Jaypee Institute of Information Technology

B.Tech Biotechnology

Semester VII

Course Descriptions

Detailed Syllabus
Lecture-wise Breakup

Course Code	10B1NPH732	**Semester :** Odd	**Semester:** VII **Session: 2019-2020** **Month from:** July to December
Course Name	Nanoscience and Technology		
Credits	3	**Contact Hours**	3

Faculty (Names)	**Coordinator(s)**	Dr. Navendu Goswami and Dr. Sandeep Chhoker
	Teacher(s) (Alphabetically)	Dr. Navendu Goswami and Dr. Sandeep Chhoker

COURSE OUTCOMES		**COGNITIVE LEVELS**
C401-4.1	Define the Nanoscience and Technology and to know about various other terminologies and developments involved with Nanoscience and Technology	Remembering (C1)
C401-4.2	Classify the nanomaterials depending on the nature of dimensionalities, type of materials classes and explain the basic concepts of nanomaterials	Understanding (C2)
C401-4.3	Apply the concepts of Nanoscience for solving the theoretical and numerical problems	Applying (C3)
C401-4.4	Determine the properties of nanomaterials through suitable characterization tools	Analyzing (C4)

Module No.	**Title of the Module**	**Topics in the Module**	**No. of Lectures for the module**
1.	Introduction	Development of nanoscience and nanotechnology, naturally occurring nanomaterials, Crystallinity of nanomaterials, Metallic nanostructures, Semiconductor nanostructures Magnetic nanomaterials, Chemically assisted nanostructures, Growth in 2-D nanostructures, Carbon nanomaterials	10
2.	Properties of Nanomaterials	Surface to volume ratio, Surface states and energy, Nanoscale oscillators, Confinement in nanostructures, Density of States and number of states of 0-, 1-, 2-, 3-dimensional systems, Change in Band structure and gap, Energy levels, confinement energy and emission in nano, Fluorescence by QDs, Concept of Single electron transistor	5
3.	Nanomaterials Synthesis	Introduction to synthesis techniques, Top down and bottom up approach, Biological methods, Sol-gel method, Nucleation and growth, Ball Milling technique, Chemical vapor deposition, Physical Vapor deposition: Concept of Epitaxy and sputtering, Basics of Photolithography and its limitations, Soft Lithography and Nanolithography	10
4.	Characterization of Nanomaterials	Resolving power (Rayleigh and other criteria) of microscopes and their limitations for nanostructure measurements, Concept of Far and Near field and modification by NSOM, Basic principle, Design of setup, Theory and working, Characterization procedure, result analysis, Merits/demerits of SEM, TEM, STM, AFM	5

5.	Application of Nanomaterials	Nanoelectronics, Nanobiotechnology, Catalysis by nanoparticles, Quantum dot devices, Quantum well devices, High T_c nano-Superconductors, Nanomaterials for memory application, CNT based devices, MEMS and NEMS	10
		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.	*Nanostructures and nanomaterials: synthesis properties and application*, Guozhong Cao, Imperial college press, London.
2.	*Introduction to nanotechnology,* Charles Poole *et al* J John Wiley & Sons, Singapore.
3.	*The Handbook of Nanotechnology: Nanometer Structures, Theory, Modeling, and Simulation*, A. Lakhtakia, Spie Press USA.
4.	*Springer Handbook of Nanotechnology,* Edited by B. Bhushan, Springer Verlag.

Detailed Syllabus
Lecture-wise Breakup

Course Code	15B1NBT832	**Semester** Odd **(specify Odd/Even)**	**Semester** VII **Session** 2019-2020 **Month from:** July to December
Course Name	Biostatistics and Its applications		
Credits	4	**Contact Hours**	4

Faculty (Names)	**Coordinator(s)**	Shalini Mani
	Teacher(s) (Alphabetically)	Shalini Mani

COURSE OUTCOMES		**COGNITIVE LEVELS**
C430-3.1	Explain the various statistical methods to design a biological studies and data representation.	Understanding (Level 2)
C430-3.2	Apply different statistical methods and approaches to study the significance of a study.	Apply (Level 3)
C430-3.3	Examine the relationship between different parameters of a study.	Analyze (Level 4)
C430-3.4	Choose appropriate statistical methods, tools and resources including prediction, validation and evaluation of the biological studies.	Evaluate (Level 5)

Module No.	**Title of the Module**	**Topics in the Module**	**No. of Lectures for the module**
1.	Introduction	Application and use of Biostatistics as a science, scope.	**1**
2.	Study design in various fields of research	general principles of study design and its implications for valid inference	**1**
3.	Sampling theory	Sampling scheme, simple/ systematic/ stratified/ cluster sampling, Sources of data collection	**2**
4.	Data presentation	Graphical, tabular, Mathematical, finding the central tendency, measure of variations	**3**
5.	Overview of different statistical methods used in the field of biological sciences.	Hypothesis testing, T-test, Chi square test, ANOVA, Sign Test, Wilcoxon Signed Rank Test, Wilcoxon Rank Sum Test, odds ratio, Binomial/normal/Poisson distribution of probabilities, determination of power of study and sample size calculation, regression analysis, correlation analysis,	**13**
6.	Analysis of data source	Assess data sources and data quality for the purpose of selecting appropriate data for specific research questions	**3**
7.	Selection of statistical methods	Identifying the appropriate statistical methods to be applied in a given research setting, applying the selected methods and analysis.	**4**
8.	Application of Biostatistical analysis.	Designing various studies of medical/ health/ Microbial/Agricultural/Genetics/Pharamaceutical science related studies. Data analysis using different methods Result interpretation	**7**
9.	Case studies	Based on various research studies and systematic	**4**

		reviews.	
10.	SPSS, Stats at the bench	Introduction to SPSS, Entering data in SPSS editor. Solving the compatibility issues with different types of files. SPSS and working with descriptive statistics.	4
		Total number of Lectures	**42**

Evaluation Criteria

Components	**Maximum Marks**
T1	20
T2	20
End Semester Examination	35
TA	25 (assignment, class test, 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.	Marcello Pagano, Kinberlee Gauvreau, Principle of Biostatistics.
2.	Stephen W Looney, Biostatistical methods, Humana Press
3.	Alan J Cann, Maths from Scratch for Biologist, John Willey and Sons Limited Press.
4.	M Bremer, R W Doerge, Statistics at the Bench, Cold Spring harbor Lab Press.
5.	B K Mahajan, Methods in Biostatistics, VII edition, Jaypee Bothers Medical Publishers, 2010.

