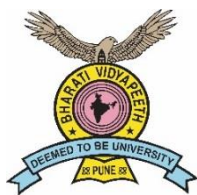


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**BHARATI VIDYAPEETH
(DEEMED TO BE UNIVERSITY), PUNE, INDIA
M.Sc. Microbiology
SEMESTER –IV
PGMB 401 : VIROLOGY (CBCS- 2018 COURSE)**

Total Credits: 4

Total Lectures: 60

Course Outcomes:

At the end of this course the students will be able to:

1. Learn different techniques in cultivation of viruses.
2. Understand details about bacterial viruses, animal and plant viruses.
3. Know concept of viroids, satellites and prions.

Course contents:

UNIT I. INTRODUCTORY VIROLOGY 10

1. Morphological types of viral capsids: Icosahedral, Helical and Complex
2. Types of viral nucleic acids with representative examples
3. Viral replication cycles:
 - Lytic cycle,
 - Lysogeny

UNIT II TECHNIQUES IN CULTIVATING VIRUSES 12

1. 'Embryonated Egg Technique'
2. Tissue culture techniques with merits and demerits:
 - Primary cell cultures
 - Diploid cell cultures
 - Continuous cell cultures
3. The science and art of making viral vaccines:
 - Inactivated or "killed" virus vaccines
 - Attenuated Virus Vaccines
 - Subunit Virus Vaccines
 - Recombinant DNA approaches to Subunit vaccines
 - Virus Like Particles
 - DNA Vaccines
 - Attenuated Viral Vectors and Foreign Gene Expression

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4. Vaccine technology for Delivery and Improving Antigenicity
 - Adjuvants
 - Delivery and formulation
 - Immunotherapy

UNIT III. BACTERIOPHAGES 10

1. Morphology, genome organization and life cycle of :
 - T-even, T-odd, coliphages, λ phage Mu-1.
2. Phage Bacterium interaction / phage Biology
3. Genome mapping- T₄R II locus, Benzer's Spot Test, Complementation test
4. Viruses that kill superbug (ESKAPE Therapy)

UNIT IV. ANIMAL VIRUSES 08

1. Reproduction of animal viruses:
 - i) Adsorption of virions
 - ii) Penetration and uncoating
 - iii) Replication and transcriptions in DNA viruses
 - iv) Replication and transcriptions in RNA viruses
 - v) Synthesis and assembly of virus capsids
 - vi) Virion Release
2. Cytocidal infections and cell damage.
3. Intrinsic Response to animal viral infections:
 - Programmed Cell Death (Apoptosis)

UNIT V PLANT VIRUSES 08

- 1) Effect of viruses on plants
- 2) Plant virus reproduction: Tobacco Mosaic Virus (TMV)
- 3) Transmission of Plant Infecting Viruses- with vectors and without vectors

UNIT VI. UNUSUAL INFECTIOUS AGENTS 12

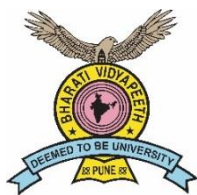
- 1) **Viroids**
 - i) Replication
 - ii) Sequence diversity
 - iii) Movement
 - iv) Pathogenesis
- 2) **Satellites**
 - i) Replication
 - ii) Pathogenesis
- 3) **Prions and transmissible spongiform encephalopathies**
 - i) Scrapie
 - ii) Creutzfeldt-Jakob disease (CJD)
 - iii) Prions and the *prnp* gene

