BIRLA INSTITUTE OF TECHNOLOGY & SCIENCE, PILANI
INSTRUCTION DIVISION
SECOND SEMESTER 2021-22

Dated: 17.01.23

Course Handout Part II

Course No. : BIO G523
Course Title : Advanced & Applied Microbiology
Instructor In-charge : RUCHI JAIN DEY, Jayati Ray Dutta
Instructors : Ruchi Jain Dey, Naresh Patnaik, Anannya Dhanwal

1. Course Description: Molecular taxonomy, Systematic Microbiology; Study of molecular diversity of microorganisms, Molecular tools employed in study of microbial ecology, clinical microbiology, human-microbe interaction, molecular plant-microbe interaction, applied microbiology, nanotechnology and synthetic microbiology.

2. Scope & Objective of the Course:
This course deals with in-depth study of microbial taxonomy and evolution as well as the molecular aspects of microbe-host interactions. In addition, it includes applied aspects of microbiology for industry and human-health. It also emphasizes on recent developments in microbial genomics, nanotechnology and biotechnology. All the experiments conducted during the course allows students to put theory into practice and gives them hands on training in basic foundation microbiology and state of the art industrially relevant techniques thereby enhancing the scope of the course, skill sets, enhancing the learning outcomes and as a consequence should meet the demands of biotechnology industry.

3. Text Book (TB):
Madigan M.T., Martinko, J.M., Dunlap, P.V., Clark, D.P., Brock, Biology of Microorganism, 12th Ed., 2009, Pearson International Education.

4. Reference Book (RB):
1. Wiley, J.M., Sherwood, L.M., Woolverton, C.J. Prescott, Harley, and Klein's Microbiology, 7th Ed. McGraw-Hill International Edition.
2. Glazer, A.N. and Nikaido, H, Microbial Biotechnology, Fundamentals of applied Microbiology, 2nd Ed., Cambridge.

5. Course Plan:

Lec. No.	Learning Objectives	Topic to be covered	Ref. to Chapters
1-4	Bacterial Evolution and Systematics	Microbial Evolution, Microbiology Systematics, Microbial taxonomy, tools and techniques used to study microbial ecology	TB-14, RB1-19
5-7	Molecular biology of Archaea	Molecular biology of Archaea, DNA replication, Transcription and RNA processing, protein synthesis, shared features of Bacteria and Archaea	TB-8
8-11	Socio-microbiology	Quorum-sensing; prospective application of quorum-sensing mechanisms in medicine, biofilm	TB-9, 23
12-15	Microorganisms for Sustainable Agriculture	Plant growth promoting microorganisms; Associative bacteria, Endophytic bacteria: mechanisms of colonization, various plant growth promoting properties; Biocontrol: Mycorrhiza	RB1-29 TB-24
16-18	Molecular Plant-Microbe interaction-1	Molecular basis of legume-rhizobia interaction, plant-pathogenic bacteria interaction	RB1-29 TB-24
19-20	Molecular Plant-Microbe interaction-2	Plant immune response: Molecular aspects	Reviews
21-24	Medical Microbiology	Microbial interactions: Microbe-human interaction, normal microbiota in human; Host-	TB-28, RB1-33

		parasite/pathogen interaction; Pathogenicity of Microorganisms, Antimicrobial Chemotherapy	RB1-34 and relevant reviews
25-26	Microbial Biosensors	Biosensors and their applications	RB1-35
27-31	Synthetic Microbiology	Synthetic/engineered microorganisms/Protein Engineering/ metabolic engineering. Applications of synthetic microbiology, designing of microbial circuits.	Reviews
32-34	Industrial Microbiology	Biocatalysts and Biotransformation, application of natural enzymes for industrial use, Bioplastics, microbial polysaccharides.	RB2-8, RB2-11
35-38	Food Microbiology	Primary and secondary metabolites, fermented foods, beverages, Enzymes, Single-cell protein, probiotics.	TB-25
39-40	Microbes & fuel generation	Biomass production, Bioethanol/biodiesel production from different microbial sources.	Reviews

List of experiments:

a) Study of the morphology of the given microbial strain using Microscopic techniques (Gram staining with Light Microscope; and Scanning Electron Microscope)
b) Production & estimation of citric acid by colorimetric methods.
c) Production & Purification (Distillation) of wine from grapes and qualitative and quantitative estimation of quality of ethanol by GC.
d) Application of probiotics and engineered microbes - Transformation, clone selection, clone confirmation and estimation of industrially relevant products eg vitamin B using techniques like UV-Spectrophotometry/HPLC/Mass spectrometry.
e) Anti-Microbial Resistance will be studied by various techniques such as –
   (i) Antibiotic sensitivity test – Disc diffusion method and Right Biotic platform
   (ii) Antibiotic susceptibility test – Minimum inhibitory concentration using Eazy MIC strip-based method,
   (iii) MIC determination using High-throughput resazurin-based Alamar blue assay and Right Biotic platform*
   (* Right Biotic platform is an in house diagnostic device developed by Late Prof. Suman Kapur (xBits)
   To read more about it please refer to following e-resources:
   https://xbitsinnovations.com/xbits-products/
   https://xbitsinnovations.com/wp-content/uploads/2019/09/RightBiotic_Monograph.pdf)
f) Nucleic acid amplification techniques (NAAT) based molecular detection of microbes- PCR and agarose gel electrophoresis based and other visual methods of detection of specific microbes

Self-Learning DIY projects (to be conducted by students followed by presentation)- Students will be assessed based on the creativity, quality of the products, efforts and presentation skill.

- *Synthesis of Bioplastic and bioplastic derived products – Self-learning project wherein students will design their DIY protocol to synthesize Bioplastic and daily use products/decorative items using the Bioplastic.*
- *Application of probiotics as food additive- Self-learning project wherein students will design their DIY protocol and utilize well defined probiotics strains as a food additive to prepare food items enriched with probiotics of their choice.*

7. Evaluation Scheme:

EC No.	Evaluation Component	Duration	Weightage (%)	Date, Time & Venue	Remarks
1.	Mid-semester	90 min	25% [50M]	13/03 2.00 - 3.30PM	25% CB
2.	Lab practical (Evaluation components include): 1. Attendance, regular interaction, viva participation in experiments, observation and lab records 2. Comprehensive Lab exam		25% [50M]	To be announced	25% OB
3.	Projects and presentations	Variable	15% [30M]	To be announced	15% OB
4.	Comprehensive	3 hours	35% [70M]	9/5/23 (FN)	35% CB
• Grand total is 200M					

8. Chamber consultation hour: To be announced in the class.

9. Notices: All notices will be displayed on Course management system.

10. Make-up policy: Make-up decisions will be considered for only genuine cases and validated by proper evidence of illness. No make-up for Lab components and assignments.

11. Academic Honesty and Integrity Policy: Academic honesty and integrity are to be maintained by all the students throughout the semester and no type of academic dishonesty is acceptable.

Instructor-in-charge
BIO G523