Department of Biotechnology

Programme Name: B.Tech Biotechnology
Semester: VII
Course Name & Code: Major Project (Part 1), 15B19BT791

Course Outcomes:

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

Sl. No.	DESCRIPTION	COGNITIVE LEVEL (BLOOM's TAXONOMY)
C450.1	Interpret the given research problem.	Understanding Level Level II
C450.2	Organize the existing literature data to formulate the hypothesis	Applying Level Level III
C450.3	Identify the experimental methods to test for the selected research problem	Applying Level Level III
C450.4	Prepare and conclude with technical report	Create Level Level VI

Department of Biotechnology

Programme Name: B.Tech Biotechnology

Course Code	15B19BT793	**Semester ODD**	**Semester** VII **Session** 2019 -2020 **Month from** July -December
Course Name	Summer Training Viva		
Credits	2	**Contact Hours**	**NA**

Faculty (Names)	**Coordinator(s)**	Dr Sujata Mohanty
	Teacher(s) (Alphabetically)	Dr Sujata Mohanty

Course Outcomes:

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

Sl. No.	DESCRIPTION	COGNITIVE LEVEL (BLOOM's TAXONOMY)
C455.1	Extend theoretical knowledge to real time Industry and Institutes	Understanding Level Level II
C455.2	Demonstrate a capacity for critical reasoning and independent learning	Understanding Level Level II
C455.3	Make use of Industrial Training experience to prepare a scientific report	Applying Level Level III
C455.4	Develop greater clarity about academic and career goals	Applying Level Level III

Detailed Syllabus
Lecture-wise Breakup

Course Code	16B1NBT733	**Semester** ODD **(specify Odd/Even)**	**Semester** VII **Session** 2019-2020 **Month from** July-December
Course Name	Waste Management		
Credits	4	**Contact Hours**	3-1

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

COURSE OUTCOMES		**COGNITIVE LEVELS**
C432-3.1	Explain the fundamental concepts related to waste management	Understand level (C2)
C432-3.2	Apply basic environmental legislation and Environmental Management System for effective waste management	Apply level (C3)
C432-3.3	Analyze the emerging waste management technologies for sustainable solution	Analyze level (C4)
C432-3.4	Assess the environmental, social and economic aspects in integrated waste management	Evaluate level (C5)

Module No.	Title of the Module	Topics in the Module	No. of Lectures for the module
1.	**An introduction to Waste management**	Definition of waste, sources, general categories of waste in context of Indian legislations, waste generation aspects, waste collection, storage and transport	**4**
2.	**Biological and chemical waste treatment technologies**	Waste incineration and waste to energy (WTE), fundamentals of thermal processing – combustion, pyrolysis, gasification, energy recovery system, aerobic and anaerobic digestion, composting, biogasification and mechanical biological treatment of wastes.	**7**
3.	**Waste handling and disposal**	Health considerations in the context of operation of facilities, handling of materials and impact of outputs on the environment, Landfills**:** Design and operation including: site selection, Geo-environmental investigations, engineered sites, liners and covers, management of landfill leachate and the mining of old landfills, gas recovery and control, including utilization of recovered gas (energy), and landfill monitoring and reclamation, Natural attenuation process and its mechanisms, integrated waste management	**7**
4.	**Source Reduction and waste Recycling**	Unit operations for separation and processing, size reduction, separation, density separation.	**8**

5.	**Product recovery and biorefinery**	Recovery of Biological Conversion Products: Composts and Biogas, recovery technologies to deliver added-value products	**5**
6.	**Hazardous Waste: Management and Treatment**	Specific waste streams including healthcare (biomedical wastes), food wastes, mineral and mining wastes, electronic waste, hazardous wastes and producer responsibility wastes.	**6**
7.	**Legal aspects and policy guidelines**	Regulatory requirements for identification, characterization and disposal of hazardous, nonhazardous and domestic wastes, International treaties addressing waste issues	**3**
8	**Environmental and Economic considerations of waste management**	Economics of the on-site v/s off site waste management options	**2**
		Total number of Lectures	**42**

Evaluation Criteria

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

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

1.	Waste from wealth- Banwari Lal, Priyangshu M Sarma, The Energy and Resources Institute, 3rd Edition, 2017.
2.	Textbook of solid waste management, Khan, Iqbal H, Ahsan, Naved, CBS Publishers & Distributor 2014
3.	Environmental Waste Management, Ram Chandra, CRC Press, 1st Edition, 2015

Detailed Syllabus
Lecture-wise Breakup

Course Code	16B1NBT734	**Semester Odd**	**Semester VII Session** 2019 -2020 **Month from** July to December
Course Name	Advanced cell biology		
Credits	**4**	**Contact Hours**	**3+1**

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

COURSE OUTCOMES		**COGNITIVE LEVELS**
C431-3.1	Explain cellular organization, integration, migration and communication	Understanding Level (C2)
C431-3.2	Illustrate membrane trafficking in cell environment	Apply Level (C3)
C431-3.3	Identify the signaling event during biogenesis	Analyze Level (C4)
C431-3.4	Compare regeneration and maintenance of different tissue	Analyze Level (C4)

Module No.	**Title of the Module**	**Topics in the Module**	**No. of Lectures for the module**
1.	Advance Microscopy	History of microscopy, Electron microscopy, scanning electron microscopy, confocal laser scanning microscopy, fluorescence microscopy, transmission electron microscopy.	3
2.	Organization of cell & tissue	Sub-cellular Fractionation and Characterization of Organelles, Integrating cells into tissue, cell-cell & epithelial-mesenchymal interaction	5
3.	Cell Adhesion, Migration & communication	Cell Adhesion Molecules, Integrins and Mucins and cell migration, Extracellular Matrix and cell communication	4
4.	Nuclear structure & dynamics	a) Nuclear envelop & traffic between the nucleus & cytoplasm b) Internal organization of nucleus c) Nucleolus d) Nucleus during mitosis	5
5.	Membrane trafficking	a) Moving proteins into membrane & organelles b) Vesicular traffic, secretion & endocytosis	5
6.	Tissue maintenance	• Apoptosis • Epidermis & its renewal by stem cells, sensory epithelia, airway and the gut • Blood vessels & endothelial cells, blood cell formation, renewal by pleuripotent cells • Genesis, modulation & regulation of skeletal muscle	8

