

Jaypee Institute of Information Technology

Integrated M.Tech Biotechnology

Semester VIII

Course Descriptions

Detailed
Syllabus
Lecture-wise
Breakup

Course Code	16B1NHS831	Semester: Odd (specify Odd/Even)	Semester: VIII Session 2023-2024 Month: JAN 2024 –JUNE 2024
Course Name	Gender Studies		
Credits	3	Contact Hours	3-0-0

Faculty (Names)	Coordinator(s)	Prof Alka Sharma
	Teacher(s) (Alphabetically)	Prof Alka Sharma Shikha Kumari

COURSE OUTCOMES		COGNITIVE LEVELS
C401-19.1	Demonstrate knowledge of the construct of gender and the way it intersects with other social and cultural identities of race, class, ethnicity and sexuality	Understand (C2)
C401 - 19.2	Apply feminist and gender theory in an analysis of gender including an examination of the social construct of femininity and masculinity	Apply (C3)
C401-19.3	Analyze the ways in which societal institutions and power structures such as the family, workplace impact the material and social reality of women's lives	Analyze (C4)
C401-19.4	Assess the need for Gender Sensitization and Gender Inclusivity and its practice in contemporary settings	Evaluate (C5)
C401-19.5	Evaluate and interpret information from a variety of sources including print and electronic media, film, video and other information technologies	Evaluate (C5)

Module No.	Title of the Module	Topics in the Module	No. of Lectures for the module
1.	Introducing Gender Issues	- Sex and Gender - Types of Gender - Gender Roles - Gender Division of Labor - Gender Stereotyping and Gender Discrimination	9
2.	Gender Perspectives of Body & Language	- Biological, Phenomenological and Socio-Cultural Perspectives of body - Body as a Site and Articulation of Power Relations - Cultural Meaning of Female Body and Women's Lived Experiences - The Other and Objectification	6

3.	Social Construction of Femininity & Feminism	• Bio-Social Perspective of Gender • Gender as Attributional Fact • Feminine & Feminist • Major Theorists of Feminism • Challenging Cultural Notions of Femininity • Feminism Today: Radical, Liberal, Socialist, Cultural, Eco feminism & Cyberfeminism • Images of Women in Sports, Arts, Entertainment, Media and Fashion Industry ; Cultural Feminism &	9
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		Celebrating Womanhood • Analysis of role women have played across cultures	
4.	Social Construction of Masculinity	• Definition and Understanding of Masculinities • Sociology of Masculinity & its Types • Social Organization of Masculinity and Privileged Position of Masculinity • Politics of Masculinity and Power • Major Theorists of Masculinity • Masculine Identities in Literature, Cinema & Media.	9
5.	Gender Sensitization Empowerment & Gender Inclusivity	• Women & Women Rights In India • From Women's Studies to Gender Studies: A Paradigm Shift • Gender Sensitization & Gender Inclusivity • Gender Studies & Media: Creating New Paradigms in Gender & Culture	9
Total number of Lectures			42

Evaluation Criteria

Components Maximum Marks

T1 20

T2 20

End Semester Examination 35

TA 25 (Project/ Assignment)

Total 100

Students will be given a project on the construction of gender and how does the major institution of the society has shaped their gender.

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 Davis K., et al, "*Handbook of Gender and Women's Studies*. London: Sage. (2006)

2 Helgeson, Vicki S., "*The Psychology of Gender*", Pearson (2012)

3	Friedan B., “ <i>The Feminine Mystique</i> ”, Penguin. (1971/1992)
4	DebeauvoirS. , “ <i>The Second Sex</i> ”, Vintage (1953/1997)
5	Wharton Amy S., “ <i>The Sociology of Gender: An Introduction to Theory & Research</i> ”, Wiley-Blackwell (2005)
6	Pachauri G.,” <i>Gender, School & Society</i> ”, R.Lall Publishers(2013)
7	Connell R.W, “ <i>Masculinities</i> ”, Cambridge: Polity. (1985)
8	MacInnes J., “ <i>The End of Masculinity</i> ”. Buckingham: Open University Press. (1998)
9	Kaul A.& Singh M., ” <i>New Paradigms for Gender Inclusivity</i> ”, PHI Pvt Ltd (2012)

