B.Sc. SEM V Microbiology

Skill Enhancement Courses (SEC) (Any One)

1. Microbial Diagnosis in health Clinics
2. Food Fermentation Techniques

Course Code ……..	**Paper – I**	**Marks: 30**
Credits: 2		**Total Hours :48**

Microbial Diagnosis in health Clinics

Objective: To make the students to understand the fundamentalknowledge of clinical diagnosis of microbial disease.

UnitNo.	Content	Hrs
1	**Introduction to disease diagnosis and sample collection** A) Common diseases and their causative agents: Typhoid, cholera, malaria and AIDS. Causative agents: Bactria, viruses, parasites, fungi and sporozoites. B) Collection and processing and of clinical samples: Blood, Urine, Sputum, CSF and Faeces.	3
2	**Laboratory Diagnosis–I** A) Steps in disease diagnosis: Microscopy, smear preparation, staining and staining types-Grams staining, acid fast staining. B) Cultivation of microorganisms: preparation of nutrient media-Nutrient agar, Blood agar, salmonella shigella agar, EMB agar and McConkey's agar, Inoculation and incubation in brief.	3
3	**Laboratory Diagnosis – II** A) Serology- definition and role of serum, plasma, serological methods- Agglutination, precipitation, common tests- WIDAL test, VDRL test and ELISA test. B) Rapid disease diagnosis tests and kits-HIV, Dengue kit, swine flu kit.	3
4	**Action of antibiotic study** A) Introduction to antibiotics: Definition, source, common antibiotics- Penicillin and ampicillin, action of antibiotics in brief. B) Methods of antibiotic sensitivity and resistance detection: sensitivity, resistance sensitivity test- Disc diffusion, MIC.	3

B.Sc. SEM V Microbiology

Skill Enhancement Courses (SEC)

Course Code ……..	**Paper – II**	**Marks: 30**
Credits: 2		**Total Hours :48**

Fermented Food and Microbial Quality Control in Food

Objective: To make the students to understand the fundamentalknowledge of Food Fermentation Techniques

UnitNo.	Content	Hrs
1	**Fermented Food**	3
	A) Fermented Foods – Definitions, types, advantages and health benefits. **B)** Probiotic foods - Definitions, types, Microorganisms and health benefits.	
2	**Types of Fermented Food**	3
	Milk based fermented food – Examples and production process of Dahi. Grain based fermented food – Examples and production process of Idli. Vegetable based fermented food – Examples and production process of Pickel. Fermented Meat and Fish – Types and Microorganism involved.	
3	**Microbial Analysis of Food**	3
	Determining Microbes in Food : Culture and Microscopic Methods – Standard Plate Count, Most Probable Number, Direct Microscopic Count, Enrichment Culture Technique, Selective Media, MBRT, Rapid detection methods of microbiological quality at milk collection centers.	
4	**Microbial Standards**	3
	HACCP for food safety and Microbial Standards – Hazard analysis of critical control point (HACCP) – Principles, flow diagram, limitations Microbial Standards for different foods and water – BIS standards for common foods and drinking water	

B.Sc. SEM V Microbiology

Discipline Elective Course (DSE) (Any Two)

1. **Medical Microbiology**
2. **Bioinstrumentation**
3. **Virology**
4. **Pharmaceutical Microbiology**

Course Code ……	**DSE-1**	**Marks: 50**
Credits: 2		**Total Hours :48**

Medical Microbiology

Objective: To make the students to understand the fundamentalknowledge of Medical Microbiology.

UnitNo.	Content	Hrs
1	**Host-Parasite Relationship** a. **Infection**: Definition, types of infections, primary infection, Secondary infection, Acute and chronic infection, Local and systemic infection, Fulminating infection, Nosocomial infection, Iatrogenic infection, Teratogenic infection, Congenital infection, Bacteremia, Septicemia, Pyaemia, Sapremia, Toxemia, Viremia b. **Disease** : Definition and example of Disease, Sign, Symptom, Syndrome, Types of disease – Infectious & noninfectious disease, Epidemic, Endemic, Pandemic, Prosodemic, Sporadic, Exotic, Venereal, Zoonotic, Epizootic, Exotic c. **Stages of Infectious disease**- Incubation period, Prodromal phase, invasive phase, decline phase, convalescence. d. **Normal flora of human body**- characteristic of normal flora, beneficial and harmful effects of normal flora, Normal flora of skin, respiratory tract, digestive tract, urino-genital tract,	**12**
2	**Dynamics of Disease Transmission and Control** **a.** Diseases of skin, eye, digestive tract, respiratory tract, urinary tract, reproductive system, nervous system, cardiovascular and lymphatic system (only list with causative organism). **b. Sources/reservoir of infections**- endogenous sources, exogenous sources, case, carriers, animals, insect, non-living sources. **c. Portals of exit, Portals of entry**. **d. Modes of transmission**- Contact, Vehicle, Vector, airborne, Trans-placental, Laboratory, Hospital. **e. Control of communicable diseases** - different methods.	**12**
3	**Microbial Mechanism of Pathogenicity** **a. Pathogenicity and Virulence, difference** b. **Variation of virulence**, Exaltation, Attenuation, methods of attenuation. c. **Virulence determining factors** i) Infectivity – MID, MLD, ID50, LD50 d. **Invasiveness**, factors responsible (aggresins) e. **Toxigenicity** – Exotoxin, Endotoxin, comparison, enterotoxin. f. Vaccine and toxoid, types	**12**
4	**Microbial Diseases of Human** Epidemiology, Pathogenesis, laboratory diagnosis, Treatment and Prevention of following diseases. i. Typhoid ii) Tuberculosis iii) Malaria iv) Dengue virus v) AIDS vi) Hepatitis A vii) Candidiasis	**12**

B.Sc. SEM V Microbiology

Discipline Elective Course (DSE)

Course Code ……	**DSE-2**	**Marks: 50**
Credits: 2		**Total Hours :48**

Bioinstrumentation

Objective: To make the students to understand the fundamental knowledge of bio instruments and analytical techniques.

