



FACULTY OF SCIENCES
DEPARTMENT OF LIFE SCIENCES

COURSE: B.Sc.
SEMESTER: VI
SUBJECT NAME: Medical Microbiology (Theory)
SUBJECT CODE: 4SC06MEM1

Teaching & Evaluation Scheme:-

Teaching hours/week				Credit	Evaluation Scheme/semester								
Th	Tu	Pr	Total		Theory				Practical				Total Marks
					Sessional Exam		University Exam		Internal		University		
					Marks	Hrs	Marks	Hrs	Pr	TW			
4	2	0	4	5	30	1	70	3	-	-		100	

Objectives:- The objective of this course is that the students can learn about basics of Medical Microbiology

Prerequisites:- Basic knowledge of Biological Sciences.

Course outline:-

Sr. No.	Course Contents	Hours
1	Normal microflora of the human body and host pathogen interaction: Normal microflora of the human body: Importance of normal microflora, normal microflora of skin, throat, gastrointestinal tract, urogenital tract Host pathogen interaction: Definitions - Infection, Invasion, Pathogen, Pathogenicity, Virulence, Toxigenicity, Carriers and their types, Opportunistic infections, Nosocomial infections. Transmission of infection, Pathophysiologic effects of LPS	08
2	Sample collection, transport and diagnosis: Collection, transport and culturing of clinical samples, principles of different diagnostic tests (ELISA, Immunofluorescence, Agglutination based tests, Complement fixation, PCR, DNA probes).	05
3	Bacterial diseases: List of diseases of various organ systems and their causative agents. The following diseases in detail with Symptoms, mode of transmission, prophylaxis and control Respiratory Diseases: <i>Streptococcus pyogenes</i> , <i>Haemophilus influenzae</i> , <i>Mycobacterium tuberculosis</i> Gastrointestinal Diseases: <i>Escherichia coli</i> , <i>Salmonella typhi</i> , <i>Vibrio cholerae</i> , <i>Helicobacter pylori</i> Others: <i>Staphylococcus aureus</i> , <i>Bacillus anthracis</i> , <i>Clostridium tetani</i> , <i>Treponema pallidum</i> , <i>Clostridium difficile</i>	15



4	Viral diseases: List of diseases of various organ systems and their causative agents. The following diseases in detail with Symptoms, mode of transmission, prophylaxis and control Polio, Herpes, Hepatitis, Rabies, Dengue, AIDS, Influenza with brief description of swine flu, Ebola, Chikungunya, Japanese Encephalitis	14
5	Protozoan diseases: List of diseases of various organ systems and their causative agents. The following diseases in detail with Symptoms, mode of transmission, prophylaxis and control Malaria, Kala-azar	05
6	Fungal diseases: Brief description of each of the following types of mycoses and one representative disease to be studied with respect to transmission, symptoms and prevention, Cutaneous mycoses: Tinea pedis (Athlete's foot) Systemic mycoses: Histoplasmosis, Opportunistic mycoses: Candidiasis	06
7	Antimicrobial agents: General characteristics and mode of action: Antibacterial agents: Five modes of action with one example each: Inhibitor of nucleic acid synthesis; Inhibitor of cell wall synthesis; Inhibitor of cell membrane function; Inhibitor of protein synthesis; Inhibitor of metabolism Antifungal agents: Mechanism of action of Amphotericin B, Griseofulvin. Antiviral agents: Mechanism of action of Amantadine, Acyclovir, Azidothymidine. Antibiotic resistance, MDR, XDR, MRSA, NDM-1	08
	Total Hours	61

Learning Outcomes:- The students are expected to

- Identification of various diseases and their symptoms.
- Mechanism of antimicrobial agents.

Books Recommended:-

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. **Goering R., Dockrell H., Zuckerman M. and Wakelin D.** (2007) Mims' Medical Microbiology. 4th edition. Elsevier
4. **Willey JM, Sherwood LM, and Woolverton CJ.** (2013) Prescott, Harley and Klein's Microbiology. 9th edition. McGraw Hill Higher Education
5. **Madigan MT, Martinko JM, Dunlap PV and Clark DP.** (2014). Brock Biology of Microorganisms. 14th edition. Pearson International Edition



