Jaypee Institute of Information Technology

M.Tech. Biotechnology

Semester II

Course Descriptions

Detailed Syllabus

Lecture-wise Breakup

Course Code	17M11BT113	**Semester** Even **(specify Odd/Even)**	**Semester** VIII / M/Tech 1st Sem **Session** 2018 -2019 **Month from** January to June
Course Name	BIOPROCESS & INDUSTRIAL BIOTECHNOLOGY		
Credits	3	**Contact Hours**	3

Faculty (Names)	**Coordinator(s)**	DR. ASHWANI MATHUR
	Teacher(s) (Alphabetically)	DR. ASHWANI MATHUR DR INDIRA P SARETHY

COURSE OUTCOMES		**COGNITIVE LEVELS**
CO1	Relate role of economic principles in biomanufacturing processes	Understanding (C2)
CO2	Apply knowledge of engineering principles in designing of bioreactors for prokaryotic and eukaryotic systems	Applying (C3)
CO3	Analyze the role of bioprocess conditions in eukaryote cell culture	Analyzing (C4)
CO4	Evaluate various strategies used for production of primary and secondary metabolites	Evaluating (C5)

Module No.	**Title of the Module**	**Topics in the Module**	**No. of Lectures for the module**
1.	Introduction to Industrial Bioprocesses	Concept of sustainability and sustainable manufacturing, Economic assessment and concept of cost and Lang factor; Non-ideal systems of cultivating microorganism and economic process scale-up	3

2.	Microbial Process Development: Solid state fermentation	Cell growth kinetics of bacteria and fungi in non-ideal reactors; Concepts of solid state fermentation; mechanism of cell growth and indirect methods of estimating cell growth kinetics, Comparison of solid *versus* submerged fermentation; water activity; bioprocess parameters regulating solid stste fermentation	8
3.	Animal cell fermentation	Animal cell metabolism: Basic understanding of substrate and by-poduct stoichiometry, Concept of primary cells, cell lines and cancerous cells; growth characteristics and kinetics, methods and reactors for scalable production of animal cells and derived products; Biomaterial properties for anchorage dependent cell lines; Graf reactor; Concept of 2D and 3D culture, Bioreactors in Tissue Engineering, reactor design consideration	7
4.	Plant Cell Fermentation	Importance of plant cell cultivation, Plant cell / hairy root culture, callus and shoot propagation, kinetics of cell growth and product formation, Reactors for plant cell culture- type of reactors, comparison of reactor performance, immobilized plant cell reactor.	8
5.	Algal Fermentation	Basic classification of algae, Morphology and physiology; Algal derived metabolites, methods of studying growth kinetics of chemotropic and phototropic algae, type of reactors; Lab scale photo-bioreactors- Design and engineering principles, Large scale pond reactors	6
6.	Production of Primary & Secondary Metabolites	Isolation, preservation and propagation of microbial culture- An industrial perspective, Process technology for production of organisc acids, amino acids, alcohols, antibiotics, vitamins, nucleotide and steroids, flavours; production of industrial enzymes: protease, cellulose, amylase, lipase; Enzyme inhibitors: inhibitors of cholesterol synthesis; biopesticides, biofertilizers, biopreservatives; biopolymers; plant	10

		derived therapeutically important metabolites	
		Total number of Lectures	**42**

Evaluation Criteria

Components	**Maximum Marks**
T1	20
T2	20
End Semester Examination	35
TA	25 (Class Test-1, Presentation / Report)
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.	P. M. Doran. *Bioprocess Engineering Principles*. Academic Press, USA, 2002
2.	S. J. Pirt. Principles of Microbe and Cell Cultivation. Blackwell Scientific Publications, Oxford Press, London, 1975
3.	P.F. Stanbury, A. Whittakar and S. J. Hall. *Principles of Fermentation Technology.* Butterworth-Heinemann, Oxford Press, London, 1994
4.	S. Aiba, A.E. Humphrey and N. F. Millis. *Biochemical Engineering.* University of Tokyo Press, Toyko, Japan, 1973
5.	A. H. Scragg. *Bioreactors in Biotechnology: A practical approach.* Ellis Horwood Publications, New York, USA, 1991
6.	WulfCruger and Anneliese Crueger. *Biotechnology: A Textbook of Industrial Microbiology.* Panima Publishing Corporation, New Delhi, India, 2003