Detailed Syllabus
Lecture-wise Breakup

Course Code	18B12PH813	Semester: EVEN	Semester: VIII Session 2023-24 0. Month from: January to June
Course Name	Bio-Physics		
Credits	3	Contact Hours	3

Faculty (Names)	Coordinator(s)	Dr Papia Chowdhury
	Teacher(s) (Alphabetically)	Dr Papia Chowdhury

COURSE OUTCOMES		COGNITIVE LEVELS
C402-5.1	Find the connections between physics and biology of living system, Physical processes in the living organisms	Remember (C1)
C402-5.2	Understand the idea of DNA computing with the construction of different DNA logic gates.	Understanding (C2)
C402-5.3	Apply the idea of different radiation sources to explain radiobiology to understand the effect of radiation on living system	Apply (C3)
C402-5.4	Analyzing the working of different bio-devices: Organic semiconductor, solar cell, OLED, PLED, AMOLED, biosensors.	Analyze (C4)

Module No.	Title of the Module	Topics in the Module	No. of Lectures for the module
1.	0. Introduction to Biophysics and DNA computation	Connections between physics and biology of living system, Physical processes in the living organisms. The need of study of physical processes in biological systems. Introduction to DNA computing, DNA structure, Hamiltonian path problem, Encoding information in DNA, Biooperations, DNA models of computation, DNA algorithms, Error rates in DNA computing DNA logic gates, Identity, NOT, OR, AND, NAND, XOR, HALF ADDER, FULL ADDER DNA logic gates, truth table, Technology of tic-tac toe game by DNA computation	0. 14
2.	Radiation Biophysics	Atomic structure models: Constituents of atomic nuclei, Isotope, Radioactivity, Ionizing radiation, excitation, radiation sources, Alfa, Beta, Gamma rays, Properties of Electromagnetic radiation, Units of radioactivity, Particle flux, X & Gamma	10

		ray interaction with matter, Energy transfer processes, Nonionising radiation, Radiobiology: Radiolysis, Production of free radicals & their interactions, Radiation on living system, productions of radionuclides, Radio tracer techniques, Radio sensitisation and protection, Target theory, Cellular effects of radiation, Radiation damage, Genetic Effect of radiolysis, Early and late effects of radiation, Effect of Chronic exposure to radiation, Radiation detection, measurement and applications: Principles of radiation detection and measurement, Dosimeters and its Principles, Design & Working.	
3.	Photo Biophysics	Light sources, Molecular structure and excited states, Physical properties of excited molecules, Photophysical processes, fluorescence, phosphorescence, Internal conversion, Intersystem crossing, Optical activity, Photophysical kinetics of bimolecular processes. Optical bio-devices in electronic industry-Organic semiconductor, solar cell, OLED, PLED, AMOLED etc. Alternative energy sources-Hydrogen fuel cell.	6
4.	Bio-sensing systems	Piezoelectric and Luminescent biosensors, Theory, reaction, design and applications; Quantum dots: dimension, exciton, excited bohr radius, colour coding by quantum dots, experimental techniques for trapping quantum dots by micellization.	7
5.	Environmental biophysics	Ozone umbrella, green house effect, global warming.	3
Total number of Lectures			40
Evaluation Criteria			
Components		Maximum Marks	
T1		20	
T2		20	
End Semester Examination		35	
TA		25 [2 Quiz (10 M), Attendance (10 M) and Cass performance (5 M)]	
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.	Biophysics, an Introduction, Rodney M. J. Cotterill, John Wiley & Sons.
2.	Methods in modern Biophysics, Bengt Nölting, Springer International Edition.
3.	Biophysics. Vasantha Pattabhi, N. Gautham, Narosa Publishing House.
4.	Biophysics. Hoppe W., Lohmann W., Mark H., and Zeigler H. M.(1983) Biophysics, Springer Verlag, Heidelberg.