PRACTICALS

Sr. No.	Course Contents
1	Identify bacteria (any three of <i>E. coli</i> , <i>Salmonella</i> , <i>Pseudomonas</i> , <i>Staphylococcus</i> , <i>Bacillus</i>) using laboratory strains on the basis of cultural, morphological and biochemical characteristics: IMViC, TSI, nitrate reduction, urease production and catalase tests
2	Study of composition and use of important differential media for identification of bacteria: EMB Agar, McConkey agar, Mannitol salt agar, Deoxycholate citrate agar, TCBS
3	Study of bacterial flora of skin by swab method
4	Perform antibacterial sensitivity by Kirby-Bauer method
5	Determination of minimal inhibitory concentration (MIC) of an antibiotic.
6	Study symptoms of the diseases with the help of photographs: Polio, anthrax, herpes, chicken pox, HPV warts, AIDS (candidiasis), dermatomycoses (ring worms)
7	Study of various stages of malarial parasite in RBCs using permanent mounts.



FACULTY OF SCIENCES
DEPARTMENT OF LIFE SCIENCES

COURSE: B.Sc.

SEMESTER: VI

SUBJECT NAME: Recombinant DNA Technology (Theory)

SUBJECT CODE: 4SC06RDT1

Teaching & Evaluation Scheme:-

Table with columns: Teaching hours/week (Th, Tu, Pr, Total), Credit, Evaluation Scheme/semester (Theory: Sessional Exam, University Exam; Practical: Internal, University), Total Marks.

Objectives:- The objective of this course is that the students can learn about basics of r-DNA technology.

Prerequisites:- Basic knowledge of Biological Sciences and genetic material.

Course outline:-

Table with columns: Sr. No., Course Contents, Hours. Contains 4 rows of course content including Introduction to Genetic Engineering, Molecular Cloning, Methods in Molecular Cloning, and DNA Amplification and DNA sequencing.



5	Construction and Screening of Genomic and cDNA libraries: Genomic and cDNA libraries: Preparation and uses, Screening of libraries: Colony hybridization and colony PCR, Chromosome walking and chromosome jumping	6
6	Applications of Recombinant DNA Technology: Products of recombinant DNA technology: Products of human therapeutic interest - insulin, hGH, antisense molecules. Bt transgenic - cotton, brinjal, Gene therapy, recombinant vaccines, protein engineering and site directed mutagenesis	6
	Total Hours	60

Learning Outcomes:- The students are expected to

- Handling the molecular tools and genomic library.
- r-DNA application in transgenic mechanism.

Books Recommended:-

1. **Brown TA.** (2010). Gene Cloning and DNA Analysis. 6th edition. Blackwell Publishing, Oxford, U.K.
2. **Clark DP and Pazdernik NJ.** (2009). Biotechnology: Applying the Genetic Revolution. Elsevier Academic Press, USA
3. **Primrose SB and Twyman RM.** (2006). Principles of Gene Manipulation and Genomics, 7th edition. Blackwell Publishing, Oxford, U.K.
4. **Sambrook J and Russell D.** (2001). Molecular Cloning-A Laboratory Manual. 3rd edition. Cold Spring Harbor Laboratory Press
5. **Wiley JM, Sherwood LM and Woolverton CJ.** (2008). Prescott, Harley and Klein's Microbiology. McGraw Hill Higher Education
6. **Brown TA.** (2007). Genomes-3. Garland Science Publishers
7. **Primrose SB and Twyman RM.** (2008). Genomics: Applications in human biology. Blackwell Publishing, Oxford, U.K.



PRACTICALS

Sr. No.	Course Contents
1	Preparation of competent cells for transformation
2	Demonstration of Bacterial Transformation and calculation of transformation efficiency.
3	Digestion of DNA using restriction enzymes and analysis by agarose gel electrophoresis
4	Ligation of DNA fragments
5	Cloning of DNA insert and Blue white screening of recombinants.
6	Interpretation of sequencing gel electropherograms
7	Designing of primers for DNA amplification
8	Amplification of DNA by PCR
9	Demonstration of Southern blotting



FACULTY OF SCIENCES
DEPARTMENT OF LIFE SCIENCES

COURSE: B.Sc. SEMESTER: VI (All Sciences)

SUBJECT NAME: Professional Etiquettes-II

SUBJECT CODE: 4SC06PRE2

Teaching & Evaluation Scheme:-

Table with columns: Teaching hours/week (Th, Tu, Pr, Total), Credit, Evaluation Scheme/semester (Theory, Practical), and Total Marks. Row 1: 2, 2, 0, 4, 3, 30, 1, 70, 3, -, -, -, 100.