		• Fibroblast & their transformation	
7.	Cytoskeleton dynamics & cellular movement	a) Self assembly & dynamic structure of cytoskeleton filaments b) Molecular motors c) Microtubule based motility	6
8.	Mitochondrial biogenesis	a) Mitochondrial & biogenesis exercise b) Factors regulating mitochondrial biogenesis c) Signalling event during biogenesis	6
		Total number of Lectures	**42**

Evaluation Criteria

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

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

1.	M. Geoffrey, Cooper & E. Robert Hausman, "The Cell: A Molecular Approach", ASM Press Publication, 6th edition, 2013
2.	Becker, J. Lewis, Kleinsmith & Jeff Hardin, "The World of the Cell", Pearson Education publication, 2015
3.	B. Alberts, A. Johnson, J. Lewis, M. Raff, K. Roberts & P. Watter, "Molecular Biology of the Cell", Garland Science Publication, DOIhttps://doi.org/10.1201/9781315735368 (2017) ebook
4.	H. Lodish, A. Berk, P. Matsudaira, C. A-Kaiser, M. Kreiger, M. P. Scott, S. Lawrence, Zipursky & J. Darnell, "Molecular Cell Biology", WH Freeman & Company Publication, 7th edition 2015
5.	Current research paper related to the course

Detailed Syllabus

Course Code	17B1NBT731	**Semester :** ODD	**Semester:** VII **Session:** 2019 -2020 **Month from:** July to December
Course Name	Food Biotechnology		
Credits	3-0-1	**Contact Hours**	4

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

COURSE OUTCOMES		**COGNITIVE LEVELS**
C432-4.1	Explain fundamental principles of food science and chemistry.	Understand level (**C2)**
C432-4.2	Outline beneficial and harmful effects of microorganisms related to food	Understand level (**C2)**
C432-4.3	Utilize microbes for development of functional food	Apply level (**C3)**
C432-4.4	Examine methods that increase shelf life and quality parameters of food	Analyze **(C4)**

Module No.	**Title of the Module**	**Topics in the Module**	**No. of Lectures for the module**
1.	**Food Science and Food Chemistry**	Food Science and Food Chemistry Concepts, Proteins in food, Lipids in food, Carbohydrates in food, Vitamin and minerals, food flavors and colors.	**08**
2.	**Food Fermentations**	Microbiology of fermented food products, traditional fermented food items like beverages (cereal and fruit juice based), bakery, fermented Vegetables and dairy products	**06**
3.	**Food Processing and Preservation**	Food spoilage and food borne diseases, Principles of food preservation – methods of preservation; irradiation, drying, heat processing(high temperature), chilling and freezing(low temperature), preservation by food additives	**10**
4.	**Functional Foods**	Single Cell Protein, Probiotics and prebiotics, Yeast as a food	**06**

		supplement.	
5.	**Processed Food Industry**	Enzyme kinetics, Enzymes in food industry, Current status of Indian processed food industry, key challenges	**06**
6.	**Food safety and control**	Food adulteration, Food safety regulations, Good manufacturing practices – HACCP, Regulations, GMO and GM Foods. International rules and regulations in export and import.	**06**
		Total number of Lectures	**42**

Evaluation Criteria

Components	**Maximum Marks**
T1	20
T2	20
End Semester Examination	35
TA	25 (presentation 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.	Food Science & Food Biotechnology, G.F.G Lopez and GVB Canovas CRC Press, Florida(2003)
2.	Bioprocess and Biotechnology for functional foods and Nutraceuticals, J.R Neeser , J.Bruce German Marcel and Dekker , New York (2004)
3.	Food Microbiology, Frazier W C, Westoff DC, Vanitha NM, Mc Graham Hill Education (2013)
4.	Essentials of food science by. Vaclavik VA and Elizabeth WC., Springer (2008)
5.	Food processing and preservation by Sivasankar B., PHI Private Limited (2008)

Detailed Syllabus
Lecture-wise Breakup

Course Code	**17B1NBT734** ELECTIVE	**Semester Odd**	**Semester VII Semester Session** 2019 - 2020 **Month from** July to December
Course Name	Stem Cells and Health Care		
Credits	4	**Contact Hours**	4

Faculty (Names)	**Coordinator(s)**	Dr. Sujata Mohanty
	Teacher(s) (Alphabetically)	Dr. Sujata Mohanty

COURSE OUTCOMES		**COGNITIVE LEVELS**
C430-1.1	Compare the unique properties of stem cells derived from different sources	Understand Level (C2)
C430-1.2	Select niche and various isolation and reprogramming methods of stem cells	Apply Level (C3)
C430-1.3	Apply the acquired knowledge in Regenerative medicines	Apply Level (C3)
C430-1.4	Analyze the guidelines, political and ethical issues for stem cell research	Analyze Level (C4)

Module No.	**Title of the Module**	**Topics in the Module**	**No. of Lectures for the module**
1.	Introduction to Stem Cells	Stem cells: the promising field of research, Unique Properties: Self-renewal, Potency and proliferation Asymmetric Cell Division, History ofStem Cells	04
2.	Types and sources of Stem Cells: Embryonic Stem cells; hESCs	Characteristics of ES cells: Sources (IVF & SCNT), Isolation and Culture Techniques, Characterization, Unique features, Genetic Manipulation and Differentiation	06
3.	Types and sources of Stem Cells: Adult Stem cells; ASCs	Types of Adult Stem Cells: Umbilical Cord Blood, Placental, Hematopoietic, Cardiac, Neural, Pancreatic Stem Cells Adult Stem Cells vs Embryonic stem cells	06
4.	Cloning and Reprogramming of somatic cells: iPSCs	Cloning strategy, Reprogramming of Cells to Stem cells, ipsc, Detail strategy and properties and application of ipsc	06
5.	Therapeutic Applications of Stem Cells	Stem cell Research and application in Healthcare, Tissue Engineering, Regenerative Medicine, Opportunities and Challenges, Case studies	10
6.	Stem cell Banking	Vision, collection and storage procedure, Insurance against life threatening diseases, Existing Centres both in India and abroad	04
7.	Stem cell research: Indian and Global scenario: Ethical	Stem cell research Centers in India and abroad and their valuable contribution, National and International guidelines for conducting stem cell research	06