UnitNo.	Content	Hrs
1	**Spectrophotometry** a. Concept of electromagnetic radiation, spectrum of light, b. Concept of chromophores, extinction coefficient c. Beer's law and its deviations, Difference between spectrophotometer and colorimeter. d. Basic principle, Instrumentation and Application - UV and visible Spectrophotometer, IR Spectrophotometer and Mass spectrophotometer.	12
2	**Chromatography** a. Partition principle, partition coefficient, Nature of partition forces. b.Adsorption Chromatography - Methods of paper chromatography, Thin layer chromatography and their Application d. Column Chromatography - Basic principle, method and application of - Gel filtration, Ion-exchange, and Affinity chromatography. d. Basic principles of HPLC and Gas Chromatography	12
3	**Electrophoresis and Blotting** a. Electrophoresis- Migration of ions under electric field, factors affecting electrophoretic mobility, b. Paper electrophoresis, cellulose acetate electrophoresis, Immunoelectrophoresis. c. Gel electrophoresis-Types of gels, solubalizers, procedure, and application d. SDS-PAGE electrophoresis- principle, procedure and applications. e. Blotting technique-Southern blotting, Northern blotting, Western blotting, Immunoblotting.	12
4	**Centrifugation and Radioactivity** a. Centrifugation - Basic principles, concept of RCF, Sedimentation coefficient, factors affecting sedimentation velocity. b. Types of centrifuges- Ultracentrifuge (Preparative and Analytical), Density gradient centrifugation (Rate zonal and Isopynic) and their application. c. Radioactive and stable isotopes, units of radioactivity, isotopic tracer techniques and Application in biology. d. Measurement of radioactivity- GM counter and Scintillation counter e. Radioactive labeling and Autoradiography.	12

Practical Course for Semester V (Paper I and II)

1. *Laboratory diagnosis of i) E.coli ii) P. vulgaris iii) S. typhi

2. *Isolation and detection of S. aureus from pus sample.

3. To study normal flora of skin and oral cavity.

4. Detection of Malaria parasite from blood sample.

5. Detection of Chikungunia and Dengue fever (demonstration only)

6. *Determination of Minimum Inhibitory Concentration (MIC) of Antibiotics.

7. *Estimation of Blood sugar by GOD-POD method

8. *Liver function test - SGOT and SGPT

9. Kidney function test- Creatinine , Urea

10. Detection of Bilirubin.

11. *Estimation of Blood cholesterol.

12. Estimation of blood urea by Diacetylmonoxime method (DAM)

13. *Paper chromatography of amino acids/sugars.

14. *TLC of lipid/amino acids.

15. Demonstration of separation of components by paper electrophoresis

16. Separation of protein by SDS-PAGE (Sodium dodecyl sulfate-Polyacrylamide gel electrophoresis)

17. Blotting of DNA by Southern Blotting technique

Note: 1. Underlined experiments are treated as major experiments. 2. Students should perform at least 4 major and 6 minor experiments 3. Practicals with asteric mark are compulsory.

Distribution of marks during practical examinations of B.Sc. Semester V

1. One major experiment-	10
2. Two minor experiment-	2 X 5 = 10
3. Viva voce-	5
4. Practical record-	5
Total	30

(Duration of Practical exam will be 10 hrs.)

Books Recommended for Theory& Practical Microbiology B.Sc. Sem. V (P I & II)

