Jaypee Institute of Information Technology

M.Tech. Biotechnology

Semester I

Course Descriptions

Lecture-wise Breakup

Course Code	17M11BT111	Semester Odd	Semester VII (Integrated) / I Sem(M.Tech) **Session** 2018 -2019
			Month from July to December
Course Name	Biomolecules and cell communication		
Credits	3	Contact Hours	3

Faculty (Names)	Coordinator(s)	Dr. Reema Gabrani
	Teacher(s) (Alphabetically)	Dr. Reema Gabrani

COURSE OUTCOMES		COGNITIVE LEVELS
C110.1	Explain the signal molecules and major cell signaling pathways	Understand Level (C2)
C110.2	Analyze cell signaling pathways in normal and diseased conditions	Analyze Level (C4)
C110.3	Interpret the mechanisms and regulation of cell cycle and cell death	Understand Level (C2)
C110.4	Analyze the therapeutic drug targets for cancer	Analyze Level (C4)

Module No.	Title of the Module	Topics in the Module	No. of Lectures for the module
1.	Signal molecules	Cytokines and Hormones, Growth factors, neurotransmitters, extracellular matrix components as signaling molecules; autocrine, paracrine, juxtacrine and endocrine signaling	3

2.	G-protein linked signaling pathways	G Protein-Coupled Receptors, Heterotrimeric G Proteins, Second messengers, Effector enzymes, Mechanism of transduction, Switching Off and Desensitization of Receptors, Visual transduction pathway	8
3.	Signaling mediated by enzyme linked cell surface receptor	Photoreceptor development in Drosphila, Ras to MAP kinase, Phosphoinositide-3-kinase and signaling through insulin receptor, JAK-STAT pathway, Signal Transduction via Integrins	7
4.	Nuclear receptor based signaling	Classification and Structure of Nuclear Receptors, Signaling by steroid hormones, Retinoids, Vitamin D3, and the T3-Hormone, Mechanisms of Transcriptional Regulation by Nuclear Receptors	4
5.	Bacterial Chemotaxis	Two-component signaling pathway, histidine kinase associated receptor, Adaptation, Chemotaxis in pathogenicity, symbiotic associations and biofilm	4
6.	Cell cycle regulation and cell death	Cyclin-CDK variation, Checkpoint signaling, Ubiquitin proteasome proteolytic system, Intrinsic and Extrinsic apoptotic pathways	8
7.	Malfunction of Signaling Pathways and Tumorigenesis	Hallmarks of cancer, Developmental pathways and cancer: Notch signalling from Drosophila to humans, Wnt signalling, Hedgehog pathway; Epigenetic changes in cancer, Signalling pathways as therapeutic targets, Analysis of signalling events via case studies	8
		Total number of Lectures	**42**

Evaluation Criteria

Components	Maximum Marks
T1	20
T2	20
End Semester Examination	35

TA	25 (Presentation, Assignments)
Total	**100**

	Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)
1.	Ernst J. M. Helmreich, "The biochemistry of cell signaling," Indian Ed., Oxford University Press, 2005
2.	B. Gomberts, "Signal transduction", Academic Press, 2009
3.	John T. Hancock, "Cell signaling", 2nd Ed. Indian Ed. Oxford University Press, 2006
4.	Alberts, Johnson, Lewis, Morgan, Raff, Roberts and Walter, "Molecular Biology of the Cell" Sixth Edition , Garland Science Publication, 2014
5.	Refereed papers from scientific journals for case studies

Detailed Syllabus

Lecture-wise Breakup

Course Code	17M11BT112	Semester Odd (specify Odd/Even)	Semester I
			Session 2018 -2019
			Month from June to Dec
Course Name	Molecular Modeling and Drug design		
Credits	3	Contact Hours	LTP 3 0 0

Faculty (Names)	Coordinator(s)	Dr Chakresh Kumar Jain
	Teacher(s) (Alphabetically)	Dr Chakresh Kumar Jain

COURSE OUTCOMES		COGNITIVE LEVELS
C112.1	Explain macromolecular structures, their Mathematical representation and visualization	Understanding (C2)
C112.2	Explain structural modeling, simulation and dynamics	Understanding (C2)
C112.3	Apply computational drug designing and simulation approaches for drug discovery	Applying (C3)
C112.4	Compare *in-silico* ligand-target interaction methods	Analyzing (C4)

Module No.	Title of the Module	Topics in the Module	No. of Lectures for the module
1.	Introduction to Molecular Modeling	Introduction to structure of DNA, protein and RNA. Structure representation and visualization, Coordinate Systems, Potential Energy Surfaces, Software and Hardware for molecular modeling, Tools such as Swiss pdb viewer, Pymol, VMD etc.	5
2.	Quantum Mechanics and Force Fields	Electron methods and molecular orbital calculations, General Features of Molecular mechanics force field , Bond Stretching. Angle Bending. Introduction to Non-bonded Interactions. Electrostatic Interactions. Van der Waals	5