	and legal issues		
		Total number of Lectures	**42**

Evaluation Criteria

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

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

1.	Robert Lanza et.al., Handbook of Stem Cells, Volume 1-Embryonic Stem Cells; 2006, Academic press
2.	Robert Lanza et.al. Handbook of Stem Cells Volume 2-Adult & Fetal Stem Cells
3.	M.J. Laughlin & H.M. Lazarus Allogeneic Stem cell Transplantation 2003 Humana Press, USA
4.	Mehmet R. TOPCUL and Idil CETIN Stem Cells in Cell Therapy and Regenerative Medicine, OMICS International, ebook, 2018
5.	Robert Paul. Essentials of Stem Cell Biology 2006 Elsevier Academic
6.	Jeanne F. Loring Human Stem Cell Manual: A Laboratory Guide, Elsevier Science& Technology, 2007
7.	Stewart Sell, Stem Cells Handbook 2003 Humana Press, USA
8.	**Recent research articles will be discussed in the class and same will be provided.**
9.	Websites: http, www.isscr.org/, https://stemcells.nih.gov/

Detailed Syllabus
Lecture-wise Breakup

Course Code	**17B1NBT737**	**Semester Odd**	**Semester 7th Session** 2019 -2020 **Month from** July- December
Course Name	**Enzymes in food processing**		
Credits	3-0-1	**Contact Hours**	3+1

Faculty (Names)	**Coordinator(s)**	Dr Neeraj Wadhwa
	Teacher(s) (Alphabetically)	Neeraj Wadhwa

COURSE OUTCOMES		**COGNITIVE LEVELS**
C431-2.1	Explain role of various enzymes in food processing	**Understand Level (C2)**
C431-2.2	Identify need for Technical enzymes	**Apply Level (C3)**
C431-2.3	Examine recent technology in Food processing Industries	**Analyze Level (C4)**
C431-2.4	List quality assurance protocol and economic consideration.	**Analyze Level (C4)**

Module No.	**Title of the Module**	**Topics in the Module**	**No. of Lectures for the module**
1.	General characteristics of Technical Enzymes	Enzyme analysis, technical Enzyme units Enzyme kinetics principles of enzyme assay and kinetic studies; techniques for enzyme extraction; high- throughput screening; statistical analysis of enzyme kinetic data; and relevance of active sites any one example .	4
2.	Description of Enzymes and their substrates	Carbohydrate Hydrolyzing Enzymes – amylases, cellulase, Hemicellulases, Isomerase, cell wall composition Pectin degradation	4
3.	Description of Enzymes and their substrates	Proteases: Plant, animal, microbial, Fat hydrolysis: Lipases , Phospholipases	4
4.	Application of Enzymes Preparation	Enzyme in Starch and Sugar Industry ,	6

		Enzyme in Brewing Industry , Analytical monitoring of mashing Process, Cold stabilization Enzymatic Alcohol production - continuous process	
5.	Commercial enzyme production, and the processing	Beverage Industry,Enzymes in Juice and Wine making	4
6.	Flour processing	Enzyme in Flour Processing and Baking – Flour component and enzymes	4
7.	Dairy Industry	Enzymes in Dairy Industry, cheese making and ripening aroma and flavor production, cold sterilization, Enzymes in product modification.	4
8.	Proteolysis	Debittering, Hydrolysis of Soy protein, fish protein, Milk protein, collagen, Blood protein	4
9.	Nutrition	Silage enzymes, Additives in fodder ,Chicken feed ,Pig husbandry,	4
10.	Future Development	Tailoring enzyme structure and function Alteration of technical properties, Increasing yields, Raw matter utilization, Improving preservation, flavors,	4
Total number of Lectures	42		

Evaluation Criteria

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

Total	**100**

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

1.	*N. Tilak, T.Steve & R. Gerald*, Enzymes in Food Processing *3rd Edition, USA: Academic Press, 1993.*
2.	J.W. Robert. & V.O.Maarten *Enzymes in Food Technology*: John Wiley and Sons: 2009.
3.	U. Helmut, *Industrial enzymes and their applications* 3rd Edition, John Wiley and Sons: 1998.
4.	W.S. Dominic, *Food enzymes: structure and Mechanism, Chapman* &Hall, USA: 1995.
5.	E. Robert, D.J. Michael ,*Enzyme assays: a practical approach*, Oxford University Press: 2002
6.	P. S. Panesar, S. Marwaha, H.C.Chopra, *Enzymes in Food Processing Fundamentals and Potential Applications* , I.K. International Publishing House Pvt Ltd , 2010

Detailed Syllabus

Course Code	**17B1NBT739**	**Semester** ODD **(specify Odd)**	**Semester VII Session** 2019 -2020 **Month from** July to December
Course Name	**Biocomputing and Applications**		
Credits	4	**Contact Hours**	4

Faculty (Names)	**Coordinator(s)**	1. Dr. Chakresh Kumar Jain
	Teacher(s) (Alphabetically)	1. Dr. Chakresh Kumar Jain

COURSE OUTCOMES		**COGNITIVE LEVELS**
C432-2.1	Understand about the biocomputing methods , principles and practices.	Understand Level (C2)
C432-2.2	Outline the advanced genomics, transcriptomics and proteomics, methods	Understand Level (C2)
C432-2.3	Apply web-based methods and tools for simulation of biological problems	Apply Level (C3)
C432-2.4	Analyze vaccine designing and protein-ligand interactions for drug discovery	Analyze Level(C4)

Module No.	**Subtitle of the Module**	**Topics in the module**	**No. of Lectures for the module**
1.	Bio-computing basics	Basics of Biological system, DNA/RNA/Protein, structures, Bioinformatics problems, Mapping, computational methods, limitations Information scope	5
2.	Genomics methods and tools	homology search programs, Psi, Phi-BLAST, Wu Blast, MEGABLAST, T-Coffee, EMBOSS, Gene mapping, Genscript, Bioedit, MEGA, PAML, etc, methods; PSSM/PWM, Entropy, information content etc.	6
3.	Web based tools for complex analysis	Genome annotation and editing methods and tools. Protein, Nucleic Acid sequences and complex, analysis and modelling tools, pipelines. Etc.	5

