## Note: This document contains the course contents of all the subject of these four combinations only

1. Maths A, Electronics, Computer Science
2. Maths A, Statistics, Computer Science
3. Botany, Zoology, Chemistry
4. Geography, Zoology, Chemistry

Subjects with Codes in all these 4 Combinations are

1. Botany **BOT-111, BOT-113, BOT-103, BOT-106**
2. Chemistry **INOC-101, ORGC-101, PHYC-101, BIOC-108, ANLC-101, CHEM-106**
3. Computer Science **CS-101, CS-102, CS-104, CS-122, CS-109, CS-124**
4. Electronics **ELEC-102, ELEC-101, ELEC-103, ELEC-104, ELEC-109**
5. English **ENG-101, ENG-102**
6. Geography **GEOG-101, GEOG-102, GEOG-104, GEOG-105**
7. Islamiyat **ISL-101**
8. Mathematics-A **MATH-101, MATH-102, MATH-109, MATH-105**
9. Pakistan Study **PST-101**
10. Physics **PHY-102, PHY-103, PHY-104, PHY-105, PHY-106, PHY-107, PHY-108, PHY-110, PHY-111**
11. Statistics **STAT-102 STAT-110, STAT-103, STAT-104, STAT-105**
12. Zoology **ZOO-104, ZOO-105, ZOO-106, ZOO-107**

Course contents for all the above subjects

1. **Botany Courses**

## BOT- 111 DIVERSITY OF PLANTS

**Credit Hours:** Four 4(3+1)

**Objectives:** To introduce the students to the diversity of plants and their structures and significance.

**Course outlines**

1. Comparative study of life form, structure, reproduction and economic significance of:
	1. Viruses (RNA and DNA types) with special reference to TMV.
	2. Bacteria and Cyanobacteria (Nostoc, Anabaena, Oscillatoria) with specific reference to biofertilizers, pathogenicity and industrial importance.
	3. Algae (Chlamydomonas, Spirogyra, Chara, Vaucheria, Pinnularia, Ectocarpus, Polysiphonia).
	4. Fungi (Mucor, Penicillium, Phyllactinia, Ustilago, Puccinia, Agaricus), their implication on crop production and industrial applications.
	5. Lichens (Physcia)
	6. Bryophytes (Riccia, Anthoceros and Funaria)
	7. Pteridophytes (Fossils and fossilization, Psilopsida (Psilotum), Lycopsida (Selaginella), Sphenopsida (Equisetum), Pteropsida (Marsilea) and Seed Habit).
	8. Gymnosperms (Cycas, Pinus and Ephedra).

**Lab Outlines**

Culturing, maintenance, preservation and staining of microorganisms. Study of morphology and reproductive structures of the types mentioned in theory. Identification of various types mentioned from prepared slides and fresh collections.

**Recommended Books**

1. Agrios, G. N. 2004. Plant Pathology. 8 Ed. Academic press London.
2. Alexopoulos, C. J., Mims, C.W. and Blackwell, M. 1996. Introductory Mycology. 4 John Wiley and Sons Publishers.
3. Andrew, H. N. 1961. Studies in Paleobotany. John Willey and Sons.
4. Ingrouille, M. 1992. Diversity and Evolution of Land Plants. Chapman & Hall.
5. Lee, R. E. 1999. Phycology. Cambridge University Press, UK
6. Marti, J. 2006. Ingrouille & Plant: Diversity and Evolution. John Wiley and Sons Publishers.
7. Mauseth, J. D. 2003. Botany: An Introduction to Plant Biology 3rd ed., Jones and Bartlett Pub.UK.
8. Prescott, L. M., Harley, J. P. and Klein, A. D. 2004. Microbiology, 3 Publishers. Ed. WMC Brown
9. Taylor, T. N. & Taylor, E. D. 2000. Biology and Evolution of Fossil Plants. Prentice Hall. N.Y.
10. Vashishta, B. R. 1991. Botany for Degree Students (all volumes). S. Chand and Company. Ltd. New Delhi.

**Journals / Periodicals:** Pakistan Journal of Botany, American Journal of Botany, Canadian Journal of Botany, Annals of Botany

## BOT- 113 PLANT NOMENCLATURE AND ANATOMY

**Credit Hours:** Four 4(3+1)

**Objectives:** To understand various systems of classification, identification and nomenclature of higher plants and structures and functions of tissues and organs at embryonic level.

