

P.K. University, Shivpuri (M.P.)
Faculty of Science
Syllabus for Ph.D. Course Work Paper – I
Research Methodology (PRESESC101)

UNIT-1: Scientific Process: Meaning and Definition, a brief history of scientific process.

UNIT-2: Introduction of Research Methodology: Meaning of research, objectives of research, types of research, significance of research, problems encountered by researchers in India.

UNIT-3: Research Problem: Definition, necessity and techniques of defining research problem, Formulation of research problem, Objectives of research problem.

UNIT-4: Research Design: Meaning, need and features of good research design, Types of Research Designs, Basic Principles of Experimental Designs, Design of experiments, Synopsis design for research topic.

UNIT-5: Sampling Designs: Census and Sample surveys, Different types of sample designs, Characteristics of good sample design, Techniques of selecting a random sample.

UNIT-6: Editing, Data Collection and Validation: Primary and secondary data, Methods of collecting primary and secondary data, Importance and methods of editing and data validation.

UNIT-7: Hypothesis: Definition, testing of hypothesis, procedures of hypothesis testing, flow diagram for hypothesis testing, Parametric and non-parametric tests for testing of hypothesis, Limitations of tests of hypothesis.

UNIT-8: Paper/Thesis Writing and Report Generation: Basic concepts of paper their writing and report generation, review of literature, Concepts of Bibliography and References, significance of report writing, steps of report writing, Types of Research reports, Methods of presentation of report.

UNIT-9: Computer Applications: Fundamentals of computers - definition, types of computers. RAM, ROM, CPU, I/O devices. Number system- binary, octal and hexadecimal, base conversion. Logic gates - AND, OR, NOT. Data Structure - array, stack (push, pop), queue (insert, delete), linked list - singly, doubly, Operating system - definition, types of OS. Use of software - MS Office - Power Point, WORD and EXCEL and ACCESS.

UNIT-10: Field and Computer hazards: viruses, misuse of internet, hacking, Field hazards.

UNIT-11: Instrumentation: Description and principles of (i) Electrophoresis (ii) PCR Machine (iii) Laminar Flow (iv) Ultracentrifuge (v) Autoclave and (vi) Light and electron microscopy, Chromatography and HPLC, Handling of instruments and precautions.

UNIT-12: Safety Measures:

- **Lab Safety Measures:** Introduction, Code of conduct - while entering in the lab, while working with the chemicals, while disposal of chemicals, Storage and disposal of chemical wastes - aqueous wastes, organic wastes and radioactive wastes, Human contribution to reduce hazardous wastes.
- **Field Safety Measures:** Food security during field trip/expedition, safety

measures during field trip/expedition - self-care, avoid in fields, care from wild animals, hazard warnings, Safety measures during visit to library and villages, first aid in the fields.

UNIT-13: Probability Distribution and Hypothesis Testing: Theoretical: binomial, poisson, normal, exponential, hyper geometric, uniform distributions. Type I and II error, testing of mean, proportion, tests for equality of mean and variances of two populations, confidence interval, Z- test T-test and χ^2 tests for goodness of fit, ANOVA (one way classification), Non parametric tests: sign test, U test.

UNIT-14: Correlation and Regression Analysis: Karl Pearson's and Rank Correlation coefficient, simple linear regression: least squares method, Linear Programming: Graphical solution, simplex method, dual, sensitivity analysis, transportation and assignment problems

Suggested Readings:

1. Blum, Deborah and Mary Knudson, eds. A field guide for science writers: the official guide of the National Association of Science Writers, New York: Oxford University Press, 1997.
2. Booth, Wayne, Gregory G Colomb, Joseph M. Williams. The craft of Research Chicago University of Chicago Press, 1995.
3. Davis, Martha. Scientific Papers and Presentations. San Diego: Academic Press, 1997.
4. Fuscaldo, AA, Erlick, BI, Hindman, B. Laboratory Safety: Theory and Practice. New York: Academic Press, 1980.
5. Bajpai, PK. Biological Instrumentation and Methodology. New Delhi: S. Chand & Co. Ltd. 2006.
6. Rajaraman, V. Fundamentals of Computers.
7. Horowitz & Sahni. Data Structure.
8. Manual of MS Office.