		Interactions. Hydrogen Bonding in Molecular Mechanics. Force Field Models for the Simulation of Liquid Water.	
3.	Energy Minimization and computer simulations	Minimization and Related Methods for exploring the Energy Surface. Non-Derivative method, Minimization methods. Computer Simulation Methods. Simple Thermodynamic Properties and Phase Space. Boundaries. Analyzing the Results of a Simulation and Estimating Errors.	5
4.	Molecular Dynamics and simulations	Molecular Dynamics Simulation Methods. Molecular Dynamics Using Simple Models. Metropolis Method. Monte Carlo methods, Web Based Resources, Databases and tools such as GROMACS, AMBER, & CHARMM.	6
5.	Structure Prediction	Principles of structure prediction, comparative modeling and protein folding, Comparative and *ab-inito* modeling, CASP, validations, Projects such as ROSETTA, protein folding at home.	6
6.	Drug designing	Introduction to drug discovery and drug development, Rational approach to drug design, Approaches to lead optimization such as conformation restriction, pharmacophore etc. Designing drugs against enzymes and receptors, Computer Aided Drug Design methods. ADMET, QSAR Tools and databases such as AUTODOCK, MOLEGRO, Drug Bank etc.	16
		Total number of Lectures	**43**

Evaluation Criteria

Components	Maximum Marks
T1	20
T2	20
End Semester Examination	35
TA	25 (Assignment-1, MCQ, Project, Presentation)
Total	**100**

Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)

1.	Andrew R leach, V.J Gillet, "An introduction to Chemoinformatics" Springer pumodel of publication, 2007
2.	Gasteiger Johann, "Chemoinformatics A text book "John Wiley, 2008

3.	Andrew R. Leach, "Molecular Modeling principles and applications" Pearson Education, Second edition, 2001

Detailed Syllabus

Lecture-wise Breakup

Course Code	17M12BT111	Semester Odd (specify Odd/Even)	Semester MTech I Session 2018 -2019 Month from July to December
Course Name	Biosensors		
Credits	3	**Contact Hours**	3

Faculty (Names)	Coordinator(s)	Prof. Sudha Srivastava
	Teacher(s) (Alphabetically)	Prof. Sudha Srivastava

COURSE OUTCOMES		COGNITIVE LEVELS
CO1	Explain principle and working of biosensors and characterization techniques	Understand Level(C2)
CO2	Evaluate different methods of immobilization and their effect on biosensor performance	Evaluate Level (C5)
CO3	Analyze performnce of a biosensor for disease diagnosis, environmental pollution, pathogen quantification	Analyze Level (C4)
CO4	Design strategy for fabrication of a given biosensor with high sensitivity and wide detection range	Create Level (C6)

Module No.	Title of the Module	Topics in the Module	No. of Lectures for the module
1.	**Introduction:**	Sensors and biosensors, definitions, types of sensors, markets, target analytes, glucose and other medical sensors	2
2.	**Biosensor Advancements and nanotechnology**	First-, second-, third generation biosensors, Nanotechnology and present day biosensors	3

3.	**Basic Design Considerations**	Calibration, dynamic Range, signal to noise, sensitivity, selectivity, interference.	3
4.	**The biological component**	Whole cell sensors, enzymes – sensing substrates or inhibitors, antibodies (Mab, Fab). And other binding proteins, oligonucleotides and aptamers.	3
5.	**Types of biosensors**	Optical biosensors, Electrochemical biosensors, Piezoelectric biosensor, Calorimetric biosensors	8
6.	**Immobilization method**	Non-covalent immobilization - entrapment and multipoint electrostatic attachment. Covalent attachment via thiol, amino and hydroxyl groups. Affinity interactions - avidin/biotin, , complementary oligonucleotides.	4
7.	**Techniques for sensing : Physical and chemical**	Absorbance, fluorescence, chemi/bioluminescence and phosphorescence, Surface Plasmon Resonance (SPR), quartz crystal microbalance, cyclic voltammetry	8
8.	**Sensor stabilization**	Storage and operational stability. Polyols, polymers and low Mw compounds as stabilizing agents for drying and long term storage. Stabilization mechanisms.	3
9.	**Applications**	Pharmaceutical**,** agricultural, food safety, biomedical applications, food processing: state of the field, market potential, unique design criteria and needs, current sensors in use.	8
		Total number of Lectures	**42**

Evaluation Criteria

Components	Maximum Marks
T1	20
T2	20
End Semester Examination	35
TA	25 (Class Test, Presentation)
Total	**100**

Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)	
1.	Ligler, F.S. and Rowe Taitt, C.A. 2002. Optical Biosensors: Present & Future. Elsevier, The Netherlands. ISBN: 0-444-50974-7.
2.	Yang, V.C. and T.T. Ngo. 2000. Biosensors and Their Applications. Kluwer Academic/Plenum Publishers, New York, NY. ISBN: 0-306-46087-4.
3.	Recent research articles

Detailed Syllabus

Lecture-wise Breakup

Course Code	17M12BT112	Semester ODD (specify Odd/Even)	Semester I Session 2018 -2019 Month from July to December
Course Name	**ANIMAL AND PLANT BIOTECHNOLOGY**		
Credits	3	**Contact Hours**	3

Faculty (Names)	Coordinator(s)	Dr. Garima Mathur
	Teacher(s) (Alphabetically)	Dr. Garima Mathur

