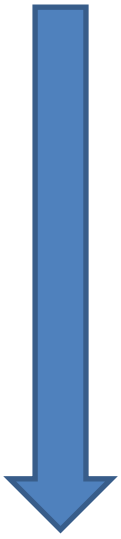
1.3.2 Number of courses that include experiential learning through project work/field work/internship during the year



Six Months Module Syllabus for Environmental Studies for Under Graduate Courses

UNIVERSITY GRANTS COMMISSION
BAHADURSHAH ZAFAR MARG
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VISION

The importance of environmental science and environmental studies cannot be disputed. The need for sustainable development is a key to the future of mankind. Continuing problems of pollution, loss of forest, solid waste disposal, degradation of environment, issues like economic productivity and national security, Global warming, the depletion of ozone layer and loss of biodiversity have made everyone aware of environmental issues. The United Nations Conference on Environment and Development held in Rio de Janerio in 1992 and world Summit on Sustainable Development at Johannesburg in 2002 have drawn the attention of people around the globe to the deteriorating condition of our environment. It is clear that no citizen of the earth can afford to be ignorant of environmental issues. Environmental management has captured the attention of health care managers. Managing environmental hazards has become very important.

Human beings have been interested in ecology since the beginning of civilization. Even our ancient scriptures have emphasized about practices and values of environmental conservation. It is now even more critical than ever before for mankind as a whole to have a clear understanding of environmental concerns and to follow sustainable development practices.

India is rich in biodiversity which provides various resources for people. It is also basis for biotechnology.

Only about 1.7 million living organisms have been described and named globally. Still many more remain to be identified and described. Attempts are made to conserve them in ex-situ and in-situ situations. Intellectual property rights (IPRs) have become important in a biodiversity-rich country like India to protect microbes, plants and animals that have useful genetic properties. Destruction of habitats, over-use of energy resources and environmental pollution have been found to be responsible for the loss of a large number of life-forms. It is feared that a large proportion of life on earth may get wiped out in the near future.

Inspite of the deteriorating status of the environment, study of environment has so far not received adequate attention in our academic programmes. Recognizing this, the Hon'ble Supreme Court directed the UGC to introduce a basic course on environment at every level in college education. Accordingly, the matter was considered by UGC and it was decided that a six months compulsory core module course in environmental studies may be prepared and compulsorily implemented in all the Universities/Colleges of India.

The experts committee appointed by the UGC has looked into all the pertinent questions, issues and other relevant matters. This was followed by framing of the core module syllabus for environmental studies for undergraduate courses of all branches of Higher Education. We are deeply conscious that there are bound to be gaps between the ideal and real. Genuine endeavour is required to minimize the gaps by intellectual and material inputs. The success of this course will depend on the initiative and drive of the teachers and the receptive students.

Members of the Expert Committee on Environmental Studies

1. Prof. Erach Bharucha
   Director
   Bharati Vidyapeeth
   Institute of Environment Education &
   Research, Pune

2. Prof. C. Manoharachary
   Department of Botany
   Osmania University
   Hyderabad

3. Prof. S. Thayumanavan
   Director
   Centre for Environmental Studies
   Anna University, Chennai

4. Prof. D.C. Goswami
   Head, Deptt. of Environment Science
   Gauhati University
   Guwahati-781 014

5. Shri R. Mehta
   Director EE Division
   Ministry of Environment & Forest
   Prayavaran Bhawan, CGO Complex
   Lodhi Road, New Delhi-110 003

UGC OFFICIALS

6. Dr. N.K. Jain
   Joint Secretary
   UGC, New Delhi

e) Energy resources: Growing energy needs, renewable and non renewable energy sources, use of alternate energy sources. Case studies.

f) Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification.

- Role of an individual in conservation of natural resources.
- Equitable use of resources for sustainable lifestyles.

(8 lectures)

Unit 3 : Ecosystems

- Concept of an ecosystem.
- Structure and function of an ecosystem.
- Producers, consumers and decomposers.
- Energy flow in the ecosystem.
- Ecological succession.
- Food chains, food webs and ecological pyramids.
- Introduction, types, characteristic features, structure and function of the following ecosystem :-

  a. Forest ecosystem

  b. Grassland ecosystem

  c. Desert ecosystem

d. Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)

(6 lectures)

Unit 4 : Biodiversity and its conservation

- Introduction – Definition : genetic, species and ecosystem diversity.
- Biogeographical classification of India
- Value of biodiversity : consumptive use, productive use, social, ethical, aesthetic and option values
- Biodiversity at global, National and local levels.
- India as a mega-diversity nation
- Hot-spots of biodiversity.
- Threats to biodiversity : habitat loss, poaching of wildlife, man-wildlife conflicts.
- Endangered and endemic species of India
- Conservation of biodiversity : In-situ and Ex-situ conservation of biodiversity.

(8 lectures)

Unit 5 : Environmental Pollution

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

g. Nuclear hazards

- Solid waste Management : Causes, effects and control measures of urban and industrial wastes.
- Role of an individual in prevention of pollution.
- Pollution case studies.
- Diaster management : floods, earthquake, cyclone and landslides.

(8 lectures)

Unit 6 : Social Issues and the Environment

- From Unsustainable to Sustainable development
- Urban problems related to energy
- Water conservation, rain water harvesting, watershed management
- Resettlement and rahabilitation of people : its problems and concerns. Case studies.
- Environmental ethics : issues and possible solutions.
- Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust. Case studies.
- Wasteland reclamation.
- Consumerism and waste products.
- Environment Protection Act.
- Air (Prevention and Control of Pollution) Act.

- Water (Prevention and control of Pollution) Act
- Wildlife Protection Act
- Forest Conservation Act
- Issues involved in enforcement of environmental legislation.
- Public awareness.

(7 lectures)

Unit 7 : Human Population and the Environment

- Population growth, variation among nations.
- Population explosion – Family Welfare Programme.
- Environment and human health.
- Human Rights.
- Value Education.
- HIV / AIDS.
- Women and Child Welfare.
- Role of Information Technology in Environment and human health.
- Case Studies.

(6 lectures)

Unit 8 : Field work

- Visit to a local area to document environmental assets – river / forest / grassland / hill / mountain

- Visit to a local polluted site – Urban / Rural / Industrial / Agricultural
- Study of common plants, insects, birds.
- Study of simple ecosystems-pond, river, hill slopes, etc. (Field work Equal to 5 lecture hours)

SIX MONTHS COMPULSORY CORE MODULE COURSE IN ENVIRONMENTAL STUDIES: FOR UNDERGRADUATES

Teaching Methodologies

The Core Module Syllabus for Environmental Studies includes class room teaching and Field Work. The syllabus is divided into eight units covering 50 lectures. The first seven units will cover 45 lectures which are class room based to enhance knowledge skills and attitude to environment. Unit eight is based on field activities which will be covered in five lecture hours and would provide students first hand knowledge on various local environmental aspects. Field experience is one of the most effective learning tools for environmental concerns. This moves out of the scope of the text book mode of teaching into the realm of real learning in the field, where the teacher merely acts as a catalyst to interpret what the student observes or discovers in his/her own environment. Field studies are as essential as class work and form an irreplaceable synergistic tool in the entire learning process.

Course material provided by UGC for class room teaching and field activities be utilized.

The universities/ colleges can also draw upon expertise of outside resource persons for teaching purposes.

Environmental Core Module shall be integrated into the teaching programmes of all undergraduate courses.

Annual System: The duration of the course will be 50 lectures. The exam will be conducted along with the Annual Examination.

Semester System: The Environment course of 50 lectures will be conducted in the second semester and the examinations shall be conducted at the end of the second semester.

Credit System: The core course will be awarded 4 credits.

Exam Pattern: In case of awarding the marks, the question paper should carry 100 marks. The structure of the question paper being:

Part-A, Short answer pattern	-	25 marks
Part-B, Essay type with inbuilt choice	-	50 marks
Part-C, Field Work	-	25 marks

REFERENCES

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. 1995. 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 Publications (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)

22. Trivedi R.K., Handbook of Environmental Laws, Rules, Guidelines , Compliances and Standards, Vol I and II, Enviro Media (R)

23. Trivedi R.K. and P.K. Goel, Introduction to air pollution, Techno-Science Publications (TB)

24. Wagner K.D.,1998. Environmental Management. W.B. Saunders Co. Philadelphia, USA 499p

(M) Magazine

(R)Reference

(TB) Textbook

SavitribaiPhule Pune University

Proposed structure of T. Y. B. Sc. (Physics) revised syllabus

To be implemented from 2014-2015

Sem III	Sem IV
PH-331: Mathematical Methods in Physics II	PH-341 Classical Electrodynamics
PH 332: Solid State Physics	PH-342: Quantum Mechanics
PH-333: Classical Mechanics	PH-343: Thermodynamics and Statistical Physics
PH-334: Atomic and Molecular Physics	PH-344: Nuclear Physics
PH-335: Computational Physics	PH-345: Electronics/Advanced Electronics
PH-336 Elective I : (Select any One)	PH-346 Elective II : (Select any One)
A: Astronomy and Astrophysics	G: Medical Electronics
B: Elements of Materials Science	H: Physics of Nanomaterials
C: Motion Picture Physics	I: Microcontrollers
D: Biophysics	J: Electro Acoustics and Entertainment Electronics
E: Renewable Energy Sources	K: Lasers
F: Applied Optics	L: Radiation Physics
PH-347: Laboratory Course I PH-348: Laboratory Course II PH-349: Laboratory Course III (Project)	

Semester III

T. Y. B. Sc. Physics

PH331 : Mathematical Methods in Physics- II

1. Curvilinear co-ordinates (14L)

Introduction to Cartesian, Spherical polar and Cylindrical co-ordinate systems, transformation equations,General Curvilinear co-ordinate system: Co-ordinate surface, co-ordinate lines, length, surfaces and volume elements in curvilinear co-ordinate system, metric coefficient.

Orthogonal Curvilinear co-ordinate system, Expressions for gradient, divergence, Laplacian and Curl, special case for gradient, divergence, Laplacian, and curl in Cartesian, spherical polar and cylindrical co-ordinate system.

(Chapter 2Ref.1 / Chapter 1Ref. 5)

2. The Special Theory of Relativity (14 L)

Introduction, Newtonian relativity Galilean transformation equation, Michelson-Morley experiment, Postulates of special relativity,Lorentz transformations, Kinematic effects of Lorentz transformation, Length contraction, Proper time, Transformation of velocities, Variation of mass with velocity, Mass-energy relation.Four vectors.

(Chapter 13 Ref. 2)

3. Differential equations (10 L)

Frequently occurring partial differential equations, degree, order, linearity and homogeneity (revision), Method of separation of variables, Singular points, Fuch's theorem (Statement only), Frobenius method for power series solution of Legendre, Hermite and Bessel differential equation. Problems

(Chapter 8 Ref. 1)

4. Special functions (10 L)

Generating function for Legendre,Hermite Polynomials, Recurrence relations, their differential equations and orthogonality properties. Bessel function of first kind and their properties. Problems

Reference books:

1. Mathematical methods for physicists, Arfken and Weber, Acadmic press Newyork.
2. Mathematical physics, Rajput, Pragatiprakashan
3. Mathematical methods in the physical sciences – Marry L. Boas, John Willy and sons publication
4. Introduction to special relativity, Robert Resnick, willyeastrn Ltd.
5. Mathematical physics, B. D. Gupta
6. Mathematical physics, H. K. Dass

T. Y. B. Sc. Physics
PH332: Solid State Physics

1. The Crystalline State (11 L)

Lattice, Basis, Translational vectors, Primitive unit cell, Symmetry operations, Different types of lattices2D and 3D (Bravais lattices) ,Miller indices, Inter planer distances, SC, BCC and FCC structures, Packing fraction, Crystal structures NaCl, diamond, CsCl, ZnS, HCP, Concept of reciprocal lattice and its properties with proof.

Problems

2. X ray Diffraction and Other Characterization Techniques (13 L)

Introduction, Crystal as a grating, Bragg's law and Bragg's Diffraction condition indirect and reciprocal lattice Ewald's construction, Experimental methods of X-ray diffraction: Laue method, Rotating Crystal method, Powder(Debye Scherer) method, Analysis of cubic structure by powder method, Characterization Techniques: Thermal gravimetric analysis(TGA), UV-visible spectroscopy, Electron microscopy(SEM), Problems

3. Free Electron and Band Theory of Metals (13 L)

Free Electron model, Energy levels and Density of orbital in 1D and 3D, Bloch theorem (statement only), Nearly free electron model, Fermi energy, Fermi level, Hall Effect, Origin of energy gap, Energy bands in Solids, Effective mass of electron (with derivation), Distinction between metal, semiconductor and insulator

Problems

4. Magnetism (11 L)

Diamagnetism, Langevin theory of Diamagnetism, Application of diamagnetic material: (Superconductor)Occurrence of Superconductivity, Critical magnetic field and Meissner effect, Paramagnetism, Langevin theory of Para magnetism, ferromagnetism, ferromagnetic domains, Hysteresis, Curie temperature. Ferromagnetism, Ferrites and its applications, antiferomagnetism, Neel temperature, Problems

Reference Books :

1 Solid State Physics-S.O.Pillai, 3rd Edition, New Age International (P) Ltd, Publisher, (1999).
2 Solid State Physics – Kakani and Hemrajani, S. Chand Publication.
3 Solid State Physics BySaxena, Gupta and Saxena, PragatiPrakation.
4 Introduction to Solid State Physics- Charles Kittel, John Wiley and Sons, 7th Edition.
5 Solid State Physics-A.J.Dekker, Macmillan India Ltd, (1998).
6 Solid State Physics- R.K. Puri, V.K. Babbar, S. Chand Publication.
7 Problems in Solid State Physics-S.O. Pillai, New Age International (P) Ltd.
8 Solid State Physics-Palanyswamy.
9 Solid State Physics- David, Snoke, Pearson Publication.

T. Y. B. Sc. Physics
PH 333 Classical Mechanics

1. Mechanics of system of particles (10 L)

1 Introduction –newton's laws
2 Applications of Newton's laws of motionProjectile motion in various medium, Rocket motion, Motion of a charged particle in constant electric, magnetic and electromagnetic field.
3 System of particles, Centre of mass, Conservation of linear momentum, angular momentum, energy of system of particles (statements only) Problems Ref 1 Ch. 3, Ref 2 Ch 1

2. Motion in Central Force Field (10 L)

1 Central force, equivalent one body problem
2 Motion in central force field
3 General features of motion, equation of orbit
4 Deduction of Kepler's laws of planetary motion
5 Orbits of artificial satellite Problems Ref1Ch. 5,Ref2Ch4

3. Scattering of particles (10 L)

Elastic and inelastic scattering, Elastic scattering - Laboratory and centre of mass system. Scattering, Relation between scattering angles in laboratory and centre of mass system. Differential cross-section, impact Parameter, total cross-section.

4. Langrangian and Hamiltonian formulation (10 L)

1 Limitations of Newtonian formulation
2 Types of constraints, degrees of freedom, generalized coordinates, configuration space
3 D' Alembert's principle of virtual work
4 Langrangian equation from D' Alembert's principle, cyclic coordinates
5 Phase space, Hamiltonian's equations

Problems Ref 1 Ch. 8, Ref 3

5. Canonical Transformation and Poisson's Bracket (08 L)

-Generating function,condition for Canonical transformation and problems , Defination , Identities , Poisson's Bracket , Jacobi identity

Reference Books

1. Introduction to Classical Mechanics, R. G. Takawale, P. S. Puranik, Tata McGraw Hill publishing Company Ltd.
2. Classical Mechanics, N. C. Rana, P. S. Joag, Tata McGraw Hill Publishing company Ltd.
3. Principles of mechanics, J. L. Synge, B. A. Griffith, TataMcGraw Hill Publishing company Ltd.
4. Classical Mechanics, Herbert Goldstein, Narosa Publishing House
5. Classical Mechanics by J.C. Upadhyaya, Himalaya publishing Houses.
6. Problem solution of classical mechanics by P.V.Panat

T. Y. B. Sc. Physics

PH334 Atomic and Molecular Physics

1. Atomic structure **(6 L)**

1 Rutherford model of atom
2 Electron orbits
3 Bohr atom
4 Energy levels and spectra (1 to 4 Revision)
Vector atom model (Concepts of space and quantization and electronspin)
5 Atomic excitation and atomic spectra, Problems Ref 1 ch4

2. One and two valence electron systems **(7 L)**

1 Pauli Exclusionprinciple and electron configuration, quantum states, Spectral notations of quantum states.
2 Spin-Orbit Interaction (Single valence electron atom), Energy levels of Na atom, selection rules, spectra of sodium atom, sodium Doublet.