5.	Conformation of Biological Molecules, Govil G. and Hosur R.V. (1982), Springer Verlag, Berlin, Heidelberg, New York.
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Department of Biotechnology

Programme Name: Integrated M.Tech Biotechnology

Semester: VIII

Course Name & Code: Major Project Part-2, 15B19BT891

Course Outcomes:

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

Sl. No.	DESCRIPTION	COGNITIVE LEVEL (BLOOM's TAXONOMY)
C451.1	Summarize research literature	Understanding Level Level II
C451.2	Develop experimental solutions to resolve the identified problem	Applying Level Level III
C451.3	Evaluate and analyze the experimental results	Evaluating Level Level V
C451.4	Compose and present the scientific findings.	Creating Level Level VI

Detailed Syllabus
Lecture-Wise Breakup

Course Code	22M12BT111	Semester:	Semester: VIII Session: 2023-2024 From: Jan to June
Course Name	Agriculture Biotechnology		
Credits	3-0-3	Contact Hours	3

Faculty (Name s)	Coordinator(s)		
	Teacher(s) (Alphabetically)	1. Prof. Krishna Sundari	
Module No.	Subtitle of the Module	Topics in the module	No. of Lectures for the module
1.	Overview of agriculture biotechnology & NAP	Introduction and significance of biotechnology in agriculture, Climate change and its impact on agriculture, National agriculture Policy, food security, SDG & agriculture, quality control in agriculture & GAP	6
2.	Plant growth & Physiology	Fundamentals of Plant growth, Photosynthesis and genes involved, symbiotic and non-symbiotic nitrogen fixation, Role of lectins, nod genes, nif genes, Structure, function and regulation of nitrogenase, Leg-haemoglobin, Nodulins, Molecular aspects of regulation and enhancement of nitrogen fixation, Synthesis and metabolism of hormones and plant signaling	6
3.	Plant Genome & Plant Genetic resources	Genome size and sequence components, Nuclear, cytoplasmic/organelle genomes and significance, conservation of plant genetic resources, seedbanks, germplasm conservation and cryopreservation	4
4.	Agriculture Biotechnology & methods for improved production	Concept of plasticity in plant development, Tissue culture, hybridization, Marker Assisted Breeding, Molecular markers for plant genotyping and germplasm analysis commercial application of plant tissue culture	8
5.	Plant genetic engineering & applications	Agrobacterium-plant interaction; Virulence; Ti and Ri plasmids; Opines and their significance; T-DNA transfer; Disarming the Ti plasmid, Agrobacterium-mediated gene delivery, Cointegrate and binary vectors and their utility, Chloroplast transformation: advantages, vectors systems of plant genetic engineering, Enhancing crop yield and crop quality improvement through Genetic Engineering for quality improvement: Seed storage proteins; essential amino acids, Vitamins and minerals, heterologous protein production in transgenic plants for agriculture, industry and pharmaceuticals uses, biodegradable plastics	12
6.	Agriculture policies & Regulations for	Provisions on crop genetic resources in Indian Biodiversity Act, CBD and Cartagena protocol, Agricultural biodiversity; International Treaty on Plant	6

	GM and non-GM crops	Genetic Resources for Food and Agriculture (PGRFA), Global efforts for management of crop genetic resources; Strategies on PVFR and Biodiversity Acts; Impact of GE crops on Biodiversity	
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.	Genetics, Agriculture, and Biotechnology, Walter Suza, Iowa State University Donald Lee, Published by University of Nebraska-Lincoln, Copyright Year: 2021
2.	Textbook of Agriculture Biotechnology, Nag Ahindra, Second Edition, PHI publications, 2018
3	Plant Biotechnology and Agriculture-Prospect for the 21st Century, Eds. Arie Altman, Paul Hasegawa, Elsevier publications, 2nd Edition, 2020.
4.	Research articles from refereed journals.