Objectives:

- To define before the students professional behavior and suggest standards for appearance, actions, and attitude in a business environment.
To explain them different communication styles and how to adjust to each.
Review the essentials of online and offline business networking.
Develop an action plan to improve personal professionalism.

Prerequisites:

- Students should have basic knowledge of English Language and grammar.
Students should have ability to speak and write correct sentences in their day to day language.
Students should be familiar with correct usage of language.

Course outline:-

Table with columns: Unit No., Content In Details Including Its Sub Topics, and Minimum Number of Hours (Theory, Practical, Total). Rows include Positive Attitude, Self Esteem, and Leadership topics.



04	Soft Skills Introduction to soft skills Importance of soft skills Intelligence quotient, Emotional quotient, Spiritual quotient Classification of soft skills: Thinking Skills: Self Awareness, Problem-Solving, Decision Making, Critical Thinking, Creative Thinking Social Skills: Interpersonal Relationships, Effective Communication, Empathy Emotional Skills: Managing Feelings/emotions, Stress Management	05	05	10
05	Goal Setting Introduction Importance 5 D's of Goal Setting: Direction, Dedication, Determination, Discipline, Deadline Steps of Goal Action Plan	04	04	08
06	Notice, Agendas of Meeting, Minutes of Meeting Preparing notice Preparing a list of agendas for meeting Drafting minutes of conducted meeting	03	02	05
07	Section-B: Literature <i>La Belle Dame Sans Merci</i> – John Keats <i>Byzantium</i> – W. B. Yeats	08	10	18

Learning Outcomes:- The students are expected to

- Prepare participants to handle a variety of social and business situations: networking events, business meetings, business meals, and many more.

Books Recommended:-

1. *Personality Development and Soft Skills*, **Mitra Barun**, Oxford University Press.
2. *Managing Soft Skills for Personality Development*, **B.N. Ghosh**, Tata McGraw-Hill.
3. *You Can Win*, **Shiv Khera**.
4. *The Monk Who Sold His Ferrari*, **Robin Sharma**, Harper Collins.
5. *Effective Personal Communication Skills for Public Relations*, **Green Andy**, Kogan age Limited.
6. *William Butler Yeats: The Byzantium Poems, The Merrill literary casebook series*, **Ed. Richard J. Finneran**, Merrill Publishing Company, Chicago.
7. *JOHN KEATS: Selected Poems*, Edited and with an Introduction and Notes, **John Barnard**, Penguin Books New Delhi.
8. *Selected College Poems*, **Ambika Sengupta**, Orient Longman Private Limited, New Delhi.



FACULTY OF SCIENCES
DEPARTMENT OF LIFE SCIENCES

COURSE: B.Sc.

SEMESTER: VI

SUBJECT NAME: DSE III (INSTRUMENTATION AND BIOTECHNIQUES)

SUBJECT CODE: 4SC06IAB1

Teaching & Evaluation Scheme:-

Teaching hours/week				Credit	Evaluation Scheme/semester								
Th	Tu	Pr	Total		Theory				Practical				Total Marks
					Sessional Exam		University Exam		Internal		University		
					Marks	Hrs	Marks	Hrs	Pr	TW			
4	0	4	8	6	30	1	70	3	30	-	70	200	

Objectives:- The objective of this course is that the students can learn about basics of Instruments and biotechniques.

Prerequisites:- Basic knowledge of Biological Sciences.

Sr. No.	Course contents	Teaching Hours
1	Microscopy: Bright field and dark field microscopy, Fluorescence Microscopy, Phase contrast Microscopy, Confocal Microscopy, Electron Microscopy(Scanning and Transmission Electron Microscopy) and Micrometry.	10
2	Chromatography: Principles and applications of paper chromatography (including Descending and 2-D), Thin layer chromatography. Column packing and fraction collection. Gel filtration chromatography, ion-exchange chromatography and affinity chromatography, GLC,HPLC.	14
3	Electrophoresis: Principle and applications of native polyacrylamide gel electrophoresis, SDS-polyacrylamide gel electrophoresis, 2Dgelectrophoresis, Isoelectric focusing, Zymo gram preparation and Agarose gel electrophoresis	14
4	Spectro photometry: Principle and use of study of absorption spectra of biomolecules. Analysis of biomolecules using UV and visible range. Colorimetry and turbidometry.	10
5	Centrifugation: Preparative and analytical centrifugation, fixed angle and swinging bucket rotors.RCF and sedimentation coefficient, differential centrifugation,	12



	density gradient centrifugation and ultra centrifugation.	
	Total Hours	60

Learning Outcomes:- The students are expected to

- Handling the Instruments.