Detailed Syllabus

Lecture-wise Breakup

Course Code	**17M11BT114**	**Semester** Even	**Semester** VIII (Integrated) / II Sem (M.Tech) **Session** 2018 -2019 **Month from** January to June
Course Name	**Diseases and Healthcare**		
Credits	3	**Contact Hours**	3

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

COURSE OUTCOMES		**COGNITIVE LEVELS**
CO1	Explain the etiology, pathogenesis of infectious diseases and genetic disorders.	Understand Level (C2)
CO2	Choose and apply the strategies of different diagnostic tests.	Apply Level (C3)
CO3	Utilise expression systems and mutagenesis techniques for biopharmaceuticals production	Apply Level (C3)
CO4	Appraise biotechnology principles for production of recombinant proteins and nucleic acids as therapeutic agents	Evaluate Level (C5)

Module No.	**Title of the Module**	**Topics in the Module**	**No. of Lectures for the module**
1.	Introduction to diseases	Infectious diseases caused by bacteria, viruses, opportunistic fungi and parasites; pathology	2
2.	Genetic diseases	Medical genetics; Genetic mechanisms leading to diseases such as thalassemia, cancer	4
3.	Diagnosis of bacteria and virus	Challenges of pathogen detection; Pathogen Detection using Cytological, biochemical and molecular methods; Molecular cytogenetics, PCR variants	8

4.	Immunodiagnostics	Immuno-diagnostics: immunofluorescence, Chemiluminescence, Microparticle Enzyme immunoassay, Fluorescence polarization immunoassay Applications in bacteriology, medicine, forensic sciences	4
5.	Cancer diagnostics	Cancer cytology analysis, genetic and epigenetic biomarkers	3
6.	Diagnosis in Forensic science	Forensic DNA typing and data analysis, Next generation sequencing technology and applications	3
7.	Engineering of Therapeuticals	Scientific and technological innovations in biopharmaceuticals production, Mutagenesis techniques	3
8.	Manipulating Host systems	Prokaryotes, yeast, baculo-virus and mammalian cells for production of recombinant proteins	5
9.	Therapeutic applications	Recombinant blood related products, hormones, interleukins, Vaccines, Monoclonal antibodies and Therapeutic enzymes	8
10.	Nucleic acid therapeutics	Antisense oligodeoxynucleotides, ribozyme, small interfering RNAs, aptamers as therapeuticals	2
		Total number of Lectures	**42**

Evaluation Criteria

Components	**Maximum Marks**
T1	20
T2	20
End Semester Examination	35
TA	25 (Assignments, Case Study)
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.	Yi-Wei Tang & Charles W Stratton, "Advanced techniques in Diagnostic microbiology", 2nd Ed. Springer 2013
2.	Jean-Louis Serre, "Diagnostic techniques in Genetics", John Wiley& Sons publication 2006
3.	Kathleen Deska and Timothy J. Pagana, "Mosby's Manual of Diagnostics and Laboratory Test" Elsevier 2005

4.	S.B. Primrose, "Molecular Biotechnology", 2nd Edition Blackwell Scientific Publication, 1999
5.	O.Kayser and R.H. Muller, 'Pharmaceutical biotechnology" Wiley-VCH, 2005
6.	Michael J. Groves, 'Pharmaceutical biotechnology" 2nd edition CRC Press, 2005
7.	S.N. Jogdand, "Biopharmaceuticals" Ist edition Himalaya Publishing House, 2006
8.	Refereed papers from scientific journals for case studies

Detailed Syllabus

Lecture-wise Breakup

Course Code	17M12BT127	**Semester :** Even	**Semester:** II **Session:** 2018 -2019 **Month from:** January to June
Course Name	Nutraceuticals		
Credits	3	**Contact Hours**	3

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

COURSE OUTCOMES		**COGNITIVE LEVELS**
CO1	Compare the traditional and modern trends in the nutraceutical Industry.	**(C2)**
CO2	Evaluate the mechanism of action of micronutrients and phytochemicals in prevention of chronic diseases.	**(C3)**
CO3	Explain the health benefits of microbial and algal nutraceuticals	**(C2)**
CO4	Compare nutraceuticals and health food products in Indian and international market.	**(C4)**

