ANDHRA PRADESH STATE COUNCIL OF HIGHER EDUCATION

(A Statutory body of the Government of Andhra Pradesh)

REVISED UG SYLLABUS UNDER CBCS

(Implemented from Academic Year 2020-21)

PROGRAMME: B.Sc. Microbiology

Domain Subject: **MICROBIOLOGY**

Skill Enhancement Courses (SECs) for Semester V, from 2022-23

(Syllabus with Learning Outcomes, References, Co-curricular Activities & Model Q.P. Pattern)

Structure of SECs for Semester–V

(To choose One pair from the Four alternate pairs of SECs)

Sem	*Domain Subject*	*Course*	*Name of the course*	*Hours/wk Theo+Pra*	*Credits*	*Max Marks*	*Remarks*
V	Microbiology	6A	Food and Dairy Microbiology	3+3	3+2	100+50	
V	Microbiology	7A	Environmental and Agriculture Microbiology	3+3	3+2	100+50	

OR

Sem	*Domain Subject*	*Course*	*Name of the course*	*Hours/wk Theo+Pra*	*Credits*	*Max Marks*	*Remarks*
V	Microbiology	6B	Clinical and Diagnostic Microbiology	3+3	3+2	100+50	
V	Microbiology	7B	Molecular Biotechnology, Biostatistics and Bioinformatics	3+3	3+2	100+50	

OR

Sem	*Domain Subject*	*Course*	*Name of the course*	*Hours/wk Theo+Pra*	*Credits*	*Max Marks*	*Remarks*
V	Microbiology	6C	Pharmaceutical Microbiology	3+3	3+2	100+50	
V	Microbiology	7C	Biosafety and IPR	3+3	3+2	100+50	

Note-1: For semester-V, for the domain subject Microbiology, any one of the three pairs of SECs shall be chosen as courses 6 & 7 i.e.,6A &7A or 6B & 7B or 6C&7C. The pair shall not be broken (ABC allotment is random, not on any priority basis).

Note-2: One of the main objectives of skill enhancement courses (SEC) is to inculcate skills related to the domain subject in students. The syllabus of SEC will be partially skill

oriented. Hence, teachers shall also impart practical training to students on the skills embedded in syllabus citing related real field situations.

Note-3: Syllabi of theory, practical's and skill oriented Field training and others inclusion of unit tests together shall be completed in 90 hours(Hours:90 hrs- Teaching: 50 hrs., Labs: 30 hrs., Field training: 05, others incl. unit tests: 05hrs.)

A.P. STATE COUNCIL OF HIGHER EDUCATION

Semester-wise Revised Syllabus under CBCS, 2020-21

Semester-V (Electives)

(Skill Enhancement Course -Credits: 05)

COURSE 6A: FOOD AND DAIRY MICROBIOLOGY

I THEORY TOTAL HOURS: 50
CREDITS: 3

A. Learning outcomes

LO1: Understanding the key concepts in food and dairy microbiology
LO2: Emphasizing the role of intrinsic and extrinsic factors on growth and survival of microorganisms in food and dairy industries
LO3: Enumerating the various methods of isolation, detection and identification of microorganisms employed in food and dairy industries
LO4: Identifying the types and nature of food spoilage caused by microorganisms
LO5: Developing principles and methods for the microbiological examination and preservation of foods
LO6: Perception of food safety regulations and the rationale use of standard methods and procedures for the microbial analysis of food and dairy products.

B. SYLLABUS

UNIT – 1 **No. of Hours:10**

Microbiology of foods: Foods as a substrate for microorganisms, Intrinsic and extrinsic parameters that affect the microbial growth in food. Survival of microbes in foods. natural flora and source of contamination of foods in general. Identification of specific groups – Bacteria, Viruses, Fungi and Protozoa. Food sanitation and control.

UNIT – II **No. of Hours:10**

Microbial spoilage of food: Spoilage of canned foods, cereals, fruits, vegetables, bread, eggs, meat and fish. Food intoxication -Staphylococcal poisoning, botulism, Food infection – Salmonellosis, Shigellosis, Mycotoxins produced by fungi - Aflatoxins in stored food and grains.

UNIT – III **No. of Hours:10**

Principles of food preservation -Methods of food preservation- Physical methods-high temperature, canning, freezing, dehydration, and radiation. chemical methods- salt, sugar, organic acids, SO2, nitrite and nitrates, ethylene oxide, antibiotics and bacteriocins Organic acids, nitrates and cresols. Food processing- Thermal processing, Chemical processing (Sugar, Salt, Smoke, acid and chemicals). Packaging materials

UNIT - IV **No. of Hours:10**

Fermented Foods: Dairy starter cultures, fermented dairy products: yogurt and cheese (Types and Production), other fermented foods: acidophilus milk, kumiss, kefir, dahi, dosa, sauerkraut, soy sauce and tampeh, Microorganisms as food – single cell protein, yeast, algae and fungal organisms. Mushrooms:Types and cultivation, Probiotics: Health benefits, types of microorganisms used, probiotic foods available in market.

UNIT – V **No. of Hours: 10**

Dairy Microbiology (Skill-based unit): Physical and chemical properties of milk, Microorganisms in milk, Sources of microbial contamination of milk - milch animal, utensils and equipment, water, milking environment. Methods of preservation of milk and milk products: Pasteurization, sterilization, dehydration.Fermentation in milk: Souring, lactic acid fermentation and proteolysis.