3. Two valence electron systems **(7 L)**

3 Spectral terms of two electron atoms, terms for equivalent electrons, LS and JJ coupling schemes.
4 SingletTriplet separation for interaction energy of LS coupling. Lande'sInterval rule, spectra of Helium atom, Problems Ref 1 ch7 Ref. 2 ch8 and ch12

4. Zeeman Effect **(4 L)**

1 Early discoveries and developments
2 Experimental arrangement
3 Normal and anomalous Zeeman Effect Problems
4 Stark effect (Qualitative discussion) Ref 2 ch10

5. X ray spectroscopy **(6 L)**

1 Nature of Xrays
2 Discrete and continuous Xray spectra, Daune and Hunt's Rule
3 Xray emission spectra
4 Mosley's law and its applications
5 Auger effect , Problems Ref 2 ch16

6. Molecular spectroscopy **(10 L)**

1 Rotational energy levels
2 Vibrational energy levels
3 Rotational and Vibrational spectra
4 Electronic spectra of molecules Problems Ref 1 ch8

7. Raman spectroscopy **(8 L)**

1 Classical theory of Raman Effect. Molecular polarizability
2 Quantum theory of Raman Effect
3 Experimental set up for Raman Effect
4 Applications of Raman spectroscopy Ref 3 ch4

Reference Books

1. Concepts of Modern Physics 4th edition Arthur Baiser (McGraw Hill International edition)
2. Introduction to Atomic spectra White.H.E (McGraw Hill International edition)
3. Fundamentals of Molecular spectroscopy , C.N.Banwell and E.M McCash (McGraw Hill International edition)
4. Modern Physics, J.B.Rajam

T. Y. B. Sc. Physics
PH335: Computational Physics

1. Concepts of programming: (6 L)

Definition and Properties of algorithms,
Algorithm development,
Flow charts- symbols and simple flowcharts.
Flow charts and Algorithms for Kinematic equations, Free fall, Equation of state, Factorial of a number.
Types of programming language: Lower, middle and higher level languages.

2. C Programming (14 L)

Structure of C program, Character set, key words, Constants andvariables, Variable names, Data types and their declarations, Symbolic Constants.
Input/output functions: scanf ( ), printf ( ), getchar ( ), putchar ( ), getch ( ), gets ( ), puts ( ).
Operators and Expressions: Arithmetic Operators, Relational Operators, LogicalOperators, Assignment Operators, Conditional Operator.
Formatted input/output
Control statements: If, if else, while, do while for loop, nested control structures (nested if, nested loops), break, continue, switch- case statement, goto statement.
Use of Library functions: e.g. mathematical, trigonometric, graphics.

3. Arrays and Pointers in C (4 L)

Arrays: 1-D, 2-D and String
Examples: Arranging numbers in descending and ascending order, Sum of matrices, multiplication of matrices.
Concept of Pointers

4. User Defined Function in C (8 L)

User defined functions: Definitions and declaration of function, functionprototype, passing arguments (Call by value, Call by reference).
Storage Classes: Auto, External, Static, Register variables.

5. Graphics in C: **(4L)**

Some simple graphic commands- Line, Circle, Arc, Ellipse, Bar.

3. Computational Physics: [12 L]

1. Errors in Computation: Inherent errors in storing numbers due to finite bit representation to use in
Computer, Truncation error, round off errors (Explain with the help of examples)
2. Iterative methods: Discussion of algorithm and flowcharts and writing Cprograms for finding single root of equation using bi-section method, NewtonRaphsonmethod.
4. Discussion of algorithm and flowcharts and writing C program for trapezoidalrule and Simpson's 1/3rd rule (derivation of formula is not expected).

Reference Books:

1. Programming in C- (Schaum's series) Gottfreid TMH
2. Programming in C- Balgurusami Prentice Hall publications
3. Let us C- YashwantKanetkar BPB publications
4. Programming with C- K.R. Venugopal, S. R. Prasad, TMH.
5. Introductory methods of numerical analysis-S. Sastry Prentice Hall
6. Computer oriented numerical methods – V. Rajaraman.

Following programs may be discussed thoroughly in theory lectures:

1. Sum of digits of an integer
2. To find factorial of a number
3. Verifying Boyle's law and Charles' law using equation of state.
4. Checking and printing of prime numbers
5. Solving kinematic equations and free fall equation: obtaining position vs. time data.
6. Obtaining rms velocity of gas using temperature and mass of the gas.
7. To find sin(x), cos(x) using series method
8. Sorting of (1) Numerical data (2) Character type data- ascending, descending.
9. Use of pointers – sorting (any one method of sorting)
10. Matrix operations – addition, subtraction, multiplication
11. Graphics- line, circle, arc, bar, ellipse.
12. Root of equation-Bisection method, Newton Raphson method
13. Numerical integration- Trapezoidal, Simpson's 1/3rd rule.

T. Y. B. Sc. Physics

PH-336 Elective I (A): Astronomy and Astrophysics

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1. Fundamentals of Astronomy: (8 L)

Introduction: Components of the Universe; Stars, Planets, Asteroids, Meteors, Comets, Galaxies. Solar System: Age, Origin Basic measurements: Planetary orbits, distances, physical size, mass, density, temperature, rotation period determination, Kepler's laws, EM Spectrum: radiation from heated objects', Wien's law, radiation curves, Doppler effect.

2. Astronomical Instruments: (10 L)

Optical telescopes, mounts, light gathering power, magnification, resolution. Spectroscopes, CCD camera, photometer, filters Radio telescopes, interferometry UV, IR, X-ray and Gamma ray telescopes. Orbiting space based telescopes: HST, Chandra.

Star and Star Systems (10 L)

Stars life cycle, Stellar processes (Nuclear). Neutron stars, black holes, Chandrasekhar limit. Spectral classification of stars, O,B,A,F,G,K,M. Star Systems: Binaries / Cepheids / RR Lyrae HR diagram: Significance Sun: Solar Cycle, Activity, Butterfly diagram, Photosphoric phenomenon Stars as distance estimators

Galaxies, Dark Matter and Dark Energy (6 L)

Galaxies, types, their formation, Quasars Hubble's tuning fork diagram Open and Globular clusters Dark Matter / Energy (evidence for both) Cosmology: (6 L) Theories: BBT, Steady State, Oscillating Universe Theory Hubble's law with equation, its significance Concept of space time, fate of our universe Multiverse (only introduction)

Observational Astronomy: (8 L)

Co-ordinate system, Celestial hemisphere, Concept of time, Magnitudes: apparent and absolute, constellations. Star dial, Observation of Sun, Eclipses, Moon, planets, meteor showers, transits, occultation's.

List of Reference Books:

1. Astronomy structure of the Universe. A.E. Roy and D. Clarke, Adam Hilger Pub.
2. Source Book of Space Sciences, Samuel Galsstone; D.VanNostrand Co. Inc
3. Astrophysics - Stars and Galaxiesl, K.D. Abhyankar, Tata McGraw Hill Pub.
4. Textbook of Astronomy and Astrophysics with elements of cosmology, V.B. Bhatia, Narosa Pub.
5. Structure of the Universe, J.V. Narlikar
6. Astrophysics, BadyanathBasu.

List of experiments:

1. Study of Binocular, refracting and reflecting telescopes and their mounts.
2. To determine the diameter of the Moon.
3. Measurement of Solar Constant.
4. Observation of emission, continuous and absorption spectra. (Mercury, sodium or iodine spectra could be obtained.)
5. To determine the temperature of an artificial star.
6. To observe the Fraunhofer lines in sunlight and determine the elements present.
7. To obtain the Solar image on the screen and trace our the existing sunspots.
8. To locate and observe the various stars, constellation, planets.

T. Y. B. Sc. Physics

PH-336 Elective I (B) Elements of Materials Science

1. Defects in Solids **(7L+1P)**

1 Material Properties – Mechanical, Electrical and thermal
2 Impurities in solids.
3 Solid solutions in metals.
4 Rules of solid solubility.
5 Imperfection in crystals.
6 Defects in solids point, line, surface and volume.
7 Atomic diffusions definition, mechanism, Fick's laws.

2. Single Phase Metals **(6L+1P)**

1 Single phase alloys
2 Deformation
3 Elastic Deformation and Plastic Deformation
4 Mechanism of plastic Deformation by slip
5 Critical resolved shear stress (CRSS)
6 Plastic deformation in poly crystalline materials

3. Molecular Phases **(7L+1P)**

1 Introduction
2 Polymers, Polymerization
3 Molecular weight of polymers
4 Linear polymers addition and condensation
5 Cross linked polymer vulcanization of rubber

4. Ceramic Materials **(09L)**

1 Ceramic Phases, Classification of ceramic materials
2 Ceramic crystals (AX)
3 Mechanical behavior of ceramics
5. Electromagnetic behavior of ceramics – a) Electric propertiesdielectrics, semiconductors, piezoelectric b) Magnetic Properties MagneticCeramics, hard and soft ferrites

5. Phase Diagrams **(9L+2P)**

1. Basic terms System, Surrounding, Component, Coordinates, Phase, Equilibrium.
2. Phase Diagram definition, importance and objective
3. Lever rule
4. Gibb's phase rule
5. Phase diagram of a) Sugar water b) NaCl water
6. Types of phase diagrams with construction a) Type ILens typeCuNiphase diagram b) Type IIOnly introduction c) Type IIIEutectic typePbSnphase diagram
7. Isothermal cuts

6. Introduction to smart materials **(5L)**

Definition of smart materials, types and structure of smart materials, Properties of smart materials, Applications of smart materials.

Reference books

1. Elements of materials science and EngineeringI.H.Vanvlach (4^{th}Edition)
2. Materials science and Engineering - V. Raghvan

List of experiments

1. To determine the dipole moment of a given liquid
2. To determine magnetic susceptibility of $FeCl_3$
3. To determine the specific heat of graphite
4. Determination of the yield point and the breaking point of an elastic material

T. Y. B. Sc. Physics

PH-336 Elective I (C) Motion Picture Physics

1. Introduction: (6 L)

S. L. R. camera, T. L. R. camera, focal plane shutter, composition of films and paper (B/W) and colour reversal film, shutter speed and Aperture

2. Camera lenses: (5 L)

Aberrations in lens, angle f view, perspective and its types, camera formats, normal, wide angle, telephoto, zoom, filters

3. Processing of photographic materials: (8 L)

Different stages involved in processing B/W printing and colour printing, chemicals used in B/W processing. Colour processes- E-6, C-41, EP-2, RA-4. Factors affecting in developing process (B/W) Master print dupe negative, release print, rush print

4. Printing Techniques: (4 L)

B/W enlarger, its construction and working, contact printing and projection printing, printing methods (color).

5. Lighting and special effects: (10 L)

Light sources and their characteristics Laboratory special effects: Matte printing, Traveling mattes, slow motion, fast motion, freeze action, reverse action, blow up, and flip over.

6. Motion picture techniques: (8 L)

Essential parts of movie camera, camera lenses and types, lenses for wide screens, shutter, intermittent, motor drive, view drive, view finders and their types, magazine, camera accessories, camera movements, shots, sound recording on film, optical recording.

7. Projection mechanism: (7 L)

The projector and its essential parts, intermittent mechanism, drive mechanism, spool boxes, light sources, projection lens, projection screen and their formats.

Reference Books :

1. Basic photography – M.J.Lagford, Focal press (London).
2. Advanced photography - M.J.Lagford, Focal press (London).
3. Professional photography - M.J.Lagford, Focal press (London).
4. Basic Motion picture technology – L. Bernard Happe, Focal press (London). List of Experiments:

Demonstrations

1. Study of S.L.R camera
2. Study of different camera lenses
3. Study of B/W enlarger
4. Study of color enlarger

A. Experiments to be performed :

1. Observe the effect of shutter speed.
2. Contact printing from B/W negative.
3. Projection printing from B/W negative.
4. Shooting and outdoor Scene (B/W or Color).
5. Processing an exposed B/W negative film.
6. Printing from processed color negative film.
7. Shooting a still life (B/W or Color).
8. Shooting and arranging a group photograph.
9. Observe the effect of aperture on depth of film.
10. Portrait Lighting (B/W Film).

T. Y. B. Sc. Physics
PH-336 Elective I (D) Biophysics

1. Introduction of Biophysics

1.1 Definition and History of Biophysics [Physical properties applied to biology- Surface tension, Viscosity, adsorption, diffusion, osmosis, dialysis and colloids] (3L)

1.2 Cell: Animal and plant cell, types of cell and composition, Functional aspects of cell membrane, cytoplasm, nucleus, mitochondria, chloroplast (Bioenergetics of mitochondria and chloroplast) (4L)

1.3 Protein structure (Primary, Secondary, Tertiary and Quaternary structure): Amino-acids structure (Specify types), Bond length, Bond angles, peptides, and Bond-Rigid planer peptides. Cis and trans configuration, torsion angle, Ramchandran plot. Photosynthesis process:- electron transport, Gibbs's free energy, Redox couple. [Redox potential , Oxidation and reduction, Examples of redox potential in biological system.] (6L)

1.4 Genetic code- symmetry, DNA structure (2L)

2. Biopotentials

2.1 Bioelectric signals: structure of neuron, resting potential, action Potential, Nernst equation (2L)

2.2 Biopotntial amplifier: input impedance, frequency characteristics, gain, CMRR, Calibration, Noise, Temperature sensitive stability. (2L)

2.3 Compaind action potentials of the human body ECG, EEG, ERG, EOG (in brief) (4L)

2.4 Transducers: Definition, types- resistive, capacitive and inductive transducers, LVDT, photo diode (2L)

2.5 Bioelectrodes_- Half cell potential, polarizable and non-polarizable electrodes, metal and glass electrodes, types and electric characteristics (3L)

3. Bioinstruments

Basic principle, Construction and working of colorimeters, spectrophotometer, ECG machine, PH meter, Centrifuge measurement. (10L)

Electro microscope: SEM, TEM. (**2L**)

4. Radiation Biophysics

4.1 Definition, Units of Radioactivity and radiation doses, X-Ray Crystallography as a method for a structure determination of biomolecules NMR. (3L)

4.2 Nuclear detector (G M Counter), radioimmunoassays (in brief) (3L)

5. New Fields

5.1 Biostatistics and Biometry, Definition and concept in brief

5.2 Mathematical modelingand Computational biology (Concept only) (2 L)

Reference Books:

1 Introduction to Biophysics - by P. Narayanan.New Age P.
2 Medical Instrumentation - by Khandpur, TMH
3 Laboratory Manuals of Biophysics Instruments - by P.B. Vidyasagar
4. Biophysics -by VatsalaPiramal, Dominant Publisher and Distributors, New Delhi-110002
5. Textbook of Biophysics - by R.N. Roy
6. Photosynthesis - by Hall and Rao.

List of Experiment

1. Recording and analysis of ECG signals
2. Verification of Beers and Lambert's Law
3. Absorption spectrum of Blood/Chlorophyll.
4. PH Value of Ammino acids.
5. Study of DNA melting
6. Bimolecular model building using standard kits.

T. Y. B. Sc. Physics

PH-336 Elective I (E) Renewable Energy Sources

1. An Introduction to Energy Sources: (10L)

Conventional and non-conventional sources of energy, Structure and characteristics of sun, Solar Constant, Electromagnetic energy spectrum, Solar radiations outside earth atmosphere, Solar radiation at the earth surface,problems.

Ref. 1: page no. 1 to 11and 15 to 37

Ref.3-3.1, 3.2, 3.3, 3.4, 3.5

2. Photothermal Applications: (10L)

Liquid flat plate collector, construction and working, Energy balance equation (without thermal analysis) , Concentrating collectors, Advantage and disadvantage, Solar distillation, Solar drying, Solar cooker(box type), Solar water heating systems.

Ref. 1: 3.3, 3.3(A), 3.5, 3.7, 3.8, 5.2, 5.8, 5.11.

Ref. 2: 2.2.6

3. Photovoltaic systems: (10L)

Introduction , Photovoltaic principle, Power output and conversion efficiency, Limitation to photovoltaic efficiency, Basic photovoltaic system for power Generation, Advantages and disadvantages, Types of solar cells, Application of solar photovoltaic systems.

Ref.3 -15.1, 15.3, 15.4, 15.5, 15.7, 15.8, 15.10.

4. Energy from Biomass: (12L)

Introduction , Bio -mass conversion technologies , Bio-gas generation Factors affecting bio-digestion (list of factors) , Working of biogas plant, Advantages and disadvantage of floating and fixed dome type plant, Bio-gas from plant wastes , Methods for obtaining energy from biomass , Thermal gasification of biomass , Working of downdraft gasifier , Advantages and disadvantages of biological conversion of solar energy

Ref 1: 7.1, 7.2, 7.2.1, 7.2.2, 7.4, 7.5, 7.6, 7.7, 7.8, 7.11, 7.23, 7.24.1, 7.25.

Ref 2: 10.3 (page no 374 to 380)

5. Wind Energy (06L)

Introduction , Classification and description of wind machines, Wind data

Ref -2 (10.2 pages from 353-366)

Reference Books:

1. Non conventional Energy sources, G. D. RAI (4th edition), Khanna Publishers, Delhi.
2. Solar Energy, S.P. Sukhatme (second edition), Tata Mc.Graw Hill Ltd, New Delhi.
3. Solar Energy Utilisation**,** G. D. RAI (5th edition), Khanna Publishers,Delhi.

List of Experiments:

1. Fuel value of wood/charcoal.
2. Study of sensible heat storage using liquid.
3. Selective and Non-selective coatings – Determination of Selectivity ratio.
4. Thermal efficiency of liquid – flat plate collector.
5. Study of box type solar cooker.
6. Determination of instantaneous thermal efficiency of parabolic collector.
7. Efficiency and fill factor of solar cells.