P.K. University, Shivpuri (M.P.)
Faculty of Science
Syllabus for Ph.D. Course Work Paper-III
Research and Publication Ethics (PRESECP103)

Unit 1: PHILOSOPHY AND ETHICS Introduction to philosophy: definition, nature and scope, concept, branches - Ethics: definition, moral philosophy, nature of moral judgments and reactions.

Unit 2: SCIENTIFIC CONDUCT Ethics with respect to science and research - Intellectual honesty and research integrity - Scientific misconducts: Falsification, Fabrication and Plagiarism (FFP) - Redundant Publications: duplicate and overlapping publications, salami slicing - Selective reporting and misrepresentation of data.

Unit 3: PUBLICATION ETHICS Publication ethics: definition, introduction and importance - Best practices / standards setting initiatives and guidelines: COPE, WAME, etc. - Conflicts of interest - Publication misconduct: definition, concept, problems that lead to unethical behavior and vice versa, types - Violation of publication ethics, authorship and contributor ship - Identification of publication misconduct, complaints and appeals - Predatory publisher and journals.

Unit 4: OPEN ACCESS PUBLISHING Open access publications and initiatives - SHERPA/RoMEO online resource to check publisher copyright & self-archiving policies - Software tool to identify predatory publications developed by SPPU - Journal finger / journal suggestion tools viz. JANE, Elsevier Journal Finder, Springer, Journal Suggested, etc.

Unit 5: PUBLICATION MISCONDUCT Group Discussion : a) Subject specific ethical issues, FFP, authorship b) Conflicts of interest c) Complaints and appeals: examples and fraud from India and abroad Software tools : Use of plagiarism software like Turnitin, Urkund and other open source software tools.

Unit 6: DATABASES AND RESEARCH METRICS (7Hrs.) Databases (4 Hrs.): Indexing databases, Citation databases: Web of Science, Scopus, etc. Research Metrics Impact Factor of journal as per Journal Citations Report, SNIP, SJR, IPP, Cite Score - Metrics: h-index, g index, i10 Index, altmetrics.

Suggested Readings:

1. Nicholas H. Steneck. Introduction to the Responsible Conduct of Research. Office of Research Integrity. 2007.
2. The Student's Guide to Research Ethics By Paul Oliver Open University Press, 2003
3. Responsible Conduct of Research By Adil E. Shamoo; David B. Resnik Oxford University Press, 2003
4. Ethics in Science Education, Research and Governance Edited by Kambadur Muralidhar, Amit Ghosh Ashok Kumar Singhvi. Indian National Science Academy, 2019. ISBN : 978-81-939482-1-7.
5. Anderson B.H., Dursaton, and Poole M.: Thesis and assignment writing, Wiley Eastern 1997.
6. Bjorn Gustavii: How to write and illustrate scientific papers? Cambridge University Press.

7. Bordens K.S. and Abbott, B.b.: Research Design and Methods, Mc Graw Hill, 2008.
8. Graziano, A., M., and Raulin, M.,L.: Research Methods – A Process of Inquiry, Sixth ‘
- 9.
10. Edition, Pearson, 2007.

P.K. UNIVERSITY, SHIVPURI (M.P.)
FACULTY OF SCIENCE
Syllabus for Ph.D. Course Work Paper – II
Advance Physics (PADVAPH102)

UNIT-1: Mathematical Methods

Complex variables, Cauchy – Riemann condition, analytic functions. Cauchy's theorem. Legendre Bessel Hermite differential eqs.. Fourier integral and Fourier transforms.

