

GANPAT UNIVERSITY

FACULTY OF SCIENCE

TEACHING AND EXAMINATION SCHEME

| Programme | Bachelor of Science | Branch/Spec. | Biotechnology | | | | | | | | | | | | | | | | |
|------------------------------|--|-------------------------------------|---------------|-------|-----------------|----|-------|------------------|----|-------|-----------------|----|-------|----------------------------|-----|-----------|-----------|-----|-------|
| Semester | V | | | | | | | | | | | | | | | | | | |
| Effective from Academic Year | 2015-16 | Effective for the batch Admitted in | | | | | | | | | | | | | | July 2013 | | | |
| Subject Code | Subject Name | Teaching scheme | | | | | | | | | | | | Examination scheme (Marks) | | | | | |
| | | Credit | | | | | | Hours (per week) | | | | | | Theory | | | Practical | | |
| | | Lecture(DT) | | | Practical(Lab.) | | | Lecture(DT) | | | Practical(Lab.) | | | CE | SEE | Total | CE | SEE | Total |
| | | L | TU | Total | P | TW | Total | L | TU | Total | P | TW | Total | | | | | | |
| UBTA501MIG | MICROBIAL GENETICS | 03 | - | 03 | - | - | - | 03 | - | 03 | - | - | - | 40 | 60 | 100 | - | - | - |
| UBTA502EBT | ENVIRONMENTAL BIOTECHNOLOGY | 03 | - | 03 | - | - | - | 03 | - | 03 | - | - | - | 40 | 60 | 100 | - | - | - |
| UBTA503POI | PRINCIPLES OF IMMUNOLOGY | 03 | - | 03 | - | - | - | 03 | - | 03 | - | - | - | 40 | 60 | 100 | - | - | - |
| UBTA504BBE | BIOPROCESS AND BIOCHEMICAL ENGINEERING | 03 | - | 03 | - | - | - | 03 | - | 03 | - | - | - | 40 | 60 | 100 | - | - | - |
| USEA 505 BNF | BIOINFORMATICS | 02 | - | 02 | - | - | - | 02 | - | 02 | - | - | - | 40 | 60 | 100 | - | - | - |
| UENA506ENG | ENGLISH-V | 02 | - | 02 | - | - | - | 02 | - | 02 | - | - | - | 40 | 60 | 100 | - | - | - |
| UPBA507PRA | PRACTICAL MODULE-V | - | - | - | 06 | - | 06 | - | - | - | 12 | - | 12 | - | - | - | - | 200 | 200 |
| Total | | 16 | - | 16 | 06 | - | 06 | 16 | - | 16 | 12 | - | 12 | 240 | 360 | 600 | - | 200 | 200 |

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|------------------------------|---------------------|-------------------------------------|--------------------|
| Programme | Bachelor of Science | Branch/Spec. | Biotechnology |
| Semester | V | Version | 1.0.0.0 |
| Effective from Academic Year | 2015-16 | Effective for the batch Admitted in | July 2013 |
| Subject code | UBTA 501 MIG | Subject Name | Microbial Genetics |
| Teaching scheme | | Examination scheme (Marks) | |
| (Per week) | Lecture(DT) | Practical(Lab.) | Total |
| | L TU | P TW | |
| Credit | 03 | | 03 |
| Hours | 03 | | 03 |
| | | Theory | 40 |
| | | Practical | -- |
| | | SEE | 60 |
| | | Total | 100 |
| | | | 200 |

Pre-requisites:

Students should have basic knowledge of Genetics of 10+2

level Learning Outcome:

The course will help the student to understand fundamentals of central dogma in microorganisms and its significance.

Theory syllabus

| Unit | Content | Hrs |
|------|--|-----|
| 1 | <p>1.1 Nature of Genetic material :Understanding of terms: Gene, allele, genotype, phenotype, intron, exon, cistron, recon, muton, plasmid, chromosome, genome, zygote, merozygote</p> <p>1.2 Experimental proof for DNA as genetic material: Work of Griffith; Avery, Mc Carty and MacLeod; Hershey and Chase</p> <p>1.3 A. Historical perspective— conservative, dispersive, semi-conservative, Bidirectional and semi-discontinuous, B. Prokaryotic DNA replication – Details of molecular mechanism Involved in Initiation, Elongation and Termination, Enzymes and proteins associated with DNA replication, C. Eukaryotic DNA replication-- Molecular details of DNA synthesis, replicating the ends of the chromosomes D. Rolling circle mode of replication</p> <p>1.4 Post-replicative modifications and their significance</p> | 11 |
| 2 | <p>2.1 Transcription A. Initiation, role of enzyme, sigma factor, promoter, operator B. Elongation, C. Termination: Rho dependent and Rho independent</p> <p>2.2 Genetic code: Properties and codon usage</p> <p>2.3 Translation: A. Initiation, 70 S initiation complex, B. Elongation: recognition, peptidyl transfer, translocation C. Termination. D. Fate of ribosomes, polysome system, polycistronic RNA</p> <p>2.4 Regulation of gene expression A. Negative inducible control - lac operon, B. Positive regulation - lac operon C. Negative repressible control - trp operon</p> | 11 |
| 3 | <p>3.1 Mutation</p> <p style="padding-left: 20px;">A. Terminology: alleles, homozygous, heterozygous, genotype, phenotype, Somatic mutation, Germline mutation, Gene mutation, Chromosome mutation, phenotypic lag, hotspots and mutator genes. Fluctuation test</p> <p>3.2 Types of mutations: Point mutation, reverse mutation, suppressor mutation, frame shift mutation, conditional lethal mutation, base pair substitution, transition, transversion, missense mutation, nonsense mutation, silent mutation, neutral mutation, pleiotropic mutations. 3.3 Chemical Agents: Mode of action and application of Phenol, alcoholic and halogen compounds</p> <p>3.3 Causes of mutation: A. Natural/spontaneous mutation--replication error, depurination, deamination.</p> <p style="padding-left: 20px;">B. Induced mutation: principle and mechanism with illustrative diagrams for-</p> | 12 |

