Jaypee Institute of Information

Technology M.Sc. Microbiology

Semester I

Course Descriptions

Detailed Syllabus
Lecture-wise Breakup

Course Code	15B1NBT832	**Semester** Odd **(specify Odd/Even)**	**Semester I Session** 2020-21 **Month** July to December 19
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	Designing various studies of medical/ health/	**7**
	Biostatistical analysis.	Microbial/Agricultural/Genetics/Pharamaceutical science related studies. Data analysis using different methods Result interpretation	
9.	Case studies	Based on various research studies and systematic reviews.	**4**
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** 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.	Pranab Kumar Banerjee, Introduction to Biostatistics (4th Edition), S Chand and Company, 2015.
2.	Veer Bala Rastogi, Biostatistics (3rd Edition), Medtech, 2015

3.	S. Kartikeyan, R. M. Chaturvedi, R. M. Bhosale, Comprehensive textbook of biostatistics and research methodology(1st Edition), Bhalani Publishing House, 2016
4.	B Antonisamy Prasanna Premkumar Solomon Christopher, Principles and Practice of Biostatistics, Elsevier India, 2017
5.	Susan Holmes, Wolfgang Huber, Modern statistics for Modern Biology. Cambridge University Press, 2019

Detailed Syllabus
Lecture-wise Breakup

Course Code	**19M21BT113**	**Semester** Odd	**Semester** M.Sc. Microbiology I **Session** 2020-21 ○ **Month from** July-December
Course Name	**Biomolecules**		
Credits	4	**Contact Hours**	4

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

COURSE OUTCOMES		**COGNITIVE LEVELS**
C113.1	Explain the biomolecules structure and function	Understand Level (C2)
C113.2	Analyze bioenergetics and metabolic pathways for physiological and pathological conditions	Analyze Level (C4)
C113.3	Apply the concepts of enzymes, hormones and signaling	Applying Level (C3)
C113.4	Illustrate the basics in genomics and proteomics	Understand Level (C2)

Module No.	**Title of the Module**	**Topics in the Module**	**No. of Lectures for the module**
1.	Carbohydrates and Bioenergetics	Chemical composition and bonding; Carbohydrates: Classification, basic chemical structure; General reactions of the functional groups; Physiological significance; Metabolism of carbohydrate: Glycolysis, TCA, gluconeogenesis, PPP, ATP role; Respiratory chain and oxidative phosphorylation	11

2.	Lipids	Classification, structure and function of major lipid subclasses; chylomicrons, LDL, HDL, and VLDL; Pathological changes in lipid levels. Formation of micelles, monolayers, bilayer, liposomes; biosynthesis of fatty acids and ketogenesis	7
3.	Proteins	Amino acids: Classification, Properties, Protein Structure: primary, secondary, tertiary and quaternary structure; separation techniques; Enzymes: kinetics, functions; biosynthesis of non-essential amino acids and catabolism of protein and amino acids in born errors of metabolism.	7
4.	Nucleotides	Nucleic acid structure, Nucleotides and nucleosides; metabolism of purines and pyrimidines	6
5.	Hormones	Characteristics of hormones/ signalling molecules; function, signal transduction	6
6.	Introduction to Genomics and proteomics	DNA sequence analysis methods; gene disease association; Introduction and scope of proteomics	5
		Total number of Lectures	**42** 42

Evaluation Criteria

Components Maximum Marks
T1 20
T2 20
End Semester Examination 35
TA 25 (Presentation, Assignments)
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.	JM Berg, L Stryer, J Tymoczko, G Gatto, "Biochemistry", 9th Ed. San Francisco, 2019 WH Freeman
2.	B Gomberts, "Signal transduction", Academic Press, 2009 Harper
3.	RK Murray, DK Granner, VW Rodwell, "Harper's Illustrated Biochemistry", 27th Ed. McGraw-Hill Lange 2006
4.	D Voet and JG Voet, "Biochemistry" 4th Ed. Wiley 2010
5.	DL Nelson and MM Cox, "Lehninger Principles of Biochemistry", 7th Ed. WH Freeman 2017