COURSE OUTCOMES		COGNITIVE LEVELS
CO131.1	Explain the concepts of animal and plant cell culturing and various transformation methods	Understand level(C2)
CO131.2	Make use of scientific literature to plan strategies for animal and plant biotechnology	Apply level(C3)
CO131.3	Identify appropriate techniques to address related biotechnological problems	Apply level(C3)
CO131.4	Examine the applicability of animal and plant biotechnology to existing Biotech Industries	Analyze level(C4)

Module No.	Title of the Module	Topics in the Module	No. of Lectures for the module
1.	**Plant Biotechnology**	Introduction and types of plant tissue culture, germplasm conservation.	5
2.	**Large scale culture and propagation methods**	Large scale culture and problems associated, Micropropagation, somaclonal variation, generation of haploid plants, embryo rescue, somatic hybrids and germplasm conservation.	10
3.	**Virus free plants**	Meristem culture and generation of virus free plants, applications and limitations	2

4.	**Transgenic plants**	Gen constructs, vectors and transformation methods, applications	6
5.	**Animal Biotechnology**	Introduction, organ culture, cell culture and initiation of cell culture, evolution of continous cell lines	4
6.	**Large scale culture of cell lines**	Large scale culture of cell lines, maintenance, growth phases, somatic cell fusion and hybridoma technology and applications	9
7.	**Stem cells**	Culture, identification, maintenance, characterization and proliferation heterogenity	2
8.	**Transgenic animals**	Gene constructs and transgenic animals	4
		Total number of Lectures	**42**

Evaluation Criteria

Components	Maximum Marks
T1	20
T2	20
End Semester Examination	35
TA	25 (…)
Total	**100**

Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)

1.	H. S. Chawla, Introduction to Plant Biotechnology, 3rd Edition, Science Publishers, 2009
2.	S.S.Bhojwani and M K Razadan, Plant tissue culture: theory and Practice, Elsevier, 1996
3.	S. Narayanaswamy, Plant cell and tissue culture, Tata Mcgraw Hill, 1992
4.	R. Ian Freshney, Culture of animal cells : a manual of basic techniques, Wiley-Liss, 2005
5.	J. R.W. Masters, Animal cell culture, 3rd Edition, Oxford University Press, 2000
6.	A. Mukhopadhyay, Animal Cell Technology, I.K. International, 2009

Detailed Syllabus

Lecture-wise Breakup

Course Code	17M12BT113	Semester ODD (specify Odd/Even)	Semester I Session 2018-2019 Month from July to December
Course Name	Information Technology for Biologist		
Credits	3	Contact Hours	3

Faculty (Names)	Coordinator(s)	Dr. Chakresh Jain
	Teacher(s) (Alphabetically)	Dr. Chakresh Jain

COURSE OUTCOMES		COGNITIVE LEVELS
C132.1	Explain about the information technology, computer resources and architecture	C2
C132.2	Summarize about high performance computing and protein simulations	C2
C132.3	Applying information technology in biological problems	C3
C132.4	Comparing the docking methods and simulations	C4

Module No.	Subtitle of the Module	Topics in the module	No. of Lectures for the module
1.	Concepts of Information Technology relevant to biologist	History of Computing in biology, Building blocks of computing systems such as Memory, ALU etc., Internet Architecture and Protocols such as IP, TCP, DNS, NTP. History of Web & internet in Bioinformatics, Scientific	10

		Computing, Public and private data in biology, Operating Systems such as Windows and Linux.Biological Information Resources.	
2.	Problem solving in Biology through data structure and Programming	Computational approaches for biologist- Definition of Algorithms, Flow charts, Decomposition and pattern recognition (gene prediction using Genscan; Protein Structure Prediction using Swiss Model), program design, errors-syntax, runtime & logic. Basics of C language. Scripting languages such as Perl, Bioperl, and HTML.	15
3.	High-performance computing in Bioinformatics	Parallel architectures, parallel computation in biological sequence analysis, Case study- Performance optimization of Clustal W and Turbo Blast. Distributed computing and its applications in protein folding simulations.	6
3.	Applications of IT in large scale biological projects	Databases and Cloud- 1000 genome project, Personal Genomes-International Consortium of Cancer Genomes, Genographics Project, Imaging- Allen Brain Atlas, NGS Data pipelines and work flow systems, Large Scale Docking Projects.	11
		Total number of lectures	42

Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)
1.   Programming Perl , Larry Wall, Tom Christiansen, Jon Orwant, ,   O'Reilly Media, 3rd edition, , July 2000.
2.   Programming in ANSI C, Balagurusamy, Tata McGraw-Hill Education, 8 rth edition, 2008 -
3.   Data Structures and Algorithms in C++, Adam Drozdek, Course Technology, 2nd Edition, 2000.

4. Bioinformatics: High Performance Parallel Computer Architectures (Embedded Multi-Core Systems), Bertil Schmidt, CRC Press; 1 edition (July 15, 2010).

