

MAHARSHI DAYANAND UNIVERSITY ROHTAK
DEPARTMENT OF ZOOLOGY
M. Sc. ZOOLOGY w.e.f. session 2012-13
Semester-I

Course no.: Zoo-101

MM: 80

Course Title: Biomolecules

Time: 3hrs

Note: There shall be nine questions in total. One question will be compulsory (short answer type) covering the entire syllabus and remaining eight questions will be set two from each unit. Students are required to attempt one from each unit.

Unit I

Biomolecular foundations of biology:

pH, pK, acids, bases, buffers, bonds- Van der Waal's, electrostatic, hydrogen bonding and hydrophobic interaction, free energy, resonance, isomerisation.

Structure of soluble biomolecular pool of cells – aminoacids and peptides; monosaccharides, oligosaccharides and polysaccharides; glycoproteins, peptido-glycans; nucleotides, oligonucleotides, lipids and vitamins.

Unit II

Proteins Structure -primary, secondary, tertiary and quaternary.

Folding, denaturation and function of polypeptides like Ribonuclease A, Myoglobin, Hemoglobin, Chymotrypsin, Lysozyme and Carboxypeptidase.

Conjugated proteins-structure and functions

Analysis of proteins: Western blotting; Reverse turns and Ramachandran plots

Unit III

Nucleic acids: - types, structural organization and helix-coil transition energetics. Physicochemical techniques and macromolecular analysis

Biomolecular interaction: Protein-ligand, protein-protein, nucleic acid-protein and nucleic acid-ligand interactions.

Unit IV

Assembly of macromolecular complexes;- Ribosomes, chromatin, plasma membrane and viruses; Nanoparticles;

Organisation of animal tissues.

Suggested Reading Material

1. D.Voet and J.G. Voet. Biochemistry, John Wiley & Sons.
2. D. Freifelder. Physical Biochemistry, W.H. Freeman & Company
3. I.H. Segal. Biochemical Calculations, John Wiley & Sons.
4. T.E. Creighton. Proteins-structure and Molecular Properties, W.H. Freeman & Company.
5. D. Freifelder, Essentials of Molecular Biology.
6. K. Wilson and K.H. Goulding. A Biologist's guide to principles and techniques of practical biochemistry.
7. T.G. Cooper. Tools of Biochemistry.
8. Hawk. Practical Physiological Chemistry.
9. R.H. Garrett and CM. Grisham. Biochemistry, Saunders College Publishers.

MAHARSHI DAYANAND UNIVERSITY ROHTAK

DEPARTMENT OF ZOOLOGY

M. Sc. ZOOLOGY w.e.f. session 2013-14

Semester-I

Course no.: Zoo-102

MM: 80

Course Title: Techniques in Animal Sciences

Time: 3hrs

Note: There shall be nine questions in total. One question will be compulsory (short answer type) covering the entire syllabus and remaining eight questions will be set two from each unit. Students are required to attempt one from each unit.

Unit I

Microscopy: Principles and applications of light, phase contrast, fluorescence microscopes, scanning and transmission electron microscopes. X-ray diffraction, pH meter, Fixation and staining; cryotechnology and flow cytometry, Confocal Microscopy.

Units II

Spectroscopy: Fluorescence, UV, visible, NMR and ESR spectroscopy; X-ray diffraction. Tracer Biology: Principles and applications of tracer techniques in biology; radioactive isotopes and half-life of isotopes; autoradiography, GCMS spectroscopy.

Unit III

Chromatography: Principles and applications of gel filtration, ion-exchange, affinity, thin layer, gas chromatography and high pressure liquid chromatography (HPLC). Electrophoresis and centrifugation: Principles and applications of agarose and polyacrylamide gel electrophoresis; ultracentrifugation (velocity and buoyant density).

Unit IV

Molecular biology techniques: Sequencing of proteins and nucleic acids; southern, northern and western blotting techniques, polymerase chain reaction (PCR), ELISA, MALDITOF. Methods for measuring nucleic acid and protein interactions, Real time PCR and reverse transcriptase PCR.

Suggested Reading Material

1. Animal Cell Culture - A practical approach, Ed. John R.W. Masters, IRL Press.
2. Introduction to Instrumental analysis, Robert Braun. McGraw Hill International Editions.
3. Shukla and Upadhyaya. Experimental Science
4. Randhir Singh. Practicals in Biochemistry
5. A Biologists Guide to Principles and Techniques of Practical Biochemistry, K. Wilson & K.H. Goulding, ELBS Edn.

