

**M.Tech Biotechnology**  
**Semester II**

## BIOPROCESS AND INDUSTRIAL BIOTECHNOLOGY

<b>Course Code</b>	17M11BT113	<b>Semester Even (Specify Odd/Even)</b>	<b>Semester II Session 2022-23</b>
<b>Course Name</b>	BIOPROCESS & INDUSTRIAL BIOTECHNOLOGY		
<b>Credits</b>	3	<b>Contact Hours</b>	3

<b>Faculty (Names)</b>	<b>Coordinator(s)</b>	DR. SONAM CHAWLA
	<b>Teacher(s) (Alphabetically)</b>	DR. SONAM CHAWLA, DR. GARIMA MATHUR

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

<b>Module No.</b>	<b>Title of the Module</b>	<b>Topics in the Module</b>	<b>No. of Lectures for the module</b>
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 <i>versus</i> submerged fermentation; water activity; bioprocess parameters regulating solid state fermentation	8
3.	Animal cell fermentation	Animal cell metabolism: Basic understanding of substrate and by-product stoichiometry, Concept of primary cells, cell lines and cancerous cells; growth characteristics and kinetics, methods and reactors for scalable	7

		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	
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 organics acids, amino acids, alcohols, antibiotics, vitamins, nucleotide and steroids, flavors; production of industrial enzymes: protease, cellulose, amylase, lipase; Enzyme inhibitors: inhibitors of cholesterol synthesis; biopesticides, biofertilizers, bio preservatives; biopolymers; plant derived therapeutically important metabolites	10
<b>Total number of Lectures</b>			<b>42</b>

#### Evaluation Criteria

Components	Maximum Marks
T1	20
T2	20
End Semester Examination	35
TA	25 (Class Test-1, Presentation / Report)
<b>Total</b>	<b>100</b>

**Project based learning:** Students will learn the economics attributes that help in designing economically viable biomanufacturing strategies. They will learn the concept, principles of solid-state fermentation, an industrially viable process for most microbial metabolites production. Students will be learning the advances in 2D and 3D culture, strategies used for production of scaffolds and implants

**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. <i>Bioprocess Engineering Principles</i> . Academic Press, USA, 2002
2.	S. J. Pirt. <i>Principles of Microbe and Cell Cultivation</i> . Blackwell Scientific Publications, Oxford

	Press, London, 1975
3.	P.F. Stanbury, A. Whittakar and S. J. Hall. <i>Principles of Fermentation Technology</i> . Butterworth-Heinemann, Oxford Press, London, 1994
4.	S. Aiba, A.E. Humphrey and N. F. Millis. <i>Biochemical Engineering</i> . University of Tokyo Press, Toyko, Japan, 1973
5.	A. H. Scragg. <i>Bioreactors in Biotechnology: A practical approach</i> . Ellis Horwood Publications, New York, USA, 1991
6.	Wulf Cruger and Anneliese Crueger. <i>Biotechnology: A Textbook of Industrial Microbiology</i> . Panima Publishing Corporation, New Delhi, India, 2003

## DISEASES AND HEALTHCARE

<b>Course Code</b>	<b>17M11BT114</b>	<b>Semester</b> Even	<b>Semester II Sem (MTech)</b> <b>Session 2022-23</b>
<b>Course Name</b>	<b>Diseases and Healthcare</b>		
<b>Credits</b>	3	<b>Contact Hours</b>	3

<b>Faculty (Names)</b>	<b>Coordinator(s)</b>	Dr. Reema Gabrani
	<b>Teacher(s) (Alphabetical ly)</b>	Dr. Reema Gabrani

COURSE OUTCOMES		COGNITIVE LEVELS
C115.1	Explain the etiology, pathogenesis of infectious diseases and genetic disorders.	Understand Level (C2)
C115.2	Choose and apply the strategies of different diagnostic tests.	Apply Level (C3)
C115.3	Utilize expression systems and mutagenesis techniques for biopharmaceuticals production	Apply Level (C3)
C115.4	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	3
2.	Genetic diseases	Medical genetics; Genetic mechanisms leading to diseases such as thalassemia, cancer	3
3.	Diagnosis of bacteria and virus	Challenges of pathogen detection; Pathogen Detection using Cytological, biochemical and molecular methods; Molecular cytogenetics, PCR variants	8
4.	Immunodiagnos tics	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 Therapeutical	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, interfering RNAs, aptamers as therapeutical	2
<b>Total number of Lectures</b>			42

Evaluation Criteria	
Components	Maximum Marks
T1	20
T2	20
End Semester Examination	35
TA	25 (Assignments) (PBL)
Total	100
PBL: Student will choose commercially available protein/ biotechnologically derived product and inspect the synthesis, purification, final product, and its market.	