T. Y. B. Sc. Physics
PH-336 Elective I (F) Applied Optics

1. Fermat Principles and its applications: Laws of reflection and refraction from Fermat's principle
   Ray paths in inhomogeneous medium, The ray equation and its solution (6L)
2. The matrix method in Paraxial optics: The matrix method, Unit planes, Nodal planes, a system of two thin lenses. (6L)
3. Multiple beam interferometry : Multiple reflection from plane parallel film, The Fabry-Perot Etalon, The Fabry-Perot interferometer, Resolving power, Interference filters. (6L)
4. Diffraction : Two slit Fraunhofer diffraction pattern, N-Slit Frauhofer diffraction pattern, Fresnel half period zones, the zone plate, Fresnel diffraction, Gaussian beam propagation. (6L)
5. Polarization :Malus law, Double refraction, Quarter wave plate, half wave plate, Optical activity, Wollstom prism, Rochon Prism. (6L)
6. Holography : Importance of coherence, Principle of holography and characteristics, Recording and reconstruction, classification of hologram and application, non-destructive testing. (6L)
7. Fibre optics: Total internal reflection, the optical fibre, the coherent bundle, Numerical aperture, Attenuation in optical fibres, single mode and multimode fibres, Pulse dispersion in optical fibres. (6L)
8. Detection of optical radiation: Human eye, bolometer, pyro-electric, photoconductive detector, photo voltaic detector and photoemissive detector, p-i-n photodiode, APD photodiode. (6L)

References :

(1) GhatakAjoy, Optics 3rd Edition, The McGraw Hill companies.
(2) M. Born and E. Wolf, Principles of Optics, Cambridge University Press
(3) F. A. Jenkins, H. E. White, Fundamentals of Optics, Mc Graw Hill

List of Experiments:

(1) Michelson Interferometer
(2) Fibre optics communication
(3) Farbry Perot Etalon
(4) Polarization of light by reflection

Semester IV

T. Y. B. Sc. Physics

PH-341: Classical Electrodynamics

1. Electrostatics: (16 L)

1.1. Coulomb's law, Gauss law, Electric field, Electrostatic Potential

1.2. Potential energy of system of charges.

1.3. Statement of Poisson's equation, Boundary Value problems in electrostatics-solution of Laplace equation in Cartesian system,

1.4. Method of image charges: Point charge near an infinite grounded conducting plane, Point charge near grounded conducting sphere.

1.5. Polarization **P**, Electric displacement **D**, Electric susceptibility and dielectric constant, bound volume and surface charge densities.

1.6. Electric field at an exterior and interior point of dielectric.

2.Magnetostatics: (16 L)

2.1. Concepts of magnetic induction, magnetic flux and magnetic field

2.2. Magnetic induction due to straight current carrying conductor, Energy density in magnetic field, magnetization of matter. Relationship between **B,H**and **M.**

2.3 Biot-Savart's law, Ampere's law for force between two current carrying loops, Ampere's circuital law,

2.4Equation of continuity, Magnetic vector potential **A**.

2.5. Magnetic susceptibility and permeability, Hysteresis loss, B-H curve.

3. Electrodynamics: (16 L)

3.1. Concept of electromagnetic induction,Faradays law of induction, Lenz's law, displacement current, generalization of Amperes' law

3.2. Maxwell's equations (Differential and Integral form) and their physical significance

3.3. Polarization, reflection & refraction of electromagnetic waves through media

3.4. Wave equation and plane waves in free space.

3.5.Poynting theorem&Poynting vector, Polarizations of plane wave.

3.6. Microscopic form of ohm's law ($\mathbf{J}=\sigma.\mathbf{E}$)

Reference Books:

1) Introduction to Electrodynamics - By D. J. Griffith

2) Classical Electrodynamics – By J. D. Jackson.

3) Introduction to Electrodynamics - By A. Z. Capri, Panat P. V.

4) Electricity and magnetism – By Reitz and Milford

5. Electrodynamics - By Gupta, Kumar, Singh (PragatiPrakashan)

6. Electromagnetic field and waves - By Paul-Lorrain and Dale R Corson

7. Electricity and magnetism – By Murugeshan (S. Chand)

T. Y. B. Sc. Physics

PH-342:Quantum Mechanics

. Origin of Quantum Mechanics: (10 L)

1. Historical Background
   a) Review of Black body radiation, b) Review of photoelectric effects.
2. Matter waves
   - De Broglie hypothesis. Davisson and Germer experiment.
3. Wave particle duality
4. Wave function of a particle having definite momentum.
5. Concept of wave packet, phase velocity, group velocity and relation betweenthem
6. Heisenberg's uncertainty principle with thought experiment.
   - Electron diffraction experiment, different forms of uncertainty.

2. The Schrodinger equation: (15 L)

1. Physical interpretation of wave function
2. Schrodinger time dependent equation.
3. Schrodinger time independent equation.(Steady state equation).
4. Requirements of wave function.
5. Probability current density, equation of continuity, and its physical significance.
6. Definition of an operator in Quantum mechanics.
   - Eigen function and Eigen values.
7. Expectation value – Ehrenfest's theorem

3. Applications of Schrodinger Steady state equation: (12 L)

1. Free particle.
2. Particle in infinitely deep potential well (one - dimension).
3. Particle in three dimension rigid box.
4. Step potential.
5. Potential barrier. (Qualitative discussion).Barrier penetration and tunneling effect.
6. Harmonic oscillator (one-dimension), correspondence principle.

4. Spherically symmetric potentials: (06 L)

1. Schrodinger's equation in spherical polar co-ordinate system.
2. Rigid rotator (free axis).
3. Hydrogen atom: Qualitative discussion on the radial and angular parts of thebound state energy, energy state functions, Quantum numbers n, l, m_l, m_s–Degeneracy.

5. Operators in Quantum Mechanics: (05 L)

1. Hermitian operator.
2. Position, Momentum operator, angular momentum operator, and total energyoperator (Hamiltonian).
3. Commutator brackets- Simultaneous Eigen functions.
4. Commutator algebra.
5. Commutator brackets using position, momentum and angular momentumoperator.
6. Raising and lowering angular momentum operator.
7. Concept of parity, parity operator and its Eigen values.

Reference Books:

1. Quantum Mechanics of Atoms, Molecules, Solids, Nuclei and particles. - By R. Eisberg and R. Resnik Published by Wiley.
2. Quantum Mechanics. - B. H. Brandsen and C. J. Joachain: Pear son Education
3. Concepts of Modern physics. - By A. Beiser Published by Mc. Grawthill. Chapter 2,3,5,6.
4. Introduction to Quantum Mechanics. - By D. Griffiths Published by Prentice Hall.
5. Quantum Mechanics. - By Ghatak and Lokanathan Published by Mc. Millan.
6. Quantum Mechanics. - By L. I. Schiff.
7. Quantum Mechanics. - By Powell and Crasemann, Addison-Wesley Pub. Co.
8. Quantum Mechanics an accessible introduction
   - Robert Scherrer Pearson - Addison Wesley

T. Y. B. Sc. Physics

PH-343: Thermodynamics and Statistical Physics

1. Kinetic Theory of Gases: (8L)

Assumptions of Kinetic theory of gases, Mean free path, Transport phenomenon, Viscosity, Thermal conductivity and diffusion, Problems

2. Maxwell Relations and Application: (10 L)

Thermodynamical functions: Internal Energy, Enthalpy, Helmholtz function, Gibb's function, Derivation of Maxwell Relations, First and Second TdS Equations, Specific heat and latent heat equations, Joule Thomson effect (Throttling Process)

3. Elementary Concepts of Statistics: (10L)

Probability, distribution functions, Random Walk and Binomial distribution, Simple random walk problem, Calculation of mean values, Probability distribution for large-scale N, Gaussian probability distributions,

4. Statistical Distribution of System of Particles: (8L)

Specification of state of system, Statistical ensembles, Basic Postulates, Probability calculations, Behaviors of density of states, Thermal, Mechanical and general interactions

5. Statistical Ensembles: (6L)

Micro canonical Ensemble (Isolated System), Canonical ensembles, simple application of canonical ensemble, Molecules in Ideal gas, Calculation of mean values in canonical ensemble.

6. Quantum Statistics: (6L)

Quantum distribution function, Maxwell-Boltzmann's statistics, Bose-Einstein Statistics, Fermi-Dirac Statistics, Comparision of the distributions.

References:

1. Statistical and Thermal physics
   - By Lokanathan, R.S. Gambhir,
2. Fundamentals of statistical and thermal physics
   - By F.Reif
3. Perspectives of modern physics
   - By A. Beiser
4. Fundamental of Statistical Mechanics
   - By B.B. Laud
5. A primer of Statistical Mechanics
   - By R.B. Singh
6. Statistical Mechanics
   - By Gupta, Kumar

T. Y. B. Sc. Physics
PH 344 Nuclear Physics

1. Basic Properties of Nucleus **(07 L)**

Composition, charge, size, density of nucleus, Nuclear Angular momentum,Nuclear magnetic dipole moment, Electric quadrupole moment, parity andsymmetry, Mass defect and Binding energy, packing fraction, classificationof nuclei, stability of nuclei (N Vs Z Curve) and problems.
Ref 1, ch (1), Ref 2, ch (4)
Problems Ref 4 ,ch (26)

2. Radioactivity **(10 L)**

Radioactivity disintegration (concept of natural and artificial radioactivity,Properties of α, β, γrays, laws of radioactive decay, halflife, mean life,specific activity and its units, successive disintegration and equilibriumsand radioisotopes).
Application of radioactivity(Agricultural, Medical, Industrial, Archiological).
Problems
Ref 1 ch (8), Ref 2 – ch (15)
Problems Ref 4 ch (27, 29)

3. Nuclear forces **(08 L)**

Meson theory of nuclear forces, Properties of nuclear forces, properties ofdeuteron system, Elementary particles, Quarks model for elementaryparticles.
Ref1ch (2, 3), Ref 2 ch (10), Ref 3 ch (3)
Problems Ref 4 ch (26)

4. Particle Accelerator and Detectors **(07 L)**

Introduction to particle Accelerators, Linear (electron/proton Linac)Cyclic (Cyclotron)
Classification of Nuclear Detector
Gas filled Detectors (G. M. counter)
Solid state detectors (NaI(Tl)scintillation counter)
Problems Ref 1ch(7,12)

5. Nuclear Reactions **(08 L)**

Introduction to Nuclear reactions, compound nucleus, Qvalue equation,Exothermic and Endothermicreaction, Threshold energy, Conservationlaws, nuclear crosssection.
Problems
Ref 1ch(13), Ref 2ch(12)Problems Ref 4ch (30)

6. Nuclear Energy **(08L)**

Nuclear fission, chain reaction and critical mass, nuclear reactor and its basic components, homogeneous and heterogeneous reactors, power reactor, fast breeders, nuclear fusion, stellar energy.
Problems. Ref 2ch(14), Problems Ref 4ch (31)

Reference Books

1 Introduction to Nuclear PhysicsH.A.Enge (Addition Wesley co.)
2 The Atomic NucleusR.D.Evans (Tata McGraw Hill co.)
3 Concepts of Nuclear Physics – B.L.Cohen (Tata McGraw Hill co.)
4 Schaum's Outline Series Modern PhysicsR.Gautrearu (McGraw Hill co.)
5 Introduction to Nuclear Physics, S. B. Patel

Additional References

1 Atomic and Nuclear PhysicsShatendra Sharma (Pearson Education,1st Edition)
2 Nuclear PhysicsKaplan (Narosa Publishing House)
3 Introduction to Nuclear PhysicsY.R. Waghmare (Oxford IBH.)

T. Y. B. Sc. Physics
PH345:Electronics

1. Special Purpose Diodes **(4L)**

LED and Photodiode, Varactor (working and characteristics), Optocoupler. Problems Ref. 1 Article5.8

2. Transistor amplifier **(8L)**

Classification of amplifier, class A, B (working, gain and efficiency calculation) class C and AB (working only), class B push pull amplifier, cross over distortion, differential amplifier (transistorized). Problems

Ref. 1 Article11.3, 11.4, 11.5, 11.6, 12.5, 17.1

3 Field Effect Transistor **(8L)**

Introduction, classification, principle, working and IV characteristics of JFET,MOSFET (DE MOSFET and E only MOSFET),Application of JFET :-as Variable resistor, electronic switch and analogue multiplexer.Problems

Ref. 1 Article13.1 to 13.9, 14.1to 14.5

4 Operational Amplifier **(4L)**

Applications of OPAMP integrator, Differentiator, Comparator, Schmitt Trigger,Instrumentation Amplifier.Problems

Ref. 1 Article20.4, 20.5, 22.1 to22.3, 22.5, 22.10

5. Timer (IC555) **(4L)**

Block diagram, Astable, monostable and bistablemultivibrator (working and design) Problems Ref. 1 Article23.7, 23.8

6. Regulated Power Supply **(4L)**

Block diagram of 3 pin IC regulator, study of IC 78XX, 79XX, dual power supply (using 3 pin IC) Block diagram of IC723 circuits and design of basic low voltage (2 to7 volt) andhigh voltage (7 to 28volt) regulator.

Problems

Ref. 1 Article24.4, for IC723 refer data book.

7. Combinational Circuits **(6L)**

Introduction to SOP and POS techniques, reduction of Boolean expression using Kmap methods (up to 4 variables), design of half adder , full adder ,half substractor , full subtractor, binary to gray and gray to binary code convertor. Introduction to multiplexer (4:1) and demultiplexer (1:4)

Ref. 2 Article5.1 to 5.8.1, 6.1, and 6.2

8. Sequential Logic Circuits , **(10L)**

Flipflops

RSflip flop using NAND/NOR clocked RS, D, JK, and Tflip flops, preset and clear inputs.

Counters

4-bit ripple counter, 4-bit parallel counter.

Registers

Buffer registers (SISO, SIPO, PISO, PIPO) use of register as a memory.

Ref. 2 Article7.1 to7.9, 8.1, 8.2, 8.4, for IC7490 Refer Data book

References

1 Electronic Principles (6th edition), Malvino (Tata McGraw Hill, New Delhi)

2 Modern Digital Electronics (3rd Edition), R.P.Jain, (Tata McGraw Hill, New Delhi)

3 Basic Electronics by R. S. Sedha, S. Chand publication

T. Y. B. Sc. Physics

PH345:Advanced Electronics

(Important Note: This course is designed for the student who has offered Electronics as one of the subjects at S.Y.B.Sc. level**)**

1. Sensors: (16 L)

Metal resistance versus Temperature devices:

Metal resistance versus Temperature devices, resistance versus temperature approximation, resistance temperature detectors.

Thermistors:

Semiconductor resistance versus Temperature, Thermistor characteristics.

Thermocouples:

Thermoelectric effects, Thermocouple characteristics, Thermocouple sensors.

Other Thermal Sensors:

Bimetal strip, Gas thermometers, Vapour pressure thermometers, Liquid expansion thermometers, solid state temperature sensors.

Motion sensors:

Types of motions, Accelerometers' principles, Types of accelerometers, applications

Optical sensors:

Photo detectors:

Photo detector characteristics, photoconductive detectors, photo voltaic detectors, photo diode detectors, photo emissive detectors.

Pyrometry: Thermal radiation, broadband pyrometers, narrowband pyrometers.

Optical sources: Conventional light sources, Laser principles

Applications: Label inspection, Turbidity, Ranging.

2. Signal Conditioning using OP-AMP: (12 L)

Principles of Analog Signal Conditioning:

Signal level and bias changes, linearization, conversions, filtering and impedance matching, concept of loading.

Passive circuits: Divider circuits, bridge circuits, RC filters, Operational Amplifier, characteristics and Specification of OP-AMP Circuits in Instrumentation, Voltage Follower, Inverting and Non-Inverting Amplifier, Instrumentation Amplifier, I to V Converter and V to I converter, Integrator(Low Pass Filter), Diffrentiator(High Pass Filter) 1st and 2nd order

3. Digital signal conditioning (10 L)

Review of digital fundamentals, digital information, Fractional Binary System, Boolean algebra, Digital Electronics, Combinational Circuits, Multiplexer, De- Multiplexer, Encoder, Decoder Converters: DAC, ADC, Data Acquisition System

Characteristics of digital data

Digitized values, sampled data systems, linearization

4. Introduction to Process Control: (10 L)

Control systems: Process control principles, servo mechanism, discrete state Control of systems

Process control block diagram

Identification of elements, block diagram

Control system evaluation: Stability, steady state regulation, Transient regulation, Evaluation criteria

Numerical Problems On Above Lectures

Reference Books:

1. Process Control Instrumentation Technology by C.D. Johnson Pearson Education 8th edition (Economic Edition).

2. Computer Based Industrial Control by Krishna Kant (Eastern Economic Edition)

3. Instrument of Device System by Rangan, Mani, Sharma

4. Instrument measurement and analysis by B. C. Nakra, K. K. Chaudhari

T. Y. B. Sc. Physics

PH346 Elective II(G) : Medical Electronics

1. Introduction: **(10 L)**

1. 1 Terminology of medical instrumentation,
1.2 Physiological system of body
1.3 Sources of bioelectric signals,
1. 4 Origin of bioelectric signals,
1.5 Analysis of ECG pattern
1.6 Nernst equation
1.7 Various types of bioelectric signals,
1.8 Basic medical instrumentation system,
1.9 Introduction to man instrument system,
Problems

Reference: 1

2. Bio potential Electrodes and sensors: **(12 L)**

2.1 Electrode-electrolyte interface,
2.2 Polarizable and non-polarizable electrodes,
2.3 Electrodes for ECG,EEG, EMG,
2.4 Resistive sensor
2.5 Capacitive sensor
2.6 Inductive sensor
2.7 Piezoelectric sensor
2.8 Radiation sensor
2.9 Temperature sensor
Problems

Reference: 2

3. Amplifiers and Signal Processing: **(09 L)**

3.1 Introduction
3.2 Basic amplifier requirements
3.3 The Differential amplifier
3.4 Common mode rejection
3.5 Instrumentation amplifier
3.6 Isolation amplifier
3.7 Pateint safety
3.8 Cardiac monitor
Problems

Reference:- 2

4. Clinical Laboratory Instrumentation: **(07 L)**

4.1 Spectrophotometry,
4.2 Spectrophotometer type instruments
4.3 Calorimetry and calorimeter,
4.4 Clinical flame photometer
Problems

Reference: 1

5. Measurements of Pressure and Volume Flow of Blood: (10 L)

5.1 Direct measurements of blood pressure,
5.2 Indirect measurements of BP.
5.3 Heart sounds, Phonocardiography,
5.4 Ultrasonic blood flow meter
5.5 Laser Doppler blood flow meter
Problems

Reference: 1

Reference Books:

1. Handbook of Biomedical Instrumentation, R.S. Khandpur

2. Medical Instrumentation application design, John G Webster, Houghon Mifflin Co.
3. Introduction to Biomedical Electronics, Joseph DfuBovy, Mc Graw Hill.
4. Clinical Biophysics, P. Narayanan
5. Introduction to Bio0medical equipment technology, fourth edition, by Joseph J. Carr and John M. Brown

Practicals

1. Measurement of BP using Mercury sphygmomanometer and digital BP meter
2. Recording of ECG and its analysis
3. Absorbance using calorimeter/ Absorption spectra using Spectrophotometer
4. Pulse oxymetry
5. Use of biosensor

T. Y. B. Sc. Physics

PH346 Elective II (H): Physics of Nanomaterials

Course Objectives:

The main objectives of course are to introduce the basic physics behind size and effect of nano materials and to understand the working principle of equipments used in nanostructures. In this course, students will gain knowledge of introduction to nanomaterials and their properties and growth techniques. It also discusses tools like UV, XRD, SEM and TEM to characterize the nanomaterials and applications of nanomaterials.

