", Springer-Verlag. 2004
5.	Bruce Schneier, "Applied Cryptography". 2015

5. Credits : 3
6. Semester : V
7. Subject Area : OEC
8. Pre-requisite : Nil
9. Objective : To familiarize the students with basic concepts in each type of IPR together with historical developments in the subject & its importance in modern times.

10. Details of Course

Unit No.	Contents	Contact Hours
1.	Introduction: Concept of IPR, Historical development , kinds of IPR,brief description of patent, trademark, copyright ,industrial design, importance of IPR, IPR authorities.	5
2.	PATENTS :Introduction, Indian Patent Act 1970 &2002, Protectable subject matter--patentable invention, Procedure for obtaining patent, Provisional and complete specification Rights conferred on a patentee, transfer of patent, Revocation and surrender of patents, Infringement of patents, Action for infringement, Patent agents, Patent in computer programs.	8
3.	Trademark: Introduction, Statutory authorities, principles of registration of trademarks, rights conferred by registration of trademarks, Infringement of trademarks and action against infringement, procedure of registration and duration,licensing in trademark	7
4.	Copyright: Introduction, Author and ownership of copyright, rights conferred by copyright,term of copyright, assignment/licence of copyright, Infringement of copyright ,remedies against infringement of copyright, registration of copyright, copyright enforcement and societies	7

6. Semester : V
7. Subject Area : OEC
8. Pre-requisite : NIL
9. Objective : To provide knowledge about the principles, concepts and applications of Database Management System.
10. Details of Course

Unit No.	Contents	Contact Hours
1.	<p>Introduction: Data base system concepts and its architecture, Data models schema and instances, Data independence and data base language and interface, Data definition languages, DML. Overall data base structure.</p> <p>Data modeling using Entity Relationship Model: E.R. model concept, notation for ER diagrams mapping constraints, Keys, Concept of super key, candidate key, primary key generalizations, Aggregation, reducing ER diagrams to tables, extended ER model.</p>	7
2.	<p>Relational Data Model and Language: Relational data model concepts, integrity constraints, Keys domain constraints, referential integrity, assertions, triggers, foreign key relational algebra, relational calculus, domain and tuple calculus, SQL data definition queries and updates in SQL.</p>	7
3.	<p>Data Base Design: Functional dependencies, normal forms, 1NF, 2NF, 3NF and BCNF, multi-valued dependencies fourth normal forms, join dependencies and fifth normal forms. Inclusion dependencies, loss less join decompositions, normalization using FD, MVD and JDs, alternatives approaches to database design.</p>	6
4.	<p>File Organization, Indexing and Hashing Overview of file organization techniques, Indexing and Hashing-Basic concepts, Static Hashing, Dynamic Hashing, Ordered indices, Multi-level indexes, B-Tree index files, B+- Tree index files, Buffer management</p> <p>Transaction processing concepts: Transaction processing system, schedule and recoverability, Testing of serializability, Serializability of schedules, conflict & view serializable schedule, recovery from transaction failures, deadlock handling.</p>	8

10. Details of Course

Unit No.	Contents	Contact Hours
1.	Introduction : Basic Definitions and key elements of Mechatronics, Mechatronic Design Approach: Functions of Mechatronic Systems, Ways of Integration, Information Processing Systems (Basic Architecture and hardware and Software trade-offs, Concurrent Design Procedure for Mechatronic Systems	6
2.	System Interfacing, Instrumentation, and Control Systems: Input and output Signals of a Mechatronic System, Signal Conditioning and microprocessor control, Microprocessor-Based Controllers and Microelectronics, Programmable Logic Controllers	6
3.	Introduction to Micro- and Nanotechnology, Micro-actuators, Micro-sensors, Nanomachines. Modeling Electromechanical Systems: Models for Electromechanical Systems, Rigid Body Models, Basic Equations of Dynamics of Rigid Bodies, Simple Dynamic Models, Elastic System Modeling, Dynamic Principles for Electric and Magnetic Circuits, Earnshaw's Theorem and Electromechanical Stability	10
4.	The Physical Basis of Analogies in Physical System Models: The Force-Current Analogy: Across and Through Variables, Maxwell's Force-Voltage Analogy: Effort and Flow Variables, A Thermodynamic Basis for Analogies	6
5.	Introduction to Sensors and Actuators: Characteristics of Sensor and Actuator Time and Frequency Measurement, The Role of Controls in modelling in Mechatronics: Integrated Modeling, Design, and Control Implementation, Special Requirements of Mechatronics that Differentiate from Classic Systems and Control Design, Modeling as Part of the Design Process, Modeling of Systems and Signals	6
6.	Design Optimization of Mechatronic Systems: Optimization Methods, Principles of Optimization : Parametric Optimization, General Aspects of the Optimization Process, Types of Optimization Methods, Selection of a Suitable Optimization Method, Optimum Design of Induction Motor (IM), IM Design Introduction : Classical IM Design, Use of a Neuron Network for the Identification of the Parameters of a Mechanical dynamic system, Mechatronics and Computer Modeling and Simulation, Mechatronics and the Real-Time use of Computers, Communications and Computer Networks, Control with Embedded Computers and Programmable Logic Controllers	8
Total		42

11. Suggested Books

S.No.	Name of Books / Authors/ Publishers
1.	Mechatronics : an introduction by Robert H Bishop, Taylor & Francis, 2005
2	Introduction to Mechatronics by KK AppuKuttan Oxford University Press, 2007

EC353 COMPUTER VISION

1. Subject Code : **EC-353** Course Title: **Computer Vision**
2. Contact Hours : L: 3 T: 0 P: 0
3. Examination Duration (ETE)(Hrs.) : Theory 3 Hrs Practical 0
4. Relative Weightage : CWS 25 PRS - MTE 25 ETE 50 PRE 0
5. Credits : 3
6. Semester : V
7. Subject Area : OEC
8. Pre-requisite : Nil
9. Objective : To introduce fundamentals of Computer Vision and algorithms for object detection, recognition and tracking.

10. Details of Course

Unit No.	Contents	Contact Hours
1.	Introduction to computer vision: Role of Artificial intelligence and image processing in Computer Vision, Industrial Machine Vision applications, System architecture. Visual Sensors: Camera sensors: RGB, IR, Kinect sensor, Camera interfaces and video standards, Characteristics of camera sensors commercially available cameras. Camera Calibration: Interior, exterior calibration and rectification using Tsai's Calibration method.	5

2.	Basics of image processing – Pixel representations histograms ,transforms, colour filters, noise removal, Geometry: Math methods -linear algebra, vectors, rotations, Stereo – Epi-polar geometry, correspondence, triangulation ,Disparity maps . Basics of video processing – Background subtraction techniques – frame differencing, Gaussian Mixture Modelling (GMM), Object localization and processing:- Contours, edges, lines, skeletons.	7
3.	Image representation: Local Wavelet basis (multiscale), Global Fourier basis(Frequency), Adaptive basis (PCA and ICA) , Adaptive basis(discriminants) Basics of Object detection – Template matching, Cascade classifiers.	8
4.	Object Recognition : Object Modeling, Bayesian Classification, Feature Selection and Boosting, Scene and Object Discrimination.	6
5.	Motion and Tracking: Motion detection and tracking of point features, optical flow, SURF, SIFT. Tracking- Kalman filter, Particle Filter, Comparison of deterministic and probabilistic methods condensation, tracking humans, multi-frame reconstruction under affine and perspective projection geometry.	8
6.	Introduction to Computer Vision programming libraries: MATLAB/ OpenCV. advantages and disadvantages of each .	8
Total		42

11. Suggested Books

S.No.	Name of Books / Authors/ Publishers
1.	Computer Vision: A Modern Approach (2nd Edition) 2nd Edition by David A. Forsyth (Author), Jean Ponce (Author), 2002
2.	Learning OpenCV: Computer Vision with the OpenCVLibrary Gary Bradski, Adrian Kaehler, 2008

6. Semester : V
7. Subject Area : OEC
8. Pre-requisite : Signals and Systems
9. Objective : To introduce the fundamentals of visual information, representation of 2-D and 3-D information, enhancement of information, retrieval of information, and various colour models.

10. Details of Course

Unit No.	Contents	Contact Hours
1.	Introduction to Image processing, fundamental steps in DIP, concept of visual information, image formation model, image sampling and quantization, digital image representation, spatial and gray level resolution, relationship between pixels, application of image processing system.	6
2.	Introduction to Multidimensional signals and systems, 2D-Signals, 2D systems, classification of 2D system, 2D convolution, 2D Z-transform, Image Transform: 2D-DFT, discrete cosine, discrete sine, Haar, Walsh, Hadamard, Slant, KL, SVD, Hough, Radon, Ridgelet.	8
3.	Image enhancement; Spatial domain: linear transformation, image negative, grey level shifting, non-linear transformation, logarithmic transformation, exponential transformation, grey level slicing, bit plane slicing, image averaging, mask processing, histogram manipulations, histogram thresholding, histogram stretching, histogram equalization, noise removing filters, smoothing filters, sharpening filters. Enhancement in Frequency Domain; ideal low pas filter, Butterworth low pass filter, ideal high pass filters, Butterworth high pass filter, band pass filter, Gaussian filters, Homomorphic filtering.	10
4.	Image restoration: degradation model, noise models, restoration in presence of noise, periodic noise removal in frequency domain, notch filters, inverse filtering, Wiener filtering.	6

7. Subject Area : OEC
8. Pre-requisite : Nil
9. Objective : To give the student an understanding of the different design steps required to carry out a complete digital VLSI (Very-Large-Scale Integration) design in silicon.

10. Details of Course

Unit No.	Contents	Contact Hours
1.	Introduction to VLSI, Manufacturing process of CMOS integrated circuits, CMOS n-well process design rules, packaging integrated circuits, trends in process technology. MOS transistor, Energy band diagram of MOS system, MOS under external bias, derivation of threshold voltage equation, secondary effects in MOSFETS	6
2.	MOSFET scaling and small geometry effects, MOS capacitances, Modeling of MOS transistors using SPICE, level I II and equations, capacitance models. The Wire: Interconnect parameters: capacitance, resistance and inductance. Electrical wire models: The ideal wire, the lumped model, the lumped RC model, the distributed RC model, the transmission line model, SPICE wire models.	6
3.	MOS inverters: Resistive load inverter, inverter with n-type MOSFET load, CMOS inverter: Switching Threshold, Noise Margin, Dynamic behavior of CMOS inverter, computing capacitances, propagation delay, Dynamic power consumption, static power consumption, energy, and energy delay product calculations, stick diagram, IC layout design and tools.	8

4. Relative Weight : CWS: 25 PRS: 0 MTE: 25 ETE: 50 PRE: 0
5. Credits : 3
6. Semester : V
7. Subject Area : OEC
8. Pre-requisite : NIL
9. Objective : To familiarize the students with power electronics and its applications.