**Course outlines**

1. **Plant Nomenclature**
2. Introduction to Plant Systematics: aims, objectives and importance.
3. Taxonomic evidences (structural and biochemical characters).
4. Classification: brief history of various systems of classification with emphasis on Takhtajan. APG-III system of classification and recent trends in phylogeny of plants
5. Brief introduction to nomenclature, importance of Latin names and binomial system with an introduction to International Code of Botanical Nomenclature (ICBN).Vienna code and ICN.
6. Phytography/Morphology: a detailed account of various, morphological characters root, stem, leaf, inflorescence, flower, placentation and fruit types.
7. **Anatomy** (Cell wall: structure and chemical composition, Concept, structure and function of various tissues like: Parenchyma, Collenchyma, Sclerenchyma, Epidermis (including stomata and trichomes), Xylem and Phloem. Meristem: types, stem and root apices, Vascular cambium.
8. Structure and development of root, stem and leaf. Primary and secondary growth of dicot stem, periderm.
9. Characteristics of wood: diffuse porous and ring –porous, sap and heart wood, soft and hard wood, annual rings.

**Lab Outlines**

**Plant Nomenclature**

Study of type specimens at various herbaria, preparation of herbarium specimens, study of International Code of Nomenclature for Plants, algae and Fungi. Study of various kinds of root, stem, leaf, inflorescence, flower, placentation and fruit types. Visits to various herbaria in the country.

**Anatomy** (Study of stomata, epidermis, Tissues of primary body of plant, study of xylem 3- dimensional plane of wood, and T.S of angiosperm stem and leaf).

**Recommended Books**

1. Eames, A. J. and MacDaniels, L. H. 2002. An Introduction to Plant Anatomy. Tata-Mac Graw-Hill Publishing Company, Limited New Delhi.
2. Esau, K. 1960. Anatomy of Seed Plants. John Wiley, New York.
3. Fahn, A. 1990. Plant Anatomy. Pergamon Press, Oxford.
4. Lawrence, G. H. M. 1951. Taxonomy of Vascular Plants. MacMillan & Co. New York.
5. Mauseth, J. D. 1998. An Introduction to Plant Biology: Multimedia Enhanced. Jones and Bartlett Pub. UK
6. Moore, R. C., Clarke, W. D. and Vodopich, D.S. 1998. Botany. McGraw Hill Company, USA.
7. Naik, V.N. 2005 Taxonomy of Angiosperms. 20th Reprint. Tata-Mac Graw-Hill Publishing Company, Limited New Delhi.
8. Panday, B. P. 2004. A textbook of Botany (Angiosperms). S. Chand and Co. New Delhi.
9. Pullaiah, T. 2007. Taxonomy of Angiosperms. 3rd Edition Regency Publications, New Delhi.
10. Raven, P. H., Evert, R. E. and Eichhorn, S. E. 1999. Biology of Plants. W. H. Freeman and Company Worth Publishers.
11. Raymond E, Eichhorn, S. E. 2005. Esau’s Plant Anatomy. Meristems cells and tissues of the plant body, 3rd Ed. John Wiley & Sons. Inc.
12. Stuessy, T. F. 1990. Plant Taxonomy. Columbia University Press, USA.

**Journals / Periodicals:** Pakistan Journal of Botany, Taxon, Phyton.

## BOT- 103 CELL BIOLOGY

**Credit Hours:** Four 4(3+1)

**Objectives:** To understand the structure and functions of cell, cell membrane, cell organelles & nucleus. Familiarization with chromosomal aberrations and reproduction in somatic and embryonic cells.

**Course outline**

1. Structures and Functions of Bio-molecules (Carbohydrates, Lipids, Proteins and Nucleic Acids)
2. Cell: Physico-chemical nature of plasma membrane and cytoplasm.
3. Ultra structure of plant cell with a brief description and functions of (Cell wall, Endoplasmic reticulum, Plastids, Mitochondria, Ribosomes, Dictyosomes, Vacuole, Microbodies (Glyoxysomes and Peroxisomes)
4. Nucleus: Nuclear membrane, nucleolus, ultra structure and morphology of chromosomes, karyotype analysis
5. Reproduction in somatic and embryogenic cell, mitosis and meiosis, cell cycle
6. Chromosomal aberrations; Changes in the number of chromosomes. Aneuploidy and euploidy. Changes in the structure of chromosomes, deficiency, duplication, inversion and translocation.