Detailed Syllabus

Course Code	15B1NHS832	Semester Even (specify Odd/Even)	Semester VIII Session 2023-24 Monthm Jan – June
Course Name	International Studies		
Credits	3	Contact Hours	3 (3-0-0)

Faculty (Names)	Coordinator(s)	Dr. Chandrima Chaudhuri
	Teacher(s) (Alphabetically)	Dr. Chandrima Chaudhuri

CO Code	COURSE OUTCOMES	COGNITIVE LEVELS
C402-8.1	Demonstrate an understanding of the basic concepts in the area of international studies	Understanding (C2)
C402-8.2	Compare the changes in India's foreign policy in the Cold War era and the post Cold War era	Applying (C3)
C402-8.3	Analyze the major political developments and events since the 20 th century	Analyzing (C4)
C402-8.4	Demonstrate an understanding of the rise of new power centers in the changing world order	Understanding (C2)

Module No.	Title of the Module	Topics in the Module	No. of Lectures for the module
1.	Basic Concepts	Balance of power and Collective security National Interest and its instruments	4
2.	An Overview of Twentieth Century International Relations History	World War I: Causes and Consequences Significance of the Bolshevik Revolution Rise of Fascism / Nazism World War II: Causes and Consequences	8
3.	Cold War Politics	Origin of the Cold War Evolution of the Cold War Collapse of the Soviet Union Causes of the End of the Cold War	8
4.	India's foreign policy during the Cold War era	Basic Determinants (Historical, Geo-Political, Economic, Domestic and Strategic) India's Policy of Non-alignment	6

5.	India's foreign policy in the Post-Cold War era	India and SAARC India and the Look East policy Impediments to regional co-operation: river water disputes; illegal cross-border migration; ethnic conflicts and insurgencies; border disputes	8
6.	Emergence of Other Power Centres	European Union Rise of Asia Powers- Russia, China and Japan	8
Total number of Lectures			42
Evaluation Criteria			
Components		Maximum Marks	
T1		20	
T2		20	
End Semester Examination		35	
TA		25 (Project, Quiz, Attendance)	
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.	A. Chatterjee, <i>International Relations Today</i> . Noida, India: Pearson, 2019
2.	Appadorai, & M.S.Rajan, <i>India's Foreign Policy and Relations</i> . New Delhi, India: South Asian Publisher, 1985
3.	E.H. Carr, <i>International Relations between the Two World Wars: 1919-1939</i> . New York, USA: Palgrave, 2009
4.	J. Baylis & S. Smith, Ed. <i>The Globalization of World Politics: An Introduction to International Relations</i> . Oxford, UK: Oxford University Press, 2011
5.	P. Calvocoressi, <i>World Politics: 1945—2000</i> . Essex, UK: Pearson, 2009

Optimization Techniques (16B1NMA831)

Simplex method and variants, game theory, queuing models, inventory models, network scheduling, CPM and PERT, sequencing problems, discrete and continuous dynamic programming, nonlinear programming problems-numerical methods.

Course Description

Course Code	16B1NMA831	Semester Even	Semester VIII Session 2023-2024
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			Month from	Jan 2024 to June 2024
Course Name	Optimization Techniques			
Credits	3		Contact Hours	3-0-0
Faculty (Names)	Coordinator(s)	Dr. Ram Surat Chauhan		
	Teacher(s) (Alphabetically)	Dr. Ram Surat Chauhan		
COURSE OUTCOMES				COGNITIVE LEVELS
After pursuing the above mentioned course, the students will be able to:				
C402-2.1	explain the basics of linear, dynamic and non-linear programming.			Understanding (C2)
C402-2.2	apply optimization techniques to solve problems related to linear programming, game theory, queuing and inventory models.			Applying (C3)
C402-2.3	analyze the problems related to dynamic programming, sensitivity analysis, sequencing and scheduling.			Analyzing (C4)
C402-2.4	determine numerical solutions of one dimensional and multidimensional nonlinear problems.			Evaluating (C5)