1. **Introduction to nanomaterials: (10 L)**
   Introduction to nano-sized materials and structures
   Brief history of nanomaterials and challenges in nanotechnology
   Significance of nano-size and properties, classification of nanostructured materials
2. **Methods of synthesis of nanomaterials: (12 L)**
   Bottom-up and Top-down approaches
   Physical methods: High energy ball milling, Physical vapour deposition, Ionized cluster beam deposition, sputter deposition, Ultrasonic spray pyrolysis etc.
   Chemical methods: colloidal method, co-precipitation and sol-gel method
   Hybrid method: Electrochemical and chemical vapour deposition.
3. **Characterization techniques: (11 L)**
   UV- visible spectroscopy
   X-ray diffraction
   Scanning electron microscopy
   Transmission electron microscopy
4. **Properties of nanomaterials: (05 L)**
   Mechanical, Electrical, Thermal, Optical, solubility, melting point and Magnetic properties
5. **Special nanomaterials: (06 L)**
   Carbon nanotubes, quantum dots, NanocrystallineZnO and TiO_2.
6. **Applications: (04 L)**
   Nanoelectronics, Medical, Biological, Automobiles, Space, Defense, Sports, Cosmetics, Cloth industry etc.

Reference Books:

1. Nanotechnology: Principles and Practices by Sulbha Kulkarni, Capital Publishing Co. New Delhi.
2. Introduction to nanotechnology, by C. P. Poole Jr. and F. J. Ownes, Willey Publications.
3. Origin and development of nanotechnology by P. K. Sharma, Vista International publishing house.
4. Nanostructure and nanomaterials synthesis, Properties and applications, by G. Cao, Imperials College Press, London.

List of experiments:

1. Synthesis of metallic nanoparticles by wet chemical method.
2. Study of optical absorption of nanoparticles.
3. Determination of nanoparticles size from X-ray diffraction spectra.
4. Synthesis of silver nanoparticles from silver nitrate by reduction using surfactant.

T. Y. B. Sc. Physics

PH346 Elective II (I): Microcontrollers

1. **ARCHITECTURE OF 8051: [10]**

Comparison of Microprocessor and Microcontroller, Overview of the 8051 family, Block diagram of Microcontroller, Functions of each block, Pin details of 8051, A and B CPU registers, Flags and Program status word (PSW), Program Counter and Data Pointer, PSW register, Memory Organization of 8051, Internal RAM, Stack and Stack Pointer, Special function registers, Internal ROM, I/O Ports, Oscillator and Clock

2. **8051 ASSEMBLY LANGUAGE PROGRAMMING: [10]**

Introduction to 8051 Assembly programming, Assembling and running an 8051 program, 8051 data types and directives, Intel hex file, Jump, loop, and call instructions, 8051 I/O programming, Addressing modes,

3. **ARITHMETIC & LOGIC INSTRUCTIONS AND PROGRAMS: [10]**

Arithmetic instructions, Signed number concepts and arithmetic operations, Logic and compare instructions, Rotate instruction, BCD, ASCII, and other application programs.

4. **TIMER AND INTERRUPTS PROGRAMMINGIN ASSEMBLY: [6]**

Timers. Programming 8051 timers, counter programming, Programming timers 0 and 1 in 8051, 8051 interrupts, Interrupt priority in the 8051

5. **SERIAL COMMUNICATION: [4]**

Basics of Serial programming , RS 232 Standards, 8051 connection to RS 232, 8051 Serial Communication Programming,

6. **INTERFACING TECHNIQUES [8]**

LCD and Keyboard interfacing,ADC, DAC, and sensor interfacing (LM35)

Reference Books:

1. 8051 Microcontroller by Kenneth J.Ayala.
2. 8051 Microcontroller and Embedded Systems using Assembly and C by Mazidi, Mazidi and D MacKinlay, 2006 Pearson Education Low Price Edition.
3. Microprocessor and Microcontroller by R.Theagarajan, Sci Tech Publication, Chennai
4. Programming customizing the 8051 Microcontroller by MykePredko, Tata McGraw Hill

List of Experiments

1. Use of Keil/Pinacle software.
2. Addition of two 16 bit numbers
3. Multiplication of two 8 bit numbers.
4. Write a program to find largest/smallest number in given block
5. Write a program to toggle bits of port 1 with delay which depends on value of number in R0
6. Memory block transfer from one location to another.
7. Find two’s complement of given number.
8. LCD Interfacing
9. Keyboard Interfacing
10. ADC Interfacing
11. Temperature Sensor Using LM 35

PH-346 Elective II –(J): Electro Acoustics and Entertainment Electronics

1. Speech and Hearing: (03 L)

Human voice and speech mechanism. Human hearing mechanism, theories of hearing

2. Electro Acoustic Transducers: (25 L)

1. Microphones: Design and operational features of carbon, moving coil and condenser microphones. Expressions for sensitivity, calibration, directivity.Problems.

2. Loudspeakers: Direct radiator dynamic type, expression for efficiency, radiated output power, effect of voice coil parameters. Horn loudspeaker cutoff frequency, output of horn.Loudspeaker cabinets – types, bass reflex cabinets.Problems.

3. Sound reinforcement system for auditoria: Power handling capacities, testing and evaluating amplifier specifications for auditoria. High-Fidelity (Hi-fi) acoustic evaluation of an auditorium/studio articulation test, sound level distribution, measurement of reverberation time.Acoustic delay units.

3. Sound recording and reproduction: (18 L)

1. Basic requirements of a system for good quality sound recording and reproduction, volume compressors, expanders, equalizers, graphic equalizers, monophonic, stereophonic sound reproducing system, surround sound. Noise reduction. Dolby A ,B system

2. Magnetic tape sound recording and reproduction basic principles, digital audio tape recording(DAT), basic principles of compact disc audio systems, motion picture sound recording and reproduction system, motion picture sound recording and reproduction variable area and variable density

4. Ultra Sonics principles and applications (2L)

Reference Books:

1. Fundamentals of Acoustics: Kinsler and fray etal, 4thedition, John Wiley and sons
2. Music, physics and Engineering H.F.Olson Dover publication 1960
3. Basic Acoustics D.E.Hall, Oxford University Press.
4. Acoustics Sourcebook Sybil Parker (Ed) McGraw Hill
5. Handbook for sound engineers G.M.Balov (Ed) New audio cyclopedia
6. Consumer Electronics by S.P. Bali (Pearson Publication)
7. Electroacoustics by Mendel and Kleiner (CRC Press)

List of experiments:

1. Non linear distortion of an amplifier.
2. Study of properties of porous acoustic materials.
3. Callibration of microphone by closed chamber method.
4. Study of a tape recorder.
5. Study of graphic equalizer.
6. Study of mufflers of noise reduction.
7. Use of distortion factormeter.
8. Acoustical evaluation of a Hall/Studio.
9. Ultrasonic Interferometer (modified).

T. Y. B. Sc. PHYSICS

PH346 Elective II (K): Lasers

1. **Introduction to Lasers: (08 L)**
   Ordinary light and Lasers, Brief history of Lasers, Interaction of radiation with matter, Energy levels, Population density, Boltzmann distribution, Transition Lifetimes, Allowed and Forbidden Transitions, Stimulated Absorption, Spontaneous Emission and Stimulated Emission, Einstein's Coefficients, Einstein's relations.
2. **Laser Action: (06 L)**
   Condition for large stimulated emission, Population inversion Condition for light amplification, Gain coefficient Active medium, Metastable states Pumping schemes: three level and four level
3. **Laser Oscillator: (07 L)**
   Optical feedback, round trip gain, threshold gain, critical population inversion, Optical resonator, condition for steady state oscillations, cavity resonance frequencies.
4. **Laser Output: (03L)**
   Lineshape broadening:
   - Lifetime broadening
   - Collision broadening
   - Doppler broadening
5. **Characteristics of Laser: (04 L)**
   Directionality,
   Monochromaticity
   Coherence
   Brightness
6. **Types of Lasers: (12 L)**
   Solid State Lasers – Ruby Laser, Diode Laser
   Gas Lasers – HeNe Laser, CO_2 Laser
   Liquid Lasers: Tunable dye laser
7. **Applications of Lasers: (08 L)**
   Industrial – welding, cutting, drilling
   Nuclear Science – laser isotope separation, laser fusion,
   Defense - range finder
   Medical - eye surgery
   Optical - holography, supermarket scanners, compact discs

Reference Books:

1. An introduction to Lasers – theory and applications, M.N. Avadhanulu, S.Chand and Co. New Delhi
2. Experiments with HeNe Laser by Sirohi
3. Optical fibre and Laser – Principle and applications, Anuradha De, New Age International Publishers, Second edition

List of Experiments:

1. Determination of wavelength of HeNe Laser by transmission grating and reflection grating.
2. Beam divergence of a Diode Laser.
3. Determination of the diameter of a thin wire using a laser.
4. Measurement of wavelength of Laser beam using Michelson Interferometer.
5. To study the interference of light using optical fibres
6. Measurement of the focal length of a given convex lens using a laser.

T. Y. B. Sc. PHYSICS

PH346 Elective II (L): Radiation Physics

[1] Low Energy Radiation: 8 Lectures.

Introduction to Microwave and Radio waves covering spectrum, power levels and detection methods. Laboratory sources of infrared, visible and ultra- violet radiation with details of energy spectrum. Detectors for microwaves, Infrared and Ultra violet radiation. Interactions of ultra violet and microwave radiation with matter

[2]Energetic Radiation : 8 Lectures.

Introduction to Cosmic radiation .Types of particles and their energies in cosmic rays. Basic laboratory sources of electrons and ions up to 50 keV. Focusing of electron and ion beams with magnetic and electrostatics lenses. Methods for measurement of electron and ion beam current and flux. Different types of neutron sources based on radioactive sources.

[3] X-Ray Radiography: 8 Lectures.

Principle and methods of generation of characteristics X-Rays. Interaction of X-Rays with matter, attenuation coefficient..Methods for recording X-Ray radiograph using photographic plate. Modern digital methods for recording X-ray radiograph. Medical applications of X-rays.

[4] Radiation Detectors and Dosimetry: 8 Lectures.

Working principle of ionization chamber and Scintillator detector, Units for radiation exposure, absorbed dose, Relative biological effective dose and dose equivalent. Fricke Dosimeter.Personal dosimeters, Film badge dosimeters, thermoluminescent dosimeter. Calibration of dosimeters. Measurement of dose delivered by an electron accelerator and high strength Cobalt -60 source.

[5]Radiation Protection: 8 Lectures.

Interaction of MeV energy electrons ,ions and gamma-rays with matter. Materials for radiation shielding. Radiation Protection and Safety rules as per the regulatory guidelines of the Government of India, Safety codes for handling radioactive sources. Monitoring of radiation levels around an open radioactive source and MeV energy electron accelerator.

[6] Radioactive Isotopes and Applications. 8 Lectures.

Naturally occurring radioactive isotopes. Production of radioactive nuclides in nuclear reactors and by charged particle beams from accelerators. Measurement of radioactivity and lifetime of radioactive sources.Radioactive pharmaceuticals and labeled compounds. Radioactive nuclei used in diagnostic applications. Applications of gamma-rays in sterilization of medical instruments , medication items and preservation of food.

Reference and Text Books:

(1)Nuclear and Radiation Physics in Medicine.
Tony Key . World Scientific.2014
(2)Radiation Protection and Health Science.
Marilyn E. Noz .World Scientific. 2007.
(3)Introduction to radiation Protection .
Grupen C. Springer. 2008.

(4)Introduction to Radiological Physics and radiation dosimetry.
Frank H. Attix. Wiley.1986.
(5)Radiation Physics for Medical Physicists.
Podgorsak Ervin B. Springer.2005.
(6)Techniques for Nuclear and Particle Physics experiments.
Leo. W.R. Springer.2005.

List of Experiments:

1) Study of Inverse square law for radiation emitted by radioactive sources using radiation survey meter.
2) Location of a hidden radioactive source by survey meter and measurement of radiation level in air around that source.
3) Measurement of linear absorption coefficient for a brick or a stone using gamma ray source and radiation survey meter.
4) Study of X-ray radiograph of a fracture bone and structurally damaged piece of a material. Estimation of size of the crack using standard procedure.
5) Estimation of attenuation coefficient for gamma rays in atleast four different soil samples using radiation survey meter.

T. Y. B. Sc. Physics

PH347 Laboratory Course I

GROUP I

GENERAL PHYSICS (ANY EIGHT)

1. Viscosity of liquid by Rotating cylinder method
2. Moment of Inertia by Bifilar suspension
3. Young's modulus by Newton's rings
4. Young's modulus by Koeing method
5. Determination of wavelength of light by Michelson's interferometer
6. Surface tension liquid by Fergusson method
7. Surface tension of mercury by Quincke's method
8. Hall Effect
1. Energy gap of a semiconductor
10. Study of XRD spectra of any matter
11. Resistivity by Four probe method
12. Platinum resistance thermometer
13. Kater's pendulum
14. Study of forced oscillations by electromagnetically driven simple pendulum
15. Y by vibration of wooden scale
16. Study of damped oscillations of physical pendulum and finding log decrement.

GROUP II

ATOMIC AND MOLECULAR PHYSICS AND OPTICS (ANY TWO)

1. Determination of Rydberg's constant
2. Zeeman Effect
3. Llyod's mirror
4. Determination of Resolving Power of grating
5. Determination of wavelength by Constant deviation spectrometer
6. Determination of refractive index of liquid using hollow prism.

STATISTICAL PHYSICS AND THERMODYNAMICS (ANY TWO)

1. Verification of Stefan's law by torch bulb filament
2. Thermal conductivity by Forbes Method.
3. Thermal conductivity of rubber tubing
4. Determination of pressure coefficient of air by constant volume thermometer.

NUCLEAR AND QUANTUM MECHANICS (ANY TWO)

1. Characteristics of G.M. tube
2. Inverse square law (γ-rays)
3. e/m by Thomson method
4. Determination of Planck's constant

ELECTROMAGNETISM (ANY TWO)

1. Self Inductance by Anderson's bridge
2. Core losses in transformers
3. Electromagnetic pendulum
4. Inductance by Maxwell's bridge

Additional Activities (Any Two)

a. Demonstrations- Any 4 demonstrations equivalent to 2 experiments

b. Study tour with report equivalent to 2 experiments

c. Mini project equivalent to 2 experiments

d. Computer aided demonstrations (Using computer simulations or animations) (Any 2 demonstrations equivalent to 2 experiments)

Students have to perform at least two additional activities in addition to sixteen experiments mentioned above. Total laboratory work with additional activities

should be equivalent to twenty experiments.

T. Y. B. Sc. Physics

PH348: Laboratory Course II

GROUP I

ELECTRONICS (ESSENTIAL) (ANY TWO)

(For the students not offering advance electronics in theory courses)

1. Characteristics of JFET
2. Design and built astablemultivibrator using IC 555/IC 741
3. IC 723 as regulated power supply
4. Integrator and differentiator using IC 741

ADVANCED ELECTRONICS (ANY TWO)

(For the students offering advance electronics in theory courses)

1. Instrumental amplifier using three op-amps
2. Temperature controller using PT 100 / thermocouple /thermistor temperature sensors
3. Object counter (two digit)
4. Study of LVDT
5. Schimdt trigger

ACOUSTICS and Lasers (ANY TWO)

1. Frequency response of loudspeaker (twitter, woofer, mid-range)
2. Study of interference by Quinck's method
3. Use of Ultrasonic interferometer to measure velocity of sound in liquids
4. Transmission loss using expansion chamber muffler.
5. Study of diffraction using a reflection grating (metal ruler)
6. Study of the characteristics of a laser beam.
7. Determination of the diameter of a thin wire using a laser beam.

NOTE: Four practicalswill be from **optional course I and II** (two each).