4.	Trancriptomics methods and tools	Transcriptome profiling, RNA-seq, NGS Data generation and analysis, KEGG, Blast2GO, Validation.	5
5	Proteomics tools	Quantitative proteomics (PANDA), Sub-cellular, localization, nuclease site prediction. Maldi-tof MS data analysis, Open source[Opl analyzer etc.], protein microarray	5
6	Immunoinformatics methods and tools	Immunoinformatics(Case study), antigen/epitopes identification, Prediction of MHC I and MHC binding site, Databases IMGT/LIGM-DB, MHC-Peptide Interaction Database , vaccine design, Peptide designing tool	7
7.	Protein ligand interactions and simulations	Molegro/Autodock software, structure of protein structure (pdb), Genetic algorithm, basics of drug-enzyme and simulations, structure based designing, target based designing, high throughput computation of drug molecule, virtual screening, Modules; QSAR, Molegro/ docker/ online free tools etc	9
		Total number of Lectures	42

Evaluation Criteria

Components	**Maximum Marks**
T1	20
T2	20
End Semester Examination	35
TA	25 (assignment, class test, quiz)
Total	**100**

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

1.	Smith, D.W, "Biocomputing: Informatics and Genome Projects", Academic press Inc., 1994
2.	Baxevanis A., D & Ouellette "Bioinformatics A practical guide to analysis of genes and protein", Wiley-Interscience, 1998.
3.	David Mount "Bioinformatics: Sequence and Genome analysis", Cold Spring Harbor Laboratory Press, 2001.

Detailed Syllabus
Lecture-wise Breakup

Subject Code	**17B1NHS733**	**Semester : ODD**	**Semester: VII Session 2019-20** **Month from** July to December
Subject Name	**Human Rights and Social Justice**		
Credits	**3**	**Contact Hours**	**(3-0-0)**

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

CO Code	COURSE OUTCOMES	COGNITIVE LEVELS
C401-18.1	Demonstrate an understanding of the concept and idea of human rights and social justice	Understand (C2)
C401-18.2	Evaluate and interpret information about human rights issues from various sources like print and electronic media, film, documentary and other information technologies	Evaluate(C5)
C401-18.3	Demonstrate an understanding of the International norms and standards of human rights	Understand (C2)
C401-18.4	Analyze the emerging dimensions of human rights and the challenges posed by them	Analyze (C4)

Module No.	Subtitle of the Module	Topics in the module	No. of Hours for the module
1.	Conceptual Background of Human Rights and Social Justice	• Meaning and Concept of Human Rights & Social Justice • Notion and Classification of Rights: Natural, Moral and Legal Rights, • Concept of Civil Rights • Three Generations of Human Rights (Civil and Political Rights; Economic, Social and Cultural Rights; Collective/Solidarity Rights), Distinction between CPR & ESCR	6
2.	Evolution of Human Rights	Human Rights in Middle Ages: • Magna Carta Modern Movement for Human Rights: • The United States Declaration of Independence • The French Declaration of the Rights of Man and the Citizen • United States Bill of Rights • Geneva Convention of 1864	9
3.	International Human Rights Standards	• Universal Declaration of Human Rights, 1948. • International Covenant on Civil and Political Rights, 1966 • International Covenant on Economic, Social and Cultural Rights, 1966	8
3.	Human Rights of the specially disadvantaged sections of the society	• Scheduled Castes/Scheduled Tribes and Other Backward Classes: Caste Prejudice and Discrimination • Minorities: Human Rights Issues of Ethnic minorities • Women and Children: Gender Discrimination, Domestic	8

		Violence and Offences against Women; Gender Sensitive Laws, Children: Child Abuse, Child Labour, Street Children • Aged and Disabled Persons: Vulnerability and social taboos	
5.	Human Rights of the Working Class	• Migrant Workers • Bonded Labourers • Agricultural Labourers • Casual Workers	5
6.	Emerging Dimensions Of Human Rights	• National Sovereignty versus 'international enforcement' of human rights • International politics of human rights and selective application of international sanctions • Unilateral use of coercion and implementation of human rights • Human rights, and science and technology	6
Total number of Hours			**42**

Evaluation Criteria

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

Detailed Syllabus
Lecture-wise Breakup

Course Code	17B1NHS731	**Semester: Odd**	**Semester** VII **Session** 2019 -2020 **Month from** July to December
Course Name	Customer Relationship Management		
Credits	3	**Contact Hours**	3-0-0

Faculty (Names)	**Coordinator(s)**	Dr. Shirin Alavi
	Teacher(s) (Alphabetically)	Dr. Shirin Alavi

COURSE OUTCOMES		**COGNITIVE LEVELS**
C401-17.1	Apply the financial, social and electronic aspects of the Customer Relationship in business situations.	Apply Level (C3)
C401-17.2	Appraise the role of customer share and customer centricity in organizations.	Apply Level (C3)
C401-17.3	Develop the skills to understand customization, innovation and co-creation in organizations and apply them in business contexts.	Analyze Level (C4)
C401-17.4	Analyze the role of interactive technology for customer engagement, customer retention and customer experience management in organizations.	Analyze Level (C4)
C401-17.5	Evaluate the technological solutions and their applications for effective Customer Relationship Management across different functions in organizations.	Evaluate Level (C5)
C401-17.6	Develop specific models for response modelling and consumer profiling in organizations.	Create Level (C6)

Module No.	**Title of the Module**	**Topics in the Module**	**No. of Lectures for the module**
1.	CRM-The Strategic Imperatives	Introduction, CRM in Marketing and IT, CRM for Business Leadership, Criticality of customer relationships, Why businesses should adopt CRM, Implementing CRM.	3
2.	Conceptual Foundations of CRM, Building Customer Relationships	Evolution of CRM, Benefits, Schools of thought on CRM, Defining CRM. Customer Retention and Customer Acquisition, Customer Profitability is Skewed, Service Benefits of CRM, Transaction Marketing vs. Relationship Marketing, Relationship Building as a process, Bonding for Customer Relationships-Financial, Social, customization and Structural bonds, Ladder of Loyalty Zero Customer Defection, CRM Framework.	7
3.	Relationship Marketing and Economics of CRM	Internal and external relationships, Electronic Relationships, Operational, Analytical and Collaborative CRM, Market Share vs. Share of Customer, Customer Lifetime Value, and Activity based costing for CRM	6
4.	CRM in B2C ,B2B Markets , Customer Experience	CRM in Product and Service Markets, Case Studies, Characteristics of Business Markets, Participants in the business buying process, Key Account Management, Using	7