<b>Recommended Reading material:</b> 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”, 2 <sup>nd</sup> Ed. Springer 2013
2.	G. Walsh, “Biopharmaceuticals: Biochemistry and Biotechnology”, 2nd Ed. John Wiley & Sons publication 2013
3.	Rodney J. Y. Ho Ph.D., FAAAS, FAAPS, Milo Gibaldi Ph.D. “Biotechnology and Biopharmaceuticals: Transforming Proteins and Genes into Drugs” John Wiley & Sons Inc. 2013
4.	Refereed papers from scientific journals for case studies

## NUTRACEUTICALS

<b>Course Code</b>	17M12BT112	<b>Semester:</b> Even	<b>Semester:</b> II <sup>nd</sup> <b>Session:</b> 2022-23
<b>Course Name</b>	Nutraceuticals		
<b>Credits</b>	3	<b>Contact Hours</b>	3

<b>Faculty (Names)</b>	<b>Coordinator(s)</b>	Dr. Smriti Gaur
	<b>Teacher(s) (Alphabetically)</b>	Dr. Smriti Gaur

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

<b>Module No.</b>	<b>Title of the Module</b>	<b>Topics in the Module</b>	<b>No. of Lectures for the module</b>
<b>1.</b>	<b>Nutraceuticals and Functional Food: An Introduction</b>	Historical perspective, classification, scope & future prospects. Applied aspects of the Nutraceutical Science. Sources of Nutraceuticals, The link between nutrition and medicine.	<b>4</b>
<b>2.</b>	<b>Nutrient Components of Food</b>	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.	<b>10</b>
<b>3.</b>	<b>Nutraceuticals of Plant Origin</b>	Plant secondary metabolites, classification and sub-classification – alkaloids, phenols, Terpenoids, uses and Preventive role in diseases.	<b>5</b>
<b>4.</b>	<b>Nutraceuticals of</b>	Animal metabolites - Examples: Chitin, Chitosan,	<b>5</b>

	<b>Animal Origin</b>	Glucosamine, Chondroitin Sulphate, uses and applications in preventive medicine and treatment.	
<b>5.</b>	<b>Microbial and Algal Nutraceuticals</b>	Concept of probiotics - principle, mechanism, production and technology involved and health benefits of probiotics. Symbiotic for maintaining good health. Algae as source of omega - 3 fatty acids, proteins, fibers, antioxidants, vitamins and minerals – examples: Chlorella, Haematococcus, Spirulina, Dunaliella	<b>6</b>
<b>6.</b>	<b>Nutraceuticals and Diseases (specific foods and food products)</b>	Tea, Garlic, Honey, Flaxseed, Mushroom, Barley, Grape seed extract and Lycopene and their preventive role in cardiovascular diseases, Metabolic disorders, Cancer, Bone health, skin diseases etc.	<b>8</b>
<b>7.</b>	<b>Nutraceutical Industry and Market Information</b>	Concept of cosmeceuticals and aquacultural, Nutraceutical industries in India and abroad (study of 5 reputed Indian and International industries involved in production and development of nutraceuticals and functional foods).	<b>4</b>
<b>Total number of Lectures</b>			<b>42</b>

**Evaluation Criteria**

**Components**

**Maximum Marks**

T1	20
T2	20
End Semester Examination	35
TA	25 (Assignment, report and viva)
<b>Total</b>	<b>100</b>

**Project based learning:** Each student in a group of 2 will study 5 reputed Indian and International industries involved in production and development of nutraceuticals and functional foods. They will prepare the report and give a presentation and will discuss the various products manufactured by the industry, product processing, manufacturing, applications, health benefits, market information, job prospects etc. This will enhance the student's understanding about various Nutraceuticals industries. This would help their employability into the nutraceutical sector.

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

<b>1.</b>	Wildman, R.E.C. ed. Handbook of Nutraceuticals and Functional Foods, CRC Press, Boca Raton, 2000.
<b>2.</b>	R. E. Aluko, Functional foods and Nutraceuticals, Springer, 2012
<b>3.</b>	Yashwant V Pathak, Handbook of Nutraceuticals, CRC Press, 2010
<b>4.</b>	Shibamoto T. Functional food and health, Oxford University Press, 2008.
<b>5.</b>	Goldberg, I. Functional Foods: Designer Foods, Pharma foods, Nutraceuticals, Chapman & Hall, 1994.
<b>6.</b>	Robert E.C. Handbook of Nutraceuticals and Functional Foods. 2 <sup>nd</sup> Ed. Wildman, 2006.