C. REFERENCE

1. Beety C. Hobbs, Food Microbiology, Arnold-Heinemann Publishing Private Limited, New Delhi
2. Hammer B.W and Babal, Dairy Bacteriology, Prentice Hall Incorporated, London.
3. Jay J.M., Modern Food Microbiology, CBS Publishers and Distributors, New York
4. Pelczar M.J., Chan E.C.S and Krieg N.R., Microbiology, McGraw Hill Book Company, New York
5. Salle A.J., Fundamental Principles of Bacteriology, Tata McGraw-Hill Publishing Company Limited, New Delhi.
6. Varnam A.H. and Evans M.G., Foodborne Pathogens, Wolfe Publishing House, London
7. M.P. Dayle et al, 2001, Food Microbiology: Fundamentals & Frontiers, 2nd edition, ASM press.
8. Adams, M.R. and Moss M.O. 1995, Food Microbiology, Royal Society of Chemistry Publication, Cambridge.
9. Frazier W.C. and West haff D.C,1988, Food Microbiology, Tata Mc.Graw Hill Publishing Company Limited, New Delhi.
10. Stantury, P.F., Whitekar, A. and Hall, S.J., 1995, Principles of Fermentation Technology.
11. Banwart, GJ, 1989, Basic Food Microbiology, CBS Publishers and Distributors, Delhi
12. Hobbs BC and Roberts.D, 1993, Food Poisoning and Food Hygiene, Edward Arnold (A division at Hodder and Strong ton) London.

II. PRACTICAL (LABORATORY) **Total hours: 30**
Credits: 2

A. LEARNING OUTCOMES

LO1: Developing skilled training in microbiological examination of foods
LO2: Technical expertise in quality testing of milk and milk products
LO3: Gaining hands on experience on concepts of acid fermentations
LO4: Understanding the principles involving various methods of food preservation
LO5: Emphasizing the nutritional value of Fermented foods
LO6: Identifying the methods to control spoilage of foods adopting safety regulations

B. SYLLABUS

1. Isolation and identification of microbes from infected fruits and vegetables
2. Isolation and identification of microbes from idly batter and pickles
3. Isolation and identification of microbes from home-made and commercial curd
4. Preparation of yogurt
5. Determination of microbiological quality of milk sample by MBRT
6. Estimation of fat content of milk by Gerber's method
7. Estimation of Lactose in milk
8. Estimation of Lactic acid in milk

C. REFERENCES

1.Srivastava, Handbook of Milk Microbiology.
2. Harrigan W.F., Laboratory methods in Food Microbiology.
3. Aneja, 2001, Experiments in Microbiology, Plant Pathology, Tissue Culture & Mushroom production Technology, 3rdEdition, New age international
4. Atlas R.M., Microbiology – fundamentals and applications, Macmillan Publishing Company, New York.
5. Cappuccino &Sherman, Microbiology: A laboratory manual, Benjamin cummings Science publishing, 5th edition.
6. Gopal Reddy, M.N. Reddy, D.V.R. Sai Gopal and K.V. Mallaiah, Laboratory Experiments in Microbiology, Himalaya Publishing House.

III. CO-CURRICULAR ACTIVITIES

A. MANDATORY: (Lab/field training of students by teacher)

1.For Teacher:

- Visit to any food processing centres
- Organising industrial tours to any dairy farms

2.For Student:

- Preparation of charts or models on Fermented foods, SCP, production flow charts etc.,
- Microorganisms and food – any event or curricular activity

B. SUGGESTED CO-CURRICULAR ACTIVITIES

1. Internships in dairy farms /food industries / research organizations, universities etc.
2.Seminars, Group discussions, Quiz, Debates etc.
3.Preparation of videos related to food processing techniques and protocols
4. Invited lectures and presentations on related topics by experts in the specified area.

COURSE 7A: ENVIRONMENTAL AND AGRICULTURE MICROBIOLOGY

I THEORY TOTAL HOURS: 50
CREDITS: 3

A.LEARNING OUTCOMES

LO1: Providing basic understanding of microbial diversity in the environment
LO2: Perception of Energy transfer efficiencies between tropic levels
LO3:Enumerating the role of microbes in waste management and bioremediation.
LO4: Emphasizing the role of microbes in maintaining soil profile and fertility
LO5: Insights into the role of microorganisms as biofertilizers and biopesticides
LO6: Enumerating the various classes of microbes affecting agricultural yields.

B. SYLLABUS

UNIT – 1 **No. of Hours:10**

Ecology- Basic concepts of Ecology and Environment, Ecosystem – Concept, components, food chains, food webs and trophic levels. Energy transfer efficiencies between trophic levels. Microflora of fresh water and marine habitats. Aero microflora and dispersal of microbes. Host-Microbe interactions: Mutualism, synergism, commensalism, competition, amensalism, parasitism, predation. Microbes and biogeochemical cycles - nitrogen, sulphur, carbon and phosphorus.

UNIT – II **No. of Hours:10**

Outlines of Waste management: Sources and types of solid waste, Methods of solid waste disposal (composting and sanitary landfill). Liquid waste management: Composition and strength of sewage (BOD and COD), Primary, secondary and tertiary sewage treatment. Microorganisms and pollution: methyl mercury, acid rain water, carbon monoxide. Microbial Bioremediation of common pesticides, organic (hydrocarbons, oil spills) and inorganic (metals) matter. Biofouling.

UNIT – III **No. of Hours:10**

Soil Microbiology- Microorganisms, soil structure, soil profile, Physio-chemical conditions, Microbial composition, sampling techniques, Role of Microorganisms in organic matter decomposition (cellulose, Hemicellulose, Lignin's). Rhizosphere and Phyllosphere microflora. Management of soil biota for maintaining soil fertility. Conversion of waste lands into fertile lands. Management of soil nutrients. Microbes in composting.