Detailed Syllabus
Lecture-wise Breakup

Course Code	19M21BT111	**Semester:** Odd	**Semester:** I **Session :** 2020-21 ○ **Month from: July to December**
Course Name	Microbial Physiology and Diversity		
Credits	4	**Contact Hours**	3-1-0

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

Course Outcomes:

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

Sl. No.	DESCRIPTION	COGNITIVE LEVEL (BLOOM's TAXONOMY)
C110.1	Classify the Diversity amongst archae, eubacteria and other microorganisms	Understanding level (Level 2)
C110.2	Demonstrate ecological diversity, habitat interaction and microbial relationship.	Understanding level (Level 2)
C110.3	Identify microbial nutritional, growth requirements and associated physiological mechanisms.	Applying level (Level 3)
C110.4	Analyze the different modes of metabolism in microorganisms.	Analyzing level(Level 4)

Module No.	Title of the Module	Topics in the Module	No. of Lectures for the module
1.	**Microbial taxonomy and evolution of diversity**	Phylogenetic and genotypic classification, Classic and molecular characteristics, Phylogenetic trees	2

2.	**The Archae (Extremophiles and their diversity)**	Introduction to Archaeal Taxonomy and Metabolism, Phylum Crenarchaeota: Habitat and energy metabolism, cold dwelling microbes (artic and antartic regions), hyperthermophiles. Phylum Euryarchaeota: extremely halophilicarchea, taxonomy and physiology of halophilicarchea. Methanogens – diversity and physiology. Thermoplasmatales– thermoplasma, Hyperthermophilic euryarcheota: Thermococcales and Methanopyrus.	4
3.	**Gram negative and positive**	Diversity, characteristic features and significance : Spirochaetes - aerobic / microaerophilic motile, helical /	5

	eubacteria	vibriod - non motile gram negative curved bacteria - gram negative and positive rod and cocci - gram negative straight, curved & helical rods - sulfur reducing bacteria - - rickettisias and chlamydias – mycoplasmas - endosymbionts. Mycobacteria – Nocardioformis. Anoxygenic phototrophic bacteria – oxygenic photosynthetic bacteria – aerobic chemolithotrophic bacteria – budding and appendaged bacteria – sheathed bacteria – non photosynthetic bacteria - Myxobacteria – archeobacteria.	
4.	**Diversity of other microorganisms**	Distribution, importance, structure and characteristics of the fungal divisions, slime molds, the algal divisions, protozoans, general properties of viruses, their structures and classification, bacteriophages	7
5.	**Microbial Diversity of various habitats**	Microorganisms in nature ecosystem, Ecological groups of Microorganisms, Microbial population interactions, Human Microbe Interactions, The soil habitat, Water as a Microbial Habitat, Microflora of air, Microflora of foodstuff	5
6.	**Microbial nutrition and growth**	Nutritional requirements of Microorganisms- Autotrophs, Heterotrophs ,Chemotrophs, Copiotrophs and Oligotrophs. Transport Mechanisms - Diffusion-Facilitated Diffusion, Active transport- Group translocation. Different phases of growth - Growth curve - Generation time - Factors influencing microbial growth - Temperature, pH, Pressure, Salt concentration, Nutrients - synchronous growth and continuous cultivation. Diauxic growth, Sporulation - Endospore formation in bacteria. Chemotherapeutic agents as growth inhibitors	5
7.	**Bacterial photosynthesis**	Photosynthetic microorganisms, photosynthetic pigments, and generation of reducing power by cyclic and non-cyclic photophosphorylation, electron transport chain in photosynthetic bacteria. Carbon dioxide fixation pathways.	5