**Lab Outlines**

1. Study of cell structure using compound microscope and elucidation of ultra structure from electron microphotographs.
2. Measurement of cell size.
3. Study of mitosis and meiosis by smear/squash method and from prepared slides.
4. Study of chromosome morphology and variation in chromosome number.
5. Extraction and estimation of carbohydrate, protein, RNA and DNA from plant sources.

**Books Recommended**

1. Carroll, S. B., Grenier, J. K. and Welnerbee, S. D. 2001. From DNA to Diversity - Molecular Genetics and the Evolution of Animal Design. Blackwell Science.
2. Dyonsager, V. R. 1986. Cytology and Genetics. Tata and McGraw Hill Publication Co. Ltd., New Delhi.
3. Hoelzel, A. R. 2001. Conservation Genetics. Kluwer Academic Publishers.
4. Ingrouille, M. J. and Eddie, B. 2006. Plant Diversity and Evolution. Cambridge University Press.

Lewin, R, 1997. Principles of Human Evolution. Blackwell Science.

1. Sinha, U. and Sinha, S. 1988. Cytogenesis Plant Breeding and Evolution, Vini Educational Books, New Delhi.
2. Strickberger, M. V. 1988. Genetics, MacMillan Press Ltd., London.
3. Strickberger, M. W. 2000 Evolution. Jones and Bartlet Publishers, Canada.
4. Verma, P. S. and V. K. Agarwal. 2009. Genetics. S. Chand and Co. Ltd., New Delhi.
5. Verma, P. S. and V. K. Agarwal. 2009. Cell Biology, Genetics, Molecular Biology, Evolution and Ecology. S. Chand and Co. Ltd., New Delhi.

## BOT- 106 ECOPHYSIOLOGY

**Credit Hours:** Four 4(3+1)

**Objectives:** To provide comprehensive knowledge to the students to assess the effects of various environmental factors on plant growth, development and functioning.

**Course outline**

1. Water molecules structure and bonding. Water relations (water potential, osmotic potential, pressure potential, matric potential). Absorption and translocation of water. Stomatal regulation. Study of different types of stomata.
2. Mineral nutrition: Soil as a source of minerals. Passive and active transport of nutrients. Essential mineral elements, role and deficiency symptoms of macronutrients.
3. Photoperiodism: Definition, historical background, Classification of plants based on photoperiodic response, Role of phytochromes, and hormones and metabolites in photoperiodism.
4. Dormancy: Definition and causes of seed and bud dormancy; methods of breaking seed dormancy. Physiological processes during seed germination.
5. Plant Movements: Classification. Types of Tropic movements, Nastic movements and Tactic movements.
6. Causes, effects and control of water logging and salinity with respect to Pakistan.
7. Soil erosion: types, causes and effects (wind and water)
8. Brief concept of pollution types and effects (air, sediments and water pollution).

**Lab Outlines**

1. Preparation of solutions of specific normality of acids/bases, salts, sugars, molal and molar solutions and their standardization.
2. Determination of uptake of water by swelling seeds when placed in sodium chloride solution of different concentrations.
3. Measurement of leaf water potential by the dye method.
4. Determination of the temperature at which beet root cells lose their permeability.
5. Determination of the effects of environmental factors on the rate of transpiration of a leafy shoot by means of a porometer/by cobalt chloride paper method.
6. Chemical tests for the following cell constituents: (Starch, Cellulose, Lignin and Proteins).
7. Extraction of chlorophyll from the leaves and separation of component pigments on a paper chromatogram. Study of absorption spectra using spectrophotometer.
8. Estimation of oxygen utilized by a respiring plant by Winkler's method.
9. Extraction of amylase from germinating wheat seeds and study of its effect on starch breakdown.
10. Measurement of carbon dioxide evolution during respiration of germinating seeds by the titration method.
11. Measurement of light and temperature.
12. Effect of light and temperature on seed germination.

