Jaypee Institute of Information Technology

M.Sc. Microbiology

Semester IV

Course Descriptions
Department of Biotechnology

Programme Name: M.Sc. Microbiology

Semester: IV

Course Name & Code: Dissertation & 19M27BT211

Course Outcomes:

COURSE OUTCOMES: Upon completion of this course, student will be able to		**COGNITIVE LEVELS**
C250.1	Define a research problem relevant to health, environment, industry and society	Understanding Level Level II
C250.2	Interpret and organize the existing literature on the chosen topic to formulate hypothesis	Applying Level Level III
C250.3	Apply standard experimental methodologies to their chosen research problem	Applying Level Level III
C250.4	Analyze experimental findings	Analyze level Level IV
C250.5	Communicate research findings both orally and in written form	Create Level Level VI

Microbiomics (18M12BT113)

Detailed Syllabus

Course Code	19M22BT213	**Semester** Even **(specify Odd/Even)**	**Semester IV Session** 2020-2021 **Month from: Jan-June**
Course Name	**Microbiomics**		
Credits	3	**Contact Hours**	3

Faculty (Names)	**Coordinator(s)**	1. Dr. Chakresh KumarJain
	Teacher(s) (Alphabetically)	Dr Chakresh Kumar Jain, Dr Ashawani Mathur

COURSE OUTCOMES		COGNITIVE LEVELS
C373.1	Explain about the microbiome, diversity and relation with biological system	Understand Level (C2)
C373.2	Summarize the role of Human microbiota and environment in infectious diseases	Understand Level (C2)
C373.3	Compare different seqeuncing methods and perform data analysis	Analyze Level (C4)
C373.4	Summarize interaction between Gut Microbiome and human nutrition	Understand Level (C2)

Module No.	Subtitle of the Module	Topics in the module	No. of Lectures for the module
1.	**Overview of microbiomics**	Fundamentals microbiomics and applications, Which functions are expressed in the microbiome - transcriptomics	7
2.	**Microbiomic theory of life**	human 'commensal' microbiota, Human microbiome project, soil or water microbiota, their features and role in living system	5
3.	**Microbiome diversity**	16s rRNA profiling analysis, Shotgun Metagenomics, andinternal Transcribed spacer (ITS), internal Transcribed region analysis, Taxonomic classification, Diversityanalysis	8
4.	**Sequencing methods**	Extracting whole genomes from the microbiome - genome sequencing through PacBio, Deep sequencing, shot gun sequencing and data analysis using computational tools and pipelines, such as	10
		MG-RAST server etc.	
5.	**Human Microbiome**	Nexus of Food, Agriculture, Human Nutrition, and Gut Microbiome	7

6	**Environment and Microbiome**	Environmental influences on bacterial genomes: bacterial epigenome and itsanalysis	4
7.	**Applications and tools**	Human microbiota and infectious diseases, liver diseases, gastrointestinal malignancy etc.	5
Total number of Lectures			**42**

Evaluation Criteria

Components MaximumMarks

T1 20

T2 20

EndSemester Examination 35

TA 25 (Assignments 1, 2 / MCQ/PBL,Attendance) **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.	Vassilios fanos, " Metagenomics and microbiomics", 2016, pp 144, Academic press. ISBN 9780128053058
2.	Pierre Baldi and Søren Brunak "Bioinformatics The Machine Learning Approach" , February 2001, The MIT Press, Cambridge, London
3.	Research papers and online resources

Detailed Syllabus

17M12BT123 Bioseparation Technology

Semester & Session	**M.Tech (II Semester) 2014-15**	**Credits**	**3**	**Semester :** Even	**Semester: IV Session:** 2020- 2021 **Month from:** Jan-June

Faculty	**Coordinator(s)**	Dr. Ashwani Mathur

(Names)	**Teacher(s) (Alphabetically)**	Dr. Ashwani Mathur

	COURSE OUTCOMES	Level
CO1	Understand the properties of biomolecule on choice of bioseparation techniques	Understand Level (C2)
CO2	Compare the principles of different instruments and techniques used in bioseparation	Understand Level (C2)
CO3	Apply different purification methods for product purification	Apply Level (C3)
CO4	Implement the purification strategies for bioproduct purification	Apply Level (C3)

Module No.	**Modules**	**Topics in Module**	**Lecture Classes**
1	Bioseparation: Overview	Introduction to bioseparation, characteristics of biological material, strategies for removing insoluble, isolation and purification of product and polishing of final product	6
2	Removal of Insoluble	for cell disruption: chemical methods and mechanical methods, Principle and equipment design; Sedimentation; Filtration and Microfiltration: equipment	8
		for conventional filtration, pretreatment, theory of filtration, microfiltration; Centrifugation: centrifuges, scale-up of centrifuges, centrifugal filtration: designing and operation	