Books Recommended:-

1. **Wilson K and Walker J.**(2010).Principles and Techniques of Biochemistry and Molecular Biology.7thEd. ,Cambridge University Press.
2. **Nelson DL and Cox MM.** (2008). Lehninger Principles of Biochemistry, 5thEd., W.H. Freeman and Company.
3. **Willey MJ, Sherwood LM &WoolvertonC J.** (2013). Prescott, Harley and Klein's Microbiology.9thEd.,McGraw Hill.
4. **Karp G.**(2010) Cell and Molecular Biology: Concepts and Experiments. 6th edition. John Wiley & Sons. Inc.
5. **De Robertis EDP and DeRobertis EMF.** (2006). Cell and Molecular Biology. 8th edition. Lipincott Williams and Wilkins, Philadelphia.
6. **CooperG.M. and Hausman R.E.**(2009). The Cell: A Molecular Approach.5thEdition. ASM Press & Sunderland, Washington D.C Sinauer Associates, MA.
7. **Nigam A and AyyagariA.**2007. Lab Manual in Biochemistry, Immunology and Biotechnology .Tata McGraw Hill.



PRACTICALS

S.No	Experiment
1	Study of fluorescent micrographs to visualize bacterial cells.
2	Ray diagrams of phase contrast microscopy and Electron microscopy.
3	Separation of mixtures by paper/thin layer chromatography.
4	Demonstration of column packing in any form of column chromatography.
5	Separation of protein mixtures by any form of chromatography
6	Separation of protein mixtures by Polyacrylamide Gel Electrophoresis (PAGE).
7	Determination of λ_{\max} for an unknown sample and calculation of extinction coefficient.
8	Separation of components of a given mixture using a laboratory scale centrifuge.
9	Understanding density gradient centrifugation with the help of pictures.



FACULTY OF SCIENCES
DEPARTMENT OF LIFE SCIENCES

COURSE: B.Sc.

SEMESTER: VI

SUBJECT NAME: DSE III (ADVANCES IN MICROBIOLOGY)

SUBJECT CODE: 4SC06AIM1

Teaching & Evaluation Scheme:-

Teaching hours/week				Credit	Evaluation Scheme/semester								
Th	Tu	Pr	Total		Theory				Practical				Total Marks
					Sessional Exam		University Exam		Internal		University		
					Marks	Hrs	Marks	Hrs	Pr	TW			
4	0	4	8	6	30	1	70	3	30	-	70	200	

Objectives:- The objective of this course is that the students can learn about basics of Advance in microbiology.

Prerequisites:- Basic knowledge of Biological Sciences.

Sr. No.	Course contents	Teaching Hours
1	Evolution of Microbial Genomes: Salient features of sequenced microbial genomes, core genome pool, flexible genome pool and concept of pan genome, Horizontal gene transfer(HGT), Evolution of bacterial virulence-Genomic islands, Pathogenicity islands(PAI)and their characteristics	15
2	Meta genomics : Brief history and development of metagenomics , Understanding bacterial diversity using meta genomics approach, Prospecting genes of biotechnological importance using meta genomics Basic knowledge of viral meta genome, meta transcriptomics, meta proteomics and meta bolomics.	15
3	Molecular Basis of Host-Microbe Interactions: Epiphytic fitness and its mechanism in plant pathogens, Hyper sensitive response(HR)to plant pathogens and its mechanism, Type three secretion systems (TTSS) of plant and animal pathogens, Biofilms: types of microorganisms, molecular aspects and significance in environment ,health care, virulence and anti microbial resistance	15
4	Systems and Synthetic Biology: Networking in biological systems, Quorum sensing in bacteria, Co-ordinated regulation of bacterial virulence factors, Basics of synthesis of polio virus in laboratory, Future implications of synthetic biology with respect to bacteria and viruses	15
Total Hours		60



Learning Outcomes:- The students are expected to

- Understanding bacterial diversity using meta genomics approach.

Books Recommended:-

1. **Fraser CM, Read TD and Nelson KE** .Microbial Genomes,2004, Humana Press.
2. **Miller RV and Day MJ**. Microbial Evolution-Gene establishment, survival and exchange, 2004, ASM Press.
3. **Bull AT**. Microbial Diversity and Bioprospecting, 2004, ASM Press.
4. **Sangdun C**. Introduction to Systems Biology, 2007, Humana Press.