1. Ananthnarayan and Panikars ,Textbook of Microbiololgy(8th edition), University Press, Hyderabad
2. JayaramPaniker CK (2004). Text book of Medical Parasitology. Fifth edition, Jaypee Brothers Medical Publishers (P) Ltd., New Delhi.
3. Essentials of Medical Microbiology. 4th Edition. Rajesh Bhatia. JAYPEE Publisher
4. Tortora G.J., Funke B.R., Case C.L.(2006). Microbiology: an Introduction. 8th edition. Pearson Education Inc.
5. Powar and Daginawala General Microbiology Vol.I&II(Himalaya Publication)
6. Dubey R. C. and Maheshwari D.K. Text Book of Microbiology, S. Chand Publishe
7. Pelzar, Chan and Kreig, Microbiology 5th edition, TMH Publishe
8. Frobisher , Hindsdill et al., Fundamentals of Microbiology : W.B. Saunders Company, 7th edition USA, Topman co. Ltd. Japan
9. Stainer, Roger et al., General Microbiology
10. Atlas R.A. Microbiology- Fundamental and Applications, Macmillan
11. Salle A.J. Fundamental Principles of Bacteriology, Tata McGraw-Hill Publishing Co. Ltd, New Delhi.
12. Brock T.D. and Madigan M.T. Biology of Microorganisms, Prentice Hall of India Private Limited
13. Alcamo, Fundamentals of Microbiology
14. Purohit, Microbiology fundamentals and applications
15. Davis, Dulbecco, Microbiology
16. Thomas , Clinical Microbiology, University Press, Hyderabad
17. Ramkrishnan, Textbook of Medical Biochemistry University Press, Hyderabad
18. Medical Microbiology and parasitology , Day and Day, Himalaya Publisher
19. Manual of Practical Microbiology and Parasitology, P. Chakroborty. NCBA, Kolkata
20. Upadhyay&Nath, Biophysical Chemistry,Himalaya publishing house,New Delhi, 2009
21. Bajpai PK (2010). Biological Instrumentation and Methodology. Revised edition, S.Chand& Co. Ltd., New Delhi.
22. Palanivelu P (2004). Analytical Biochemistry and Separation techniques. Third edition, MKU Co-op, Press Ltd., Palkalai Nagar, Madurai.
23. Subramanian MA (2005). Biophysics – Principles and Techniques. First edition, MJP Publishers, A Unit of Tamil Nadu Book House, Chennai
24. Aneja KR (2005). Experiments in Microbiology, Plant pathology and Biotechnology. Fourth edition, New Age International Publishers, Chennai.
25. Dubey RC and Maheswari DK (2004).Practical microbiology First edition, S Chand and Company Ltd., New Delhi.
26. James G Cappuccino and Natalie Sherman (2004). Microbiology: A laboratory manual. Sixth edition, Published by Pearson Education
27. Jayaraman., Lab Manual in Biochemistry
28. David T. Plummer, An Introduction to Practical Biochemistry
29. Curikshank, Medical Microbiology 10. Parasitology, Chatterjee

B.Sc. SEM V Microbiology

Discipline Elective Course (DSE)

Course Code ……	**DSE-3**	**Marks: 50**
Credits: 2		**Total Hours :48**

Virology

Objective: To make the students to understand the fundamentalknowledge of Virology

UnitNo.	Nature and Properties of Viruses	Hrs
1	Introduction: Discovery of viruses, nature and definition of viruses, general properties, concept of viroids, virusoids, satellite viruses and Prions. Structure of Viruses: Capsid, Helical and Icosahedra symmetry. Cultivation of viruses, Isolation and purification of Virus.	12
2	**Taxonomy, Bacteriophage and Virus replication**	12
	Viral taxonomy: Classification and nomenclature of different groups of viruses. lytic and Lysogenic phages (lambda phage). Modes of viral transmission: Persistent, non-persistent, vertical and horizontal Salient features of viral Nucleic acid: Unusual bases (TMV, T4 phage), overlapping genes (ϕX174, Hepatitis B virus), alternate splicing (HIV), terminal redundancy (T4 phage), terminal cohesive ends (lambda phage), partial double stranded genomes (Hepatitis B).	
3	**Oncogenic Virus and Application of Virology**	12
	Introduction to oncogenic viruses, Types of oncogenic DNA and RNA viruses: Concepts of oncogenes and proto-oncogenes. Use of viral vectors in cloning and expression, Gene. Antiviral compounds and their mode of action, Interferon and their mode of action.	
4	**Prevention & control of viral diseases**	12
	Prevention and control of viral diseases- SARS-CoV, MERS-CoV and nCoV-19, influenza and hepatitis virus.General principles and types of viral vaccines.	

VIROLOGY (PRACTICAL) – DSE 3

1. Study of the structure of important animal viruses (rhabdo, influenza, paramyxo hepatitis B and retroviruses) using electron micrographs.
2. Studying isolation and propagation of animal viruses by chick embryo technique.
3. Study of cytopathic effects of viruses using photographs.
4. Perform local lesion technique for assaying plant viruses.
5. 5. Study of the structure of important plant viruses (caulimo, Gemini, tobacco ring spot, cucumber mosaic and alpha-alpha mosaic viruses) using electron micrographs
6. 6. Study of the structure of important bacterial viruses (ϕX 174, T4, λ) using electron micrograph.
7. Isolation and enumeration of bacteriophage (PFU) from water/sewage sample using double agar layer technique.

Distribution of marks during practical examinations of B.Sc. Semester V

1. One major experiment-	10
2. Two minor experiment-	2 X 5 = 10
3. Viva voce-	5
4. Practical record-	5
Total	30

(Duration of Practical exam will be 10 hrs., 5 hrs. each for two consecutive days)

Books Recommended for Theory& Practical For Virology

1. Dimmock, NJ, Easton, AL, Leppard, KN (2007). Introduction to Modern Virology. 6th edition, Blackwell Publishing Ltd.
2. Carter J and Saunders V (2007). Virology: Principles and Applications. John Wiley and Sons.
3. Flint SJ, Enquist, LW, Krug, RM, Racaniello, VR, Skalka, AM (2004). Principles of Virology, Molecular biology, Pathogenesis and Control. 2nd edition. ASM press Washington DC.
4. Levy JA, Conrat HF, Owens RA. (2000). Virology. 3rd edition. Prentice Hall publication, New Jersey.
5. Wagner EK, Hewlett MJ. (2004). Basic Virology. 2nd edition. Blackwell Publishing.
6. Mathews. (2004). Plant Virology. Hull R. Academic Press, New York.
7. Nayudu MV. (2008). Plant Viruses. Tata McGraw Hill, India.
8. Bos L. (1999) Plant viruses-A text book of plant virology by. Backhuys Publishers.
9. Versteeg J. (1985). A Color Atlas of Virology. Wolfe Medical Publication.

