OSMANIA UNIVERSITY

Faculty of Pharmacy

SCHEME OF INSTRUCTION, EXAMINATION AND EVALUATION

(Effective for Batches Admitted from 2016 – 17 Academic Year Onwards)

Program Code: 881 B. Pharmacy (Second Year)

SEMESTER - III

Course Code	Description	Course Title	Hours/Week			Credits	Marks		Duration of Exam
			L	T	P		Internal	End Exam	
PY.06.881.3.1.T	PS, CORE	Pharmaceutical Organic Chemistry-II	4	0	-	4	30	70	3
PY.06.881.3.2.T	PS, CORE	Pharmaceutical Analysis-I (Chemical Analysis)	4	0	-	4	30	70	3
PY.06.881.3.3.T	BS, FC	Pharmaceutical Microbiology	3	0	0	3	30	70	3
PY.06.881.3.4.T	PS, CORE	Pharmaceutical Engineering-I	4	0	0	4	30	70	3
PY.06.881.3.5.T	BS, FC	Environmental Sciences	3	0	-	3	30	70	3
PY.06.881.3.6.P	PS, CORE	Pharmaceutical Organic Chemistry-II - Practical	0	0	4	2	30	70	4
PY.06.881.3.7.P	PS, CORE	Pharmaceutical Analysis-I (Chemical Analysis) - Practical	0	0	4	2	30	70	4
PY.06.881.3.8.P	BS, FC	Pharmaceutical Microbiology-Practical	0	0	4	2	30	70	4
			18	0	12	24	240	560	

Note: Candidates admitted through lateral entry into B.Pharm. III Semester directly from Diploma Stream should study and qualify the papers of Mathematics (Only for those Candidates Admitted to Diploma in Pharmacy from Biology Stream at +2 Level) and Basic Computer Applications (Theory and Practicals) as Bridge Course for B. Pharm Program and will not be part of CGPA.

PHARMACEUTICAL ORGANIC CHEMISTRY - II

Scheme of Instruction		Scheme of Examination	
Total Duration	: 40 hrs	Maximum Marks	: 100
Periods / Week: 4		Internal Exam	: 30
Credits	: 4	End Semester	: 70
Instruction Mode	: Lecture	Exam Duration	: 3 Hrs
Subject Code	: PY.06.881.3.1.T		

Unit – I

Aromatic Hydrocarbons (Benzene and Derivatives)

Structure of Benzene, stability of Benzene (Heats of hydrogenation), Aromatic character – Huckel's (4n + 2 electron) rule. Nomenclature of Benzene derivatives. Electrophilic substitution reactions (Halogenation, Nitration, Sulphonation, Friedel- Crafts alkylation and acylation), Effect of substituent on Reactivity and orientation of monosubstiuted Benzenes. Nucleophilic substitution in Halobenzenes. Acidity and Reactions of Phenols.

Polynuclear Hydrocarbons: Napthalene and Anthracene: Structure, relative stability and aromaticity, Electrophilic substitution reactions - orientation, reduction and oxidation.

Unit – II

Stereo Chemistry

Stereoisomerism, conformational isomerism, Cis-trans (E & Z) isomerism, sequence rules for E & Z configurations. Enantiomerism and optical activity:

Plane of symmetry, asymmetry or chirality, plane polarized light, Relative (D & L) configurations, Absolute (R & S) configurations, sequence rules, Diastereomers, Meso structures, racemic modifications, concept of stereospecificity.

Unit – III

Heterocyclic Compounds Containing One Hetero Atom

Introduction, classification and nomenclature of Heterocyclic compounds, Ring structure, methods of preparation and characteristic reactions of pyrrole, furan, thiophene, Pyridine, Indole, Quinoline, Isoquinoline and Acridine. Structure and specific uses of two medicinally important compounds representing each of the heterocyclic systems.

Unit – IV

Heterocyclic Compounds Containing Two Hetero Atoms

Structure and preparation of Pyrazole, Imidazole, Benzimidazole, Oxazole, Isoxozole, thiazole, diazine, pyrimidius, pyrazine and phenothiazine.

Nomenclature and Ring Structure and specific uses of two medicinally important compounds representing each of the above heterocyclic systems; Benzofuran, Benzopyran, dioxane, cinnoline, phenazine, oxazine, triazine, triazole, tetrazole, phenam and cepham.