	Management	KAM for Customer Segmentation, Customer Retention Strategy, KAM as a growth and Development Strategy, Customer Value Management in Business Markets, Importance of CRM in B2B Markets, Customer Emotion, Customer Knowledge, Reciprocity, Voice of the Customer, Participation.	
6.	Components of e CRM solutions (Overview) and Role of Digital Technologies	Data warehousing, Datamining and CRM, Market Basket Analysis and Retail sector, Campaign Management, Sales Force Automation, Customer Service and Support, Corporate Blogs, Online communities, Twitter, Wikis. The Experience ecosystem. CEM, Consumer engagement, segmentation and differentiation.	7
7.	Product offerings in the CRM Marketplace(Overview) and CRM Roadmap	Evaluating Technological solutions for CRM, Comparison of Siebel, Oracle, MySAP.com and People Soft Enterprise solutions, Comparison of Talisma, Sales logix, Microsoft and Sales notes for small and medium enterprises, Defining a CRM strategy, CRM Implementation Roadmap, Developing a relationship orientation, Customer centric marketing and processes, Building organizational capabilities through internal marketing, Issues in implementing a technology solution for CRM.	7
8.	Operational issues in implementing CRM,Social CRM	Process view of CRM, Budgeting for attraction vs. retention, Learning from customer defections, Customer Retention Plans, Evaluating Retention programs, Social Customer Relationship Management, Social Customer Insights, Social CRM Strategy, and Social Customer Analytics.	5
Total number of Lectures			**42**
Class Presentations			**6**

Evaluation Criteria

Components	**Maximum Marks**
T1	20
T2	20
End Semester Examination	35
TA	25 (Presentation , Class Test 1,Class Test 2, 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.	Customer Relationship Management, Ed. Peelan Rob Beltman, 2nd Edition, Pearson, 2014.
2.	Ou, Y. C., Verhoef, P. C., & Wiesel, T. The effects of customer equity drivers on loyalty across services industries and firms. Journal of the Academy of Marketing Science, *45*(3), 336-356, 2017.
3.	Lin, Y. C., Lee, Y. C., & Lin, S. Y. The influence of the personality traits of webcasters on online games. International Journal of Electronic Customer Relationship Management, *11*(1), 94-103, 2017
4.	Menzel, C. M., & Reiners, T.Customer relationship management system a case study on small-medium-sized companies in north Germany. In *Information Systems for Small and Medium-sized Enterprises* pp. 169-197. Springer, Berlin, Heidelberg, 2014.
5.	Customer Relationship Management-A strategic perspective, G. Shainesh, Jagdish Sheth, Reprinted Macmillan Publishers India Limited, 2009.
6.	Mukerjee, K., Customer Relationship Management-A Strategic approach to Marketing, 3rd Edition Prentice Hall of India, 2007.

7.	Customer Relationship Management Concepts and Technologies-Francis Buttle, 3rd Edition Taylor and Francis, 2015.
8.	Berry, Michael, J. A, Linoff, Gordon S., Datamining Techniques for Sales, Marketing and CRM, 2nd Edition, Wiley Publications, 2007.

Detailed Syllabus
Lecture-wise Breakup

Course Code	**16B1NHS831**	**Semester: Odd** **(specify Odd/Even)**	**Semester: VII Session** 2019 -2020 **Month:** July to December
Course Name	Gender Studies		
Credits	3	**Contact Hours**	(3-0-0)

Faculty (Names)	**Coordinator(s)**	Dr Parineeta Singh
	Teacher(s) (Alphabetically)	Dr Parineeta Singh

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 and Gender Division of Labor • Gender Stereotyping and Gender Discrimination • The Other and Objectification	8
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	8
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 & Cyber feminism • Images of Women in Sports, Arts,	9

		Entertainment, Media and Fashion Industry ;Cultural Feminism & 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 , Law & Women Rights In India • From Women's Studies to Gender Studies: A Paradigm Shift • Gender Studies & Media: Creating New Paradigms in Gender & Culture	8
		Total number of Lectures	**42**

Evaluation Criteria

Components	**Maximum Marks**
T1	20
T2	20
End Semester Examination	35
TA	25 (Assignment, 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	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., "*The Feminine Mystique"*, Penguin. (1971/1992)
4	Debeauvoir S. , "*The Second Sex",* Vintage (1953/1997)
5	Wharton Amy S., "*The Sociology of Gender: An Introduction to Theory & Research*", Wiley-Blackwell (2005)
6	Pachauri G.," *Gender, School & Society*", R.Lall Publishers(2013)
7	Connell R.W, "*Masculinities*", Cambridge: Polity. (1985)
8	MacInnes J., "The *End of Masculinity"*. Buckingham: Open University Press. (1998)
9	Kaul A.& Singh M., *"New Paradigms for Gender Inclusivity*", PHI Pvt Ltd (2012)

Detailed Syllabus
Lecture-wise Breakup

Course Code	**18B12HS412**	**Semester** Odd	**Semester** VII **Session 2019 -2020** **Month from** July - December
Course Name	**HUMAN RESOURCE ANALYTICS**		
Credits	**3**	**Contact Hours**	**3-0-0**

Faculty (Names)	**Coordinator(s)**	Dr Kanupriya Misra Bakhru
	Teacher(s) (Alphabetically)	Dr Kanupriya Misra Bakhru

COURSE OUTCOMES		**COGNITIVE LEVELS**
C401-20.1	Understand different analytical techniques used for solving HR related problems**.**	Understand Level (C 2)
C401-20.2	Apply descriptive and predictive analysis techniques to understand trends and indicators in human resource data.	Applying Level (C 3)
C401-20.3	Analyze key issues related to human resource management using analytical techniques.	Analyze Level (C 4)
C401-20.4	Critically asses and evaluate the outputs obtained from analytical tools and recommend HR related decisions.	Evaluate Level (C 5)
C401-20.5	Create hypotheses, propose solutions and validate using appropriate analytical techniques	Create Level (C6)