UNIT – IV **No. of Hours:10**

Microorganisms in Agriculture: Biofertilizers - definition, types (bacterial - Rhizobium, Azotobacter; phosphate solubilizers (PSB) - examples of Bacterial sps., BGA, Azolla; kind of association, mode of application, merits and demerits. Biopesticides - introduction, types (Bacterial - Bacillus thuringiensis, viral - NPV, fungal - Trichoderma), mode of action, factors influencing, genes involved and target pests. Mycorrhiza-Importance of mycorrhizal inoculums, types of mycorrhizae associated plants, Production and field applications of Ectomycorrhizae and VAM.

UNIT – V **No. of Hours: 10**

Contributions of G. Rangaswamy, Beijerinck, Winogradsky and Winogradsky's coloumn. Study of microbes as plant pathogens: Fungi - *Puccinia graminis, Plasmopara viticola*, *Cercospora arachidicola* Bacteria - *Xanthomonas oryzae*, *Xanthomonas campestris* Mycoplasma - sandal spike, grassy shoot Viruses - TMV (Tobacco Mosaic Virus), tomato leaf curl. Advantages, social and environmental aspects of transgenic plants (Bt crops, golden rice).

C. REFERENCE

1. Atlas RM and Bartha R. (2000). Microbial Ecology: Fundamentals & Applications. 4th edition, Benjamin/Cummings Science Publishing, USA
2. Barton LL & Northup DE (2011). Microbial Ecology. 1st edition, Wiley Blackwell, USA
3. Campbell RE. (1983). Microbial Ecology. Blackwell Scientific Publication, Oxford, England.
4. Coyne MS. (2001). Soil Microbiology: An Exploratory Approach. Delmar Thomson Learning.
5. Lynch JM & Hobbie JE. (1988). Microorganisms in Action: Concepts & Application in Microbial Ecology. Blackwell Scientific Publication, U.K.
6. Maier RM, Pepper IL and Gerba CP. (2009). Environmental Microbiology. 2nd edition, Academic Press.
7. Martin A. (1977). An Introduction to Soil Microbiology. 2nd edition. John Wiley & Sons Inc. New York & London.
8. Okafor, N (2011). Environmental Microbiology of Aquatic & Waste systems. 1st edition, Springer, New York.
9. Singh A, Kuhad, RC & Ward OP (2009). Advances in Applied Bioremediation. Volume 17, Springer-Verlag, Berlin Hedeilberg
10. Subba Rao NS. (1999). Soil Microbiology. 4th edition. Oxford & IBH Publishing Co. New Delhi.

II. PRACTICAL (Laboratory)Total hours: 30

Credits: 2

A. LEARNING OUTCOMES

LO1: Gaining skilled expertise in identification and isolation of Microorganisms
LO2: Estimating BOD of water samples
LO3: Checking water potability with suitable procedures
LO4: Acquiring skilled training in soil analysis
LO5: Understanding the microbe borne diseases affecting agricultural crops
LO6: Estimating, characterizing and identification of air flora and soil flora

B. SYLLABUS

1. Enumeration of bacteria, fungi and actinomycetes from soil
2. Enumeration and identification of rhizosphere micro flora
3. Isolation of rhizobium from root nodules.
4. Isolation of Azotobacter from soil.

5. Observation& description of any three bacterial and fungal plant diseases
6. Analysis of soil - pH, Moisture content and water holding capacity.
7. Study of air flora by Petri plate exposure method.
8. Analysis of potable water by Standard plate count
9. Determination of coliform count in water by MPN (Presumptive, confirmed and completed test).
10. Determination of Biological Oxygen Demand (BOD) of waste water samples.

C. REFERENCES

1. Aneja K.R., Experiments in Microbiology, Plant Pathology, Tissue culture and Mushroom cultivation, New Age International, New Delhi.

2. Hurst. C.J., Environmental Microbiology, ASM Press, Washington D.C

3. Mehrotra R.S., Plant Pathology, Tata McGraw Hill Publications Limited, New DelhiHurst C.J, Manual of Environmental Microbiology, 2nd Edition.

4. A practical manual of soil microbiology laboratory methods, Land and Water Division

5. Microbiology Laboratory Manual, Naveena Varghese, P.P. Joy**,** Kerala Agricultural UniversityPractical Manual for Undergraduates Microbiology by Mukesh Kumar (Author)

6. Environmental Microbiology A Laboratory Manual 2nd Edition - December 13, 2004, Authors: Ian Pepper, Charles Gerba, Jeffrey Brendecke, eBook ISBN: 9780080470511

III. CO-CURRICULAR ACTIVITIES

A. MANDATORY: (Lab/field training of students by teacher)

1.For Teacher:

- Visit to any agriculture field
- Organising awareness programmes on environmental pollution

2.For Student:

- Preparation of charts or models on biodegradable and eco-friendly mechanisms etc.,
- Encouraging pollution free practices, any event or curricular activity

B. SUGGESTED CO-CURRICULAR ACTIVITIES

1. Organizing Eco club activities to promote eco-friendly green belts
2. Promoting awareness to create a clean and pollution free environments
3.Seminars, Group discussions, Quiz, Debates etc.
4. Invited lectures and presentations on related topics by experts in the specified area
5. Visiting Agriculture farms/biodiversity parks/Forest nurseries, research institutes, universities etc.