10. Details of Course:

Unit No.	Contents	Contact Hours
1.	Solid State Power Devices: Principle of operation of SCR, dynamic characteristic of SCR during turn ON and turn OFF, parameters of SCR, dv/dt and di/dt protection, snubber circuit, commutation circuits; Principle of operation of MOSFET, IGBT, GTO, MCT, SIT, SITH, IGCT, their operating characteristics.	8
2.	Single-phase Converter: Half wave converter, 2-pulse midpoint converter, half controlled and fully controlled bridge converters, input current and output voltage waveforms, effect of load and source impedance, expressions for input power factor, displacement factor, harmonic factor and output voltage, effect of free-wheeling diode, triggering circuits. Three-phase Converter: Half wave, full wave, half controlled and fully controlled bridge converters, effect of load and source impedance, expressions for input power factor, displacement factor, harmonic factor and output voltage,	8
3.	AC-AC Converters: Principle of operation of cycloconverter, waveforms, control technique; Introduction of matrix converter.	4
4.	DC-DC Converters: Principle of operation of single quadrant chopper, continuous and discontinuous modes of operation; Voltage and current commutation, design of commutating components; Introduction to SMPS.	4

4. Relative Weight : CWS: 25 PRS: 0 MTE: 25 ETE: 50 PRE: 0
5. Credits : 3
6. Semester : V
7. Subject Area : OEC
8. Pre-requisite : NIL
9. Objective : To familiarize the students with electrical machines and power systems.

10. Details of Course:

Unit No.	Contents	Contact Hours
1	Transformers : constructional features, types, Special constructional features – cruciform and multiple stepped cores, cooling methodology, conservators, breather, Buchholz relay, voltage, current and impedance relationships, equivalent circuits and phasor diagrams at no load and full load conditions, voltage regulation, losses and efficiency, all day efficiency, auto transformer and equivalent circuit, parallel operation and load sharing.	8
2	Asynchronous machines: General constructional features of poly phase asynchronous motors, concept of rotating magnetic field, principle of operation, phasor diagram, Equivalent circuit, torque and power equations, torque-slip characteristics, losses and efficiency.	8
3	Synchronous machines : General constructional features, armature winding, emf equation, effect of distribution and pitch factor, flux and mmf relationship, phasor diagram, non-salient pole machine, equivalent circuit, determination of equivalent circuit parameters by open and short circuit tests, voltage regulation using synchronous impedance method, power angle characteristics	9
4	Single line diagram of power system, brief description of power system elements, synchronous machine, transformer, transmission line, bus bar, circuit breaker and isolator. Supply System: different kinds of supply system and their comparison, choice of transmission voltage. Transmission Lines: configurations, types of conductors, resistance of line, skin effect	9

5	Transmission lines: Calculation of inductance and capacitance of single phase, three phase, single circuit and double circuit ,transmission lines, representation and performance of short, medium and long transmission lines, Ferranti effect,surge impedance loading.	8
Total		42

11. Suggested Books

S. No.	Name of Authors /Books / Publishers
1	Fitzgerald. A.E., Charles Kingsely Jr, Stephen D.Umans, 'Electric Machinery', Tata McGraw Hill, 2006.
2	M.G. Say, 'Performance and Design of Alternating Current Machines', CBS Publishers, New Delhi, 2008
3	Nagrath I. J and Kothari D.P. 'Electric Machines', Tata McGraw Hill Publishing Company Ltd, 2010.
4	Power System Analysis, J. Grainger and W.D. Stevenson, TMH, 2006.
5	Electrical Power Systems,C. L.Wadhwa, New age international Ltd. Third Edition, 2010
6	Electric Power Generation, Transmission&Distribution,S.N.Singh, PHI Learning, 2008.

EE-355 INSTRUMENTATION SYSTEMS

- | | |
|--------------------------------|---|
| 1. Subject Code: EE-355 | Course Title: Instrumentation Systems |
| 2. Contact Hours | : L: 3 T: 0 P: 0 |
| 3. Examination Duration (Hrs.) | : Theory: 3 Practical: 0 |
| 4. Relative Weight | : CWS: 25 PRS: 0 MTE: 25 ETE: 50 PRE: 0 |
| 5. Credits | : 3 |
| 6. Semester | : V |
| 7. Subject Area | : OEC |

8. Pre-requisite : NIL
9. Objective : To familiarize the students with instrumentation systems.
10. Details of Course:

Unit No.	Contents	Contact Hours
1	Transducers-I:Definition, advantages of electrical transducers, classification, characteristics, factors affecting the choice of transducers, strain gauges, resistance thermometer, thermistors, thermocouples, LVDT, RVDT	8
2	Transducers-II:Capacitive, piezoelectric, Hall effect and opto electronic transducers. measurement of motion, force, pressure, temperature flow and liquid level.	8
3	Telemetry:General telemetry system, land line & radio frequency telemetering system, transmission channels and media, receiver & transmitter. Data Acquisition System:A/D and D/A converters, analog data acquisition system, digital data acquisition system, modern digital data acquisition system and signal conditioning.	8
4	Display Devices and RecordersDisplay devices, storage oscilloscope, DSO, spectrum analyzer, digital recorders. RecentDevelopments:Introduction to virtual and intelligent instrumentation, fibre optic transducers, smart sensors, smart transmitters, process instrumentation diagrams.	8
5	Programmable Logic Controllers :Evolution of PLC-sequential and programmable controllers, architecture and programming of PLC, relay logic and ladder logic, functional blocks, communication networks for PLC, field bus, profi-bus, mod-bus	10
Total		42

11. Suggested Books:

S. No.	Name of Authors /Books / Publishers
1	Electronic Instrumentation and Measurement Techniques, W.D. Cooper and A.D. Helfrick, Prentice Hall International, 2009.
2	Measurement Systems Application and Design Ernest Doebelin, McGraw- Hill Higher Education, 5 th edition , 2003
3	Instrumentation, Measurement and Analysis, B.C. Nakra& K. Chaudhry, Tata McGraw Hill, 2 nd Edition, 2001.
4	Advanced Measurements and Instrumentation, A.K. Sawhney, DhanpatRai& Sons, 2010
5	Process Control Instrumentation Technology, Curtis D. Johnson, Pearson, 6 th edition, 1999
6	Programmable Logic Controllers, Frank D. Petruzella McGraw-Hill Higher Education, 4 th edition, 2010

EE357 UTILIZATION OF ELECTRICAL ENERGY

1. Subject Code: **EE-357** Course Title: **Utilization of Electrical Energy**
2. Contact Hours : L: 3 T: 0 P: 0
3. Examination Duration (Hrs.) : Theory: 3 Practical: 0
4. Relative Weight : CWS: 25 PRS: 0 MTE: 25 ETE: 50 PRE: 0
5. Credits : 3
6. Semester : V
7. Subject Area : OEC
8. Pre-requisite : NIL
9. Objective : To familiarize the students with the concept of electrical power, energy and its utilization.

10. Details of Course:

Unit No.	Contents	Contact Hours
1.	Illumination: Definition:- Luminous flux, solid angle, luminous intensity, illumination, luminous efficiency, depreciation factor, coefficient of utilization, space to height ratio, reflection factor, glare, shadow, lux. Nature of light, visibility spectrum curve of relative sensitivity of human eye and wave length of light, Review of laws of illumination, Different types of lighting sources and their use in domestic, street and industrial lighting, Energy considerations. LED's and their driving circuits.	10
2	Electric Heating : Advantages of electrical heating, Heating methods: Resistance heating – direct and indirect resistance heating, properties of resistance heating elements, Induction heating; principle of core type and coreless induction furnace, Electric arc heating; direct and indirect arc heating, construction, working and applications of arc furnace, Dielectric heating, applications in various industrial fields, Infra-red heating and its applications, Microwave heating	08
3.	Electric Welding: Introduction to electric welding, Welding methods, Principles of resistance welding, types – spot, projection seam and butt welding and welding equipment used, Principle of arc production, electric arc welding, characteristics of arc, Design of Power supply and welding control circuit, comparison between AC and DC arc welding, welding control.	08
4.	Electrolytic Processes: Need of electro-deposition laws of electrolysis, process of electro-deposition - clearing, operation, deposition of metals, polishing, buffing equipment and accessories for electroplating factors affecting electro-deposition , principle of galvanizing and its applications, anodising and its applications, electroplating on non-conducting materials, manufacture of chemicals by electrolytic process, electrolysis for water purification	08
5.	Refrigeration and Air Conditioning and Water Coolers: Principle of air conditioning, vapour pressure, refrigeration cycle, eco-friendly refrigerants, description of electrical circuit used in a) refrigerator, b) air-conditioner, and c) water cooler, variable speed drive for compressors, high speed compressors, insta-chill, Peltier effect, thermoelectric cooling, sterling engines, solar concentrator heating and cooling,	08
Total		42

11. Suggested books:

S. No.	Name of Authors /Books / Publishers
1.	Dubey G. K., "Fundamentals of Electric Drives", 2 nd Ed., Narosa Publishing House,2007.
2.	Taylor E. O., "Utilization of Electric Energy (in SI units)", Orient Longman, Revised in S.I. units by Rao, V.V.L,1999
3.	Hancock N. N., "Electric Power Utilisation", Wheelers,1979.

EE-359 NON-CONVENTIONAL ENERGY SYSTEMS

1. Subject Code: **EE-359** Course Title: **Non-conventional Energy Systems**
2. Contact Hours : L: 3 T: 0 P: 0
3. Examination Duration (Hrs.) : Theory: 3 Practical: 0
4. Relative Weight : CWS: 25 PRS: 0 MTE: 25 ETE: 50 PRE: 0
5. Credits : 3
6. Semester : V
7. Subject Area : OEC
8. Pre-requisite : NIL
9. Objective : To familiarize the students with the non-conventional sources of energy and their integration to the grid.

10. Details of Course:

Unit No.	Contents	Contact Hours
1	Introduction to Non Conventional Energy Systems Various non-conventional energy resources Introduction, availability, classification, relative merits and demerits. Solar Cells: theory of solar cells, solar cell materials, solar cell array, solar cell power plant, limitations. Solar Thermal Energy: solar radiation, flat plate collectors and their materials, applications and performance, focusing of collectors and their materials, applications and performance, solar thermal power plants, thermal energy storage for solar heating and cooling, limitations.	10
2	Geothermal Energy Resources of geothermal energy, thermodynamics of geothermal energy conversion, electrical conversion, non-electrical conversion, environmental considerations. Magneto-hydrodynamics (MHD): principle of working of MHD power plant, performance and limitations.	8
3	Fuel Cells: Basic principle of working, various types of fuel cells, performance and limitations.	8
4	Thermo-electrical and thermionic conversions Principle of working of thermo-electrical and thermionic conversions, performance and limitations. Wind energy: wind power and its sources, site selection criteria, momentum theory, classification of rotors, concentrations and augments, wind characteristics, performance and limitations of wind energy conversion systems.	8
5	Energy from Bio-mass, Ocean Thermal, Wave and bio-waste Availability of bio-mass and its conversion principles, ocean thermal energy conversion principles, performance and limitations, wave and tidal energy conversion principles, performance and limitations, bio-waste recycling power plants.	8
Total		42

11. Suggested books:

S. No.	Name of Authors /Books / Publishers
1	Renewable Energy Resources, John Twidell, Tony Weir, Taylor and Francis, 2 nd edition, 2005.