PRACTICALS

S.No	Experiment
1	Extraction of meta genomic DNA from soil
2	Understand the impediments in extracting meta genomic DNA from soil
3	PCR amplification of meta genomic DNA using universal 16s ribosomal gene primers
4	Case study to understand how the polio virus genome was synthesized in the laboratory
5	Case study to understand how networking of metabolic path ways in bacteria takes place



FACULTY OF SCIENCES
DEPARTMENT OF LIFE SCIENCES

COURSE: B.Sc.

SEMESTER: VI

SUBJECT NAME: DSE III (BIOSAFETY AND INTELLECTUAL PROPERTY RIGHTS)

SUBJECT CODE: 4SC06BSI1

Teaching & Evaluation Scheme:-

Table with columns: Teaching hours/week (Th, Tu, Pr, Total), Credit, Evaluation Scheme/semester (Theory, Practical), and Total Marks. Includes sessional and university exam details.

Objectives:- The objective of this course is that the students can learn about basics of Biosafety and IPR.

Prerequisites: - Basic knowledge of Biological Sciences.

Table with 3 columns: Sr. No., Course contents, Teaching Hours. Lists 6 topics related to biosafety and intellectual property with their respective teaching hours.



Agreement; Hague Agreement; WIPO Treaties; Budapest Treaty on international recognition of the deposit of microorganisms; UPOV & Brene conventions; Patent Co-operation Treaty(PCT); Indian Patent Act1970 & recent amendments.	
Total Hours	60

Learning Outcomes:-

At the end of the course the student would have sufficient knowledge of IPR.

Books Recommended:

1. **Bare Act,2007. Indian Patent Act 1970**Acts & Rules, Universal Law Publishing Co. Pvt. Ltd., NewDelhi.
2. **Kankanala C(2007)**. Genetic Patent Law & Strategy, 1stEdition, Manupatra Information Solution Pvt. Ltd. New Delhi.
3. **Mittal , D.P.(1999)**.Indian Patents Law, Taxmann , Allied Services(p)Ltd.
4. **Singh KK(2015)**.Biotechnology and Intellectual Property Rights: Legal and Social Impliocations, Springer India.
5. **GoelD & Prashar S(2013)**.IPR ,Bio safety and Bioethics. Pearson.
6. **Senthil Kumar Sadha sivam and Mohammed Jaabir,M.S.** 2008.IPR, Bio safety and biotechnology Management. Jasen Publications, Tiruchirappalli, India.



PRACTICALS

S.No	Experiment
1	Study of components and design of a BSL-III laboratory
2	Filing applications for approval from bio safety committee
3	Filing primary applications for patents
4	Study of steps of a patenting process
5	A case study



FACULTY OF SCIENCES
DEPARTMENT OF LIFE SCIENCES

COURSE: B.Sc.
SEMESTER: VI
SUBJECT NAME: DSE IV (PLANT PATHOLOGY)
SUBJECT CODE: 4SC06PPY1

Teaching & Evaluation Scheme:-

Table with columns: Teaching hours/week (Th, Tu, Pr, Total), Credit, Evaluation Scheme/semester (Theory, Practical), Marks, Hrs, Internal, University, Total Marks.

Objectives:- The objective of this course is that the students can learn about basics of Plant pathology.

Prerequisites: - Basic knowledge of Biological Sciences.

Table with 3 columns: Sr. No., Course contents, Teaching Hours. Contains 4 rows of course content details.



	<p>virulence(avr) gene; gene for gene hypothesis, types of plant resistance: true resistance–horizontal & vertical, apparent resistance.</p> <p><i>Defense Mechanisms in Plants:</i> Concepts of constitutive defense mechanisms in plants, inducible structural defenses (histological- corklayer, abscission layer, tyloses, gums), inducible biochemical defenses [hypersensitive response (HR),systemic acquired resistance(SAR),phytoalexins, pathogenesis related(PR)proteins, planti bodies, phenolics, quinones, oxidative bursts].</p>	
5	<p>Control of Plant Diseases: Principles & practices involved in the management of plant diseases by different methods,viz. regulatory quarantine, crop certification, avoidance of pathogen, use of pathogen free propagative material cultural-host eradication, crop rotation, sanitation, polyethylene traps and mulches chemical-protectants and systemic fungicides, antibiotics, resistance of pathogens to chemicals. Biological-suppressive soils, antagonistic microbes-bacteria and fungi, trapplants.</p> <p>Genetic engineering of disease resistant plants-with plant derived genes and pathogen derived genes</p>	12
	Total Hours	60

Learning Outcomes:-

At the end of the course the student would have sufficient knowledge of Plant Pathology.