Detailed Syllabus

Lecture-wise Breakup

Course Code	17M12BT114	Semester Odd	Semester M. tech 1st Session 2018 - 2019
			Month from July to Dec
Course Name	Enzyme Technology		
Credits	3	Contact Hours	3

Faculty (Names)	Coordinator(s)	Dr. Priyadarshini
	Teacher(s) (Alphabetically)	Dr. Priyadarshini, Dr. Smriti Gaur

COURSE OUTCOMES		COGNITIVE LEVELS
CO1	Explain enzyme kinetics and its regulation.	Understand Level (C2)
CO2	Outline the purification and characterization strategies for industrial enzymes.	Understand Level (C2)
CO3	Plan the production of metabolites in biological system .	Apply Level (C3)
CO4	Apply acquired knowledge for commercialization of products.	Apply Level (C3)

Module No.	Title of the Module	Topics in the Module	No. of Lectures for the module
1.	Fundamentals of Enzymology	Objectives and strategies of Enzyme purification, Introduction to enzyme Kinetics, Mechanism of enzyme action and control of enzyme activity with examples related to control of metabolic pathways .	8
2.	Sources of industrial enzymes	Natural & recombinant), enzymes in the cell and in organized systems, enzyme turnover, correlation between rate of turnover and structure and function of enzymes	6
3.	Enzyme immobilization	Preparation and kinetics of immobilized enzymes, enzyme reactors, membrane reactors, packed bed reactors, continuous flow reactors, stirred tank reactor, fluidized reactors, along with their application in dairy, cereal, fruit juice, oil and fat industry, and their safety aspects ,	3

		use of immobilized raffinase, lipase, invertase and lactase in industry Recent advances in enzyme technology .	
4.	**Enzymes as commercial products**	The large-scale use of enzymes	**4**
5.	**Enzymes in plant fiber based industry**	Biopulping Paper and Pulp industry , Textile industry and in Laundry detergents	**4**
6.	**Enzymes in Waste remediation**	Explosives, Organophosphates in Pesticide Residues and Nerve Gas, Oil and Gas Desulfurization	**4**
7.	**Enzymes in Animal nutrition and in Food production**	Pig husbandry, Chicken feed, cattle fodder like Milk and Cheese industries, Sugar industry, Meat industry, Oil, Fat, Flavor and Fragrance industry	**4**
8.	**Enzymes as therapy targets and Pharmaceuticals**	Proteases, Cycloxygenase, Antivirals,and reverse transcriptase, Polyketide Synthases in Pharmaceutical processing, FDA-Approved Enzyme Drugs and research and development products.	**4**
9.	**Introduction to Metabolic engineering**	Analysis of sequence of reactions and Stoichiometry, Synthesis of primary and secondary metabolites, The genetic switch in E.coli illustrating the dynamic nature of the genome, Metabolic Flux analysis and Metabolic control analysis, Case studies.	**7**
		Total number of Lectures	**42**

Evaluation Criteria

Components	Maximum Marks
T1	20
T2	20
End Semester Examination	35
TA	25 (Assignment 1, Assignment 2)
Total	**100**

Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)	
1.	Industrial enzymes and their applications Helmut Uhlig, John Wiley and sons.
2.	Biochemical engineering and Biotechnology Atkins and Mavituna 2nd edition Stockton Press New york

3.	Industrial Enzymology . Godfrey T. West ,S.(eds) 1996, Mac millan Press London
4.	Industrial Application of Immobilized enzymes . Tanaka , A . Tosa , T . and Kobayashi, T .(eds).1993 Marcel Dekker , New York
5.	Gerharts W, "Enzyme Industry-Production and Applications"
6.	Tailor, R.F., "Protein immobilisation-Fundamentals and application"
7.	Zubay G., "Biochemistry"

Detailed Syllabus

Lecture-wise Breakup

Course Code	17M12BT116	Semester Odd	Semester X Session 2018 -2019
			Month from July to December
Course Name	Regulatory affairs		
Credits	3	**Contact Hours**	3

Faculty (Names)	Coordinator(s)	Dr Shweta Dang
	Teacher(s) (Alphabetically)	Dr Shweta Dang

COURSE OUTCOMES		COGNITIVE LEVELS
CO1	Explain regulatory markets and agencies; preclinical and clinical trials	Understanding (Level 2)
CO2	Analyze the guidelines for approvals of new drugs/biologics	Analyzing (Level 4)
CO3	Compare innovator and generic pharmaceutical industry with Patent and Non patent exclusivity	Evaluating (Level 5)
CO4	Interpret ICH guidelines applicable to drugs and biotechnology based therapeutic products.	Understanding (Level 2)
CO5	Assess regulatory approvals via related case studies	Evaluating (Level 5)

Module No.	Title of the Module	Topics in the Module	No. of Lectures for the module
1.	**Introduction To Regulatory agencies**	CDSCO, India USFDA, USA EMEA, Europian Union TGA, Australia	2
2.	**Introduction To Pharmacopoeias and Monographs**	Indian Pharmacopoeia (IP) British Pharmacopoeia (BP)	2