Module No.	**Title of the Module**	**Topics in the Module**	**No. of Lectures for the module**
1.	**Nutraceuticals and Functional Food: An Introduction**	Historical perspective, classification, scope & future prospects. Applied aspects of the Nutraceutical Science. Sources of Nutraceuticals, The link between nutrition and medicine.	**3**

2.	**Nutrient Components of Food**	Bioactive Carbohydrates: Polysaccharides, Soluble Fibers, Insoluble Fiber, Resistant Starch, Prebiotics, Slowly Digestible Starch. Bioactive Lipids: MUFA, PUFA, Omega 3 and 6 Fatty Acid, Conjugated Linoleic Acid(CLA). Bioactive Peptides: Sources, Isolation and Purification methods. Antihypertensive, Antioxidant, Antimicrobial, Anticancer and immunomodulating Peptides. Polyphenols: Specific polyphenolic products Caratenoids : Lycopene	**10**
3.	**Nutraceuticals of Plant Origin**	Plant secondary metabolites, classification and sub-classification – alkaloids, phenols, Terpenoids Extraction and purification, applications with specific examples with reference to skin, hair, eye, bone, muscle, heart, brain, liver, kidney, general health and stimulants. Concept of cosmoceuticals and aquaceuticals.	**5**
4.	**Nutraceuticals of Animal Origin**	Animal metabolites - Sources and extraction of nutraceuticals of animal origin. Examples: chitin, chitosan, glucosamine, chondroitin sulphate and other polysaccharides of animal origin, uses and applications in preventive medicine and treatment	**5**
5.	**Microbial and Algal Nutraceuticals**	Concept of probiotics - principle, mechanism, production and technology involved, applications - examples of bacteria used as probiotics, use of prebiotics in maintaining the useful microflora - extraction from plant sources. Synbiotics for maintaining good health. Algae as source of omega - 3 fatty acids, antioxidants and minerals - extraction and enrichment	**4**
6.	**Nutraceuticlasand**	Preventive role of nutraceutical in cardiovascular diseases, Metabol;ic disorders, Cancer, Bone health, skin diseases	**8**

	Diseases	etc.	
7.	**Product development and clinical trials**	Activity screening, formulations, toxicology, bioavailability, bioequivalence; use of animal models and pre-clinical and clinical trials involved	**3**
8.	**Nutraceutical Industry and Market Information**	Nutraceutical industries in India and abroad (study of 5 reputed Indian and International industries involved in production and development of nutraceuticals and functional foods).	**4**
		Total number of Lectures	**42**

Evaluation Criteria

Components	**Maximum Marks**
T1	20
T2	20
End Semester Examination	35
TA	25 (Assignment, report and viva)
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.	Wildman, R.E.C. ed. Handbook of Nutraceuticals and Functional Foods, CRCPress, Boca Raton, 2000.
2.	R. E. Aluko, Functional foods and Nutraceuticals, Springer, 2012
3.	Yashwant V Pathak, Handbook of Nutraceuticals, CRC Press, 2010
4.	Shibamoto T. Functional food and health, Oxford University Press, 2008.
5.	Goldberg, I. Functional Foods: Designer Foods, Pharma foods, Nutraceuticals, Chapman & Hall, 1994.
6.	Robert E.C. Handbook of Nutraceuticals and Functional Foods. 2nd Ed. Wildman, 2006.

Detailed Syllabus

Lecture-wise Breakup

Course Code	17M12BT131	**Semester** Odd	**Semester** X **Session** 2018 -2019 **Month from** July to December
Course Name	Drug Delivery		
Credits	3	**Contact Hours**	3

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

COURSE OUTCOMES		**COGNITIVE LEVELS**
CO1	Explain the basics of drug administration and delivery	**Understanding (Level 2)**
CO2	Analyse clinical pharmcokinetics of drug molecules in body.	**Analyzing (Level 4)**
CO3	Identify the applications of various drug delivery systems	**Applying (Level 3)**
CO4	Assess the role of nano-carriers in therapeutics.	**Evaluation (Level 5)**
CO5	Examine pharmacodynamics, pharmacodynamic-pharmacokinetic interactions	**Analyzing (Level 4)**