| | | |
|--------------------------|---|----|
| | <p>i. Chemical mutagens- base analogues, nitrous acid, hydroxyl amine, intercalating agents and alkylating agents</p> <p>ii. Physical mutagen, iii. Biological mutagen (only examples)</p> <p>C. Ames test</p> <p>D. Detection of mutants</p> <p>3.4 DNA Repair: Mismatch repair, Light repair, Repair of alkylation damage, Base excision repair, Nucleotide excision repair, SOS repair</p> | |
| 4 | <p>4.1 Transformation: Types of transformation in prokaryotes—Natural transformation in <i>Streptococcus pneumoniae</i>, <i>Haemophilus influenzae</i>, and <i>Bacillus subtilis</i>, Mapping of bacterial genes using transformation</p> <p>4.2 Conjugation: Properties of F plasmid/Sex factor, The conjugation machinery, Hfr strains, their formation and mechanism of conjugation, F' factor, origin and behavior of F' strains, Sexduction, Mapping of bacterial genes using conjugation (Wolman and Jacob experiment)</p> <p>4.3 Transduction</p> <p>i. Introduction and discovery, ii. Generalised transduction</p> <p>iii. Use of Generalised transduction for mapping genes, iv. Specialised transduction</p> <p>4.4 A. Plasmids: Nature and its types</p> <p>B. Transposable Elements in Prokaryotes: a. Insertion sequences b. Transposons</p> <p>C. Recombination in bacteria: a. General/Homologous recombination i. Molecular mechanism, ii. Holliday model of recombination, b. Site –specific recombination</p> | 12 |
| Text Books | | |
| 1 | JD Watson, "Molecular biology of the gene", latest edn. | |
| 2 | Benjamin Lewin, "Genes IX", , Jones and Bartlett publishers. | |
| Reference Books | | |
| | <ol style="list-style-type: none"> 1. Benjamin A. Pierce, "Genetics a conceptual approach", 5th ed., W. H. Freeman and company. 2. D.Nelson and M.Cox, (2005), "Lehninger's Principles of biochemistry", 4th ed., Macmillan worth Publishers. 3. Fairbanks and Anderson, (1999), "Genetics", Wadsworth Publishing Company. 4. M.Madigan, J.Martinko, J.Parkar, (2009), "Brock Biology of microorganisms", 12th ed., Pearson Education International. 5. Nancy Trun and Janine Trempey, (2004), "Fundamental bacterial genetics", Blackwell Publishing 6. Peter J. Russell (2009), "Genetics-A molecular approach", 3rd ed. 7. Prescott, Harley and Klein, "Microbiology", . 7th edition Mc Graw Hill international edition. 8. R. H. Tamarin, (2010), "Principles of genetics", 7th edition. Tata McGraw Hill. 9. Robert Weaver, "Molecular biology", , 3rd edn. Mc Graw Hill international edition. 10. Snustad, Simmons, "Principles of genetics", latest edn. John Wiley & sons, Inc. | |
| Practical Content | | |
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|---|---|-------------------------|-----------------|--------------|-------------------------------------|------------------------------------|---------------|-----------|-------|
| Programme | | Bachelor of Science | | | Branch/Spec. | | Biotechnology | | |
| Semester | | V | | | Version | | 1.0.0.0 | | |
| Effective from Academic Year | | | 2015-16 | | Effective for the batch Admitted in | | | July 2013 | |
| Subject code | | UBTA 502 EBT | | Subject Name | | ENVIRONMENTAL BIOTECHNOLOGY | | | |
| Teaching scheme | | | | | Examination scheme (Marks) | | | | |
| (Per week) | Lecture(DT) | | Practical(Lab.) | | Total | | CE | SEE | Total |
| | L | TU | P | TW | | | | | |
| Credit | 03 | - | - | - | 03 | Theory | 40 | 60 | 100 |
| Hours | 03 | - | - | - | 03 | Practical | -- | - | - |
| Pre-requisites: | | | | | | | | | |
| Students should have basic knowledge of Environment of 10+2 level | | | | | | | | | |
| Learning Outcome: | | | | | | | | | |
| The course will help the student to understand fundamentals of Environmental pollution and its control. | | | | | | | | | |
| Theory syllabus | | | | | | | | | |
| Unit | Content | | | | | | | | Hrs |
| 1 | Pollution and contamination of natural components of environment : Define pollution and contamination; sources of pollutants. Transport and fate of contamination in the environment. Isolation and screening of microbes degrading contamination (pollutants) : selective and enrichment cultivation techniques. Biodegradation : Definitions -Ready biodegradability, Ultimate biodegradation, Inferential biodegradability, Recalcitrant compound, Anthropogenic compounds (Xenobiotics). | | | | | | | | 11 |
| 2 | An overview of selected compounds : Petroleum hydrocarbons; Alkenes, Cycloalkanes, Aromatics, Polycyclic, Aromatics & Pesticides. Transformation of pesticides - DDT (Dechlorination) to DBP and Biomagnification Reductive dechlorination of PCE & TCE. Reductive dechlorination of Petroleum hydrocarbons. | | | | | | | | 11 |
| 3 | Water purification-Dwelling supply and Municipal Supply, Microbiological analysis of drinking water. Role of indicator organisms, W.H.O. microbiological standards for drinking water, Physical, chemical & Biological properties of Wastewater Primary & Secondary treatment, (Biological oxidation processes) & Tertiary treatment process. Treatment of solid wastes (Anaerobic digestion and composting). | | | | | | | | 12 |
| 4 | Bioremediation: types and overview of bioremediation of air, soil and water. Biofertilizers. Bioplastics. Bioleaching and MEOR (Microbially enhanced oil recovery). | | | | | | | | 12 |
| Text Books | | | | | | | | | |
| 1 | Atlas, R.M. (1997) Principles of Microbiology. (2nd ed.). Win. C Brown Publishers. Dubuque. | | | | | | | | |
| 2 | Tortora, G.J., Funke, B.R., Case, C.L. (2001) Microbiology: An Introduction. (7th Ed). Benjamin | | | | | | | | |

Cummings N.Y. Atlas & Bartha. Microbial Ecology.

Reference Books

1. APHA. Standard Methods for the Examination of Water and Wastewater 22nd Ed. (2012).
2. Arciwala, S. J. Waste water treatment for pollution control . Tata McGraw-Hill Publications, New Delhi.
3. Bruce E. Rittmann and Perry L. Mccarty. Environ mental Biotechnology: Principles and application, McGraw- Hill International.
4. Christson. Manual of Environmental Microbiology, ASM press.
5. Eugenia J. Olguin, Gloria Sanchez and Elizabeth Hernandez. Environmental Biotechnology and Cleaner Bioprocess, Taylor and Francis.
6. Martine Alexander. Biodegradation and Bioremediation.
7. Peter Morris (Editor), Riki Therivel. Methods of Environmental Impact Assessment.
8. Prescott, L.M., Harley, J.P., Klein. DA., (2002) Microbiology (5 th Ed Y McGraw Hiil. International Ed.

