S.Y.B.Sc. (CBCS – 2018 Course)  
SEM. - III  
P – 31: MATHEMATICAL METHODS FOR PHYSICS

Total Credits:  04  
Total Lectures:  60

Course Learning Outcomes:
By the end of this course student will be able to have following learning outcomes,

• Understanding of how partial differentiation works and different types of coordinates systems
• Ability to explain complex algebra using their different forms, associated theorems and trigonometric functions
• Explain the vector algebra and vector analysis
• Understanding of different vector identities and their physical significance

Course Content:
1. Partial Differentiation:    (16)
   Introduction, Idea, Definition and notation of partial differentiation, rules for obtaining partial derivative, total differential, exact differential, chain rule, Theorems of differentiation, change variables from the Cartesian to Spherical polar co-ordinates, problems based on change of variables, maxima and minima (Qualitative treatment), Problems, Frequently occurring differential equations (Cartesian coordinates), Degree, order, linearity and homogeneity of differential equation.

2. Complex Algebra:    (16)
   Complex Numbers, algebra of complex numbers, complex conjugate. Argand Diagram, Algebra of complex numbers by using Argand diagrams; Rectangular and polar form of complex numbers; Exponential form of complex numbers; Euler's relations De-Moivre's theorem (statement only), Trigonometric functions; exponential and hyperbolic functions, powers and roots of complex numbers; Applications of complex numbers to determine velocity and acceleration in Curved motion, Problems.

3. Vector Algebra    (08)

4. Vector Analysis:    (20)
   Introduction, differentiation of a vector with respect to scalar, scalar and vector fields, Vector differential operator and Laplacian operator, gradient of a scalar, physical significance of a gradient of a scalar, physical significance of divergence of a vector field, curl of a vector field, its physical significances, del operator, some vector identities, Problems.

(a)  \( \nabla \times \nabla \phi = 0 \),  
(b)  \( \nabla.(\nabla \times \mathbf{V}) = 0 \),  
(c)  \( \nabla.(\nabla \phi) = (\nabla \cdot \nabla) \phi \),  
(d)  \( \nabla.(\phi \mathbf{A}) = \nabla \phi \cdot \mathbf{A} + \phi.( \nabla \cdot \mathbf{A}) \),  
(e)  \( \nabla \times (\nabla \mathbf{A}) = \mathbf{\phi} (\nabla \times \mathbf{A}) + (\nabla \phi) \times \mathbf{A} \),  
(f)  \( \nabla.(\mathbf{A} \times \mathbf{B}) = \mathbf{B} . (\nabla \times \mathbf{A}) - \mathbf{A} . (\nabla \times \mathbf{B}) \)
**Reference books:**

1. A Course in Mathematics - Laud and Takawale
3. Mathematical Physics - B.D. Gupta and Gupta
4. Vector Analysis - Spiegel (Schaum Series)
5. Mathematical Physics - B.S. Rajput (Pragati prakashan)
Course Learning Outcomes:
By the end of this course student will be able to have following learning outcomes,

- Understanding the basics of optics
- Properties of light such as interference, diffraction and polarization
- Applications of properties of light in modern world

Course Content:

1. Geometrical Optics: (10)
   - Introduction, thin and thick Lenses, Sign convention, lens equation for thin lenses, Lens maker equation, Magnification of thin lens, Deviation by thin lens, Power of thin lens, Equivalent focal length of two thin lenses, Cardinal points, Optical instruments: Simple Microscope, Compound Microscope, Eyepieces - Ramsden and Huygen's Eyepieces, their merits and demerits, Problems.

2. Interference: (20)
   - Introduction - (Revision of Idea of coherence, Analytical treatment of interference - Intensity distribution in interference pattern, classification of interference), phase change on reflection (Stoke's treatment). Interference by parallel sided thin films, fringes of equal thickness (conditions for maxima and minima only), interference in thin wedge shaped films (normal incidence), Newton's rings. Theory and its application to determine wavelength of light, refractive index of liquid and flatness testing (Brief description)

3. Diffraction: (20)
   - Concept of diffractions, Fresnel and Fraunhofer diffractions - Fraunhofer diffraction at a single slit. Theory of plane transmission grating, intensity distribution in diffraction pattern, Fresnel diffraction - rectilinear propagation of light, simple theory of zone plate, Rayleigh's criteria of resolution, Resolving power, R.P of prism and transmission grating, crystal as a diffraction grating, Bragg's diffraction condition, Problems.

4. Polarization: (10)
   - Introduction to polarization, Methods to produce polarized light, Brewster's law, polarization by refractionpile of plates, Law of Malus polarization by reflection, detection of polarized light, polarized by selective absorption, Double refraction in uniaxial crystals, Construction of polarizer, Quarter and Half Wave plates, Nicol prism, Problems

Reference Books

1. Geometrical and Physical Optics - Jenkins and White
2. Optics - Ajay Ghatak 2nd edition
3. Principles of optics - D.S. Mathur, Gopal Press, Kanpur
4. Optics - Brijlal and Subramanyarn
5. Optics - Ghatak Loknathan.
7. Lasers and Non-linear light - Dr. B.B. Laud
S.Y.B.Sc. (CBCS – 2018 Course)
SEM. - III
P – 33: PRACTICAL COURSE - III

Total Credits: 02
Total Lectures : 60

Learning Outcome:
1. Study of acceleration due to gravity 'g' by resonance pendulum
2. Study of coupled oscillators
3. Measurement of Young’s modulus and modulus of rigidity
4. To understand Zener stabilized power supply.
5. To know diode as rectifier and calculation or ripple factor

Course Content:
1. 'g' by resonance pendulum - change in length of simple pendulum for two different amplitudes of compound pendulum.
2. Log decrement - Determination of Log decrement in air
3. Study of coupled oscillators comprising two simple pendulum (Mechanical) and determination of coupling coefficient.
4. Study of musical scales using a signal generator and musical instruments.
5. Determination of frequency of AC mains using sonometer.
6. Measurement of coefficient of absorption of sound for different materials (cork, thermocol, mica, paper etc.)
8. Y by vibration of wooden bar.
9. Velocity of Sound by phase shift method.
10. Study of acoustic resonance by using bottle as a resonator.
11. Newton's Ring: Determination of wavelength of monochromatic light source
12. Dispersive power of glass prism
13. Measurement of beam divergence / beam size of a LASER beam
14. Diffraction at the edge of a razor blade.
15. Optical activity of sugar solution (polarimeter)
16. Wavelengths of any three colors in the Hg spectrum using Diffraction Grating.
17. Zener stabilized power supply, load and line regulation and % ripple factor
18. Study of rectifiers & calculation of ripple factor with & without filter