3	Memory Architecture and Devices; Input-Output Devices and Mechanisms	5
4	Instruction Set and Addressing Modes, Interfacing of Memory and Peripheral Devices – Functional and Timing Issues	6
5	Application Specific Logic Design using Field Programmable Devices and ASICs	2
6	Analog to Digital and Digital to Analog Converters	2
7	Bus I/O and Networking Considerations, Bus and Wireless Protocols	4
8	Embedded Systems Software : Constraints and Performance Targets	2
9	Real-time Operating Systems : Introduction, Scheduling in Real-time Operating Systems	4
10	Memory and I/O Management : Device Drivers	2
11	Embedded Software Development : Flow, Environments and Tools	2
12	System Specification and Modelling	2
13	Programming Paradigms	2
14	System Verification	2
15	Performance Analysis and Optimisation : Speed, Power and Area Optimisation, Testing of Embedded Systems	4
Total		42

11. Suggested Books:

S. No.	Name of Authors /Books / Publishers
1.	S. Heath, "Embedded Systems Design", Elsevier India,2005
2.	M. Ben-Ari, "Principles of Concurrent and Distributed Programming", Pearson,2005
3.	Jane Liu, "Real Time Systems", Pearson,2002

3	UNIT-III Emerging Issues - E-waste, Hazardous Waste, Nuclear Waste, Nano pollution, Thermal Pollution, pollutant emission and treatment	8
4	UNIT-IV Emerging pollutants' emergence and fate in surface and ground water, as well as mathematical modelling, Sustainable Development, Risk mitigation	8
5	UNIT-V Transformation Products of Emerging Contaminants in the Environment, Removal of emerging contaminants from water, soil and air, methods and preventive measures.	8
Total		42

Course Outcome:

1. Introduction to new and emerging contaminants and their transformation products.
2. Study of pollutants from manufacturing of goods.
3. Emerging area in environmental pollution.
4. Study of life cycle of a contaminant, modeling and mitigation.

11. Suggested Books:

S. No.	Name of Authors /Books / Publishers
1.	G. Buttiglieri, T.P. Knepper, (2008), Removal of emerging contaminants in Wastewater Treatment: Conventional Activated sludge Treatment, Springer-Verlag Berlin Heidelberg, HdbEnvChem, vol. 5, Part S/2:1-35, DOI: 10.1007/698_5_098
2.	Alok Bhandari; Rao Y. Surampalli; Craig D. Adams; Pascale Champagne; Say Kee Ong; R. D. Tyagi; and Tian Zhang, Eds., (2009) Contaminants of Emerging Environmental Concern, American Society of Civil Engineers, ISBN (print): 978-0-7844-1014-1, ISBN (PDF): 978-0-7844-7266-8
3.	Dimitra A. Lambropoulou, Leo M. L. Nollet Eds. () Transformation Products of Emerging Contaminants in the Environment: Analysis, Processes, Occurrence, Effects and Risks, 1st Edition, Wiley, ISBN-13: 978-1118339596, ISBN-10: 1118339592

EN353 OCCUPATIONAL HEALTH AND SAFETY MANAGEMENT

1. Subject Code: **EN- 353** Course Title: **Occupational Health and Safety Management**
2. Contact Hours : L: 3 T: 0 P: 0
3. Examination Duration (ETE) (Hrs.) : Theory 3 Hrs
4. Relative Weightage : CWS 25 PRS 0 MTE 25 ETE 50 PRE 0
5. Credits : 3
6. Semester : V
7. Subject Area : OEC
8. Prerequisite : Nil
9. Course Objectives : 1. Introduction about occupational health and related issues.
2. To give a basic idea about environmental safety management, industrial hygiene.
3. To introduce about training cycle, chemical hazards and control measures.
4. To aware and provide knowledge about ergonomics and different disorders.
5. To provide knowledge about different standards related to safety and health.

10. Detail of Course:

Unit no.	Contents	Contact Hours
1	UNIT –I Definition of Occupational Health as per WHO/ILO. Occupational Health and Environmental Safety Management – Principles practices. Common Occupational diseases: Occupational Health Management Services at the work place. Pre-employment, periodic medical examination of workers, medical surveillance for control of occupational diseases and health records.	8

2	UNIT –II Occupational Health and Environment Safety Management System, ILO and EPA Standards. Industrial Hygiene: Definition of Industrial Hygiene, Industrial Hygiene: Control Methods, Substitution, Changing the process, Local Exhaust Ventilation, Isolation, Wet method, Personal hygiene, housekeeping and maintenance, waste disposal, special control measures.	8
3	UNIT –III Element of training cycle, Assessment of needs. Techniques of training, design and development of training programs. Training methods and strategies types of training. Evaluation and review of training programs. Chemical Hazard: Introduction to chemical hazards, dangerous properties of chemical, dust, gases, fumes, mist, Vapours, Smoke and aerosols. Evaluation and control of basic hazards, concepts of dose response relationship, bio-chemical action of toxic substances. Concept of threshold, limit values.	9
4	UNIT –IV Occupational Health Hazards, Promoting Safety, Safety and Health training, Stress and Safety, Exposure Limit. Ergonomics-Introduction, Definition, Objectives, Advantages. Ergonomics Hazards. Musculoskeletal Disorders and Cumulative Trauma Disorders. Physiology of respiration, cardiac cycle, muscle contraction, nerve conduction system etc. Assessment of Workload based on Human physiological reactions. Permissible limits of load for manual lifting and carrying. Criteria or fixation limits.	9
5	UNIT –V Bureau of Indian standards on safety and health 14489 - 1998 and 15001 – 2000, OSHA, Process Safety Management (PSM) as per OSHA, PSM principles, OHSAS – 18001, EPA Standards, Performance measurements to determine effectiveness of PSM. Importance of Industrial safety, role of safety department, Safety committee and Function.	8
Total		42

Course Outcomes:

1. The student will be able to understand the basics of occupational health and related issues.
2. Understanding of the fundamental aspects of safety, industrial hygiene along with learning theory to safety training methodology.
3. Considerate about hazardous materials, emergency management, ergonomics and human factors

10. Detail of Course:

Unit no.	Contents	Contact Hours
1	Unit-1: Geographic Information System Introduction, Definition of GIS, Components of GIS, Input data for GIS, Geographical concepts	7
2	Unit-2:GIS Data GIS data types, Data representation, Data sources, Geo-referencing of GIS data, GIS database, Database Management System, Data analysis terminology, GIS software packages, GIS application	9
3	Unit-3:Remote Sensing Introduction to Remote Sensing and Remote Sensing System, Multi concept of remote sensing, Advantages and disadvantages of remote sensing, Electromagnetic radiation, Polarisation, Thermal radiation	8
4	Unit-4:Remote Sensing Platforms Important remote sensing satellites, Classifications of sensors and platforms, Passive and Active sensors, Major remote sensing sensors, Spatial resolution, Spectral resolution, Radiometric resolution, Temporal resolution, Global Positioning System	9
5	Unit-5:Application of Remote Sensing Digital Image Processing, Application of Remote Sensing in Land use and Land cover mapping, Ground water mapping, Urban growth studies, Wasteland mapping, Disaster management, Agriculture, Forestry application	9
Total		42

Course Outcomes:

1. The Student will learn about basics of GIS and its significance.
2. The Student will be able to understand the utility of GIS data as well as Data Management System.
3. The Student will learn the fundamentals of remote sensing.
4. The unit of Remote Sensing Platform will generate a clear cut understanding among students about the satellites, their functioning and Global Positioning System. Geographical information system, its components, DMS and its various applications in real life.
5. The Student will be able to attain thorough knowledge about the application of remote sensing in different areas.

11. Suggested Books:

S. No.	Name of Authors /Books / Publishers
1.	Fundamentals of Remote Sensing – George Joseph, University Press, Hyderabad, India.
2.	Remote Sensing and Geographical Information System – AM Chandra & SK Ghosh Narosa Publishing House, New Delhi.
3.	Concepts and Techniques of Geographic Information Systems – C. P. Lo & Albert K.W. Yeung, PHI Learning Private Limited, New Delhi.
4.	Geographic Information System – Kang Tsung Chang, Tata Mc Graw hill, Publication Edition, 2002.

EP351 PHYSICS OF ENGINEERING MATERIALS

1. Subject code: **EP351** Course title: **Physics of Engineering Materials**
2. Contact Hours : L: 3 T: 0 P: 0
3. Examination Duration (Hrs) : Theory: 3 Practical: 0
4. Relative Weight : CWS: 25 PRS: 0 MTE: 25 ETE: 50 PRE: 0
5. Credits : 3
6. Semester : V
7. Subject area : OEC
8. Pre-requisite : NIL
9. Objective : To familiarize the fundamentals /basic concepts and advances of the different materials keeping in view of the engineering applications. There is ample opportunity to become involved in cutting edge Materials Science and Engineering Research

10. Detail of Course:

Unit No.	Contents	Contact Hours
1.	Crystallography: Introduction to crystal physics, Space lattice, Basis and the Crystal structure, Bravais lattices; Miller indices, simple crystal structures, Interplanar spacing, Intra and Intermolecular bonds (Ionic, Covalent, Metallic, Van der Waals and Hydrogen Bond), Defects in crystals, Basics of X- ray diffraction and its applications	10
2.	Semiconductors: Band theory of solids, Intrinsic and Extrinsic semiconductors, Statistics of electrons and holes in intrinsic semiconductor, Hall effect, Effect of temperature on conductivity, Generation and recombination, drift and diffusion current, Einstein relation, Applications of Semiconducting Materials.	10
3.	Dielectric and Magnetic Materials <i>Dielectric Materials:</i> Dielectric polarization and dielectric constant, Various polarization processes, Applications of Dielectric Materials <i>Magnetic Materials:</i> Concept of Magnetism, Classification of dia-para, Ferro, Antiferro and Ferrimagnetism, ferrites, soft and hard magnetic materials, Applications of Magnetic Materials	07
4.	Superconductivity: Introduction and historical developments; General properties of super conductors, Meissner effect and its contradiction to the Maxwell's equation; Types of Superconductors, London equations, Penetration depth, High Temperature Superconductors, Applications of superconductors.	07
5.	Advanced Engineering Materials: Introduction, Synthesis, characterization and applications of Photonic glasses, Phosphors and Nanophosphors, other selective topics in advanced materials.	08
Total		42

10. Detail of Course:5th/6th Semester

S. No.	Contents	Contact Hours
1.	Introduction to nuclear security: Basics of nuclear security, Practice and culture, Background, Objective, Scope, Structure, Nuclear security and safety culture: Characteristics of nuclear security culture	08
2.	Nuclear security regime, Importance of human factor and management leadership in nuclear security, Nuclear security threats: Threat informed security, The design basis threat	07
3.	System characterization, PPS requirements and objectives: Facility characterization, Target identification, Consequence analysis, PPS performance objectives	06
4.	Physical protection system technologies: Intrusion detection, Exterior and Interior Sensors, Access control, Contraband detection, Field detection sensors at borders/major public Events, Alarm assessment, Communication and display, Access delay, Response and neutralization, Response strategies and impact of On and Off site response, Cyber security.	09
5.	Security system design and evaluation: Adversary path analysis and Multi path optimization, Scenario development, Insider analysis, Transportation, Design approaches and vulnerability assessments, System design at major public events, Design of security systems to interrupt illicit trafficking, Analysis of quantitative risk assessment methods.	08
6.	Consequence mitigation and event response: Consequence management following nuclear events, Analysis of deterrence value of security measures, Roles and responsibilities of institutions and individuals	04
Total		42