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FACULTY OF SCIENCE

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|--|---|-------------------------|-----------------|--------------|-------------------------------------|---------------|----|-----------|-------|
| Programme | | Bachelor of Science | | | Branch/Spec. | Biotechnology | | | |
| Semester | | V | | | Version | 1.0.0.0 | | | |
| Effective from Academic Year | | | 2015-16 | | Effective for the batch Admitted in | | | July 2013 | |
| Subject code | | UBTA 503 POI | | Subject Name | PRINCIPLES OF IMMUNOLOGY | | | | |
| Teaching scheme | | | | | Examination scheme (Marks) | | | | |
| (Per week) | Lecture(DT) | | Practical(Lab.) | | Total | CE | | SEE | Total |
| | L | TU | P | TW | | | | | |
| Credit | 03 | - | - | - | 03 | Theory | 40 | 60 | 100 |
| Hours | 03 | - | - | - | 03 | Practical | - | - | - |
| Pre-requisites: | | | | | | | | | |
| Students should have basic knowledge of Immune system of 10+2 level | | | | | | | | | |
| Learning Outcome: | | | | | | | | | |
| The course will help the student to understand components and role of Immune system. | | | | | | | | | |
| Theory syllabus | | | | | | | | | |
| Unit | Content | | | | | | | | Hrs |
| 1 | <p>Immunity : A. Concept of innate (native) and acquired (adaptive) immunity B. Types of immunity C. Innate immunity: species, racial and individual D. Acquired immunity: active and passive; natural and artificial E. Concept of herd immunity.</p> <p>Immune response (IR) : A. Concept and basic functions of IR, two arms (branches) of IR: Antibody mediated (humoral) and cell mediated immune (CMI). B. Characteristics of IR: Discrimination, diversity, specificity, memory and transferability C. Primary and secondary IR.</p> <p>Cells and organs of immune system: A. Lymphocytes as main actors; Types of lymphocytes, B-cells, T-cells and Null cells B. Importance of antigen presenting cells in IR C. An introduction to the primary (central) and secondary (peripheral) lymphoid organs.</p> <p>Introduction to the advanced concept of immunology : A. MHC and HLA, B. Clonal selection, C. Monoclonal antibodies.</p> | | | | | | | | 11 |
| 2 | <p>Antigens: A. Concept of antigen, immunogen and haptens, B. Physico-chemical and biological properties of antigens.</p> <p>Various types of antigens ABO blood group antigens, Rh antigen Antigens occurring in bacterial cell.</p> <p>Antibodies: A. Concept of antibody, immunoglobulin and myeloma proteins B. Basic structure of antibodies.</p> <p>A. Classes of immunoglobulins: Physicochemical and biological properties B. Antibody diversity</p> | | | | | | | | 11 |
| 3 | <p>Antigen-antibody reactions (serological reactions) & other immunological tests, Mechanism of Ag-Ab reactions (zone phenomenon); Concept of lattice formation.</p> <p>Principles and applications antigen-antibody reactions: i. Precipitin reaction ii. Agglutination reaction, iii. Complement fixation reaction, iv. Immunofluorescence, v. Enzyme Linked Immunosorbent Assay (ELISA), vi. Radio Immunoassay (RIA); Radio-Allergo-Sorbent test (RAST), vii. Western blot.</p> <p>Various skin tests.</p> <p>Measurement of cell mediated immune response (CMI)</p> | | | | | | | | 12 |

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| 4 | <p>Hypersensitivity – types I, II, III & IV. Autoimmune diseases – Immunotolerance, Autoantigen. Transplantation (Tissue) Rejection, types of grafts, mechanism of rejection, Graft versus Host Disease. Immunodeficiencies – Congenital and Acquired</p> | 12 |
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Text Books

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|---|--|
| 1 | Ananthanarayan and Paniker (2005) Textbook of Microbiology |
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Reference Books

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| 1. | A.K. Abbas, A.H. Uchtman, J.S. Pober (1994). Cellular Molecular immunology -W.B. Saunders Co.Philadelphia. |
| 2. | IM Roitt, J. Brostoff and DK Male (1993). Immunology. BMP, London. |
| 3. | J. Kuby (1991). Immunology. Freeman and company. |
| 4. | Jacqueline Sharon. Basic Immunology. |
| 5. | V.E. Cells (1994). Cell Biology Vol-I Immunology to III - Academic Press. |

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| | Antibiotic fermentation- Penicillin. | |
| Text Books | | |
| 1 | Casida L. E., "Industrial Microbiology" 2009 Reprint, New Age International (P) Ltd, Publishers, New Delhi | |
| 2 | Crueger W. and Crueger A. "Biotechnology -"A Textbook of Industrial Microbiology", latest Edition, Panima Publishing Corporation, New Delhi. | |
| 3 | Prescott and Dunn's "Industrial Microbiology" latest Edition, McMillan Publishers | |
| 4 | Ratledge & B. Kristinsen 2nd edn 2006. "Basic Biotechnology". Cambridge University Press. | |
| Reference Books | | |
| 1 | Agrawal A. K. and P. Parihar "Industrial Microbiology"- Fundamentals and Application AGRIBIOS (India) | |
| 2 | H. A. Modi, 2009. "Fermentation Technology" Vols 1 & 2, Pointer Publications, India | |
| 3 | Okafor Nkuda 2007 "Modern Industrial Microbiology and Biotechnology", Science Publications Enfield, NH, USA. | |
| 4 | Peppler, H. J. and Perlman, D. "Microbial Technology". Vol 1 & 2, Academic Press | |