Note: At least 8 experiments should be performed from the course

REFERENCE BOOKS:
1. Advanced Practical Physics - Worsnop and Flint
2. Advanced Practical Physics Vol I and 2, - Chauhan and Singh
3. Experimental Physics - Rajopadhye and Purohit
4. B.Sc. Practical Physics - C. N. Arora
5. Physics through Experiments Vol. 1, Mechanical System - B. Saraf
S.Y.B.Sc (CBCS-2018 Course)  
SEMESTER – III  
C - 31 : PHYSICAL & ANALYTICAL CHEMISTRY-I

Credits: 04  
Total Lectures: 60

Course Learning Outcomes:

After completion of this course students should be able to:
1. Know the meaning of conductance, specific conductance, molecular conductance etc.
2. Understand the efficiency of Carnot cycle.
3. Solve numerical based on entropy.
4. Study the real meaning of sampling.
5. Realize the actual calculations of significant figures.
6. Analyse qualitative and quantitative estimation of C,H,(O)

Course Content:

SECTION - I (PHYSICAL CHEMISTRY)

1. Electrochemistry  
   Introduction, Conduction of electricity, Types of conductors: electronic and electrolytic,  
   Explanation of the Terms: Specific, equivalent and molecular conductance’s, relation  
   between specific and equivalent conductance, variation of conductance with dilution,  
   equivalent conductance at infinite dilution, Measurement of Conductance by Wheatstone  
   Bridge, Types of Conductivity cells, Cell constant and its determination, Migration of  
   Ions, Hittorf's Rule (Migration), Transport number, Determination of transport number  
   by moving boundary method, Factors influencing transport number: Concentration,  
   Temperature, Complex formation, Abnormal transport number, Degree of hydration,  
   Kohlrausch Law: i) Relation between ionic conductance, ionic mobility and transport  
   number ii) Determination of equivalence conductance at infinite dilution for weak  
   electrolytes iii) Determination of degree of dissociation iv) Determination of  
   product of water v) Determination of solubility and solubility product of sparingly  
   soluble salts.
   Conductometric Titrations: Theory, general procedure, different types of conductometric  
   titrations and applications of conductometric titrations.
   Ref.7 Page no. 339-464.

2. Thermodynamics - I  
   Spontaneous and non-spontaneous process, Second law of thermodynamics and its  
   different statements, Carnot's Theorem (Heat engine), Carnot cycle and its efficiency.  
   Numerical.  
   Ref.1 and 2.

3. Thermodynamics - II  
   Entropy: Introduction, Concept of entropy, Entropy as a state function, Definition  
   mathematical expression, unit, physical significance of entropy, Entropy changes for  
   reversible and irreversible processes in isolated system, Entropy changes for an ideal  
   gas as a function of V and T and as a function of P and T, Entropy change in mixing of gases.  
   Entropy change in Physical transformations: (i) Fusion of a solid.(ii) Vaporization of a  
   liquid. (iii) Transition from one crystalline form to another.
   Third law of thermodynamics, Absolute entropy and Evaluation of absolute entropy, Use  
   of absolute entropies: Determination of entropy changes in chemical reactions.
   Ref.1 and 2.
REFERENCE BOOKS:

SECTION – II (ANALYTICAL CHEMISTRY)

1) Importance of Analytical Chemistry and Sampling [04]
The analytical process, types of analytical techniques and their comparison. Sampling, storage of samples, sampling of solids, liquids and gases.

2) Errors in Quantitative Analysis. [06]
Accuracy, precision, mean deviation, standard deviation, classification of errors, minimization of errors, significant figures and computations, reliability of results, Numericals.

3) Theory of Qualitative Analysis [10]
Basic principle, common ion effect, solubility, solubility product, preparation of original solution, classification of basic radicals in groups, separation of basic radicals, removal of interfering anions (Phosphate and borate), detection of acidic radicals.

4) Analysis of Organic Compounds (Qualitative & Quantitative) [10]
I. Qualitative
A. Types of organic compounds, Characteristic tests and classifications, reactions of different functional groups, analysis of binary mixtures.

II Quantitative
B. Estimation of C, H, (O) by combustion tube, detection of nitrogen, sulfur, halogen and phosphorous by Lassigen’s test.
C. Estimation of nitrogen by Dumas’s Kjeldahl’s flask method, estimation of halogen, sulphur and phosphate by Carious tube method.
D. Determination of empirical and molecular formula and numerical problems.

REFERENCE BOOKS:
1) The Quantitative Inorganic Chemistry - by A.I. Vogel
2) Fundamentals of Analytical Chemistry - by S.M.Khopkar
3) Quantitative Analysis - by Day and Underwood
4) Analytical Chemistry - by G.D.Christian
S.Y.B.Sc (CBCS-2018 Course)
SEMESTER – III
C-32 : ORGANIC & INORGANIC CHEMISTRY-III

Credits: 04
Total Lectures: 60

Course Learning Outcomes:

After completion of this course students should be able to:

1. Understand the types of organic reaction and mechanism of some name reactions.
2. Write stereochemistry of cycloalkanes.
3. Study of ethers and epoxides.
4. Know synthesis and reactions of pyridine, quinoline & isoquinoline.
5. Explain study of chemistry of d-block elements.
6. Describe the role metals in bioinorganic compounds.
7. Specify principles in metallurgy and its applications

Course Content:

SECTION – I (ORGANIC CHEMISTRY)

1. Organic reaction Mechanism
   a) Introduction, types of reagents—electrophile, nucleophile and free radical.
   b) Types of organic reactions: Addition, Elimination (β-elimination and Hofmann elimination), substitution (aliphatic electrophilic and nucleophilic, aromatic electrophilic) and rearrangement.
   c) Mechanism: (i) Aldol condensation (ii) Markovnikov and anti-Markovnikov addition reaction (iii) SN^1 and SN^2 reactions
      Ref. 1 & 4