Unit – V

Synthetic Reagents and Reactions

Specific synthetic Applications (at least two) of the following reagents:

Lithium Aluminium Hydride (LAH), Lead Tetra Acetate (LTA), N-Bromosucinimide (NBS), Selenium oxide, sodium periodate, perchloric acid,

Mechanism of the following reactions: Fries migration, Beckmann Re-arrangement, Birch reduction, Hoffman's hypobromite reaction, oppenneur oxidation. MPV reduction, ArndtEistert synthesis.

Examination : One question from each unit with internal choice.

Text Books

1. 'Organic Chemistry' by T.T.Morrison & R.Boyd. Prentice Hall of India Private Limited, New Delhi and 2. Organic Chemistry by FERGUSON.

Reference Books

1. The Fundamental Principles of Organic Chemistry, by I.L.Finar, ELBS, London.
2. Pharmaceutical Chemistry, by T.M.Atherden, Bentley and Drivers, Oxford Univ. Press, U.K.,

PHARMACEUTICAL ANALYSIS – I
(CHEMICAL ANALYSIS)

Scheme of Instruction		Scheme of Examination	
Total Duration	: 40 hrs	Maximum Marks	: 100
Periods / Week: 4		Internal Exam	: 30
Credits	: 4	End Semester	: 70
Instruction Mode	: Lecture	Exam Duration	: 3 Hrs
Subject Code	: PY.06.881.3.2.T		

This course shall cover the theoretical basis of analysis with special reference to methods of assay mentioned in Indian Pharmacopoeia.

Unit – I

Computation of analytical results - Significant figures, Concept of error, precision, accuracy, specificity, sensitivity, detection limit, linearity and range, ruggedness, standard deviation Rejection of doubtful values with special reference to volumetric and gravimetric analysis. Calibration of analytical equipment.

Fundamentals of volumetric analysis, methods of expressing concentration, primary and secondary standards.

Unit – II

Physico-chemical concepts required for analysis such as electrolytic dissociation, Modem theory of acids, bases and salts - Bronstead - Lowry theory, Lewis electronic theory; chemical equilibrium, pH and buffer action, solubility product, common ion effect, hydrolysis of salts and amphoteric substances.

Principles of Neutralization reactions; Theory of indicators and Neutralization indicators.

Unit – III

Principles of oxidation-reduction titration's, redox, self-indicators and their use, reactions in pharmaceutical analysis precipitation.

Principles of gravimetric analysis - typical methods involving precipitation, coagulation, digestion, drying procedures, co-precipitation.

Unit – IV

Theory and applications of complexometric titration's, argentometry, iodometry, potassium iodate, potassium bromate, EDT A, non-aqueous tritrations redox titration's, ammonium sulphate, titanous chloride. Principles of gas analysis.

Unit – V

Stoichiometry of Ionic equations and Solutions: The Mole concept, Measuring of Moles of Elements and Compounds; Percentage Composition; Emperical and Molecular Formula; Balancing of Chemical Equations; Some analytical problems and calculations based on mass balance, limiting reagent theoretical yield and percentage yield;

Examination : One question from each unit with internal choice. Text Books

1. Pharmaceutical Chemistry, L.M.Antherden, Bentleys & Drivers, Oxford Univ. Press, U.K.

2. Vogel's Quantitative Inorganic Analysis by Bassett, R.C.Denny & B.H.Jeffery, ELBS, U.K.,

Reference Books

1. Practical Pharmaceutical Chemistry, Vol I & II by A.H.Beckett and J.B.Stanlake, The Athlone Press of the University of London.

PHARMACEUTICAL. MICROBIOLOGY

Scheme of Instruction		Scheme of Examination	
Total Duration	: 40 hrs	Maximum Marks	: 100
Periods / Week: 3		Internal Exam	: 30
Credits	: 3	End Semester	: 70
Instruction Mode	: Lecture	Exam Duration	: 3 Hrs
Subject Code	: PY.06.881.3.3.T		

Unit – I

Introduction to the Science of Microbiology and Microscopy. Groups of microbes (bacteria, fungi, virus and actinomycetes) classification, macro and micro morphology and taxonomy. Different methods of bacterial count. Nutrition, Cultivation, Isolation, Identification and Preservation of pure cultures. Organisms important in Pharmacy.

Unit – II

Different biochemical reactions employed in identification of organisms, stains and staining, tolerance, Physiology and reproduction of bacteria, actinomycetes, fungi, yeasts and viruses. Microbial genetics and Variation: Introduction, genetic organization, mutation, mutagens, different types of mutants, physical and chemical mutagenesis repair mechanism and their isolation.