10. Details of Course

Unit	Contents	Contact Hrs
1.	Introduction Concept of Econometrics, methodology of Econometrics, types of Econometrics, Difference between Econometrics and Mathematical Economics, Type of Data, Sources of data, Estimating Economic Relationship	8
2.	Mathematics and Economic Application Differential Calculus and its application in Economics- Price and Cros Elasticity of demand, Profit maximization under Perfect Competition, Monopoly, Oligopoly and Monopolistic Competition Integral Calculus and its application in Economics - Capital Formation, Compound Interest; Capital value and Flow Value; Consumer surplus under pure competition and monopoly; Producers Surplus Differential Equation and its application in Economics – Market Price Function; Dynamic Multiplier;	12
3.	Regression Statistical verses Deterministic Relationships, Regression verses Causation; Two variable Regression Analysis; Population Regression Function (PRG), Stochastic specification of PRF; The Significance of the Stochastic Term; stochastic disturbance Term; the sample regression Function (SRF); Method of Ordinary Least Squares; Properties of Least Square Estimators: The Gauss-Markov Theorem, Coefficient of determination r^2 : A Measure of “goodness of fit”; Monto Carlo Experiments	8
4.	Classical Normal Linear Regression Mode (CNLRM) The Probability distribution of Disturbances (meu); Normality Assumption, Method of Maximum Likelihood Multiple regression Analysis: The Problem of estimation; The problem of Inference Cobb-Douglas Production function; Polynomial Regression Model; Testing for structural or Parametric stability of regression Models; the Chow test	6
5.	Dummy Variable (DV) Regression Models Nature; ANOVA models; Regression with a mixture of Quantitative and Qualitative regressors: The ANCOVA Models; DV alternative to the Chow Test; Interaction effects using Dummy Variable; Use of DV in seasonal Analysis	6
Total		40

3	Contribution of Indian Mathematicians in the field of Mathematics: Value of Pi, The symbol zero, Number theory, Trigonometry, and Mensuration, Hindu Multiplication, Long Division, Indeterminate equation	7
4	Mathematicians Around the world: Newton, Leibnitz, Cauchy, Lagrange in the field of Geometry, Calculus, Algebra, Probability	7
5	Algebra in the Renaissance: Solution of cubic equation, Ferrari's Solution in the quartic equation, Irreducible Cubics and complex numbers	7
6	Paradoxes, Fallacies and Pitfalls of Mathematics	7
Total		42

11. Suggested books

S.No.	Name of Books, Authors, Publishers
1.	History of Mathematics, by Carl B Boyer, Wiley International edition, 1968.
2.	Mathematics of Music, Susan Kelly, UW-L Journal of under graduate research, Vol-XIV, 2011.

ME 351 POWER PLANT ENGINEERING

- | | |
|--------------------------------|---|
| 1. Subject Code: ME 351 | Course Title: Power Plant Engineering |
| 2. Contact Hours: 42 | : L: 3 T: 0 P: 0 |
| 3. Examination Duration (Hrs.) | : Theory: 3 Practical: 0 |
| 4. Relative Weight | : CWS: 25 PRS: 0 MTE: 25 ETE: 50 PRE: 0 |
| 5. Credits | : 3 |
| 6. Semester | : V |
| 7. Subject Area | : OEC |
| 8. Pre-requisite | : NIL |
| 9. Objective | : To familiarize the students with thermodynamic cycles and various components of power plants. |

10. Details of Course:

S. No.	Contents	Contact Hours
1	Indian energy scenario, Indian coals: formation, properties, analysis, beneficiation and heating value calculation of coals; coking and non-coking coals, fuel handling systems; coal gasification. Classification of power plants, base load and Peak load power stations, co-generated power plant, captive power plant, and their fields of application & selection criteria,.	7
2	Steam Generators: High pressure utility boiler, natural and forced circulation, coking and non-coking coal, coal beneficiation, coal pulverization, pulverized fuel firing system, combustion process, need of excess air, cyclone furnace, fluidized bed boiler, electrostatic precipitators and wet scrubbers, boiler efficiency calculations, water treatment.	7
3	Combined Cycle Power Plants: Binary vapour cycles, coupled cycles, gas turbine- steam turbine power plant, gas pipe line control, MHD-Steam power plant.	7
4	Other power plants: Nuclear power plants - working and types of nuclear reactors, boiling water reactor, pressurized water reactor, fast breeder reactor, controls in nuclear power plants, hydro power plant -classification and working of hydroelectric power plants, tidal power plants, diesel and gas power plants.	7
5	Instrumentation and Controls in power plants: Important instruments used for temperature, flow, pressure, water/steam conductivity measurement; flue gas analysis, drum level control, combustion control, super heater and re-heater temperature control, furnace safeguard and supervisory system (FSSS), auto turbine run-up system(ATRS).	7
6	Environment Pollution and Energy conservation: Economics of power generation: load duration curves, power plant economics, pollution from power plants, disposal/management of nuclear power plant waste, concept of energy conservation and energy auditing.	7
Total		42

11. Suggested Books:

S. No.	Name of Authors /Books / Publishers
1	Power Plant Engineering by M.M. Elwakil, Tata McGraw Hill, ISBN- 0070662746.
2	Power Plant Engineering by P.K Nag, Tata McGraw Hill, ISBN- 0070435993.
3	Steam and Gas turbines by A Kostyuk and V Frolov, MIR Publishers, ISBN- 9785030000329.
4.	Modern Power Plant Engineering by J Wiesman and R Eckart, Prentice hall India Ltd, ISBN- 97801359725.
5.	Planning Fundamentals of thermal Power Plants by F.S Aschner, John Wiley, ISBN- 07065159X.
6.	Applied Thermodynamics by T.D Eastop and McConkey, Longman Scientific and Technical, ISBN- 0582305351.
7.	CEGB volumes on power plant, Cwntral Electricity Generation Board, ISBN- 0080155680.
8.	NTPC/NPTI publications on Power plants, ISBN- 9788132227205.

ME353 RENEWABLE SOURCES OF ENERGY

- | | |
|--------------------------------|---|
| 1. Subject Code: ME 353 | Course Title: Renewable Sources of Energy |
| 2. Contact Hours: 42 | : L: 3 T: 0 P: 0 |
| 3. Examination Duration (Hrs.) | : Theory: 3 Practical: 0 |
| 4. Relative Weight | : CWS: 25 PRS: 0 MTE: 25 ETE: 50 PRE: 0 |
| 5. Credits | : 3 |
| 6. Semester | : V |
| 7. Subject Area | : OEC |
| 8. Pre-requisite | : NIL |
| 9. Objective | : To familiarize the students with renewable energy sources like solar, geothermal, wind and tidal. |

10. Details of Course:

Unit No.	Contents	Contact Hours
1	Man and Energy, world production and reserve of conventional energy sources, Indian production and reserves, Energy alternatives	7
2	Solar radiation: Origin, nature and availability of solar radiation, estimation of solar radiation. Photovoltaic cells. Design consideration and performance of different types of solar cells. Flat plate, focusing collectors. Effects of receiving surface location and orientation.	7
3	Devices for solar thermal collection and storage. Energy storage devices such as water storage systems, packed Bed storage systems, phase change storage systems. Heat transfer considerations relevant to solar energy. Characteristics of materials and surfaces used in solar energy absorption.	7
4	Application systems for space heating, solar water pumps, solar thermal pond, Solar Thermal Power plants, solar distillation, Solar Refrigeration and solar air conditioning, other solar energy utilization.	7
5	Solar PV systems. Fuel Cell Technologies. Generation and utilization of biogas, design of biogas plants, Wind energy systems.	7
6	Geothermal Energy Systems. Tidal energy systems. Oceanic power generation. Design considerations, Installation and Performance Evaluation. MHD power generations. Role of the nonconventional energy sources in power planning.	7
Total		42

11. Suggested Books:

S. No.	Name of Authors /Books / Publishers
1	G. D. Rai, "Energy Technolgy", Khanna Publishers, ISBN- 97881740907438.
2	S.P. Sukhatme, " Solar Energy", Tata-Mcgraw hill, New Delhi, ISBN- 0074624531.
3	"Solar Energy thermal process" JADuffie and W.A. Beckman, John Wiley& sons, New York, ISBN- 1118418123.

4. Relative Weight : CWS: 25 PRS: 0 MTE: 25 ETE: 50 PRE: 0
5. Credits : 3
6. Semester : V
7. Subject Area : OEC
8. Pre-requisite : NIL
9. Objective : To familiarise the students with the process of thermodynamic analysis of engineering systems and to enhance critical thinking and provide them with a wider view to handle engineering problems.

10. Details of Course:

S. No.	Contents	Contact Hours
1	Fundamentals: properties of pure substance in Solid, Liquid and Vapour Phases, PVT Behavior of simple compressible system, T-S and H-S diagram, Steam Tables, determination of quality of steam, Throttling Calorimeter, Combined Separating & Throttling Calorimeter, Maxwell and other thermodynamics relations, mixture of non reactive ideal gases, Real gases, Compressibility chart, Law of corresponding state, Air water vapor mixture, calculation of properties of air water vapour mixture.	7
2	Rankine Cycle And Analysis: Rankine cycle and its representation on T-S and H-S diagrams; Effect of low backpressure and high entry pressure and temperature and its limitations; necessity of re-heating, ideal and actual regenerative feed water heating cycle and its limitations. Typical feed water heating arrangements for various capacity power plants.	7
3	Introduction To Boilers: Classification of Boilers, Boiler mountings and accessories; draft systems, circulation system; Combustion and its calculations, and Boiler performance.	7
4	Steam Nozzles: Types of Nozzles, Flow of steam through nozzles; Condition for maximum discharge through nozzle; Nozzle efficiency. Effect of friction and Supersaturated flow through nozzle.	7

5	Steam Turbines : Working principle and types of steam turbines; Velocity diagrams for impulse and reaction turbines, compounding of impulse turbines; Optimum velocity ratio and maximum efficiency. Comparison of impulse and reaction turbines. Condition line and reheat-factor, losses in steam turbines; governing of steam turbines.	7
6	Condensers and Cooling towers: Types and working of condensers, types and performance of cooling towers.	7
Total		42

11. Suggested Books:

S. No.	Name of Authors /Books / Publishers
1	Engineering Thermodynamics by P.K.Nag, Tata McGraw Hill Publishing Company Limited, ISBN – 1259062562, 2013.
2	Engineering Thermodynamics by Rogers, Pearson Education, ISBN- 631197036.
3	Thermodynamics by Kenneth Wark, Mcgraw-hill Book Company, 5 th edition, ISBN- 0070682860, 1988.
4.	Engineering Thermodynamics: work and heat transfer by Gordon Rogers and Yon Mayhew, Longman, 4 th edition, ISBN – 0471861731, 1992.
5.	Fundamentals of Classical Thermodynamics by Van Wylen and Sonntag, John Wiley & Sons Inc., 3 rd edition, ISBN – 0471861731, 1986.
6.	Fundamentals of Engineering Thermodynamics by Moran and Shaprio, John Wiley & Sons, Inc., 7th edition, ISBN – 0470917687, 2010.
7.	Thermodynamics: An Engineering Approach by Cengel and Boles, The McGraw-Hill Companies, 8 th edition, ISBN: 0073398179, 2014.
8.	Applied Thermodynamics for Engineering Technologists by T.D. Eastop, Prentice Hall, 5 th edition, ISBN- 05820919344, 1993.
9.	Treatise on Heat Engineering by V. P.Vasandani and D.S. Kumar, Metropolitan Book Co. (p) Ltd., ISBN- 810003500.