UNIT-2: Classical Mechanics

D'Alembert's principle and Lagrange's equations, Hamilton's principle, the principle of least action, Canonical transformations.

UNIT-3: Non Relativistic Quantum Mechanics

Schrodinger equation and its applications, Theory of angular momentum, Quantum theory of Scattering, S-matrix Theory.

UNIT-4: Statistical Physics

Foundation of Statistical mechanics, Elements of ensemble theory – a system in Microcanonical, Canonical and Grand Canonical ensembles, Partition functions applications of ensemble theory Maxwell - Boltzmann, Bose-Einstein, Fermi-Dirac distributions.

UNIT-5: Atomic and Molecular Physics

Electronic spectra, Radiative transitions, Applications of Laser in spectroscopy, Basic idea of two photon processes and frequency up conversion.

UNIT-6: Nuclear and particle Physics

Nuclear forces, Nuclear Models, Beta decay Fermi theory, parity violation, Symmetry and conservation laws, Special Unitary Symmetries and Quark model.

UNIT-7: Electrodynamics and Plasma Physics

Maxwell's equations in four dimensions, Gauge transformations, Lorentz transformations, Elementary concept of Plasma and Magneto- Hydrodynamics.

UNIT-8: Relativistic Quantum Mechanics

Relativistic Quantum Mechanics, Basic concepts of Quantum Field Theory.

UNIT-9: Electronics

Linear integrated circuits, Operational amplifier and its applications.

UNIT-10: Condensed Matter Physics

Debye theory of solids, Bloch theorem, K.P. Model distinction between Metal, insulator and semiconductor, Superconductivity

Suggested Readings:

1. M.S. Longair : *Theoretical concepts in physics*, 1986.
An alternative view of theoretical reasoning in physics for final-year undergrads.
2. Arnold Sommerfeld: *Lectures on Theoretical Physics*
Sommerfeld is God for mathematical physics.
3. Richard Feynman: *The Feynman lectures on Physics (3 vols)*
Highly recommended texts compiled from the undergraduate lecture course given by Feynman.
4. Jearle Walker: *The Flying Circus of Physics*
5. There is the entire Landau and Lifshitz series. They have volumes on classical mechanics, classical field theory, E&M, QM, QFT, statistical physics, and more. Very good series that spans the entire graduate-level curriculum.

P.K. UNIVERSITY, SHIVPURI (M.P.)
FACULTY OF SCIENCE
Syllabus for Ph.D. Course Work Paper – II
Advance Chemistry (PADVACH102)

UNIT-1: GREEN CHEMISTRY

Basic Principles of Green Chemistry. Designing a Green Synthesis: Choice of starting materials, choice of reagents, choice of catalysts, choice of solvents. Green reagents, Green catalysts, Phase transfer catalysis for green synthesis. Organic synthesis in solid phase. Versatile ionic liquids as green solvents. Some examples of synthesis involving basic principles of green chemistry of industrial importance.

UNIT-2: NANOCHEMISTRY

Introduction, classification of nanoparticles, synthesis, characterization, properties and application of nanomaterials.

UNIT-3: ADVANCED MATERIALS CHEMISTRY

Structure of solids, symmetry concepts, crystal structure. Preparative methods and characterization of inorganic solids. Crystal defects and non-stoichiometry. Interpretation of phase diagrams, phase transitions. Basics of magnetic, thermal, electrical, optical and mechanical properties of solids.

UNIT-4: APPLICATION OF SILICATE-BASED INORGANIC SOLIDS

Silicates, Clays, Nano clays, Zeolite and Zeolitic Materials: Importance of Zeolite and Zeolitic Materials: As adsorbents and molecular sieves, As heterogeneous reusable catalysts in petrochemical industry, As filler in fire retardant materials, In nuclear industry, In agricultural industries

UNIT-5: SPECTROSCOPY: APPLICATIONS FOR ORGANIC CHEMISTS

NMR Techniques in the identification and characterization of organic compounds, inorganic complexes and Polymers.