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FACULTY OF SCIENCE

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|--|--|----|-----------------|----|-------------------------------------|---------------|-----|-------|-----|
| Programme | Bachelor of Science | | | | Branch/Spec. | Biotechnology | | | |
| Semester | V | | | | Version | 1.0.0.0 | | | |
| Effective from Academic Year | 2015-16 | | | | Effective for the batch Admitted in | July 2013 | | | |
| Subject code | USEA 505 BNF | | Subject Name | | BIOINFORMATICS | | | | |
| Teaching scheme | | | | | Examination scheme (Marks) | | | | |
| (Per week) | Lecture(DT) | | Practical(Lab.) | | Total | CE | SEE | Total | |
| | L | TU | P | TW | | | | | |
| Credit | 02 | - | - | - | 02 | Theory | 40 | 60 | 100 |
| Hours | 02 | - | - | - | 02 | Practical | - | - | - |
| Pre-requisites: | | | | | | | | | |
| Students should have basic knowledge of computer and Biological Data of 10+2 level | | | | | | | | | |
| Learning Outcome: | | | | | | | | | |
| The course will help the students to understand Basics and applications of Bioinformatics. | | | | | | | | | |
| Theory syllabus | | | | | | | | | |
| Unit | Content | | | | | | | | Hrs |
| 1 | Bioinformatics and Bioweb resources Introduction: History, scope and importance of bioinformatics Bioinformatics Applications: Phylogenetics, Pharmacogenomics (Drug Discovery), Crop Genomics (Agroinformatics), Metabolomics, Chemo informatics Introduction to Internet, Search Engines (Google, Yahoo, Entrez, SRS) Biological databases (Nucleotide, Protein). | | | | | | | | 15 |
| 2 | Biological data generation and Sequence Analysis Human Genome Project: Objective, History, major landmarks, Method of Sequencing Human Genome, Status of HGP, Application and ELSI Hap Map Project Biological sequence analysis ; Sequence similarity and alignment Sequence similarity tools (BLAST,FASTA) | | | | | | | | 15 |
| Text Books | | | | | | | | | |
| 1 | Bioinformatics: methods and Applications: by Rastoi | | | | | | | | |
| Reference Books | | | | | | | | | |
| 1 | Bioinformatics : Principles and Applications: by Zhumar Ghos and Bibekanand mallick | | | | | | | | |
| 2 | Developing Bioinformatics Computer Skills: by Cyntbia Gibas | | | | | | | | |
| 3 | Instant Notes: Bioinformatics: by Westhead | | | | | | | | |
| 4 | Introduction to Bioinformatics: by Arthur M Lesk | | | | | | | | |
| 5 | Introduction to Bioinformatics: by Attwood T K, Parry D J, Phukan Samiron, Pearson Education | | | | | | | | |

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|---|---|----|-----------------|-------------------------------------|---------------|-----------|-----|-----------|-----|
| Programme | Bachelor of Science | | | Branch/Spec. | Biotechnology | | | | |
| Semester | V | | | Version | 1.0.0.0 | | | | |
| Effective from Academic Year | 2015-16 | | | Effective for the batch Admitted in | July 2013 | | | | |
| Subject code | UENA 506 ENGLISH | | Subject Name | ENGLISH-V | | | | | |
| Teaching scheme | | | | Examination scheme (Marks) | | | | | |
| (Per week) | Lecture(DT) | | Practical(Lab.) | | Total | CE | SEE | Total | |
| | L | TU | P | TW | | | | | |
| Credit | 02 | - | - | - | 02 | Theory | 40 | 60 | 100 |
| Hours | 02 | - | - | - | 02 | Practical | - | - | - |
| Pre-requisites: | | | | | | | | | |
| Students should have basic knowledge of English language 10+2 level | | | | | | | | | |
| Learning Outcome: | | | | | | | | | |
| The course will help the students to understand Basics of Presentation skill and personality development. | | | | | | | | | |
| Theory syllabus | | | | | | | | | |
| Unit | Content | | | | | | | Hrs | |
| 1 | Great Expectations by Charles Dickens | | | | | | | 05 | |
| 2 | Great Expectations by Charles Dickens | | | | | | | 05 | |
| 3 | Presentation Skills & Personality Building <ul style="list-style-type: none"> ➤ Finding out about Environment, ➤ Preparing Text, ➤ Element of body language, ➤ Use of Visual Aids in Presentation ➤ Grooming etiquettes ➤ Avoiding boredom factors in a presentation | | | | | | | 09 | |
| 4 | Drafting an advertisement <ul style="list-style-type: none"> ➤ Essentials of drafting an advertisement ➤ Advertisement for Job Recruitment ➤ Advertisement Marketing a Product | | | | | | | 05 | |
| Text Books | | | | | | | | | |
| 1 | Business Communication by Rodha Doctor and Aspi Doctor | | | | | | | | |
| Reference Books | | | | | | | | | |
| 1 | Great Expectations by Charles Dickens | | | | | | | | |
| 2 | Business Communication by Urmila Rai & S. M. Rai | | | | | | | | |

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|------------------------------|-------------------------|-------------------------------------|-----------------------------|----|-----|-----------|
| Programme | Bachelor of Science | Branch/Spec. | Biotechnology | | | |
| Semester | V | Version | 1.0.0.0 | | | |
| Effective from Academic Year | 2015-16 | Effective for the batch Admitted in | July 2013 | | | |
| Subject code | UPBA 507 PRA | Subject Name | PRACTICAL MODULE - V | | | |
| Teaching scheme | | | Examination scheme (Marks) | | | |
| (Per week) | Lecture(DT) | Practical(Lab.) | Total | CE | SEE | Total |
| | L | TU | P | TW | | |
| Credit | | | 06 | | 06 | Theory |
| Hours | | | 12 | | 12 | Practical |
| | | | | | -- | 200 |
| | | | | | | 200 |

Pre-requisites:

Students should have basic knowledge of enzymes, Soil and water microbiology and immune cells of 10+2 level.

Learning Outcome:

The course will help the student to understand Screening of industrially important enzymes, characterizing soil and water properties and study of immune cells and components etc.

Practical content

Content

1. Isolation, Screening and characterization of Amylolytic microbes .
2. Isolation, Screening and characterization of Proteolytic microbes.
3. Isolation, Screening and characterization of Lipolytic microbes.
4. Screening of antibiotic producing microorganisms by Crowded Plate Technique.
5. Screening of antibiotic producing microorganisms by Wilkin's method.
6. Optimization of medium parameters for the production Enzyme (Amylases).
7. Fermentation of Alcohol/Citric acid/Amylase.
8. Isolation of antibiotic resistant mutant(s) bacterium by direct selection (Gradient Plate Technique)
9. Isolation of antibiotic resistant mutant(s) bacterium by indirect selection (Replica Plate Technique)
10. Determination of Total Solids (TS), Total Dissolved Solids (TDS) and Total Suspended Solids (TSS).
11. Estimation of Chloride from the given water sample.
12. Estimation of Sulfate from the given water sample.
13. Isolation of non-symbiotic nitrogen fixers from soil.
14. Isolation of symbiotic nitrogen fixers.
15. Total count of White Blood Cells (WBCs).

16. Total count of Red Blood Cells (RBCs).
17. Differential Count of White Blood Cells (WBCs).
18. Estimation Hemoglobin by Sahli's Method.
19. Blood grouping
20. WIDAL test (Slide Test)
21. Usage of NCBI resources for Biological Information.

