GANPAT UNIVERSITY

FACULTY OF SCIENCE

Teaching and Examination scheme

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Syllabus of

B.Sc. Microbiology

Semester - VI

Effective from July 2020

GANPAT UNIVERSITY

FACULTY OF SCIENCE

TEACHING AND EXAMINATION SCHEME

Programme	Bachelor of Science	Branch/Spec.	Microbiology
Semester	VI		
Effective from Academic Year	2020-21	Effective for the batch Admitted in	July 2018

Sr. No.	Subject Code	Subject Name	Teaching scheme												Examination scheme (Marks)					
			Credit						Hours (per week)						Theory			Practical		
			Lecture(DT)			Practical(Lab.)			Lecture(DT)			Practical(Lab.)			CE	SEE	Total	CE	SEE	Total
			L	TU	Total	P	TW	Total	L	TU	Total	P	TW	Total						
1	BMIC6RDT	Recombinant DNA Technology	3	--	3	2		2	3	--	3	3	1	4	40	60	100	40	60	100
2	BMIC6VAM	Virology and Mycology	3	--	3	2		2	3	--	3	3	1	4	40	60	100	40	60	100
3	BMIC6IMB	Industrial Microbiology - II	3	--	3	2		2	3	--	3	3	1	4	40	60	100	40	60	100
4	BMIC6AAM	Analytical and Applied Microbiology	3	--	3	2		2	3	--	3	3	1	4	40	60	100	40	60	100
5		Elective*	2	--	2	-		-	2	--	2	-	--	--	40	60	100	--	--	--
	Total		14	--	14	08		08	14	--	14	12	04	16	200	300	500	160	240	400

*Any one subject can be offered from the following list of elective subjects

Elective

Sr. No.	Subject Code	Subject Name
1	BELE6BIS	Biostatistics
2	BELE6MHD	Management of Human Microbial Diseases
3	BELE6IPR	Intellectual Property Rights
4	MOOCs courses from SWAYAM PORTAL	

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FACULTY OF SCIENCE

Programme	Bachelor of Science	Branch/Spec.	Microbiology
Semester	VI	Version	2.0.0.0
Effective from Academic Year	2020-2021	Effective for the batch Admitted in	July-2018
Subject code	BMIC6RDT	Subject Name	Recombinant DNA Technology

Teaching scheme						Examination scheme (Marks)			
(Per week)	Lecture(DT)		Practical(Lab)		Total		CE	SEE	Total
	L	TU	P	TW					
Credit	03	--	02		05	Theory	40	60	100
Hours	03	--	03	01	07	Practical	40	60	100

Pre-requisites:

Basic knowledge of molecular biology is required.

Learning Outcome:

- Graduates will know the basic, process and construction recombined DNA molecules and its applications.
- Graduates will get to know the importance and application of recombinant DNA in the production of vaccines and protein therapies.
- Graduates will help in the understanding of gene expression, advantage of natural genetic variation, modifying genes and transferring genes to new hosts.

Theory syllabus

Unit	Content	Hrs
1	- Introduction to genetic engineering: Milestones in genetic engineering and biotechnology. - Various tools of genetic engineering: Restriction modification systems: Types I, II and III. Mode of action, nomenclature, applications of Type II restriction enzymes in genetic engineering DNA modifying enzymes and their applications: DNA polymerases. Terminal deoxynucleotidyl transferases, kinases and phosphatases, and DNA ligases: Cohesive and blunt end ligation; Linkers; Adaptors, Homopolymeric tailing. - Labeling of DNA: Nick translation, Random priming, Radioactive and non-radioactive probes. - Hybridization techniques: Northern, Southern and Colony hybridization, Fluorescence in situ hybridization; Chromatin Immunoprecipitation; DNA-Protein Interaction.	10
2	- Cloning Vectors: Definition and Properties Plasmid vectors: pBR and pUC series, Bacteriophage lambda and M13 based vectors, Cosmids, BACs, YACs, Use of linkers and adaptors. - Expression vectors: *E. coli* lac and T7 promoter-based vectors, yeast YIp, YEp and YCp vectors, Baculovirus based vectors, mammalian SV40-based expression vectors. Plant based vectors, Ti and Ri as vectors, Shuttle vectors	12