Books Recommended:

1. **Agrios GN.**(2006).Plant Pathology.5thedition.Academic press,SanDiego.
2. **Lucas JA.**(1998). Plant Pathology and Plant Pathogens. 3rd edition. Blackwell Science, Oxford.
3. **Mehrotra RS.**(1994).Plant Pathology. Tata McGraw-Hill Limited.
4. **Rangaswami G.**(2005).Diseases of Crop Plants in India. 4th edition. Prentice Hall of India Pvt. Ltd., NewDelhi.
5. **Singh RS.**(1998).Plant Diseases Management. 7th edition. Oxford & IBH, New Delhi



C. U. SHAH UNIVERSITY



PRACTICALS

Experiment

Demonstration of Koch's postulates in fungal, bacterial and viral plant pathogens. Study of important diseases of crop plants by cutting sections of infected plant material- <i>Albugo</i> , <i>Puccinia</i> , <i>Ustilago</i> , <i>Fusarium</i> , <i>Colletotrichum</i>
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FACULTY OF SCIENCES
DEPARTMENT OF LIFE SCIENCES

COURSE: B.Sc.

SEMESTER: VI

SUBJECT NAME: DSE IV (MICROBES IN SUSTAINABLE AGRICULTURE AND DEVELOPMENT)

SUBJECT CODE: 4SC06MAD1

Teaching & Evaluation Scheme:-

Table with columns: Teaching hours/week (Th, Tu, Pr, Total), Credit, Evaluation Scheme/semester (Theory: Sessional Exam, University Exam; Practical: Internal, University), Total Marks. Row 1: 4, 0, 4, 8, 6, 30, 1, 70, 3, 30, -, 70, 200.

Objectives:- The objective of this course is that the students can learn about basics of Microbes in sustainable agriculture and development.

Prerequisites:- Basic knowledge of Biological Sciences.

Table with 3 columns: Sr. No., Course contents, Teaching Hours. Rows 1-6 detailing course topics like Soil Microbiology, Mineralization, Microbial Activity, etc. Total Hours: 60.



Learning Outcomes:-

At the end of the course the student would have sufficient knowledge of agriculture.

Books Recommended:

1. **Agrios GN.**(2006).Plant Pathology.5th edition. Academic press, San Diego.
2. **Singh RS.**(1998).Plant Diseases Management. 7th edition. Oxford & IBH, New Delhi.
3. **GlickBR, PasternakJJ, and PattenCL** (2010) Molecular Biotechnology 4thedition,ASM Press.
4. **Atlas RM and Bartha R.**(2000). Microbial Ecology: Fundamentals & Applications. 4thedition.Benjamin/Cummings Science Publishing,USA.
5. **Maier RM, Pepper IL and Gerba CP.** (2009). Environmental Microbiology. 2ndedition, Academic Press.
6. **Barton LL & Northup DE**(2011). Microbial Ecology. 1stedition, Wiley Blackwell,USA.
7. **Campbell RE.**(1983).Microbial Ecology. Blackwell Scientific Publication, Oxford, England.
8. **CoyneMS.**(2001).Soil Microbiology: An Exploratory Approach. Delmar Thomson Learning.
9. **Altman A**(1998).Agriculture Biotechnology, I st edition, Marcel decker Inc.
10. **MahendraK. Rai**(2005). Hand Book of Microbial Biofertilizers, The Haworth Press, Inc. New York.
11. **Reddy, S.M. et.al.**(2002).Bioinoculants for Sustainable Agriculture and Forestry, Scientific Publishers.
12. **SaleemF and Shakoori AR**(2012) Development of Bio insecticide, Lap Lambert Academic Publishing Gmb HKG



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PRACTICALS

S.No	Experiment
1	Study soil profile
2	Study micro flora of different types of soils
3	<i>Rhizobium</i> as soil inoculants characteristics and field application
4	<i>Azotobacter</i> as soil inoculants characteristics and field application
5	Design and functioning of a biogas plant
6	Isolation of cellulose degrading organisms