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| Text Books | |
| 1 | Practical Microbiology by Rakesh Patel |
| Reference Books | |
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|------------------------------|---------------------|-------------------------------------|----------------------------|-----------|-----|-------|-----|
| Programme | Bachelor of Science | Branch/Spec. | Biotechnology | | | | |
| Semester | V | Version | 1.0.0.0 | | | | |
| Effective from Academic Year | 2015-16 | Effective for the batch Admitted in | July 2013 | | | | |
| Subject code | UBTA 501 MIG | Subject Name | Microbial Genetics | | | | |
| Teaching scheme | | | Examination scheme (Marks) | | | | |
| (Per week) | Lecture(DT) | Practical(Lab.) | Total | CE | SEE | Total | |
| | L | TU | P | TW | | | |
| Credit | 03 | | 03 | Theory | 30 | 70 | 100 |
| Hours | 03 | | 03 | Practical | -- | 200 | 200 |

Pre-requisites:

Students should have basic knowledge of Genetics of 10+2 level

Learning Outcome:

The course will help the student to understand fundamentals of central dogma in microorganisms and its significance.

Theory syllabus

| Unit | Content | Hrs |
|------|---|-----|
| 1 | 1.1 Nature of Genetic material :Understanding of terms: Gene, allele, genotype, phenotype, intron, exon, cistron, recon, muton, plasmid, chromosome, genome, zygote, merozygote 1.2 Experimental proof for DNA as genetic material: Work of Griffith; Avery, Mc Carty and MacLeod; Hershey and Chase 1.3 A. Historical perspective— conservative, dispersive, semi-conservative, Bidirectional and semi-discontinuous, B. Prokaryotic DNA replication – Details of molecular mechanism Involved in Initiation, Elongation and Termination, Enzymes and proteins associated with DNA replication, C. Eukaryotic DNA replication-- Molecular details of DNA synthesis, replicating the ends of the chromosomes D. Rolling circle mode of replication 1.4 Post-replicative modifications and their significance | 11 |
| 2 | 2.1 Transcription A. Initiation, role of enzyme, sigma factor, promoter, operator B. Elongation, C. Termination: Rho dependent and Rho independent 2.2 Genetic code: Properties and codon usage 2.3 Translation: A. Initiation, 70 S initiation complex, B. Elongation: recognition, peptidyl transfer, translocation C. Termination. D. Fate of ribosomes, polysome system, polycistronic RNA 2.4 Regulation of gene expression A. Negative inducible control - lac operon, B. Positive regulation - lac operon C. Negative repressible control - trp operon | 11 |
| 3 | 3.1 Mutation B. Terminology: alleles, homozygous, heterozygous, genotype, phenotype, Somatic mutation, Germline mutation, Gene mutation, Chromosome mutation, phenotypic lag, hotspots and mutator genes. Fluctuation test 3.2 Types of mutations: Point mutation, reverse mutation, suppressor mutation, frame shift mutation, conditional lethal mutation, base pair substitution, transition, transversion, missense mutation, nonsense mutation, silent mutation, neutral mutation, pleiotropic mutations. 3.3 Chemical Agents: Mode of action and application of Phenol, alcoholic and halogen compounds 3.3 Causes of mutation: A. Natural/spontaneous mutation--replication error, depurination, | 12 |

| | | |
|--------------------------|--|----|
| | <p>deamination.</p> <p>B. Induced mutation: principle and mechanism with illustrative diagrams for-</p> <p>i. Chemical mutagens- base analogues, nitrous acid, hydroxyl amine, intercalating agents and alkylating agents</p> <p>ii. Physical mutagen, iii. Biological mutagen (only examples)</p> <p>C. Ames test</p> <p>D. Detection of mutants</p> <p>3.4 DNA Repair: Mismatch repair, Light repair, Repair of alkylation damage, Base excision repair, Nucleotide excision repair, SOS repair</p> | |
| 4 | <p>4.1 Transformation: Types of transformation in prokaryotes—Natural transformation in <i>Streptococcus pneumoniae</i>, <i>Haemophilus influenzae</i>, and <i>Bacillus subtilis</i>, Mapping of bacterial genes using transformation</p> <p>4.2 Conjugation: Properties of F plasmid/Sex factor, The conjugation machinery, Hfr strains, their formation and mechanism of conjugation, F' factor, origin and behavior of F' strains, Sexduction, Mapping of bacterial genes using conjugation (Wolman and Jacob experiment)</p> <p>4.3 Transduction</p> <p>i. Introduction and discovery, ii. Generalised transduction</p> <p>iii. Use of Generalised transduction for mapping genes, iv. Specialised transduction</p> <p>4.4 A. Plasmids: Nature and its types</p> <p>B. Transposable Elements in Prokaryotes: a. Insertion sequences b. Transposons</p> <p>C. Recombination in bacteria: a. General/Homologous recombination i. Molecular mechanism, ii. Holliday model of recombination, b. Site –specific recombination</p> | 12 |
| Text Books | | |
| 1 | JD Watson, "Molecular biology of the gene", latest edn. | |
| 2 | Benjamin Lewin, "Genes IX", , Jones and Bartlett publishers. | |
| Reference Books | | |
| | <p>11. Benjamin A. Pierce, "Genetics a conceptual approach", 5th ed., W. H. Freeman and company.</p> <p>12. D. Nelson and M. Cox, (2005), "Lehninger's Principles of biochemistry", 4th ed., Macmillan worth Publishers.</p> <p>13. Fairbanks and Anderson, (1999), "Genetics", Wadsworth Publishing Company.</p> <p>14. M. Madigan, J. Martinko, J. Parkar, (2009), "Brock Biology of microorganisms", 12th ed., Pearson Education International.</p> <p>15. Nancy Trun and Janine Trempey, (2004), "Fundamental bacterial genetics", Blackwell Publishing</p> <p>16. Peter J. Russell (2009), "Genetics-A molecular approach", 3rd ed.</p> <p>17. Prescott, Harley and Klein, "Microbiology", . 7th edition Mc Graw Hill international edition.</p> <p>18. R. H. Tamarin, (2010), "Principles of genetics", 7th edition. Tata McGraw Hill.</p> <p>19. Robert Weaver, "Molecular biology", , 3rd edn. Mc Graw Hill international edition.</p> <p>20. Snustad, Simmons, "Principles of genetics", latest edn. John Wiley & sons, Inc.</p> | |
| Practical Content | | |
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GANPAT UNIVERSITY