## BIOTECHNIQUES LAB-II

<b>Course Code</b>	17M17BT112	<b>Semester Even (Specify Odd/Even)</b>	<b>Semester II Session 2023-24</b>
<b>Course Name</b>	<b>Biotechniques Lab-II</b>		
<b>Credits</b>	3	<b>Contact Hours</b>	6

<b>Faculty (Names)</b>	<b>Coordinator(s)</b>	Dr Pooja Choudhary
	<b>Teacher(s) (Alphabetically)</b>	Dr. Vibha Gupta, Dr. Ashwani Mathur, Dr. Sudha Srivastava,

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

<b>Module No.</b>	<b>Title of the Module</b>	<b>List of Experiments</b>	<b>CO</b>
1.	Analytical techniques	To run High-performance liquid chromatography (HPLC); prepare and analyze curcumin extract by HPLC; purification of plant extract	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	SDS-PAGE analysis and fluorescent staining	3
4.	Natural product analyses	Extraction of antioxidant compound from <i>in vitro</i> grown plant and bacteria; purification of compound; antioxidant capacity analyses of extracts	3

### **Evaluation Criteria**

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

**Project Based Learning:** The students learn HPLC, cell culture techniques, natural products characterization, which are required for Biotech and pharmaceutical industry.

**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 <a href="http://site.iugaza.edu.ps/mwhindi/files/BIOTECHNOLOGY-PROCEDURES-AND-EXPERIMENTS-HANDBOOK.pdf">http://site.iugaza.edu.ps/mwhindi/files/BIOTECHNOLOGY-PROCEDURES-AND-EXPERIMENTS-HANDBOOK.pdf</a>
2.	Cornelia Kasper, Verena Charwat, Antonina Lavrentieva, "Cell Culture Technology" Springer, 2018
3.	ChukwuebukaEgbuna, Jonathan ChinenyeIfemeje, Jaya Vikas Kurhekar, Stanley Chidi Udedi, Shashank Kumar, "Phytochemistry Volume 2" Apple Academic Press, 2019
4.	Methods standardized in lab
5.	Lab manual on Biotechniques <a href="http://inpressco.com/lab-manual-on-biotechniques/">http://inpressco.com/lab-manual-on-biotechniques/</a>

**PROJECT BASED LEARNING- I**

<b>Project based learning-1 (17M17BT112) - Dr. Ashwani Mathur</b>				
<b>Project-Based Learning - I</b> (M.Tech II Sem Student &M.Tech (Integrated) XI Sem) Viva- I / Mid Term Viva: 30 Marks Viva-II / End Term Viva: 30 Marks Day to Day Marks from Supervisor: 40				
<b>C216.1</b>	Select biotechnological problems based on literature	Applying Level Level III	<b>Viva-I</b> (Rational of the study) - <b>10, Day to Day</b> (Rational of the study) - <b>5</b>	Exit Survey
<b>C216.2</b>	Interpret scientific data to address the biotechnological problem	Evaluate level Level V	<b>Viva I</b> (Problem statement) - <b>5 Marks; Day to Day</b> (Problem statement) - <b>5 Marks;</b>  <b>Viva II</b> (Design of research strategy for identified problem / Elaboration of case studies / Literature reviewed) – <b>5 Marks, Day to Day marks from supervisor</b> ( Design of research strategy for identified problem / Elaboration of case studies / Literature reviewed) - <b>5 Marks</b>	Exit Survey
<b>C216.3</b>	Design Research strategy for identified problem	Evaluate level Level VI	<b>Viva-I</b> (Literature review) – <b>15 Marks, Day to Day from Supervisor</b> (Literature Review) – <b>5 Marks</b>  <b>Viva – II</b> (Analysis and interpretation of result / Analysis of results from literature / Survey outcome) – <b>10 Marks, Day to Day Marks from Supervisor</b> (Analysis and interpretation of result / Analysis of results from literature / Survey outcome) – <b>10 Marks</b>	Exit Survey
<b>C216.4</b>	Analyze	Analyzing	<b>Viva-II</b> (Conclusion /	Exit Survey

	and present the research finding	Level IV	Learning Outcome, Report) – <b>15, Day to Day marks from Supervisor</b> (Conclusion / Learning Outcome, Report) – 10 <b>Marks</b>	
<p><b>Project based learning:</b> The students perform lab based, in-silico, experimental and systematic review or survey based analysis to define the problem statement and learn biotechnological and allied approaches to answer the problem statements. Such knowledge help student to develop independent thinking and inculcate the practice of following good laboratory, scientific and ethical practices in their career.</p>				