2. Stereochemistry of Cycloalkanes
   a) Baeyer’s strain theory, Heat of combustion,
   b) cycloalkanes, factors affecting the stability of conformation,
   c) Conformation of cyclohexane - equatorial and axial bonds,
   d) Monosubstituted cyclohexane stability with -CH3 and -C(CH_3)_3 substitutes.
      Ref. 3

3. Ethers and Epoxides
   a) Ether linkage, classification, Nomenclature, Physical properties.
   b) Industrial source.
      i) Williamson's synthesis.
      ii) Diazomethane method.
      iii) Alkoxy mercuration demercuration.
      iv) Reactions of ethers with cold HI, hot HI and dil H_2SO_4.
      v) Synthesis of epoxides, Acid base catalyzed ring opening of epoxides, Reactions with Grignard reagent
         (Ref.1, Pages 699 - 708, 713 - 719)
4. Heterocyclic Chemistry [06]
   a) Introduction.
   b) Structure.
   c) Nomenclature.
   d) Synthesis and reactions of:- (i) Pyridine (ii) Quinoline (iii) Isoquinoline.
      (Ref. 5 :- Sections 7 & 8, Pages :- 223-232, 273-293).

Reference Books:
   3. Stereochemistry of carbon compounds - E. L. Elieel
   4. Reactions, rearrangements and reagents – S N Sanyal

SECTION – II (INORGANIC CHEMISTRY)

1. Chemistry of d-block elements [08]
   Position of d-block in periodic table, electronic configuration, trends in properties of these elements w.r.t.(a) Size of atoms & ions (b) Reactivity (c) Catalytic activity (d) Oxidation states (e) Complex formation ability (f) Colour (g) Magnetic properties (h) Nonstoichiometry(i) Density (j) Melting & Boiling points.
   Ref.1 Page no. 651-675 and
   2 Page no. relevant pages.

2. Bioinorganic chemistry [08]
   Role of metals in bioinorganic compounds, Biological role of some alkali metals and transition metals: compounds of Ca, Mg, Fe and Co, Bioinorganic chemistry of iron, Haemoglobin and myoglobin, Functions of oxygen transfer, oxyhaemoglobin and deoxyhaemoglobin, photosynthesis; photosystem-I and photosystem-II, Vitamin B-12, Structure and Applications.
   Ref.3. page no. 851-921
   4. page no. 645-655.

3. General Principles of Metallurgy: [08]
   Introduction, occurrence of metals, ores and minerals, types of ores, operations involved in metallurgy, Crushing, Pulverisation, Methods of concentration such as Hand picking, Gravity separation, Magnetic separation. Froth flotation, Calcinations, Roasting etc.
   Reduction, Various methods of reduction such as smelting, Aluminothermic process and Electrolytic reduction, Refining of metals, Various methods of refining such as poling, liquation, electrolytic and vapour phase refining (Van Arkel Process).
   Ref. 5. page no. 262-271.
   6. page no. 2.3-2.8, 2.13-2.17.
4. Metallurgy of Aluminium (Electrometallurgy):


Ref. 5 page no. 458-463. 6 page no. 2.209 to 2.211.

References:

1. Concise Inorganic Chemistry by J. D. Lee.
2. General Chemistry-Raymond Chang.
3. Inorganic Chemistry-James Huheey, Third Ed
4. Inorganic Chemistry-Shriver and Atkins, Third Ed
5. Advanced Inorganic Chemistry, Satyaparakash, Tuli, Basu,
S.Y.B.Sc (CBCS-2018 Course)
SEMESTER – III

C-33 : PRACTICAL COURSE - III

Credits: 02

Course Learning Outcomes:
After completion of this course students should be able to:
1. Study the reaction between K$_2$S$_2$O$_8$ and KI.
2. Determine the normality of strong acid conductometrically.
3. Find out the CST of phenol-water system.
4. Analyse binary mixture of organic compound.
5. Estimate the Vitamin C and Acetamide.

Course Content:
A. PHYSICAL CHEMISTRY EXPERIMENTS (Any 5)
1. To study the reaction between K$_2$S$_2$O$_8$ and KI (Equal concentrations).
2. To determine the normality of the given strong acid by titrating it against strong alkali conductometrically.
3. Determination of solubility of benzoic acid at different temperature and to determine $\Delta H$ of dissociation process.
4. To determine critical solution temperature of phenol water system
5. To determine molecular weight of given organic liquid by steam distillation
6. To study neutralization of acid (HCl) base (NaOH) and CH$_3$COOH by NaOH and H$_2$SO$_4$ by NaOH.
7. To determine the rate constant of base catalyzed ester hydrolysis.
8. To determine the specific and molar refractions of benzene, toluene and xylene by Abbe’s refractometer and hence determination of the refraction of -CH$_2$- group (Methylene group). (Densities should be determined by students.)

B. ORGANIC CHEMISTRY EXPERIMENTS

Organic qualitative analysis: (3 Mixtures)
a) Separation of binary mixtures (without ether) followed by Type determination, Recrystalization, M.P./B.P. of separated organic components from mixture.
   Type determination, Recrystalization, M.P./B.P.
   The following compounds should be selected:-
   Acids:- Benzoic, salicylic, phthalic, cinnamic and oxalic acid.
   Phenols:- $\alpha$-Naphthol, $\beta$-Naphthol & Resorcinol
   Bases:- Aniline, p-Toluidine, o-Nitroaniline, p-Nitroaniline, mNitroaniline, and N-N dimethyl aniline.
   Neutrals:- Acetone, Ethylmethyl ketone, Ethyl acetate, Naphthalene, m-Dinitrobenzene, Nitrobenzene, Acetanilide, Thiourea

Volumetric analysis : (Any two)
   (i) Estimation of Acetamide.
   (ii) Estimation of Carboxylic acid.
   (iii) Estimation of Vitamin C
S.Y.B.Sc. (C.B.C.S. 2018 Course)
SEMESTER-III
B - 31 : ANGIOSPERM TAXONOMY
Core Course – Theory; Credits- 04
Total lectures- 60 L

Course Learning Outcomes :
On Completion of this course, students are able to:

1. Know the vegetative characteristics of the plant.
2. Know the scope and importance of the discipline.
3. Learn about the reproductive characteristics of the plant.
4. Understand the plant morphology and the diversity of angiosperms.
5. Understand the comparative account among the families of angiosperms.
6. Know the economic importance of the angiosperm plants.
7. Understand plant communities and ecological adaptations in plants.