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B.Sc. SEM V Microbiology

Discipline Elective Course(DSE)

Course Code ……	**DSE-4**	**Marks: 50**
Credits: 2		**Total Hours :48**

PHARMACEUTICAL MICROBIOLOGY

Objective: To make the students to understand the fundamentalknowledge of Pharmaceutical Microbiology

UnitNo.	Content	Hrs
1	**Phytopharmaceuticals** Introduction – Overview of products, classification of pharmacologic agents based on chemistry and source. Phytopharmaceuticals: screening tests for phytoconstituents – alkaloids and terpenoids. Three examples of commercial natural products from marine and terrestrial organisms.	12
2	**Drug Development** Drug development: Biology guided fractionation methods: in vitro assay systems based on enzymes, tissue, and organ or growth inhibition. Animal models: transgenic animals, cell lines. Antimicrobial activity studies (antibacterial, antiviral, antifungal and antiparasitic activities).	12
3	Gene Therapy and Vaccines Gene therapy: general introduction, ex vivo and in vivo gene therapy, potential targets for gene therapy, inherited disorders. Vaccine design and production, classification, genetically recombinant vaccines, advantages and disadvantages – examples, DNA vaccines – principles and mechanism. Immunologicals: Antisera – hyper immune gamma globulin – monoclonal antibodies – uses. Recombinant proteins: strategies and genetic manipulations for overproduction of biomolecules	12
4	**Probiotics and Neutrachemicals** Other biomolecules: Probiotic and neutraceuticals – economic and legal considerations in pharmaceutical biotechnology: FDA guidelines – preclinical trials, acute, sub-acute, chronic and teratogenic studies. Clinical trials – Phases I, II, III and IV. ICMR guidelines for design and conduct of clinical trials, licensing and drug control.	12

PHARMACEUTICAL MICROBIOLOGY (PRACTICAL) – DSE 4

1. Preparation of medicinal plant extracts.
2. Sterility testing of vaccines and injections.
3. Antibacterial activity of antibiotic preparations.
4. Antifungal tests.
5. Estimation of thiamine, riboflavin, ascorbic acid content of multivitamin formulations.
6. MIC- by broth and agar dilution method.
7. Phenol co-efficient test.
8. Proteolytic digestion of antibodies.
9. Analysis of digested fragments.
10. Visit to a vaccine production unit and observe the unit operation procedures

Distribution of marks during practical examinations of B.Sc. Semester V

1. One major experiment-	10
2. Two minor experiment-	2 X 5 = 10
3. Viva voce-	5
4. Practical record-	5
Total	30

(Duration of Practical exam will be 10 hrs., 5 hrs. each for two consecutive days)

Books Recommended for Theory& Practical Pharmaceutical Microbiology

1. Pharmaceutical Microbiology Principles And Application by Dr Chandrakant KokareNirali Prakashan.

Course Code ……Paper - IMarks: 30	
Credits: 2	**Total Hours :12**

2. “Pharmaceutical Microbiology” by Reddy A Venkateswara.

3. “Pharmaceutical Microbiology” by Ashutosh Kar.

4. “A Textbook of Pharmaceutical Microbiology” by Prahlad Singh Mehra.

5. “Hugo and Russell’s Pharmaceutical Microbiology” by Stephen P Denyer and Norman Hodges.

6. “Pharmaceutical Microbiology 1” by Sheth Z P.

7. “Pharmaceutical Microbiology” by Dr Chandrakant Kokare.

8. “Pharmaceutical Microbiology: Essentials for Quality Assurance and Quality Control” by Tim Sandle.

9. “Pharmaceutical Microbiology” by Gujar K.

10. “Pharmaceutical Microbiology” by Sneha Sardana.

B.Sc. SEM VI Microbiology

Skill Enhancement Courses (SEC) (Any One)

1. Biofertilizers and Biopesticides
2. Mushroom and Spirulina Cultivation

Biofertilizers and Biopesticides		
Objective: To make the students to understand the fundamentalknowledge of Biofertilizers and Biopesticides.		
UnitNo.	**Content**	**Hrs**
1	**Biofertilizers** A) General account of the microbes used as biofertilizers (any one) for various crop plants and their advantages over chemical fertilizers. B) Symbiotic N2 fixers: Rhizobium - Isolation, characteristics, types, inoculum production and field application, legume/pulses plants	**3**
2	**Non Symbiotic Nitrogen Fixers** C) Free living Azotobacter- free isolation, characteristics, mass inoculums, production and field application.	**3**
3	**Phosphate Solubalizers** A) Phosphate solubilizing microbes (any one) - Isolation, characterization, mass inoculum production, field Application. B) Mycorrhizal Biofertilizers: Importance of Mycorrhizal inoculum, types of Mycorrhizae and associated plants, Mass inoculum production of VAM, field applications of Ectomycorrhizae and VAM.	**3**
4	**Bioinsecticides** A) General account of microbes used as bioinsecticides and their advantages over synthetic pesticides, Bacillus thuringiensis, production, Field applications.	**3**