Module No.	**Title of the Module**	**Topics in the Module**	**No. of Lectures for the module**
1.	**Introduction to concepts of Drug delivery**	Conventional vs novel drug delivery systems Targeted drug delivery systems Controlled drug delivery systems Modified drug delivery systems	**02**
2.	**Pharmacokinetics**	Pharmacokinetic parameters-Absorption, Volume of	**10**

	and Pharmacodynamics of drugs	Distribution, Hepatic Metabolism, Excretion, renal and hepatic clearance, extraction ratio. One, two and multi compartment models. Pharmacodynamic models. Measurement of bioavailability and bioequivalence. Pharmacokinetics of Protein and peptide based drugs.	
3.	**Drug delivery and design of formulations through various route of administration**	Formulation, characterization and in vivo evaluation of Oral Drug delivery Parentral drug delivery Nasal drug delivery Pulmonary drug delivery Ocular drug delivery Transdermal drug delivery Brain drug delivery	**16**
4.	**Carrier Concepts in Drug Delivery**	Liposomes, Niosomes, Submicron emulsions, microspheres, nanoparticles.	**10**
5.	**Drug Targeting**	Active and passive targeting, lignads, conjugation, PEGylation, Gene drug delivery	**02**
6.	**Products approved and in market and IPR related issues in Drug delivery**	Latest Drug delivery Products approved by regulatory agencies. latest patents in the area of drug delivery	**02**
		Total number of Lectures	**42**

Evaluation Criteria

Components	**Maximum Marks**
T1	20
T2	20
End Semester Examination	35
TA	25 (Class Test, Assignment I)
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.	Leon Shargel, Susanna Wu-Pong, Andrew Yu, Applied Biopharmaceutics & Pharmacokinetics, 5th edition,

	Mc Graw Hill Publishers,2005.
2.	Vasant V. RanadeMannfred A. Hollinger, Drug Delivery Systems, 2nd Edition, CRC Press,2004.
3.	SP Vyas, RK Khar, Targetted and controlled drug delivery: Novel carrier systems, 1st edition, CBS Publishers, 2002.
4.	Bernd Meibohm, Pharmacokinetics and Pharmacodynamics of Biotech Drugs, WILEY-VCH,2006.

Detailed Syllabus

Lab-wise Breakup

Course Code	**17M15BT112**	**Semester** Even **(specify Odd/Even)**	**Semester** II **Session** 2018 -2019 **Month from** January to June
Course Name	**Biotechniques Lab-II**		
Credits	3	**Contact Hours**	6

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

COURSE OUTCOMES		**COGNITIVE LEVELS**
CO1	Experiment with high end analytical techniques in biotechnology	**Apply (Level C3)**
CO2	Develop basic and applied skills in cell culture	**Apply (Level C3)**
CO3	Examine and analyse disease-specific drug targets	**Analyze (Level C4)**
CO4	Analyse bioactive compounds from plant and microbial systems	**Analyze (Level C4)**

Module No.	**Title of the Module**	**List of Experiments**	**CO**
1.	Analytical techniques	To learn andperform High-performance liquid chromatography (HPLC); Prepration and characterization of plant extracts using HPLC; To learn and perform Gas chromatography	3
2.	Cell culture techniques	Preparation and sterilization of media for cell culture; subculture of animal cell lines; analysis and counting of adherent cells; cell cytotoxicity determination	3
3.	Drug target analyses	Analyze drug targets by biochemical and fluorescent assays	3
4.	Natural product	Extraction of antioxidant compound from *in vitro* grown plant and bacteria; purification of compound; antioxidant	3

	analyses	capacity analyses of extracts	
		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.	Biotechnology Procedures and Experiments Handbook http://site.iugaza.edu.ps/mwhindi/files/BIOTECHNOLOGY-PROCEDURES-AND-EXPERIMENTS-HANDBOOK.pdf
2.	J.M. Davis, "Basic Cell Culture – A Practical Approach", 2nd edition Oxford University Press, 2002
3.	Lab manual on Biotechniques http://inpressco.com/lab-manual-on-biotechniques/
4.	Methods standardized in lab

Detailed Syllabus

Lecture-wise Breakup

Course Code	**17M17BT112**	**Semester** EVEN	**Semester** XI and M.Tech II sem **Session** 2018-2019 **Month from** January to June
Course Name	**Project Based Learning-I**		
Credits	2	**Contact Hours**	2

Faculty (Names)	**Coordinator(s)**	DrAshwaniMathur
	Teacher(s) (Alphabetically)	DrAshwaniMathur