8.	**Bacterial Respiration**	Bacterial aerobic respiration, components of electron transport chain, free energy changes and electron transport, oxidative phosphorylation and theories of ATP formation, inhibition of electron transport chain. Electron transport chain in some heterotrophic and chemolithotrophic bacteria. Bacterial anaerobic respiration: Introduction. Nitrate, carbonate and sulfate as electron acceptors. Electron transport chains in some anaerobic bacteria. Catalase, super oxide dismutase, mechanism of oxygen toxicity.	5
9.	**Bacterial Chemolithotrophy**	Physiological groups of chemolithotrophs, ammonia oxidation by members of Genus Nitroso group, nitrite oxidation by Nitro group of genera. Oxidation of molecular hydrogen by *Hydrogenomonas* species. Ferrous and sulfur/sulfide oxidation by *Thiobacillus* species.	4
		Total number of Lectures	

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.	Microbial Diversity by Colwd , D. 1999, Academic Press.
2.	Prescott L M, J P Harley and D A Klein (2005). Microbiology. Sixth edition, International edition, McGraw Hill.
3.	Advances in Applied Microbiology. Vol. 10. Edited by Wayne W. Umbreit and D. Pearlman. Academic Press.
4.	Brocks Biology of Microorganisms. 8th Edition. (International Edition - 1997) by Michael T. Madigan, John M. Martinko. Jack Parker. Prentice Hall Internation Inc.
5.	Microbial Ecology. Fundamentals and Applications by. Ronald M. Atlas and Richard Bartha. 2nd and 4th Edition. The Benjamin Cummins Publication Co. Inc.
6.	David white. The physiology and biochemistry of prokaryotes. Oxford university press. 4th edition (2011).

Detailed Syllabus
Lecture-Wise Breakup

Course Code	19M21BT115	**Semester:** Odd	**Semester:** 1st **Session :** 2020-21 **Month from: July to December**
Course Name	Microbial Genetics & Molecular Biology		
Credits	3-1-0-4	**Contact Hours**	4

COURSE OUTCOMES: Upon completion of the course, students will be able to		**COGNITIVE LEVELS**
CO112.1	• Explain fundamental principles of molecular biology and technological advances in the field	Understanding Level (C2)
CO112.2	• Apply knowledge of microbial genome architecture and gene regulation	Apply Level (C3)
CO112.3	• Analyse various methods of gene transfer and extrachromosomal inheritance	Analysis Level (C4)
CO112.4	Interpret different aspects of DNA mutations, DNA repair, Linkage & Mapping	Understanding Level (C2)

Faculty (Names)	**Coordinator(s)**		
	Teacher(s) (Alphabetically)	1. Prof. Krishna Sundari 2. Dr. Vibha Gupta	
Module No.	**Subtitle of the Module**	**Topics in the module**	**No. of Lectures for the module**
1.	**The nature of Genetic material**	Discovery of DNA and experimental evidence, The structure of DNA and RNA; Melting of DNA, Superhelicity, Genome architecture, Chromatin arrangement, nucleosome formation, C value paradox, central dogma	02

2.	**DNA replication and repair**	DNA replication mechanism, enzymes involved and models of DNA replication, DNA methylation, inhibitors of DNA replication, DNA damage and repair: Molecular basis of spontaneous and induced mutations, types of mutation, Ames test, DNA repair pathways - excision, mismatch, photoreactivation, Double Strand Break Repair	06
3.	**DNA transcription**	Transcription machinery - various transcription enzymes and cofactors, initiation, elongation and termination, enhancer sequences and control of transcription, Structure and function of RNA polymerase, Post-transcriptional processes: RNA processing, Capping and polyadenylation, rRNA and tRNA processing, RNA Editing; RNAi and miRNAs, Antisense RNA	07

4.	**DNA translation**	The genetic code and protein structure, Mechanisms of translation - initiation complex, ribosomes and tRNA, factors, elongation and termination, *in vitro* translation systems, polycistronic/monocistronic synthesis, inhibitors of translation, stringent response in bacteria, Post-translational processes: Protein modification, folding, chaperones, transportation; protein degradation	06
5.	Methods of gene transfer in Bacteria	Transformation - natural transformation systems, mechanism, chemical-mediated and electro transformation; Conjugation - nature of donor strains and compatibility, interrupted mating and temporal mapping, F plasmid, Hfr transfer, horizontal gene transfer	04
6.	Plasmids & Movable genetic elements	Plasmid types, detection, replication, partitioning, copy-number control, properties of some known plasmids, Extrachromosomal inheritance	04
7.	Genetic control mechanism in prokaryotes	Operons, lac system, trp system for negative & positive gene regulation, lambda phage, complex operons	04