Practicals for Paper I

1. Soil Sample collection for isolation of agriculturally important micro-organism
2. Identification and characterization of Micro-organism used for Biofertilizer production
3. Small scale production of Bio-inoculants in Laboratory
4. Efficacy check of developed inoculants by using Pot experiment and its comparison with already available commercial Biofertilizers

5. Visit to Biofertilizers Production Unit/ Industry

Suggested Reading for Paper I

1. Kannaiyan, S. (2003). Bioetchnology of Biofertilizers, CHIPS, Texas.
2. Mahendra K. Rai (2005). Hand book of Microbial biofertilizers, The Haworth Press, Inc. New York.
3. Reddy, S.M. et. al. (2002). Bioinoculants for sustainable agriculture and forestry, Scientific Publishers.
4. Subba Rao N.S (1995) Soil microorganisms and plant growth Oxford and IBH publishing co. Pvt. Ltd. NewDelhi.
5. Saleem F and Shakoori AR (2012) Development of Bioinsecticide, Lap Lambert Academic Publishing GmbH KG
6. Aggarwal SK (2005) Advanced Environmental Biotechnology, APH publication.

B.Sc. SEM VI Microbiology

Skill Enhancement Courses (SEC)

Course Code ……	Paper - II Marks: 30	
Credits: 2		**Total Hours :12**
Mushroom and Spirulina Cultivation		
Objective: To make the students to understand the fundamentalknowledge of Food Fermentation Techniques		
UnitNo.	**Content**	**Hrs**
1		**3**
	Edible and non-edible mushroom, historical account, most commonly cultivated mushroom in the world, distribution and production in various countries. Cultivation of button, oyster and paddy straw mushroom, raising a pure culture, spawn preparation and mass cultivation, harvest pests diseases in mushroom.	
2		**3**
	Economics of mushroom cultivation, precaution of mushroom cultivation, precaution to be taken while selecting the area, spawn preparation, spawn run, duringcropping harvesting etc. mushroom recipes -western and Indian recipes, pickles, powder and jams.	
3		**3**
	Introduction to SCP production- historical use and rediscovery of Spirulina importance, morphology, taxonomy and habitat of Spirulina, biochemical composition including proximate composition, amino acids, unsaturated fatty acids, Minerals and vitamins. Human health benefits of Spirulina.	
4	**Microbial Standards**	**3**
	Natural production, laboratory cultivation, small production commercial and mass cultivation (tank construction, culture medium, strain selection, scaling up of the process), importance of light and pH in Spirulina cultivation, harvesting, drying and packing.	

Practicals for Paper II

1. Spawn preparation of mushroom

2. Lab scale cultivation of button mushroom.

3. To check disease in mushroom

4. Preparation of mushroom powder

5. To study the morphology of Spirulina

6. Lab Scale production of Spirulina

7. Visit to mushroom cultivation plant.

8. Visit to Spirulina cultivation plant.

B.Sc. SEM VI Microbiology

Discipline Elective Course (DSE) (Any Two)

2. **Recombinant DNA Technology**
3. **Bioinformatics**
2. **Immunology**
4. **Microbes in sustainable Agriculture**

Practical Course for Semester VI (Paper I) Marks: 30

Course Code ……DSE-1Marks: 50		
Credits: 2		**Total Hours :48**
Recombinant DNA Technology		
Objective: To make the students to understand the fundamentalknowledge of Genetic engineering and Recombinant DNA Technology.		
UnitNo.	**Content**	**Hrs**
1	**Tools of Genetic Engineering** **A) DNA Cutting Enzymes –** Endonuclease, Exonuclease, Restriction Enzymes – Types and Nomenclature. **B)DNA modifying enzymes –** Liagases, Alkaline Phosphatase, DNA Polymerase, Reverse transcriptase, Polynucleotide Kinase, Terminal Transferase, DNase and RNase. **C) Cloning Vectors –** Features of cloning vectors (Site of cloning, Marker Gene, Reporter Gene, Expression Elements). **D) Types of cloning vectors** – Bacterial vectors (pBR322, pUC18), Bacteriophage vectors (Lambda), Plant vector (Ti Plasmid), Artificial Chromosome vectors (YAC, BAC), Shuttle vectors and Expression vectors.	**12**
2	**Techniques of Genetic Engineering** **A) Methods of DNA isolation** - Isolation of Genomic and Plasmid DNA, Determination of purity and concentration of DNA. **B) Insertion of r-DNA into vector** – by Homopolymer tailing, Linkers and Adapters. **C) Methods of r-DNA transfer into host** – Gene gun, Microinjection, Lipofection, and Electroporation. **D)Methods of selection of recombinant host cells** – Insertional inactivation, Blue-White selection, Colony hybridization.	**12**
3	**Amplification and Sequence Analysis of DNA** **A)Types of Gene Libraries** – Genomic and cDNA libraries. **B) Methods of DNA sequencing** – Maxam-Gilbert, Sangers, Automated sequencer and Express sequence tag (EST). **C) Polymerase Chain Reaction (PCR)** – Principle, Procedure and Application. **D) Detection of DNA sequence** – DNA fingerprinting, DNA microarray. **E) Genomics** and **Proteomics** and their types	**12**
4	**Application of Genetic Engineering** **A) Applications in Medical Field –** Hybridoma technology and Monoclonal antibody production, Gene therapy- Types and applications, Stem Cell technology, Transgenic Animal – Knockout Mice. **B)Applications in Agriculture Field –** Transgenic plant – Insect resistant (Bt Cotton), Herbicide resistant (Roundup), Virus resistant. **C) Application in Medicine Field** – Vaccines production (Hepatitis B vaccine, DNA vaccine, Edible vaccine), Production of Insulin, Somatotropin and Interferon. **D) GM Food** – Pros and Cons and Examples.	**12**