COURSE OUTCOMES		**COGNITIVE LEVELS**
CO1	Select biotechnological problems based on literature	Applying Level Level III
CO2	Interpret scientific data to address the biotechnological problem	Evaluate level Level V
CO3	Demonstrate an ability to function in a task oriented team with distribution of roles	Understanding Level 2
CO4	Analyze the research finding and conclude through presentation and project report	Analyzing Level 4

Detailed Syllabus

Lecture-wise Breakup

Course Code	**18M12BT116**	**Semester** Even **(specify Odd/Even)**	**Semester** VIII **Session** 2018 -2019 **Month from** January to June
Course Name	**IPR in Biotechnology**		
Credits	3	**Contact Hours**	3

Faculty (Names)	**Coordinator(s)**	Dr. Indira P. Sarethy
	Teacher(s) (Alphabetically)	Dr. Indira P. Sarethy, Dr. Shweta Dang

COURSE OUTCOMES		**COGNITIVE LEVELS**
CO1	Explain and interpret the types of intellectual property rights, related laws and systems	**Understand (C2)**
CO2	Apply specific IPR issues pertaining to medical biotechnology	**Apply (C3)**
CO3	Evaluate plant and traditional knowledge protection	**Evaluate (C5)**
CO4	Appraise commercialization of intellectual property, infringements and laws applicable	**Evaluate (C5)**

Module No.	**Title of the Module**	**Topics in the Module**	**No. of Lectures for the module**
1.	**Introduction**	Intellectual Property Rights - their Relevance, Importance and Business Interest to Industry, Academia, Protection of Intellectual Property, Relationship of IPRs with biotechnology	**2**
2.	**Types of Intellectual Property Rights**	Patents, Trademarks, Copyrights, Industrial Designs, Geographical Indications, Trade secrets, non-disclosure agreements	**2**
3.	**Patents**	General Introduction to Patents, Patent Terminology, Patent Claims, Patent Life and Geographical Boundaries,	**4**

		Utilization of Intellectual Patents, Licensing of patents	
4.	**Elements of patentability**	Invention/Discovery, What constitutes Patentable subject matter, the Utility, novelty and non-obviousness of an invention, Patentability in Biotechnological Inventions: Case studies	**2**
5.	**Preparation and Process for Patenting**	Procedural steps to grant of a patent, Process of filing patents in India, PCT application, protocols of application, pre-grant & post-grant opposition	**3**
6.	**Patent Search**	Invention in context of "prior art", Patent Search methods, Patent Databases & Libraries, online tools, Country-wise patent searches (USPTO, EPO, India etc.), patent mapping	**2**
7.	**IPR laws**	Basic features of the Indian Patent Act, the Indian Copyright Act, and the Indian Plant Varieties Protection and Farmers' Rights Act, A brief overview of other Patent Acts & Latest Amendments of Indian, European & US patent systems	**2**
8.	**Patent issues in Drugs and Pharmaceuticals**	Generics, Compulsory Licensing, Exclusive Marketing Rights (EMR), Bolar provision, Bayh-Dole act, Second medical use	**2**
9.	**Worldwide Patent Protection, WTO & TRIPS Agreement**	Brief Background of different International conventions such as Paris convention, TRIPS, WTO, PCT and Patent Harmonisation including Sui-generis system, The relationship between IPRs and international trade, Overview of WTO & TRIPS Agreement, Enforcement and dispute settlement under the TRIPS Agreement, The implication of TRIPS for developing countries in the overall WTO system	**2**
10.	**Gene patents**	Introduction & overview, what constitutes gene patents, Bayh-Dole Act, ESTs, Cohen-Boyer technology, PCR patents, EPO case, BRCA gene, Types of IPR involved, Genetic Use Restriction Technologies, Patenting of biologics, Hatch Waxman Act	**9**
11.	**Protection of Plant Varieties /Seeds**	The interface between technology and IPRs in the context of plants, Key features of UPOV 1978, UPOV 1991 and TRIPS with respect to IPRs on plants, Indian Law on Protection of Plant Varieties, DUS criteria, patenting of genetically modified plants, The significance of IPRs in agricultural biotechnology, Biodiversity, Conventions & Treaties, plant patents, Plant Varieties Protection Act, Plant Breeders' Rights, UPOV, benefit sharing, *sui*	**4**