3	- Construction and Screening of Genomic and cDNA libraries:Insertion of Foreign DNA into Host Cells; Transformation. - Construction of libraries; Isolation of mRNA and total RNA; cDNA and genomic libraries; cDNA and genomic cloning. - Expression cloning; Jumping and hopping libraries; Southwestern and western cloning; Protein-protein interactive cloning and Yeast two hybrid system; Phage display; Principles in maximizing gene expression.	12
4	- Site specific mutagenesis and Protein engineering: PCR Based Site directed mutagenesis, Random mutagenesis, Use of Phage display technique to facilitate the selection of mutant peptide,Gene Shuffling, Production of chimeric protein. - PCR: Basics of PCR, RT-PCR, Real-Time PCR. - Sanger's method of DNA Sequencing: traditional and automated sequencing. - Primer walking and shotgun sequencing, pyro sequencing, 454 GS Junior, 454 GSFLX, Illumina, NGS, Ion Torrent method.	11

Reference Books	
1	Primrose SB *et al*. Principles of Gene Manipulation, S.B.University Press.
2	Sambrook and Russel. Molecular Cloning: A Laboratory Manual, Vols 1-3, CSHL.
3	Brown TA. Genomes 3, Garland Science.
4	Clark DP and Pazdernik NJ. Biotechnology: Applying the Genetic Revolution. Elsevier Academic Press, USA.
5	Glick, B.R., Pasternak, J. Molecular Biotechnology- Principles and Applications of recombinant DNA. ASM Press, Washington.
6	Willey JM, Sherwood LM, and Woolverton CJ. Prescott, Harley and Klein's Microbiology. McGraw Hill Higher Education.

List of Practicals	
1	Digestion of DNA using restriction enzymes and analysis by agarose gel electrophoresis.
2	Preparation of competent cells for transformation.
3	Demonstration of Bacterial Transformation and calculation of transformation efficiency.
4	Demonstration of Southern blotting.
5	Demonstration of Northern blotting.
6	Amplification of DNA by PCR.
7	Cloning of DNA insert and Blue white screening of recombinants.
8	Isolation of RNA.
9	Demonstration of RFLP.

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Programme	Bachelor of Science	Branch/Spec.	Microbiology
Semester	VI	Version	2.0.0.0
Effective from Academic Year	2020-2021	Effective for the batch Admitted in	July-2018
Subject code	BMIC6VAM	Subject Name	Virology and Mycology

Teaching scheme						Examination scheme (Marks)			
(Per week)	Lecture(DT)		Practical(Lab)		Total		CE	SEE	Total
	L	TU	P	TW					
Credit	03	--	02		05	Theory	40	60	100
Hours	03	--	03	01	07	Practical	40	60	100

Pre-requisites:

Students should have basic knowledge of fungi and viruses of 10+2 level. Knowledge of life of prokaryoticmicrobes is also preferable.

Learning Outcome:

The course will help the student to learn about various types of viruses, their cultivation and classification. Inaddition student will also gain knowledge of structure, cultivation classification,replication and importance offungi.

Theory syllabus

Unit	Content	Hrs
1	- Introduction to Viruses: Discovery, Nature and Definition of viruses. General properties. Concept of viroids, virusoids, satellite viruses and Prions. Theories of viral origin. Introduction to persistent, latent and slow viruses. Oncogenic viruses. - Structure of Viruses: Capsid symmetry, enveloped and non-enveloped viruses. - Isolation, purification and cultivation of viruses: Animal cultivation. Cultivation in embryonated eggs. *In vitro* culture using cell lines (primary, secondary and continuous cell lines), cytopathic effects. Cultivation of bacteriophages. - Viral taxonomy: Nomenclature and Classification of different groups of viruses. - Enumeration (assay) of viruses: Plaque assay, Fluorescent focus assay, Infectious center assay, Transformation assay, Endpoint dilution assay.	12
2	- Plant viruses: Introduction, salient features of the viruses infecting different hosts and replication of plant viruses (TMV). - Animal viruses: Introduction and replication (adsorption, penetration, uncoating, replication, synthesis, assembly, and release) of animal viruses in general (HIV & Hepatitis viruses). - Bacteriophages: T4 & Lambda. - Viral multiplication in cell: Lytic and lysogenic cycles. - Applications of virology: Use of viral vectors in cloning and expression, Gene therapy and Phage display.	11