Unit – III

Disinfections: Factors influencing disinfections, dynamics of disinfections, different groups of disinfectants and antiseptics and their evaluation and applications.

Sterilization: Premises and Equipment, detailed evaluation and application of different sterilization methods. Sterilization indicators and their importance.

Unit – IV

Microbial attack and host defense, virulence and pathogen city, primary and specific defensive mechanisms of body.

General Principles of immunology and their applications. Immunogenetics: Classification and principles of different types of immunity, Immune systems - humoral immunity, cellular immunity and tolerance. Phagocytosis, Hypersensitivity and other reactions.

General Principles of Serology and Chemical nature of antigens, antibodies. Different antigen - antibody reactions and their applications. Precipitation, agglutination and their significance in diagnosis and diagnostic tests. Different antigens of bacterial cells, monophasic and biphasic variation. Bacterial exotoxins and endotoxins, Toxoids.

Unit – V

General principles of infection and communicable diseases. Significant symptoms, General modes of transmission of the following epidemic and endemic diseases.

a) Tuberculosis, cholera, typhoid. b) Diphtheria, whooping cough. c) Plague, malaria, filariasis, infuenza. d) Infective hepatitis, poliomyelitis.

Systematic studies of a few selected organisms - E.Coli, Pencillium sps, Streptomyces sps, Saccharomyces sps. Microbiology of water and milk.

Examination : One question from each unit with internal choice.

Text Books

1. **Text book of Microbiology by Pelezair & Reid**
2. **Text book of Microbiology – Probisher**

PHARMACEUTICAL ENGINEERING – I

Scheme of Instruction		Scheme of Examination	
Total Duration	: 40 hrs	Maximum Marks	: 100
Periods / Week: 4		Internal Exam	: 30
Credits	: 4	End Semester	: 70
Instruction Mode	: Lecture	Exam Duration	: 3 Hrs
Subject Code	: PY.06.881.3.4.T		

Unit – I

Materials of Construction: Factors affecting the material selection for Pharmaceutical plants.

Ferrous Metals: Cast iron steels and Stainless steels,

Non-Ferrous Metals: Copper, Aluminum, Lead, Tin, Silver, Nickel, Zinc, Platinum, Chromium and their important alloys.

Nonmetals: Glass, Stoneware, Stone slate, Brick, Concrete, Asbestos, Rubber, Timber, Plastics.

Corrosion and its Prevention: Types of corrosion, factors influencing corrosion, theories of corrosion, methods of prevention of corrosion.

Definition of unit operations, unit processes. Steady and unsteady states, dimensionless equations, dimensional formulas, dimensional analysis, and dimensionless groups.

Unit – II

Fluid Flow: Fluid static's, manometers, types of flow, Bernoulli's theorem, losses in mechanical energy of flowing fluids, measurement of fluids flow rate - orifice, venturi, pitot and rotameter, flow meters.

Heat Transfer: Nature of heat flow,

Conduction: - Fourier's law, thermal conductivity, compound resistance in series, heat flow through a cylinder - mean radius and mean area.

Convection: - Natural and forced convection, temperature gradients in forced convection, surface and over all coefficients. Parallel current and counter current flow.

Radiation: -black body, Stefan Boltzaman law, and gray body. Heaters, heat interchangers, scraped surface exchangers, extended surface equipment.

Steam as heating medium: - properties and uses of steam traps, vacuum pumps, condensers, entrainment separators, foam and its prevention.

Unit – III

Transportation of Materials

Solids: - Classification, principles of construction & uses of different types of conveyers, detailed study of belt, screw and pneumatic conveyers.

Fluids: - Pipes, tubes, joints, fittings, valves, Different types of reciprocating & rotary pumps, air lift pumps, screw pumps, monopumps, peristaltic pumps.

Gases: - Fans, Blowers, types of compressors, ejectors, vacuum pumps, jet pumps.

Unit – IV

Humidification dehumidification and air conditioning: Definition of various terms, wet bulb and adiabatic saturation temperatures, humidity chart, determination of humidity, methods of increasing and decreasing humidity. Air conditioning - applications in pharmacy.

Refrigeration: Definition; compression and absorption; types of refrigeration cycles; coefficient of performance, refrigerants and their choice; Brine systems, load and

applications in pharmacy.