Module No.	**Title of the Module**	**Topics in the Module**	**No. of Lectures for the module**
1.	Introduction to Human Resource (HR) Analytics	Understanding the need for mastering and utilizing HR analytic techniques, Human capital data storage and 'big (HR) data' manipulation, Predictors, prediction and predictive modeling, Current state of HR analytic professional and academic training, HR's Contribution to Business Value, the Changing Nature of HR.	8
2.	Human Resource information systems and data	Understanding HR metrics and data, Data collection, tracking, entry, Data availability in the entire Employment Lifecycle, Approaches and costs of collecting HR related data, Analysis software options, Using SPSS, Preparing the data.	8
3.	Analysis Strategies	From descriptive reports to predictive analytics, Statistical significance, Data integrity, Types of data, Categorical variable types, Continuous variable types, Using group/team-level or individual-level data, Dependent variables and independent variables, Introduction of tools for HR data analysis: Correlation, Regression, Factor Analysis, Cluster Analysis, Structural equation modeling.	10
4.	Application of Human Resource Analytics	Workforce Planning Analytics, Diversity Analytics, Talent Sourcing Analytics, Talent Acquisition Analytics, Talent Engagement Analytics, Training and Intervention Analytics, Analytical Performance Management, Retention Analytics.	10

5.	Future of Human Resource Analytics	Rise of Employee Behavioral Data, Automated Big Data Analytics, Big Data Empowering Employee Development, Quantification of HR, Artificial Intelligence in HR.	6
		Total number of Lectures	**42**

Evaluation Criteria

Components	**Maximum Marks**
T1	20
T2	20
End Semester Examination	35
TA	25 (Project, 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.	Bhattacharyya, HR Analytics: Understanding Theories and Applications, Sage, 2017
2.	Pease, Byerly and Jac Fitz-enz, Human Capital Analytics: How to Harness the Potential of Your Organization's Greatest Asset, Wiley, 2012
3.	Isson, Harriott and Jac Fitz-enz, People Analytics in the Era of Big Data: Changing the Way You Attract, Acquire, Develop, and Retain Talent, Wiley, 2016
4.	Guenole, Ferrar and Feinzig, The Power of People: How Successful Organizations Use Workforce Analytics To Improve Business Performance, First Edition, Pearson, 2017
5.	Sesil, Applying Advanced Analytics to HR Management Decisions: Methods for Selection, Developing, Incentive and Improving Collaboration, Pearson, 2014

Detailed Syllabus
Lecture-wise Breakup

Course Code	**17B1NHS732**	**Semester :** Odd	**Semester** VII **Session** 2019 -2020 **Month from** July to December
Course Name	Indian Financial System		
Credits	3	**Contact Hours**	3-0-0
Faculty (Names)	**Coordinator(s)**	Dr. Mukta Mani(Sec62), Dr. Sakshi Varshney(Sec128)	
	Teacher(s) (Alphabetically)	Dr. Mukta Mani(Sec62), Dr. Sakshi Varshney(Sec128)	

COURSE OUTCOMES		**COGNITIVE LEVELS**
After pursuing the above mentioned course, the students will be able to:		
C401-1.1	Understand the inter-linkage of components of financial system and financial instruments of Money market and Capital market.	Understanding Level (C2)
C401-1.2	Analyze ways of fund raising in domestic and international markets	Analyzing Level (C4)
C401-1.3	Understand functioning of Stock market and evaluate securities for investment.	Evaluating Level (C5)
C401-1.4	Apply the knowledge of Mutual Funds and Insurance in personal investment decisions	Applying Level (C3)
C401-1.5	Apply knowledge of Income tax for calculation of tax liability of individual.	Applying Level (C3)

Module No.	**Title of the Module**	**Topics in the Module**	**No. of Lectures for the module**
1.	Introduction	Meaning, Importance, and functions of Financial system. Informal and Formal financial system, Financial markets, Financial Institutions, Financial services and Financial instrument	4
2.	Money Market	Features of money market Instruments: Treasury bills, commercial bills, commercial papers, certificates of deposit, call and notice money, Functions of money market, Linking of money market with Monetary policy in India	5
3.	Capital Market	Features of Capital market instrument: Equity shares, Bonds. Fund raising through Initial Public Offering, Rights issue, Preferential allotment and Private Placement. Process of Initial Public Offering-Intermediaries in IPO, Book building process and allotment of shares	6
4.	Foreign investments in India	Fund raising from foreign market through: Foreign direct investment and foreign institutional investment, American Depository Receipts, Global Depository Receipts, External Commercial Borrowings, and Private equity.	5
5.	Stock Market	Trading in secondary market- Stock exchanges, regulations, demutualization, broker, listing of securities, dematerialization, trading, short selling, circuit breaker, stock market indices- methods of calculation of indices.	5

7.	Stock Valuation and Analysis	Investing basics: Consideration of Risk and Return, Stock Valuation and Analysis- Fundamental analysis: Economy, industry and company analysis; Technical Analysis of stocks using technical charts	6
8.	Investing in Mutual Funds and Insurance	Mutual Funds: Basics, Types of funds, risk and return considerations in selection of funds; Insurance: Basics, Life insurance and health insurance, types of policies	4
9.	Overview of Income Tax	Basics of Income tax- Concept of previous year, assessment year, person, income. Calculation of Income tax liability for individuals: Income from salaries- Salary, Allowances, Perquisites, Income from Capital Gain, Deductions under section 80C to 80U.	7
Class presentations			**6**
Total number of Lectures			**42**

Evaluation Criteria

Components	**Maximum Marks**
T1	20
T2	20
End Semester Examination	35
TA	25 (Presentation, class tests, 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.	Pathak Bharti V, *Indian Financial System*, 5th Edition, Pearson Education, 2018
2.	Madura Jeff, *Personal Finance*, 6th Ed, Pearson Education, 2017.
3.	Machiraju H R, *Indian Financial System*, 4th Ed, Vikas Publication, 2010
4.	Bhole L M, *Financial Institutions and Markets*, 4th ed. Tata McGraw Hill Publication, 2006.
5.	Singhania & Singhania, Students Guide to Income Tax, Taxmann Publication, 2019.
6.	*How to Stimulate the Economy Essay* [Online]Available: https://www.bartleby.com/essay/How-to-Stimulate-the-Economy-FKJP5QGATC
7.	Reserve Bank of India, 'Money Kumar & the Monetary Policy', 2007
8.	Ashiwini Kumar,Sharma,' De-jargoned: Book building process, Live Mint,2015.
9.	Madhavan, N. "Pushing the accelerator instead of brakes: Can Subhiksha make a comeback?", Business Today, 28th June 2009.
10.	Kaul, Vivek, "Master Move: How Dhirubhai Ambani turned the tables on the Kolkata bear cartel", The Economic Times, July 1, 2011.