		*generis*systems Case studies	
12.	**Traditional Knowledge and Intellectual Property Rights**	The importance and relevance of Traditional Knowledge for developing nations, The various approaches to protecting TK, The local, national and global dimensions of the issues in TK and IPRs, Traditional Medicine & IP Protection, Folklore, Patenting of Health Foods: Case studies	**4**
13.	**Patent Infringement and Commercializing Intellectual Property Rights**	What all are considered as patent Infringement: Case studies, defenses to infringement including experimental use, patent misuse, legal considerations, Patent Valuations, Competition and Confidentiality issues, Assignment of Intellectual Property Rights, Technology Transfer Agreements	**4**
		Total number of Lectures	**42**

Evaluation Criteria

Components	**Maximum Marks**
T1	20
T2	20
End Semester Examination	35
TA	25 (Assignments 1, 2. Presentation 1)
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.	USPTO Web Patent Databases at: www.uspto.gov/patft
2.	Government of India's Patents Website: patinfo.nic.in
3.	Intellectual property India: www.ipindia.nic.in
4.	"Indian Patent Law : Legal and Business Implications" by AjitParulekar, Sarita D'Souza Macmillan India publication, 2006
5.	"Agriculture and Intellectual Property Rights", edited by: Santaniello,V., Evenson, R.E., Zilberman, D. and Carlson, G.A. University Press publication, 2003
6.	Research papers and Reports provided from time to time

Detailed Syllabus

Lecture-wise Breakup

Course Code	19M12BT111	**Semester** EVEN	**Semester II Session** 2018 -2019 **Month from** January to June
Course Name	Natural Products and Bioprospecting		
Credits	3	**Contact Hours**	3

Faculty (Names)	**Coordinator(s)**	Dr. GarimaMathur
	Teacher(s) (Alphabetically)	Dr. GarimaMathur

COURSE OUTCOMES		**COGNITIVE LEVELS**
CO1	Explain various natural products sources	**Understand level (C2)**
CO2	Identify appropriate method for production of natural products and characterization of compounds	**Apply level (C3)**
CO3	Examine Bioprospecting potential of natural resources	**Analyze level (C4)**
CO4	Assess the products as per national and international agreements and regulations	**Evaluate level (C5)**

Module No.	**Title of the Module**	**Topics in the Module**	**No. of Lectures for the module**
1.	**Introduction to natural products and bioprospecting**	Introduction to natural products science, History of the field, primary and secondary metabolites, characteristics of natural products	**5**
2.	**Plant derived natural products and their classification**	Biogenetic classification of natural products (Alkaloids, Phenylpropanoids, Polyketides and fatty acids, Terpenoids), therapeutically important natural products with interesting bioactivities	**10**
3.	**Bioactive compounds from microorganisms and marine**	Antibiotic and non-antibiotic drugs from microorganisms and marine sources, microbial phytotoxins, Genetically engineered natural products	**5**

	sources		
4.	**Industrial applications of natural products**	Case studies on production and applications of important natural products: Vinka alkaloids, morphine, cocaine, cyclopamine, Reseveratrol, Genistein, tea catechins	**8**
5.	**Bioprospecting in development of natural products**	current aspects of bioprospecting in development of natural products from medicinal plants, marine ecosystem and microbial population, Screening concepts, extraction, isolation of natural products, Bioassay-directed fractionation of natural products depicting examples.	**8**
6.	**Conventions and regulations in Bioprospecting**	legal issues with bio-prospecting, understanding biopiracy, International law regulating bio-prospecting (Convention on Biological Diversity, Rio Earth Summit, Declaration on the Rights of Indigenous Peoples, Nagoya Protocol), Indian law regulating bio-prospecting, Prior approval from the National Biodiversity Authority, Prior Intimation to the State Biodiversity Board, critical analysis of bio-prospecting regime in India	**6**
Total number of Lectures			**42**

Evaluation Criteria

Components	**Maximum Marks**
T1	20
T2	20
End Semester Examination	35
TA	25 (Assignment 1, Assignment 2, Quiz)
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.	Leland J. Cseke, Ara Kirakosyan, Peter B. Kaufman, Sara Warber, James A. Duke, Harry L. Brielmann. Natural Products from Plants, CRC Press, 2006
2.	Sujata V. Bhat, Bhimsen A. Nagasampagi, MeenakshiSivakumar. Natural Products: Chemistry and Applications. Narosa Publishing house, 2014.