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References

1. Black J.G. (2002) Microbiology Principles and Explorations – ‘Viruses’ 255 – 283. 5th Edn. John Wiley & Sons Inc.
2. Darnell J.E. and Baltimore, Allan Campbell, General Virology
3. Dimmock N.J., A.J. Easton and K.N. Leppes, “Introduction to Modern Virology” Fifth edition, Blackwell Science (Topic B)
4. Flint S.J., L.W. Enquist, R.M. Krug, V.R. Racaniello, A.M. Skalka (2000) Principles of Virology, Molecular Biology Pathogenesis and Control ASM Press.
5. Lewin B. (2000) Genes VII. Oncogenes & Cancer 875-913. Oxford University Press.
6. Matthew K. Waldor, David I. Friedman and Sankar L. Adhya (2005) Phages : Their role in Bacterial Pathogenesis and Biotechnology, ASM Press, Washington DC
7. McKane. L. and K.J. Kandel. (1996) Microbiology Essentials and Applications. Viruses – pg. 305-332 McGraw-Hill Inc.
8. Packer. M. (1983) Veterinary Bacteriology and Virology. 7th Edition CBS Publisher.
9. Rangaswami G & D.J. Baygyaraj. (1993) Agriculture Microbiology, 2nd Edn. Viral diseases of plants – 313-323.
10. Talaro. K.P and A. Talaro. (2002) Foundation in Microbiology. 4th Edition. An introduction to viruses. 159 – 185. McGraw Hill.

* Students are supposed to refer to “Current Contents” and periodicals for recent & additional information.



BHARATI VIDYAPEETH
(DEEMED TO BE UNIVERSITY), PUNE, INDIA
M.Sc. Microbiology (CBCS-2018 COURSE)
SEMESTER –IV
PGMB 402–MEDICAL MICROBIOLOGY

Total Credits: 4

Total Lectures: 60

Course Outcomes:

At the end of this course the students will be able to:

1. Know in details the mechanism of entry of certain pathogens in host cells.
2. Understand different symptoms and medical terms commonly used during diagnosis and treatment of patients.
3. Understand details of bacterial, viral, fungal and protozoal diseases as mentioned in the syllabus.
4. Know the ways of controlling infections in hospitals.

Course contents:

UNIT I.	MICROBIAL ADHESION AND INVASION	15
	1. Role of sulfatide receptors in the pathogenesis of <i>Mycoplasma</i>	
	2. Significance of Ganglio and Lacto series glycolipids in pulmonary infections.	
	3. Molecular interactions between ‘Human Rhinoviruses and ‘ICSM-1’	
	4. Role of Heparin sulfate Glycosaminoglycans in the spread of Herpes simplex virus.	
	5. Interactions of Poliovirus with immunoglobulin like cell receptor.	
	6. Mycolic Acid based invasion, (<i>Mycobacteria</i>)	
	7. Quorum Sensing	
UNIT II.	INFECTIOUS DISEASE SYNDROMES	11
	1. Bacteremia	
	2. Sepsis	
	3. Pathophysiology of septic shock	
	4. Vascular damage and peripheral vasodilation	
	5. Infective endocarditis	
	6. Pyrexia	
	7. Centrally distributed maculopapular eruptions	
	8. Peripheral eruptions	
	9. Vesicular eruptions	
	10. Purpuric eruptions	

UNIT III. DETAILED STUDY OF FOLLOWING DISEASES 30

1. Tuberculosis
2. Gonorrhoea
3. Syphilis
4. Bacillary Dysentery
5. Cholera
6. Herpes
7. Hepatitis A and B
8. Influenza
9. Dengue
10. Chikungunya
11. Systemic candidiasis
12. Invasive aspergillosis
13. Malaria
14. Amoebiasis
15. Nosocomial infections: *Staphylococcus* and *Pseudomonas*

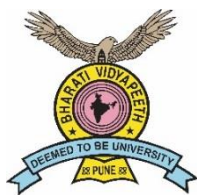
UNIT IV. CONTROL OF INFECTIONS IN HOSPITALS 04

1. Nursing Precautions
2. Isolation Policies
3. Hospital acquired infections
4. Prevention of surgical wound infections and burn infections.