3	Isolation of bioproducts	Extraction: Principle of extraction, batch, staged and differential extraction, fractional extraction. Aqueous two phase partitioning; Adsorption: chemistry, batch adsorption, adsorption in continuous stirred tank, adsorption in fixed bed.	5
4	Product Purification	Chromatography: principle, types of chromatography, properties of adsorbents, kinetics analysis, scaling up of chromatography; precipitation: precipitation with non-solvent, salt and temperature, large scale precipitation, ultrafiltration and electrophoresis: principles, electro-dialysis and isoelectric focusing	7
5	Product Polishing	Crystallization: crystal size distribution, batch crystallization, recrystallization; Drying: basic concept, drying equipment, conduction drying, adiabatic drying, lyophilization: instrument design and principle; spray drying	7
6.	Process design for purification of biomolecules	Bioseparation strategies for the purification of antibiotics (penicillin), enzymes, carotinoids, organic acids and monoclonal antibodies	5
7	Ancillary operations	Solvent recovery, waste disposal, biosafety	4
TOTAL			**42**

Evaluation Criteria

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

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

1.	P.F. Stanbury, A. Whitaker and S.J. Hall. *Principles of Fermentation Technology*. Oxford, U.K.: Butterworth-Heinemann, 1994.

2.	P.A. Belter, E.L. Cussler, W-S. Hu. *Bioseparations: Downstream processing for Biotechnology*. USA: A Wiley- Interscience Publication, 1988
3.	ML. Schuler and F. Kargi. *Bioprocess Engineering*. Prentice Hall, 1992
4.	B. Atkinson and F. Mavituna. *Biochemical Engineering and Biotechnology handbook*. U.K: Macmillan Publishers Ltd., The Nature Press, 1983.

17M12BT128 Structural Biology (3 Credits)

Biological macromolecules, Structure Analysis methods, Macromolecular structure principles and Bioinformatics, Biomolecular recognition, Macromolecular structure-function relationship, Structure based drug-designing

Detailed Syllabus

17M12BT128 Structural Biology

Semester & Session	**X Semester 2020-21**	**Credits**	**3**	**Contact Hours L T P**	**3 3 - -**
Faculty (Names)	**Coordinator(s)**	1. Vibha Gupta			
	Teacher(s) (Alphabetically)	1. Vibha Gupta			

Course Outcome: Upon completion of the course students will be able to:

S. No.	Course Outcomes	Course Outcomes
C232-2.1	Describe the modern methods for determination of structure of biological molecules particularly proteins	**C2**
C232-2.2	Relate knowledge of the three-dimensional structures of proteins with their functions	**C4**
C232-2.3	Apply modern bioinformatic tools for visualizing structures and for drug designing	**C4**
C232-2.4	Read and critique a structure paper	**C5**

Pre-requisite : NA

Module No.	Subtitle of the Module	Topics in the module	No. of Lectures for the module
1.	Biological Macromolecules	Type of macromolecules, Structural architecture	**4**
2.	Structure Analysis Methods	X-ray crystallography, NMR, small-angle X-ray and neutron scattering (SAXS/SANS), cryo-electron microscopy, mass spectrometry, Circular Dichroism, Fluorescence spectroscopy, Static and Dynamic Light scattering, Differential Scanning Calorimetry and Isothermal Titration Calorimetry, Surface Plasma Resonance, analytical ultracentrifugation	**7**
3.	Structural bioinformatics	Biological Sequence and Structural data banks – PDB, NDB, RNA Structure Database, CSD, bioinformatic approach for prediction of secondary and tertiary structures of proteins and nucleic acids, molecular modeling and threading	**3**

4.	Structural chemistry of biological macromolecules	Characterization of forces acting in biology, protein folding, binding interfaces, protein dynamics, misfolding and human disease	**4**
5.	Biomolecular recognition	**Protein Interactions:** Substrate recognition by DNA polymerases; antigen antibody interaction; **RNA RNA recognition in vivo; DNA-DNA interactions** (DNA Microarray); **Cell-cell interactions:** receptor mediated recognition in immune system surveillance, macrophage-B-Cell collaboration, T Cell and natural killer cell function, Phage display	**10**
6.	Structure and function	Macromolecular structure and function case studies in relation to transcription, translation, folding and other fields of cell (G-protein coupled receptors, nuclear pore complex, transporters, ion channels myosin, signal transduction proteins, membrane proteins etc)	**10**
7.	Structure assisted Drug Designing	Steps in drug designing for known as well as unknown targets	**4**
		Total number of Lectures	42
Evaluation Criteria **Components Maximum Marks** T1 20 T2 20 End Semester Examination 35 TA 25 (Class Test, assignment, quiz, PBL)			