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M. Sc. ZOOLOGY w.e.f. session 2012-13
Semester-I

Course no.: Zoo -103

MM: 80

Course Title: Animal Cell Biology

Time: 3hrs

Note: There shall be nine questions in total. One question will be compulsory (short answer type) covering the entire syllabus and remaining eight questions will be set two from each unit. Students are required to attempt one from each unit.

Unit I

Introduction-experimental systems in Cell Biology;
Structure of pro-and eukaryotic cells;
Structure and function of cells and intracellular organelles of both prokaryotes and eukaryotes); Significance of intracellular compartments;
Mechanism of cell division including (mitosis and meiosis) and cell differentiation;
Cell-cell interaction.

Unit II

Biomembranes: Molecular composition and arrangement functional consequences; Model membranes; Liposomes.
Transport across cell membrane-
Diffusion, active transport and pumps, uniports, symports and antiports; Membrane potential; Co-transport by symporters or antiporters; Transport across epithelia.
Cytoskeleton:
Microfilaments and microtubulus-structure and dynamics; Microtubules and mitosis; Cell movements- intracellular transport, role and kinesin and dynein; Cilia and Flagella

Unit III

Cell-Cell signaling:
Signal transduction mechanisms;
Cell surface receptors;
Second messenger system;
MDP kinase pathways;
Signalling from plasma membrane to nucleus.
Cell-Cell matrix, adhesion and communication
Ca⁺⁺ dependent & independent homophilic cell-cell adhesion; Gap junctions and connexins
Cell matrix adhesion: Integrins, Collagen, Non-collagen components & Cellulose fibril synthesis and orientation

Unit IV

Cell cycle: Cyclines and cyclin dependent kinases and Regulation of CDK-cycline activity
Genetic analysis in Cell Biology: Nucleus; Mitochondria and chloroplasts and their genetic organization;
Biology of cancer, Biology of aging and Apoptosis-definition, mechanism and significance

Suggested Reading Material

1. Molecular Cell Biology, J. Darnell, H. Lodish and D. Baltimore Scientific American Book, Inc., USA.
2. Molecular Biology of the Cell, B. Alberts, D. Bray, J. Lewis, M. Raff, K. Roberts, and J.D. Watson. Garland Publishing Inc., New York.

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Semester-I

Course no.: Zoo-104

MM: 80

Course Title: Computer and Biostatistics

Time: 3hrs

Note: There shall be nine questions in total. One question will be compulsory (short answer type) covering the entire syllabus and remaining eight questions will be set two from each unit. Students are required to attempt one from each unit.

Unit I

Computer peripherals and hardware description- computer system design, recognition and structure of different components of a computer system and their respective usage. Input/output and storage devices. Introduction of internet. Office application: MS office 2000 including MS word, MS excel and MS power point Overview of Windows XP. Number system and flow charts in computing language. DOS internal and external commands Generations of programming languages, system and application software; Introduction of programming in BASIC.

Unit II

Collection, classification and tabulation of data. Frequency distribution, Diagrammatic and Graphical presentation of

statistical data, Sampling techniques. Central tendency, Dispersion, coefficient of variation; Standard error; Confidence limits; Skewness and Kurtosis Measures of Relationship: Correlation, Regression, Non-parametric tests

UNIT III

Probability: Approaches to measurement of Probability, Random experiments, sample space, events.

Mathematical definition of probability of an event.

Probability distributions: - Distribution of Binomial, Poisson and Normal Distributions and their properties; (including problems).

UNIT IV

Testing of Hypothesis, Chi-square test, 't' and 'F' test. Analysis of variance for one-way classified data, and two-way classified data.

Suggested Reading Material

1. Batschelet, E. Introduction to mathematics for life scientists. Springer-Verlag, Berlin.
2. Snedecor, G.W. and W.G. Cochran. Statistical methods. Affiliated East-West Press, New Delhi (Indian ed.).
3. Green, R.H. Sampling design and statistical methods for environmental biologists. John Wiley & Sons, New York.
4. Computer fundamentals: concepts, systems and application by PK Sinha. BPB publications
5. Computer fundamentals (Paperback) by Ashok Arora, Shefali Bansai and Shefali Bansal. Excel Books
6. Discovering computers: fundamentals (paperback) by Gary B. Shelly. Pub: Course technology
7. Discovering computers: fundamentals, 4th ed. (Shelly Cashman) (paperback) by Grey B Shelly Thomas J Cashman and Misty E Vermaat. Pub: Course technology
8. Computer fundamentals architecture and organization (paper back) by B Ram. Pub: New age publications (academic)