Unit – V

Filtration: Laboratory filtration equipment, classification of industrial filters, sand filters, chamber press, plate & frame filter press, brief description of leaf filters, rotary continuous filters, top feed filters, streamline & meta filters, choice of filtration unit. Membrane filters, Air filtration. Filter operation - effect of pressure, filter aids, Filter media, factors affecting rate of filtration, pretreatment of materials. Filtration theory - Mechanism of filtration, Kozeny equation and its limitations.

Centrifugation: Theoretical considerations, large scale centrifuges classification, perforated & non perforated basket centrifuges, disc centrifuge bowls, tubular bowl centrifuges, horizontal centrifuges, continuous centrifuges, vertical solid bowl centrifuge, laboratory equipment.

Examination : One question from each unit with internal choice.

Text Books

1. **Pharmaceutical Engineering by Prof. K.Samba Murthy**
2. **Introduction to Chemical Engineering by W.L.Badger & Banchero, Macrohill Int. book company, London.**
3. **C.V.S. Subrahmanyam, J. Timma Setty, V. Kusum Devi and Sarasija Suresh, Pharmaceutical Engineering, Principles and practices, Vallabh Prakashan, New Delhi, 2007.**

Reference Books

1. **Elements of Chemical Engineering – Mc Cabe & Smith 4th edn. 2000.**
2. **Handbook of Chemical Engineering by Perry.**

ENVIRONMENTAL STUDIES

Scheme of Instruction		Scheme of Examination	
Total Duration	: 40 hrs	Maximum Marks	: 100
Periods / Week: 3		Internal Exam	: 30
Credits	: 3	End Semester	: 70
Instruction Mode	: Lecture	Exam Duration	: 3 Hrs
Subject Code	: PY.06.881.3.5.T		

Unit – I

The Multidisciplinary Nature of Environmental Studies

Definition, Scope and Importance; Indicators for Sustainable Development;

Natural Resources: Forest, Land, Mineral, Food, Water and Energy Resources; Uses, Benefits, Safety, Security and over-exploitation; Role of an individual in conservation of natural resources.

Sustainability Theory and Practice; Equitable use of resources for sustainable lifestyles; Ecosystem: Concepts, Types, Characteristic Features, Structure and Functions

Unit – II

Biodiversity and Its Conservation

Introduction, Definition, Types and Levels of Biodiversity; Genetic, Species and Ecosystem diversity; Species Richness; Indigeneous Knowledge, Magnitude and Distribution of Biodiversity;

Medicinal and Economic Value of biodiversity; Consumptive and Productive use; Biodiversity at Global, National and Local levels.

Biogeographical Classification of India - India as a mega-diversity nation and Hot spots; Threats to biodiversity; Endangered and endemic species of India;

Conservation of biodiversity: In-situ conservation of biodiversity.

Relevance of Biotechnology and Nanotechnology in Sustainable Development, Production and Environment Protection

Unit – III

Environmental Pollution and Its Problems

Local and Global Issues - Definition, causes, effects and control measures of:

a) Air pollution, b) Water pollution, c) Soil pollution, d) Marine pollution, e) Noise pollution, f) Thermal pollution and g) Nuclear hazards

Role of an individual in pollution prevention and case studies of pollution.

Solid and Hazardous Waste Management: Causes, effects and control measures of urban and industrial wastes; Development of Value added products from Solid Wastes;

Waste Minimization in Manufacturing Industry: Alternative Methods and Routes for Process Development; Reduce, Recycle and Reuse; Cost Beneft analysis of a Process or Method and Importance of Mass Balance; Case studies with refernce to Pharma Industry;

Green House Gas Effects: Climate change, global warming, acid rain and forest, ozone layer and ground water depletion.

Environmental Problems in India: Drinking Water, Sanitation and Public Health;

Unit – IV

Social Issues and the Environment

Human Population and Environment: Population Growth and Population Explosion;

Social Problems related to poverty, energy, water, shelter, infrastructure, food, health, sanitation, hygiene, land scape, livelihood, information, environment and value education.

Effects of Human Activities on the quality of Environment: Urbanization; Communication, Transportation, Industrialization and Green revolution;
Water conservation, Rain Water harvesting, Watershed Management;
Resettlement and Rehabilitation of People, its problems and concerns. Case Studies. Environmental ethics; Civic Sense, Issues and Possible Solutions.
Disaster management plan: Natural and Man Made disasters, floods, earthquake, cyclone, tsunami, landslides, nuclear accidents, fire and bioterrorism;
Case studies related to social issues: Wasteland reclamation. Consumerism and waste products.