1. *Isolation of plasmid DNA
2. *Isolation of genomic DNA from bacterial cell and separation of isolated genomic DNA by agarose gel electrophoresis

3. *Digestion of DNA using restriction enzyme and analysis by agarose gel electrophoresis
4. Ligation of digested DNA fragment
5. DNA amplification by PCR (Demonstration)
6. Gene cloning- cloning of GFP gene

Note:

1. Underlined experiments are treated as major experiments.
2. Students should perform at least 4 major and 6 minor experiments
3. Practicals with asteric mark are compulsory.
4. An educational tour (visit to Pharmaceutical ,Dairy industry, Research institute) is compulsory in V or VI semester
5. For project a suitable microbial investigation involving laboratory work or survey work may be given to 1-3 students at the beginning of semester
6. Report on project / review work preferably printed should be submitted duly certified by incharge teacher and head of the department

Distribution of marks of practical examinations of B.Sc. Sem. -VI

1.One major experiment- 08
2.Two minor experiment- 2 X 4= 08
3.Project (lab or review work) 06
4.Viva voce- 04
5.Practical record- 04

Total 30

Duration of Practical examination will be 10hrs., 5 hrs. each for two consecutive days

B.Sc. SEM VI Microbiology

Discipline Elective Course (DSE)

Course Code ……DSE-2	**Marks: 50**	
Credits: 2		**Total Hours :48**
	Immunology	
Objective: To make the students to understand the fundamentalknowledge of Immunology.		
UnitNo.	**Content**	**Hrs**
1	**Structure and functions of Immune system** **A)** General concept and short history of immunology **B)** Primary Lymphoid organs- Thymus and Bone marrow **C)** Secondary Lymphoid organs- Spleen and Lymph node **D)** Lymphoid tissues- MALT / GALT **E)** Cells of immune system- B Lymphocytes, T Lymphocytes, Comparison, Types of T lymphocytes, **F)** Other immune-competent cells- Monocytes, macrophages, Dendritic cells, Killer cells, Antigen presenting cells, Neutrophil, Eosinophil, basophil, Mast cell	**12**
2	**Resistance/ Immunity of the host** **A)** Types of immunity. **B)** Non-specific resistance (Natural/ Innate immunity- Species, racial and individual resistance. **C)** Factors influencing Innate immunity- Age, Sex, hormonal and nutritional. **D)** Mechanism of Innate immunity – anatomic and physiologic barriers, phagocytosis, inflammatory response, fever. **E)** Specific/Adoptive resistance(Acquired immunity)- Active and passive immunity, comparison, types, **F)** Humoral immune response, primary and secondary immune response **G)** Cell mediated immunity, mechanism, MHC complex and MHC molecules.	**12**
3	**Antigens, Antibodies and Antigen-Antibody reactions.** **A)**Definition of antigen, epitope, Hapten, Types of antigen, Factors determining Antigenicity. **B)** Definition of Antibody, general structure, Classes of immunoglobulins, Structure and their functions **C)** Antigen-Antibody reactions. i) Precipitation reaction- precipitation in liquid, immuno-diffusion. ii) Agglutination reaction- Slide and Tube agglutination, Coomb's test. iii) Complement fixation reaction- Wasserman test. **D)** Tagged Antibody test- ELISA, Radioimmunoassay (RIA), Immunofluorescence.	**12**
4	**Centrifugation and Radioactivity** **A)** Definition of Hypersensitivity, Gell and Coomb's classification-Immediate (Type I, Type II & Type III), Delayedhypersensitivity (Type IV), examples. **B)** Mechanism of hypersensitivity – Type I (Anaphylaxis), Type II (erythroblastosis fetalis), Type III (Arthus reaction, serum sickness), Type IV (Contact dermatitis, Mantaux test). **C)** Immunological tolerance **D)**Autoimmunity, mechanism , causes of autoimmunity, autoimmune disorders (Rheumatic arthritis and Myasthenia gravis)	**12**

Practical Course for Semester VI (Paper II) Marks: 30

1. *Blood group and Rh factor
2. *Total Leucocyte count
3. Differential Leucocyte count
4. *Haemoglobin % in Blood.
5 *Detection of Typhoid and Paratyphoid fever by slide/tube agglutination test (WIDAL)
6. *Detection of Syphilis by TRUST antigen test.
7. *Detection of Pregnancy in women by strip method
8. Demonstration of HBsAg by Hepacard test
9. *Estimation of Antigen by Single Radial Immune Diffusion(RIA).
10. Detection of AIDS by ELISA test.
11. Test for Rheumatoid arthritis (RA)

Note:

1. Underlined experiments are treated as major experiments.
2. Students should perform at least 4 major and 6 minor experiments
3. Practicals with asteric mark are compulsory.
4. An educational tour (visit to Pharmaceutical, Dairy industry, Research institute) is compulsory in V or VI semester
5. For project a suitable microbial investigation involving laboratory work or survey work may be given to 1-3 students at the beginning of semester
6. Report on project / review work preferably printed should be submitted duly certified by incharge teacher and head of the department