UNIT-6: INTRODUCTORY QUANTUM CHEMISTRY

Postulates of Quantum Mechanics. Operators, Chemical bonding: Born-Oppenheimer approximation. Variational treatment of hydrogen molecule ion. Valence bond and MO (LCAO) treatment of hydrogen molecule.

UNIT-7: ADVANCED CHEMICAL KINETICS

Experimental methods for fast reactions. Temperature jump, pressure jump stopped flow and flash photolysis pulse technique as applied to reaction rates of short lived species. Shock tube kinetics. NMR studies in rate processes. Enzyme kinetics of complicated systems, theory of diffusion controlled reactions.

UNIT-8: ANALYTICAL TECHNIQUES FOR MATERIAL CHARACTERIZATION

Diffraction Methods: X-Ray Diffraction, Neutron Diffraction, Electron Diffraction.

Thermal Methods: TGA, DTA, DSC, Thermometric Titration. Adsorption/ Desorption Techniques: BET and EGME methods of determination of external and total surface area.

Suggested Readings:

- a. D.A. Skoog, F.J. Holler & S. Crouch (ISBN 0-495-01201-7) Principles of Instrumental
- b. Analysis, Cengage Learning India Edition, 2007.
- c. Willard, Merritt, Dean, Settle, Instrumental Methods of Analysis, 7th ed, IBH Book House, New Delhi.
- d. Atkins, P.W & Paula, J.D. Physical Chemistry, 10th Ed., Oxford University Press (2014).
- e. Kakkar, R. Atomic and Molecular Spectroscopy: Concepts and Applications. Cambridge University Press, 2015.
- f. Castellan, G. W. Physical Chemistry 4th Ed., Narosa (2004).
- g. Banwell, C. N. & McCash, E. M. Fundamentals of Molecular Spectroscopy 4th Ed. Tata McGrawHill: New Delhi (2006).

P.K. UNIVERSITY, SHIVPURI (M.P.)
FACULTY OF SCIENCE
Syllabus for Ph.D. Course Work Paper – II
Applied Mathematics (PAPPLMA102)

UNIT-1: Fuzzy set and fuzzy logic: From classical crisp sets to fuzzy sets, operations on fuzzy sets, Introduction to fuzzy arithmetic, fuzzy relation, fuzzy logic, fuzzy relations equations, and uncertainty- based information, and applications of fuzzy sets in decision making and physical sciences.

UNIT-2: Chaos and bifurcation: Iteration of functions, phase portraits, periodic points and stable sets, differentiability and hyperbolicity, chaos in perspective, Routes to chaos, Chaos (definitions and examples), characteristics of chaos, bifurcation (definitions and examples).

UNIT-3: Optimization Techniques: Unconstrained optimization techniques, constrained optimization techniques and solutions of constrained nonlinear optimization problems, Decision Theory, Introduction to Game theory, Heuristics based optimization problems, Decision Theory, Introduction to Game theory, Heuristics based optimization Techniques.

Suggested Reading:

1. Discrete Dynamical systems by R.A.Holmgren
2. Chaos theory tamed by Garnett P. Williams, A Joseph Henry
3. Chaotic Dynamical systems by R.L devaney
4. Bifurcation and chaos in complex systems by Jian – Qiao Sun and Albert lu
5. Operations Research by H.A.Taha
6. Operations Techniques by Chander Mohan and kusum Deep
7. Engineering optimization by S.S.Rao
8. Fuzzy sets and fuzzy logic by Klir and Boyuan
9. Fuzzy sets, Uncertainty and information by Klir and Folger
10. Fuzzy sets and logics by Zimmerman

P.K. UNIVERSITY, SHIVPURI (M.P.)
FACULTY OF SCIENCE
Syllabus for Ph.D. Course Work Paper – II
Applied Botany (PAPPLBO102)

UNIT-1: Microbes and Mycorrhiza and their significance.