Module No.	Title of the Module	Topics in the Module	No. of Lectures for the module
1.	Review of Linear Programming	Convex sets, Linear Programming Problems (LPP), graphical method, simplex method and its variants, revised simplex method, Duality theory, dual simplex method, sensitivity analysis.	08
2.	Game Theory	Rectangular Games, Minmax Theorem, Graphical Solution of $2 \times n$, $3 \times n$, $m \times 2$, $m \times 3$ and $m \times n$ Games, Solution of games using LPP technique.	06
3.	Queuing Theory & Inventory Model:	Introduction, Steady-State Solutions of Markovian Queuing Models: M/M/1, M/M/1 with limited waiting space, M/M/C, M/M/C with limited waiting space. Inventory Models: Deterministic and Probabilistic models.	08
4.	Sequencing & Scheduling	Processing of Jobs through Machines: Processing of n jobs through two machines, two jobs through m machines and n jobs through m machines. Project Scheduling: Network diagram, Critical Path Method (CPM), Project Evaluation and Review Technique (PERT).	07
5.	Dynamic Programming	Discrete and Continuous Dynamic Programming: Bellman's principle of optimality, linear and nonlinear dynamic programming problems, Simple Illustrations.	06
6.	Nonlinear Programming	Unimodal function, One Dimensional minimization problem: Newton's method, Golden section method, Fibonacci search method, Bisection method. Multidimensional minimization problem: Steepest descent method, Multidimensional Newton's method.	07

		Total number of Lectures	42
Evaluation Criteria			
Components		Maximum Marks	
T1		20	
T2		20	
End Semester Examination		35	
TA		25 (Quiz, Assignments)	
Total		100	
Project based learning: Each student in a group of 4-5 will collect literature on dynamic programming to solve some practical problems. To make the subject application based, the students analyze the optimized way to deal with aforementioned topic.			
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.	Taha, H. A., Operations Research - An Introduction, Tenth Edition, Pearson Education, 2017.		
2.	Rao, S. S. - Engineering Optimization, Theory and Practice, Third Edition, New Age International Publishers, 2010.		
3.	Hillier F., Lieberman G. J., Nag,B. and Basu, P., Introduction to Operations Research, 10th edition, McGraw-Hill, 2017.		
4.	Wagner, H. M., Principles of Operations Research with Applications to Managerial Decisions, 2 nd edition, Prentice Hall of India Pvt. Ltd., 1980.		

BIOPROCESS AND INDUSTRIAL BIOTECHNOLOGY

Course Code	17M11BT113	Semester Even (Specify Odd/Even)	Semester VIII / M/Tech IInd Sem Session 2023-2024 Month from Jan-May

Course Name	BIOPROCESS & INDUSTRIAL BIOTECHNOLOGY		
Credits	3	Contact Hours	3

Faculty (Names)	Coordinator(s)	Dr. Anirudh Sharma
	Teacher(s) (Alphabetically)	Dr. Anirudh Sharma

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	Analyze various strategies used for production of primary and secondary metabolites	Analyzing (C4)

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 <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 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 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
Total number of Lectures			42
Evaluation Criteria Components		Maximum Marks	
T1			
T2		20	
End Semester Examination		20	
TA		35	
Total		25 (Class Test-1, Presentation / Report)	
		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. <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

Detailed syllabus
Lecture-wise Breakup

Subject Code	21B12HS411	Semester: EVEN	Semester 2 nd 24 Month from Jan to June
Subject Name	URBAN SOCIOLOGY		
Credits	3	Contact Hours	3-0-0
Faculty (Names)	Coordinator(s)	Dr Yogita Naruka	
	Teacher(s) (Alphabetically)	Dr Yogita Naruka	

COURSE OUTCOMES		COGNITIVE LEVELS
C401 - 25.1	Understand the concepts and theories of urban sociology	Understanding Level (C2)
C401 – 25.2	Apply and analytical framework to understand the structural characteristics of cities students are residing in	Applying Level (C3)
C401 – 25.3	Analyze the role of agencies and actors in shaping the process of urbanization	Analyse Level (C4)
C401 – 25.4	Evaluate importance of good governance and urban planning	Evaluating Level (C5)