Distribution of marks of practical examinations of B.Sc. Sem. -VI

1.One major experiment- 08
2.Two minor experiment- 2 X 4= 08
3.Project (lab or review work) 06
4.Viva voce- 04
5.Practical record- 04

Total 30

Duration of Practical examination will be 10hrs., 5 hrs. each for two consecutive days

Books Recommended for Theory& Practical Microbiology B.Sc. Sem. VI

1. Singh B.D.(2007),Biotechnology, Kalyani Publisher
2. Mitra (2005). Genetic engineering. Published by Macmillan India Ltd., Chennai.
3. Jogdand SN (2005). Gene biotechnology. Himalaya Publishing House, Mumbai
4. JOGDAND S.N. (2007) Advances in Biotechnology , Himalaya Publishing House, 2007
5. Satyanarayana (2005). Biotechnology. First edition, Books and Allied (P) Ltd., Kolkata.
6. Preeti Joshi (2002). Genetic engineering and its application. First edition, Agrobios (India).
7. Dubey RC (2005). A Text of Biotechnology. Multicolour Illustrative edition, S.Chand and Company Ltd., New Delhi.
8. Bernad R Glick (2003). Molecular Biotechnology - Principles and Applications of Recombinant DNA. Third edition, ASM Press, Washington, D.C.
9. Ramawat K and ShailyGoyal (2010). Molecular Biology and Biotechnology. First edition, S.Chand and company Ltd., New Delhi.
10. Dale J.W., Molecular Genetics of bacteria, 1994, John Wiley & Sons.
11. James D. Watson, Nancy H. Hopkins, Jeffrey W. Roberts, Joan ArgetsingerSteitz, Alan M. Weiner 1987, 4th edition. The Benjamin/Cummings Pub.
12. Lewin B. 2002 Genes VIII. Oxford.
13. Nancy Hopkins -Microbial genetics :.
14. Freifelder, D., 2000, Molecular Biology, second edition, Naros Publishing House, New Delhi.
15. Lehninger, 2010, Principles of Biochemistry, 5th edn., by Nelson & Cox, W.H. Freeman and Co.NYork.
16. Watson, J.D. et.al., 2004, Molecular Biology of the Gene, 5th edn., Pearson pub.,
17. Brown, T.A. 2000, Gene Cloning, fourth edition, Chapman and Hall Publication, USA.
18. Old R.W. and PrimroseS.B.,1996, Prin.of Gene Manipulations, Blackwell Science Publications, London.
19. Mahadav Sharma &NirmalTripathi, Immunobiotechnolgy,
20. Kannan, Immunology
21. Roitt Ivan M. ,Brostoff Jonathan, Male DevidK.,Immunology 3rd edn,
22. Richard A. Goldsby, Thomas J. Kindt, JanisKuby Immunology 5th edn, .
23. Principles of Immunology, N.V. Shastri. Himalaya publisher.
24. P. Chakroborty. NCBA, Kolkata Manual of Practical Microbiology and Parasitology,
25. R.P. Singh ,Immunology and Medical Microbiology -Kalyani publishers
26. Bansal M P , Molecular Biology & Biotechnology, Basic exp. Protocol,TERI,New Delhi
27. Immunology and Microbiology, Dulsy Fatima, A. Mani. Saras Publication

B.Sc. SEM VI Microbiology

Discipline Elective Course (DSE)

Course Code ……DSE-3Marks: 50		
Credits: 2		**Total Hours :48**
Bioinformatics		
Objective: To make the students to understand the fundamentalknowledge of Bioinformatics.		
UnitNo.	**Introduction to Computer, Bioinformatics and Biological Databases**	**Hrs**
1	RDBMS - Definition of relational database, Mode of data transfer (FTP, SFTP, SCP), advantage of encrypted data transfer. Biological databases - nucleic acid, genome, protein sequence and structure, gene expression databases, Database of metabolic pathways, Mode of data storage - File formats - FASTA, Genbank and Uniprot, Data submission & retrieval from NCBI, EMBL, DDBJ, Uniprot, PDB.	**12**
2	**Sequence Alignments, Phylogeny and Phylogenetic trees**	
	Local and Global Sequence alignment, pairwise and multiple sequence alignment. Scoring an alignment, scoring matrices, PAM & BLOSUM series of matrices, Types of phylogenetic trees, Different approaches of phylogenetic tree construction - UPGMA, Neighbour joining, Maximum Parsomony, Maximum likelihood.	**12**
3	**Genome organization and analysis**	
	Diversity of Genomes: Viral, prokaryotic & eukaryotic genomes, Genome, transcriptome, proteome, 2-D gel electrophoresis, MaldiToff spectroscopy, Major features of completed genomes: *E.coli, S.cerevisiae,* Arabidopsis, Human.	**12**
4	**Protein Structure Predictions**	**12**
	Hierarchy of protein structure - primary, secondary and tertiary structures, modeling Structural Classes, Motifs, Folds and Domains, Protein structure prediction in presence and absence of structure template, Energy minimizations and evaluation by Ramachandran plot, Protein structure and rational drug design.	

