**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)  

<table>
<thead>
<tr>
<th>Sem</th>
<th>Domain Subject</th>
<th>Course</th>
<th>Name of the course</th>
<th>Hours/wk Theo+Pra</th>
<th>Credits</th>
<th>Max Marks</th>
<th>Remarks</th>
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<tbody>
<tr>
<td>V</td>
<td>Microbiology</td>
<td>6A</td>
<td>Food and Dairy Microbiology</td>
<td>3+3</td>
<td>3+2</td>
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<td>V</td>
<td>Microbiology</td>
<td>7A</td>
<td>Environmental and Agriculture Microbiology</td>
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<tr>
<td>V</td>
<td>Microbiology</td>
<td>6B</td>
<td>Clinical and Diagnostic Microbiology</td>
<td>3+3</td>
<td>3+2</td>
<td>100+50</td>
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<tr>
<td>V</td>
<td>Microbiology</td>
<td>7B</td>
<td>Molecular Biotechnology, Biostatistics and Bioinformatics</td>
<td>3+3</td>
<td>3+2</td>
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<td>V</td>
<td>Microbiology</td>
<td>6C</td>
<td>Pharmaceutical Microbiology</td>
<td>3+3</td>
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<tr>
<td>V</td>
<td>Microbiology</td>
<td>7C</td>
<td>Biosafety and IPR</td>
<td>3+3</td>
<td>3+2</td>
<td>100+50</td>
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**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 – I

No. of Hours:10


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

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.  

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 trophic 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 – I


UNIT – II

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


UNIT – IV

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

Contributions of G. Rangaswamy, Beijerinck, Winogradsky and Winogradsky’s columnn.
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


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

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 cycles and their outbreaks
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 diagnosis of diseases
LO6: Developing insights into clinical practices and serological techniques

B. SYLLABUS

UNIT – 1

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


UNIT – III


UNIT - IV


UNIT – V

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

10. SharmaJ.B., Medical Microbiology – A Clinical perspective, paras publishing.

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
5. Blood grouping and Rh typing
6. Hemoglobin estimation
7. RBC and WBC count
8. Bleeding time and Clotting time,
10. Laboratory diagnosis of common helminthes infections (permanent slide observations of Helminths’ Round worm, Hook worm and Pin worm)

C. REFERENCES

3. Bailey and Scott, Diagnostic Microbiology.
5. Murray, Rosenthal, Medical Microbiology
6. J. G Collee, A.G. Fraser, B.P Marmion,A. Simmons, Mackie & Mccartney Practical Medical Microbiology
8. Seiverd, Charles E. Hematology for Medical Technologies. 4th Ed. Lea & Febiger,U.S.,

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 – I

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

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

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

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


C. REFERENCE

1. Primrose, Modern Biotechnology, Black well scientific publication Oxford.
7. Durbin, Eddy, Krogh, Mathison, Biological sequence analysis.

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 Insilico 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

C. REFERENCES

4. Genome analysis, 2000, 4 volumes, ESHL Press.

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 THEOREY

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

UNIT – II  No. of Hours:10

UNIT – III  No. of Hours:10

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


C. REFERENCE

3. T Sammes Ellis Horwood, topics in Antibiotic chemistry Voll to V.
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
5. Hand book on microbiological quality control in pharmaceuticals and medical devices by Baird norman

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 production techniques 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


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


II. PRACTICAL (LABORATORY)

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
9. A case study on patents of biotechnological inventions
10. A case study of copy rights-Delhi university case

A. REFERENCES


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. \((5 \times 2 = 10 \text{ M})\)

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

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Section – B

Answer any five of the following questions.

√ Draw a labelled diagram wherever necessary \((5 \times 5 = 25 \text{ M})\)

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

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Section – C

Answer any four of the following questions.

√ Draw a labelled diagram wherever necessary \((4 \times 10 = 40 \text{ M})\)

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

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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**

<table>
<thead>
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<th>Max. Time: 3 Hours</th>
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<td>2. Minor experiment</td>
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<tr>
<td>3. Principle and procedure</td>
<td>05</td>
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<td>4. Spotters</td>
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<td>5. Record</td>
<td>05</td>
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<tr>
<td>6. Viva-voce</td>
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