## IPR IN BIOTECHNOLOGY

<b>Course Code</b>	18M12BT116	<b>Semester Even (Specify Odd/Even)</b>	<b>Semester II Session 2022-23</b>
<b>Course Name</b>	<b>IPR in Biotechnology</b>		
<b>Credits</b>	3	<b>Contact Hours</b>	3

<b>Faculty (Names)</b>	<b>Coordinator(s)</b>	Prof. Shweta Dang
	<b>Teacher(s) (Alphabetically)</b>	Prof. Indira P. Sarethy, Prof. Shweta Dang

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

<b>Module No.</b>	<b>Title of the Module</b>	<b>Topics in the Module</b>	<b>No. of Lectures for the module</b>
<b>1.</b>	<b>Introduction</b>	Intellectual Property Rights - their Relevance, Importance and Business Interest to Industry, Academia, Protection of Intellectual Property, Relationship of IPRs with biotechnology	<b>2 [CO1]</b>
<b>2.</b>	<b>Types of Intellectual Property Rights</b>	Patents, Trademarks, Copyrights, Industrial Designs, Geographical Indications, Trade secrets, non-disclosure agreements	<b>2 [CO1]</b>
<b>3.</b>	<b>Patents</b>	General Introduction to Patents, Patent Terminology, Patent Claims, Patent Life and Geographical Boundaries, Utilization of Intellectual Patents, Licensing of patents	<b>4 [CO1, CO2]</b>
<b>4.</b>	<b>Elements of patentability</b>	Invention/Discovery, what constitutes Patentable subject matter, the Utility, novelty and non-obviousness of an invention, Patentability in Biotechnological Inventions: Case studies	<b>2 [CO2, CO3]</b>

5.	<b>Preparation and Process for Patenting</b>	Procedural steps to grant of a patent, Process of filing patents in India, PCT application, protocols of application, pre-grant & post-grant opposition	3 [CO2, CO3]
6.	<b>Patent Search</b>	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 [CO2, CO3]
7.	<b>IPR laws</b>	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 [CO1, CO2, CO3]
8.	<b>Patent issues in Drugs and Pharmaceuticals</b>	Generics, Compulsory Licensing, Exclusive Marketing Rights (EMR), Bolar provision, Bayh-Dole act, Second medical use	2 [CO2, CO3]
9.	<b>Worldwide Patent Protection, WTO &amp; TRIPS Agreement</b>	Brief Background of different international conventions such as Paris convention, TRIPS, WTO, PCT and Patent Harmonization 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 [CO1, CO2, CO3]
10.	<b>Gene patents</b>	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 [CO3, CO4]
11.	<b>Protection of Plant Varieties /Seeds</b>	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, <i>sui generis</i> systems Case studies	4 [CO3, CO4]
12.	<b>Traditional Knowledge and Intellectual Property Rights</b>	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 [CO3, CO4]
13.	<b>Patent Infringement and</b>	What all are considered as patent Infringement: Case studies, defenses to infringement including experimental use, patent misuse, legal considerations,	4 [CO4]

	<b>Commercializing Intellectual Property Rights</b>	Patent Valuations, Competition and Confidentiality issues, Assignment of Intellectual Property Rights, Technology Transfer Agreements	
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**Total number of Lectures**    **42**

**Evaluation Criteria**

<b>Components</b>	<b>Maximum Marks</b>
T1	20
T2	20
End Semester Examination	35
TA Presentation 1)	25 (Assignments 1 (PBL based 5 Marks), Assignments 2.
<b>Total</b>	<b>100</b>

PBL: Students will be given keywords to do art search from free patent databases like google patents, UPTO and they can analyze the types of patents filed under various domains.