GROUP II

COMPUTER INTERFACED PHYSICS EXPERIMENTS/INSTRUMENTATION (ANYTWO)

1. Charging and discharging of capacitor and RC time constant
2. Measurement of g using simple pendulum
3. Velocity of sound
4. Radiation detection
5. IV Characteristics of diode
6. Temperature controller using AD590
7. Study of IC 7490 as mod 2, mod 5, mod 7 and mod 10 counter

C-PROGRAMMING (ANY FOUR)

1. Factorial of a number by simple and recursive method.
2. To find out the first 100 prime numbers
3. Matrix multiplication
4. Graphics (line, circle, arc, ellipse, bar, draw poly)
5. Position time data using kinematic equations
6. Finding pressure using Vander Waals' equation of state

COMPUTATIONAL PHYSICS (NUMERICAL BASED) (ANY TWO)

1. Roots of an algebraic equation (Bisection)
2. Roots of polynomial (Newton Raphson)
4. Trapezoidal and Simpson's 1/3 rule

Additional Activities (Any Two)

a. Demonstrations- Any 4 demonstrations equivalent to 2 experiments
b. Study tour with report equivalent to 2 experiments

c. Mini project equivalent to 2 experiments

d. Computer aided demonstrations (Using computer simulations or animations) (Any 2 demonstrations equivalent to 2 experiments)

e. Use of plagiarism software to find plagiarism in research work.

Students have to perform at least two additional activities in addition to sixteen experiments mentioned above. Total laboratory work with additional activities should be equivalent to twenty experiments.

T. Y. B. Sc. Physics

PH348 Laboratory Course III

Project

It is expected that

1. The student does work equivalent to about twenty laboratory experiments through out both the semesters in the third year.

2. One bears in mind that the project work is a practical course and it is intended to develop a set of skills pertaining to the laboratory work apart from the cognition of students. Therefore, the guides should not permit projects that involve no contribution on part of student.

3. The project must have a clear and strong link with the principles of basic physics and/or their applications.

4. The theme chosen should be such that it promotes better understanding of physics concepts and brings out the creativity in the students.

5. The evaluation of the project work must give due credit to the amount of the project work actually done by a student, skills shown by the student, understanding of the physics concepts involved and the presentation of the final report at the time of viva voce.

6. The viva voce should be conducted at least for thirty minutes per student. Extra care must be taken in the evaluation of projects done in a pair or group. Delegation of the work done by individuals must be sought from the students in such cases.

7. Any ready-made material used in the report (such as downloaded pages from the web) must be clearly referred to and acknowledged.

Time schedule for project work:

(1) Allotment of Internal guide by 30th July

(2) Submission of synopsis by 14th August

(3) Project work revision – every week

(4) First draft by 15th February

(5) Final report submission by 5th March.

Any non-adherence to this norm should attract a penalty by way of deduction in the marks awarded to a student. It is recommended that the College will provide consumables/contingencies for every project, to the tune of Rs. 500/- each. It is also recommended that a teacher will look after 4 projects at one time.

UNIVERSITY GRANTS COMMISSION

Ability Enhancement Compulsory Course (AECC – Environment Studies)

Unit 1 : Introduction to environmental studies

- Multidisciplinary nature of environmental studies;
- Scope and importance; Concept of sustainability and sustainable development.

(2 lectures)

Unit 2 : Ecosystems

- What is an ecosystem? Structure and function of ecosystem; Energy flow in an ecosystem: food chains, food webs and ecological succession. Case studies of the following ecosystems :
  a) Forest ecosystem
  b) Grassland ecosystem
  c) Desert ecosystem
  d) Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)

(6 lectures)

Unit 3 : Natural Resources : Renewable and Non-renewable Resources

- Land resources and landuse change; Land degradation, soil erosion and desertification.
- Deforestation: Causes and impacts due to mining, dam building on environment, forests, biodiversity and tribal populations.
- Water : Use and over-exploitation of surface and ground water, floods, droughts, conflicts over water (international & inter-state).
- Energy resources : Renewable and non renewable energy sources, use of alternate energy sources, growing energy needs, case studies.

(8 lectures)

Unit 4 : Biodiversity and Conservation

- Levels of biological diversity : genetic, species and ecosystem diversity; Biogeographic zones of India; Biodiversity patterns and global biodiversity hot spots
- India as a mega-biodiversity nation; Endangered and endemic species of India
- Threats to biodiversity : Habitat loss, poaching of wildlife, man-wildlife conflicts, biological invasions; Conservation of biodiversity : In-situ and Ex-situ conservation of biodiversity.
- Ecosystem and biodiversity services: Ecological, economic, social, ethical, aesthetic and Informational value.

(8 lectures)

Unit 5 : Environmental Pollution

- Environmental pollution : types, causes, effects and controls; Air, water, soil and noise pollution
- Nuclear hazards and human health risks
- Solid waste management : Control measures of urban and industrial waste.
- Pollution case studies.

(8 lectures)

Unit 6 : Environmental Policies & Practices

- Climate change, global warming, ozone layer depletion, acid rain and impacts on human communities and agriculture

- Environment Laws: Environment Protection Act; Air (Prevention & Control of Pollution) Act; Water (Prevention and control of Pollution) Act; Wildlife Protection Act; Forest Conservation Act. International agreements: Montreal and Kyoto protocols and Convention on Biological Diversity (CBD).
- Nature reserves, tribal populations and rights, and human wildlife conflicts in Indian context.

(7 lectures)

Unit 7 : Human Communities and the Environment

- Human population growth: Impacts on environment, human health and welfare.
- Resettlement and rehabilitation of project affected persons; case studies.
- Disaster management : floods, earthquake, cyclones and landslides.
- Environmental movements : Chipko, Silent valley, Bishnois of Rajasthan.
- Environmental ethics: Role of Indian and other religions and cultures in environmental conservation.
- Environmental communication and public awareness, case studies (e.g., CNG vehicles in Delhi).

(6 lectures)

Unit 8 : Field work

- Visit to an area to document environmental assets: river/ forest/ flora/fauna, etc.
- Visit to a local polluted site-Urban/Rural/Industrial/Agricultural.
- Study of common plants, insects, birds and basic principles of identification.
- Study of simple ecosystems-pond, river, Delhi Ridge, etc.

(Equal to 5 lectures)

Suggested Readings:

1. Carson, R. 2002. *Silent Spring*. Houghton Mifflin Harcourt.
2. Gadgil, M., & Guha, R. 1993. *This Fissured Land: An Ecological History of India*. Univ. of California Press.
3. Gleeson, B. and Low, N. (eds.) 1999. *Global Ethics and Environment*, London, Routledge.
4. Gleick, P. H. 1993. *Water in Crisis*. Pacific Institute for Studies in Dev., Environment & Security. Stockholm Env. Institute, Oxford Univ. Press.
5. Groom, Martha J., Gary K. Meffe, and Carl Ronald Carroll. *Principles of Conservation Biology*. Sunderland: Sinauer Associates, 2006.
6. Grumbine, R. Edward, and Pandit, M.K. 2013. Threats from India's Himalaya dams. *Science,* 339: 36-37.
7. McCully, P. 1996. *Rivers no more: the environmental effects of dams* (pp. 29-64). Zed Books.
8. McNeill, John R. 2000. Something New Under the Sun: An Environmental History of the Twentieth Century.
9. Odum, E.P., Odum, H.T. & Andrews, J. 1971. *Fundamentals of Ecology*. Philadelphia: Saunders.
10. Pepper, I.L., Gerba, C.P. & Brusseau, M.L. 2011. Environmental and Pollution Science. Academic Press.
11. Rao, M.N. & Datta, A.K. 1987. *Waste Water Treatment*. Oxford and IBH Publishing Co. Pvt. Ltd.
12. Raven, P.H., Hassenzahl, D.M. & Berg, L.R. 2012. *Environment*. 8th edition. John Wiley & Sons.
13. Rosencranz, A., Divan, S., & Noble, M. L. 2001. *Environmental law and policy in India*. *Tripathi* 1992.
14. Sengupta, R. 2003. *Ecology and economics*: An approach to sustainable development. OUP.
15. Singh, J.S., Singh, S.P. and Gupta, S.R. 2014. *Ecology, Environmental Science and Conservation*. S. Chand Publishing, New Delhi.
16. Sodhi, N.S., Gibson, L. & Raven, P.H. (eds). 2013. *Conservation Biology*: *Voices from the Tropics*. John Wiley & Sons.
17. Thapar, V. 1998. *Land of the Tiger*: *A Natural History of the Indian Subcontinent*.
18. Warren, C. E. 1971. *Biology and Water Pollution Control*. WB Saunders.
19. Wilson, E. O. 2006. *The Creation: An appeal to save life on earth*. New York: Norton.
20. World Commission on Environment and Development. 1987. *Our Common Future*. Oxford University Press.

SavitribaiPhule Pune University

(Formerly University of Pune)

Three Year B.Sc. Degree Program in Zoology

(Faculty of Science & Technology)

S.Y.B.Sc. Zoology

(w.e.f. June 2020)

As per

Choice Based Credit System

Syllabusimplemented from

Academic Year 2020-2021

Preamble:

Zoology is one of the major subjects of Basic Sciences and deals with all aspects of animal biology. It includes an interesting range of highly diverse topics. A zoology student needs to gain understanding of many areas of the subject to keep pace with advancements in Life Sciences.

This under-graduate degree program has been designed by the Board of Studies in Zoology of SavitribaiPhule Pune University with a substantial component of what is needed from zoologists as a skilled career and what zoologists need to pursue for post-graduation and further academic studies. It follows the guidelines laid down by the University Grants Commission, New Delhi. This newly designed curriculum is a perfect blend of the classical aspects in Zoology and the advanced and more specialized areas.

This degree offers Discipline Specific Core Courses **[CC]** in Animal Systematics, Animal Ecology, Animal Cell biology, Applied Zoology, Pest Management, Histology, Biological Chemistry, Genetics, Developmental Biology, Parasitology, Medical & Forensic Zoology, Animal Physiology, Molecular Biology, Entomology, Techniques in Biology and Evolutionary Biology.

In addition to the Core Courses, Ability Enhancement Compulsory Courses **[AECC]** have been added in the second year i.e. Semester III and Semester IV of the undergraduate course. In the third year i.e. Semester V and Semester VI, Discipline specific Elective Courses **[DSEC]** and Skill Enhancement Courses **[SEC]** have been offered. The students, therefore, have an opportunity to take courses in Environment Awareness, Language communication: English/Marathi, Aquarium Management, Poultry Management and Environmental Impact Assessment. In Semester VI the students also have a course dedicated to Project work.

The syllabus has been framed in such a way that the student gains each year, a broader perspective of the subject as he progresses towards completion of the degree program. Field trips, Educational visits and the Project work have been included for the student to experience the applications of the theory learnt in the classroom.

After completion of the program, it is expected that students will understand and appreciate: animal diversity, few applications of Zoology, the structure, functions and life processes at cellular, tissue, organ and system level, significance of evolution, and basic concepts of human health. The students would also gain an insight into laboratory and field work through the practical course, field work and the project.

While presenting this new syllabus to the teachers and students of F. Y. B. Sc. Zoology, I am extremely happy to state that efforts have been made to seek inputs of all the stake holders to make it more relevant.

The new course that will be effective from the academic year 2019- 2020 and will follow the Choice Based Credit System in a Semester mode. It has been primed keeping in view the distinctive requirements of B. Sc. Zoology students. The contents have been drawn-up to accommodate the widening prospects of the discipline of Life Sciences. They reflect the changing prerequisites of the students. This program has been introduced with 132 credits for the subject group while 08 credits to earn from any of the 08 groups offering a range of curricular, cocuricular and extracurricular activities. This pattern has been specially aimed towards the overall development of the students'. The calculation of credits and CGPA will be as per the guidelines of the University. The B. Sc. Zoology program provides an appropriate blend of classical and applied aspects of the subject. This newly designed curriculum will allow students to acquire the skill in handling scientific instruments planning and performing in the laboratory and exercising critical judgement, independent thinking and problem solving skills.

The Syllabus has been revised with the following aims

- To foster curiosity in the students for Zoology
- To create awareness amongst students for the basic and applied areas of Zoology
- To orient students about the importance of abiotic and biotic factors of environment and their conservation.
- To provide an insight to the aspects of animal diversity.
- To inculcate good laboratory practices in students and to train them about proper • handling of lab instruments.

Course Structure:

Course Structure with Credit Distribution of the Undergraduate Science Program in Zoology

Course	Course Code and Name of the Course		Credits
F. Y. B. Sc.	**SEMESTER I**	**SEMESTER II**	
CC	ZO - 111 Animal Diversity I	ZO-121 Animal Diversity II	2 + 2
CC	ZO - 112 Animal Ecology	ZO-122 Cell Biology	2 + 2
CC	ZO - 113 Zoology Practical Paper	ZO-123 Zoology Practical Paper	1.5 +1.5
S. Y. B. Sc.	**SEMESTER III**	**SEMESTER IV**	
CC	ZO - 231 Animal Diversity III	ZO - 241 Animal Diversity IV	2 + 2
CC	ZO - 232 Applied Zoology I	ZO - 242 Applied Zoology II	2 + 2
CC	ZO - 233 Zoology Practical Paper	ZO - 243 Zoology Practical Paper	2 + 2
AECC	EVS 231- Environment Awareness	EVA 241- Environment Awareness	2 + 2
AECC	LA 231 - English/Marathi	LA 241 - English /Marathi	2 + 2
T. Y. B. Sc.	**SEMESTER V**	**SEMESTER VI**	
DSEC	ZO - 351 Pest Management	ZO - 361 Medical & Forensic Zoology	2 + 2
DSEC	ZO - 352 Histology	ZO - 362 Animal Physiology	2 + 2
DSEC	ZO - 353 Biological Chemistry	ZO - 363 Molecular Biology	2 + 2
DSEC	ZO - 354 Genetics	ZO - 364 Entomology	2 + 2
DSEC	ZO - 355 Developmental Biology	ZO - 365 Techniques in Biology	2 + 2
DSEC	ZO - 356 Parasitology	ZO - 366 Evolutionary Biology	2 + 2
DSEC	ZO- 357 Zoology Practical Paper 1	ZO - 367 Zoology Practical Paper 1	2 + 2
DSEC	ZO- 358 Zoology Practical Paper 2	ZO - 368 Zoology Practical Paper 2	2 + 2
DSEC	ZO- 359 Zoology Practical Paper 3	ZO - 369 Zoology Practical Paper 3	2 + 2
SEC	ZO - 3510 Aquarium Management	ZO- 3610 Environmental Impact Assessment	2 + 2
SEC	ZO - 3511 Poultry Management	ZO - 3611 Project	2 + 2

Detailed Syllabus of S. Y. B. Sc.

Paper	Semester III Course Code & Course	Credits	No of Hours	Marks (Internal + University)		Semester IV Course Code & Course	Credits	No of Hours	Marks (Internal + University)
I	ZO - 231 Animal Diversity III	02	30	15+ 35= 50		ZO - 241 Animal Diversity IV	02	30	15+ 35 = 50
II	ZO - 232 Applied Zoology I	02	30	15+ 35 = 50		ZO - 242 Applied Zoology II	02	30	15+ 35 = 50
III	ZO - 233 Zoology Practical Paper	02	14 Practicals	15+ 35 = 50		ZO - 243 Zoology Practical Paper	02	14 Practicals	15+ 35 = 50
AECC	EVS 231- Environment Awareness	02	30	15+ 35 = 50		EVA 241- Environment Awareness	02	30	15+ 35 = 50
AECC	LA 231- English/ Marathi	02	30	15+ 35 = 50		LA 241- English/ Marathi	02	30	15+ 35 = 50

Animal Diversity III & IV

Objectives –

1. To understand the origin and advancement of higher vertebrates (tetrapoda).
2. To understandgeneral characters of different groups of higher vertebrates.
3. To classify vertebrates and to become able to understand the possible group of vertebrates observed in nature.
4. To understand different behaviours and adaptations in higher vertebrates
5. To understand affinities among different groups of higher vertebrates.

Learning Outcomes for the course -

1. The students will be able to understand, classify and identify the diversity of higher vertebrates.
2. The students will able to understand the complexity of higher vertebrates
3. The students will be able to understand different life functions of higher vertebrates.
4. The students will be able to understand the linkage among different groups of higher vertebrates.
5. The student will become aware regarding his role and responsibility towards nature as a protector, to understand his role as a trustee and conservator of life which he has achieved by learning, observing and understanding life.

Course Title: Animal Diversity - III

Course Code: ZO – 231,

Semester - III (2 credits – 30 Hours)

No. Title & Contents **Number of Lectures**

1. Introduction to Phylum Chordata – (03)

1.1 Origin & Ancestry of Chordates.

1.2 Comparative account of fundamental characters of Chordates with Non Chordates.

1.3 Salient features of Phylum Chordata.

1.4 Classification of Phylum Chordata upto classes – Pisces, Amphibia, Reptilia, Aves, Mammalia.

2. Introduction to Group – Protochordata. (03)

2.1 Salient features of Protochordata.

2.2 Salient features of subphylumswith two example each - Names only.

Hemichordata – *Balanoglossus*and*Rhabdopleura*, Urochordata - *Herdmania*and*Salpa*, Cephalochordata –*Branchiostoma*(Amphioxus) and*Asymmetron*.

3. Introduction to subphylum – Vertebrata (02)

3.1 Salient features of Vertebrata.

3.2 Introduction and General characters of sections with two examples - Names only.

Agnatha–*Petromyzon&Myxine*&Gnathostomata–Frog&*Labeo*.