Module No.	Subtitle of the Module	Topics in the module	No. of Lectures for the module
1.	Introduction to Urban Sociology	Basic Concepts and terminologies of the urban sociology, Origin of urban societies, Rural-Urban Continuum	2
2.	Theories of Urban Sociology	The classical theories – Simmel, Weber, Tonnies, Louis Wirth, Durkheim & Engels; Ecological Theories – Chicago School, Concentric Zone theory, Sector theory, Multiple Nuclei theory	5
3.	Contemporary Urban Processes	Industrialisation, Colonialism, Class-Conflict theories (Marxism), Neo-liberalism	5
4.	Urbanisation in India	Development of urban sociology in India, Evolution of urban structures, Spatial Structures and Classification of cities	4
5.	Urban Planning	Concept of urban planning – History, need and relevance, Principles of Urban planning, Urban planning in India – Agencies and Stakeholders, Strategies and techniques of urban planning – Social area analysis, mapping and zoning, role of cooperatives	7
6.	Urban Governance	Urban governance – Concept and need, Urban Governance in India, Urban decentralization – agencies and role of local bodies	4
7.	Urban Issues in India	Urban Poverty, Informality & Exclusion, Urban Environment Lessons from Pandemic	4
8.	Technology and urbanisation	Smart cities, Case studies of smart cities and use of digital technologies in urban	5
9.	Sustainable urban Development	Sustainable urban development – concept, need, tenets and strategies Sustainable development goals (SDGs) in relation to urban	4
10.	Global perspectives on urban	Neo-liberalism and urban, Globalization and urban, Emergence of megacities	5

Total number of Hours			45
Evaluation Criteria			
Components	Maximum Marks		
T1	20		
T2	20		
End Semester Examination	35		
TA	25 (Project, Assignment/Quiz)		
Total	100		

Project Based Learning: The students would be divided into a group of 4-5. They would be asked to map and discuss the different parts of their cities. The lectures and readings on the process of urbanization and models of urbanization will form the basis for this exercise. Students would be required to critically analyse the urban spaces using sociological perspectives and theories. The students would be needed to make a presentation and also submit a report.

Recommended Reading material:	
	Gottdiener, M., Budd, L., & Lehtovuori, P. <i>Key concepts in urban studies</i> . Sage. (2015)
2.	Lin Jan and Mele Christopher, ed. <i>The Urban Sociology Reader</i> . London: Routledge. (2005)
	Rao, M. S. A., ed. Longman. (1974) <i>Urban Sociology in India: Reader and Source Book</i> . New Delhi: Orient
4.	Savage, M., and Warde, A. Higher Education. (1993) <i>Urban sociology, capitalism and modernity</i> . Macmillan International
	Sivaramakrishnan, K.C., Kundu, Amitabh & Singh, B.N. <i>Handbook of Urbanization in India</i> . Oxford University Press (2007)
6.	Wirth, Louis. <i>Urbanism as a Way of Life</i> . American Journal of Sociology. (1938)
7.	Sharma, A.K. and Misra, B.D. Books Pvt. Ltd.(2018) <i>Urbanization in India: Issues & Challenges</i> . New Delhi: Ane

Detailed Syllabus
Lecture-wise Breakup

Subject Code	19M13HS111	Semester: Even	Semester: M.Tech II & Dual degree VIII Session 2023-24 Month from January to May 2024
Subject Name	English Language Skills for Research Paper Writing		
Credits	2	Contact Hours	2-0-0
Faculty (Names)	Coordinator(s)	Dr. Ekta Singh	
	Teacher(s) (Alphabetically)	Dr. Ekta Singh	

Course Outcomes:

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

COURSE OUTCOMES		COGNITIVE LEVELS
C204.1	Demonstrate an understanding of all the aspects of grammar and language needed to write a paper.	Understand Level (C2)
C204.2	Apply grammatical knowledge & concepts in writing and presentation.	Apply level (C3)
C204.3	Examine each section of a paper after careful analysis of Literature Review.	Analyze Level (C4)
C204.4	Determine the skills needed to write a title, abstract and introduction, methods, discussion, results and conclusion.	Evaluate Level (C5)
C204.5	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 Conclusion The Final Check	4
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	4

		References Annexures Ensuring good quality in submission	
Total number of Lectures and Tutorials			28

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

PBL: The students in groups of 6-7 will identify a topic of their choice and write a self-edited research paper with all the essential components such as title, abstract and introduction, methods, discussion, results and conclusion in it.