		United Sates Pharmacopoeia (USP) International Pharmacopoeia (Int. Ph.) European Pharmacopoeia (Eur. Ph.)	
3.	**Safety and efficacy of drugs/biologics, preclinical studies, Clinical phases**	Case studies of safety issues in history, Preclinical requirements, acute and chronic toxicity, dose determination, NOAEL, phases of clinical trials (I,II III)	**4**
4.	**Approval pathways for Drugs/ biologic/ biopharmaceuticals in USFDA**	FDA,CDER, CBER, IND, NDA, BLA, recalls, Phase IV, filing procedures	**7**
5.	**Approval pathways for Drugs/ biologic/ biopharmaceuticals in europe**	EMEA, market authorization application. Centralized, Decentralized, National, Mutual recognition procedure. CTD, eCTD, Nees Submissions, ICH M4	**4**
6.	**Approval pathways for Drugs/ biologic/ biopharmaceuticals in India and Japan**	Central Drug Standard Control Organization, INDIA, Pharmaceutical and Medical Devices Agency of Japan	**3**
7.	**Generics and Biosimilars**	Hatch Wax man Act (Para I,II,III and IV filings), BPCI act USA, CDSCO guildines, EMEA guidelines, Status of guidelines	**6**
8.	**Non Patent Exclusivities**	Orphan Drug law, Market exclusivity, Pediatrics exclusivity, First to file exclusivity	**5**
9.	**ICH Guidelines for Biologics and Good Clinical Practices**	Overview of ICH guidelines, ICH QSEM, ICH Q5 ,Q6,. ICH E6, ICH Q8,9,10	**5**
11.	**Case Studies**	Relevant Case studies	**4**
		Total number of Lectures	**42**

Evaluation Criteria

Components	Maximum Marks
T1	20
T2	20
End Semester Examination	35
TA	25 (Class Test, Assignment I and II)

Total	100

	Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)
1.	Sandy Weinberg, GUIDEBOOK FOR DRUG REGULATORY SUBMISSIONS, 2009 (first edition), John Wiley & Sons, Inc.
2.	The Common Technical Document (CTD), Internet: http://www.ich.org/
3.	Guideline for submitting supporting documentation in drug applications for the manufacture of drug substances, February 1987, Internet: http://www.fda.gov/cder/guidance/drugsub.pdf
4.	ICH Guideline: The Common Technical Document for the Registration of Pharmaceuticals for Human Use: Quality - M4Q; Quality Overall Summary of Module 2, Module 3: Quality, Internet: http://www.ich.org/MediaServer.jser?@_ID=556&&@_MODE=GLB

Detailed Syllabus

Lecture-wise Breakup

Course Code	14M1NBT334/17 M12BT118	Semester Odd	Semester III. Session 2018 -2019 Month fromJune to Dec ember
Course Name	**Product Development in Biotechnology**		
Credits	4	**Contact Hours**	4

Faculty (Names)	Coordinator(s)	Dr. NeerajWadhwa
	Teacher(s) (Alphabetically)	Dr. NeerajWadhwa

COURSE OUTCOMES		COGNITIVE LEVELS
CO1	Outline various processes relevant for Biobusiness	**Understand (C2)**
CO2	Compare marketing techniques and related ethics	**Apply Level (C2)**
CO3	Select appropriate technology for the production of Biological products	**Understand Level (C3)**
CO4	Explain financial, regulatory, health policy aspects for biobased industries	**Understand Level (C2)**

Module No.	Title of the Module	Topics in the Module	No. of Lectures for the module
1.	**Biotechnology Industries overview**	Biotech industries in India and abroad, ,Biotechnology as a function of science and business ,Company structures versus other non-biotech companies , Functional units Company structure and functions Emerging technology and technical convergences issues	5
2.	**Business in the context of biotechnology** **Entrepreneurship-**	Science/development, the idea and its development , Plant tissue culture lab-equipment- glasswares chemical requiremen-- construction,techniquesin culturing and export abroad, Vermitechnology, Mushroom cultivation, single cell protein, Biofertilizer technology-production, Textile	10

		processing, leather treatment, Detergent industry, bakery, diary Pharmaceutical drug development, Medical device product development ,Technology product development Other biotech product development, such as biofuels, bioengineered foods, etc.- commercialization of Bakery and dairy products	
3.	**Product development**	a. Production of commercially important primary metabolites like organic acids, amino acids and alcohol & Production processes for various classes of secondary metabolites: Antibiotics, Vitamins and Steroids. b.Production of Industrial Enzymes, Biopesticides, Biofertilizers, Biopreservatives, Biopolymers Biodiesel. Cheese, Beer, SCP & Mushroom culture, Bioremediation. c.Production of recombinant proteins having therapeutic and diagnostic applications, vaccines. Bioprocess strategies in Plant Cell and Animal Cell culture. d.Biotransformation applications of enzymes - Hydrolytic- Ester bond, Amide, Epoxides, Nitriles, Reduction reactions –aldehydes, Ketones, C=C, Oxidation reactions – Alkanes, Aromatic, Baeyer-Villiger, Enzymes in organic synthesis – esters, amide, peptide , Modified and Artificial Enzymes , Catalytic antibodies	**12**
4.	**Intellectual property, Bioethics,legal issues**	Patents , Confidentiality , Licensing agreements Business Development/Licensing, Strategy Marketing and public perception in product development, genetically modified products and organism- transgenic products licencing and branding concerns	**5**