3	- Introduction to Fungi: General characteristics, somatic structure, ultra-structure of fungal cell, hyphal modifications. - Cultivation of fungi: Principles of fungal nutrition. Cultivation media and methods, slide culture technique, prevention of bacterial contamination. Preservation of fungi. - Importance of fungi: Primary and Secondary metabolites produced by fungi and its importance. - Diseases caused by fungi in plants and animals.	12
4	- Reproduction in fungi: Asexual and sexual methods of reproduction, parasexuality among fungi, fruiting bodies in fungi. - Fungal classification: Criteria used for classification, classification system. - Brief outline of different classes of fungi: (Structure, habitat, reproduction/life cycle and economic importance): *Zygomycetes* (*Zygomycotina*), *Ascomycetes* (*Ascomycotina*), *Basidiomycetes* (*Basiomycotina*) and *Deutromycetes* (*Duteromycotina*). - Slime molds.	11

Reference Books	
1	Atlas R M, Principles of Microbiology.Wm. C. Brown Pub., USA.
2	Willey *et al*., Prescott's Microbiology, Mc Graw Hill Publishing Co.
3	Flint, Enquist, Racanillo and Skalka, Principles of virology, ASM press.
4	Edward Wagner and Martinez Hewlett "Basic Virology", Blackwell Publishing.
5	Teri Shors. Understanding viruses. Jones and Bartlett publishers.
6	Sharma O P, Textbook of Fungi, Tata McGraw-Hill Publishing Co. Ltd.
7	Alexopoulos C J, Mims C W, Blackwell M. Introductory Mycology, Blackwell Publishing.
8	Dube HC. An Introduction to Fungi, Vikas Publishing House Pvt Ltd.
9	Biswas SB, Biswas A. An Introduction to Viruses, Vani Educational Books, New Delhi.

`List of Practicals	
1	Study of the structure of important animal viruses (rhabdo, influenza, paramyxo hepatitis B and retroviruses) using electron micrographs
2	Study of the structure of important plant viruses (caulimo, Gemini, tobacco ring spot, cucumber mosaic and alpha-alpha mosaic viruses) using electron micrographs.
3	Study of the structure of important bacterial viruses (ϕX 174, T4, λ) using electron micrograph.
4	Isolation and enumeration of bacteriophages (PFU) from water/sewage sample using double agar layer technique
5	Study of industrially and economically important fungi.
6	Study of plant diseases.

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Semester	VI	Version	2.0.0.0
Effective from Academic Year	2020-2021	Effective for the batch Admitted in	July-2018
Subject code	BMIC6IMB	Subject Name	Industrial Microbiology - II

Teaching scheme						Examination scheme (Marks)			
(Per week)	Lecture(DT)		Practical(Lab)		Total		CE	SEE	Total
	L	TU	P	TW					
Credit	03	--	02		05	Theory	40	60	100
Hours	03	--	03	01	07	Practical	40	60	100

Pre-requisites:

Students should have basic knowledge of Fermentation process and basic instrumentation techniques used in fermentation.

Learning Outcome:

The course will help the student to understand the downstream processes and the procedures thereafter.