Detailed Syllabus
Lecture-wise Breakup

Course Code	17B1NCI736	**Semester** ODD **(specify Odd/Even)**	**Semester** VII **Session** 2019 -2020 **Month from** July to December
Course Name	Bioinformatics Algorithms		
Credits	4	**Contact Hours**	3-1-0

Faculty (Names)	**Coordinator(s)**	Mr. Prantik Biswas
	Teacher(s) (Alphabetically)	Mr. Prantik Biswas

COURSE OUTCOMES		**COGNITIVE LEVELS**
C432-1.1	Relate to different computational challenges in Computational Molecular Biology.	Level-2
C432-1.2	Examine proper algorithmic concepts to solve a computational problem.	Level-4
C432-1.3	Determine the importance of traditional to contemporary approaches for solving the biological problems.	Level-5
C432-1.4	Design strategy to resolve real-world biological challenges.	Level-6
C432-1.5	Identify appropriate algorithmic technique to solve a given bioinformatics related task.	Level-3
C432-1.6	Develop an optimized solution model for computational biology problems.	Level-6
C432-1.7	Formulate prediction tools and estimate the solutions for biological problems.	Level-6

Module No.	**Title of the Module**	**Topics in the Module**	**No. of Lectures for the module**
1	Algorithms and Complexity	Introduction, Biological Algorithms versus Computer Algorithms, The Change Problem, Comparative Analysis of Various Classes of Algorithms.	2
2	Molecular Biology	Introduction, Structure of Genetic Materials, Structural Formation of Proteins, Information Passage Between DNA and Proteins, Evaluation of Bioinformatics.	3
3	Exhaustive Search	Restriction Mapping, Practical Restriction Mapping Algorithm, Regulatory Motifs in DNA Sequences, Profiles, Search Trees, Finding Motifs, Finding a Median String.	4
4	Greedy Algorithms	Genome Rearrangements, Sorting by Reversals, Approximation Algorithms, Breakpoints: A Different Face of Greed, A Greedy Approach to Motif Finding.	3
5	Dynamic Programming Algorithms	Classical Problems: DNA Sequence Comparison, The Manhattan Tourist Problem, etc, Edit Distance and Alignments, Global Sequence Alignment, Scoring Alignments, Local Sequence Alignment, Alignment with Gap Penalties, Multiple Alignment, Gene	7

		Prediction, Statistical Approaches to Gene Prediction, Similarity-Based Approaches to Gene Prediction, Spliced Alignment.	
6	Divide-and-Conquer Algorithms	Divide-and-Conquer Approach to Sorting, Space-Efficient Sequence Alignment, Block Alignment and the Four-Russians Speedup, Constructing Alignments in Sub-quadratic Time.	4
7	Graph Algorithms	Graphs and Genetics, DNA Sequencing, Shortest Superstring Problem, DNA Arrays as an Alternative Sequencing Technique, Sequencing by Hybridization, SBH as a Hamiltonian Path Problem, SBH as an Eulerian Path Problem, Fragment Assembly in DNA Sequencing, Protein Sequencing and Identification, The Peptide Sequencing Problem, Spectrum Graphs, Protein Identification via Database Search, Spectral Convolution, Spectral Alignment.	8
8	Combinatorial Pattern Matching	Repeat Finding, Hash Tables, Exact Pattern Matching, Keyword Trees, Suffix Trees, Heuristic Similarity Search Algorithms, Approximate Pattern Matching	4
9	Clustering and Trees	Hierarchical Clustering, k-Means Clustering, Evolutionary Trees, Distance-Based Tree Reconstruction, Reconstructing Trees from Additive Matrices, Evolutionary Trees and Hierarchical Clustering, Character-Based Tree Reconstruction	3
10	Applications	BLAST: Comparing a Sequence against a Database; The Motif Finding Problem, Gene Expression Analysis, Clustering and Corrupted Cliques, Small and Large Parsimony Problem, Hidden Markov Models, Randomized Algorithms	4
		Total number of Lectures	**42**

Evaluation Criteria

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

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

1	Jones, N. C., & Pevzner, P. (2004). *An introduction to bioinformatics algorithms*. MIT press.
2	Schölkopf, B., Tsuda, K., & Vert, J. P. (2004). *Kernel methods in computational biology*. MIT press.
3	Jiang, T., Xu, Y., & Zhang, M. Q. (2002). *Current topics in computational molecular biology*. MIT Press.
4	Pevzner, P. (2000). *Computational molecular biology: an algorithmic approach*. MIT press.
5	Gusfield, D. (1997). *Algorithms on strings, trees and sequences: computer science and computational biology*. Cambridge university press.
6	Lesk, A. (2013). *Introduction to bioinformatics*. Oxford University Press.
7	Gollery, M. (2005). Bioinformatics: Sequence and Genome Analysis, David W. Mount. Cold

	Spring Harbor, NY: Cold Spring Harbor Laboratory Press, 2004, 692 pp., ISBN 0-87969-712-1. *Clinical Chemistry, 51*(11), 2219-2219.
8	Cormen, T. H. (2009). *Introduction to algorithms*. MIT press.
9	*IEEE/ACM Transactions on Computational Biology and Bioinformatics*
10	*Bioinformatics* , https://academic.oup.com/bioinformatics
11	Nature Communications, http://www.nature.com/ncomms/

Course Code	15B19BT792	**Semester Odd** **(specify Odd)**	**Semester** VII **Session** 2019 -2020 **Month from July -Dec**
Course Name	Term Paper		
Credits	4	**Contact Hours**	

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

COURSE OUTCOMES		**COGNITIVE LEVELS**
C460.1	Conduct literature survey to identify the research problem	**Understanding** (C2)
C460.2	Identify the gaps/inadequacies in the existing literature based on a problem	**Applying** (C3)
C460.3	Present an overview of the relevant literature for the specific research topic	**Applying** (C3)
C460.4	Conclude on the findings and compile the term paper	**Analyzing** (C4)