3	Refrigerants and Absorption Refrigeration: Desirable properties of refrigerants, classification of refrigerants used, nomenclature, ozone depletion, global warming, vapor absorption system, calculation of max COP.	4
4	Air Conditioning: Psychometric properties & processes, comfort air-conditioning, summer and winter air-conditioning, cooling & dehumidification systems, load calculation and applied psychrometry.	7
5	Human Comfort: Requirements of human comfort and concept of effective temperature, comfort chart, comfort air-conditioning, requirements of industrial air-conditioning, air-conditioning load calculations.	7
6	Control: Refrigeration and air-conditioning control, air handling, air distribution and duct design	7
Total		42

11. Suggested Books:

S. No.	Name of Authors /Books / Publishers
1	Refrigeration and Air Conditioning by C. P. Arora, Tata McGraw Hill, ISBN- 9788120339156.
2	Refrigeration and Air Conditioning by A. R .Trott and T. C. Welch, Butterworth-Heinemann, ISBN- 9780080540436.
3	Refrigeration and Air ConditioningTechnology by Whitman, Jhonson and Tomczyk, Thomson Delmer Learning, ISBN- 1111644470.
4	Refrigeration and Air Conditioning by Abdul Ameen, Prentice Hall of India Ltd, ISBN- 9789303206560..
5	Basic Refrigeration and Air Conditioning by P. N. Ananthanarayan, Tata McGraw Hill, ISBN- 9789383286560.
6	Refrigeration and Air Conditioning by Wilbert F. Stoecker and Jerold W. Jones, Tata McGraw Hill, ISBN- 007061623X.
7.	Refrigeration and Air Conditioning by Richard Charles Jordan, Gayle B. Priester, Prentice hall of India Ltd, ISBN-9780406269313.

3	Production Planning and Control Types and characteristics of production systems Objective and functions of Production, Planning & Control, Routing, Scheduling and Operations scheduling, production scheduling, job shop scheduling problems, sequencing problems, scheduling tools and techniques, Loading, Dispatching and its sheets & Gantt charts	7
4	Quality Engineering Quality concept and costs; statistical quality control, Concept of specification limits, statistical control limits, process capability, Process control and control charts for both attributes and variable data. Acceptance Sampling- Single and double sampling	7
5	Reliability and Maintenance Reliability, availability and maintainability; distribution of failure and repair times; determination of MTBF and MTTR, reliability models; system reliability determination; Maintenance management and its objectives, Various types of Maintenance Planning, House Keeping, 5S concepts	7
6	Material Handling Principles, functions, and objectives of Material Handling; Selection and classification of Material Handling Equipments; Relation of material handling with plant layout	7
Total		42

11. Suggested Books

S. No.	Name of Authors /Books / Publishers
1	Industrial Engineering and Management; B. Kumar, Khanna Publication, ISBN- 8174091963, 2011.
2	Introduction to work Study, International Labour Office, Geneva, 3 rd edition, Oxford and IBH publishing Co. Pvt. Ltd, New Delhi, ISBN- 8120406028, 2008.
3	Industrial Engineering and Management, Pravin Kumar, Pearson Education, 1 st edition, ISBN- 9789332543560, 2015.

5	Material selection: Materials in design. The evolution of engineering materials. Design tools and material data. Material selection strategy, attribute limits, selection process, material selection. Case studies	5
6	Process selection: Introduction. Process classification: shaping, joining and finishing. Systematic process selection, process cost. Computer – aided process selection	5
7	Design for manufacture and assembly: Design for Manufacture and Assembly (DFMA). Reasons for not implementing DFMA. Advantages of DFMA with case studies. Design features and requirements with regard to assembly, Design for Manufacture in relation to any two manufacturing processes: machining and injection molding. Need, objectives	4
8	System Simulation: Techniques of simulation, Monte Carlo method, Experimental nature of simulation, Numerical computation techniques, Continuous system models, Analog and Hybrid simulation, Feedback systems, Computers in simulation studies, Simulation software packages	4
9	Simulation of Mechanical Systems: Building of Simulation models, Simulation of translational and rotational mechanical systems, Simulation of hydraulic systems	4
Total		42

11. Suggested Books:

S. No.	Name of Authors /Books / Publishers
TEXT BOOKS:	
1	David G Ullman, "The Mechanical Design Process." Publisher- McGrawhillIncSingapore, ISBN-13: 9780072975741, 1992.
2	Kevin Otto & Kristin Wood Product Design: "Techniques in Reverse Engineering and new Product Development." 1 / e 2004 , Publisher- Pearson Education New Delhi , ISBN-13: 9780130212719,
3	L D Miles "Value Engineering."Publisher- McGraw-Hill, 1972
4	Karl T Ulrich, Steven D Eppinger , " Product Design &Development."Publisher- Tata McGrawhill New Delhi, ISBN-13: 9780078029066, 2003

8. Pre-requisite : NIL
9. Objective : To enable students to apply Galerkin method and virtual work principle to problems in solid mechanics. To teach them numerical solution of differential equations with finite element method.

10. Details of Course:

Unit No.	Contents	Contact Hours
1	Fundamental concepts of the Finite Element Method. One Dimensional Problem(Bar of uniform and variable cross sections), The Galerkin Approach, The potential –Energy Approach, shape Functions, Derivation of stiffness matrix and load vector for the element and for the entire domain. Evaluation of displacement, stresses and reaction forces.	12
2	Trusses :- Introduction, Plane Trusses, Local and Global coordinate Systems, Element Stiffness Matrix and Stress calculations	3
3	Two –Dimensional problem using Constant strain triangles(CST), Two-dimensional isoparametric elements and numerical integration ,element stiffness matrix, Force vector.	6
4	Applications of finite element method to heat transfer.	4
5	Application of finite element method to electrical systems.	10
6	Dynamic analysis :- Element mass matrices,Evaluation of Eigenvalues and Eigenvectors. Use of Softwares such as MAT LAB/ABAQUS/ANSYS/ NASTRAN/ IDEAS. Basic feature of these softwares.	7
Total		42

Unit No.	Contents	Contact Hours
1	Introduction: Extensive definition of Concurrent Engineering (CE), CE design methodologies, Review of CE techniques like DFM (Design for manufacture), DFA (Design for assembly), QFD (Quality function deployment), RP (Rapid prototyping), TD (Total design), for integrating these technologies, Organizing for CE, CE tool box, Collaborative product development	8
2	Use of Information Technology: IT support, Solid modeling, Product data management, Collaborative product Commerce, Artificial Intelligence, expert systems, Software hardware component design.	8
3	Design Stage: Lifecycle design of products, Opportunities for manufacturing enterprises, Modality of concurrent engineering design, automated analysis, Idealization control, CE in optimal structural design, Real time constraints	8
4	Need for PLM: Importance of PLM, Implementing PLM, Responsibility for PLM, Benefits to different managers ,Components of PLM, Emergence of PLM, Lifecycle problems to resolve, Opportunities to seize	9
5	Components of PLM: Components of PLM, Product lifecycle activities, Product organizational structure, Human resources in product lifecycle, Methods, techniques, Practices, Methodologies, Processes, System components in lifecycle, slicing and dicing the systems, Interfaces, Information, Standards	9
Total		42

11. Suggested Books:

S. No.	Name of Authors /Books / Publishers
1	Integrated Product Development M.M. Anderson and L Hein IFS Publications
2	Design for Concurrent Engineering J. Cleetus CE Research Centre, Morgantown
3	Concurrent Engineering Fundamentals: Integrated Product Development Prasad Prentice hall India

8. Pre-requisite : Nil
9. Objective : Familiarizing the students with the financial environment of business, especially the financial markets and acquaint them with accounting mechanics, process and system.

10. Details of Course:

Unit No.	Detail Contents	Contact Hours
1	Introduction to Management :Basic concepts of management, management process, principles of management, functions, levels, managerial roles and skills, managerial ethics and corporate social responsibility	8
2	Introduction to Financial Environment and accounting: Financial Markets - Capital Markets, Basics of capital market mechanism, instruments, financing and rating institutions. Importance, Objectives and Principles of Accounting, Accounting Concepts and conventions, and the Generally Accepted Accounting Principles (GAAP) Overview of the Accounting Process. Accounting standards as Issued by Institute of Chartered Accountants of India (ICAI).	10
3	Overview of Business Activities and Principal Financial Statements: Observe the types of information provided by the three principal financial statements and how firms might use this information in managing and evaluating a business. Understand the rationale and the information value of the statements of Balance Sheet, Profit and Loss statement, cash flows.	8
4	Financial Analysis-I: Distinction between cash profits and book profits. Understanding the cash flow statement and the funds flow statement.	8
5	Financial Analysis –II: Importance, objectives and concept of Ratio Analysis- Liquidity, leverage, solvency and profitability ratios.	8
Total		42

11. Suggested Books

S. No.	Name of Books / Authors/ Publishers
1	Fundamental of Management, Stephen P. Robbins, David A. De Cenzo and Mary Coulter, Pearson Education,2011, ISBN- 978-0273755869
2	Introduction to Accountancy, 10 ed., T.S. Grewal, S. Chand and Company (P) Ltd., New Delhi,2009, ISBN- 9788121905695
3	Advance Accounts by M.C Shukla and T.S Grewal and SC Gupta, S. Chand and Company (P) Ltd., New Delhi,1997, ISBN- 9788121902786
4	Financial Accounting, 4 ed, S.N. Maheshwari and S.K. Maheshwari, Vikas Pulication,2005, ISBN- 8125918523
5	Financial Accounting Reporting & Analysis, Cengage, 7/e, W Albrecht Stice & James Stice, Cengage Learning,2010, ISBN- 0538746955

MG353 FUNDAMENTALS OF MARKETING

1. Subject Code : **MG353** Course Title : **Fundamentals of Marketing**
2. Content Hours : L: 3 T: 0 P: 0
3. Examination Duration (ETE)(Hrs.) : Theory: 3 Hrs Practical 0
4. Relative Weightage : CWS:25 PRS MTE:25 ETE:50 PRE
5. Credits : 3
6. Semester : V
7. Subject Area : OEC
8. Pre-requisite : Nil
9. Objective : The basic objective of this paper is to make students aware of fundamental concepts of marketing necessary for making decisions in complex business situations by managers and start up entrepreneurs.

10. Details of Course:

Unit No.	Detail Contents	Contact hours
1	Basic concepts of management: management process, principles of management, functions, levels, managerial roles and skills, managerial ethics and corporate social responsibility	8
2	Introduction to marketing: nature and scope of marketing, marketing mix, marketing vs. sales, role of marketing in society, interface of marketing with other departments in organization, Customer Life Time Value, ethical issues in marketing Concept of market segmentation: consumer and industrial, targeting and positioning, sales forecasting	9
3	Product mix decisions: new product development process, test marketing, concept of Product Life Cycle, product packaging decisions	8
4	Pricing decisions : consideration in setting price, major pricing strategies, promotional mix decisions: advertising, sales promotion, personal selling, publicity, opportunities and avenues of online promotion	9
5	Promotion and distribution decisions : design and management of distribution channel for physical products and services, reasons of channel conflict, handling strategies, basic challenges in supply chain management of e-commerce firms	9
Total		42

11. Suggested Books

Unit No.	Name of Books / Authors/ Publishers
1	Fundamental of Management, Stephen P. Robbins, David A. De Cenzo and Mary Coulter, Pearson Education, 2011, ISBN-978-0273755869
2	Marketing Management, 14 th ed., Philip Kotler , Kevin Lane Keller, Abraham Koshy and MithileswarJha, Pearson Education, New Delhi, 2013,(ISBN-10: 9788131767160)

2.	Introduction: Concept, nature, scope, objectives and importance of HRM; Evolution of HRM; Environment of HRM; Personnel Management vs HRM. Acquisition of Human Resources: HR Planning; Job analysis – job description and job specification; recruitment – sources and process; selection process – tests and interviews; placement and induction. Job changes – transfers, promotions/ demotions, separations.	9
3.	Training and Development: Concept and importance of training; types of training; methods of training; design of training programme; evaluation of training effectiveness; executive development – process and techniques; career planning and development.	8
4.	Performance Appraisal: Performance appraisal – concept and objectives; traditional and modern methods, limitations of performance appraisal methods.	8
5.	Compensation and Maintenance: Compensation: job evaluation – concept, process and significance; components of employee remuneration – base and supplementary; maintenance: overview of employee welfare, health and safety, social security.	9
Total		42

11. Suggested Books

S. No	Name of the book /Authors /Publishers
1	Fundamental of Management, Stephen P. Robbins, David A. De Cenzo and Mary Coulter, Pearson Education, 2011, ISBN-978-0273755869
2	Human Resource Management, G. Dessler, B. Varkkey, Pearson prentice Hall, 2011, (ISBN – 978-81-317-5426-9)
3	International HRM a cross cultural approach, T. Jackson, Sage publications, London, 2002, (ISBN – 0-7619-7404-0)
4	HRM and Performance: Achievements and Challenges, D. E. Guest, J .Paauwe, P. Wright, John Wiley and sons, UK, 2013, (ISBN – 978-1-118-48261-2)
5	A Handbook of Human Resource Management Practice, M. Armstrong, Kogan Page Limited, UK, 2007 ,(ISBN – 978–0–7494–4631-4)

MG357 KNOWLEDGE AND TECHNOLOGY MANAGEMENT

1. Subject Code : **MG 357** Course Title : **Knowledge and Technology Management**
2. Content Hours : L: 3 T: 0 P: 0
3. Examination Duration (ETE)(Hrs.) : Theory: 3 Hrs Practical 0
4. Relative Weightage : CWS:25 PRS MTE:25 ETE:50 PRE
5. Credits : 3
6. Semester : V
7. Subject Area : OEC
8. Pre-requisite : Nil
9. Objective : Preparing the students to understand how the new age organizations are leveraging on the power of knowledge and technology. Acquiring the knowledge to address the issues faced by the corporate world for a deeper understanding.