UNIT-2: Biodiversity assessment and conservation: Distribution pattern, endemism, resource utilization and conservation.

UNIT-3: Modern trend in taxonomy with special reference to Biosystematics.

UNIT-4: Ecosystems: Diversity and Management with special reference to the Himalaya.

UNIT-5: Genetic engineering and its implications: Gene isolation, enzymatic synthesis of gene, transgenic crops, PCR (Polymerase Chain Reaction).

UNIT-6: Biotechnology: Scope and importance of biotechnology, tissue culture techniques in biotechnology, biotechnology in medicine and agriculture.

Suggested Readings:

1. Mitra, Sandhya (1996) Genetic Engineering. Mc-Millan India Co. Ltd., New Delhi.
2. Gupta, P.K. (2001). Elements of Biotechnology. Rastogi Publications, Meerut, Pp:1-13.
3. Odum, E.P.(2000). Fundamentals of Ecology. Thomson Asia Pvt. Ltd., Singapore.
4. Ricklefs, Robert, E. and Gary L. Miller (2009). Ecology (IVth edition). W.H. Freeman and Company, New York.
5. Chawala, H.S (2006). Introduction to Plant Biotechnology. Oxford and IBH Pub. Co., New Delhi.
6. Naik, V.N. (2001). Taxonomy of Angiosperms. Tata MC Graw- Hill Pub. Co. Ltd., New Delhi.
7. Christian Leveque and Jean-Claude Mounoluv. – Biodiversity, John Wiley & Sons, Ltd.
8. Smith, S.E. & D.J. Read- Mycorrhizal Symbiosis. Academic Press.
9. Mahendra Raj & Ajit Verma – Diversity and Biotechnology of Actomycorrhiza.

P.K. UNIVERSITY, SHIVPURI (M.P.)
FACULTY OF SCIENCE
Syllabus for Ph.D. Course Work Paper – II
Advance Zoology (PADVAZO102)

UNIT-1: Biodiversity: levels of biodiversity, value of biodiversity, regional, national and global status of biodiversity, threats to biodiversity, conservation and management of biodiversity, biodiversity act and related international conventions, bio-geographical classification of India.

UNIT-2: Environmental stresses and their management, global warming, atmospheric ozone, Biodegradation and bioremediation of chemicals.

UNIT-3: Chemistry of gene: structure of nucleic acids (A,B,C & Z DNAs) RL model of Saisephara, super coiling, genetic & Non-genetic RNA, DNA replication, DNA repair (excision repair, mismatch repair and SOS repair) and genetic diseases in humans. restriction enzymes in cloning, techniques used in recombinant DNA technology and its application, DNA fingerprinting.

UNIT-4: Social behavior of animals: costs and benefits of group-living, types of social acts, individual adjustments of group-living, parental care and socio- functional organization in apes & monkeys.

UNIT-5: Special features of selected micro-organisms: animal viruses, plant viruses, bacteriophages, rickettsiae, mycobacterium, mycoplasma, actinomycetes, fungi and slime-moulds.

UNIT-6: A brief knowledge of **environmental endocrinology**.

UNIT-7: Cells in culture: requirements for cell culture, aseptic technique, primary culture, organotypic cultures.

UNIT-8: Pesticides: brief history, pesticide industries and markets. Dose-response relationship, insecticide, carcinogenic, teratogenic effects.

Suggested Readings:

1. Crustacean Aquaculture, Mc Vey, J (Ed.), CRC Press.
2. Disease of Cultured Penaeid Shrimp in Asia and The United States, Fulks, W & Main, K.L (Eds.), Argent Laboratories Press.
3. Intensive Shrimp Production Technology, Wyban, J.A. & Sweeney, J.N. (Eds.), Argent Laboratories Press.
4. Standard Method for the Nutrition and Feeding of Farmed Fish and Shrimp, Albert GJ Tacon (Ed.), Argent Laboratories Press.
5. Gene Expression and Manipulation in Aquatic Organisms, Ennion, S.J. & Goldspink, G (Eds.), Cambridge University Press.