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DEPARTMENT OF ZOOLOGY
M. Sc. ZOOLOGY w.e.f. session 2012-13
Semester-I

Course no.: Zoo -105 (i)

MM: 80

Course title : Systems Biology [Programme elective]

Time: 3

Hrs

Note: There shall be nine questions in total. One question will be compulsory (short answer type) covering the entire syllabus and remaining eight questions will be set two from each unit. Students are required to attempt one from each unit.

Unit I

Systems Microbiology - 'The Cell as a Well-stirred Bioreactor'

Introduction Michaelis-Menten Kinetics
Equilibrium Binding Cooperativity: Michaelis-Menten Kinetics
Lambda Phage Multistability: A Genetic Switch in Lambda Phage
Synthetic Genetic Switches

Unit II

Systems Microbiology - 'The Cell as a Well-stirred Bioreactor'

Stability Analysis
Introduction *E. coli* Chemotaxis
Fine-tuned versus Robust Chemotaxis Models; Wrapping up Chemotaxis
Biological Oscillators; Genetic Oscillators; Biological Oscillators
Stochastic Chemical Kinetics: The Origin and Consequences of Noise in Biochemical Systems

Unit III

Cell Systems Biology - 'The Importance of Diffusion and Gradients for Cellular Regulation'

Introduction Cell Systems Biology: Fick's Laws
Local Excitation: Global Inhibition Theory & Model
Rapid Pole-to-pole Oscillations in *E. coli*
Models for Eukaryotic Gradient Sensing
Modeling Cytoskeleton Dynamics

Unit IV

Developmental Systems Biology - 'Building an Organism Starting From a Single Cell'

Quorum Sensing
Drosophila Development

Suggested Readings:

1. . Alberts, Bruce, et al. *Molecular Biology of the Cell*. 4th ed. New York: Garland Science, 2002.
2. Multistability Hasty, Jeff, Joel Pradines, Milos Dolnik, and J. J. Collins. "Noise-based Switches and Amplifiers for Gene Expression." *Proc. Natl. Acad. Sci. USA* 97, no. 5 (Feb 29, 2000): 2075-80.
3. Isaacs, Farren J., Jeff Hasty, Charles R. Cantor, and J. J. Collins. "Prediction and Measurement of an Autoregulatory Genetic Module." *PNAS* 100, no. 13 (June 24, 2003): 7714-19.
4. Synthetic Genetic Switches Gardner, Timothy S., Charles R. Cantor, and James J. Collins. "Construction of a Genetic Toggle Switch in *Escherichia coli*." *Nature* 403, no. 6767 (January 20, 2000): 339-42.
5. Modeling *Escherichia coli* chemotaxis Spiro, Peter A., John S. Parkinson, and Hans G. Othmer. "A Model of Excitation and Adaptation in Bacterial Chemotaxis." *Proc. Natl. Acad. Sci. USA* 94, no. 14 (July, 1997): 7263-68.
6. Oscillators Elowitz, Michael B., and Stanislas Leibler. "A Synthetic Oscillatory Network of Transcriptional Regulators." *Nature* 403, no. 6767 (January 20, 2000): 335-8.
Atkinson, Mariette R., Michael A. Savageau, Jesse T. Myers, and Alexander J. Ninfa. "Development of Genetic Circuitry Exhibiting Toggle Switch or Oscillatory Behavior in *Escherichia coli*." *Cell* 113, no. 5 (May 30, 2003): 597-607.
8. Howard, Martin, Andrew D. Rutenberg, and Simon de Vet. "Dynamic Compartmentalization of Bacteria: Accurate Division in *E. Coli*." *Physical Review Letters* 87, no. 27 (December 31, 2001).
9. Eukaryotic Gradient Sensing Narang, Atul, K. K. Subramanian, and D. A. Lauffenburger. "A Mathematical Model for Chemoattractant Gradient Sensing based on Receptor-regulated Membrane Phospholipid Signaling Dynamics." *Annals of Biomedical Engineering* 29, no. 8 (2001): 677-91.