Recommended Reading material:	
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 Students Independently published, 2018

IPR IN BIOTECHNOLOGY

Detailed Syllabus

Lecture-wise Breakup

Course Code	18M12BT116	Semester Even (specify Odd/Even)	Semester VIII :2023-24 Month from January to June
Course Name	IPR in Biotechnology		
Credits	3	Contact Hours	3

Faculty (Names)	Coordinator(s)	Dr. Shweta Dang
	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 [CO1]
2.	Types of Intellectual Property Rights	Patents, Trademarks, Copyrights, Industrial Designs, Geographical Indications, Trade secrets, non-disclosure agreements	2 [CO1]
3.	Patents	General Introduction to Patents, Patent Terminology, Patent Claims, Patent Life and Geographical Boundaries, Utilization of Intellectual Patents, Licensing of patents	4 [CO1, CO2]
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 [CO2, CO3]
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 [CO2, CO3]
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 [CO2, CO3]
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 [CO1, CO2, CO3]
8.	Patent issues in Drugs and Pharmaceuticals	Generics, Compulsory Licensing, Exclusive Marketing Rights (EMR), Bolar provision, Bayh-Dole act, Second medical use	2 [CO2, CO3]
9.	Worldwide Patent Protection, WTO & TRIPS Agreement	Brief Background of different International conventions such as Paris convention, TRIPS, WTO, PCT and Patent Harmonisation including	2 [CO1, CO2, CO3]

		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	
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 [CO3, CO4]
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, <i>sui generis</i> systems Case studies	4 [CO3, CO4]
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 [CO3, CO4]
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 [CO4]
Total number of Lectures			42

Evaluation Criteria

Components

Maximum Marks

T1 20

T2 20

End Semester Examination 35

TA 25 (Assignments 1 (PBL based 5 Marks), Assignments 2.

Presentation 1)

Total 100

PBL: students will be given keywords to do prior art search from free patent databases

like google patents, USPTO and they can analyse 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: 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 Ajit Parulekar, 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

Lecture-wise Breakup

Subject Code	18M12BT112	Semester Even (specify Odd/Even)	Semester Integ MTech VIII Session 2023-24 Month from Jan to June
Subject Name	Nanobiotechnology		
Credits	3	Contact Hours	3

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

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 biotechnologies 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
Total number of Lectures			42
PBL: Students will make a report and present the nanotechnological solutions for healthcare/industrial biotechnology/environmental issues/problems			

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.	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: Ecaterina Andronescu, Alexandru Mihai Grumezescu, Elsevier, 2017
4.	Recent Research articles

Detailed Syllabus

Course Code	18M12BT113	Semester : Even	Semester: VIII Session: 2023 -2024 Month from: January
Course Name	Nutraceuticals		
Credits	3	Contact Hours	3

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

COURSE OUTCOMES (New)		COGNITIVE LEVELS
CO 1	Compare the traditional and modern trends in the nutraceutical Industry.	(C2)
CO 2	Evaluate the mechanism of action of nutraceuticals in prevention of chronic diseases.	(C3)
CO 3	Apply microbial and algal nutraceuticals for human health improvement	(C3)

CO 4	Compare the Indian and international market for nutraceuticals and health food products.	(C4)
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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.	4
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.	10
3.	Nutraceuticals of Plant Origin	Plant secondary metabolites, classification and sub-classification – alkaloids, phenols, Terpenoids, uses and Preventive role in diseases.-	5
4.	Nutraceuticals of Animal Origin	Animal metabolites - Examples: Chitin, Chitosan, Glucosamine, Chondroitin Sulphate, uses and applications in preventive medicine and treatment.	5
5.	Microbial and Algal Nutraceuticals	Concept of probiotics - principle, mechanism, production and technology involved and health benefits of probiotics. Synbiotics for maintaining good health. Algae as source of omega - 3 fatty acids, proteins, fibers, antioxidants, vitamins and minerals – examples: Chlorella, Haematococcus, Spirulina, Dunaliella	6
6.	Nutraceuticals and Diseases (specific foods and food products)	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.	8
7.	Nutraceutical Industry and Market Information	Concept of cosmoceuticals and aquaceuticals, 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	

Project based learning: Each student will study, present and submit a report about 5 reputed Indian and International industries involved in production and development of nutraceuticals and functional foods. They will present and discuss in detail about the industries and their products. This will enhance the student's understanding about various application aspects of Nutraceuticals.

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. 2 nd Ed. Wildman, 2006.