**Books Recommended**

1. Hopkins, W. B. 1999. Introduction to Plant Physiology. 2nd Ed John Wiley and Sons New York
2. Hussain, F. 1989. Field and Laboratory Manual of Plan Ecology. National Academy of Higher Education, Islamabad.
3. Hussain, S. S. 1989. Pakistan Manual of Plant Ecology; National Book Foundation, Islamabad.
4. I. Ihsan. 1995. Plant Physiology, Biochemical Processes in Plants, UGC Press.
5. Larcher, W. 2003 Physiological Plant Ecology: Ecophysiology and Stress Physiology of Functions Groups– Springer Verl
6. Salisbury, F. B. and Ross C. B. 1992. Plant Physiology. 5th Edition. Wadsworth Publishing Co. Belmont CA.
7. Taiz, L. and Zeiger, E. 2006. Plant Physiology. 4th Ed. Sinauers Publ. Co. Inc. Calif
8. Witham and Devlin. 1986. Exercises in Plant Physiology, AWS Publishers, Boston.

**Journals / Periodicals:** Plant Physiology, Journal of Ecology

**2. Chemistry Courses**

**INOC-101 INORGANIC CHEMISTRY-I**

**Credit Hours: 4(3+1)**

**Course Objectives**

After completing this course, students will have sufficient knowledge about; the development of periodic law , properties of elements in a systematic way, principal of chemical bonding, concepts of acid and bases and the chemistry of p-block elements.

**Course Contents**

**Periodic Law and Periodicity**

Development of Periodic Table; classification of elements based on s, p, d and f orbitals, group trends, periodic properties i.e., atomic radii, ionic radii, ionization potential, electron affinities, electronegativities and redox potential in s, p, d and f block elements

**Principles of Chemical Bonding**

Types of chemical bonding; ionic bonding; the localized bond approach: valance bond (VB) theory, hybridization and resonance; the delocalized approach to bonding: molecular orbital theory as applied to diatomic and polyatomic molecules, three center bond, bonding theory of metals and intermetallic compounds; conductors, insulators and semiconductors; bonding in electron deficient compounds; hydrogen bonding.

**Acids and Bases**

Concepts of acids and bases including SHAB concept, relative strength of acids and bases, significance of pH, pKa, pKb and buffer solutions, theory of indicators, solubility, solubility product, common ion effect and their industrial applications.

**Chemistry of p-block Elements**

Chemistry and structure of p-block elements; main emphasis on the chemistry and structure of noble gases and their compounds, chemistry and structure of interhalogens, pseudohalogens and polyhalides. Prediction of shapes of molecules using VSEPR model and hybridization.

**PRACTICAL**

Laboratory Work Illustrating Topics Covered in the Lectures of CHEM-311.5

**Recommended Books**

1 Miessler, G. L.; Tarr, D.A., *Inorganic Chemistry*, Prentice-Hall International, New Jersey, USA, **1991**.

2 Day, M.C.; Selbin, J., *Theoretical Inorganic Chemistry*, 2nd ed., Van Nostrand Reinhold Company, New York, USA, **1969**.

3 Shriver, D. F.; Atkins, P. W.; Langford, C. H., *Inorganic Chemistry*, 2nd ed., Oxford University Press, **1994**.

**Supplementary Reading Material**

1 Huheey, J. E.; Keiter, E. A.; Keiter, R. L., *Inorganic Chemistry: Principles of Structure and Reactivity*, 4th ed.., Harper and Row, New York, **2001.**

2 Cotton, F. A.; Wilkinson, G. *Basic Inorganic Chemistry*, 3rd ed., Wiley, New York, **1995**.

3 Lee, J.D., *Concise Inorganic Chemistry*, Chapman and Hall, 5th ed., **1996**.

**ORGC-101 Organic Chemistry-I**

**Credit Hours: 3**

**Course Objectives**

The objectives of Organic Chemistry offered in this semester are to provide the beginning student with the necessary knowledge and experience to be able to:

1. Realize the importance of organic chemistry in our daily life and learn the evolutionary historical developments of organic chemistry.
2. Draw proper chemical structures and ways in which organic structures may be drawn.
3. Get familiarized with the systematic nomenclature of hydrocarbons beside compounds having heteroatomic functional groups.
4. Understand the basic concepts of chemical bonding, molecular structure, inductive and field effects, resonance theory, aromaticity and tautomerism besides the Lewis and Bronsted–Lowry theories of acids and bases.
5. Identify centers of reactivity in organic structures, including the names, structures and basic chemical properties of the most important functional groups.
6. Learn characteristic reactions of basic organic functional groups and use this knowledge to predict products of reactions and distinguish related compounds.