Unit – V

Institutional Setup and Legislation
Government Regulatory Bodies in Monitoring and Enforcement of Environmental Regulations; Environment Protection Acts: Air (Prevention and Control of Pollution) Act. Water (Prevention and control of Pollution) Act, Coastal Regulation Zone (CRZ) Act, EIA Notification, Hazardous Waste Rules and Municipal Solid Waste Rules;
Right to Information Act, Wildlife Protection Act and Forest Conservation Act,
International Conventions on Environment: Stockholm, Rio, Basel, Arhus, Ramsur and Kyoto.
Environment Impact Assesment (EIA) Studies: Definition, Classification, Direct, Indirect and Cumulative Assessment of Impacts; Reversible, Irreversible, Negative and Positive Impacts;
Eco Audit and Eco Labelling (ISO: 14000); Environmental Management Plan (EMP); Design for Environment; Relavance of Command Control Paradigm in Environmental Governance; Issues involved in enforcement of environmental legislation. Public awareness. Case Studies.

Note: Atleast one field visit is must for studying of Environment in a Local Area / Ecosystem / Industry and also an Assignment on Environment.

Examination : One question from each unit with internal choice.

Text Books

1. **Anjaneyulu . Y., Introduction to Environmental Sciences. B.S.Publications, 2003.**
2. **Murali Krishna K.V.S., Glimpses of Environment, Environment Protection Society, 2003**

Reference Books

1. **Agarwal, K.C.2001 Environmental Biology, Nidi Publ. Ltd Bikaner.**
2. **Bharucha Erach, The Biodiversity of India, Mapin Publishing Pvt. Ltd., Ahmedabad – 380 013, India, Email: mapin@icenet.net (R)**
3. **Brunner R.C.,1989, Hazardous Waste Incineration, McGraw Hill Inc.480p**
4. **Clark R.S., Marine Pollution, Clanderson Press Oxford (TB)**
5. **Cunningham, W.P.Cooper, T.H.Gorhani, E & Hepworth, M.T.2001, Environmental Encyclopedia, Jaico Publ.House, Mumbai, 1196p**
6. **De A.K., Environmental Chemistry, Wiley Eastern Ltd.**
7. **Down to Earth, Centre for Science and Environment (R)**
8. **Gleick, H.P. 1993. Water in crisis, Pacific Institute for Studies in Dev., Environment & Security. Stockholm Env. Institute. Oxford Univ. Press. 473p**

9. Hawkins R.E, Encyclopedia of Indian Natural History, Bombay Natural History Society, Bombay (R)
10. Heywood, V.H. & Watson, R.T 1995. Global Biodiversity Assessment. Cambridge Univ. Press 1140p.
11. Jadhav, H & Bhosale, V.M.19965. Environmental Protection and Laws. Himalaya Pub. House, Delhi 284 p.
12. Mckinney, M.L. & Schoch, R.M.1996. Environmental Science systems & Solutions, Web enhanced edition.639p.
13. Mhaskar A.K, Matter Hazardous, Techno-Science Publication (TB)
14. Miller T.G. Jr., Environmental Science, Wadsworth Publishing Co. (TB)
15. Odum, E.P 1971. Fundamentals of Ecology. W.B.Saunders Co.USA, 574p
16. Rao M.N.& Datta, A.K.1987. Waste Water treatment. Oxford & IBH Publ. Co.Pvt.Ltd.345p.
17. Sharma B.K., 2001. Environmental Chemistry. Goel Publ. House, Meerut
18. Survey of the Environment, The Hindu (M)
19. Townsend C., Harper J, and Michael Begon, Essentials of Ecology, Blackwell Science (TB)
20. Trivedi R.K., Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standards, Vol I and II, Enviro Media (R)
21. Trivedi R.K. and P.K.Goel, Introduction to air pollution, Techno-Science Publications (TB)
22. Wagner K.D.,1998. Environmental Management. W.B. Saunders Co. Philadelphia, USA

PHARMACEUTICAL ORGANIC CHEMISTRY – II PRACTICALS

Scheme of Instruction		Scheme of Examination	
Total Duration	: 48 Hrs	Maximum Marks	: 100
Periods / Week: 4		Internal Exam	: 30
Credits	: 2	End Semester	: 70
Instruction Mode	: Practical	Exam Duration	: 4 Hrs
Subject Code	: PY.06.881.3.6.P		