FACULTY OF SCIENCE

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|---|---|-------------------------------|-----------------|--------------|-------------------------------------|------------------------------------|---------------|-----|-------|
| Programme | | Bachelor of Science | | | Branch/Spec. | | Biotechnology | | |
| Semester | | V | | | Version | | 1.0.0.0 | | |
| Effective from Academic Year | | 2015-16 | | | Effective for the batch Admitted in | | July 2013 | | |
| Subject code | | UBTA 502 EBT | | Subject Name | | ENVIRONMENTAL BIOTECHNOLOGY | | | |
| Teaching scheme | | | | | Examination scheme (Marks) | | | | |
| (Per week) | Lecture(DT) | | Practical(Lab.) | | Total | | CE | SEE | Total |
| | L | TU | P | TW | | | | | |
| Credit | 03 | - | - | - | 03 | Theory | 30 | 70 | 100 |
| Hours | 03 | - | - | - | 03 | Practical | -- | - | - |
| Pre-requisites: | | | | | | | | | |
| Students should have basic knowledge of Environment of 10+2 level | | | | | | | | | |
| Learning Outcome: | | | | | | | | | |
| The course will help the student to understand fundamentals of Environmental pollution and its control. | | | | | | | | | |
| Theory syllabus | | | | | | | | | |
| Unit | Content | | | | | | | | Hrs |
| 1 | Pollution and contamination of natural components of environment : Define pollution and contamination; sources of pollutants. Transport and fate of contamination in the environment. Isolation and screening of microbes degrading contamination (pollutants) : selective and enrichment cultivation techniques. Biodegradation : Definitions -Ready biodegradability, Ultimate biodegradation, Inferential biodegradability, Recalcitrant compound, Anthropogenic compounds (Xenobiotics). | | | | | | | | 11 |
| 2 | An overview of selected compounds : Petroleum hydrocarbons; Alkenes, Cycloalkanes, Aromatics, Polycyclic, Aromatics & Pesticides. Transformation of pesticides - DDT (Dechlorination) to DBP and Biomagnification Reductive dechlorination of PCE & TCE. Reductive dechlorination of Petroleum hydrocarbons. | | | | | | | | 11 |
| 3 | Water purification-Dwelling supply and Municipal Supply, Microbiological analysis of drinking water. Role of indicator organisms, W.H.O. microbiological standards for drinking water, Physical, chemical & Biological properties of Wastewater Primary & Secondary treatment, (Biological oxidation processes) & Tertiary treatment process. Treatment of solid wastes (Anaerobic digestion and composting). | | | | | | | | 12 |
| 4 | Bioremediation: types and overview of bioremediation of air, soil and water. Biofertilizers. Bioplastics. Bioleaching and MEOR (Microbially enhanced oil recovery). | | | | | | | | 12 |
| Text Books | | | | | | | | | |
| 1 | Atlas, R.M. (1997) Principles of Microbiology. (2nd ed.). Win. C Brown Publishers. Dubuque. | | | | | | | | |
| 2 | Tortora, G.J., Funke, B.R., Case, C.L. (2001) Microbiology: An Introduction. (7th Ed). Benjamin | | | | | | | | |

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| | Cummings N.Y. Atlas & Bartha. Microbial Ecology. |
| Reference Books | |
| | <p>9. APHA. Standard Methods for the Examination of Water and Wastewater 22nd Ed. (2012).</p> <p>10. Arciwala, S. J. Waste water treatment for pollution control . Tata McGraw-Hill Publications, New Delhi.</p> <p>11. Bruce E. Rittmann and Perry L. Mccarty. Environ mental Biotechnology: Principles and application, McGraw- Hill International.</p> <p>12. Christson. Manual of Environmental Microbiology, ASM press.</p> <p>13. Eugenia J. Olguin, Gloria Sanchez and Elizabeth Hernandez. Environmental Biotechnology and Cleaner Bioprocess, Taylor and Francis.</p> <p>14. Martine Alexander. Biodegradation and Bioremediation.</p> <p>15. Peter Morris (Editor), Riki Therivel. Methods of Environmental Impact Assessment.</p> <p>16. Prescott, L.M., Harley, J.P., Klein. DA., (2002) Microbiology (5 th Ed Y McGraw Hiil. International Ed.</p> |

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|--|---|----|-----------------|-------------------------------------|----------------------------|-----------|-----|-------|-----|
| Programme | Bachelor of Science | | | Branch/Spec. | Biotechnology | | | | |
| Semester | V | | | Version | 1.0.0.0 | | | | |
| Effective from Academic Year | 2015-16 | | | Effective for the batch Admitted in | July 2013 | | | | |
| Subject code | UBTA 503 POI | | Subject Name | PRINCIPLES OF IMMUNOLOGY | | | | | |
| Teaching scheme | | | | | Examination scheme (Marks) | | | | |
| (Per week) | Lecture(DT) | | Practical(Lab.) | | Total | CE | SEE | Total | |
| | L | TU | P | TW | | | | | |
| Credit | 03 | - | - | - | 03 | Theory | 30 | 70 | 100 |
| Hours | 03 | - | - | - | 03 | Practical | - | - | - |
| Pre-requisites: | | | | | | | | | |
| Students should have basic knowledge of Immune system of 10+2 level | | | | | | | | | |
| Learning Outcome: | | | | | | | | | |
| The course will help the student to understand components and role of Immune system. | | | | | | | | | |
| Theory syllabus | | | | | | | | | |
| Unit | Content | | | | | | | Hrs | |
| 1 | <p>Immunity : A. Concept of innate (native) and acquired (adaptive) immunity B. Types of immunity C. Innate immunity: species, racial and individual D. Acquired immunity: active and passive; natural and artificial E. Concept of herd immunity.</p> <p>Immune response (IR) : A. Concept and basic functions of IR, two arms (branches) of IR: Antibody mediated (humoral) and cell mediated immune (CMI). B. Characteristics of IR: Discrimination, diversity, specificity, memory and transferability C. Primary and secondary IR.</p> <p>Cells and organs of immune system: A. Lymphocytes as main actors; Types of lymphocytes, B-cells, T-cells and Null cells B. Importance of antigen presenting cells in IR C. An introduction to the primary (central) and secondary (peripheral) lymphoid organs.</p> <p>Introduction to the advanced concept of immunology : A. MHC and HLA, B. Clonal selection, C. Monoclonal antibodies.</p> | | | | | | | 11 | |
| 2 | <p>Antigens: A. Concept of antigen, immunogen and haptent, B. Physico-chemical and biological properties of antigens.</p> <p>Various types of antigens ABO blood group antigens, Rh antigen Antigens occurring in bacterial cell.</p> <p>Antibodies: A. Concept of antibody, immunoglobulin and myeloma proteins B. Basic structure of antibodies.</p> <p>A. Classes of immunoglobulins: Physicochemical and biological properties B. Antibody diversity</p> | | | | | | | 11 | |
| 3 | <p>Antigen-antibody reactions (serological reactions) & other immunological tests, Mechanism of Ag-Ab reactions (zone phenomenon); Concept of lattice formation. Principles and applications antigen-antibody reactions: i. Precipitin reaction ii. Agglutination reaction, iii. Complement fixation reaction, iv. Immunofluorescence, v. Enzyme Linked Immunosorbent Assay (ELISA), vi. Radio Immunoassay (RIA); Radio-Allergo-Sorbent test (RAST), vii. Western blot.</p> <p>Various skin tests.</p> <p>Measurement of cell mediated immune response (CMI)</p> | | | | | | | 12 | |