**Course Contents**

**Introduction to Organic Chemistry:**

Organic Chemistry- the chemistry of Carbon compounds; Nature of organic chemistry-a historical perspective.

**Basic Concepts in Organic Chemistry:**

Localized and delocalized chemical bonding; concept of hybridization leading to bond angles, bond lengths, bond energies and shapes of organic molecules; dipole moment; inductive and field effects, resonance; aromaticity; tautomerism; hyperconjugation; hydrogen bonding, acids and bases; factors affecting the strengths of acids and bases.

**Nomenclature of Organic Compounds:**

Classification of organic compounds; development of systematic nomenclature of organic compounds; IUPAC nomenclature of hydrocarbons and heteroatom functional groups.

**Functional Group Chemistry:**

A brief introduction to the chemistry of hydrocarbons, alkyl halides, alcohols, phenols, ethers, aldehydes, ketones, amines, carboxylic acids and their derivatives.

**Practical-I**

Laboratory Work Illustrating Topics Covered in the Lectures of CHEM-321.6

**Recommended Books**

(Latest available editions of the following books)

1. Clayden, J.; Greeves, N.; Warren, S.; Wothers, P., *Organic Chemistry*, Oxford University Press, New York.
2. Wade Jr., L. J., *Organic Chemistry*, Pearson Education, Delhi.
3. Younas, M., *A Text Book of Organic Chemistry*, Ilmi Kitab Khana, Lahore.
4. Morrison, R. T.; Boyd, R. N., *Organic Chemistry*, Prentice-Hall of India, New Delhi.
5. Panico, R.; Powell, W. H.; Richer, J. C., *A Guide to IUPAC Nomenclature of Organic Compounds*, Jain-Interscience Press, Delhi.

**Supplementary Reading Material**

1. Loudon, G. M., *Organic Chemistry*, Oxford University Press, New York. Sorrel, T. N., *Organic Chemistry*, Viva Books Private Ltd., New Delhi.
2. Finar, I. L., *Organic Chemistry*. Vol. 1, Pearson Education, Delhi.
3. Carey, F. A., *Organic Chemistry*, McGraw-Hill, New York.
4. Ahluwalia, V. K.; Goyal, M., *A Text Book of Organic Chemistry*, Narosa Publishing House, New Delhi.
5. March, J., *Advanced Organic Chemistry*, John Wiley & Sons, New York.
6. Bansal, R. K., *Organic Reaction Mechanisms*, Tata McGraw-hill Publishing Company Ltd., New Delhi.
7. Pine, S. H., *Organic Chemistry*, National Book Foundation, Islamabad.
8. Bailey Jr., P. S.; Bailey, C. A., *Organic Chemistry-A Brief Survey of Concepts ad Applications*, Prentice-Hall, New Jersey.
9. Morrison, R. T.; Boyd, R. N., *Organic Chemistry*, Prentice-Hall of India, New Delhi.
10. Carey, F. A.; Sundberg, R. J., *Advanced Organic Chemistry Part A: Structure and Mechanisms*, Kluwer Academic/Plenum Publishers, New York.
11. Sykes, P., *A Guide Book to Mechanism in Organic Chemistry*, Longman, London.
12. Hand, C. W.; Blewitt, H. L., *Acid-Base Chemistry*, Macmillan Publishing Company, New York.
13. McMurry, J., *Organic Chemistry*, Brooks/Cole Publishing Company, California.
14. Solomons, T. W. G.; Fryhle, C. B., *Organic Chemistry*, John Wiley & Sons, New York.
15. Panico, R.; Powell, W. H.; Richer, J. C., *A Guide to IUPAC Nomenclature of Organic Compounds*, Jain-Interscience Press, Delhi.
16. Streitwieser Jr., A.; Heathcock, C. H., *Introduction to Organic Chemistry*, Macmillan Publishing Company, New York.
17. Fox, M. A.; Whitesell, J. K., *Organic Chemistry*, Jones and Bartlett Publishers, London.