List of experiments

1. Synthesis of 2,5 – Dimethyl pyrrole from Acetonyl acetone
2. Synthesis of 2,5 – Dimethyl thiophene from Acetonyl acetone
3. Synthesis of 1,2,3,4-tetra hydrocarbazole from Cyclohezahone.
4. Synthesis of 4,5 – Dephenylimidazole from Benzil
5. Synthesis of 3,5 - Dimethylpyrazole from Acetonylacetone
6. Synthesis of 3,4-ethyl-l-phenyl-5-pyrazole from elthylacetoacetate
7. Synthesis of 3,5-Dimethyl isoxazole from Hydroxylamine
8. Synthesis of Benzimidazole from o – Phenylene diamine
9. Synthesis of Benzothiazole from o-Phenylene diamine
10. Synthesis of 2,3-Diphenyl Quinoline from o-Phenylene diamine and Benzil
11. Synthesis of Phenothiazon from Diphenylurea

Reference Books

1. B. S. Furniss, A. J. Hannaford, P. W. G. Smith and A. R. Tatchell, Vogel's Text Book of Practical Organic Chemistry, 5th Edition, Longman Singapore Publishers, Singapore, 1996.
2. R.K Bansel, Laboratory Manual of Organic Chemistry, 4th Edition, New Age International Publishers, New Delhi, 2005.
3. F.G Mann and B. C Saunders, Practical Organic Chemistry, 4th Edition, Orient Longman, Hyderabad, 2004.
4. Vogel A.I, Elementary Practical Organic Chemistry Part – I, S

PHARMACEUTICAL ANALYSIS – I

Scheme of Instruction		**Scheme of Examination**	
Total Duration	**: 48 Hrs**	**Maximum Marks**	**: 100**
Periods / Week: 4		**Internal Exam**	**: 30**
Credits	**: 2**	**End Semester**	**: 70**
Instruction Mode	**: Practical**	**Exam Duration**	**: 4 Hrs**
Subject Code	**: PY.06.881.3.7.P**		

List of Experiments

1. **Calibration of Weights and Pipette and Burette.**
2. **Standardization of acid, bases, perchloric acid, potassium permanganate EDTA.**
3. **Experiments on Acidimetry and Alkalimetry.**
4. **Experiments on Oxidation and reduction reaction.**
5. **Experiments on Iodimetry and Iodometry.**
6. **Experiments based on complelxometric titration.**
7. **Non-aqeous titration using perchloric Acid.**
8. **Experiments based on gravimetry, silver salt method.**

Reference Books

1. **A.H Beckett and J.B Stenlake, Practical Pharmaceutical Chemistry, Part – I, 4th Edition, CBS Publications, New Delhi, 2004.**
2. **B.H Jeffery and R.C Denny, Vogel's Text book of Quantitative Chemical Analysis, 6th Edition, Pearson Education, Delhi.2004.**
3. **Indian Pharmacopoeia, Controller of Publications, Delhi, 1996.**

PHARMACEUTICAL MICROBIOLOGY

Scheme of Instruction
Total Duration : 48 Hrs
Periods / Week: 4
Credits : 2
Instruction Mode: Practical
Subject Code : PY.06.881.3.8.P

Scheme of Examination
Maximum Marks : 100
Internal Exam : 30
End Semester : 70
Exam Duration : 4 Hrs

List of Experiments

1. **Basic equipments used in Microbiology Laboratory**
2. **Sterilization by dry heat and moist heat technique**
3. **Preparation of various media.**
4. **Aseptic transfer technique**
5. **Staining techniques**
6. **Study of bacterial motility by hanging drop technique**
7. **Biochemical reactions for identification of bacteria**
8. **Isolation of pure cultures**
9. **Enumeration & isolation of bacteria from air.**
10. **Bacteriology of milk and water**
11. **Preservation of cultures**

Reference Books

1. **F.C. Garg, Experimental Microbiology, CBS Publishers, New Delhi, 2003.**
2. **R.S Gaud and G.D Gupta, Practical Microbiology, 6th Edition, Nirali Prakashan, Pune, 2006.**
3. **R.S Gaud, G.D Gupta and S.B. Gokhale, Practical Biotechnology, 2nd Edition, Nirali Prakashan, Pune, 2004.**
4. **Vinita Kale and Kishore Bhusar, Practical Microbiology Principles and Techniques, Himalaya Publishing House, Hyderabad, 2005.**
5. **Ulhas Patil, J.S Kulkarni, A.B Chaudhari and S.B Chinchokar, Foundation in Microbiology, 3rd Edition, Nirali Prakashan, Pune, 2005.**