Literature Cited

1. Ananthanarayan R., C.K.Jayram Paniker, “ Textbook of Microbiology” 8th Edition , Orient Longman Pvt.Ltd. (Topic C)
2. Collee J.G., J.P.Duguid, A.G.Fraser, B.P.Marmion, “Practical Medical Microbiology” Thirteenth edition, Churchill Livingstone (Topic C)
3. Dimmock N.J. , A.J.Easton and K.N.Leppsr, “ Introduction to Modern Virology” Fifth edition, Blackwell Science (Topic B)
4. Flint S.J., L.W.Enquist, R.M.Krug, V.R.Racaniello, A.M. Skalka (2000) Principals of Virology, Molecular Biology Pathologeneis and Control ASM Press.
5. King Maurice, “ A Medical Laboratory for developing countries” First Edition, Oxford University Press (Topic D)
6. Magnus Hook, Lech Switalski, Microbial Adhesion and Invasial, First Edition, Springer – Verlag New Yark Inc. (Topic A)
7. Matthew K Waldor, David J Friedman and Sankar L. Adhya, “Phages” 2005, American Society for Microbiology Press (Topic A)
8. Saravanan P., Virology, MJP Publishers Chennai. (Topic C)
9. Sharma B., ‘Medical Microbiology’ A Clinical Perspective’ First edition 2001, Paras Medicl Publishers Hydrabad (Topic D)
‘Principles of Virology’ 2000, American Society for Microbiology Press (Topic C)

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**BHARATI VIDYAPEETH
(DEEMED TO BE UNIVERSITY), PUNE, INDIA**

M.Sc. Microbiology (CBCS- 2018 COURSE)

SEMESTER –IV

PGMB 403: FOOD AND DAIRY MICROBIOLOGY

Total Credits: 4

Total Lectures: 60

Course Outcomes:

At the end of this course the students will be able to:

1. Know the details of foodborne pathogens, fermented food products and role of microorganisms in dairy industry.
2. Understand concept and use of probiotics.

Course contents:

UNIT I	FOOD MICROBIOLOGY	12
	1. Food borne pathogens.	
	▪ Bacterial pathogens: <i>Salmonella</i> , <i>Shigella</i> , <i>E. coli.</i> , <i>Staph. aureus</i> , <i>Clostridium botulinum</i>	
	▪ Toxigenic molds: <i>Aspergillus</i> spp.	
	• Detection and identification of Aflatoxins,	
	• Viruses: Hepatitis, mechanism of pathogenesis, characteristics of disease, stability in foods, outbreaks.	
	▪ Parasites (different examples) , <i>Entamoeba histolytica</i>	
	2. Fermented food products	08
	• Fermented vegetables.	
	• Fermented meat, poultry and fish.	
	• Traditional Fermented foods.	
	• Wine.	
UNIT II	DAIRY MICROBIOLOGY	06
	1. Milk and milk processing.	
	• Milk composition and components.	
	• Milk processing. Different processes to manufacture products from milk.	

- Changes in milk components during processing.

2. The Microbiology of Raw milk. 08

- Initial microflora of raw milk.
- Milk and public health, safeguarding milk supply.
- Biosecurity, Udder disease and bacterial content of Raw milk.
- Environmental sources.
- Microflora of milking equipment and its effect on raw milk.
- Influence of storage and transport on the microflora of raw milk.

3. Microbiology of market milks. 08

- Market milk industry in India.
- Indian Standards
- Composition, Factors affecting composition, Food and Nutritive value.
- Current heat treatments.
- The microflora and Enzymatic Activity of heat-treated market milks – Influence on Quality and shelf life.
- Manufacture, Packaging and storage of pasturised milk.
- Pathogenic microorganisms associated with heat-treated market milks.
- Influence of added Ingredients.
- Potential Application of Alternative to heat for market milks.
- Flavor Defects in milk- causes and prevention.

4. Fermented milk products 06

- Special milks- Sterilised milk, Homogenised milk, Flavored milk, and frozen concentrated milk.
- Cream.
- Butter.
- Indian dairy products-Whole Milk, Dahi, Paneer

UNIT III PROBIOTICS 12

1. Probiotic microorganisms associated with therapeutic properties.
2. Criteria associated with probiotic microorganisms.
3. Safety of issues associated with use of Probiotic cultures for Humans.
4. Beneficial health effects of Probiotic cultures.
5. Effective daily intake of Probiotics.
6. Probiotic dairy products.
7. Factors affecting Probiotic survival in food Systems.