Course content
TAXONOMY

1. Introduction to plant taxonomy:
   09 L
   Definition, objectives, importance, concept of systematics and taxonomy.

2. Aspects of plant systematic:
   09 L
   System of classification: Natural, Artificial and Phylogenetic.

3. System of classification:
   09 L
   Salient features of Bentham & Hooker’s and Engler&Prantle’s system of classification with merits & demerits.

4. Botanical nomenclature:
   11 L
   Salient features of ICBN; concept of binomial nomenclature, taxonomic ranks and concept of species.

5. Study of plant families:
   22 L
   Study of following flowering plant families according to Bentham & Hooker’s system distribution, distinguishing character, floral formula, floral diagram and economic importance.
   • Annonaceae
   • Brassicaceae
   • Meliaceae
   • Caesalpinaceae
   • Apiaceae
   • Asteraceae
   • Solanaceae
   • Acanthaceae
   • Euphorbiaceae
   • Amaryllidaceae
Reference Books:

Course Learning Outcomes:

On Completion of this course, students are able to:

1. Understand the various components of stem and wood during its secondary growth.
2. Enlighten about the mechanism of pollination and basic structure of the embryo.
3. Understand the scope & importance of anatomy and embryology.
4. Know various tissue systems, normal and anomalous secondary growth in plants and their causes. Perform the techniques in anatomy.
5. Understand structure and development of microsporangium and megasporangium.
6. Understand male and female gametophytes.
7. Know fertilization, endosperm and embryogeny.

Course content

DEVELOPMENTAL BOTANY:

1. **Organization of higher plant body:** 06 L
   - Primary structure of root and shoot systems, tissue systems in plants.
   - Meristematic tissues: general characters, theories—Histogen theory, apical cell theory and Tunica corpus theory; shoot apical meristem, root apical meristem, lateral meristems and their functions, Permanent tissues.

2. **Epidermal tissue system** 05 L
   - Epidermal cells, structure of typical stoma, types & functions,
   - Epidermal outgrowths - trichomes and their functions.

3. **Mechanical tissues system** 04 L
   - Types of mechanical tissues, distribution of mechanical tissues in
     - Coleus, Zea maize.
     - Leaf - Eucalyptus, Cycas
     - Root - Zea maize - Functions of the mechanical tissue system.

4. **Secondary growth:** 05 L
   - Normal secondary growth in dicotyledone root, stem and leaf root, monocotyledon root stem, and leaf; their tissues and thier function

5. **Anamolous Secondary Growth:** 05 L
   - Definition, causes, anomalous secondary growth in Bignonia, Borrhaevia, Dracena.

EMBRYOLOGY

1. **Introduction to plant Embryology, definition and scope.** 03 L
2. **Microsporangium** 08 L
   - structure of tetrasporangiate anther, tapetum types, sporogenous tissue.
   - Male gametophyte: structure of pollen grain, development of male gametophyte.
3. **Megasporangium** 10 L
   - Structure and types of ovules – anatropous, orthotropous, amphitropous, campylotropous, circinotropous.
   - Megasporogenesis: Tenuinucellate and crassinucellate ovules, types of megaspore tetrads.
**Female gametophyte:** structure of typical 8-nucleate embryo sac, types and development of embryo sacs – monosporic, bisporic and tetrasporic.

4. **Fertilization**

   Pollen stigma interaction, self compatibility, entry of pollen tube, discharge of pollen tube content, fusion of gametes, syngamy, triple fusion, significance of double fertilization.

5. **Endosperm types:** nuclear, helobial, cellular.

6. **Embryo** - structure of dicot and monocot embryo (development not expected)

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**Reference books:**

S. Y. B.Sc. (C.B.C.S. 2018 Course)
SEMESTER- III
B 33 - Botany Practical course

Core Course – Practical; Credits- 02
Contact hours per practical – 04 h (ANY-10)

Course Learning Outcomes :
On Completion of this course, students are able to:
• Understand the plant morphology and the diversity of angiosperms.
• Understand the comparative account among the families of angiosperms.
• Know the economic importance of the angiosperm plants.
• Understand the scope & importance of Anatomy and Embryology.
• Know various tissue systems, normal and anomalous secondary growth in plants and their causes. Perform the techniques in anatomy.

Course content
ANGIOSPERM TAXONOMY
1.- 6 Study of plant families (according to Bentham & Hooker’s system of classification) with the help of locally available specimen.
   - Annoniaceae
   - Brassicaceae
   - Meliaceae
   - Caesalpinaceae
   - Apiaceae
   - Asteraceae
   - Solanaceae
   - Acanthaceae
   - Euphorbiaceae
   - Amaryllidaceae

7. Study hydrophytic and xerophytic plants and their adaptations.


9. Determination of rain fall, temperature, light intensity and humidity of atmosphere.

DEVELOPMENTAL BOTANY & EMBRYOLOGY
10. Study of epidermal structures -
   i) Stomata - types with suitable examples.
   ii) Multilayered epidermis in Nerium and Opuntia.
   iii) Trichomes - types with suitable examples.
11. Study of mechanical tissues in
   i) Stem - Coleus, maize.
15. Study of dicoylidons and embryo
    B)Study of pollen grains by NPC observation.
Reference books:
5. Practical Botany-S. B. Agarwal
6. A Mannual in Plant Physiology Practical –Vaidya&Kulkarni
S. Y. B.Sc. (CBCS - 2018 Course)
SEMESTER III
Z31 : Functional Anatomy of Non-Chordates II and Biodiversity

Total Credits: 04
Total lectures: 60

Course Outcomes:

On completion of the course, students are able to:

1. Understand the systematic position and external morphology of Starfish.
2. Understand and study the various systems like structure and types of pedicellariae, digestive system, respiratory system, nervous system, sense organs, autotomy and regeneration in starfish.
3. Understand the classification and diversity of various classes of phylum Arthropoda, Mollusca, Echinodermata, Hemichordata.
4. Understand and study classification and general characters of Nematoda, Nematode development.
5. Study and understand various types of shell and foot modification in Mollusca.
6. Explain, study and understand concept of mimicry in insects.
7. Study and understand metamorphosis in insects.
8. Gain knowledge about Bioluminescence.