5.	**Biobusiness plans**	Concerns and oppurtunities, Bank loan and finance strategy, Budget planning,Policy and regulatory concerns,Corporate partners marketing- Model project Case studies of different industries and strategic planning	10
6.	**Biotechnology Industries overview**	Biotech industries in India and abroad, ,Biotechnology as a function of science and business ,Company structures versus other non-biotech companies , Functional units Company structure and functions Emerging technology and technical convergences issues	5
7.	**Business in the context of biotechnology** **Entrepreneurship-**	Science/development, the idea and its development , Plant tissue culture lab-equipment- glasswares chemical requiremen-- construction,techniquesin culturing and export abroad, Vermitechnology, Mushroom cultivation, single cell protein, Biofertilizer technology-production, Textile processing, leather treatment, Detergent industry, bakery, diary Pharmaceutical drug development, Medical device product development ,Technology product development Other biotech product development, such as biofuels, bioengineered foods, etc.- commercialization of Bakery and dairy products	10
8.	**Product development**	a. Production of commercially important primary metabolites like organic acids, amino acids and alcohol & Production processes for various classes of secondary metabolites: Antibiotics, Vitamins and Steroids. b.Production of Industrial Enzymes, Biopesticides, Biofertilizers, Biopreservatives, Biopolymers Biodiesel. Cheese, Beer, SCP & Mushroom culture, Bioremediation. c.Production of recombinant proteins having therapeutic and diagnostic applications, vaccines. Bioprocess strategies in Plant Cell and Animal Cell culture. d.Biotransformation applications of enzymes - Hydrolytic- Ester bond, Amide, Epoxides, Nitriles, Reduction reactions –aldehydes, Ketones, C=C, Oxidation reactions – Alkanes, Aromatic, Baeyer-	12

		Villiger, Enzymes in organic synthesis – esters, amide, peptide , Modified and Artificial Enzymes , Catalytic antibodies	
9.	**Intellectual property, Bioethics,legal issues**	Patents , Confidentiality , Licensing agreements Business Development/Licensing, Strategy Marketing and public perception in product development, genetically modified products and organism- transgenic products licencing and branding concerns	**5**
		Total number of Lectures	**42**

Evaluation Criteria

Components	Maximum Marks
T1	20
T2	20
End Semester Examination	35
TA	25 (Assignment)
Total	**100**

Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)	
1.	Satyanarayana, U. "Biotechnology" Books & Allied (P) Ltd., 2005.
2.	Kumar, H.D. "A Textbook on Biotechnology" 2nd Edition. Affiliated East West Press Pvt. Ltd., 1998.
3.	Balasubramanian, D. etal., "Concepts in Biotechnology" Universities Press Pvt.Ltd., 2004.
4.	Ratledge, Colin and Bjorn Kristiansen "Basic Biotechnology" 2nd Edition Cambridge University Press, 2001
5.	Faber K , Biotransformations in Organic Chemistry, IV edition , Springer

6.	Dubey, R.C. "A Textbook of Biotechnology" S.Chand& Co. Ltd., 2006.Trevor Palmer , Enzymes II edHorwood Publishing Ltd
7.	Cruger,Wulf and Anneliese Crueger, "Biotechnology: A Textbook of Industrial Microbiology", 2nd Edition, Panima Publishing, 2000
8.	Moo-Young, Murrey, "Comprehensive Biotechnology", 4 Vols. Pergamon Press, (An Imprint of Elsevier) 2004.
9.	Richard Oliver " The coming Biotech Age ; the business of Biomaterials" Mc Graw Hill Publication , New York USA2000
10.	Karthikeyan,S and Arthur Ruf." Biobusiness"MJP Publication Chennai India 2009
11.	Cynthia Robins," The business of Biotechnology". UK Harper Collins 2001

Detailed Syllabus

Lecture-wise Breakup

Subject Code	17M12BT119	Semester : ODD	Semester : X Session : 2018-2019 Month from : July to December
Subject Name		**PHYTOTHERAPEUTICS AND PHARMACOLOGY**	
Credits	3	Contact Hours	3

Faculty (Names)	Coordinator(s)	1. Dr.Vibha Rani
	Teacher(s) (Alphabetically)	1. 2.

COURSE DESCRIPTION Introduction of Indian medicinal plants and natural therapeutics; Classes of secondary metabolites; Analysis of phytomolecules – quantitative and qualitative; Purification methods - HPLC, GC-MS, FTIR, NMR; Phytomolecules' structure and their function relationship; Therapeutic applications and mechanism of action of secondary metabolites; Herbal therapies for diseases affecting human health such as respiratory, urinary, cardiovascular, cancer, neurodegenerative diseases, etc.; Current aspects of phytomedicine on toxicity and clinical analyses; Case studies.

COURSE OUTCOMES		COGNITIVE LEVELS
CO130.1	Analyze the existing biotechnological techniques to develop plant based therapeutics	**Analyzing (C4)**
CO130.2	Evaluate the classes, synthesis and structure functional relationship of phytomolecules	**Evaluating (C5)**
CO130.3	Explain the therapeutic applications of phytochemicals	**Understanding (C2)**
CO130.4	Identify the current aspects of phytomedicines on toxicity and clinical trials	**Applying (C3)**
CO130.5	Case studies to analyze Ayurpharmacoepidemiology	**Analyzing (C4)**
CO130.6	Use of bioinformatics tools and approaches to predict the molecular function of novel bioactive molecules	**Creating (C6)**