**PHYC-101 Physical Chemistry-I**

**Credit Hours: 4(3+1)**

##### **Course Objectives**

To acquire the basic knowledge of physical states of matter, chemical thermodynamics, chemical kinetics, solution chemistry and surface chemistry. Completion of this course will enable students to study the more advanced physical chemistry courses.

**Course Contents**

**Physical States of Matter**

Ideal and real gases, equations of state, critical phenomenon and critical constants. Molecules in motion: collision diameter and mean free path. Physical properties of liquids: surface tension, viscosity, refractive index etc. and their applications. Brief account of interactions among the molecules in liquids. Packing of atoms in solids. Unit cells and crystal systems. Method of crystal structure analysis. Brief account of polymers and composite materials with special emphasis on superconductors, semi-conductors etc. Introduction to plasma.

**Chemical Thermodynamics**

Laws of thermodynamics and their applications. Thermodynamic functions: internal energy, enthalpy, entropy and free energy. Relation between thermodynamic functions. van’t Hoff’s equation. Heat capacities, concept of entropy and probability.

**Chemical Kinetics**

Rate of reaction and Rate law. Order and molecularity of the reactions. Zero, first and second order reactions. Determination of reaction order and its rate constant. Effect of temperature on the reaction rate. Concepts of chemical equilibrium. Le-Chatelier’s principle and it s applications. Elementary concepts underlying complex and fast reactions.

**Solution Chemistry**

Ideal and non-ideal solutions. Raoult’s and Henery’s laws and their applications. Molecular interactions in solutions. Colligative properties. Distillation and concept of azeotropic mixture.

**Surface Chemistry**

Concept of interfaces. Adsorption and adsorption isotherms: Freundlich and Langmuir adsorption isotherms. Catalysis, colloids emulsion and their industrial applications.

 **Practical**

Laboratory Work Illustrating Topics Covered in the Lectures of CHEM-432.7

**Recommended Books**

**Theory:**

1. Alberty R. “Physical Chemistry” 17th ed., John Wiley and Sons (1987).
2. Atkins, P.W. “Physical Chemistry” 6th ed., W.H. Freeman and Co. New York (1998).
3. Barrow G.M. “Physical Chemistry” 5th ed., McGraw Hill (1992).
4. Laidler K.J., John H.M. and Bryan C.S. “Physical Chemistry” 4th ed., Houghton Mifflin Publishing Company Inc.(2003).

**Practicals:**

1. Jaffar M. “Experimental Physical Chemistry” University Grants Commission (1989).
2. Levitt B.P. “Findlay’s Practical Physical Chemistry” 9th ed., Longman Group Limited (1978).
3. Shoemaker D. “Experiments in Physical Chemistry” 5th ed., McGraw Hill Publishing Company Limited (1989).

**ANLC-101 ANALYTICAL CHEMISTRY-I**

**Credit Hours: 2**

**Course Objectives**

To familiarize students with the concept of accuracy, manipulation and use of statistical analysis in data handling for quantitative determination.

**Course Contents**

**Introduction to Analytical Chemistry:**

Scope and applications of analytical chemistry, quantitative reactions, stoichiometric relationships, solution chemistry, expression of quantities and concentrations. Basic approach to equilibrium.

**Sampling:**

Types of sampling techniques, sampling of gas, liquid and solid, treatment of samples to obtain

homogenous solutions.

**Errors in chemical analysis and minimization**:

Steps in analytical procedures, errors, precision, accuracy, types of errors, steps involved in

minimization of errors.

**Statistical evolution of data**:

Ways of expressing accuracy, mean, median, mode, deviation, standard deviation, mean

deviation, relative standard deviation. The confidence limit, confidence intervals, rejection of

the results, limit of detection and quantification.

**Quality control and quality assurance.**

**Recommended Books**

1. Skoog, D.A.; West, P.M.; Holler, F.J.; Crouch, S. R., *Fundamentals of Analytical*

 *Chemistry*, 8th Edition, Holt, Rinehart and Winston, NY, USA, 2004.