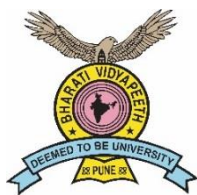
Literature Cited

1. Banwart. G.J. (1987) Basic Food Microbiology CBS Publishers and distributors.
2. Barnum. S.R. (1998) Biotechnology: An introduction. Wadsworth Publishing company. An International Thomson Publishing company.
3. Davis. J.G. (2002) Milk Testing. Agrobios – India. Jodhpur.
4. De. S. (980) Outlines of Dairy Technology. Oxford University Press.
5. Doyle M.P. Beychat. L.R. and T.J” Montville (1997) Food Microbiology Fundamentals and Frontiers. ASM Press. Washington D.C.
6. Frazier. W.C. and D.C. Westhoff. (1988). Food Microbiology. 4th Edn. Tata McGraw Hill. Publ. Co. Ltd.

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7. Jay. J.M. (1986) Modern Food Microbiology 3rd Ed. CBS Publishers and Distributors.
8. Kinson. T.A. and R.F. Sherwook. Biotech Handbooks & series (1995). Eds. Larry Barton. Plenum Press New York.
9. Rajvaidya N. and D.K.Markandey. (2004) Applied Microbiology. Vol. 1-5 APH Publishing Corp. New Delhi.
10. Robinson R.K. (2002) Dairy Microbiology Handbook: The Microbiology of milk and milk products. :Publ: Wiley Interscience. A John Wiley & Sons. Inc. Publication.
11. Versalovic James and Wilson Michael (2008) Therapeuti Microbiology Probiotics and Related Strategies, ASM Press, Washington, DC.
12. Winton and Winton. (2002) milk and milk Products Agrobios India, Jodhpur.

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**BHARATI VIDYAPEETH
(DEEMED TO BE UNIVERSITY), PUNE, INDIA**

M.Sc. Microbiology (CBCS- 2018 COURSE)

SEMESTER –IV

MB- 404: ADVANCED BIOTECHNOLOGY

Total Credits: 4

Total Lectures: 60

Course Outcomes:

At the end of this course the students will be able to:

1. Understand different aspects of plant, animal and marine biotechnology.
2. Know different regulatory authorities and conduction of clinical trials.
3. Understand the concept and significance of patents.

Course contents:

UNIT I PLANT BIOITECHNOLOGY TECHNIQUES AND APPLICATIONS 20

1. Plant tissue culture laboratory design
2. Plant tissue culture and applications.
 - Micropropagation.
 - From callus to plant.
 - Somatic embryogenesis & synseeds
 - Somaclonal variation.
 - Valuable germplasm.
 - Chemicals from plants and techniques for study of - Hairy root, Elicitation, Biotransformation,
 - Bioreactor in PTC/ Fermentor in PTC.
3. Methods for gene transfer / Formation of transgenic plants
4. Applications of plant genetic engineering.
 - Crop improvement.
 - Herbicide resistance.
 - Insect resistance.
 - Virus resistance.
 - Plants as Bioreactors.
 - The first genetically engineered food plants.
 - Frost resistant plants
 - Fruit Vaccine.