6. Molecular Biology and Toxicology of Metals, Rudolfs K Zalups & James Koropatnick (Eds.), Taylor and Francis
7. Crustacean Farming: Ranching and Culture, John F. Wickins & Daniel O.C. Lee (Eds.), Blackwell Science.
8. Microscopic Anatomy of Invertebrates, Vol. 10. Decapod Crustacean, Harrison, F.W. & Humes, A.G. (Eds.),
9. Advances In Molecular Ecology, Gary R Carvalho (Ed.), ISO Press, Ohmsha NATO Science Series. M.Phil. / Ph.D. Zoology (2018-19 onwards) Page 6 of 19
10. Practical Handbook of Biochemistry and Molecular Biology, Gerald D. Fasman (Ed.), CRC Press.
11. Aquaculture Principles and Practices, Pillay, TVR (Ed.), Fishing News Books, USA.

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FACULTY OF SCIENCE
Syllabus for Ph.D. Course Work Paper – II
Advance Biotechnology (PADVABT102)

UNIT-1: Hybridization techniques: Southern, Western, Northern and Dot Blots

UNIT-2: Gene expression studies: Real-Time-PCR. Micro arrays & Gene chips

UNIT-3: Sequencing: DNA and protein sequencing

UNIT-4: Immunological techniques: Radial Immunodiffusion test. ELISA, RIA, Surface Plasmon Resonance

UNIT-5: Molecular Marker: RFLP, AFLP, SCARs, SNPs, ESS-SSR

UNIT-6: Spectroscopic methods: UV/Vis, fluorescence spectrometry

UNIT-7: Electrophoretic techniques: Vertical, Horizontal, 2-Dimensional, Denaturing gradient gel electrophoresis, Thermal gradient gel electrophoresis

UNIT-8: Variants of PCR and Amplification of gene: Semi-quantitative RT PCR, Nested PCR, Multiplex PCR, DOP-PCR

UNIT-9: Bioinformatics: Data Mining GENBANK, Blasting sequence, Primer designing etc.

Suggested Readings:

1. Bowtell, D and Sambrook, J. DNA Microarrays: A Molecular cloning manual. CSHL press
2. Glick, BR., Pasternak, JJ (1998) Molecular Biotechnology: Principles and Applications of recombinant DNA, ASM Press.
3. Grandi, G (2004) Genomics, Proteomics and Vaccines. Wiley press.
4. Hannon, GJ, RNAi: A guide to gene silencing. CSHL Press
5. Kirby, LT (1990) DNA finger printing: An introduction, Stockton press.
6. Lewin, B (2004). Genes VIII. Pearson Prentice Hall Press
7. Principles of genetic manipulation; Ed. Old and Primrose, 6th Edition. Blackwell Science publication

P.K. UNIVERSITY, SHIVPURI (M.P.)
FACULTY OF SCIENCE
Syllabus for Ph.D. Course Work Paper – II
Modern Computer Science (PMODECS102)

Unit 1 - Digital Image Processing

Introduction to Digital Image Processing: Enhancement, Segmentation, Object Detection and Recognition.

Unit 2 - Machine Learning

Introduction to Artificial Intelligence, Artificial neural network, Support Vector Machine (SVM) with applications.

Unit 3 - Soft Computing

Introduction to Fuzzy Logic, Fuzzy Sets and Operations, Introduction to Genetic Algorithm and its Applications.

Unit 4 - Network Services

Introduction to Cloud Computing, Mobile Computing and Ad Hoc Network.

Unit 5 - Computing Software

Introduction to MATLAB and R.