2. Christian, G.D., *Analytical Chemistry*, 6th ed., John Wiley and Sons, Inc., NY, USA, 1999.

**Supplementary Reading Material**

1. Harris, D. C., *Quantitative Chemical Analysis*, 5th ed. W. H. Freeman and Company, NY, USA, 1999.
2. Braun, R.D., *Introduction to Chemical Analysis*, International Student Edition, 1985.
3. Vogel, A.I., *A Text Book of Quantitative Inorganic Analysis*, 3rd ed. The English Language Book Society, 1961.
4. Kolthoff, I.M.; Sandal, E.B., *Text Book of Quantitative Inorganic Analysis*, The

 MacMillan Company, NY, USA, 1943.

1. Miller, J.C.; Miller, J.N., *Statistics for Analytical Chemistry*, Ellis Horwood Limited, Chichester, England, 1984.
2. Woodget, B.W.; Cooper, D., *Samples and Standards*; Editor: Chapman, N.B., Analytical Chemistry by Open Book Learning, John Wiley and Sons, Inc., NY, USA,1987.

**BIOC-108 Biochemistry**

**Credit Hours: 2**

**Course Objectives**

This course provides fundamental concepts in biochemistry, which focuses upon the major macromolecules and chemical properties of living systems. Primary topics include the structures, properties and functions of amino acids, proteins, carbohydrates, lipids and nucleic acids.

**Course Contents**

**Introduction to Biochemistry**

Brief introduction to the scope and history of Biochemistry. Molecular logic of the living organism. Cell structures and their functions. Origin and nature of biomolecules.

**Carbohydrates**

Definition, classification, chemistry, physical and chemical properties of various classes of carbohydrates. Biological functions of starch, glycogen, cellulose and cell wall polysaccharides, acid mucopolysaccharides and proteoglycans.

**Lipids**

Definition and classification of lipids. Chemistry and biological importance of fatty acids, waxes, glycerides, phospholipids, sphingolipids, glycolipids, sterols and prostaglandins. Significance of lipids in biological membranes and transport mechanism.

**Proteins**

Chemistry and classification of Amino acids, physical and chemical properties of amino acids. Biological significance of amino acids and peptides. Proteins; their classification, properties and biological significance. Primary, secondary, tertiary and quaternary structure of proteins. Denaturation of proteins. Protein sequencing.

**Nucleic Acids**

Chemical composition, structure and biological significance of nucleic acids. Chemical synthesis of oligonucleotides. Nucleic acids hydrolysis. Isolation and separation of Nucleic acids. Introduction to recombinant DNA technology.

**Recommended Books**

1. Nelson, D. L.; Cox, M. N., *Lehninger principles of biochemistry*, 4th ed. Worth Publisher, New York, 2004.
2. Murray, R. K.; Mayes P. A.; Granner, D. K.; and Rodwell, V. W., *Harper’s Biochemistry*, Appleton & Lange, 2000.
3. West, W. R.; Todd, H. S., *Text Book of Biochemistry*, 4th ed. Macmillan, London, 1968.

**Supplementary Reading Material**

1. Voet, D.; Voet J. G., *Biochemistry*, 3rd ed. John Wiley & Sons, New York, 2004.
2. Zubay, G., *Biochemistry*, 4th ed. Macmillan Publishing Co, 1999.
3. [www.bio.mtu.edu/campbell/401sch1.html](http://www.bio.mtu.edu/campbell/401sch1.html)

## 3. Computer Science Courses

## CS-101 FUNDAMENTALS OF COMPUTER

**Credit Hours:** 3(2+1)

## Prerequisites: Nil

**Course Description:** This course is designed for students with little or no computer experience. This course introduces computer concepts, hardware components, basic computer operations and use of software applications to solve problems. Students will have complete understanding and use of personal computers and application software such as Microsoft Word, Excel and PowerPoint.

**Aims and Objectives:** Students successfully completing this course should be able to:

* Develop a vocabulary of key terms related to the computer and to software programs.
* Identify the components of a personal computer system.
* Demonstrate mouse and keyboard functions.
* Demonstrate window and menu commands and how they are used.
* Demonstrate how to organize files and documents on a USB/hard drive.
* Compose, format and edit a word document.
* Send email messages and navigate and search through the internet.