10. Details of Course:

Unit No.	Contents	Contact Hours
1.	Basic concepts of management , management process, principles of management, functions, levels, managerial roles and skills, managerial ethics and corporate social responsibility	8
2.	Introduction to Knowledge Management: Data, Information, Knowledge Management (KM), Knowledge Society, Knowledge Economy, Types of Knowledge, Tacit knowledge and explicit knowledge, Essential components of KM model Building Knowledge Assets: Various knowledge assets, Tools of Knowledge, Knowledge Audit, AAR (After Action Review), Analyzing current knowledge state.	9

3.	Creating Strategies for Success: KM strategy, Codification, Personalization, Knowledge Management Implementation, Generating a KM-specific vision, Integrating organizational and business goals with KM, Choosing the right KM techniques, Relevant case studies in this area.	9
4.	Understanding Technology: Definition, Key concepts, Need for technology, History of technological developments, Role and importance of technology in 21st century, Recent developments in the field of technology.	8
5.	Technology-Management integration: Management as a concept, Technology management, Life cycle approach to technology management, Innovation, Creativity, Technology innovation process.	8
Total		42

11. Suggested Books

S. No.	Name of Books /Authors/Publishers
1.	Fundamental of Management, Stephen P. Robbins, David A. De Cenzo and Mary Coulter, Pearson Education,2011, ISBN-978-0273755869
2	Knowledge Management in Organizations: A Critical Introduction, Donald Hislop, Oxford University Press,2013, ISBN: 9780199691937.
3	The Knowledge-Creating Company: How Japanese Companies Create the Dynamics of Innovation, IkujiroNonaka and Hirotaka Takeuchi, Oxford University Press,1995, ISBN: 0195092694.
4	Hitotsubashi on Knowledge Management (Hardcover), Hirotaka Takeuchi and IkujiroNonaka, John Wiley and Sons, 2004, ISBN: 0470820748.
5	Management of Technology: The Key to Competitiveness and Wealth Creation, Tarek Khalil and Ravi Shankar, McGraw Hill Education (India) Private Limited, 2nd Edition, 2012, ISBN: 9780070677371.

PE351 ADVANCED MACHINING PROCESS

1. Subject Code: **PE-351** Course Title: **Advanced Machining Process**
2. Contact Hours : L: 3 T: 0 P: 0
3. Examination Duration (Hrs.) : Theory: 3 Practical: 0
4. Relative Weight : CWS: 25 PRS: 0 MTE: 25 ETE: 50 PRE: 0
5. Credits : 3
6. Semester : V
7. Subject Area : OEC
8. Pre-requisite : NIL
9. Objective : To understand basic principles of various processes and their applications. State various parameters influencing the machining process.
10. Details of Course:

Unit No.	Contents	Contact Hours
1	Introduction, need of advanced machining processes, hybrid processes, microelectro mechanical system, (MEMS), nano electromechanical systems(NEMS),Ultrasonic micro machining - mechanics of cutting, parametric analysis, process capabilities, applications.	7
2	Abrasive jet machining: Introduction, set ups, gas propulsion system, abrasivefeeder, machining chamber, AJM nozzle, abrasive parametric analysis, processcapabilities, applications, abrasive micro machining, Water jet machining:Introduction, process characteristics, process performance, applications, Abrasive Water jet machining: Abrasive finishing process: Working principle, parametric analysis, process variables, process performance and applications,	8

6. Semester : V
7. Subject Area : OEC
8. Pre-requisite : NIL
9. Objective : To understand the key considerations at the various stages involved in the supply of product in order to maintain the smooth flow from source to the point of consumption so that overall organizational performance may improve.

10. Details of Course:

Unit No.	Contents	Contact Hours
1	Introduction: Perspective of Supply Chain Management, Managing uncertainty, Key issue in supply chain management.	6
2	Inventory Management and Risk Pooling: Inventory management, Classification of inventory, Centralized versus Decentralized Warehousing and Risk pooling, Value of Information, Quantification of Bullwhip effect, Causes and remedies of Bullwhip effect.	8
3	Resource planning: Aggregate Production Planning- Chase and leveling strategies, MRP, MRP-II, Agile manufacturing Systems	6
4	Procurement and Outsourcing strategies: Introduction, outsourcing benefits and risks, Make/Buy decision, e-procurement, Vendor selection and quota allocation.	7
5	Strategic Alliances: Introduction, Third party logistics, Demand driven strategies, Distribution strategies- direct shipment, cross docking, transshipment, Supplier relationships management, Customer relationship management.	8
6	International Issues in Supply Chain Management: Concepts in Globalization, Globalization forces, Risks and Advantages of International supply chains, Issues in International supply chain management, Regional differences in logistics.	7
Total		42

2	Human factor in work-study: Relationship of work-study man with management, supervisor & workers, qualities of a work-study man.	5
3	Method-study: Definition, objectives, step-by-step procedure, questioning techniques, charts and diagrams for recording data. Like outline process charts, flow process charts, multiple activity charts, two handed process chart, string diagram, travel chart, cycle graph, Chrono-cycle graph, therbligs, micro motion study and film analysis, Simo chart, principles of motion economy. Development and installation of new method..	9
4	Work-Measurement: Definition, various techniques of work-measurement work-sampling, stopwatch time study & its procedure, Job selection, Equipment and forms used for time study, rating, methods of rating, allowances and their types, standard time, numerical problems, predetermined - time standards and standard data techniques. Incentive: Meaning, objectives of an incentive plan, various types of incentive plans	9
5	Ergonomics: Introduction, history of development, man-machine system and its components. Introduction to structure of the body- features of the human body, stress and strain, metabolism, measure of physiological functions- workload and energy consumption, biomechanics, types of movements of body members, strength and endurance, speed of movements. NIOSH lifting equation, Lifting Index, Maximum acceptable Weights and Forces, Distal upper extremities risk factors, Strain Index, RULA, REBA.	8
6	Applied anthropometry - types, use, principles in application, design of work surfaces and seat design. Visual displays for static information, visual displays of dynamic information, auditory, tactual and olfactory displays and controls. Assessment of occupational exposure to noise, heat stress and dust .Effect of vibration/ noise, temperature, illumination and dust on human health and performance	7
Total		42

11. Suggested Books:

S. No.	Title, Author, Publisher and ISBN No.
1.	Barnes Ralph M., "Motion & Time study: Design and Measurement of Work", Wiley Text Books, ISBN-10: 8126522178, 2009.

2	<p>Product life cycle: New product introduction: early introduction, increased product life. Life cycle management tool, System integration, QFD, House of quality, Pugh's method, Pahl and Beitz method. Case studies.</p>	6
3	<p>Value engineering: Introduction, nature and measurement of value. Value analysis, job plan. Creativity and techniques of creativity. Value analysis test. Case studies.</p> <p>Material selection: Materials in design. The evolution of engineering materials. Design tools and material data. Functional material, shape and process. Material selection strategy, attribute limits, selection process, common methods of material selection. Case studies.</p>	6
4	<p>Concurrent/ reverse engineering: Introduction, basic principles, components, benefits of concurrent engineering. Concept of reengineering.</p> <p>Process selection: Introduction. Process classification: shaping, joining and finishing. Systematic process selection, Ranking, process cost. Computer – aided process selection.</p>	6
5	<p>Design for manufacture and assembly: Design for Manufacture and Assembly (DFMA). Reasons for not implementing DFMA. Advantages of DFMA with case studies. Design features and requirements with regard to assembly, product Design for Manufacture in relation to any two manufacturing processes: machining and injection molding. Need, objectives.</p>	8
6	<p>System Simulation: Techniques of simulation, Monte Carlo method, Experimental nature of simulation, Numerical computation techniques, Continuous system models, Analog and Hybrid simulation, Feedback systems, Computers in simulation studies, Simulation software packages.</p> <p>Simulation of Mechanical Systems: Building of Simulation models, Simulation of translational and rotational mechanical systems, Simulation of hydraulic systems.</p>	10
Total		42

4. Relative Weight : CWS: 25 PRS: 0 MTE: 25 ETE: 50 PRE: 0
5. Credits : 3
6. Semester : V
7. Subject Area : OEC
8. Pre-requisite : NIL
9. Objective : To understand the philosophy and core values of Total Quality Management (TQM); determine the voice of the customer and the impact of quality on economic performance and long-term business success of an organization;

10. Details of Course:

Unit No.	Content	Contact Hours
1	Introduction to Quality- Definition of Quality- product, user, value, and manufacturing based perspectives, Dimensions of Quality, Quality Planning, Quality costs- optimization of quality costs, seven tools of quality control;Philosophies of Quality Gurus- Deming, Juran, Crosby, Feigenbaum, Ishikawa, Taguchi. Comparison of Quality Philosophies.	9
2	Statistical Process Control- Introduction to Quality characteristics-variables and attributes, Types and causes of variations, Control Charts for variables and attributes, Process capability.	8
3	Acceptance Sampling- Sampling process and lots formation; Advantages and applications of acceptance sampling; characteristics of O.C. Curve; Single, double, multiple, sequential sampling; ASN, ATI, AOQL, AOQ, AQL, LQL, Producer's and Consumer's risks.	7
4	Six Sigma and ISO 9000:2000- Principles of Six Sigma, Statistical basis, Tools and techniques, DMAIC principle, application of six sigma in manufacturing and service organizations, structure of ISO standards, Factors leading to ISO, Implementation and registration, Benefits of ISO.	6

5	Life Testing-Reliability -Life testing: objective, failure data analysis, MTTF, MTBF, hazard rate, exponential and Weibull models, system reliability-series, parallel and mixed configurations, Markov model.	6
6	Reliability Design and Allocation - Design for reliability, reliability improvement techniques, active redundancy and standby redundancy, K-out-of-N redundancy and maintenance policies.	6
Total		42

11. Suggested Books:

S. No.	Title, Author, Publisher and ISBN No.
1.	Evans JR,Lindsay WM, "The Management and Control of Quality", Cengage learning, India, ISBN-10: 8131501361, 2011
2	BediKanishka,"Quality Management",Oxford University Press India, ISBN-10: 0195677951, 2006
3	Besterfield,"Total Quality Management", Pearson Education, ISBN-10: 9332534454, 2015
4	Gryna FM, Chua RCH, Defeo JA, "Juran"s Quality Planning and Analysis for Enterprise Quality", McGraw Hill Education (India) Private Limited, ISBN-10: 0070618488, 2006

PT361 HIGH PERFORMANCE POLYMERS

- | | |
|--------------------------------|---|
| 1. Subject Code: PT361 | Course Title: High Performance Polymers |
| 2. Contact Hours | : L: 03 T: 00 P: 00 |
| 3. Examination Duration (Hrs.) | : Theory: 03 Practical: 00 |
| 4. Relative Weight | : CWS: 25 PRS: 00 MTE: 25 ETE: 50 PRE: 00 |
| 5. Credits | : 03 |
| 6. Semester | : V |
| 7. Subject Area | : OEC |
| 8. Pre-requisite | : NIL |

9. Objective : To impart knowledge about heat resistant polymers, liquid crystalline polymers, conducting and other special polymers.