Module No.	Subtitle of the Module	Topics in the module	No. of Lectures for the module
1	**Introduction**		2
2	**Medicinal Plants Metabolites**	Introduction to metabolites Secondary metabolites, properties and beneficial aspects.	4
3	**Isolation technique**	Isolation from medicinal plants.	4

	extraction procedure	Isolation from aromatic plants.	
4	**Characterization technique**	Qualitative and quantitative Analysis Gas Chromatogrophy High Performance Liquid Chromatography: (HPLC) High Performance Thin Layer Chromatography: (HPTLC)	4
5	**Structure functional relationship**	Mechanism of Action Unidentified Therapeutic Intakes Factors That Affect Metabolism	4
6	**Therapeutic Application**	Plants used in respiratory system. Plants used in urinary system. Plants used with antimicrobial activity. Plants used with Plants used in dermatology. Plants used in cardiovascular system. Plants used in romatology.	8
7	**Toxicity Issue and Clinical Trials**	Current aspects of phytomedicine on toxicity and clinical trials	6
9	**Case studies**		8
10	**Potential risks associated and future aspects**		2
12			
		Total number of Lectures	**42**

Evaluation Criteria

Components	Maximum Marks
T1	20
T2	20
End Semester Examination	35
TA	25 (Class Test-1, Assignment-1&2, Case studies 1, 2& 3)
Total	**100**

Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Papers, Reports, Websites etc. in the IEEE format)	
1.	Plant Bioactives and Drug Discovery: Principles, Practice, and Perspectives. Valdir Cechinel-Filho (Ed.). 2012 John Wiley & Sons, Inc.
2.	Phytotherapeutics (Recent Progress in Medicinal Plants). S. K. Sharma, J. N. Govil, V. K. Sing. 2005. Studium Press.
3.	Phytotherapies: Efficacy, Safety, and Regulation. Iqbal Ramzan (Ed.) 2015 John Wiley & Sons, Inc.
4.	Recent research articles and reviews related to each module.

Detailed Syllabus

Lecture-wise Breakup

Course Code	17M12BT122	Semester: Odd	Semester: I Session : 2018 -2019
			Month from: July to December
Course Name	Advanced Microbiology and Immunology		
Credits	3-0-0	Contact Hours	3

Faculty (Names)	Coordinator(s)	Dr Rachana	
	Teacher(s) (Alphabetically)	Dr Rachana , Dr Smriti Gaur	

COURSE OUTCOMES		COGNITIVE LEVELS
CO1	Explain ecological diversity of microorganisms.	Understating (C2)
CO2	Outline various structural and functional elements of immune system.	Understating (C2)
CO3	Make use of metabolic pathways for various biotechnological applications.	Applying (C3)
CO4	Analyze Communicable and non communicable diseases and associated immune responses.	Analyzing (C4)

Module No.	Title of the Module	Topics in the Module	No. of Lectures for the module
1.	Microbial ecology	Structure, function and diversity from various habitats, functional diversity and its understanding from ecological and biotechnological perspectives	6
2.	Virology	Diversity, classification, replication, virus biotechnology, viral diseases	5
3.	Industrial	Metabolic pathways and products; important metabolites	5

	microbiology	produced by microorganisms; industrial processes	
4.	Environmental microbiology	Biotechnology in waste treatment, microbial biosensors, microbial fuel cells	5
5.	Key players of immune system	Humoral and cell mediated immunity; Antigen; Primary and secondary immune response; Cells of the immune system	6
6.	Disorders of the Immune System	Immunity against pathogens; Immunological tolerance and Autoimmunity; Hypersensitivity; Immunodeficiency	7
7.	Tumor Immunology	Immune response to tumor; immune evasion	4
8.	Immunological Applications	Medical role of antibodies in Diagnostics and Therapeutics; Immuno fluorescence	4
		Total number of Lectures	**42**

Evaluation Criteria

Components	**Maximum Marks**
T1	20
T2	20
End Semester Examination	35
TA	25 (Comprises of attendances and Assignments)
Total	**100**

	Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)
1.	K. Murphy, "Janeway's Immunobiology", 8th edition, Garland Science, 2012.
2.	B. Osborne, R. Goldsby,"Kuby Immunology", 4nd Ed. W. H. Freeman & Co., 2000
3.	J. Black. *Microbiology: Principles and Applications*. New Jersey, USA: Prentice Hall, 2004.
4.	L. M. Prescott, J. P. Harley and D. A. Klein. *Microbiology*, 6thedition. New York, USA: McGraw Hill, 2005.
5.	M. J. Pelczar, E. C. S. Chan and N. R. Krieg. *Microbiology: Concepts and Applications.* India: Tata McGraw Hill, 1993.
6.	Bruce Alberts "The cell " by, E- copy, 2003

7.	Kaja SL, Kiran SS, Kattapagari KK, Chitturi RT, Chowdary SD, Reddy BV. J Orofac Sci A review on tumor immunology 2017; 9:7-15.
8.	Immunochemical Techniques by Lenka Fialová, translated by Jan Pláteník a Martin Vejražka and Ustav Lékařské Biochemie , Immunochemical Methods, 2010- 2011
9.	Referred papers from scientific journals for case studies