Suggested Readings:

1. “Digital Image processing” by Rafael C. Gonzalez, Richard Eugene Woods Prentice Hall.
2. “Introduction to Artificial Intelligence and Expert System” by Dan W. Patterson, PHI.
3. “Neural Network, Fuzzy Logic and Genetic Algorithm” by S. Rajashekharan, G.A. Vijay Laxmi, PHI
4. “MATLAB Primer” by Timothy A. Devis Kermit Sigmon, Chapman and Hall.

P.K. UNIVERSITY, SHIVPURI (M.P.)
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Syllabus for Ph.D. Course Work Paper – II
Advance Biochemistry (PADVABC102)

Unit 1. Genomics

Global expression profiling; Whole genome analysis of mRNA and protein expression; Real time PCR to monitor changes in expression levels; Concept of microarrays and its applications for DNA, RNA and proteins.

Unit 2. Spectroscopy and Spectrometry

General principles of spectroscopy and spectrometry, theory and applications of various spectroscopic techniques; Mass spectrometry and its biological applications.

Unit 3. Recombinant DNA Technology

Use of Restriction and modification enzymes in cloning, Plasmid/Phagemid vector, Ligation, Transformation and Plasmid isolation, Design of primers; PCR: Standard PCR, Hot Start PCR, Allele-Specific PCR, Colony PCR, Nested PCR, Applications of PCR in research, Basic DNA sequencing methods. Sanger's chain termination method, and automated DNA sequencing, Introduction to next generation sequencing (NGS) methods including base calling, sequence alignment, and variant calling.

Unit 4. Growth, Maintenance and Genetic engineering of Mammalian cells

Basic requirements for in vitro cell culture, live cell staining and counting. Synchronization of mammalian cells and cell cycle analysis. Various ways of overexpressing and silencing genes in mammalian cells; Generation of transient and stable lines. Use of radioisotopes in cell biology.

Unit 5. Concepts of vaccine development

Vaccine development history, Vaccine generations and types, Vaccines and immunological memory, adjuvants, mechanism and need of adjuvant, vaccine engineering, antigen and antigenicity, Immune epitope database (IEDB), epitope mapping, vaccine preparation and protein expressions, vaccine testing and clinical trials.

Unit 6. Purification and Characterization of proteins and Drug discovery

Expression vectors; Expression, isolation and purification of heterologous proteins; Chromatography techniques for protein purification; Mapping of protein interactions: two hybrid, Protein fragment complementation, Concepts of drug discovery and development.

SUGGESTED READINGS

1. Physical Biochemistry: Applications to Biochemistry and Molecular Biology (1982) 2nd ed., Freifelder, D., W.H. Freeman and Company (New York), ISBN:0-7167-1315-2 / ISBN:0-7167-1444-2.
2. Molecular Cloning: A laboratory Manual (2012) Vol. 1-3, 4th ed., Green M.R. and Sambrook J., Cold Spring Harbour Laboratory Press (New York). ISBN: 978-1- 936113-41-

5 / ISBN: 978-1-936113-42-2.

3. Animal Cell Culture & Technology (2004) 1 st ed., Butler, M., Tailor & Francis Publishers (UK), ISBN-1: 859960499.
4. Principles and Techniques of Biochemistry and Molecular Biology (2010) 7 thed, Keith Wilson and John Walker, Cambridge University Press India Pvt. Ltd., ISBN-13: 978-0-521-17874-7 / ISBN:10: 0-07-099487-0.
5. R. Burgess, M. P. Deutcher. 2009. Guide to Protein Purification, Academic Press, San Diego, USA.
6. System vaccinology: The history, the translational challenge and the future (2022); Academic Press Inc; ISBN-10: 0323859410.
7. Vaccine Design: Methods and Protocols, Volume 3. Resources for Vaccine Development: 2412 (Methods in Molecular Biology); Springer-Verlag New York Inc.; 2nd ed. 2022 edition; ISBN-101071618946

P.K. UNIVERSITY, SHIVPURI (M.P.)
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Syllabus for Ph.D. Course Work Paper – II
Advance Food Technology (PADVAFT102)

Unit 1: Concept of food quality and food safety, need for food safety, major challenges to food safety, major consumer concerns and issues regarding food safety and quality, food safety scenario in India, food safety and quality measures techniques in India, FPO, MFPO, MMPO, AGMARK.