Course Content

UNIT I

Study of starfish (Asterias rubens)

i) Systematic position, Habits and habitat.
ii) External characters.
iii) Structure and types of pedicellariae.
iv) Digestive system – Alimentary canal, food, feeding mechanism and physiology of digestion.
v) Water vascular system.
vi) Nervous system and sense organs.
vii) Reproductive system, Larval development and metamorphosis.
viii) Autotomy and regeneration.

UNIT II

Salient features and classification upto classess of the following : (any two examples from each class)

i) Arthropoda – Crustacea, Arachnida, Insecta, Myriapoda, Onychophora
ii) Mollusca – Aplacophora, Gastropoda, Pelecypoda, Scaphopoda, Cephalopoda
iii) Echinodermata - Asteroidea, Ophuroidea, Holothuria, Echinoidea, Crinoidea
iv) Hemichordata – Enteropneusta, Pterobranchia

UNIT III

Study of following with reference to

i) Nematoda – Classification and general characters of Nematoda, Nematode development, Some common nematode parasites of man (Any Four)
ii) Arthropoda – Metamorphosis in Insects, Mimicry in Insects
iii) Mollusca – Shell and foot modification in mollusca

UNIT IV

Bioluminescence in Firefly
Reference books:
1. The invertebrates – Hyman L. H.
2. Arthropoda, Mollusca and Echinodermata – Kotpal R.L.
3. Mollusca – Mortan J.E.
4. Echinodermata – Nicholas D.
8. Invertebrates – Kotpal R.C.
10. A Text book of Invertebrate zoology – Srivastava M.
12. Invertebrate structure and function – Barrington.
13. Biology of Non-chordates – Nigam
17. College Zoology – Boolootin and stiles.
Course Outcomes:
On completion of the course, students are able to:

1. Understand the term histology.
2. Understand how tissues are produced from cells.
3. Understand and study cell, various types of tissue- structure and function, organ and system.
4. Study and understand gross anatomical structure of various organs through vertical section, longitudinal section and transverse section.
5. Study and understand gross anatomical structure and function of endocrine glands.

Course Content
UNIT I 20L
Study of Tissues
Review of the following tissues with reference to structure and functions.

i) **Epithelial Tissues**
   a) Simple epithelial tissue
   b) Compound epithelial tissue
   c) Glandular epithelium

ii) **Connective Tissues**
   a) Loose connective tissue
   b) Reticular tissue
   c) Adipose tissue.
   d) Skeletal tissue – Cartilage and Bone
   e) Fluid connective tissue – Blood and Blood cells

iii) **Muscular tissue**
   a) Smooth muscle
   b) Striated muscle
   c) Cardiac muscle

iv) **Nervous tissue**
   a) Neuron
   b) Nerve fibre

UNIT II 25L
Study of gross histological structure of different system organs Part I.

i) Skin
ii) Tooth
iii) Tongue
iv) Alimentary canal
   a) Oesophagus b) Stomach c) Duodenum. D) Ileum
v) Associated glands
   a) Salivary glands
   b) Liver
   c) Pancreas
vi) Respiratory system
   a) Lung
   b) Trachea

UNIT III 15L

Study of gross histological structure of different system organs Part II.
   i) Kidney
   ii) Spinal cord
   iii) Reproductive organs
       a) Testis
       b) Ovary
   iv) Endocrine glands- General idea of endocrine glands
       a) Pituitary gland
       b) Thyroid gland
       c) Adrenal gland

Reference books:
4. Histology by : A.W. Ham Lippnocott.
6. Histology: Greep, R. O. and Well L.

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S. Y. B.Sc. (CBCS - 2018 Course)
SEMESTER III
Z 33 : Zoology Practical course
(Practical based on paper: Z-31, Z-32)

Total Credits: 02
Contact hours per practical – 04 h

Course Outcomes:

On completion of the course, students are able to:

1. Study of general and distinguishing characters and classification of non-chordates with the help of museum specimens.
2. Understand the systematic position and external characters of Starfish.
3. Understand digestive system, water vascular system in Starfish.
4. Understand structure of T. S. of arm of starfish, tube feet and gonads in starfish.
5. Understand shell and foot modification in Mollusca with some examples.
6. Impart the knowledge about mimicry in insects.
7. Students gain fundamental knowledge of various types of tissues with the help of permanent slides.
8. Gain knowledge and understand structure of various organs with the help of permanent slides.

Course Content

Functional Anatomy of Non-Chordates II and Biodiversity

1. Study of general and distinguishing characters and classification of non-chordates upto class level with one example of each class.
   (Sketches/Photographs may be used)
   a. Arthropoda
   b. Mollusca
   c. Echinodermata
   d. Hemichordata

2. Study of systematic position, external features and digestive system of Starfish.

3. A. Study of water vascular system of Starfish.
   B. Temporary preparation of gonads and tube feet from star fish.

4. Study of permanent slides of T. S. of an arm of Starfish and bipinnaria larva.

5. Study of shell in mollusca.
7. Study of Mimicry in insects.

Histology of mammals

1. Study of permanent slides of tissues.
   a. Squamous epithelium
   b. Columnar epithelium
   c. Areolar connective tissue
   d. Hyaline cartilage
   e. Smooth muscle fibre
   f. Striated muscle fibre
9. Study of permanent slides of following organs.
   a. Skin – vertical section
   b. Tooth – vertical section
   c. Tongue – vertical section
   d. Oesophagus – cross section
   e. Stomach – cross section
   f. Duodenum – cross section
   g. Ileum – cross section
   h. Salivary gland – parotid
   i. Liver – cross section
   j. Pancreas – cross section
   k. Trachea – cross section

10. Study of permanent slides of following organs.
    l. Kidney – longitudinal section
    m. Spinal cord - cross section
    n. Testis - cross section
    o. Ovary - cross section
    p. Thyroid gland - cross section
    q. Adrenal gland - cross section
    r. Pituitary gland - cross section

Reference books:

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Course Outcomes:

At the end of this course the students will be able to:

1. Understand different aspects of microbial metabolism needed for commercial exploitation of microorganisms.
2. Understand different properties of enzymes.
3. Know how to investigate the active site of enzymes.
4. Understand different ways of transportation of nutrients.
5. Know differential photosynthesis in bacteria, plants and algae.