4. Introduction to Class – Pisces (04)

4.1 Salient features of Class – Pisces.

4.2 Introductaionand Salient features of sections with two examples - Names only.

Class – Chondrichthyes–*Scoliodon*and *Chimaera*&Osteichthyes – *Labeo*and*Catla*

4.3 Types of Scales in Fishes.

4.4 Types of Fins in Fishes.

5. Introduction to Class – Amphibia (03)

5.1 Salient features of Class – Amphibia.

5.2 Introduction to order – Apoda–*Ichthyophis*,Urodela–*Salamandra*(Salamander) and& Annura - *Rana*.

5.3 Parental care in Amphibia.

6. Study of *Scoliodon* (15)

Scoliodon – 6.1 - Systematic position, Geographical distribution, Habit, Habitat 01

6.2 - External characters 01

6.3 - Digestive System, Food and feeding mechanism. 02

6.4 - Respiratory System – Structure of Holobranch only. 02

6.5- External & Internal Structure of heart, Working of heart. 02

6.6 - Nervous System – Brain only. 03

6.7 - Male urinogenital system & Female reproductive System. 03

6.8- Yolk sac placenta. 01

Applied Zoology I and II

Objectives :

1. To understand the basic life cycle of the honeybees, beekeeping tools and equipments.
2. To learnfor managing beehives for honey production and pollination.
3. To understand the basic information about fishery, cultural and harvesting methods of fishes.
4. To understand fish preservation techniques.
5. To understand the biology, varieties of silkworms and the basic techniques of silk production and harvesting of cocoons.
6. To learn the different silkworm species and their host plants.
7. To study types of agricultural pests and Major insect pests of agricultural importance.
8. To study Pest control practices.

Learning Outcomes of the course:

1. The learner understands the basics about beekeeping tools, equipment, and managing beehives.
2. The learner understands the basic information about fishery, cultural and harvesting methods of fishes and fish preservation techniques.
3. The learner understands the biology, varieties of silkworms and the basic techniques of silk production.
4. The learner understands the types of agricultural pests, Major insect pests of agricultural importance and Pest control practices.

Course Title - Applied Zoology I

Course Code - ZO - 232

Semester III **2 Credits - 30 lectures**

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1) Sericulture: **16**

1.1 An introduction to Sericulture, Study of different types of silk moths, their distribution, Taxonomic position and varieties of silk produced in India : Mulberry, Tassar, Eri and Muga silk moths. 02

1.2 ExternalMorphology and life cycle of *Bombyxmori*. 02

1.3 Cultivation of mulberry :

a) Varieties for cultivation,

b) Rain fed and irrigated mulberry cultivation- Fertilizer schedule, Pruning methods and leaf yield. 02

1.4 Harvesting of mulberry : **a)** Leaf plucking, **b)** Branch cutting, **c)** Whole shoot cutting. 01

1.5 Silk worm rearing :

a) Varieties for rearing,

b) Rearing house,

c) Rearing techniques,

d) Important diseases and pests. 03

1.6 Preparation of cocoons for marketing. 01

1.7 Post harvest processing of cocoons :

a) Stiffling, sorting, storage, deflossing and riddling,

b) Cocoon cooking, reeling equipment and rereeling, washing and polishing. 03

1.8 Biotechnological and biomedical applications of silk. 02

2) Agricultural Pests and their control: **14**

2.1 An introduction to Agricultural Pests, types of pests (agricultural, store grain, veterinary). 01

2.1 Major insect pests of agricultural importance (Marks of identification, life cycle, nature of damage and control measures). 06

a) Jowar stem borer,

b) Red cotton bug,

c) Brinjal fruit borer,

d) Mango stem borer,

e) Blister beetle,

f) Rice weevil,

g) Pulse beetle,

h) Tick.

2.3 Non insect pests: Rats, Crabs, Snails, and Squirrels 01

2.4 Pest control practices in brief: Cultural control, Physical control, Mechanical control, Chemical control, Biological control, Pheromonal control, Autocidal control and Concept of IPM in brief. 04

2.5 Plant protection appliances: Shoulder type Rotary duster, Knapsack sprayer, Cynogas Pump. 02

Course Title: Zoology Practical Paper

Course Code: ZO – 233

Semester - III **(2 credits – 60 Hours)**

Animal Diversity - III

1. Museum study of Group Protochordata : *Balanoglossus*, *Herdmania*, *Petromyzon*. (D)
2. Museum study of Class Pisces: Labeo, *Scoliodon*, *Hippocampus.* (D)
3. Museum study of Class Amphibia :*Salamandra*, *Rana*, *Ichthyophis*. (D)
4. Study of types of scales in fishes: Placoid scale, Cycloid scale, Ctenoid scale & Ganoid scale. (D)
5. Study of types of tail fins in fishes: Homocercal, Heterocercal &Diphycercal. (D)
6. Study of external characters & digestive system of locally available fish. (E) - Compulsory
7. Study of brain of locally available fish. (D)
8. Temporary preparation of scales & its identification from locally available fish. - (E) Compulsory
9. Compulsory field visit to study pond ecosystem with reference to Pisces and amphibians, report writing and submission. (**2 P**)

Sericulture –

1. Study of external morphology and life-cycle of *Bombyx mori.* (D)
2. Study of five equipments in Sericulture. (E) - Compulsory
3. Preparation of a map showing distribution of silk moth and rearing/ sericulture practices in India. (E)
4. Compulsory submission of Photographs/ sketches of Mulberry, Tassar, Eri and Muga silkmoths. (E)

Agricultural Pests and their control -

1. Study of following insect pests with respect to marks of identification, nature of damage, economic importance and control measures. (D)
   a) Jowar stem borer,
   b) Red cotton bug,
   c) Brinjal fruit borer,
   d) Mango stem borer.
2. Study of following pests with respect to marks of identification, nature of damage, economic importance and control measures. (D)
   a) Blister beetle,

b) Rice weevil,

c) Pulse beetle,

d) Tick.

3. Study of any two non insect pests corresponding to theory course. (D)
4. Compulsory submission of at least five Insect Pests/ Photographs/ Sketches. (E)
5. Study of pest control appliances (as per theory course). (D)
6. Compulsory field visit to Sericulture farm/ Agricultural farm, report writing and submission. **(2 P).**

Minimum 14 practicals must be conducted with at least Seven practicals from each paper.

Course Title: Animal Diversity - IV

Course Code: ZO – 241

Semester - IV (2 credits – 30 Hours)

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1. Introduction to class –Reptilia (04)

1.1 Salient features of class Reptilia with one example (name only) – *Chelone*, *Calotes*.

1.2 Venomous and Non-venomous snakes – Cobra, Russell's viper, Rat snake, Grass snake.

1.3 Snake venom, symptoms, effect and cure of snake bite, first aid treatment of snakebite.

1.4 Desert adaptations in reptiles in brief.

2. Introduction to class –Aves (05)

2.1 Salient features of class Aves with two examples (names only) – Sparrow, Parrot.

2.2 Flight adaptations in birds.

2.3 Types of Beaks and feet in birds.

2.4 Migration in birds – Altitudinal, Latitudinal.

3. Introduction to class - Mammalia. (04)

3.1 Salient features of class Mammalia with two examples (names only) – Rat, Rabbit.

3.2 Egg laying mammals.

3.3 Aquatic adaptations in mammals.

3.4 Flying adaptations in mammals.

3.5 Cursorial and fossorial adaptation in mammals

4. Study of Rat (17)

4.1 Systematic position, habit and habitat.	01
4.2 External characters.	01
4.3 Digestive system, food and feeding.	02
4.4 Respiratory system.	02
4.5 Blood vascular system – Structure of Heart.	02
4.6 Nervous system – Central Nervous system only.	03
4.7 Sense organs – Structure and functions of Eye & Ear.	03
4.8 Reproductive system.	03

Course Title - Applied Zoology II

Course Code - ZO-242

Semester IV **2 Credits- 30 lectures**

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1. Apiculture: **16**

1.1 An introduction to Apiculture, Systematic position, Study of habit, habitat and nesting behaviour of *Apisdorsata*, *Apisindica*, *Apis florae* and *Apismellifera*. 02

1.2 Life cycle, Colony organization and Division of labour. 02

1.3 Bee behaviour and communication (Round Dance and Wag-Tail Dance) . 02

1.4 Bee keeping equipments :

a) Bee box (Langstroth type),

b) Honey extractor,

c) Smoker,

d) Bee-veil,

e) Gloves,

f) Hive tool,

g) Bee Brush,

h) Queen excluder. 02

1.5 Bee keeping and seasonal management. 02

1.6 Bee products (composition and uses) :

a) Honey,

b) Wax,

c) Bee Venom,

d) Propolis,

e) Royal jelly,

f) Pollen. 02

1.7 Diseases and enemies of Bees :

a) Bee diseases - Protozoan (Nosema), Bacterial (American foul brood), Viral (Sac brood), Fungal (Chalk brood).

b) Bee pests - Wax moth (Greater and Lesser), Wax beetle.

c) Bee predators - GreenBee eater, King crow, Wasp, Lizard. 02

1.8 Bee pollination and management of bee colonies for pollination. 02

2. Fisheries : **14**

2.2 An introduction to fisheries and its types (in brief) : Freshwater fisheries, Marine fisheries, Brackish water fisheries. 02

2.3 Habit, habitat and culture methods of following freshwater forms : 03

a) Rohu (*Labeo rohita*) ,

b) Catla (*Catla catla*) ,

c) Mrigal (*Cirrhinus mrigala*).

2.3 Harvesting methods of following marine forms: 03

a) *Harpodon*,

b) Mackerel,

c) Pearl oyster.

2.4 Crafts and Gears in Indian Fishery: 02

a) Crafts – Catamaran, Machwa, Dinghi.

b) Gears – Gill net, Dol net, Rampani net, Cast net.

2.5 Fishery byproducts: 02

a) Fish meal,

b) Fish flour,

c) Fish Liver oil,

d) Fish manure,

e) Fish fin soup.

2.6Fish preservation technique: 02

a) Chilling,

b) Freezing,

c) Salting,

d) Drying,

e) Canning.

Course Title: Zoology Practical Paper

Course Code: ZO – 243

Semester - IV **(2 credits – 60 Hours)**

Animal Diversity - IV

1. Museum study of Class Reptilia: Venomous & Non-venomous snake – Two each. (D)
2. Identification of Venomous & Non-venomous snakes with the help of pictorial taxonomic keys. – (D) -Compulsory
3. Museum study of Class Aves: Crow, *Kingfisher*& Duck. (D)
4. Study of types of beaks &feets in birds – Any two each. (D)
5. Museum study of Class Mammalia: Rat, Shrew & Bat. (D)
6. Study of external characters & digestive system of Rat. (D)
7. Study of Heart of Rat. - (D) -Compulsory
8. Study of brain of Rat. (D)
9. Study of reptilian / avian diversity in and around the campus (**2 P**) - (E) -Compulsory
10. Compulsory visit to Zoo / Wildlife sanctuary / Bird sanctuary, report writing and submission. (**2 P**)

Apiculture –

1. Study of external morphology, life cycle and polymorphism in Honey Bee. (D)
2. Temporary mountingof mouth parts, legs, wings and sting apparatus of worker bee. (E)
3. Study of Bee keeping Equipment: Bee box, Honey extractor, Smoker**,** Bee-veil, queen excluder. (D)- Compulsory
4. Study of Bee products: Honey, Wax, Venom, Royal jelly, Pollen. (D)
5. Estimation of carbohydrates from Honey in different samples. (D)- Compulsory
6. Study of Bee enemies: Wax moth, Bee eater, ant. (D)

Fisheries –

1. Identification, Classification and study of habit, habitat and economic importance of **a)** Rohu (*Labeo rohita*), **b)** Catla (*Catla catla*), **c)** Mrigal (*Cirrhinus mrigala*). (D)
2. Identification, Classification and study of habit, habitat and economic importance of **a)** Prawn, **b)** Crab, **c)** Lobster, **d)** Pearl Oyster. (D)
3. Study and maintenance of Aquarium. (D) - Compulsory

4. Study of crafts: **a)** Catamaran, **b)** Machwa, **c)** Dinghi (Photographs/models/line drawings). (D)

5. Study of gears in fishing: **a)** Gill net, **b)** Dol net, **c)** Rampani net, **d)** Cast net. (Photographs/models/line drawings). (D)

7. Study of nutritional value of fish: Biochemical estimation of fish muscle proteins by using Biuret method. (E) - Compulsory

7. Compulsory study tour/field visit to Apiculture institute / Fish farm/ Aquarium. (E) **(2 P)**.

Minimun 14 practicals must be conducted with at least Seven practicals from each paper.

Recommended Reference Books

Animal Diversity – III & IV

1. Text Books of Zoology, Invertebrates Vol- II, 1992, T.J.Parker and W.A. Haswel, Edited by Marshall and Williams,CBS publications and distribution, New Delhi.
2. Integrated Principles of Zoology, Eleventh Edition, Hickman CP, Roberts LS & Larson A. International Edition ISBN 0–07–118077–X, The McGraw-Hill Companies, Inc.,
3. Modern Text Book of Zoology, Vertebrates. R. L. Kotpal, 3rd edn. Rastogi Publications, Meerut.
4. Chordate Zoology, 1982, P.S.Dhami and J.K.Dhami, R. Chand and Co., New Delhi.
5. Biology, Campbell nand Reece. 7th Edn. Pearson Education in South Asia, Delhi.
6. Young, J. Z. (2004). The Life of Vertebrates. III Edition. Oxford university press.
7. Pough H. Vertebrate life, VIII Edition, Pearson International.
8. Integrated Principles of Zoology, Eleventh Edition, Hickman C. P., Roberts L. S.& Larson A. International Edition ISBN 0–07–118077–X, The McGraw-Hill Companies, Inc.,
9. Arora M.P. Chordates I. Himalya Publications.
10. Organic Evolution. R.S. Lull. Light & Life Publishers.
11. Jordan E. L.&Verma P. S. 2003. Chordates Zoology. S. Chand & Company Ltd. New Delhi.
12. Biology, Campbell Nand Reece. 7th Edn. Pearson Education in South Asia, Delhi.

Applied Zoology I & II

1. Principal of Sericulture, 1994. HisaoArguo, Oxford & Co.
2. An Introduction of Sericulture, 1995. G.Ganga, J. Sulochana, Oxford & IBH Publication Co. Bambay.
3. FAQ Manual of Sericulture. Vol I - Mulberry Cultivation, Vol II - Silkworm Rearing. Central Silk Board, Bangalore.
4. Mane, P.C., Chaudhari R. D. et al. Highly sensitive label-free bio-interfacial colorimetric sensor based on silk fibroin-gold nanocomposite for facile detection of chlorpyrifos pesticide. Scientific Reports2020,10, 4198. https://doi.org/10.1038/s41598-020-61130-y
5. Entomology & Pest Management. Pedigo L. P. Prentice Hall, India 1996.
6. General & Applied Entomology, Nayar K. K. & T. N. Ananthkrishnan& B. V. Davis, Tata McGraw Hill Publication, New Delhi.
7. Insects. M. S. Mani, National Book Trust, India, 2006.
8. Insects & Mites of Crops in India. M. R. G. K. Nair – by ICAR, New Delhi.
9. The Science of Entomology. W. S. Romosor and J. G. Stoffolano, McGraw Hill Publication, 1988.

10. Agricultural Insect Pests of India and their Control, Dennis S. Hill, Cambridge University Press.
11. Applied Entomology. Vol. I & II. K. P. Srivastava. Kalyani Publication, Ludhiana, New Delhi.
12. Principles of Insect Pest Management. G. S. Dhaliwal and Ramesh Arora, Kalyani Publications, Ludhiana.
13. Pest Management and Pesticides: Indian Scenario. Editor- B. Vasantaraj David, Namrutha Publications, Madras (Chennai).
14. Concepts of Insect Control. Ghosh M. R. Wiley Eastern Ltd. New Delhi.
15. Destructive and useful Insects, their habit and Control, 1973. C.L. Metcalf and W. P. Flint, Tata McGraw Hill Publications, New Delhi.
16. A Text Book of Entomology, 1974. V. K. Mathur and K. D. Upadhayay, Goel Printing Press, Barani.
17. Imm's general Text Book of Entomology, Vol I & II, Richard and Davis Owen.
18. Biology of Insects, 1992. S. C. Saxena. Oxford and IBH Publishing Co., New Delhi, Bombay, Calcutta.
19. Bee and Bee Keeping, 1978, Roger A. Morse, Conell University Press, London.
20. The Behaviour& Social Life of Honey Bees, C. R. Ribbandas, Dover Publication inc. New York.
21. Fishes. Mary Chandy. National Book Trust India, 2005.
22. Economic Zoology, Shukla Upadhyay, Rastogi Publication, Meerut, India, 1998.
23. Fisheries Developments, K. K. Trivedi, Oxford and IBH Pub. Co.
24. Marine Fishes in India, 1990, D.V. Bal & K. Virabhdra, Tata McGraw Hill Publication.
25. Fishery Management, 1990, S. C. Agarwal, Avinash Publication House, New Delhi.

Note – Use latest editions of the books.