10. Details of Course

S. No.	Contents	Contact Hours
1	Heat resistant polymers: Requirements for heat resistance, Determination of heat resistance, Synthesis, Structure-property relationships, Applications of heat resistant polymers like polyamides, polyimides and its derivatives, polyquinolines, polyquinoxalines, PBT, PBO, PBI, PPS, PPO, PEEK, engineering plastic blends.	9
2	Liquid crystalline polymers, Concept of liquid crystalline phase, Theories of liquid crystallinity, Characteristics of LC state and LCPs, Rheology of liquid crystalline polymers, Blends of LCPs, Self reinforced composites, Applications.	9
3	Conducting polymers, Conduction mechanism, semi-conductors and conducting polymers, Band theory, Doping of polymeric systems, Processing and testing of conducting polymers, Applications and recent advances in conducting polymers.	9
4	Synthesis and applications of photosensitive polymers, Curing reactions.	6
5	Polymers in specialty applications: Polymers in agricultural applications, Green houses, Mulches, Control release of agricultural chemicals, Seed coatings, Polymers in construction and building applications.	9
Total		42

11. Suggested Books

S. No.	Name of Books/Authors/Publisher
1	Encyclopedia of Polymer science and Engineering Vol.1-17/ J.I. Kroschwitz, 2007
2	Additive for coatings/ John Bieleman/ Wiley-VCH, 2000.
3	Fire Properties of Polymeric Composites Materials/ A.P. Mouritz, A G. Gibson/ Springer, 2006.

5. Credits : 03
6. Semester : V
7. Subject Area : OEC
8. Pre-requisite : NIL
9. Objective : To make student aware about the fundamentals and applications of non-conventional energy.

10. Details of Course

Unit No.	Contents	Contact Hours
1	Renewable and non-renewable energy sources, trends in energy consumption, Global and National scenarios, Prospects of renewable energy sources, Energy Management.	6
2	Solar Energy: Solar radiation - beam and diffuse radiation, solar constant, earth sun angles, measurement of solar radiation, flat plate collectors, concentrating collectors, Solar air heaters-types, solar driers, Storage of solar energy-thermal storage, Photo voltaics - solar cells & its applications.	6
3	Wind Energy: Basic system principles, Assessment of wind available, Design principles, Manufactured designs, Sizing and storage of energy, System efficiency, Overview of wind industry.	4
4	Energy from Biomass: Calorific value of Biomass samples, Pyrolysis, Biomass conversion technologies, Biogas generation plants, classification, advantages and disadvantages, constructional details, site selection, digester design consideration, filling a digester for starting, maintaining biogas production, Fuel properties of bio gas, utilization of biogas.	6
5	Geothermal Energy: Estimation and nature of geothermal energy, geothermal sources and resources like hydrothermal, geo-pressured hot dry rock, magma. Advantages, disadvantages, and application of geothermal energy.	4

4. Relative Weight : CWS: 25 PRS: 00 MTE: 25 ETE: 50 PRE: 00
5. Credits : 03
6. Semester : V
7. Subject Area : OEC
8. Pre-requisite : NIL
9. Objective : To impart knowledge about polymer waste and their management.

10. Details of Course

Unit No.	Contents	Contact Hours
1	Polymer and Plastics Waste: Definition of plastics waste and the associated problems, Identification, collection methods and separation. Integrated waste management – source reduction, recycling, energy recovering process through thermal and biological destruction, Land filling and composting.	8
2	Plastics waste management: Source reduction, reuse, repair, recycling, and incineration with examples. Plastics recycling: Classification, Code of practice, Primary, secondary, tertiary and quaternary recycling with examples, Waste plastics as fillers.	8
3	Recycling and degradation of plastics: Recycling and sustainability correlation, Basic principles and recovery, recycling and resource conservation.	9
4	Recycling of plastics by surface refurbishing, Application of a coating, polishing, Plastics, Environmental and Thermal ageing, Chemical degradation, Wear and erosion, Biodegradable plastics – an overview.	9
5	Environmental issues, policies and legislation in India.	8
Total		42

S. No.	Contents	Contact Hours
1	Concepts of nanotechnology, Time and length scale in structures, Nanosystems, Dimensionality and size dependent phenomena, Surface to volume ratio-Fraction of surface atoms, Surface energy and surface stress, surface defects, Properties at nanoscale (optical, mechanical, electronic, and magnetic).	8
2	Nano-materials, Classification based on dimensionality, Quantum Dots, Wells and Wires, Carbon-based nano-materials, Metal based nano-materials, Nanocomposites, Nanopolymers, Nanoglasses, Nanoceramics, Biological nanomaterials.	8
3	Synthesis of nanopolymers, Chemical Methods, Metal Nanocrystals by Reduction, Solvothermal Synthesis, Photochemical Synthesis, Sonochemical Routes, Chemical Vapor Deposition, Metal Oxide - Chemical Vapor Deposition, Physical Methods such as ball Milling, electrodeposition, spray pyrolysis, flame pyrolysis, DC/RF magnetron sputtering, Molecular beam epitaxy.	9
4	Nanofabrication, Photolithography and its limitations, Electron beam lithography, Nanoimprint, Soft lithography patterning, Characterization with Field Emission Scanning Electron Microscopy, Environmental Scanning Electron Microscopy, High Resolution Transmission Electron Microscope, Scanning Tunneling Microscope, Surface enhanced Raman spectroscopy, X-ray Photoelectron Spectroscopy, Auger electron spectroscopy, Rutherford back scattering spectroscopy.	9
5	Applications of nanomaterials, Solar energy conversion and catalysis, Molecular electronics and printed electronics, Nanoelectronics, Polymers with aspecial architecture, Applications in displays and other devices, Nanomaterials for data storage, Photonics, Plasmonics, Nanomedicine, Nanobiotechnology and Nanotoxicology.	8
Total		42

11. Suggested Books

S. No.	Name of Books/Authors/Publisher
1	Organic and Inorganic Nanostructures/ Nabok/ Artech House, 2005.
2	Nanoscience: Nanotechnologies and Nanophysics/ Dupas, Houdy, Lahmani/ Springer-Verlag Berlin Heidelberg ,2007

3	Reinforcements, Properties and applications of Glass, Carbon, Kevlar, polyethylene, boron, ceramic and natural fibers. Concepts of matrix material, Thermoset matrix materials like - epoxy, polyester, vinyl esters, phenolic resin, polyimides, Thermoplastic matrix materials like - polyolefins, polyether ether ketones, polyphenylene sulfide, thermoplastic polyimides.	9
4	Concept of composites, particulate and fibrous composites, Properties of composites, Fabrication of continuous and short fiber composites and particulate composites, mechanical and physical properties	9
5	Applications of blends and composites for civil, aerospace, automobiles etc	8
Total		42

11. Suggested Books

S. No.	Name of Books/Authors/Publisher
1	Fibre Reinforced composites/ P. K. Malik/ Marcel Dekkar, 1988.
2	Composites Manufacturing: Materials, Product, and Process Engineering/ S.K. Mujumdar/ CRC press ,2002
3	Fibre-glass Reinforced Plastics/ N. P. Cheremisinoff (Ed)/ Noyce Pub, 1988.
4	Design Data for Reinforced Plastics/ N. L. Hancex, R. M. Mayer/ Chapman Hall, 1994.
5	Reinforced Plastics: Properties and Applications/ Raymond Seymour/ The Materials Information Society, 1991.

IT351 ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING

NAME OF DEPTT:

Information Technology

1. Subject Code: **IT351**

Course Title: **Artificial Intelligence and Machine Learning**

2. Contact Hours

: L: 3 T: 0 P: 0

3. Examination Duration (ETE)(Hrs.)

: Theory 3 Hrs Practical 0

4. Relative Weightage : CWS 25 PRS 0 MTE 25 ETE 50 PRE 0
5. Credits : 3
6. Semester : V
7. Subject Area : OEC
8. Pre-requisite : Knowledge of discrete mathematics
9. Objective : The student should be able to understand the different supervised, unsupervised and reinforcement learning algorithms and choose the appropriate machine learning tool for different real world examples.

10. Details of Course

S.No.	Contents	Contact Hours
1.	Introduction to Artificial Intelligence and Machine learning, State Space representation of problems, Concept of Search, overview of different tasks: classification, regression, clustering, control, Concept learning.	6
2.	Heuristic Search Techniques: Generate and Test, Hill Climbing, Best-first search, Branch and bound, A* algorithm, Game playing.	6
3.	Knowledge Representation: Propositional logic, Predicate Logic, semantic nets, frames	8
4.	Supervised Learning: Decision trees, nearest neighbors, linear classifiers and kernels, neural networks, linear regression; Support Vector Machines.	8
5.	Unsupervised Learning: Clustering, Expectation Maximization, Dimensionality Reduction, Feature Selection, PCA, factor analysis, manifold learning.	8
6.	Applications &Research Topics: Applications in the fields of web and data mining, text recognition, speech recognition	6
TOTAL		42

8. Pre-requisite : Nil
9. Objective : The objective of the course is to familiarize students with basic data structures and their use in fundamental algorithms.