COURSE 6B: CLINICAL AND DIAGNOSTIC MICROBIOLOGY

I THEORY TOTAL HOURS: 50
CREDITS: 3

A. LEARNING OUTCOMES

LO1: Deep understanding of the disease cyclesand their out breaks
LO2: Gaining theoretical knowledge of most common disease-causing organisms
LO3: Enumerating the methods and vehicles of disease transmission
LO4: Understanding the basics of Clinical laboratory protocols
LO5: Systematic knowledge on the pathogenesis and laboratory diagnosisof diseases
LO6: Developing insights into clinical practices and serological techniques

B. SYLLABUS

UNIT – 1 **No. of Hours:10**

Diseases- sources and types of diseases. Epidemiology of Infectious diseases, Diseases in population- Epidemic, Pandemic, Endemic diseases, Sporadic, outbreaks, Portals of Entry and Exit, Herd Immunity, Control of Disease transmission. Methods of transmission and role of biological vectors- (1) House fly (2) Mosquitoes (3) sand fly in disease transmission.

UNIT – II **No. of Hours:10**

Types of Infections –Description of pathogenesis, etiology and laboratory diagnosis of bacteraemia, blood stream infections, Respiratory tract infections (Pneumonia, Flu) Central Nervous System infections (meningitis, encephalitis) Urinary tract infections and Gastrointestinal tract infections (*E. coli and Klebsiella*). Sexually transmitted diseases: *Treponema, Neisseria.*

UNIT – III **No. of Hours:10**

Identification of organisms - microscopic examination of specimen for Bacterial pathogens – simple, differential staining, Giemsa, Leishman, Wright stains and motility. Biochemical reaction – Sugar fermentation test, antibiotic Susceptibility testing – MIC, Kirby Bauer, dilution methods. Cultural tests- IMVIC tests. Isolation and identification of viruses.

UNIT - IV **No. of Hours:10**

Clinical lab technology- Methods of collection of urine, blood, sputum, stool etc. The techniques of preservation of samples. Separation of blood plasma and serum. Blood smear preparations, E.S.R, P.C.V, Blood indices - Platelet count: BT, CT. Examination of urine: Sample collection, microscopic examination- crystals, casts, sediments, pregnancy tests. Examination of Stool - Indication, Collection, Microscopic examination and its significance

UNIT – V **No. of Hours: 10**

Serology – Antigen - antibody reactions – Agglutinations (blood grouping, WIDAL) Hemagglutination, Precipitation (VDRL), Complementation fixation test, Immunodiffusion, Immunoelectrophoretic (rocket, counter current). ELISA, RIA. Quantitative study of Antigen - Antibody precipitin reactions, Western blot analysis for HIV.

C. REFERENCE

1. Ananthanarayan R. and Paniker C.K.J. (2009) Textbook of Microbiology. 8th edition, University Press Publication
2. Brooks G.F., Carroll K.C., Butel J.S., Morse S.A. and Mietzner, T.A. (2013) Jawetz, Melnick and Adelberg's Medical Microbiology. 26th edition. McGraw Hill Publication
3. Virology, Sawant, K.C., 2005, First edition, Dominant Publishers and distributors, Delhi.
4. Subash O. Panija Textbook of Medical Parasitology, 1996. First edition. All India Publishers and Distributors Regd. 920 Poonamallee High Road, Chennai.
5. Rajesh Karyakarte and Ajith Damle (2005) Medical Parasitology, books and Allied (P)Ltd. Kolkata.
6. Jaya Ram Paniker, Textbook of Medical Parasitology, Published by 'Jaypee Brothers', 4th Edition.
7. Coloratlas, Textbook of Diagnostic Microbiology (5th Edition), edited by Eimer.W. Koneman, published by Lippinett.
8. Mosby, Diagnostic Microbiology by Bailey and Swotts, 10th Edition, published.
9. David Greenwood, Richard C.B.Slack, John.F.Peutherer, Medical Microbiology, 16th Edition.
10. SharmaJ.B., Medical Microbiology – A Clinical perspective, paras publishing.
11. Patrick R.Murray, Ken.S.Rosenthal, George.S.Kobayashi, Michael A. Ptaller, Medical Microbiology, 3rd Edition.
12. Jawetz, Melnick and Adelberg's, Medical Microbiology (2004) 23rd Edition, Mc Graw Hill.

II. PRACTICAL (LABORATORY)Total hours: 30

Credits: 2

A. LEARNING OUTCOMES

LO1: Demonstrating culture dependent studies of microbes and their diseases
LO2: Acquiring technical expertise in handling microbe under aseptic conditions
LO3: Providing hands-on experience to basic serological techniques
LO4: Performing microbial isolation and biochemical characterization of test samples
LO5: Imparting knowledge in serological testing
LO6: Handling serological kits with ease

B. SYLLABUS

1. Preparation of different media used in diagnostic Microbiology (culture media/observation): Blood Agar, Mannitol salt agar, MacConkey agar,
2. Collection of throat swabs – culturing the specimen. And laboratory examination for *streptococcus pyogenes*
3. Examination of urine for pathogenic microorganisms –collection of urine, microscopic examination of urine, Enterobacteriaceae – *Escherichia coli, Klebsiella pneumonia*
4. Mycology – Direct microscopy – cultures using Sabouraud's Dextrose agar medium, Wet mount preparations using Lactophenol cotton blue/KOH mount
5. Blood grouping and Rh typing
6. Hemoglobin estimation

7. RBC and WBC count
8. Bleeding time and Clotting time,
9. Medical Parasitology – *E. histolytica, G. lamblia, Trypanosomas, Leishmania and Plasmodium* (Permanent Slide Observation)
10. Laboratory diagnosis of common helminthes infections (permanent slide observations of Helminths' Round worm, Hook worm and Pin worm)