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| 4 | <p>Hypersensitivity – types I, II, III & IV. Autoimmune diseases – Immunotolerance, Autoantigen. Transplantation (Tissue) Rejection, types of grafts, mechanism of rejection, Graft versus Host Disease. Immunodeficiencies – Congenital and Acquired</p> | 12 |
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Text Books

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| 1 | Ananthanarayan and Paniker (2005) Textbook of Microbiology |
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Reference Books

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| 6. | A.K. Abbas, A.H. Uchtman, J.S. Pober (1994). Cellular Molecular immunology -W.B. Saunders Co.Philadelphia. |
| 7. | IM Roitt, J. Brostoff and DK Male (1993). Immunology. BMP, London. |
| 8. | J. Kuby (1991). Immunology. Freeman and company. |
| 9. | Jacqueline Sharon. Basic Immunology. |
| 10. | V.E. Cells (1994). Cell Biology Vol-I Immunology to III - Academic Press. |

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|--|--|----|-----------------|----|---|---------------|-----|-------|-----|
| Programme | Bachelor of Science | | | | Branch/Spec. | Biotechnology | | | |
| Semester | V | | | | Version | 1.0.0.0 | | | |
| Effective from Academic Year | 2015-16 | | | | Effective for the batch Admitted in | July 2013 | | | |
| Subject code | UBTA 504 BBE | | Subject Name | | BIOPROCESS AND BIOCHEMICAL ENGINEERING | | | | |
| Teaching scheme | | | | | Examination scheme (Marks) | | | | |
| (Per week) | Lecture(DT) | | Practical(Lab.) | | Total | CE | SEE | Total | |
| | L | TU | P | TW | | | | | |
| Credit | 03 | - | - | - | 03 | Theory | 30 | 70 | 100 |
| Hours | 03 | - | - | - | 03 | Practical | - | - | - |
| Pre-requisites: | | | | | | | | | |
| Students should have basic knowledge of Fermentation of 10+2 level | | | | | | | | | |
| Learning Outcome: | | | | | | | | | |
| The course will help the students to understand Fermentation media Formulation and production of Industrially important metabolites. | | | | | | | | | |
| Theory syllabus | | | | | | | | | |
| Unit | Content | | | | | | | | Hrs |
| 1 | Concept of fermentation and changing phases in industrial microbiology. Stages in development of fermentation process (component parts). Range of fermentation processes. Screening of industrially important organisms : A. Characteristics of an industrially ideal organism, B. Primary screening of amylase, organic acid, antibiotics and amino acid producers, C. Introduction to secondary screening | | | | | | | | 11 |
| 2 | 1. Introduction: A. Principles of media formulation B. Media ingredients: Water, carbon sources, nitrogen sources, minerals, growth factors, buffers, precursors, inducers, inhibitors, antifoam agents. Sterilization of media, Use of high-pressure steam: Principle, batch and continuous sterilization process. Use of filtration: Principle, types of filters. Inoculum development: General principles for development of seed culture. | | | | | | | | 11 |
| 3 | Mode of operation (Batch, fed-batch, semi-continuous, continuous, SSF). Power Input for mixing (mechanical, hydrodynamic and pneumatic). Types of fermentors - typical constructional features and their importance in the specific processes. i. Mechanical - Waldhof fermenter, trickling generator ii. Hydrodynamic- deep-jet fermenter iii. Pneumatic - air-lift fermenter, bubble-cap fermenter, acetator, cavitator. iv. Animal cell culture reactors. v. Photo-bioreactor, tower and packed tower fermenters Process parameter monitoring and control Temperature, flow, pressure, dissolved oxygen, foam, inlet and exit gases, pH. | | | | | | | | 12 |

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| 4 | Solvent fermentation- Alcohol. Organic acid fermentation- Citric acid. Enzyme fermentation- Amylase. Antibiotic fermentation- Penicillin. | 12 |
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Text Books

- 1 Casida L. E., "Industrial Microbiology" 2009 Reprint, New Age International (P) Ltd, Publishers, New Delhi
- 2 Crueger W. and Crueger A. "Biotechnology -"A Textbook of Industrial Microbiology", latest Edition, Panima Publishing Corporation, New Delhi.
- 3 Prescott and Dunn's "Industrial Microbiology" latest Edition, McMillan Publishers
- 4 Ratledge & B. Kristinsen 2nd edn 2006. "Basic Biotechnology". Cambridge University Press.

Reference Books

- 1 Agrawal A. K. and P. Parihar "Industrial Microbiology"- Fundamentals and Application AGRIBIOS (India)
- 2 H. A. Modi, 2009. "Fermentation Technology" Vols 1 & 2, Pointer Publications, India
- 3 Okafor Nkuda 2007 "Modern Industrial Microbiology and Biotechnology", Science Publications Enfield, NH, USA.
- 4 Peppler, H. J. and Perlman, D. "Microbial Technology". Vol 1 & 2, Academic Press