10. Details of Course

S.No.	Contents	Contact Hours
1.	Introduction: Introduction to Algorithmic, Complexity- Time-Space Trade off. Introduction to C programming through Arrays, Stacks, Queues and Linked lists.	8
2.	Trees: Basic Terminology, Traversals, Binary search trees, optimal and average BST's. 2-4 trees, Applications of Binary search Trees, Complete Binary trees, Extended binary trees.	7
3.	Introduction to algorithms: Concept of algorithmic efficiency, run time analysis of algorithms, Asymptotic Notations. Growth of Functions, Master's Theorem, Searching and Searching: Linear Search, Binary search, Insertion Sort, Quick sort, Merge sort, Heap sort, Radix Sort.	9
4.	Graphs: Terminology and Representations, Graphs & Multi-graphs, Directed Graphs, Representation of graphs, Breadth first search and connected components. Depth first search in directed and undirected graphs and strongly connected components.	8
5.	Spanning trees: Prim's and Kruskal's algorithm, union-find data structure. Dijkstra's algorithm for shortest paths, shortest path tree. Directed acyclic graphs: topological sort and longest path. Dynamic programming: Principles of dynamic programming. Applications: Matrix multiplication, Travelling salesman Problem.	10
Total		42

11. Suggested Books

S.No.	Name of Books / Authors/ Publishers	Year of Publication/ Reprint
Text Books:		
1.	Horowitz and Sahni, "Fundamentals of Data structures", Galgotia publications	1983
2.	Tannenbaum, "Data Structures", PHI	2007(Fifth Impression)
3.	T .H . Cormen, C . E . Leiserson, R .L . Rivest "Introduction to Algorithms", 3 rd Ed., PHI.	2011 (reprint)
4.	E. Horowitz, S. Sahni, and S. Rajsekar, "Fundamentals of Computer Algorithms," Galgotia Publication	
Reference Books		
1.	R.L. Kruse, B.P. Leary, C.L. Tondo, "Data structure and program design in C", PHI	2009(Fourth Impression)
2.	Aho ,Ullman "Principles of Algorithms "	

IT355 COMMUNICATION AND COMPUTING TECHNOLOGY

NAME OF DEPTT:

Information Technology

1. Subject Code: **IT355**

Course Title: **Communication and Computing Technology**

2. Contact Hours

: L: 3 T: 0 P: 0

3. Examination Duration (ETE) (Hrs.)

: Theory 3 Hrs Practical 0

4. Relative Weightage

: CWS 25 PRS 0 MTE 25 ETE 50 PRE 0

5. Credits

: 3

6. Semester

: V

7. Subject Area

: OEC

8. Pre-requisite : Operating systems, Algorithm Design and Analysis and data structures

9. Objective : To introduce the concept of Communications in Computer networks

10. Details of Course

S.No.	Contents	Contact Hours
1.	Introduction to Goals and Applications of Networks, Network structure and architecture, The TCP/IP reference model, services, Network Topology.	6
2.	Data Link Layer and Medium Access sub layer - Channel Allocations, LAN protocols -ALOHA protocols - Overview of IEEE standards - FDDI. - Elementary Data Link Protocols, Sliding Window protocols.	6
3.	Network Layer: Routing, Congestion control, Internetworking -TCP / IP, IP packet, IP address, IPv6 and Mobile IP.	8
4.	Transport Layer: Design issues, TCP and UDP, connection management, Congestion control, Leaky bucket, Token bucket algorithm. QoS.	8
5.	Application Layer: File Transfer, Access and Management, Electronic mail, Virtual Terminals, Internet and Public Networks, Firewalls	6
6.	Information and Web security: IP Security, Architecture, Authentication header, Encapsulating security payloads, combining security associations, Secure Socket Layer(SSL) and transport layer security, TSP, Secure Electronic Transaction (SET), Electronic money.	8
TOTAL		42

11. Suggested Books

S.No.	Name of Books / Authors/ Publishers	Year of Publication/ Reprint
Text Book		
1.	S. Tananbaum, "Computer Networks", 3rd Ed, PHI	1999

2.	U. Black, "Computer Networks-Protocols, Standards and Interfaces", PHI	1996
3.	W. Stallings, "Computer Communication Networks", PHI	1999
3.	Data Communications and Networking, Behrouz A. Forouzan 5/e	2013
Reference Book		
4.	William Stallings, "Cryptography and Network Security: Principals and Practice", Prentice Hall, New Jersey.	2001
5.	Behrouz A. Forouzan, "Cryptography and Network Security", TMH.	2006

IT357 INTERNET AND WEB PROGRAMMING

NAME OF DEPTT:	Information Technology
1. Subject Code : IT357	Course Title: Internet and Web Programming
2. Contact Hours	: L: 3 T: 0 P: 0
3. Examination Duration (ETE) (Hrs.)	: Theory 3 Hrs Practical 0
4. Relative Weightage	: CWS 25 PRS 0 MTE 25 ETE 50 PRE 0
5. Credits	: 3
6. Semester	: V
7. Subject Area	: OEC
8. Pre-requisite	: Nil
9. Objective	: To introduce the concept of internet and web programming

10. Details of Course

S.No.	Contents	Contact Hours
1.	Internet and WWW: Internet basic, Introduction to internet and its applications, E- mail, telnet, FTP, e-commerce, video conferencing, e-business. Internet service providers, domain name server, internet address World Wide Web (WWW): World Wide Web and its evolution, uniform resource locator (URL), browsers - internet explorer, netscape navigator, opera, firefox, chrome, mozilla. Search engine, web saver - apache, IIS, proxy server, HTTP protocol.	6
2.	WEBSITES BASIC ANDWEB 2.0: Web 2.0: Basics-RIA Rich Internet Applications - Collaborations tools - Understanding websites and web servers: Understanding Internet – Difference between websites and web server- Internet technologies Overview – Understanding the difference between internet and intranet; HTML and CSS: HTML 5.0 , XHTML, CSS 3.	6
3.	E-MAIL SECURITY & FIREWALLS : PGP - S/MIME - Internet Firewalls for Trusted System: Roles of Firewalls - Firewall related terminology- Types of Firewalls - Firewall designs - SET for E-Commerce Transactions, intellectual property: copyright, patents, trademarks, cyber laws	8
4.	SERVELETS AND JSP: JSP Technology Introduction-JSP and Servelets- Running JSP Applications Basic JSP- JavaBeans Classes and JSP-Tag Libraries and Files- Support for the Model- View- Controller Paradigm- Case Study- Related Technologies.	8
5.	XML: Introduction to XML, uses of XML, simple XML, XML key components, DTD and Schemas, Well formed, using XML with application.XML, XSL and XSLT. Introduction to XSL, XML transformed simple example, XSL elements, transforming with XSLT	6
6.	PHP: Starting to script on server side, Arrays, function and forms, advance PHP, Basic command with PHP examples, Connection to server, creating database, selecting a database, listing database, listing table names creating a table, inserting data, altering tables, queries, deleting database, deleting data and tables, PHP my admin and database bugs.	8
TOTAL		42

11. Suggested Books

S.No.	Name of Books / Authors/ Publishers	Year of Publication/ Reprint
Text Books		
1.	Internet and Web Technologies by Raj Kamal, Tata McGraw Hill edition. (ISBN: 9780070472969)	2002
2.	An Introduction to Search Engines and Web Navigation, Mark Levene, Pearson Education. (ISBN: 978047052684)	2010
3.	Modeling the Internet and the Web, Pierre Baldi, Paolo Frasconi, Padhraic Smyth, John Wiley and Sons Ltd. (ISBN: 978-0-470-84906-4)	2003
Reference Books		
4.	HTML: A Beginner's Guide by Wendy Willard, Tata McGraw-Hill (ISBN: 9780070677234)	2009
5.	PHP and MySQL for Dynamic Web Sites, Ullman, Larry, Peachpit Press.1 (ISBN: 978-0-321-78407-0)	2012

IT359 JAVA PROGRAMMING

NAME OF DEPTT: Information Technology

1. Subject Code: **IT359** Course Title: **Java Programming**

2. Contact Hours : L: 3 T: 0 P: 0

3. Examination Duration (ETE) (Hrs.) : Theory 3 Hrs Practical 0

4. Relative Weightage : CWS 25 PRS 0 MTE 25 ETE 50 PRE 0

5. Credits : 3

6. Semester : V

7. Subject Area : OEC

8. Pre-requisite : Nil

9. Objective : To introduce the concept of java programming

10. Details of Course

S.No.	Contents	Contact Hours
1.	Introduction to Java: Programming language Types and Paradigms, Computer Programming Hierarchy, How Computer Architecture Affects a Language? , Why Java?, Flavors of Java, Java Designing Goal, Role of Java Programmer in Industry, Features of Java Language, JVM –The heart of Java , Java’s Magic Byte code.	6
2.	The Java Environment: Installing Java, Java Program Development, Java Source File Structure, Compilation, Executions. Lexical Tokens, Identifiers, Keywords, Literals, Comments, Primitive Datatypes, Operators Assignments.	6
3.	Object Oriented Programming: Class Fundamentals , Object & Object reference, Object Life time & Garbage Collection, Creating and Operating Objects , Constructor & initialization code block, Access Control, Modifiers, methods Nested , Inner Class & Anonymous Classes, Abstract Class & Interfaces Defining Methods, Argument Passing Mechanism, Method Overloading, Recursion, Dealing with Static Members, Finalize() Method, Native Method.	8
4.	Extending Classes and Inheritance: Use and Benefits of Inheritance in OOP, Types of Inheritance in Java, Inheriting Data members and Methods, Role of Constructors in inheritance, Overriding Super Class Methods, Use of “super”, Polymorphism in inheritance, Type Compatibility and Conversion Implementing interfaces.	8
5.	Package: Organizing Classes and Interfaces in Packages, Package as Access Protection, Defining Package, CLASSPATH Setting for Packages, Making JAR Files for Library Packages Import and Static Import Naming Convention For Packages.	6
6.	GUI Programming: Designing Graphical User Interfaces in Java, Components and Containers, Basics of Components, Using Containers, Layout Managers, AWT Components, Adding a Menu to Window, Extending GUI Features Using Swing Components, Java Utilities (java.util Package) The Collection Framework: Collections of Objects, Collection Types, Sets , Sequence, Map, Understanding Hashing, Use of Array List & Vector.	8
TOTAL		42

10. Details of Course

S. No.	Contents	Contact Hours
1	Introduction to Geoinformatics, Remote Sensing, GIS and GPS: Definitions of Geoinformatics, Remote Sensing, GIS and GPS, sources of energy, electromagnetic spectrum, electromagnetic radiation, reflection, transmission and absorption, Platforms and sensors, active and passive sensors, PAN, Multi and hyperspectral remote sensing data acquisition systems	8
2	Maps, Datums, Projections Systems and spatial data analysis - Plane and Geodetic surveying, Classification of surveys, Basic Principles of Surveying, Type of maps, scales and uses, plotting accuracy, map sheet numbering. Datums, coordinates and map projection systems. Data retrieval and querying, measurements in GIS, classification, accuracy.	8
3	Optical, Thermal and Microwave Remote Sensing. Brief review of Optical, thermal and microwave remote sensing, their utility, merit and demerits, Interaction of EMR with atmosphere, scattering, refraction, absorption, transmission, atmospheric windows, interaction of EMR with earth surface, spectral characteristics of remote sensing data,	8
4	Basic Photogrammetry and Digital Image Processing: Photogrammetry, aerial and terrestrial, applications of photogrammetry, types and geometry of aerial photograph, flying height and scale, relief (elevation) displacement. Digital image, digital image processing introduction to, preprocessing, enhancement, classification, visual image interpretation, Introduction to software - MATLAB, ENVI, ERDAS, AutoCAD etc	10
5	Applications of Geoinformatics, Remote Sensing, GIS and GPS: Land cover classification survey and Mapping, Digital elevation model (DEM), Introduction to SAR data, Applications in Disaster management, geology, forest security and military projects.	8
Total		42

11. Suggested Books:

S.N.	Name of Books/ Authors	
1	Agarwal, C.S. and Garg, P.K., "Remote Sensing in Natural Resources Monitoring and Management", Wheeler Publishing House(ISBN 6-74-268173-4)	2000
2	Bossler, J.D., "Manual of Geospatial Science and Technology", Taylor and Francis. (ISBN 0-74-68914355-7)	2002
3	Burrough, P.A. and McDonnell, R.A., "Principles of Geographic Information System", Oxford University Press. (ISBN 0-07-985256-4)	2000
4	Chandra, A.M. and Ghosh, S.K., "Remote Sensing and Geographical Information Systems", Alpha Science. (ISBN 0-07-8452567-1)	2005
5	Gopi, S., "Global Positioning System: Principles and Applications", Tata McGraw Hill. (ISBN 0-07-7691528-1)	2005



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(Estd. by Govt. of NCT of Delhi vide Act 6 of 2009)

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