C. REFERENCES

1. J.G.Cappucinno and H.Sherman, Microbiology: A laboratory manual, 4th Edition.
2. K.R.Aneja, Experiments in Microbiology, Plant pathology, Tissue culture and Mushroom cultivation, 3rd Edition.
3. Bailey and Scott, Diagnostic Microbiology.
4. Sastry A.S,Bhat .S,Essentials Of Medical Microbiology
5. Murray, Rosenthal, Medical Microbiology
6. J. G Collee, A.G. Fraser, B.P Marmion,A. Simmons, Mackie & Mccartney Practical Medical Microbiology
7. Manual of Clinical Microbiology, Lenetle, E., Balows, H.A., Hausler, W.J and Shadomy J., 1985. Bethesda American Society of Microbiology.
8. Seiverd, Charles E. Hematology for Medical Technologies. 4th Ed. Lea & Febiger,U.S.,
9. CullingC.F.A. Handbook of Histopathological and Histochemical Technique – Third Edition. Butterworths. London.
10. Abdul Khader, 2003, Medical laboratory techniques,First edition. Frontline Publications, Hyderabad.
11. Godkar P.B., Text Book of Medical Laboratory Technology, 2nd Edn.2003. Bhalani Publication.
12. Subish.C.Panija, Textbook of Medical Parasitology, published by 'All India Publishers and distributors'.

III. CO-CURRICULAR ACTIVITIES

A. MANDATORY: (Lab/field training of students by teacher:

1.For Teacher:

- Visit to any hospital facilities/diagnostic centres
- Creating practical awareness on diseases-spread, prevention and control

2.For Student:

- Preparation of charts or models on notifiable diseases, epidemiological studies etc.,
- Diagnostic infrastructure or forensic case studies – any event or curricular activity

B. SUGGESTED CO-CURRICULAR ACTIVITIES

1. Internships in MLT labs/ hospital facilities/ research organizations, universities etc.
2.Seminars, Group discussions, Quiz, Debates etc.
3.Preparation of videos related to recent diagnostic techniques and forensic protocols
4. Invited lectures and presentations on related topics by experts in the specified area.

COURSE 7B: MOLECULAR BIOTECHNOLOGY, BIOSTATISTICS AND BIOINFORMATICS

I THEORY TOTAL HOURS: 50
CREDITS: 3

A. LEARNING OUTCOMES

LO1: Developing sound knowledge on procedural repertoire and strategies in gene cloning
LO2: Enumerating the versatile tools and techniques employed in Molecular biotechnology
LO3: Enlisting the applications of genetic engineering and their impact on society
LO4: Emphasizing the structural and functional analysis of rDNA recombinants
LO5: Imparting basic knowledge of biostatistical tools employed for quantitative analysis
LO6: understanding an overview on searching and alignment of biological databases in-silico

B. SYLLABUS

UNIT – 1 **No. of Hours:10**

r-DNA technology- Introduction, DNA sequencing- Maxam-Gilbert and Di-deoxy methods. Blotting techniques - Southern, Northern and western blotting. DNA finger printing, PCR-principle, types, applications. DNA Microarray technique. Restriction endonucleases and other enzymes involved in rDNA technology. Ligases- DNA ligases, ligation of fragments with cohesive ends & blunt ends; homopolymer tailing.

UNIT – II **No. of Hours:10**

Cloning strategies- Transformation, microinjection, Ballistic Gun Method, Electroporation, Liposome and Ti plasmid mediated Gene Transfer. Cloning vectors- Plasmids, Cosmids and bacteriophages, Phagemids, YACs and BACs. Construction of genomic and cDNA libraries. Selection of transformed cells. Screening methods (Genetic marker and blue white screening).

UNIT – III **No. of Hours:10**

Applications of rDNA technology-In medicine (recombinant insulin), industry (production of amylase) and agriculture (Biopesticides, Biofertilizers). Role of microorganisms in creation of transgenic animals and plants. Genetically engineered microbes for industrial applications- Biogas, Biosensors, Bioplastics, Recombinant vaccines, Golden rice. Introduction to GM crops and challenges-Bt cotton, brinjal, ELSI (Ethical, legal and social issues) of Biotechnological inventions.

UNIT - IV **No. of Hours:10**

Biostatistics: Measures of Central tendency and distribution – mean, median, mode, range, standard deviation, variance. Basic principles of Probability theory, Bayes theorem, Normal distribution, Statistical inference. Comparison of variance (F-test), t-test for comparison of

means, Chi square test. Analysis of variance (ANOVA) One way and two way. Correlation and Linear regression analysis

UNIT – V **No. of Hours: 10**

Bioinformatics-Introduction to Bioinformatics and internet, Scope of Bioinformatics. Biological databases: NCBI, EMBL. Concept of World Wide Web: HTML, HTPP. Searching sequence databases using BLAST and FASTA. Genomics- Sequencing, Assembly, annotation, comparative genomics. Proteomics- Peptide finger printing. Gene prediction – Statistical based approaches and Similarity based approaches, Molecular phylogenetics.