UNIT II	ANIMAL BIOTECHNOLOGY TECHNIQUES AND APPLICATIONS	20
1.	Types of cell cultures – <ol style="list-style-type: none">Primary , secondaryContinuous, established cell linesMonolayer ,suspension cell cultures	
2.	Cell culture media: <ol style="list-style-type: none">Nutrient requirements,Media constituents, types of media, growth conditions, etc.	
3.	Culture techniques: <ol style="list-style-type: none">Culturing, subculturing, establishment,Maintenance and preservation of cell linesQuantification- Cell counting, Plating efficiency, Growth curve.CytotoxicityOrganotypic culture.Molecular Techniques in cell culture<ul style="list-style-type: none">• Gene transfer methods in animals:• Microinjection.• Microprojectile Gene Gun• Embryonic stem cell Gene Transfer.• Retrovirus and Gene transfer.• Cell hybridization• Monoclonal antibody production	
5.	Applications of ATC <ul style="list-style-type: none">• Transgenic animals.• Animal propagation.	
UNIT III	MARINE BIOTECHNOLOGY	10
1.	Aquaculture.	
2.	Algal products.	
3.	Algal cell culture.	
4.	Fuels from algae.	
5.	Medical applications.	
6.	Probing the marine environment.	
7.	Conservation.	
8.	Terrestrial agriculture.	
9.	Transgenic fish.	
UNIT IV	CLINICAL DEVELOPMENT OF BIOLOGICAL PRODUCTS	05
1.	Regulatory authorities for introduction of medicines in market- Role of food and drug administration, FDA guidelines for drugs/biologicals, Validation (GMP, GLP, GCP, etc.).	
2.	Clinical studies: Phase I, Phase II, Phase III, and Phase IV of clinical trials- Objectives, Conduct of trials, Outcome of trials.	
3.	Delivery systems- formulations, targeted drug delivery, sustained release drugs	

UNIT V REGULATIONS, PATENT AND SOCIETY.

05

1. The deliberate release of Genetically engineered organisms.EPA Guidelines
2. Risk assessment.
3. Patents and Biotechnology.
4. IPR & Ethical issues
5. Sustainable Biotechnology.
6. Biosafety Guidelines

Literature cited

1. Barnum. S.R. (1998) Biotechnology: An introduction. Wadsworth Publishing company. An International Thomson Publishing company.
2. Borem A. Santos R. and D.E. Bowen (1998) Understanding Biotechnology.
3. Casida. L.E. (2003) reprint Industrial Microbiology Publ: New Age International (p) Ltd. New Delhi.
4. Chirikjian J.G. (1995) Biotechnology Theory and Techniques. Vol. I. Plant Biotechnology. Animal cell culture. Immunobiotechnology. Ed. Karen Graf. Edvotex. Ind. Jones and Bartlett. Publishers.
5. Freshney R.I. (2000) Culture of Animal cells. A Manual of Basic Technique. 4th Edn. Publ: Wiley – Liss:
6. Grace E.S. (1997) Biotechnology unzipped. Promises and Realities Joseph. Henry Press Washington D.C.
7. Kumar. H.D. (1993) Molecular Biology and Biotechnology 2nd revised edition Vikas Publishing house Pvt. Ltd.
8. Mukhopadhyay. S.N. (2001) Process Biotechnology Fundamentals viva Books Pvt. Ltd.
9. Patel. A.H. (2003 reprint) Industrial Microbiology Publ: Macmillan. India Ltd. New Delhi.
10. Purohit S.S. (2004) Plant tissue culture Published by Student Edition, Jodhpur.
11. Ranga M.M. (2002) Animal Biotechnology – 2nd Edn. Publ: Agrobios India, Jodhpur.
12. Ratledge. C. and B. Kristiansen. (2001) Basic Biotechnology 2nd Edn. Cambrige University Press
13. Schmauder. H.P.; M Schweizer. (1997) Methods in Biotechnology. Taylor and Francis publisher.
14. Trehan. K. (1990). Biotechnology. New Age International New Delhi.

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2. Boyer. R. (2000) Modern Experimental Biochemistry. 3rd Edition. Pearson Education Asia.
3. Mathews C.K. and K.E. Van Holde (1996) Biochemistry. The Benjamin Cunnings publishing Co. Inc. 2nd Edition.
4. Lehninger. A.L. , Devid L, Nelson M, M.Cockes (1992) Principles of Biochemistry “ Second Edition” Publisher – CBS Publieshrs
5. Satyanarayana (1999) Biochemistry. Books & Allied (p) Ltd.
6. Pattabiraman T.N. (1993) Principles of Biochemistry Gajanan Publisher.