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.	Bernhard Rupp "Biomolecular crystallography: principles, practice and applications to structural biology" Abingdon, New York: Garland Science, Taylor & Francis Group, 2010
2.	Leonard J. Banaszak "Foundations of Structural Biology"Academic Press

3.	Irwin H. Segel "Enzyme Kinetics: Behavior and Analysis of Rapid Equilibrium and Steady State Enzyme Systems" Wiley
4.	Charles R. Cantor, Paul R. Schimmel's three part series – Biophysical Chemistry: Part I: The conformation of Biological Macromolecules; Part II: Techniques for the study of biological structure and function; Part III: The Behavior of Biological Macromolecules WH Freeman and Co, Oxford.
5.	Research papers and Reports

Brief Syllabus

17M12BT128 Structural Biology (3 Credits)

Biological macromolecules, Structure Analysis methods, Macromolecular structure principles and Bioinformatics, Biomolecular recognition, Macromolecular structure-function relationship, Structure based drug-designing

Detailed Syllabus

17M12BT128 Structural Biology

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	Teacher(s) (Alphabetically)	1. Vibha Gupta			

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C232-2.1	Describe the modern methods for determination of structure of biological molecules particularly proteins	Understand level (C2)
C232-2.2	Relate knowledge of the three-dimensional structures of proteins with their functions	Analyze level (C4)
C232-2.3	Apply modern bioinformatic tools for visualizing structures and for drug designing	Analyze level (C4)

C232-2.4 Read and critique a structure paper Evaluate level (C5)

Pre-requisite : NA

CO-PO and CO-PSO Mapping:

Course Outcomes	PO1	PO2	PO3	PSO1
C232-2.1	2	1		1
C232-2.2	2	2		2
C232-2.3	1	2	2	2
C232-2.4	2	1	2	1
Average	**2**	**2**	**2**	**2**

Module No.	**Subtitle of the Module**	**Topics in the module**	**No. of Lectures for the module**
1.	Biological Macromolecules	Type of macromolecules, Structural architecture	**4**

2.	Structure Analysis Methods	X-ray crystallography, NMR, small-angle X-ray and neutron scattering (SAXS/SANS), cryo-electron microscopy, mass spectrometry, Circular Dichroism, Fluorescence spectroscopy, Static and Dynamic Light scattering, Differential Scanning Calorimetry and Isothermal Titration Calorimetry, Surface Plasma Resonance, analytical ultracentrifugation	**7**
3.	Structural bioinformatics	Biological Sequence and Structural data banks – PDB, NDB, RNA Structure Database, CSD, bioinformatic approach for prediction of secondary and tertiary structures of proteins and nucleic acids, molecular modeling and threading	**3**
4.	Structural chemistry of biological macromolecules	Characterization of forces acting in biology, protein folding, binding interfaces, protein dynamics, misfolding and human disease	**4**
5.	Biomolecular recognition	**Protein Interactions:** Substrate recognition by DNA polymerases; antigen antibody interaction; **RNA RNA recognition in vivo; DNA-DNA interactions** (DNA Microarray); **Cell-cell interactions:** receptor mediated recognition in immune system surveillance, macrophage-B-Cell collaboration, T Cell and natural killer cell function, Phage display	**10**
6.	Structure and function	Macromolecular structure and function case studies in relation to transcription, translation, folding and other fields of cell (G-protein coupled receptors, nuclear pore complex, transporters, ion channels myosin, signal transduction proteins, membrane proteins etc)	**10**
7.	Structure assisted Drug Designing	Steps in drug designing for known as well as unknown targets	**4**
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1. Bernhard Rupp "Biomolecular crystallography: principles, practice and applications to structural biology" Abingdon, New York: Garland Science, Taylor & Francis Group, 2010

2. Leonard J. Banaszak "Foundations of Structural Biology"Academic Press

3. Irwin H. Segel "Enzyme Kinetics: Behavior and Analysis of Rapid Equilibrium and Steady State Enzyme Systems" Wiley

4. Charles R. Cantor, Paul R. Schimmel's three part series – Biophysical Chemistry: Part I: The conformation of Biological Macromolecules; Part II: Techniques for the study of biological structure and function; Part III: The Behavior of Biological Macromolecules WH Freeman and Co, Oxford.

5. Research papers and Reports