University of Pune

S. Y. B. Sc. [Botany]

Class – S.Y. B .Sc. (To be implemented From June 2014)		
Paper	**Semester - I**	**Semester – II**
I	Taxonomy of Angiosperms and Plant community	Plant Anatomy and Embryology
II	Plant Physiology	Plant Biotechnology
III	Practicals based on Theory courses (Paper I and II)	

Equivalence of previous syllabus at S.Y.B.Sc. Botany

Paper	**2008 Pattern (Implemented from 2009)**	**2013 Pattern (To be implemented from 2014)**
Paper I Semester I	BO-211: Fundamentals of Plant Systematics and Plant Ecology	BO-211: Taxonomy of Angiosperms and Plant community
Paper II Semester I	BO-212:Fundamentals of Plant Physiology	BO-212:Plant Physiology
Paper I Semester I	BO-221: Structural Botany(Anatomy, Embryology and Palynology)	BO-221: Plant Anatomy and Embryology
Paper II Semester I	BO-222: Fundamentals of Plant Biotechnology	BO-222: Plant Biotechnology
Practical Course	Practical based on theory courses (Paper I and Paper II)	Practical based on theory courses (Paper I and Paper II)

S.Y.B.Sc. Botany

(Semester I, Paper I)

Taxonomy of Angiosperms and Plant Community (48 Lectures)

1. Introduction to Plant Taxonomy **3L**

1.1 Definition, scope, objectives and importance

1.2 Identification, classification, nomenclature

1.3 Concept of Systematics

2. Systems of classification **6L**

2.1 Types of systems with their merits and limitations- a)Artificial system- Carl Linnaeus , b)Natural system -Bentham and Hooker, c) Phylogenetic system- Engler and Prantl

3. Taxonomic literature **2L**

Flora, monograph, revisions, manuals, journals, periodicals and references books.

4. Sources of data for Systematics **6L**

4.1 Morphology

4.2 Anatomy

4.3 Cytology

4.4 Embryology

4.5 Phytochemistry

4.6 Molecular biology

5. Botanical Nomenclature **6L**

5.1 History

5.2 Binomial nomenclature

5.3 ICBN- principles

5.4 Rules of nomenclature

5.5 Coining of generic names and specific epithets.

5.6 Ranks and endings of taxa names

5.7 Principle of priority

5.8 Effective and valid publications

5.9 Single and double authority citation

5.10 *Nomina conservanda*

6. Study of Plant Families **11L**

Study of following families with reference to systematic position, salient features, floral formula, floral diagram and any five examples with their economic importance – Annonaceae, Meliaceae, Myrtaceae, Rubiaceae, Solanaceae, Asclepiadaceae, Euphorbiaceae and Amaryllidaceae

7. Computer in taxonomy **4L**

7.1 Concept of herbarium their advantages and limitations

7.2 Digital /e-herbarium and their advantages

7.3 Data bases: concept and needs.

7.4 Use of computer in plant classification

8. Introduction to ecology **5L**

8.1 Definition

8.2 Concept

8.3 Autecology and synecology

8.4 Ecosystem and its components: biotic and abiotic.

8.5 Food chain

8.6 Food web

8.7 Ecological pyramids

9. Ecological grouping of the plants **5L**

Ecological grouping of the plants with reference to their significance of adaptive external and internal features: a) Hydrophytes, b) Mesophytes c)Xerophytes d) Halophytes with examples.

References-

1. Chopra G.L.- Angiosperms
2. Cronquist, A. 1968. The Evolution and Classification of Flowering Plants. Thomas Nel and Sons Ltd. London.
3. Datta S.C.- A Hand Book of Systematic Botany
4. Davis P.H and V.H Heywood 1963. Principles of Angiosperm Taxonomy. Oliver and Boyd London.
5. Gurucharan Singh 2005- Systematics theory and practice (Oxford IBH)
6. Heywood V.H 1967. Plant Taxonomy, London.
7. Lawrence, G.H.M 1951. Taxonomy of Vascular Plants. N.Y.

8. Lawrence G.H.M 1955. An Introduction to Plant Taxonomy N.Y.
9. Naik V.N.- Taxonomy of Angiosperms.
10. Pande B.P 1997. Taxonomy of Angiosperms. S.Chand.
11. Priti Shukla and Shital Mishra- An introduction to Taxonomy of angiosperms
12. Rendle A.B. 1925. The Classification of flowering plants. 2 Vols. London.
13. Santapau H. 1953. The Flora of Khandala on the Western Ghats of India.
14. Singh V. and D.K Jain, 1981 Taxonomy of Angiosperms. Rastogi Publication, Meerut.
15. Sharma O.P, Plant taxonomy (Tata Mc grow Hill)
16. Stewart W.N. and Rathwell G.W. 1993. Paleobotany and the Evolution of plants. Cambridge University Press.
17. Swingle D.B. 1946. A Text book of Systematic Botany. Mc Graw Hill Book Co. New York.
18. Takhtajan A. 1969. Flowering Plants; Origin and Disposal.
19. Theodore Cooke(1903)- The flora of The Presidency of Bombay Vol. I, II, III
20. V.V.Shivrajan-Introduction to Principles plant taxonomy
21. Yadav S.R. and Sardesai M.R.- Flora of Kolhapur District.

S. Y. B. Sc. [Botany]

(Semester I, Paper II)

Plant Physiology (48 Lectures)

1. Introduction to Plant Physiology **2L**

Brief history,Scope and applications of plant physiology

2. Plant – water relations **8L**

2.1 Physico-chemical properties of water

2.2 Membrane structure, permeability and aquaporin

2.3 Diffusion – Definition, factors affecting diffusion, importance of diffusion in plants

2.4 Osmosis – Definition, types of solutions – hypotonic, hypertonic and isotonic, endosmosis and exosmosis, concept of osmotic pressure (OP), turgor pressure (TP), wall pressure (WP), Diffusion pressure deficit (DPD), relation between OP, TP and DPD, role of osmosis in plants.

2.5 Plasmolysis – Definition, mechanism, deplasmolysis, significance of plasmolysis

2.6 Imbibition – Concept, mechanism and significance

3. Absorption of water **3L**

3.1 Role of water in plants

3.2 Concept of water potential and capillary water

3.3 Mechanisms of water absorption

3.4 Factors affecting rate of water absorption

4. Ascent of sap **4L**

4.1 Introduction and definition.

4.2 Theories of ascent of sap

4.3 Vital theories: Jamin – Chame theory and Bose theory

4.3.1 Physical force theories: a) Capillary theory, b) Imbibitional theory, c) Atmospheric pressure theory,

4.3.2 Transpiration pull or cohesion-tension theory, evidences and objections

4.4 Factors affecting ascent of sap

5. Transpiration **6L**

5.1 Definition

5.2 Types of transpiration – cuticular, lenticular and stomatal

5.3 Structure of stomata

5.4 Mechanism of opening and closing of stomata –Steward's hypothesis, active K^+ transport mechanism

5.5 Factors affecting the rate of transpiration

5.6 Significance of transpiration

5.7 Antitranspirants

5.8 Guttation

5.9 Exudation

6. Plant growth and plant growth regulators 6L

6.1 Introduction

6.2 Phases of growth

6.3 Measurement of growth- Arc auxanometer, Bose crescograph, fresh and dry weight method

6.4 Factors affecting growth

6.5 Plant Growth Regulators- Introduction and definition

6.6 Properties and practical applications of auxins, cytokinins, gibberellins, ethylene and abscisic acid

7. Nitrogen metabolism 8L

7.1 Introduction

7.2 Biological nitrogen fixation

7.2.1 Symbiotic nitrogen fixation, nitrogenase enzyme- structure and function

7.2.2 Non-symbiotic nitrogen fixation

7.3 Denitrification, ammonification and nitrification

7.4 Reductive amination and transamination

7.5 Role of nitrogen in plants

8. Seed dormancy and germination 4L

8.1 Definition and types of seed dormancy

8.2 Methods to break seed dormancy

8.3 Metabolic changes during seed germination

9. Physiology of flowering 7L

9.1 Photoperiodism – Concept, definition, short day plants, long day plants and day neutral plants, photoperiodic induction, phytochrome and flowering

9.2 Phytohormones and initiation of flowering

9.3 Applications of photoperiodism

9.4 Vernalisation – concept and definition, mechanism of vernalisation, applications of vernalisation, devernalization

References:

1. Bidwell, R.G.S. 1974. Plant Physiology. Macmillan Pub. Co., N.Y.
2. Devlin, R.M. And F.H. Witham. 1983. Plant Physiology. Willard Grant Press. U.S.A.
3. Hans-Walter Heldt. 1997. Plant Biochemistry And Molecular Biology. Oxford University Press, New York. Usa.
4. Moore, T.C. 1979. Biochemistry And Physiology Of Plant Hormones. Springer-Verlag. Berlin.
5. Raman, K. 1997. Transport Phenomena In Plants. Narosa Publishing House. New Delhi.
6. Jain, V.K. (2000): Fundamentals Of Plant Physiology,S.Chand&Co, New Delhi.
7. Pandey, S.N. (1991): Plant Physiology, Vikas Publishing House (P) Ltd., New Delhi, India.
8. Verma, V. (2007): Text Book Of Plant Physiology, Ane Books India, New Delhi.
9. Nobel, P.S. 2009. Physicochemical and Environmental Plant Physiology.4th edition Academic Press, UK
10. Taiz, L. and Zeiger, E. 2006. Plant Physiology. 4th Edition. Sinnauers Associates, Saunders land, Massachusetts, USA
11. Salisbury F.B. and Ross C.B. 2005. Plant Physiology. 5th Edition. Wadsworth Publishing Co. Belmont CA.
12. Helgi OPik, Stephen A. Rolfe, Arthur J. Willis. 2005. The Physiology of Flowering Plants, Cambridge University Press, UK
13. Kirkham, M.B. 2004. Principles of Soil and Plant Water Relations. Elsevier, Amsterdam, Netherlands.
14. Dennis, D.T., Turpin, D.H., Lefebvre, D.D. and Layzell, D.B. 1997. Plant Metabolism. 2nd Edition. Longman Group, U.K.
15. Fitter, A. and Hay, R.K.M. 2001. Environmental Physiology of Plants. Academic Press, UK.
16. Press, M.C., Barker, M.G., and Scholes, J.D. 2000. Physiological Plant Ecology, British Ecological Society Symposium, Volume 39, Blackwell Science, UK.

S. Y. B. Sc. [Botany]

(Semester II, Paper I)

Plant Anatomy and Embryology (48 Lectures)

Plant anatomy:

1. Introduction **2L**

Definition, scope of plant anatomy and types of tissues

2. Epidermal tissue system **4L**

Structure and function of epidermal tissue system, uniseriate and multiseriate epidermis, stomata: structure, types and functions, epidermal outgrowth: glandular and non-glandular

3. Mechanical tissue system **4L**

Principles involved in distribution of mechanical tissues – inflexibility, incompressibility, inextensibility and shearing stress, tissues providing mechanical support, their distribution in leaf, stem and root of dicots and monocots.

4. Vascular tissue system **4L**

Structure and function of xylem, phloem and cambium

5. Normal secondary growth **5L**

Introduction, cambium and its role, process in stems of *Helianthus annus* and *Annona sqamosa*, extrastelar and intrastelar secondary growth**,** annual rings, periderm, bark, tylosis and lenticel

6. Anomalous secondary growth **5L**

Introduction, causes, anomalous secondary growth in dicot stem (*Bignonia*) dicot root (*Raphanus*) and monocot stem (*Dracaena*).

Plant Embryology

7. Introduction **1L**

Definition and scope of plant embryology

8. Microsporangium and male gametophyte **5L**

a. Microsporangium**:** structure of tetrasporangiate anther, types of tapetum, sporogenous tissue.
b. Microsporogenesis: process and its types, types of microspore tetrad.
c. Male gametophyte: structure and development of male gametophyte.

10. Megasporangium and female gametophyte: 7L

a. Megasporangium: structure, types of ovules – anatropous, orthotropous, amphitropous, campylotropous, circinotropous.
b. Megasporogenesis: tenuinucellate and crassinucellate ovules, types of megaspore tetrads.
c. Female gametophyte: structure of typical embryo sac, types of embryo sacs with examples – monosporic, bisporic and tetrasporic.

11. Fertilization: 5L

Mechanism of pollination- entomophily, anemophily, hydrophily, zoophily, germination of pollen grain, double fertilization (syngamy and triple fusion) and its significance.

12. Endosperm and embryo 6L

a. Endosperm: Types – nuclear, helobial and cellular.
b. Embryogeny**:** structure of dicot and monocot embryo and seed formation.

References

1. Plant Anatomy, Chandurkar P J, Plant Anatomy Oxford and IBH publication Co. New Delhi 1971
2. B P Pandey, Plant Anatomy,S Chand and Co. Ltd, New Delhi 1978
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4. Eams and Mc Daniel,An Introduction to Plant Anatomy, McGraw –Hill Book Co. Ltd and Kogakusha Co, Tokyo, Japan
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9. Bhojwani S S and Bhatnagar S P, An Embryology of Angiosperms
10. Maheshwari P, An introduction to Embryology of Angiosperm
11. Nair P K K Essentials of Palynology.

S. Y. B. Sc. [Botany]

(Semester II, Paper II)

Plant Biotechnology (48 Lectures)

1. **Introduction** **2L**

1.1 Biotechnology- Definition, concept and scope

1.2 Interdisciplinary nature of biotechnology

2 . **Enzyme Technology** **7L**

2.1 Introduction, definition and properties of enzymes.

2.2 Classification of enzymes

2.3 Industrial applications of enzymes.

2.4 Production of amylase, proteases and lipase enzyme

2.5 Enzymes immobilization - concept and techniques of immobilization

3. **Fermentation Technology**. **7L**

3.1 Introduction.

3.2 Liquid and solid state fermentations

3.3 Principles of microbial growth

3.4 Bioreactors used in fermentations- stirred tank and tubular tower and digestive tank fermenters

3.5 Media composition for liquid and solid state fermentations

3.6 Industrial applications of fermentation

3.7 Downstream processing- citric acid production.

4. **Single cell protein** **5L**

4.1 Introduction

4.2 Need of proteins in diet

4.4 Production of SCP from algae (*Spirulina*) and fungi (Yeast)

4.5 The economic implications of SCP

4.6 Acceptability of SCP

5. **Environmental Biotechnology** **6L**

5.1 Introduction

5.2 Phytoremediation- definition and concept

5.3 Methods of phytoremediation- Rhizofilteration, phytoextraction, phytostabilization, phytovolatization, phytodegradation,

5.4 Environmental sustainability

6 . **Basics of plant genetic engineering** **7L**

6.1 Introduction and structure of DNA

6.2 Structure of gene in prokaryots and eukaryots- Promoter, coding region and terminator

6.3 General method of gene isolation from the plants-DNA isolation, restriction enzymes, restriction digestion of DNA, DNA electrophoresis, southern hybridization, lygation of DNA fragments

6.4 Gene cloning- vectors used for gene cloning

7**. Methods of gene transfer in plants** **8**L

7.1 Direct gene transfer methods- Electroporation, biolystic gene transfer, liposome mediated transfer.

7.2 Vector mediated gene transfer- *Agrobacterium* mediated gene transfer in plants, Ti-plasmid: structure and functions, Ti plasmid based vectors, advantages.

8**. Application of plant genetic engineering in crop improvement.** **4L**

8.1 Introduction

8.2 Insect pest resistance, abiotic stress tolerance, herbicide resistance, storage protein quality

9. **Nano-biotechnology** **2L**

9.1 Definition and concept

9.2 Applications of nanotechnology in agriculture (fertilizers and pesticides).

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S. Y. B. Sc. [Botany] Paper III

Practicals Based on Theory Paper I and II

a) Taxonomy of Angiosperms and Plant Community

1. Description of flowering plant in botanical terms (01 P)
2. Study of plant families (any four) (03 P)
3. Study of ecological adaptations in Hydrophytes with any two examples (01P)
4. Study of ecological adaptations in Xerophytes with any two examples (01P)
5. Study of vegetation by list count quadrat method. (01P)
6. Study of tools of taxonomy and ecological instruments (any four each) (01P)

b) Plant Physiology

1. Determine water holding capacity (WHC) and pH of soil (pH by pH meter.) (01 P)
2. Study of plasmolysis in suitable plant material (01 P)
3. Determination of Diffusion Pressure Deficit (DPD). (01 P)
4. Determine rate of transpiration under different conditions of (01 P)
   Sunlight, Shade and wind
5. Demonstration Experiments. (Compulsory Practical) (01 P)
   a. Curling Experiment
   b. Imbibition in seeds
   c. Arc Auxanometer
   d. Effect of auxins on rooting
   e. Transpiration pull
   f. Spectrophotometer
   g. Portable leaf area meter
   h. Conductivity meter
   i. Centrifuge
6. Assessing seed viability by TTC method (01 P)

c) Plant Anatomy and Embryology

1. Study of epidermal tissue system – non-glandular and glandular trichomes, multilayered epidermis, typical stomata (dicot and monocot). (01 P)
2. Study of mechanical tissues and their distribution in root, stem and leaves. (01 P)
3. Study of normal secondary growth in dicot stem – *Annona* /*Moringa*. (01 P)
   (Double stained temporary preparation).

4. Study of anomalous secondary growth in *Bignonia* and *Dracaena* stem. (01 P)
   (Double stained temporary preparation).
5. Study of tetrasporangiate anther and types of ovules. (01 P)
6. Study of dicot and monocot embryo. (01 P)

b) Plant Biotechnology

1. Production of citric acid by *Aspergillus niger* and estimation of citric acid by titration method. (02 P)
2. Production of single cell protein production i.e. *Spirulina* / yeast and study of commercial products (01 P)
3. Demonstration of fermentation and fermentation products (01 P)
4. Demonstration of separation of plasmid DNA by agarose gel electrophoresis (01 P)
5. Demonstration of enzyme immobilization (01 P)

N.B. Botanical excursion tour and submission of at least five correctly identified wild plant photographs is compulsory.