Theory syllabus

Unit	Content	Hrs
1	- Introduction to downstream processing. - Recovery of fermentation product - Removal of microbial cells and suspended solids (Foam separation, Precipitation, Filtration and Centrifugation. Methods of cell disruption. - Product concentration and purification: Liquid-liquid extraction and Membrane processes. Finishing stages: Drying and Crystallization. - Effluent treatment of fermentation industry.	12
2	- Quality Assurance, Quality control and GMP: Definitions, QC of raw materials, in-process items, finished products, packaging materials, labels. Sterility assurance and testing. Microbiological Assays. - Fermentation Economics - Isolation, strain improvement, market potential, equipment, media, air sterilization, temperature control, aeration and agitation, recovery, water recycling etc.	10
3	- Immobilization of cell and enzymes: Basic concept of immobilization in biotechnology, Principles and mechanism of Immobilization, Methods of Immobilization. - Bioreactor for Immobilization: Bioreactor and their Types. - Biosensors: Principles and definition, characteristics of Ideal biosensors. - Synthesis of nanomaterials by Biological methods and Applications in biotechnology and medical field.	10
4	- Solvent fermentation - Alcohol. - Organic acid fermentation - Citric acid. - Enzyme fermentation - Amylase. - Antibiotic fermentation - Penicillin. - Amino acid -Lysine. - Vitamin - Vitamin B12.	13

Reference Books	
1	Stanbury PF, Whitaker A and Hall SJ. Principles of Fermentation Technology, Butterworth-Heinemann and Elsevier.
2	Waites, MJ and Morgan NL. Industrial Microbiology: An Introduction, Blackwell Science
3	Crueger W and Crueger A. Biotechnology: A Textbook of Industrial Microbiology, Panima Publishing Corporation, New Delhi, India
4	Mansi EMTEL, Bryle CFA. Fermentation Microbiology and Biotechnology, Taylor & Francis Ltd., UK.
5	Casida LE, Jr.Industrial Microbiology, Wiley Eastern Ltd, New Delhi, India.
6	Patel AH. Industrial Microbiology, Macmillan India Limited
7	Keith Wilson and John Walker, Principles and Techniques of Practical Biochemistry, Cambridge, University Press.
8	Upadhyay & Nath, Biophysical Chemistry, Himalaya Publishing House.
9	Chatwal and Anand, Instrumental Methods of Chemical Analysis, HPH.
List of Practicals	
1	Microbial fermentations for the production and estimation (qualitative and quantitative) of:
	(a) Enzymes: Protease.
	(b) Amino acid: Glutamic acid.
	(c) Organic acid: Citric acid.
	(d) Alcohol: Ethanol.
2	Immobilization of enzyme.
3	Immobilization of cells by calcium-alginate entrapment method.
4	Estimation of streptomycin by sodium nitroprusside method.
5	Bioassay of Penicillin.
6	Optimization of medium parameters for the production Enzyme (Amylase).
7	Demonstration of recovery of crude protein / amylase from fermentation broth either by salting out (ammonium sulfate) or by using isopropyl alcohol.

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Programme	Bachelor of Science	Branch/Spec.	Microbiology
Semester	VI	Version	2.0.0.0
Effective from Academic Year	2020-2021	Effective for the batch Admitted in	July-2018
Subject code	BMIC6AAM	Subject Name	Analytical and Applied Microbiology

Teaching scheme						Examination scheme (Marks)			
(Per week)	Lecture(DT)		Practical(Lab)		Total		CE	SEE	Total
	L	TU	P	TW					
Credit	03	--	02		05	Theory	40	60	100
Hours	03	--	03	01	07	Practical	40	60	100

Pre-requisites:

Basic concepts of fermentation and other bioprocess is required.

Learning Outcome:

Students will be able to learn principles and applications of instruments used in research and industries and applied aspects of microbiology.

Theory syllabus

Unit	Content	Hrs
1	**COLORIMETERY AND SPECTROPHOTOMETRY:** - Principle, Instrumentation Method and Application of - UV-Visible Spectroscopy, Atomic Absorbtion Spectroscopy, Flame Photometry, Infra-Red Spectroscopy, Mass Spectroscopy (for Protein Characterization & Identification).	11
2	**ELECTROPHORESIS**: - Electrophoresis: Principle, Support Media, Methods and Applications of electrophoresis, Separation of protein and nucleic acids (PAGE, SDS-PAGE, Agarose and IEF).	11
3	**CHROMATOGRAPHY**: - Introduction, Definition and Types of Chromatography, General Principles Underlying Chromatographic techniques. Working and Applications of: Thin Layer Chromatography, Adsorption chromatography, Ion Exchange Chromatography, Molecular Sieve Chromatography, Gas Liquid Chromatography, HPLC, Affinity Chromatography.	11
4	**APPLIED MICROBIOLOGY:** - Principle, Method and application of Bioleaching. - MEOR. - Bioremediation approaches. - Biofertilizer and Bioinsecticides. - Biofuels.	12