10. Postma, Marten, and Peter J. M. Van Haastert. "A Diffusion–Translocation Model for Gradient Sensing by Chemotactic Cells." *Biophysical Journal* 81, no. 3 (September, 2001): 1314-23.
11. Modeling Cytoskeleton Dynamics Dogterom, Marileen, and Stanislas Leibler. "Physical Aspects of the Growth and Regulation of Microtubule Structures." *Physical Review Letters* 70, no. 9 (March 1, 1993).
12. Cytrynbaum, E. N., V. Rodionov, and A. Mogilner. "Computational Model of Dynein-dependent Self-organization of Microtubule Asters." *Journal of Cell Science* 117, no. 8 (March 15, 2004): 1381-

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Semester- I

Course no.: Zoo -105 (ii) [Programme elective]

MM: 80

Course Title: Communication skills in Life Science

Time: 3hrs

Note: There shall be nine questions in total. One question will be compulsory (short answer type) covering the entire syllabus and remaining eight questions will be set two from each unit. Students are required to attempt one from each unit.

Unit I

Scientific and technical writing: Preparation of scientific report, Thinking and planning, Information, ideas, order of writing, Paragraph writing proper use of verb, Nouns, pronouns, tense, use of MS office, excel, powerpoints for preparing a scientific report.

Unit II

Scientific presentation: Preparation of presentation, Order of material, Use of web information in presentation, Ethical/copyright issues in presentations, Title, objective, methodology and results presentation, Different ways to make impressive presentations.

Unit III

Oral presentations: General gesture for presentations, Speed, loudness, clarity during presentations, use of appropriate vocabulary during presentation, General discussions, scientific presentation, Sharing view and ideas.

Unit IV

Use of web to collect specific information, Scientific paper and review writing, Correspondence with editors and reviewers, appropriate citations, copyright and Ethical issues in paper drafting, Acknowledgment, Keywords, Use of appropriate citations, usage of different softwares for manuscript preparation, usage of line-,bar-graphs, charts to describe the results.

Suggested readings: -

1. Rastogi, B.C., Bioinformatics, Concept, Skills & Applications, CBS Publications.
2. Richard Ellis, Communication Skills: Stepladders to success for professional, Gutenberg Press, Malta.
3. John W. Davis, Communication skills: a guide for engineering and applied science students, Prantics Hall, 2001.
4. Gupta S., Communication skills and Functional Grammar, University Science Press, New Delhi 110002.
5. Llyod M., Bor R., Communication skills for medicine, Elsevier press, Churchill Liverstone Elsevier.

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Semester- I

Course no.: Zoo-LC-I

Course Title : Laboratory Course

M.M. : 150

Time : 6 Hrs.

Tentative list of the proposed experiments

- To separate and identify sugar by TLC
- To prepare casein from milk
- To plot the calibration curve for protein estimation by Lowry method
- To plot standard curve for estimation of carbohydrate by anthrone method
- Estimation of creatinine in blood
- Colorimetric estimation of DNA and RNA³²¹
- Separation and identification of amino acids by paper chromatography
- To study the effect of auxochromes on the absorption properties of chromophore using spectrophotometer
- To study the effect of pH on absorption properties of chromophore using spectrophotometer
- To study effect of solvent polarity on the absorption properties of chromophore using spectrophotometer
- Measurement of H₂ ion concentration in given sample with the help of pH meter
- Apply gravimetric methods to estimate the amount of sulphate in a given sample
- To determine standard plate count out of water, air and soil sample
- Ouchterlony double diffusion (antigen-antibody pattern)
- To analyse the given sample by SDS PAGE
- To perform gel chromatography for analysis of given sample
- Separation of molecules using ion exchange chromatography
- Separation and identification of amino acids by radial chromatography
- To study different stages of mitosis in onion root tips
- To perform protein estimation test with the help of Bradford method
- Estimation of DNA by diphenylamine reaction
- Determination of RNA by orcinol method
- Isolation of DNA of tissue
- Discuss the problems based on central tendency mean, median, mode, geometric mean, range and standard deviation
- Correlation and regression analysis
- Graphical representation of data
- Parametric and non parametric tests
- Study computer hardware and its parts
- Application of MS office in interpretation of biological data
- Programming in BASIC/C
- Biological Data Base assessment tools
- Analysis of biological information by any bioinformatics tool
- Preparation of presentation on suggested topic
- Review writing on suggested topic
- Assessing and compilation of scientific data various parameters
- Microbial culture
- Microbial growth measurement methods
- Aseptic techniques in culture
- Effect of various parameters on culture
- Movements models in early life