8.	Viral genome & Methods of gene transfer in Viruses	Introduction to viral genetics, viral life cycles and phage replication, Transduction - Generalized and specialized transduction; gene mapping by specialized transduction	03
9.	Linkage and gene Mapping	Recombination (homo and heterologous), linkage symbolism, single and double cross overs, linkage maps, genetic analysis	03
10.	Technological advances	Recombination as a molecular biology tool, Genetically modified organisms (GMOs) and applications	03
		Total number of Lectures 4	42 **2**

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.	Lewin's Genes XII by Jocelyn E. Krebs, Elliott S. Goldstein and Stephen T. Kilpatrick Jones and Bartlett Publishers, Sudbury, Massachusetts, 2018.
2.	Molecular Biology of the Gene by J.D. Watson, T.A. Baker, S.P. Bell, A. Gann, M. Levin, R. Losick, 7th edition, Benjamin Cummings, San Francisco, USA, 2013.
3.	Molecular Biology of the Cell by B. Alberts, A. Johnson, J. Lewis, M. Raff, K. Roberts, P. Walter, 6th edition, Garland Science, New York and London, 2017.
4.	Lehninger Principles of Biochemistry Seventh Edition – David L. Nelson; Michael M. Cox, 2017
5.	An Introduction to Genetic Analysis by Suzuki DT, Griffiths AJF, Miller JH and Lewontin RC, WH freeman and Company, New York

Detailed Syllabus
Lab-wise Breakup

Course Code	19M25BT111	**Semester** Odd **(specify Odd/Even)**	**Semester** I **Session** 2020-21 **Month from** July-December
Course Name	**Microbiology Lab-I**		
Credits	4	**Contact Hours**	8

Faculty (Names)	**Coordinator(s)**	Dr. Ashwani Mathur
	Teacher(s) (Alphabetically)	Dr. Ashwani Mathur, Dr. Indira P. Sarethy, Dr. Rachana, Prof. Neeraj Wadhwa, Dr. Shalini Mani, Prof. Sudha Srivastava, Prof. Sujata Mohanty, Prof. Vibha Rani

COURSE OUTCOMES		**COGNITIVE LEVELS**
CO1	Understand various culture media, their applications and methods of sterilization	**Understand (Level C2)**
CO2	Apply standard microbiological techniques for isolation, culturing and enumeration of microorganisms	**Apply (Level C3)**
CO3	Make use of different methods for microbial identification and characterization	**Apply (Level C3)**
CO4	Compare methods of DNA isolation from microorganisms	**Analyze (Level C4)**

Module No.	**Title of the Module**	**List of Experiments**	**Hours**
1.	Isolation of microorganisms from different sources	Media preparation & sterilization – Bacteria; Media preparation & sterilization – fungi; Preparation of agar plants and slants; Culturing microorganisms on agar media by streaking / stab / point inoculation; Serial dilution of microbial culture; Estimation of microbial growth by colony counting	Week 1 – Week 3
2.	Characterization of Microorganisms	Microbial diversity – characterization of bacteria & fungi; IMVIC Test; Computational tool for strain identification	Week 4 – Week 6
3.	Microbial Growth	Effect of substrate / culture conditions on microbial growth; To study diauxic growth in bacteria; Data presentation & Analysis	Week 7 – Week 9
4.	Molecular Biology	Isolation of DNA from bacteria; Isolation of bacteria from fungi; Agarose Gel Electrophoresis	Week 10– Week 12
		Total	**12**

Evaluation Criteria

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

Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)	
1.	https://microbeonline.com/imvic-tests-principle-procedure-and-results/
2.	Vashist Hemraj , Sharma Diksha, Gupta Avneet (2013), A review on commonly used biochemical test for bacteria Innovare Journal of Life Science, Vol 1: Issue 1, 1-7
3.	Manual of Microbiology : Tools and Techniques- Kanika Sharma ISBN 10: 8180520889 / ISBN 13: 9788180520884