Practical Course for Semester VI (Paper III) Marks: 30

1. Introduction to different operating systems - UNIX, LINUX and Windows
2. Introduction to bioinformatics databases (any three): NCBI/PDB/DDBJ, Uniprot, PDB
3. Sequence retrieval using BLAST
4. Sequence alignment & phylogenetic analysis using clustalW&phylip
5. Picking out a given gene from genomes using Genscan or other softwares (promoter region Identification, repeat in genome, ORF prediction). Gene finding tools (Glimmer, GENSCAN), Primer designing, Genscan/Genetool
6. Protein structure prediction: primary structure analysis, secondary structure prediction usingpsipred,homology modeling using Swiss model. Molecular visualization using jmol, Protein structure model evaluation (PROCHECK)
7. Prediction of different features of a functional gene

Distribution of marks for practical examinations of B.Sc. Semester VI

1. One major experiment-	10
2. Two minor experiment-	2 X 5 = 10
3. Viva voce-	5
4. Practical record-	5
Total	30

(Duration of Practical exam will be 10 hrs.)

Books Recommended for Bioinformatics

1. Saxena Sanjay (2003) A First Course in Computers, Vikas Publishing House
2. Pradeep and Sinha Preeti (2007) Foundations of Computing, 4th ed., BPB Publications
3. Lesk M.A.(2008) Introduction to Bioinformatics . Oxford Publication, 3rd International Student
4. Rastogi S.C., Mendiratta N. and Rastogi P. (2007) Bioinformatics: methods and applications,
   genomics, proteomics and drug discovery, 2nd ed. Prentice Hall India Publication
5. Primrose and Twyman (2003) Principles of Genome Analysis & Genomics. Blackwell.

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B.Sc. SEM VI Microbiology

Discipline Elective Course (DSE)

Course Code ……DSE-4Marks: 50		
Credits: 2		**Total Hours :48**
Microbes in Sustainable Agriculture and development		
Objective: To make the students to understand the fundamentalknowledge of Sustainable Agriculture.		
UnitNo.	**Content**	**Hrs**
1	**Soil Microbiology** Soil as Microbial Habitat, Soil profile and properties, Soil formation, Diversity and distribution of microorganisms in soil. Mineralization of cellulose, hemicelluloses, lignocelluloses, lignin and humus, phosphate, nitrate, silica, potassium.	**12**
2	**Microbial Activity in Soil and Green House Gases** Carbon dioxide, methane, nitrous oxide, nitric oxide – production and control. Microbial Control of Soil Borne Plant Pathogens : Biocontrol mechanisms and ways, Microorganisms used as biocontrol agents against Microbial plant pathogens, Insects, Weeds.	**12**
3	**Biofertilization,Phytostimulation,Bioinsecticides** Plant growth promoting bateria, biofertilizers – symbiotic (Bradyrhizobium, Rhizobium, Frankia), Non Symbiotic (Azospirillum, Azotobacter, Mycorrhizae, MHBs, Phosphate solubilizers, algae), Novel combination of microbes as biofertilizers, PGPRs.	**12**
4	**Secondary Agriculture Biotechnology** Biotech feed, Silage, Biomanure, biogas, biofuels – advantages and processing parameters.GMcrops: Advantages, social and environmental aspects, Bt crops, golden rice, transgenic animals.	**12**

Microbes in Sustainable Agriculture and Development (PRACTICALS) – DSE 4

1. Study soil profile.
2. Study microflora of different types ofsoils.
3. *Rhizobium* as soil inoculants characteristics and fieldapplication.
4. *Azotobacter* as soil inoculants characteristics and fieldapplication.
5. Design and functioning of a biogasplant.
6. Isolation of cellulose degradingorganisms.

Distribution of marks during practical examinations of B.Sc. Semester VI

1. One major experiment-	10
2. Two minor experiment-	2 X 5 = 10
3. Viva voce-	5
4. Practical record-	5
Total	**30**

(Duration of Practical exam will be 10 hrs.)

SUGGESTED READINGS

1. Agrios GN. (2006). Plant Pathology. 5th edition. Academic press, SanDiego,
2. SinghRS.(1998).PlantDiseasesManagement.7thedition.Oxford&IBH,NewDelhi.
3. GlickBR,PasternakJJ,andPattenCL(2010)MolecularBiotechnology4th edition,A SM Press,
4. AtlasRMandBarthaR.(2000).MicrobialEcology:Fundamentals&Applications .4th edition. Benjamin/Cummings Science Publishing,USA
5. MaierRM,PepperILandGerbaCP.(2009).EnvironmentalMicrobiology.2ndedi tion, Academic Press
6. BartonLL&NorthupDE(2011).MicrobialEcology.1stedition,WileyBlackwell,USA
7. CampbellRE.(1983).MicrobialEcology.BlackwellScientificPublication,Oxf ord, England.
8. CoyneMS.(2001).SoilMicrobiology:AnExploratoryApproach.DelmarThom son Learning.
9. AltmanA(1998).AgricultureBiotechnology,Istedition,MarceldeckerInc.
10. MahendraK.Rai(2005).HandBookofMicrobialBiofertilizers,TheHaworthPress, Inc. NewYork.
11. Reddy,S.M.et.al.(2002).BioinoculantsforSustainableAgricultureandForestry,Scie ntific Publishers.
12. SaleemFandShakooriAR(2012)DevelopmentofBioinsecticide,LapLambertAcad emic Publishing GmbHKG