Course Content

(I) Enzymes

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<tr>
<th>No. Of lectures</th>
<th>Enzymes</th>
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  i) Physicochemical properties of enzymes
  ii) Theories of enzyme catalysis
      a) Proximation effect
      b) Pauling concept of strain
      c) Acid-Base Catalysis
      d) Covalent Catalysis
  iii) Nomenclature of enzymes
  iv) Factors affecting enzyme activity – pH & Temperature
  v) Mechanism of enzyme action:
     a) Lock and Key hypothesis
     b) Induced fit hypothesis
  vi) Enzyme specificity –
      a) Absolute specificity
      b) Group specificity
      c) Optical specificity
      d) Geometrical specificity
  vii) Introduction to ‘Allosteric Enzymes’
  viii) Biological role of Enzymes
  ix) Methods of investigation of active site
      a) Trapping of ‘Enzyme substrate complex’
      b) Use of ‘substrate analogues’

(II) Bioenergetics

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<th>No. Of lectures</th>
<th>Bioenergetics</th>
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  i) Principles of Bioenergetics
  ii) Role of ATP in bacterial metabolism
  iii) Reducing power and its significance in bacterial metabolism
  iv) Generation of ATP through substrate level phosphorylation
  v) Component’s of Electron Transport chain (ETC)
     a) Flavoproteins (FMN & FAD)
     b) Quinones (Ubiquinone & Menaquinone)
     c) Iron sulphur proteins
     d) Cytochromes
  vi) Generation of ATP through ETC
(III) Energy Cycles (18)
i) Energy Production by Anaerobic Processes
   a) EMP pathway
   b) Pentose phosphate pathway
   c) Entner Doudoroff pathway
ii) Energy Production by aerobic processes
   a) Tricarboxylic Acid cycle
   b) Anaplerotic reactions of ‘Tricarboxylic Acid cycle’.

(IV) Transport of Nutrients by Bacteria: (08)
i) Passive Diffusion
ii) Facilitated Diffusion
iii) Group Translocation
iv) Active Transport

(V) Photosynthesis (07)
i) Bacterial Photosynthesis
ii) Concept of ‘Purple Membrane’ in Halobacterium and its significance.
iii) Plant /Algal/Cyanobacterial Photosynthesis.

References:
S. Y. B.Sc. (CBCS - 2018 Course)  
Semester III  
MB – 32 Bacterial Genetics

Total credits 04  
Total 60 Lectures

Course Outcomes:
At the end of this course the students will be able to:
1. Understand different aspects of genetics needed for commercial exploitation of microorganisms.
2. Understand replication of bacterial DNA.
4. Understand the process of mutagenesis and repair.

Course Content

I. Structure of DNA, Gene and Chromosome  
   13
   i) Characteristics of Genetic Material
   ii) The Molecular Basis of Heredity:-
       a) Different experiments which helped to understand the structure and function of DNA 1928-1956
       b) RNA as Genetic Material
   iii) The Structure of DNA
        a) The Primary and Secondary Structure of DNA
        b) DNA Methylation, Bends in DNA

II. DNA Replication  
    15
    i) Semi conservative Replication
    ii) Meselson and Stahl’s Experiment
    iii) Requirements of Replication: Enzymes, Proteins and mechanisms involved
    iv) The Mechanism of Replication:
        a) Initiation, Unwinding, Primers, Elongation, Termination
        b) Bacterial DNA Replication - Components required for Replication
        c) The fidelity of DNA replication

III. The Genetic Code  
    12
    i) The one gene one enzyme hypothesis
    ii) The Genetic code:
        a) Milestones in deciphering the Genetic code
        b) Dictionary of the Genetic code
    iii) Features of the Genetic code:
        a) Genetic code is degenerate
        b) Genetic code is universal
        c) Genetic code is a triplet code
        d) Genetic code is non-overlapping
        e) Genetic code is comma less
iv) Initiation and Termination codons  
v) Wobble hypothesis, Isoaccepting tRNAs  
vi) The Central Dogma, Overlapping Genes  
vii) The process of Transcription and Translation  

IV. Mutagenesis and Repair  
i) Mutagenesis: Definitions, Auxotrophic Mutants, Conditional Lethal mutants, Resistant Mutants. Experiments using mutants  
ii) Mutations are Spontaneous or induced?: Luria and Delbruck Experiment, the Newcomb Experiment, The Lederberg’s Experiment  
iii) Mutation Rate: Calculation of mutation Rates  
iv) Types of Mutations:  
a) Microlesions and Macrolesions: different types  
b) Transitions and Transversions  
c) Chemicals that mimic normal DNA bases–base analogs  
d) Chemicals that react with DNA bases–base modifiers  
e) Chemicals that bind DNA bases–Intercalators  
f) Mutagens that physically damage the DNA; Ultraviolet light and ionizing radiations  
v) Reversion and suppression: Types with examples  
vi) Isolating mutants: Réplica plating, Enrichment techniques  
vii) Complementation  
viii) Ames’ Test: How have we exploited mutants?  
ix) Repair:  
a) Photo- reactivation  
b) The methyl – Directed mismatch Repair system  
c) Nucleotide Excision repair  
d) Recombination repair  
e) SOS inducible repair  

References:  

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**S. Y. B.Sc. (CBCS - 2018 Course)**
**Semester III**
**MB-33 : Practical Course**
*(based on MB 31, MB 32)*

**Course Outcomes:**
At the end of this course the students will be able to:
1. Develop the skills for detecting different microbial enzymes.
2. Understand carbohydrate fermentations and other tests used for gross identification of bacteria.
3. Learn the techniques used for study and control of microbial growth.
4. Understand the basic laboratory techniques for the study of bacterial genetics.

**Course content**

**Total number of Experiments: 18**

I. **Extracellular Enzymatic Activities of Micro-organisms** (04)
   i) Starch hydrolysis
   ii) Lipid hydrolysis
   iii) Caesin hydrolysis
   iv) Gelatin hydrolysis

II. **Intracellular Enzymatic Activities of Microorganisms.** (06)
    i) Carbohydrate fermentation – Lactose, Sucrose, Dextrose,
    ii) Triple Sugar Iron Agar test.
    iii) Hydrogen sulfide test.
    iv) Urease test.
    v) Litmus milk test.
    vi) Nitrate Reduction test.
    vii) Catalase test.