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**BHARATI VIDYAPEETH
(DEEMED TO BE UNIVERSITY), PUNE, INDIA**

M.Sc. Microbiology (CBCS-2018 COURSE)

SEMESTER : IV

PGSEC 401: Exploring Microbial Diversity

Total Credits: 2

Total Lectures:30

Course Outcomes:

At the end of this course the students will be able to:

1. Understand different aspects of microbial diversity and taxonomy.
2. Know methods for identification of unculturable microorganisms.
3. Understand different methods of gene sequencing.

Course contents:

UNIT I. Microbial diversity	4
1. Definition of species in prokaryotes.	
2. Types of 'species' Species Divergence	
3. Measures and indices of diversity.	
UNIT II Taxonomy	8
1. Introduction to Bacterial Taxonomy	
2. Bergey's Manuals and the classification of prokaryote	
• Determinative Bacteriology : Phenetic Approach	
• Systematic Bacteriology : Phylogenetic Approach	
• Polyphasic Approach	
UNIT III Gene sequencing	12
1. Outline of gene sequencing procedures	
• Maxam Gilbert's method, Sangers method	
• Automated Sequencer	
• BLAST analysis	
• RFLP	
• RAPD	
• Strategies for whole genome sequencing	
• Whole Genome Shotgun Sequencing	
• Applications of gene sequencing (identification of organisms)	

Unit IV : Unculturable microorganisms

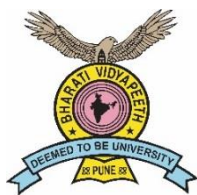
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- Culture independent molecular methods for identifying unculturable bacteria.

References

1. Fakruddin1* and Khanjada Shahnewaj Bin Mannan2eylon C Methods for Analyzing Diversity of Microbial Communities in Natural Environments Md Journal of Science (Bio. Sci.) 42(1): 19-33, 2013 DOI: 10.4038/cjsbs.v42i1.5896 *
2. Breed and Buchanan. Bergey's Manual of Determinative Bacteriology. 9th Edition, 1982.
3. Breed and Buchanan. Bergey's Manual of Systematic Bacteriology. 2nd Edition, (Volumes. 1 – 5) (2001 – 2003). Berguys Mannual of Systematics of bacteriology
4. J., Fritsch, E. F. And Maniatis, T. (1989) Molecular Cloning: A laboratory Manual, 2nd ed. Cold Spring harbour NY: Cold Spring Harbour Laboratory Press
5. Sonia R. Vartoukian, Richard M. Palmer & William G. MINIREVIEW Strategies for culture of 'unculturable' bacteria Wade King's College London Dental Institute, Infection Research Group, London, FEMS Microbiol Lett 309 (2010) 1–7 UK DOI:10.1111/j.1574-6968.2010.02000.x
6. Sandy Primrose, Richard Twyman, Bob Old (2001), Principles of Gene Manipulation 6th Edition, Blackwell Science Ltd. 2. Sambrook,

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**BHARATI VIDYAPEETH
(DEEMED TO BE UNIVERSITY), PUNE, INDIA
M.Sc. Microbiology (CBCS- 2018 COURSE)**

SEMESTER –IV

PGMB 411:- Practical Course 5.

Total Credits: 2

Total Lectures: 120

Course Outcomes:

At the end of this course the students will be able to:

1. Develop the skills for isolation and cultivation of viruses.
2. Develop the skills for performing clinical microbiology experiments.

Course contents:

I. Virology:

- Isolation of phages and Study of phage titre 4 P
- Study of plant viruses. 2 P
- Study of animal cell culture 2 P
- Egg inoculation technique for animal viruses. 3 P
- Preparation of animal viral vaccines (Visit) 1 P

II. Clinical Microbiology:

- Isolation of pathogens from wound and burn infections. 4 P
- Study of antibiotic resistance pattern of these isolates. 2 P

III Biochemistry:

- Estimation of chlorides, sodium,/ potassium,/calcium /ions in blood 4 P

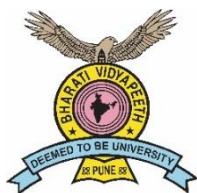
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Literature Cited

