

Course title: Microbial pathogenesis				
Course code: BBP 145		No. of credits: 2	L-T-P: 15-15-0	Learning hours: 30
Pre-requisite course code and title (if any): None				
Department: Department of Biotechnology				
Course coordinator(s): Prof. Ramakrishnan Sitaraman			Course instructor(s): Prof. Ramakrishnan Sitaraman	
Contact details: rkraman@terisas.ac.in				
Course type: Elective			Course offered in: Semester 2	
Course description: Microbial diseases impose significant social and economic burdens on human society. However, the insights gained from both medicine and basic biology thus far have led to a better understanding of disease mechanisms. This new knowledge has greatly helped in the prevention, management and cure of several diseases. This course aims to impart an understanding of some of the current paradigms in microbial pathogenesis. The study material for this course will include textbooks, case studies and articles from field journals. This is a highly participatory course with a significant component of self-study of assigned material from the literature and student presentations of case studies. Problem-based learning will be a critical component of the evaluation process. Evolutionary and ecological perspectives will be emphasized to provide a truly integrative framework to understand host-pathogen interactions and their consequences.				
Course objectives: 1. To present key aspects of the biology of different pathogens and their interactions with the host. 2. To enable synthesis of information in order to study communicable diseases within an evolutionary-ecological framework.				
Course contents				
S.No	Topic	L	T	P
Module 1	Introduction			
1	Symbiosis, parasitism and evolution	2		
2	Pathogens and Koch's postulates. Contribution of '-omic' sciences to our understanding of pathogens.	1		
3	Modes of disease transmission, epidemics and the spread of anti-microbial resistance	3		
Module 2	Mechanisms and Molecules			
1	Host-pathogen interactions at the molecular level, host resistance and susceptibility genes and the determinants of outcomes.	4		
2	The microbiome in health and disease	3		
3	Diagnostics, vaccines and therapeutic agents	2		
Module 3	Case studies in microbial pathogenesis			
1	SARS-CoV-2 and the WHO vaccine programme		3	
2	Anthrax – an acute zoonotic disease		3	
3	Tuberculosis – a chronic and worldwide problem		3	
4	Helicobacter pylori – commensal, pathogen and carcinogen		3	
5	ESKAPE pathogens: <i>Pseudomonas aeruginosa</i> – a wide-ranging opportunist		3	
	Total	15	15	0

Evaluation criteria:

Minor test 1 – 30% weightage

Minor test 2 – 30% weightage

Major test (end semester) – 40% weightage

Learning outcomes:

1. Knowledge of basic concepts in the field (Minor test 1, Minor test 2 and Major test).
2. Ability to critically analyze and synthesize primary data to develop coherent models or frame testable hypotheses (Minor test 1, Minor test 2 and Major test).
3. Detailed understanding of pathogens and their strategies for colonization, immune evasion and dispersal (Minor test 2 and Major test).

Pedagogical Approach:

Classroom lectures and self-study assignments. Detailed discussion and student presentation of articles from peer-reviewed journals in class for module 3.

Skill Set:

1. Critical analysis of concepts, hypotheses and experimental design.
2. Formulation of experimental strategies for molecular genetic studies of model host-pathogen systems.
3. Comparative analysis of preventive and therapeutic strategies.

Employability:

1. Academic and industrial research on microbial pathogens.
2. Intellectual property firms.
3. Life science teaching at school and undergraduate levels.
4. Pathology laboratories.
5. Management and/or supervision of laboratory-based research in academic/industrial/medical settings.

Materials:**Required texts**

1. B.A. Wilson *et al.* Bacterial Pathogenesis: A Molecular Approach. ASM Press, ed. 4, 2019.
2. J.C. Herron, S. Freeman. Evolutionary Analysis. Pearson Education, India. ed. 5, 2013.
3. B. Tungland. Human Microbiota in Health and Disease: From Pathogenesis to Therapy. Elsevier Science, 2018.
4. Viral Pathogenesis, From Basics to Systems Biology. Academic Press, ed. 3, 2016.
5. N. Bergman. *Bacillus anthracis* and Anthrax. Wiley-Blackwell, 2010.
6. P. Sutton & H. Mitchell (eds.). *Helicobacter pylori* in the 21st Century (Advances in Molecular and Cellular Biology Series). CABI, 2010.
7. S.E. Hasnain *et al.* *Mycobacterium tuberculosis*: Molecular Infection Biology, Pathogenesis, Diagnostics and New Interventions. Springer Singapore, 2019.
8. B.H.A. Rehm (ed.). *Pseudomonas*: Model Organism, Pathogen, Cell Factory. Wiley-VCH, 2008.
9. R. Rappuoli & F. Bagnoli (eds). Vaccine Design: Innovative Approaches and Novel Strategies. Horizon Scientific Press, 2011.
10. S. Pan & J. Tang (eds.). Clinical Molecular Diagnostics. Springer, 2021.
11. L. Pirofski & A. Casadevall. *mBio* 11(4), e01175-20 (2020). doi: 10.1128/mBio.01175-20
12. E. Janik *et al.* *Medicina*, 56(11), 591 (2020). doi: 10.3390/medicina56110591
13. S. Suerbaum & P. Michetti. *New England Journal of Medicine* 347(15), 1175-86 (2002). doi: 10.1056/NEJMr020542
14. L.I. Rankine-Wilson *et al.* *Microbiology (Reading)* 167(4):001041 (2021). doi: 10.1099/mic.0.001041
15. I. Jurado-Martín *et al.* *Int J Mol Sci.* 22(6), 3128 (2021). doi: 10.3390/ijms22063128.
16. Y. Taoufik *et al.* *Front Immunol.* 2021 12, 692598 (2021). doi: 10.3389/fimmu.2021.692598.

17.M.J. Culyba & D. van Tyne. *PLoS Pathog* 17(9), e1009872 (2021). doi: 10.1371/journal.ppat.1009872

Case studies

Suggested readings

Journals

Other readings

Additional information (if any):

Student responsibilities:

1. Class attendance (online/offline).
2. Study/self-study/presentation of course materials as specified by the instructor.
3. Ensuring functionality of essential IT hardware & software at their preferred location(s).

Course reviewers:

1. Prof. Vijaya Satchidanandam, Department of Microbiology and Cell Biology, Indian Institute of Science, Bengaluru (superannuated) and Adjunct Professor, St. John's Medical College, Sarjapur Road, Bengaluru – 560034
2. Dr. S. Ramachandran, Chief Scientist, Professor of the AcSIR in the Faculty of Biological Sciences, Room 130, CSIR-Institute of Genomics and Integrative Biology, Mathura Road, Near Sukhdev Vihar Bus Depot
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