**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: <a href="http://www.uspto.gov/patft">www.uspto.gov/patft</a>
2.	<a href="http://patinfo.nic.in">Government of India's Patents Website: patinfo.nic.in</a>
3.	Intellectual property India: <a href="http://www.ipindia.nic.in">www.ipindia.nic.in</a>
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

## ENGLISH LANGUAGE SKILLS FOR RESEARCH PAPER WRITING

<b>Subject Code</b>	19M13HS111	<b>Semester: Even</b>	<b>Semester: M.Tech II &amp; Dual degree VIII Session 2022-23 Month from January to May 2023</b>
<b>Subject Name</b>	<b>English Language Skills for Research Paper Writing</b>		
<b>Credits</b>	2	<b>Contact Hours</b>	2-0-0
<b>Faculty (Names)</b>	<b>Coordinator(s)</b>	Dr. Ekta Singh	
	<b>Teacher(s) (Alphabetically)</b>	Dr. Ekta Singh	

### Course Outcomes:

At the completion of the course, students will be able to,

COURSE OUTCOMES		COGNITIVE LEVELS
<b>C204.1</b>	Demonstrate an understanding of all the aspects of grammar and language needed to write a paper.	Understand Level (C2)
<b>C204.2</b>	Apply grammatical knowledge & concepts in writing and presentation.	Apply level (C3)
<b>C204.3</b>	Examine each section of a paper after careful analysis of Literature Review.	Analyze Level (C4)
<b>C204.4</b>	Determine the skills needed to write a title, abstract and introduction, methods, discussion, results and conclusion.	Evaluate Level (C5)
<b>C204.5</b>	Compile all the information into a refined research paper after editing and proofreading	Create Level (C6)

Module No.	Subtitle of the Module	Topics in the module	No. of Lectures and Tutorials for the module
1.	Grammar & Usage	Structure of English Language Voice, Aspect & Tense SVOCA Sense & Sense Relations in English Enhancing Vocabulary Connotation, Denotation & Collocation	6
2.	Elements of Paper Writing	Planning & Preparation Word Order Breaking Long Sentences Structuring Paragraphs Being Concise and Removing Redundancy Avoiding Ambiguity and Vagueness	4
3.	Paraphrasing & Writing	Highlighting Your Findings Hedging and Criticising Paraphrasing and Plagiarism Sections of a Paper Abstracts; Introduction	6
4.	Process of Writing	Review of Literature Methods Results Discussion	4



		Conclusion The Final Check	
5.	Key Skills Needed	Key skills needed when writing a Title Key skills needed when Writing an Abstract Key skills needed when writing an Introduction Key skills needed when writing a Review of the Literature Key skills needed when writing Methods & Results Key skills needed when writing Discussion & Conclusion	4
6.	Refining the Paper	Incorporating useful phrases Editing Proofreading References Annexures Ensuring good quality in submission	4
<b>Total number of Lectures and Tutorials</b>			<b>28</b>

<b>Evaluation Criteria</b>	
<b>Components</b>	<b>MaximumMarks</b>
<b>Mid Term</b>	<b>30</b>
<b>End Semester Examination</b>	<b>40</b>
<b>TA</b>	<b>30 (Project, Assignment/ Class Test/ Quiz, Class Participation)</b>
<b>Total</b>	<b>100</b>

### **3. Employability/entrepreneurship/skill development**

Researchers whose first language is not English write at least two-thirds of published scientific papers. Twenty percent of the comments referees make when reviewing papers for possible publication in international journals regard English language issues. In some disciplines, acceptance rate by journals of papers originating from the US/UK is 30.4%, and is higher than all other countries

Publishing your research in an international journal is key to your success in academia. This course is based on a study of some sample manuscripts and reviewers' reports revealing why papers written by non-native researchers are often rejected due to problems with English usage and poor structure and content. The course prepares the students on how to:

- prepare and structure a manuscript
- increase readability and reduce the number of mistakes you make in English by writing concisely, with no redundancy and no ambiguity
- write a title and an abstract that will attract attention and be read
- decide what to include in the various parts of the paper (Introduction, Methodology, Discussion etc)
- highlight your claims and contribution
- avoid plagiarism
- discuss the limitations of your research
- choose the correct tenses and style
- satisfy the requirements of editors and reviewers