Unit 2: Principles of food safety management: good hygienic practices (GHP), good manufacturing practices (GMP), food safety hazards, hazard analysis, HACCP principles and implementation in food industry, Good laboratory practices: concept, present status and future need for food industry, concept of food traceability and its need for food safety management system.

Unit 3: Food safety management systems, Food safety standards: purpose, classification and types of food standards, standards setting organizations, ISO 15161: 2001, ISO 15161:20002, ISO 22000, legal aspects of food safety management systems, global laws on food safety, Food Safety and Standards Act of India (FSSA): prospects and problems.

Unit 4: Quality assurance and management systems in food industry, principles of quality control, quality standards, ISO standards for food industry, total quality management (TQM) in food industry, certification for food safety and quality management systems, certification criteria, selection of certification bodies, role of accreditation in food industry, accreditation agencies, benefits of certification and accreditation.

Suggested Readings:

1. Arora, K.C. 2000. TQM and ISO 14000, Kataria Publications, New Delhi. * Bank, J. 1996.
2. The Essence of Total Quality Management, Printice Hal of India, New Delhi. * Jouve, J.L., Stringer, M.F., Baird Parker, A.C. 1998.
3. Food Safety Management Tools, International Life Science Institute, ILSI Europe, Brussels. * Hester, R.E., Harrison, R.M. 2001.
4. Food Safety and Food Quality, The Royal Society of Chemistry. * Inteaz Alli. 2003.

P.K. UNIVERSITY, SHIVPURI (M.P.)
FACULTY OF SCIENCE
Syllabus for Ph.D. Course Work Paper – II
Applied Microbiology (PAPPLMB102)

Unit 1: Fermentation

Submerged and solid state fermentations, Types of fermenters, Design and operation of Fermenters, Concepts for selection of a reactor. Growth and product formation kinetics: Monod growth kinetics, Kinetics of colony formation and pellet growth. Concepts for calculation of yield coefficient, specific growth rate, specific productivity, maintenance coefficient. Biomass and substrate balance calculations for chemostat, chemostat with recycles, multistage chemostat systems and fed-batch systems.

Unit 2: Stoichiometry of cell growth

Elemental balance, Electron balance, Theoretical calculation of oxygen demand, Upper limit of yield and energy changes occurring due to growth and product formation. Sterilization: Kinetics of cell death and nutrient degradation during heat killing ; Batch and continuous sterilization; Scale up of sterilization. Brief account of Downstream processing: Downstream process economics, Cost cutting strategies in downstream processing industry.

Unit 3: Enzymes

Commercial applications; Production of industrially important enzymes such as Amylases, Proteases, Lipases, Enzymes used for analytical purpose: Glucose oxidase, cholesterol oxidase; Medicinal enzymes: L-Asparaginase.

Unit 4: Techniques

Techniques of enzyme immobilization; Kinetic Parameters for soluble and Immobilized Enzyme Systems, Reactors for Enzyme Catalyzed Reactions. Idealized Enzyme Reactor Performance, Mass transfer limitations in immobilized enzyme reactors.

Suggested Readings:

1. Physiology and Biochemistry of Prokaryotes by David White, published by Oxford University Press, 4th edition, 2011
2. Microbial Biochemistry by G. N. Cohen published by Springer Netherlands, 3rd edition, 2014
3. Microbial Physiology by Albert G. Moat, John W. Foster, Michael P. Spector, published by John Wiley & Sons, 4th edition, 2002
4. Biochemistry by Geoffrey Zubay, published by William C Brown, 4th edition, 2002
5. The Metabolic Pathway Engineering Handbook by Christina Smolke, published by CRC Press, 2009.