C. REFERENCE

1. Primrose, Modern Biotechnology, Black well scientific publication Oxford.
2. Old & Primrose, Principles of Gene Manipulation: An introduction to genetic engineering.
3. J.D. Watson et al., Recombinant DNA, Wiley scientific 7. J.M. Walker, Molecular Biology &Biotechnology, Roya society of chemistry.
4. H. Krenzer, Recombinant DNA & Biotechnology. 9. M.Schena, DNA micro arrays.
5. David Freifelder, 2008, Molecular Biology, 2nd Edition, Narosa Publishing House.
6.Daniel, 2006 , Biostatistics, Eighth Edition. John Wisely and sons.
7. Durbin, Eddy, Krogh, Mathison, Biological sequence analysis.
8. T.A. Attwood and D.J. parry – smith, 2001, Introduction of Bioinformatics.
9. David W, 2005, Bio-informatics; sequence and Genome Analysis, 2nd Edition by Mount CBS publishers

II. Practical (Laboratory) **Total hours: 30**
Credits: 2

A. LEARNING OUTCOMES

LO1: Developing practical experience in extraction of DNA
LO2: Hands on experience in restriction digestion, gel electrophoresis
LO3: Gaining skilled knowledge in performing Transformation using molecular kit
LO4: Understanding the principle and working of PCR
LO5: Demonstrating the Insilco analysis for genome annotation and gene prediction
LO6: Working on problems related to measures of t-test and chi square test

B. SYLLABUS

1. Isolation of DNA from E. coli/coconut.
2. Transformation in Bacteria using plasmid.
3. Agarose gel electrophoresis
4. Restriction digestion of DNA and Ligation of DNA molecules
5. Activity of DNase and RNase on DNA and RNA.
6. Isolation of Plasmid DNA.
7. Demonstration of PCR
8. Use of Internet/software for sequence analysis of nucleotides and proteins: Studies of public domain databases for nucleic acid and protein sequences.

9. Genome sequence analysis
10. Problems related to measures of central tendency, dispersion, t-test and chi square test.

C. REFERENCES

1. Sambrook and Russell, Molecular Cloning – A Laboratory Manual, 3rd Edition, Volumes I to III, CSHL Press.
2. Ausbel et al., 2000, Current Protocols in molecular biology.
3. R.Twyman, Advanced Molecular Biology: A concise reference, Springer.
4. Genome analysis, 2000, 4 volumes, ESHL Press.
5. Baxevanis, Bioinformatics-A Practical Guide to the Analysis of Genes and Proteins. 2 nd Edition.
6. Higgis, Bioinformatics: Seqence, structure and Data Bank: A Practical Approach.
7. A.D. Baxevaris, 1998, Bioinformatics: A practical guide to the analysis of genes and proteins, (Edited) B.F .Publication.
8.Daniel, 2006, Biostatistics, Eighth Edition. John Wisely and sons

III. CO-CURRICULAR ACTIVITIES

A. Mandatory: (Lab/field training of students by teacher)

1.For Teacher:

- Visit to any forensic labs /molecular diagnostic centres and research institutes
- Creating awareness biostatistical and bioinformatic online free tools– any event or curricular activity

2.For Student:

- Preparation of charts or models or flow charts of gene cloning strategies and applications etc.,
- Computational programming of gene and protein sequencing through NCBI websites

B. Suggested Co-Curricular Activities

1. Internships in genomic and transcriptional programmes/ research institutes/ universities
2.Seminars, Group discussions, Quiz, Debates etc.
3.Preparation of videos related rDNA technology, genomics and protein structure predictions
4. Invited lectures and presentations on related topics by experts in the specified area.

COURSE 6C: PHARMACEUTICAL MICROBIOLOGY

I THEORY TOTAL HOURS: 50
CREDITS: 3

A. LEARNING OUTCOMES

LO1: Developing insights into the hierarchy of quality control and quality in Pharma industry
LO2: Enumerating the various sterility tests practised in manufacture of medicines
LO3: Emphasizing the types of microbial spoilage and their preventive measures
LO4: Perception of rules and regulations pertaining to GMP/GLP
LO5: Understanding the basic concepts of drug discovery and designing
LO6: Enlisting the various types and production of vaccines

B. SYLLABUS

UNIT – 1 **No. of Hours:10**

Microbiological Laboratory and Safe Practices -Quality assurance, quality control definition, history and introduction. Standard Methods involved in assessment of microbial quality control. Laboratory facility design for quality control: Sterilization, disinfection and decontamination. Personnel training: Hygiene and handling techniques. Good Manufacturing practices and good laboratory practices.

UNIT – II **No. of Hours:10**

Microbial Spoilage - Types of microbial spoilage,factors affecting spoilage. Design of specialized media for identification of pathogens- raw material, water, pH. Uses of media. sample preparation from Aqueous, soluble, insoluble, medical and pasteurized materials. Selective and indicator media used in pharmaceutical and food industries. Control of microbial risk in medicines -Sterility tests, Microbial limit tests and endotoxin tests/LAL test.

UNIT – III **No. of Hours:10**

Techniques for enumeration of microorganisms: Counting methods: pour plate, spread plate, membrane filtration. Most Probable Number (MPN) and MIC. Turbidimetric methods. Staining techniques for identification bacteria and Fungi.Biochemical, molecular and immunological methods. Instruments associated in QC and QA: Principle involved, working conditions, uses and precautions of Laminar Air Flow (LAF), Autoclave, Incubator, pH meter, Colony counter, Hot air oven, Centrifuges and storage devices.

UNIT - IV **No. of Hours:10**

Introduction- History of drug design, Current approaches and philosophies in drug design, Molecular mechanisms of diseases and drug action with examples. Pharmaceutical products of microbial origin (antibiotics) animal origin (sex hormones), plant origin (Alkaloids & Morphine). Sources of Drugs- Microbial drugs, Plants as a source of drugs, *E. coli* as a source of recombinant therapeutic proteins.

UNIT – V **No. of Hours: 10**

Expression of recombinant proteins in yeasts, animal cell culture systems. Rational drug design and Combinatorial approaches to drug discovery. Drug development process- Impact of genomics and related technologies upon drug discovery: Gene chips, Proteomics, Structural genomics and Pharmacogenetics. Drug manufacturing process- Guides to good manufacturing practice. Vaccines-Traditional vaccine preparations, Attenuated and inactivated viral and bacterial vaccines, Toxoids. Peptide vaccines.