<b>Recommended Reading material:</b>	
1.	Goldbort R. 'Writing for Science', Yale University Press (available on Google Books), 2006
2.	Day R. 'How to Write and Publish a Scientific Paper', Cambridge University Press, 2006
3.	Adrian Wallwork. 'English for Writing Research Papers', Springer, New York, Dordrecht Heidelberg, London, 2011
4.	Yadugari M.A. ' Making Sense of English: A Textbook of Sounds, Words & Grammar' Viva Books Private Limited, New Delhi, 2013, Revised Edition
5.	Strauss Jane. 'The Blue Book of Grammar and Punctuation, Josseybass, Wiley, San Francisco, 1999.
6.	Rizvi, A. R. 'Effective Technical Communication' 2nd edition, McGraw Hill Education Private Limited, Chennai, 2018
7.	Eckert, K. 'Writing Academic Paper in English:Graduate and Postgraduate Level', Moldy Rutabaga Books, 2017
8	Barros, L.O, 'The Only Academic Phrasebook You'll Ever Need: 600 Examples of Academic Language' Create Space Independent Publishing Platform; 1st edition,2016
9	Wallwork, A. 'English for Writing Research Papers (English for Academic Research)'.Springer; 2nd ed. 2016 edition.
10	Wallace,M&Wray,A. 'Critical Reading and Writing for Postgraduates (Student Success) SAGE Publications Ltd; Third edition, 2016
11	Butler, L. 'Longman Academic Writing Series 1: Sentences to Paragraphs, with Essential Online Resources', Pearson Education ESL; 2nd edition,2016
12	Saramäki, J. 'How to Write a Scientific Paper: An Academic Self-Help Guide for PhD StudentsIndependently published, 2018

## NANOBIOTECHNOLOGY

<b>Subject Code</b>	17M12BT125	<b>Semester Even</b> (specify Odd/Even)	<b>Semester Integ MTech VIII/ MTech II</b>	<b>Session 2022-23</b>
<b>Subject Name</b>	Nanobiotechnology			
<b>Credits</b>	3	<b>Contact Hours</b>	3	

<b>Faculty (Names)</b>	<b>Coordinator(s)</b>	1. Prof. Sudha Srivastava
	<b>Teacher(s) (Alphabetically)</b>	1. Prof. Sudha Srivastava 2. Prof. Shweta Dang
<b>COs</b>	<b>Cos description</b>	<b>Level</b>
<b>CO111.1</b>	Understand nanoparticles, their properties, characterization techniques and associated health hazards	Understand Level 2
<b>CO111.2</b>	Apply concepts of nanotechnology in healthcare, agriculture and environment	Apply level 3
<b>CO111.3</b>	Explain nanotechnological advancements for development of cutting edge technologies	Understand Level 2
<b>CO111.4</b>	Apply Nano-carrier based Drug Delivery to clinical pharmacokinetics	Apply level 3

Module No.	Subtitle of the Module	Topics in the module	# of Lectures
1.	Introduction to Nanotechnology	Introduction to Nanomaterials; Properties of Nanomaterials; Methods of Nanomaterials Synthesis	6
2.	Characterization Techniques	X-ray Diffraction (XRD analysis) Transmission Electron Microscopy (TEM), Scanning Electron Microscopy(SEM)	4
3.	Nanotechnology in Healthcare	Applications of nanoparticles in Healthcare : Imaging, bone regeneration, tissue engineering, Medical and Environmental	9
4.	Nanoparticles based Drug-Delivery Systems	Formulations, characterization techniques, Pharmacokinetics and Pharmacodynamics of Nano-carriers for Drug delivery: Lipid-based nanoparticles, Polymer-based nanoparticles, nanoemulsions, Micelles, Lipoplexes and polyplexes, protein nanoparticles Commercial therapeutic products based upon nanocarriers	14
5.	Novel bio-technologies employing nanoparticles	DNA sequencing using nanopores; Nanoparticles in PCR; Magnetic nanoparticles in SNP detection.	4
6.	Environmental and health hazards of nanotechnology	Sources - Anthropogenic and Natural nanomaterials; Environmental Risks; Health Risks - Nanoparticles toxicity, Routes of exposure, translocation and elimination.	6
<b>Total number of Lectures</b>			<b>42</b>
<b>PBL: Students will make a report and present the nanotechnological solutions for healthcare/industrial</b>			

<b>biotechnology/environmental issues/problems</b>
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<b>Recommended Reading material:</b> Author(s), Title, Edition, Publisher, Year of Publication etc. ( Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)
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1.	Nanostructures and Nanomaterials: Synthesis, Properties and Applications; G. Cao, Imperial College Press.
2.	Nanobiotechnology in Molecular Diagnostics: Current Techniques and Applications, K.K. Jain, Horizon Bioscience.
3.	Nanostructures for Drug Delivery: EcaterinaAndronescu, Alexandru Mihai Grumezescu, Elsevier, 2017
4.	Recent Research articles