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|--|--|----|-----------------|----|-------------------------------------|---------------|-----|-------|-----|
| Programme | Bachelor of Science | | | | Branch/Spec. | Biotechnology | | | |
| Semester | V | | | | Version | 1.0.0.0 | | | |
| Effective from Academic Year | 2015-16 | | | | Effective for the batch Admitted in | July 2013 | | | |
| Subject code | USEA 505 BNF | | Subject Name | | BIOINFORMATICS | | | | |
| Teaching scheme | | | | | Examination scheme (Marks) | | | | |
| (Per week) | Lecture(DT) | | Practical(Lab.) | | Total | CE | SEE | Total | |
| | L | TU | P | TW | | | | | |
| Credit | 02 | - | - | - | 02 | Theory | 30 | 70 | 100 |
| Hours | 02 | - | - | - | 02 | Practical | - | - | - |
| Pre-requisites: | | | | | | | | | |
| Students should have basic knowledge of computer and Biological Data of 10+2 level | | | | | | | | | |
| Learning Outcome: | | | | | | | | | |
| The course will help the students to understand Basics and applications of Bioinformatics. | | | | | | | | | |
| Theory syllabus | | | | | | | | | |
| Unit | Content | | | | | | | | Hrs |
| 1 | Bioinformatics and Bioweb resources Introduction: History, scope and importance of bioinformatics Bioinformatics Applications: Phylogenetics, Pharmacogenomics (Drug Discovery), Crop Genomics (Agroinformatics), Metabolomics, Chemo informatics Introduction to Internet, Search Engines (Google, Yahoo, Entrez, SRS) Biological databases (Nucleotide, Protein). | | | | | | | | 15 |
| 2 | Biological data generation and Sequence Analysis Human Genome Project: Objective, History, major landmarks, Method of Sequencing Human Genome, Status of HGP, Application and ELSI Hap Map Project Biological sequence analysis ; Sequence similarity and alignment Sequence similarity tools (BLAST,FASTA) | | | | | | | | 15 |
| Text Books | | | | | | | | | |
| 1 | Bioinformatics: methods and Applications: by Rastoi | | | | | | | | |
| Reference Books | | | | | | | | | |
| 1 | Bioinformatics : Principles and Applications: by Zhumar Ghos and Bibekanand mallick | | | | | | | | |
| 2 | Developing Bioinformatics Computer Skills: by Cyntbia Gibas | | | | | | | | |
| 3 | Instant Notes: Bioinformatics: by Westhead | | | | | | | | |
| 4 | Introduction to Bioinformatics: by Arthur M Lesk | | | | | | | | |
| 5 | Introduction to Bioinformatics: by Attwood T K, Parry D J, Phukan Samiron, Pearson Education | | | | | | | | |

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FACULTY OF SCIENCE

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|---|--|----|-----------------|-------------------------------------|----------------------------|-----------|-----|-----------|-----|
| Programme | Bachelor of Science | | | Branch/Spec. | Biotechnology | | | | |
| Semester | V | | | Version | 1.0.0.0 | | | | |
| Effective from Academic Year | 2015-16 | | | Effective for the batch Admitted in | July 2013 | | | | |
| Subject code | UENA 506 ENGLISH | | Subject Name | ENGLISH-V | | | | | |
| Teaching scheme | | | | | Examination scheme (Marks) | | | | |
| (Per week) | Lecture(DT) | | Practical(Lab.) | | Total | CE | SEE | Total | |
| | L | TU | P | TW | | | | | |
| Credit | 02 | - | - | - | 02 | Theory | 30 | 70 | 100 |
| Hours | 02 | - | - | - | 02 | Practical | - | - | - |
| Pre-requisites: | | | | | | | | | |
| Students should have basic knowledge of English language 10+2 level | | | | | | | | | |
| Learning Outcome: | | | | | | | | | |
| The course will help the students to understand Basics of Presentation skill and personality development. | | | | | | | | | |
| Theory syllabus | | | | | | | | | |
| Unit | Content | | | | | | | Hrs | |
| 1 | Great Expectations by Charles Dickens | | | | | | | 05 | |
| 2 | Great Expectations by Charles Dickens | | | | | | | 05 | |
| 3 | Presentation Skills & Personality Building <ul style="list-style-type: none"> ➤ Finding out about Environment, ➤ Preparing Text, ➤ Element of body language, ➤ Use of Visual Aids in Presentation ➤ Grooming etiquettes ➤ Avoiding boredom factors in a presentation | | | | | | | 09 | |
| 4 | Drafting an advertisement <ul style="list-style-type: none"> ➤ Essentials of drafting an advertisement ➤ Advertisement for Job Recruitment ➤ Advertisement Marketing a Product | | | | | | | 05 | |
| Text Books | | | | | | | | | |
| 1 | Business Communication by Rodha Doctor and Aspi Doctor | | | | | | | | |
| Reference Books | | | | | | | | | |
| 1 | Great Expectations by Charles Dickens | | | | | | | | |
| 2 | Business Communication by Urmila Rai & S. M. Rai | | | | | | | | |

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FACULTY OF SCIENCE

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|------------------------------|---------------------|----|-----------------|-------------------------------------|---------------|-----------|-----|-------|
| Programme | Bachelor of Science | | | Branch/Spec. | Biotechnology | | | |
| Semester | V | | | Version | 1.0.0.0 | | | |
| Effective from Academic Year | 2015-16 | | | Effective for the batch Admitted in | July 2013 | | | |
| Subject code | UPBA 507 PRA | | Subject Name | PRACTICAL MODULE - V | | | | |
| Teaching scheme | | | | Examination scheme (Marks) | | | | |
| (Per week) | Lecture(DT) | | Practical(Lab.) | | Total | CE | SEE | Total |
| | L | TU | P | TW | | | | |
| Credit | | | 06 | | 06 | Theory | | |
| Hours | | | 12 | | 12 | Practical | -- | 200 |

Pre-requisites:

Students should have basic knowledge of enzymes, Soil and water microbiology and immune cells of 10+2 level.

Learning Outcome:

The course will help the student to understand Screening of industrially important enzymes, characterizing soil and water properties and study of immune cells and components etc.

Practical content

Content

21. Isolation, Screening and characterization of Amylolytic microbes .
22. Isolation, Screening and characterization of Proteolytic microbes.
23. Isolation, Screening and characterization of Lipolytic microbes.
24. Screening of antibiotic producing microorganisms by Crowded Plate Technique.
25. Screening of antibiotic producing microorganisms by Wilkin's method.
26. Optimization of medium parameters for the production Enzyme (Amylases).
27. Fermentation of Alcohol/Citric acid/Amylase.
28. Isolation of antibiotic resistant mutant(s) bacterium by direct selection (Gradient Plate Technique)
29. Isolation of antibiotic resistant mutant(s) bacterium by indirect selection (Replica Plate Technique)
30. Determination of Total Solids (TS), Total Dissolved Solids (TDS) and Total Suspended Solids (TSS).
31. Estimation of Chloride from the given water sample.
32. Estimation of Sulfate from the given water sample.
33. Isolation of non-symbiotic nitrogen fixers from soil.
34. Isolation of symbiotic nitrogen fixers.
35. Total count of White Blood Cells (WBCs).

- 36. Total count of Red Blood Cells (RBCs).
- 37. Differential Count of White Blood Cells (WBCs).
- 38. Estimation Hemoglobin by Sahli's Method.
- 39. Blood grouping
- 40. WIDAL test (Slide Test)
- 21. Usage of NCBI resources for Biological Information.

Text Books

1 Practical Microbiology by Rakesh Patel

Reference Books

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