C. REFERENCE

1.W.B.Hugo & A.D. Russell, Pharmaceutical Microbiology edited, 6thEdition, BlackWell science.
2.Shanson D.C., Microbiology in clinical practice, 2nd edition, London; Wright.
3.T Sammes Ellis Horwood, topics in Antibiotic chemistry VolI to V.
4.Wulf Crueger, Biotechnology – A text book of Industrial Microbiology, 2nd Edition,Panima publishers
5. A.H .Patel,1984, Industrial Microbiology, Macmilan India Limited.
6. Coulson C.J., London; Taylor and Francis, Molecular mechanisms of drug action.
7. Denyes S.P.& Baird R.M. Chichester, Ellis Horwood, Guide to microbiologicalControl in Pharmaceuticals.
8. Murray S.Cooper, Quality control in the Pharmaceutical Industry-Edt., Vol-II,Academic press, NewYork.
9.Sydney H. Willin, Murray M. Tuckerman, William S. Hitchings IV, GoodManufacturing practices of pharmaceuticals, second Edt., Mercel Dekker NC, New york.
10.Rajesh Bhatia, Rattan lal punjani, Quality assurance in Microbiology, CBSPublisher &Distributors, New Delhi.

II. Practical (Laboratory)Total hours: 30
Credits: 2

A. Learning outcomes

LO1: Developing practical knowledge on microbiological quality testing
LO2: Acquiring skilled expertise in performing assays of antibiotics
LO3: Technical expertise on isolation and characterization of contaminated microbes
LO4: Gaining procedural acumens into antibiotic sensitivities towards test pathogens
LO5: Developing practical insights for good laboratory practices
LO6: Microbiological analysis of air and water

B. Syllabus:

1. Isolation and enumeration of bacteria from spoiled food / pharmaceutical source.
2. Quality Assurance of water by MPN method.
3. Preparation of any two selective and indicator media commonly used Q.A & Q.C
4. Microbial quality of in and around laboratory conditions.
5. Isolation and Identification of fungi by using selective media and staining procedures.
6. Identification of MIC of any one antibiotic (Penicillin/streptomycin) by tube dilution method

7. Antibiotic sensitivity by Well diffusion method-antibacterial and antifungal
8. Isolation of Actinomycetes from soil.
9. Identification of antibacterial activity of actinomycetes
10. Assay of any one antibiotic (Penicillin).

C. References

1. General Practice A Practical Manual With Cd 5Ed by Vaidya G.
2. Microbial Contamination Control In Pharmaceutical Industry by Luis Jimenez, Taylor & Francis
3. Clinical Microbiology Quality In Laboratory Diagnosis (Pb) by Stratton, Demos Medical Publishing
4. Hand book of Microbial Quality control by Rosamund. M, Baird Norman. A, Hodges and Stephen. P, Denyer. CRC press.
5. Hand book on microbiological quality control in pharmaceuticals and medical devices by Baird norman
5. Aneja, 2001, Experiments in Microbiology, Plant Pathology, Tissue Culture & Mushroom production Technology, 3rdEdition, New age international

III. Co-curricular Activities:

A. Mandatory: (Lab/field training of students by teacher:

1.For Teacher:

- Visit to any R and D research laboratories/universities/ Drug developing institutes
- Organising industrial tours to any pharma industries

2.For Student:

- Preparation of charts or models on SOPs, Documentation, production flow charts etc.,
- Laboratory safety guidelines, – any event or curricular activity

B. Suggested Co-Curricular Activities:

1. Internships in pharmaceutical industry/ research organizations, universities etc.
2.Seminars, Group discussions, Quiz, Debates etc.
3.Preparation of videos related to drug design and productiontechniques and protocols
4. Invited lectures and presentations on related topics by experts in the specified area.

COURSE 7C: BIOSAFETY AND INTELLECTUAL PROPERTY RIGHTS

I THEORY TOTAL HOURS: 50
CREDITS: 3

A. LEARNING OUTCOMES

LO1: Enlisting a wide range of safety protocols in maintenance of biological safety cabinets
LO2: Developing insights into the Role of Institutional Biosafety Committees (IBSC)
LO3: Enumerating the Biosafety rules and regulations at National and International level
LO4: Perception of the properties and limitations of patents, trade secrets and copy rights
LO5: Emphasizing the steps involved in filing of patent application filing
LO6: Understanding the international conventions in maintaining IPRs.

B. SYLLABUS

UNIT – 1 **No. of Hours:10**

Biosafety: Introduction; biosafety issues in biotechnology; Biological Safety Cabinets & their types; Primary Containment for Biohazards; Biosafety Levels of Specific Microorganisms. Biosafety Guidelines: Biosafety guidelines and regulations (National and International)

UNIT – II **No. of Hours:10**

GMOs- Concerns and Challenges; Role of Institutional Biosafety Committees (IBSC), RCGM, GEAC etc. for GMO applications in food and agriculture; Environmental release of GMOs; Risk Analysis; Risk Assessment; Risk management and communication; Overview of International Agreements - Cartagena Protocol. RES guidelines for using radioisotopes in laboratories and precautions.

UNIT – III **No. of Hours:10**

Introduction to Intellectual Property: Types of IPR, Trade secrets, Trademarks, patents, Copyright & Related Rights, Industrial Design and Rights, Geographical Indications-importance of IPR, Management of IPR, Advantages and Disadvantages. International co-operation of IPRs, legal protection of biotechnological inventions – World Intellectual Property Rights Organization (WIPO).