Detailed Syllabus

Lab-wise Breakup

Course Code	17M15BT111	Semester Odd (specify Odd/Even)	Semester I Session 2018 -2019 Month from July to December
Course Name	**Biotechniques Lab-I**		
Credits	3	**Contact Hours**	6

Faculty (Names)	Coordinator(s)	Prof. Pammi Gauba
	Teacher(s) (Alphabetically)	Dr. Indira P. Sarethy, Prof. PammiGauba, Dr.Reema Gabrani, Dr. Shweta Dang, Dr.Vibha Rani

COURSE OUTCOMES		COGNITIVE LEVELS
CO1	Apply basic analytical techniques in biotechnology	Apply Level (C3)
CO2	Develop skills in molecular biology techniques	Apply Level (C3)
CO3	Examine and analyse gene expression	Analyze (Level C4)
CO4	Make use of purification techniques for natural products	Apply Level (C3)

Module No.	Title of the Module	List of Experiments	CO
1.	Analytical techniques	To learn about basic calculations/mole concepts; To learn about UV-VIS spectrometry/ plot calibration curves and calculate analyte concentration, to prepare drug-loaded nanoparticles; to analyze entrapment efficiency via UV-VIS Spectrophotometer	3
2.	Molecular biology techniques	To isolate plasmid DNA from bacterial cells; separate and visualize DNA bands by agarose gel electrophoresis;	3
3.	Gene expression techniques	Designing primers for amplification of gene of interest by PCR	3
4.	Purification techniques	To obtain antimicrobial compound from bacterial culture; to purify the antimicrobial compound by column chromatography; use of bioactivity-guided fractionation to	3

		analyse and quantitate the compound	
		Total	**12**

Evaluation Criteria

Components	Maximum Marks
Mid-Term Viva	20
Day-to-Day (Lab record, attendance, performance)	60
Final Viva	20
Total	**100**

Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)	
1.	Introduction to Biotechnology, Laboratory Manual: http://www.austincc.edu/awheeler/Files/BIOL%201414%20Fall%202011/BIOL1414_Lab%20Manual_Fall%202011.pdf
2.	Frederick M. Ausubel, Roger Brent, Robert E. Kingston, David D. Moore, J.G. Seidman, John A. Smith, Kevin Struhl (eds.) Current Protocols in Molecular Biology. John Wiley & Sons Inc; ringbou edition (December 4, 2003)
3.	Molecular Biology web book- http://www.web-books.com/MoBio/
4.	S. V. S. Rana, Biotechniques Theory and Practice. Rastogi Publications 2008.
5.	Methods standardized in lab

Detailed Syllabus

Lecture-wise Breakup

Course Code	18M12BT211	Semester ODD (specify Odd/Even)	Semester X Session 2019 -2020 Month from July to December
Course Name	PUBLIC HEALTH ECONOMICS AND POLICY		
Credits	3	Contact Hours	3

Faculty (Names)	Coordinator(s)	DR. ASHWANI MATHUR
	Teacher(s) (Alphabetically)	DR. ASHWANI MATHUR

COURSE OUTCOMES		COGNITIVE LEVELS
C141.1	Explain Government policies , socio-economic conditions and research methods in Public Health	Understanding (Level 2)
C141.2	Explain fundamentals of disease epidemiology	Understanding (Level 2)
C141.3	Applying computational tools for determining health indicators from primary and secondary data	Applying (Level 3)
C141.4	Analysis of the role of health care in policy making	Analyzing (Level 4)

Module No.	Title of the Module	Topics in the Module	No. of Lectures for the module
1.	Importance of Public Health	Introduction to Public Health, Health Promotion and Disease Prevention, Relevance of policy response in public health, Public health research methods – qualitative and quantitative methods, Role of ethics in research	6
2.	Basic Epidemiology	Introduction to Fundamentals of Epidemiology; Disease-History, prevention and intervention; measurement of occurrence, effect and impact; cohort studies	7
3.	Statistical Tool in Public Health	Introduction to probability, Probability Distribution, Hypothesis testing, Baye's Theorem, Continuous and	5

		categorical outcome	
4.	Health Economics and micro economics	Economics and Health; Use and understanding of Universal indicators, HDI, LE, Mortality and Morbidity; Principles of economics in health	6
5.	Economic Evaluation	Welfare economics, monetary value of health changes; revealed and expressed preference approach, cost benefit analysis, cost effectiveness analysis	6
6.	Health Policy Analysis	Policy analysis process; health care and health policy; Role of government in policy making; Policy analysis process-identification, evaluation (technology assessment; economic viability)	7
7.	Health financing	Cost behaviour and break even analysis, depreciation concept, health as inventory and investment	**5**
		Total number of Lectures	42

Evaluation Criteria

Components	Maximum Marks
T1	20
T2	20
End Semester Examination	35
TA	25 (Assignment / Class Test-1 & 2)
Total	**100**

	Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)
1.	**Schneider, M-J. Introduction to Public Health. Jones and Bartlett Publishers, USA**
2.	**Bhattacharya, J., Hyde, T., Tu, P. Health Economics. Palgrave Macmillan**
3.	**Drummond M., et al. Methods for the Economic Evaluation of health care programmes. Oxford University Press**
4.	**Johannesson, Magnus. Theory and Methods of Economic Evaluation of Healthcare. Springer Science Business Media**