Reference Books

1	Principles and techniques of Practical biochemistry - Wilson and Walker.
2	Biotechnology and Genetic Engineering - P.K. Gupta.
3	Biophysical chemistry - principles and techniques - Upadhyay, Upadhyay and Nath.
4	Instrumental methods of chemical analysis - Chatwal and Anand.
5	Biochemistry - Zubay, G. L.

6	Atlas RM and Bartha R. Microbial Ecology: Fundamentals & Applications. Benjamin/Cummings Science Publishing, USA.
7	Madigan MT, Martinko JM and Parker J. Brock Biology of Microorganisms, Pearson/ Benjamin Cummings.
8	Maier RM, Pepper IL and Gerba CP. Environmental Microbiology. Academic Press.
List of Practicals	
1	Determination of Lambda max.
2	Paper chromatography.
3	Thin layer chromatography.
4	Separation of components of India ink by paper electrophoresis.
5	Resolution and visualization of proteins by Polyacrylamide Gel Electrophoresis (SDS-PAGE).
6	Demonstration of HPTLC.
7	Demonstration of HPLC.

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Programme	Bachelor of Science	Branch/Spec.	Microbiology
Semester	VI	Version	2.0.0.0
Effective from Academic Year	2020-2021	Effective for the batch Admitted in	July-2018
Subject code	BMIC6BIS	Subject Name	Biostatistics

Teaching scheme						Examination scheme (Marks)			
(Per week)	Lecture(DT)		Practical(Lab)		Total		CE	SEE	Total
	L	TU	P	TW					
Credit	02	--	--	--	02	Theory	40	60	100
Hours	02	--	--	--	02	Practical	--	--	--

Pre-requisites:

Knowledge of basic mathematics up to 10 + 2 level.

Learning Outcome:

Students will learn to use mathematical statistics to study and work towards improving human health. This course will hel the students to carry out the study based on three basic principles of experimental statistics like randomization, replication and errors in designing research experiments. Graduates will understand about the development and applications of statistical methods to design biological experiments, collection and analyses of data and interpretation of results.

Theory syllabus

Unit	Content	Hrs
1	- History, Scope, Organization of Statistics in Biological research, Types of Data, Collection of data: Primary & Secondary data, Classification, Organization and Presentation of Statistical data. - Measures of central tendency and Dispersion. Measures of Skewness and Kurtosis.	15
2	- Methods of sampling, confidence level, critical region, Testing of hypothesis and standard error, large sample test and small sample test. - Problems on test of significance, t-test, chi-square test for goodness of fit and analysis of variance (ANOVA). Correlation with examples from Biological Sciences.	15

Reference Books

1	Veerbala Rastogi, Biostatistics.
2	Danial W. Biostatistics: A foundation for Analysis in Health Sciences, John Wiley and Sons Inc.
3	Forrth Jerrold H Zar. Biostatistics analysis.
4	Kothari CR. Research Methodology.

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Programme	Bachelor of Science	Branch/Spec.	Microbiology
Semester	VI	Version	2.0.0.0
Effective from Academic Year	2020-2021	Effective for the batch Admitted in	July-2018
Subject code	BMIC6MHD	Subject Name	Management of Human Microbial Diseases

Teaching scheme						Examination scheme (Marks)			
(Per week)	Lecture(DT)		Practical(Lab)		Total		CE	SEE	Total
	L	TU	P	TW					
Credit	02	--	--	--	02	Theory	40	60	100
Hours	02	--	--	--	02	Practical	40	60	100

Pre-requisites:

Basic knowledge of Immunology and Microbiological practices is required.

Learning Outcome:

Students will be able to learn management of various human diseases caused by microbes.