III. **Study of bacterial Growth** (02)
     i) Enumeration of cell numbers-direct counting/ turbidometry.
     ii) Determination of viable count.

IV. **Study of Environmental Influences on Bacterial Growth** (02)
     i) Study of Effect of Energy Source and Role of buffers on growth
     ii) Study of oxygen requirements of bacteria.

V. **Study of control of Microbial Growth by Antimicrobial Agents (Any Two)** (01)
    i) Study of Effect of Antiseptic and Disinfectant.
    ii) Determination of Phenol coefficient.
    ii) Study of lethal action of UV light and photoreaction in Bacteria.

VI. **Study of Bacterial Genetics (Any Two)** (02)
    i) Isolation of Temperature variants/Antibiotic Resistant variants.
    ii) Isolation of Nutritional Mutants by Replica plating
    iii) Mutant isolation by Gradient Plate method.
References:


Course Learning Outcomes:
At the end of this course students are expected to be able to-

i) Examine and evaluate the limits of functions of two and three variables.
ii) Discuss and examine the continuity of functions at given points.
iii) Expansions of functions about the point by Taylor’s theorem.
iv) Evaluate double and triple integrals.

Course content:

Unit 01 - FUNCTIONS OF SEVERAL VARIABLES:
1. Functions of two and three variables
2. Notions of limits and continuity for functions of two and three variables.
3. Simultaneous limit, limit along a path, repeated limits.
4. If \( f(x,y) \) approaches to \( l \) as \( (x, y) \) approaches \( (a, b) \) then \( f(x,y) \) approaches the limit \( l \) along any path (Proof).
5. Counter examples on continuity.
6. Partial derivatives and higher order partial derivatives
7. Chain rules.
8. Differential and differentiability. Necessary and sufficient
   Conditions for differentiability (with proof), Counter examples..
10. Converse of Euler's theorem (with proof).

Unit 02 - MEAN VALUE THEOREMS.
1. Lagrange's mean value theorem for functions of two variables (with proof).
2. Taylor's theorem for functions of two variables (with proof).

Unit 03 - EXTREME VALUES
1. Extreme values for functions of two variables.
2. Maxima, minima and saddle points of functions of two variables.
3. Necessary condition for extreme values (with proof).
4. Sufficient condition for the existence of extreme values. (without proof).
5. Lagrange's method of undetermined multipliers.

Unit 04 - MULTIPLE INTEGRALS
1. Integrals over plane areas in xy plane.
2. Evaluation of double and triple integrals.
3. Area of a region by double integrals.
4. Volume by double and triple integrals.
5. Change of order of integration for two variables.
6. Change of variables in double integrals.
7. Change of variables in polar co-ordinates.
8. Illustrative examples of change of variables using Jacobians.
Reference Books:
1. T. M. Apostol; Calculus, Wiley Student edition.
6. J.N. Sharma - Mathematical Analysis - II (Chapter 4); Krishna Prakashan Mandir, 119 Shivaji Rd., Meerat
7. J.N. Sharma - Differential Calculus (Chapter 3); Krishna Prakashan Mandir, 119 Shivaji Rd., Meerat
8. M.L. Khanna : Integral Calculus (Chapter 5 & 7); Jai Prakash Nath

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Course Learning Outcomes:  
At the end of this course students are expected to be able to.  
(i) Understand the concepts in Group and simple properties of group.  
(ii) Understand the concepts of subgroup and simple properties of subgroup.  
(iii) Understand the concept of differential equations of first order and higher degree.  
(iv) Concept of linear differential equations with constant coefficients.

Course content:

Unit-01: GROUPS:  
1. Binary operations, definition and examples.  
2. Definition of a group with examples.  
3. Types of groups.  
4. Simple properties of group.  
5. Integral powers of Elements in a Group.

Unit-02: SUBGROUPS:  
1. Introduction.  
2. Subgroups.  
3. Criteria for a subset to be subgroup.  
   a. H is subgroup of G iff for all a, b ∈ G implies ab⁻¹ ∈ G  
   b. H is subgroup of G iff  
      i. for all a, b ∈ G implies ab ∈ G  
      ii. a ∈ G implies a⁻¹ ∈ G  
   c. Intersection of two subgroups of a group G is also a subgroup G.  
4. Order of an element in a group.  
5. Properties of order of an element in a group.  
6. Cyclic subgroups.  
7. Properties of cyclic subgroup

Unit-03: DIFFERENTIAL EQUATIONS OF FIRST ORDER AND HIGHER DEGREE  
2. Equations solvable for y.  
3. Equations solvable for x.  
4. Clairaut's equation.  
5. Lagrange's equation.  

Unit-04: LINEAR DIFFERENTIAL EQUATIONS WITH CONSTANT COEFFICIENTS:  
1. Introduction.  
2. Complementary function and Particular Integral.  
3. Fundamental laws of operators, f (D) y = 0,
4. The operator \( \frac{1}{f(D)} \)
5. Evaluation of \( \frac{1}{f(D)} e^{ax} \)
6. Evaluation of \((D^2 + a^2)^{-1} \sin ax\) and \((D^2 + a^2)^{-1} \cos ax\).
7. Evaluation of \( \frac{1}{f(D)} x^m \)
8. Evaluation of \( \frac{1}{f(D)} e^{ax} V \) and \( \frac{1}{f(D)} (xV) \)
   where \( V \) is a function of \( x \)

Reference Books :-
1) N.S. Gopalkrishna ; University Algebra ; Wiley Eastern, 1986.
2) P.B. Bhattacharya, S.K.Jain and S.R.Nagpal Basic Abstract Algebra (2nd Edition),
5) D.A. Murry; Introductory course in Differential Equations; Orient Longman (India 1967)
6) E.A. Cochington; A Introduction to ordinary Differential Equations; Prentice Hall of India, 1961.
7) Gupta P.P.; Malik G.S.; Mittal S.K.; Differential Equations; Pragati Prakashan Meerut.
9) David A Murray: Introductory Course in Differential Equations; Orient Logman.