UNIVERSITY OF PUNE
BOARD OF STUDIES IN ZOOLOGY

Revised Syllabus for S. Y. B. Sc. (Zoology) To be implemented from June, 2014

S.Y. B. Sc. (Zoology) New Syllabus

Semester-I

Paper I- ZY-211: Animal Systematics and Diversity – III

Paper II- ZY-212: Applied Zoology – I

Semester-II

Paper I- ZY-221: Animal Systematics and Diversity – IV

Paper II- ZY-222: Applied Zoology – II

Semester-I and II (Annual Examination)

Paper III- ZY-223: Practical course (Corresponding to Theory papers)

UNIVERSITY OF PUNE
BOARD OF STUDIES IN ZOOLOGY
COURSE STRUCTURE OF UNDERGRADUATE CLASSES

Class: F.Y. B. Sc. (To be implemented from June 2013)

Paper	Course No.	Term I	Term II
I	ZY 101	Animal Systematics and Diversity -I	Animal Systematics and Diversity –II
II	ZY 102	Fundamentals of Cell Biology	Genetics
III	ZY 103	Practical course	

Class: S.Y. B. Sc. (To be implemented from June 2014)

Paper	Course No.	Semester I	Course No.	Semester II
I	ZY.211	Animal Systematics and Diversity -III	ZY. 221	Animal Systematics and Diversity –IV
II	ZY.212	Applied Zoology I	ZY.222	Applied Zoology II
III	ZY.223	Practical course		

Class: T.Y. B. Sc. (To be implemented from June 2015)

Paper	Course	Semester III	Course	Semester IV
I	ZY.331	Animal Systematics and Diversity V	ZY.341	Biological Techniques
II	ZY.332	Mammalian Histology	ZY.342	Mammalian Physiology and Endocrinology
III	ZY.333	Biological Chemistry	ZY.343	Genetics and Molecular Biology
IV	ZY.334	Environmental Biology and Toxicology	ZY.344	Organic Evolution
V	ZY.335	Parasitology	ZY.345	General Embryology
VI	ZY.336	General Pathology or Cell Biology	ZY.346	Public Health and Hygiene or Medical Entomology
VII	ZY.347	Practicals corresponding to ZY 331, ZY 332, ZY 341 & ZY 342		
VIII	ZY.348	Practicals corresponding to ZY 333, ZY 334, ZY 343 & ZY 344		
IX	ZY.349	Practicals corresponding to ZY 335, ZY 336, ZY 345 & ZY 346		

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University of Pune

University of Pune

Draft of Syllabus to be implemented from June 2014

S. Y. B. Sc. Zoology

Semester-I

Paper I- ZY-211: Animal Systematics and Diversity – III

Paper II- ZY-212: Applied Zoology – I

Semester-II

Paper I- ZY-221: Animal Systematics and Diversity – IV

Paper II- ZY-222: Applied Zoology – II

Semester-I and II (Annual Examination)

Paper III- ZY-223: Practical course (Corresponding to Theory papers)

Equivalence of Previous Syllabus:

Semester	Old Course (2009 Pattern)	New Course (2014 Pattern)
Semester-I	Paper I: General Zoology and Biological Techniques-I	Paper I: Animal Systematics and Diversity –III
Semester-I	Paper II: Applied Zoology-I	Paper II: Applied Zoology-I
Semester-II	Paper I: General Zoology and Biological Techniques-II	Paper I: Animal Systematics and Diversity –IV
Semester-II	Paper II: Applied Zoology-II	Paper II: Applied Zoology-II
Annual Examination	Paper III: Practical course	Paper III: Practical course

PAPER I: FIRST SEMESTER

ZY-211: ANIMAL SYSTEMATICS AND DIVERSITY -III

1. **Salient features and classification upto classes of the following: (any two examples from each class) :** **15**

   1.1 Arthropoda :- Crustacea, Arachnida, Insecta, Myriapoda, Onychophora.

   1.2 Mollusca:- Aplacophora, Gastropoda, Pelecypoda, Scaphopoda, Cephalopoda.

   1.3 Echinodermata:- Asteroidea, Ophuroidea, Holothuria, Echinoidea, Crinoidea.

2. **Study of following with reference to:** **15**

   2.1 Arthropoda:- Mouthparts in Insects, Metamorphosis in Insects, Mimicry in Insects,

   Economic importance of Insects, Larval forms in Crustacea

   2.2 Mollusca:- Economic importance of mollusc, Shell and foot modification in mollusc,

   Torsion and Detorsion in mollusc, Larval forms in molluscs

   2.3 Echinodermata:- Origin of Echinodermata, Types of Pedicellariae, Larval forms in Echinodermata,

3. **Study of Starfish :** **18**

   4.1 Systematic position, Habit and habitat

   4.2 External characters

   4.3 Digestive system

   4.4 Water vascular system

   4.5 Reproductive system

   4.6 Autotomy and regeneration

PAPER –I: SECOND SEMESTER

ZY-221: ANIMAL SYSTEMATICS AND DIVERSITY – IV

1. Salient features of following classes and its subclasses with two examples of each: **12**

- **1.1** Reptilia
- **1.2** Aves
- **1.3** Mammalia

2. General topics: **16**

- **2.1** Poisonous and non-poisonous snakes (Two examples each)
- **2.2** Desert adaptations in reptiles in brief.
- **2.3** Beak and feet modifications in birds
- **2.4** Migration in birds
- **2.5** Aerial adaptations in birds
- **2.6** Egg laying mammals
- **2.7** Aquatic mammals

3. Study of *Scoliodon* : **20**

- **3.1** Systematic position, Habit and habitat
- **3.2** External characters
- **3.3** Digestive system, food, feeding and physiology of digestion
- **3.4** Respiratory system
- **3.5** Blood vascular system
- **3.6** Nervous system and sense organs
- **3.7** Male urinogenital system and female reproductive system

PAPER II: FIRST SEMESTER

ZY-212: APPLIED ZOOLOGY – I

1. Fisheries :

1.1 An introduction to fisheries and its types (in brief) : Freshwater fisheries, Marine fisheries, Brackish water fisheries. **2**

1.2 Different types of ponds used in fishery : Nursery pond, Rearing pond Stock pond **2**

1.3 Habit, habitat and culture methods of following freshwater forms : **10**

- **a)** Rohu (*Labeo rohita*)
- **b)** Catla (*Catla catla*)
- **c)** Mrigal (*Cirrhinus mrigala*)
- **d)** Giant prawn (*Macrobrachium rosenbergi*)

1.4 Harvesting methods of following marine forms : **4**

- ***a)*** *Harpadon*
- **b)** Mackerel
- **c)** Lobster
- **d)** Pearl oyster

1.5 Crafts and gears in Indian Fishery : **2**

a) Crafts – Catamaran, Machwa, Dinghy, Dug out canoe, Built –up boat
Gears – Gill net, Dol net, Purse net, Rampani net, Cast net

1.6 Fishery byproducts : **2**

- **a)** Fish meal
- **b)** Fish flour
- **c)** Liver oil
- **d)** Ising glass
- **e)** Fish glue
- **f)** Fish manure
- **g)** Fish fin soup

1.7 Fish preservation technique : **2**

- **a)** Chilling
- **b)** Freezing
- **c)** Salting
- **d)** Drying
- **e)** Canning

2. Agricultural Pests and their control :

2.1 An introduction to Pest, types of pests (agricultural, household, stored grain, structural, veterinary, forestry and nursery) **2**

2.2 Major insect pests of agricultural importance (Marks of identification, life cycle, nature of damage and control measures) **9**

- **a)** Jowar stem borer
- **b)** Red cotton bug
- **c)** Brinjal fruit borer
- **d)** Mango stem borer
- **e)** Pulse beetle
- **f)** Rice weevil

2.3 Non insect pest : Rats and Bandicoots, Crabs, Snails, Slugs, Birds and Squirrels **2**

2.4 Pest control practices in brief : Cultural control, Physical control, Mechanical control, Chemical control, Biological control, Pheromonal control and Concept of IPM in brief **6**

2.5 Plant protection appliances : Rotary duster, Knapsack sprayer, Cynogas Pump. **3**

2.6 Hazards of pesticides on human and antidotes. **2**

PAPER II: SECOND SEMESTER

ZY-222: APPLIED ZOOLOGY – II

1. **Apiculture :**

1.1 An introduction to Apiculture, Study of habit, habitat and nesting behavior of *Apis dorsata*, *Apis indica*, *Apis florae* and *Apis mellifera*. **3**

1.2 Life cycle, Colony organization and division of labour, Polymorphism **3**

1.3 Bee behaviour and bee communication. **3**

1.4 Bee keeping equipments : **a)** Bee box (Langstroth type) **b)** Honey extractor **c)** Smoker **d)** Bee-veil **e)** Gloves **f)** Hive tool **g)** Bee Brush **h)** Queen excluder **3**

1.5 Bee keeping and seasonal management. **2**

1.6 Bee products (collection methods, composition and uses: **a)** Honey **b)** Wax **c)** Bee Venom **d)** Propolis **e)** Royal jelly **f)** Pollen grains **4**

1.7 Diseases and enemies of Bees:

a) Bee diseases – Protozoan, Bacterial, Viral, Fungal – with two examples.

b) Bee pests – Wax moth (Greater and Lesser), Wax beetle.

c) Bee Enemies – Bee eater, King crow, Wasp, Lizard, Bear, Man. **5**

1.8 Bee pollination **1**

2. **Sericulture :**

2.1 An introduction to sericulture, Study of different types of silk moths, their distribution and varieties of silk produced by Mulberry, Tassar, Eri and Muga silk worms in India. **4**

2.2 External morphology and life cycle of *Bombyx mori*. **3**

2.3 Cultivation of mulberry (moriculture): **a)** Varieties for cultivation, **b)** Rainfed and irrigated mulberry cultivation – Fertilize schedule, Prunning methods and leaf yield. **4**

2.4 Harvesting of mulberry: **a)** Leaf plucking **b)** Branch cutting **c)** Whole shoot cutting. **2**

2.5 Silk worm rearing: **a)** Types of rearing **b)** Rearing house **c)** Rearing techniques **d)** Important diseases and pests. **7**

2.6 Post harvest processing of cocoons:

a) Harvesting and Preparation of cocoons for marketing

b) Stiffling, Sorting, Storage, Deflossing and Riddling

c) Cocoon cooking, Reeling Equipment and Rereeling, Washing and Polishing. **4**

PAPER III: FIRST AND SECOND SEMESTER

ZY-223: PRACTICAL COURSE

Practical 1.	Study and classification with reasons of the following animals Phylum Arthropoda:- Scorpion, Crab, Cockroach, Head louse, Centipede, Peripatus	(D)
Practical 2.	Study and classification with reasons of the following animals Phylum Mollusca:- Chiton, Snail, Bivalve, Dentalium, Octopus,	(D)
Practical 3.	Study and classification with reasons of the following animals Phylum Echinodermata:- Star fish, Brittle star, Holothuria, Sea Urchin, Echinus	(D)
Practical 4.	Study of permanent slides of mouthparts of the following insects : Cockroach, Mosquito, Plant bug/Bed bug, Butterfly, Honey Bee and Housefly	(D)
Practical 5.	A) Study of Shell:- Chiton, Pila, Sepia, Pecten, Dentalium, B) Study of Foot:- Chiton,Patella, Aplysia, Sepia, Octopus, Dentalium	(D)
Practical 6.	To Study the external characters and digestive system of *starfish*.	(E)
Practical 7.	A) Study of water vascular system of *starfish*. B) Temporary preparation of gonads from *starfish.*	(E) (E)
Practical 8.	A) Study of permanent slides of T. S. of arm and types of pedicellariae of *starfish*. B) Larval forms in Echinodermata.	(D) (D)
Practical 9.	Identification, Classification and study of habit, habitat and economic importance of the following: a) Rohu, Catla, Mrigal, Pomphret. b) Prawn, Crab, Oyster.	 (D) (D)
Practical 10.	Study and maintenance of Aquarium.	(E)
Practical 11.	Study of any three types of crafts and gears in fishing.	(D)
Practical 12.	Study of insect pests with respect to marks of identification, nature of damage and economic importance (Examples related to theory course)	(D)
Practical 13.	Study of pest control appliances (Sprayer/Duster)	(D)
Practical 14.	Study and classification with reasons of the following animals Class Reptilia – Cobra, Garden lizard, Turtle, Rat snake, Draco	(D)

Practical 15.	Study and classification with reasons of the following animals Class Aves – Sparrow, Crow, Parrot, Woodpecker Class Mammals – Rabbit, Mungoose, Kangaroo	(D)
Practical 16.	Identification of Poisonous and non- poisonous snakes with the help of identification key with two examples of each	(D)
Practical 17.	Study of modifications of beaks and feet in birds (Museum specimen) a) Beaks: tearing and piercing, fruit eating, mud probing, fish catching, wood chiseling and flower probing. b) Feet: perching, raptorial, climbing, swimming, running.	(D)
Practical 18.	Study of external characters and digestive system of *Scoliodon*.	(E)
Practical 19.	Study of brain of *Scoliodon*	(E)
Practical 20.	a) Temporary preparation of placoid scales from *Scoliodon* b) Study of cranial nerves, eye ball muscles of *Scoliodon* c) Study of Membranous labyrinth of *Scoliodon*	(E) (D) (D)
Practical 21.	a) Study of life cycle of Honey bee b) Study of mouth parts, thoracic appendages (legs and wings) and sting apparatus of Honey bee	(D) (E)
Practical 22.	Study of various bee keeping equipments	(D)
Practical 23.	Study of: a) bee products, b) bee pests, d) bee enemies	(D)
Practical 24.	a) Study of life cycle of *Bombyx mori*. b) Study of any five equipments in Sericulture.	(D) (D)
Practical 25.	Compulsory submission of field visit report along with at least five Photographs/ sketches of insect pest/fishes/any animal corresponding to theory courses	
Practical 26.	Compulsory study tour/visit to sea coast/fishery institute/sericulture farm/ apiculture institute / agricultural farm.	

Practical Skeleton Paper

Class – S.Y.B.Sc. **Subject – Zoology**

Time – 10.00 am onwards **Max. Marks – 80**

Q.1 – Dissect Starfish/*Scoliodon* so as to expose its.……system. (16)

Q.2 – Make a stained temporary preparation of ……

from Honey bee/Starfish/*Scoliodon* (10)

Q.3 – Identification (Non-chordates and Chordates) (21)

a) Identify and classify giving reasons (Arthropoda)

b) Identify and classify giving reasons (Mollusca/Echinodermata)

c) Identify and classify giving reasons (Cyclostomata/Reptiles)

d) Identify and classify giving reasons (Aves/Mammals)

e) Identify and describe the types of mouthparts of insect

f) Identify and describe (Shell/Foot of mollusca/Poisonous/Non poisonous snake)

g) Identify and comment on its modifications (Beak/feet modifications in birds)

Q.4 – Identification (Applied Zoology) (18)

a) Identify and give its economic importance (Any fish)

b) Identify and describe (Any gear/craft)

c) Identify and give its application (Plant protection appliance)

d) Identify and describe (One stage of life cycle of honeybee/silkworm)

e) Identify and describe (Sericulture equipment)

f) Identify and describe (Bee keeping equipment/Bee product)

Q.5 – a) Tour report and Certified Journal (05)

b) Viva- voce (05)

Q.6- Submission of field visit report along with five photographs/sketches of insect pest/fishes/any animal (05)

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ZY-211 Animal Systematics and Diversity - III

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2. Life of Invertibrates, 1980, S. N. Prasad, Vikas Publishing Co. Sahldabad.
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5. Text Books of Zoology, Invertibrates Vol- II, 1992, T.J.Parker and W.A. Haswel, Edited by Marshall and Williams, CBS publications and distribution, New Dehli.
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10. Diversity of Organisms. Edited by Caroline M., Pond Biology- Form and Function. Published by Hodder and Stoughton, The Open University, London.
11. An Introduction to Mollusca. H. S. Bhamrah, Kavita Juneja. Anmol Publications Pvt. Ltd. New Dehli- 110002 (India).
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ZY- 212 Applied Zoology Part- I

Fisheries & Agricultural pests and their Control

1. Fishes . Mary Chandy. N.B.T. India, 2005.
2. Economic Zoology, Shukla Upadhyay, Rastogi Publication, Meerut, India, 1998.
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8. Insects. M.S. Mani, NBT, India, 2006.
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12. Agricultural Insect Pests of India and their Control, Dennis S.Hill, Cambridge University Press.
13. Applied Entomology. Vol. I & II. K.P. Srivastava. Kalyani Publication, Ludhiyana, New Dehli.
14. Principles of Insect Pest Management. G.S. Dhaliwal and Ramesh Arora, Kalyani Publications, Ludhiyana.
15. Pest Management and Pesticides: Indian Scenario. Editor- B. Vasantaraj David, Namrutha Publications, Madras (Chennai).
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ZY- 221 Animal Systematics and Diversity - IV

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5. Chordate Zoology, E.L. Jordon. S. Chand & Co., New Dehli.
6. Organic Evolution. R.S. Lull. Light & Life Publishers.
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ZY-222 Applied Zoology Part-II

Apiculture and Sericulture

1. Destructive and useful Insects, their habit and Control, 1973. C.L. Metcalf and W. p. Flint, Tata McGraw Hill Publications, New Dehli.
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