Theory syllabus

Unit	Content	Hrs
1	**Human Diseases** Infectious and non-infectious diseases, microbial and non-microbial diseases, Deficiency diseases, occupational diseases, Incubation period, mortality rate, nosocomial infections **Microbial diseases** Respiratory microbial diseases, gastrointestinal microbial diseases, Nervous system diseases, skin diseases, eye diseases, urinary tract diseases, Sexually transmitted diseases: Types, route of infection, clinical systems and general prevention methods, study of recent outbreaks of human diseases (SARS/Swine flu/Ebola) – causes, spread and control, Mosquito borne disease – Types and prevention.	12
2	**Therapeutics of Microbial diseases** Treatment using antibiotics: beta lactam antibiotics (penicillin, cephalosporins), quinolones, polypeptides and aminoglycosides. Judicious use of antibiotics, importance of completing antibiotic regimen, Concept of DOTS, emergence of antibiotic resistance, current issues of MDR/XDR microbial strains. Treatment using antiviral agents: Amantadine, Acyclovir, Azidothymidine. Concept of HAART. **Prevention of Microbial Diseases** General preventive measures, Importance of personal hygiene, environmental sanitation and methods to prevent the spread of infectious agents transmitted by direct contact, food, water and insect vectors. Vaccines: Importance, types, vaccines available against microbial diseases, vaccination schedule (compulsory and preventive) in the Indian context	18

Reference Books

1	Ananthanarayan R. and Paniker C.K.J. Textbook of Microbiology. University Press Publication.
2	Brooks G.F., Carroll K.C., Butel J.S., Morse S.A. and Mietzner, T.A. Jawetz, Melnick and Adelberg's Medical Microbiology, McGraw Hill Publication
3	3. Goering R., Dockrell H., Zuckerman M. and Wakelin D. Mims' Medical Microbiology. Elsevier
4	4. Willey JM, Sherwood LM, and Woolverton CJ. Prescott, Harley and Klein's Microbiology. McGraw Hill Higher Education
5	5. Madigan MT, Martinko JM, Dunlap PV and Clark DP. Brock Biology of Microorganisms. Pearson International Edition

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FACULTY OF SCIENCE									
Programme	Bachelor of Science					Branch/Spec.	Microbiology		
Semester	VI					Version	2.0.0.0		
Effective from Academic Year				2020-2021		Effective for the batch Admitted in			July-2018
Subject code	BMIC6IPR			Subject Name		Intellectual Property Rights			
Teaching scheme						Examination scheme (Marks)			
(Per week)	Lecture(DT)		Practical(Lab)		Total		CE	SEE	Total
	L	TU	P	TW					
Credit	02	--	--	--	02	Theory	40	60	100
Hours	02	--	--	--	02	Practical	--	--	--

Pre-requisites:

Basic concept regarding intellectual properties is enough.

Learning Outcome:

This will help in the understanding of patents, examples of patents granted to new as inventions, trademarks, copyright, different types of intellectual property rights. Students will know how to protect creations of innovative inventions,literary and novel products to benefit their work.

Theory syllabus

Unit	Content	Hrs
1	- Introduction to Intellectual Property: Introduction to Indian Patent Law. Types of IP: Patents, Trademarks, Copyright & Related Rights, Industrial Design, Traditional Knowledge, Geographical Indications, Protection of New GMOs; International framework for the protection of IP. - IP as a factor in R&D; IPs of relevance to Biotechnology and few Case Studies. - Introduction to GATT, WTO, WIPO and TRIPS and its related intellectual property provisions.	15
2	- Basic of Patents: Types of patents; Indian Patent Act 1970; Recent Amendments; Filing of a patent application; Precautions before patenting-disclosure/non-disclosure; WIPO Treaties; Budapest Treaty; PCT and Implications; Role of a Country Patent Office; Procedure for filing a PCT application, Patent application- forms and guidelines, fee structure, time frames; Types of patent applications: provisionaland complete specifications	15

Suggested for reading important Link

1	www.w3.org/IPR/
2	www.ipr.co.uk/IP_conventions/patent_cooperation_treaty
3	www.patentoffice.nic.in
4	www.iprlawindia.org/