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S.Y.B.Sc. (CBCS 2018 Course)
Semester – III
M-33: Mathematics Practical Course-III
(Practicals based on the applications and Problems of articles in M-31 and M-32)
Total Credit :02

**Course Learning Outcomes:**
At the end of this course students are expected to be able to
1. Knowledge of applications of Euler’s theorem, Taylor’s theorem and Maclaurin’s series.
2. Finding the extreme values of multivariable functions.
3. Solving the problems of double and triple integration.
4. Solving the Differential equations of first order and higher degree.
5. Finding the solution of Linear differential equations with constant coefficient.

**Course content**

**List of Practicals:**

1) Euler’s theorem for homogeneous functions.
2) Expansions of functions of two and three variables by using Taylor’s theorem and Maclaurin’s theorem.
3) Lagrange’s method of undetermined multipliers.
4) Necessary condition for extreme values.
5) Evaluation of double integrals by change of order of integration and change of variables in double integrals.
6) Problems in Groups.
7) Problems in Subgroups.
8) Differential equations of first order and higher degree.
9) Clairaut’s equation and Lagrange’s equation.
10) Linear differential equations with constant coefficients.
S.Y.B.Sc. (CBCS 2018 Course)  
Semester – III  
ENG 31: English – I

**Course Outcomes:**
At the end of this course, a student shall be able to:
- get exposed to the prose passages, grammar units and communicative skills
- read and interpret the various types of texts on their own and discuss them among peers
- communicate effectively by developing their proficiency in language
- understand their language abilities and facilitate them to with the necessary online & offline resources

**Course content:**

**Lectures**

60 Lectures

a. Texts - *Pleasant Prose Selection* by Oxford University Press
   1. Old Man at the Bridge - Earnest Hemingway
   2. Mebel - W. Somerset Maugham
   3. Too Dear - Leo Tolstoy
   4. The Open Window - H.H. Munro (‘Saki’)
   5. The Bet - Anton Chekhov
   6. The Necklace - Guy de Maupassant

b. Dialogue Writing:
   1. Asking, Giving & Refusing Permission  
   2. Inviting
   3. Asking for Information  
   4. Suggesting

c. English Grammar:
   1. Prepositions  
   2. Conjunctions

**The books recommended:**
S.Y.B.Sc.: (CBCS 2018 Course)

Semester-III

SEC32: MARATHI - I

अध्ययन निष्ठांती:

1. मराठीतील विज्ञान साहित्याच्या प्रेरणा, उगम, वाटचाल आणि विकास जाणून घेण्यास मदत झाली.
2. वैज्ञानिक साक्षरता व वैज्ञानिक दृष्टिकोण विकसितगळ्याने.
3. विज्ञानातूनसर्वभाषेतूनकण्यासाठी आवश्यक ती भाषिक क्षमता वाढविस लागली.
4. मराठीतील विज्ञान कथांच्या स्थूल स्वरूपात परिचय झाला.

Total Credit :- 04

तासिका - 60

घटक-विवेचण:

1. संकरित (विज्ञानकथासंग्रह) - डॉ.संजय धोले, मेहता पल्लिणिंग हाउस, पुणे
   (१) उत्तपरिचर (२) परिचर (३) मोहीम फते (४) कोठि (५) अकल्यत (६) संकरित
2. मराठी विज्ञान साहित्याच्या प्रेरणा
3. मराठी विज्ञान साहित्याची वाटचाल
4. मराठी विज्ञान साहित्याचा विकास
5. मराठी विज्ञान साहित्यातील कथांचे स्वरूप
6. विज्ञान साहित्य आणि मराठी वाचक
7. मराठी विज्ञान साहित्यातील विषयांची विविधता
8. निवंधांठांने

संदर्भ - साहित्य:

1. विज्ञान : उद्य व विकास-डॉ. प्र. न. जोशी, सन पल्लिणिंग हाउस, पुणे
2. अंश-अंशकथा-डॉ. नृंद्र दामोळकर, राजहंस प्रकाशन, पुणे
3. प्रभमनिरास -डॉ. नृंद्र दामोळकर, राजहंस प्रकाशन, पुणे
4. मराठी विज्ञान साहित्य-संग्रह. म. सु. पणारे, प्रशांत प्रकाशन, पुणे
5. विज्ञान कथा : स्वरूप आणि समीक्षा - श्री. विश्वचवर सावेदर, शालका प्रकाशन, मुंबई
6. विज्ञान साहित्य आणि संकल्पना- व. डू. कुलकर्णी, निरंजन घाटे, निहारा प्रकाशन, पुणे
7. विज्ञान गुंग- वार्षिक दिवाळी आंक १९५६, विज्ञान कथा विशेषण
8. निवंध आणि कला - डॉ.प्र.न.जोशी, स्नेहर्विन प्रकाशन, पुणे
9. व्याखारिक मराठी - (संपा.) डॉ.लीला गोविलकर, डॉ.जयश्री पाटणकर,स्नेहर्विन प्रकाशन, पुणे
10. व्याखारिक मराठी - (संपा.) डॉ.स्नेहल तावेर,स्नेहर्विन प्रकाशन, पुणे
Course Learning Outcomes:
On completion of the course, students are able to:
1. Understand and study importance of medical diagnostic.
2. Study diagnostics methods used for analysis of blood.
3. Study and understand diagnostic methods used for urine analysis.
4. Impart the knowledge about non-infectious and infectious diseases.
5. Understand and study types of tumors, detection and metastasis; MRI and CT Scan (using photographs).

Course Content

Unit 1: Introduction to Medical Diagnostic and its Importance

Unit 2: Diagnostics Methods Used for Analysis of Blood
Blood composition, Types of Blood groups, Methods of Blood grouping – slide method, six tube method, Haemolytic Disease of New born (HDN)

Unit 3: Diagnostic Methods Used for Urine Analysis
Urine Analysis: Physical characteristics; Abnormal constituents

Unit 4: Non-infectious Diseases
Causes, types, symptoms, complications, diagnosis and prevention of Diabetes (Type I and Type II), Hypertension (Primary and secondary), Testing of blood glucose using Glucometer/Kit

Unit 5: Infectious Diseases
Causes, types, symptoms, diagnosis and prevention of Tuberculosis and Hepatitis

Unit 6: Tumours
Types (Benign/Malignant), Detection and metastasis; MRI and CT Scan (using photographs).

Suggested Readings
1. Park, K. (2007), preventive and Social Medicine, B.B. Publishers
3. Cheesbrough M., A Laboratory Manual for Rural Tropical Hospital, A Basis for Training Courses

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