Detailed Syllabus
Lecture-wise Breakup

Course Code	17M11BT114	Semester Even	Semester VIII (Integrated) / II Sem (M.Tech) Session 2023 -2024 Month from January -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
C115.1	Explain the etiology and pathogenesis of diseases	Understand Level (C2)
C115.2	Choose and apply the strategies of different diagnostic tests	Apply Level (C3)
C115.3	Analyze expression systems and mutagenesis techniques for biopharmaceutical production	Analyze Level (C4)
C115.4	Appraise biotechnology principles for the 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
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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.	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 Therapeutics	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 therapeutics	2

Total number of Lectures **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.

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

	Yi-Wei Tang & Charles W Stratton, “Advanced techniques in Diagnostic microbiology”, 2 nd Ed. Springer
0.	G. Walsh, “ Biopharmaceuticals: Biochemistry and Biotechnology”, 2nd Ed. John Wiley & Sons publication
0.	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.
0.	Refereed papers from scientific journals for case studies

Detailed Syllabus
Lecture-wise Breakup

Course Code	21B12EC413	Semester Even (specify Odd/Even)	Semester 8th Session 2023-24 Month from January-May
Course Name	Solar Engineering		
Credits	3	Contact Hours	3L

Faculty (Names)	Coordinator(s)	Nisha
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COURSE OUTCOMES		COGNITIVE LEVELS
C402-37.1	Recall the basic concepts of Solar Energy and Global Energy Needs for Solar Engineering	Remembering Level (C1)
C402-37.2	Interpret the Physics of the Sun and Its Energy Transport.	Understanding Level (C2)
C402-37.3	Implement solar thermal and electrical system for performance estimation	Applying Level(C3)
C402-37.4	Differentiate Solar Water-Heating Systems for Commercial/Industrial Applications	Analyzing Level (C4)

Module No.	Title of the Module	Topics in the Module	No. of Lectures for the module
1.	Introduction to Solar Energy Conversion	Introduction , Environmental Characteristics, Heat transfer concept, Heat Transfer coefficient, Optimization of Heat Losses, Thermal analysis and effect of environment with economic analysis	5
2	Fundamentals of Solar Radiation	The Physics of the Sun and Its Energy Transport, Thermal Radiation Fundamentals, Sun–Earth Geometric Relationship, Extraterrestrial Solar Radiation, Estimation of Terrestrial Solar Radiation, Models Based on Long-Term Measured Horizontal Solar Radiation and Measurement of Solar Radiation	8
3.	Solar Engineering-I: Electrical Aspect	Solar Cell materials, Single crystal solar cell or solar grade, Types of Solar Energy Collectors, Performance of Solar Collectors, Photovoltaic Systems, Design and Modeling of Solar Systems, Solar Energy Analysis	10
4.	Solar Engineering-II: Thermal Aspect	Solar Thermal Power Systems, PVT air/water collectors performance, design and modeling, Thermodynamic Power Cycles, Design of Parabolic Trough–Based Power Plants, Parabolic Dish Systems, Central Receiver Tower Systems	10
5.	Solar Heating Systems and other applications	Solar Water-Heating Systems, Solar Space Heating and Cooling, Industrial Process Heat, Solar Dryers, Solar Desalination Systems, Solar Cooling and Dehumidification and applications of Solar Energy in Electronics and communication engineering Commercial/Industrial Applications	10
Total number of Lectures			43

Evaluation Criteria	
Components	Maximum Marks
T1	20

T2	20
End Semester Examination	35
TA	25 (Assignments, Attendance & Quiz)
Total	100

Project based learning: Students will review and prepare report on any one of the discussed application of solar energy. They can implement solar thermal and electrical system for performance estimation.

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.	G.N. Tiwari, Solar Energy : fundamentals, Design, Modelling and applications. Narosa Publishing House, 2016.
2.	Chetan Singh Solanki, Solar Photovoltaics: Fundamental, technologies and applications. Prentice Hall of India, 2015
3.	James Momoh, Smart Grid: Fundamentals of Design and Analysis, Wiley-IEEE Press, 2012.
4	Juan Bisquert, The Physics of Solar Cell, CRC Press, Taylor & Francis group, 2018