Detailed Syllabus
Lecture-wise Breakup

Course Code	19M21HS111	**Semester: Odd**	**Semester: I** 2020-21 ○ **Month: July-Dec 2019**
Course Name	Presentation and Communication Skills		
Credits	2	**Contact Hours**	2-0-0

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

COURSE OUTCOMES		**COGNITIVE LEVELS**
C101.1	Develop an in-depth understanding and appreciate the subtle aspects of English as a communication tool.	Understand(C2)
C101.2	Assess the communication challenges of a diverse, global marketplace	Analyze (C4)
C101.3	Create & Compose different forms of Professional writing	Create (C6)
C101.4	Evaluate the effectiveness of sample Presentations	Evaluate (C5)
C101.5	Apply the acquired skills in delivering effective presentations	Apply (C3)

Module No.	**Title of the Module**	**Topics in the Module**	**No. of Lectures for the module**

1.	**Communication Process, Grammar, and Vocabulary**	● Communication: Definition, Model, Channel, Goals ● Process of Communication: *Linear Concept, Shannon-Weaver Model, the Two-Way Process* ● Communication Traits: *Communication Apprehension, Style, Argumentativeness* and *Verbal Aggressiveness* ● Grammar: *denotative* and *connotative* words, subject-verb agreement ● Techniques of Vocabulary Building	5
2.	**Intercultural Communication**	● Recognizing cultural diversity: variations in a diverse world ● Developing Cultural Intelligence: *High-Context Cultures* and *Low-Context Cultures* ● Time as a cultural factor: *Monochronic* and *Polychronic* Time ● Challenges of Intercultural Communication ● Developing Cultural Competency and Guidelines for Adapting.	5
3.	**Business Etiquettes, and Presentation Skills**	● Ekman's classification of communicative movements ● Face Facts, Positive Gestures, Negative Gestures, Lateral Gestures ● Preparing and Delivering a Presentation ● Using Audio-Visual Aids: Presentation Support ● Sample Presentations: 1. Steve Jobs, *Three Stories of my Life* (Stanford University Commencement Address, 2005) 2. Dr. Shashi Tharoor, *Britain does owe India reparations* (Oxford Union Debate)	5
4.	**Communication**	● Negotiation, Mediation, and Conciliation	5
	for Conflict Management	● Stages in the Negotiation Process ● Strategies of Conciliation ● Solving Deadlocks ● Reaching an Agreement	
5.	**Communication for Employment**	● Guidelines for writing a Resume, Types of Resumes ● Interviews: Purpose and Types. ● Interviews: Preparation, Process, Common Mistakes to Avoid. ● Group Discussion: Stages (Forming, Storming, Norming, Performing, Adjourning) ● Formal/Informal Group Dynamics	5
6.	**Technical Communication**	● Characteristics of a Report ● Types of Report ● 5 W's and 1 H of a Report ● Structure, Format, Parts of a Report ● Referencing, and Documentation	5
		Total number of Lectures	

Evaluation Criteria

Components Maximum Marks
Mid Term Examination (Presentation) 30
End Semester Examination 40
TA 30(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	C.L.Bovee, J.V.Thill, Roshan Lal Raina, *Business Communication Today*, 13th Ed, Pearson Education, 2017.
2	R.C. Sharma and Krishna Mohan, *Business Correspondence and Report Writing*, Mc Graw Hill Education, 2016.
3	Meenakshi Raman and Sangeeta Sharma, *Technical Communication: Principles and Practice*, Oxford University Press, 2015.
4	Anna Koneru, *Professional Communication*, Mc Graw Hill Education Pvt Ltd., 2017.
5	Murli Krishna, *Communication Skills for Engineers*, Pearson, 2014.
6	Meenu Dudeja, *Communication Skills for Professionals*, Satya Prakashan, 2017.
7	Barun K. Mitra, *Personality Development and Soft Skills*, Oxford University Press, 2012.