UNIT - IV **No. of Hours:10**

Grant of Patent and Patenting Authorities: Types of patents, properties of patents, patentability, patenting life forms and biotechnological inventions. Patent Filing Procedures; Patent licensing and agreement; Patent infringement- meaning, scope, litigation, case studies, Rights and Duties of patent owner.

UNIT – V **No. of Hours: 10**

Agreements and Treaties: International conventions, GATT, TRIPS Agreements; Role of Madrid Agreement; Hague Agreement; WIPO Treaties; Budapest Treaty on international recognition of the deposit of microorganisms; UPOV & Berne conventions; Paris Convention Treaty (PCT); Indian Patent Act 1970 & recent amendments. Intellectual properties Appellate board (IPAB).

C. REFERENCE

1. Bare Act, 2007.Indian Patent Act 1970 Acts & Rules, Universal Law Publishing Co. Pvt. Ltd., New Delhi.
2. Kankanala C (2007). Genetic Patent Law & Strategy, 1st Edition, Manupatra Information Solution Pvt. Ltd. New Delhi.
3. Mittal, D.P. (1999). Indian Patents Law, Tax mann, Allied Services (p) Ltd.
4. Singh K K (2015). Biotechnology and Intellectual Property Rights: Legal and Social Implications, Springer India.
5. Goel D & Prashar S (2013). IPR, Biosafety and Bioethics. Pearson
6.Sydney H. Willin, Murray M. Tuckerman, William S. Hitchings IV, Good Manufacturing practices for pharmaceuticals, second Edt., Mercel Dekker NC New york
7. Senthil Kumar Sadhasivam and Mohammed Jaabir, M. S. 2008. IPR, Biosafety and biotechnology Management. Jasen Publications, Tiruchirappalli, India.
8. Singh B.D.,1998, Biotechnology, Kalyani publishers, Rajinder Nagar, Ludhiana

II. PRACTICAL (LABORATORY)

Total hours: 30
Credits: 2

A. LEARNING OUTCOMES

LO1: Developing awareness of biological safety cabinets
LO2: Technical expertise in filing of patents
LO3: Understanding the guidelines of safety measures
LO4: Acquiring knowledge on QA and QC in pharma
LO5: Perception of legalities in IPR maintenance
LO6: Deep insights of case studies of IPRs and their disputes

B. SYLLABUS

1. Study of components and design of a BSL – III laboratory (models)
2. Filing applications for approval from bio safety committee (models)
3. Study of bio safety measures in pharmaceutical industry.
4. Study on QA & QC parameters followed in R&D laboratory.
5. Filing primary applications for patents
6. Study of steps of patenting process
7. A case study of patents application-Gene technology/ processes
8. A case study of Patent disputes-AMUL/kwality
9. A case study on patents of biotechnological inventions
10. A case study of copy rights-Delhi university case

A. REFERENCES

1. Hand book of Microbial Quality control by Rosamund. M, Baird Norman. A, Hodges and Stephen. P, Denyer. CRC press.
2. Guide to Microbiological Control in Pharmaceuticals and Medical Devices, Second Edition, Stephen P. Denyer, Rosamund M. Baird, CRC Press.

3. Denyes S.P. & Baird R.M. Chichester, Ellis Horwood, Guide to microbiological control in Pharmaceuticals.
4. Murray S. Cooper, Quality control in in the Pharmaceutical Industry- Edt., Vol- II, Academic press, New York.
5. Sydney H. Willin, Murray M. Tuckerman, William S. Hitchings IV, Good Manufacturing practices for pharmaceuticals, second Edt., Mercel Dekker NC Nework

III. CO-CURRICULAR ACTIVITIES

A. MANDATORY: (Lab/field training of students by teacher:

1.For Teacher:

- Working on patents & other IPRs case studies for legalities and disputes
- Organising industrial tours to any production or quality control units

2.For Student:

- Preparation of charts or models on safety measures, flow charts etc.,
- Web search for new patents and copy rights - any event or curricular activity

B. SUGGESTED CO-CURRICULAR ACTIVITIES

1. Internships in R and D wings of pharma/ research organizations, universities etc.
2.Seminars, Group discussions, Quiz, Debates etc.
3.Preparation of videos related to biological safety cabinets,techniques and protocols
4. Invited lectures and presentations on related topics by experts in the specified area.

Suggested Model Question Paper pattern for Theory Examination(s) at Semester end

Max.Time: 3 Hrs. Max. Marks: 75 M

Section – A

Answer all the following questions. (5 x 2 = 10 M)

√ One question should be given from each Unit in the syllabus.

1	
2	
3	
4	
5	

Section – B

Answer any five of the following questions.

√ Draw a labelled diagram wherever necessary (5 x 5 = 25 M)

One question should be given from each Unit in the syllabus.

1	
2	
3	
4	
5	
6	
7	
8	

Section – C

Answer any four of the following questions.

√ Draw a labelled diagram wherever necessary (4 x 10 = 40 M)

√ At least one question is to be given from each Unit in the syllabus.

1	
2	
3	
4	
5	
6	

Note: Questions should be framed in such a way to test the understanding, analytical and creative skills of the students. All the questions should be given within the frame work of the syllabus prescribed

Model Question Paper pattern for Practical Examination

Semester- V: Microbiology Skill Enhancement Course

Max.Time:3Hours Max.Marks:50

	Marks
1. Major experiment	15
2. Minor experiment	10
3. Principle and procedure	05
4. Spotters	05
5. Record	05
6. Viva-voce	10