1. Varly H.C. (Fourth Edition) Practical Clinical Biochemistry, CBS Publishers & Distributers Pvt. Ltd, New Delhi, Bangalore, Pune, Cochin, Chennai (Indai), First Indian Edition 1988, reprint : 2002, 2003, 2004, 2005.
2. Ananthanarayan R., C.K.Jayram Paniker, “ Textbook of Microbiology” 8th Edition , Orient Longman Pvt.Ltd. (Topic C)
3. Collee J.G., J.P.Duguid, A.G.Fraser, B.P.Marmion, “Practical Medical Microbiology” Thirteenth edition, Churchill Livingstone (Topic C)

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4. Deb A.C. Comprehensible Viva & Practical (First Pub 1996) Biochemistry (Third Edition : 2005), New Central Book Agency (P) Ltd
5. Dimmock N.J. , A.J.Easton and K.N.Leppsr, “ Introduction to Modern Virology” Fifth edition, Blackwell Science (Topic B)
6. Jayraman – Laboratory manual in Biochemistry, New Age International Publishers, New Delhi
7. Luxton R (2010), Clinical Biochemisrty , 2nd Edition
8. Mathews C.K. and K.E. Van Holde (1996) Biochemistry. The Benjamin Cunnings publishing Co. Inc. 2nd Edition



**BHARATI VIDYAPEETH
(DEEMED TO BE UNIVERSITY), PUNE, INDIA
M.Sc. Microbiology (CBCS- 2018 COURSE)**

SEMESTER –IV

PGMB 412: – Practical Course-6

Total Credits: 2

Total Lectures: 120

Course Outcomes:

At the end of this course the students will be able to:

1. Develop the skills for performing experiments in food and dairy industries.
2. Understand the concept of plant cell culture and mushroom cultivation.

Course contents:

1. Isolation and identification of food borne pathogens from food.- *Salmonella*,
Shigella, *E.coli*., *Staph.aureus*. 4 P
2. Isolation of Aflatoxin producing organism and detection of Aflatoxin. 2 P
3. Microbial analysis of raw and pasteurized milk. 2 P
4. Production of gluconic acid by shake flask culture 3 P
5. Production of Antibiotics like polymyxin /Bacitracin etc. 2 P
6. Preparation of traditional fermented foods 1 P
e.g. Curd, Idli, Dhokla etc .
7. Study of commercial probiotic products 5 P
8. Study of plant cell culture 1 P
9. Mushroom cultivation. 2 P

22 P

Literature Cited

1. Varly H.C. (Fourth Edition) Practical Clinical Biochemistry, CBS Publishers & Distributors Pvt. Ltd, New Delhi, Bangalore, Pune, Cochin, Chennai (Indai), First Indian Edition 1988, reprint : 2002, 2003, 2004, 2005.
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6. Jayraman – Laboratory manual in Biochemistry, New Age International Publishers, New Delhi
7. Luxton R (2010), Clinical Biochemisrty , 2nd Edition
8. Mathews C.K. and K.E. Van Holde (1996) Biochemistry. The Benjamin Cunnings publishing Co. Inc. 2nd Edition
9. Nayak S., (2007) Manipal Mannual of Clinical Biochemistry, Publisher Jaypees Brother Medical Publisher
10. Plummer D.T, (1992)An introduction to Practical Biochemistry Tata cGraw Hill Publisher, New Delhi

45. Teaching learning processes:

The teaching learning processes incorporate a variety of modes and a regular use of ICT. These are listed below:

1. **Classroom Teaching** for topics which are intensely information-based. This a very regular feature of all the courses in Microbiology
2. **Power Point slides** for topics which involve information related to intricate biological pathways such as metabolic pathways in bacteria and other microorganisms. Use of Power Point presentations are also made whenever the lectures are to be summarized in a crisp and pointwise manner to highlight salient / important conclusions from the topics.
3. **Classroom Discussions** are a regular feature while teaching. The students are drawn into impromptu discussions by the teacher during the process of teaching.
4. **Video Displaying**, both real-time and animations, are used for topics which require 3D dimensional viewing of the biological mechanisms to drive the point home. These have proved to be very helpful while teaching concepts of molecular biology like DNA replication, transcription and translation. These are also used to convey complexities of antigen-antibody interactions and generation of antibody diversity during the teaching of Immunology.
5. **Model Making** is also used especially for understanding and building a perception of the students for the structures of viruses which cannot be seen by a light microscope and can be seen only under expensive equipment like electron microscopes.
6. **Laboratory Practicals** are an integral part of every course included in UG programme in Microbiology. The is also a daily affair for UG students of Microbiology.
7. **Problem Solving** is encouraged during the laboratory work.
8. **Group Activity** as well as discussions with the laboratory supervisor/ among the students themselves/ Mentor is also encouraged during laboratory work.
9. **Project work** is included in the programme where students work individually or in groups to design experiments to solve/answer a problem suggested by the Mentor or identified by the students in consultation with the Mentor. The students are mentored regularly during the duration the project is in progress.
10. **Presentations by the Students** are regularly done. The students are mentored in presentation of data, interpretation of data and articulation with the students/teachers/Research Scholars during their presentation.
11. **Presentation by Experts** in different specialties of Microbiology are arranged to broaden the horizons of the students.

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12. Interaction with Experts is also encouraged during/after presentations to satisfy/ignite curiosities of the students related to developments in the different areas of Microbiology.

13. Visit to Industries/Laboratories related to Microbiology like fermentation, food, diagnostics etc. are organized to acquaint the students with real-life working environments of the professional microbiologists with a view to broaden their perspective of the subject of Microbiology

46. Assessment Tasks:

It is important that the students of UG Microbiology program achieve the desired results in terms of the learning outcomes to be professionally sound and competitive in a global society. Achieving the desired learning outcomes is also imperative in terms of job employment leading to a happy and prosperous individual further leading to a happy and prosperous family and thereby a happy and prosperous society or nation. The assessments tasks are pivotal to get an authentic feedback for the teaching learning process and for mid-course corrections and further improvements in future. The assessment tasks are carried out at various stages of the duration of the UG Microbiology programme like Mid-term assessments, End-term assessments, Semester examinations, Regular assessments, viva-voce etc. The assessment tasks are listed below:

1. Multiple Choice Questions (MCQ) are one of the predominant form of assessment tasks. This task may be used during all kinds of term and semester examinations.

2. Short-Answer Questions/ Long –Answer Questions during term and semester examinations are used to assess the ability of the student to convey his thoughts in a coherent way where prioritization of the information in terms of their significance is tested.

3. Surprise Quizzes are regularly used during continuous assessment while the teaching learning process is continuing which prepares the student to quickly recall information or quickly analyze a problem and come up with proper solutions.

4. Visual/Pictorial Quizzes are used to sharpen the comprehension of the students after looking at all the components of a system.

5. Impromptu Opinions on microbiological problems are sought from student during regular teaching learning which help them to think quickly in a given context. This help build their ability to come up with solutions to problems which the students might not have confronted previously.

6. Problem Solving question are generally given during the laboratory work.

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7. Data Interpretation is also another assessment task which is used to develop analytical skills of the students. This assessment is used during laboratory work as well as during conduction of project work.

8. Analytical Skills are assessed during work related to several experiments like enzyme kinetics, growth of bacteria and bacteriophages, mutation frequencies.

9. Paper/ Project presentations are used to assess the articulation skills of the student. These are carried out both during the duration of the teaching learning processes as well as during end-Semester examinations.

10. Report Writing is used to assess the keenness of the students for details related to microbiology while visiting laboratories / industries as students invariably are required to submit a report after such visits.

11. Assignment Writing are used to assess the writing abilities of the students.

12. Viva-voce during the laboratory working hours and during laboratory examination are used to assess the over-all knowledge and intelligence of the students.

47. Key Words:

Microbiology, Biochemistry, Immunology, Genetics, Microbial Ecology, Scientific writing, Internship, Virology, Medical Microbiology, Food and Dairy Microbiology, Advanced analytical techniques.