**Course Contents:** Data and Information, Information Processing Cycle, Components of a Computer, Advantages and Disadvantages of Using Computers, Categories of Computers, Computer Applications in Society. Keyboard and Pointing Devices, Types of Input, Input for Smart Phones, Game Controllers, Digital Cameras, Voice Input, Video Input, Scanners and Reading Devices, Biometric Input, Terminals. Display Devices, LCD Monitors and LCD Screens, Plasma Monitors, CRT Monitors, Printers, Nonimpact Printers, Impact Printers, Speakers, Headphones, Data Projectors. Interactive Whiteboards, Storage, Hard disks, Flash Memory Storage, Solid State Drives, Memory Cards, USB Flash Drives, Cloud Storage, Optical Discs, Blue-Ray Discs, Magnetic Tapes, Magnetic Stripe Cards and Smart Cards, Microfilm and Microfiche, Enterprise Storage. Motherboard, Processor, Control Unit, Arithmetic Logic Unit, Machine Cycle. Data Representation, Memory Sizes, Types of Memory, RAM, Cache, ROM, Flash Memory. System Software, Operating Systems, Utility Programs. Application Software, Business Software, Graphics and Multimedia Software, Software for Home, Personal, and Educational Use, Web Applications. Application Software for Communications. Internet, World Wide Web, Networks, Intranets. Enterprise Computing, Computer Security Risks, Viruses. Introduction to MS Word, MS Excel, MS PowerPoint.

## Recommended Books

* 1. Shelly, G. B., & Vermaat, M. E. (2012). *Discovering computers fundamentals: your interactive guide to the digital world (Latest ed.)*. Cengage Learning.

## Bibliography

1. Sawyer, S. C., & Williams, B. (2000). *Introduction to Using Information Technology (Latest ed.)*. McGraw-Hill Higher Education
2. Brookshear, G. G., & Brookshear, J. G. (2002). *Computer science: an overview (Latest ed.)*. Addison-Wesley Longman Publishing Co., Inc.
3. O'Leary, T. (2010). *Computing Essentials (Introductory ed.)*. Career Education.
4. Sinha, P.K.(2007). *Computer Fundamentals (6th ed.)*. BPB publication.

**CS-102**  **Programming Fundamentals**

**Credit Hours:** 4(3+1)

## Prerequisites: Nil

**Course Description:** This is the first programming courses in this program. It provides the core knowledge to begin programming. The course covers creating programs to explore data types, conditions, loops, variables, and expressions; working with different kinds of data and seeing how they affect memory**.**

**Aims and Objectives:** When students complete this course, they will be able to:

* Understand the motivation for programming for a Computer Science (CS) graduate.
* Understand the basic components of a program development environment.
* Analyze a problem and devise a solution for it.
* Implement small programs.
* Define a problem and implement its sub-problems using functions.

**Course Contents:** Introduction to Programming and Importance for a CS Graduate, Basics of Programming and Software Development, C++ Development Environment and Basic Program Construction, Header Files and Library Files, Variables and Data Types, Operators (Arithmetic, Logical, Increment, Decrement) and Precedence, Type Conversion,Input and Output Statements in C++, IF Statement, IF -ELSE Statement, ELSE-IF Statement, Conditional Operator Switch Statement, GOTO Statement, Arrays, One Dimensional and Two Dimensional Arrays, FOR Loop, Nested FOR loops, Loops with Arrays, WHILE Loop, DO-WHILE Loop, Break Statement, Continue Statement, Functions and its Importance, Parts of Functions, Passing Arguments to Functions, Returning Values from Functions, Inline Functions, Default Arguments, Recursion, Strings, String Manipulation Functions, Structures and its Importance, Declaring Structures and Structures Variables, Accessing Structures Members, Nested Structures, Passing Structures Function, Enumerations, Array of Structures, Pointers and its Importance, Pointers and Arrays, Pointers and Function (Call by Value and Call by Reference), Pointers and Strings, File Handling in C++, Reading from a File, Writing to a File.

## Recommended Books

1. Deitel, P., & Deitel, H. (2016). *C++ How to Program (Latest ed.)*. Prentice Hall.
2. Lafore, R. (2005). *Object-oriented programming in C (Latest ed.)*. Indianapolis, Ind: Sams*.*

## Bibliography

1. Sahay, S. (2012). *Object oriented programming with C (Latest ed.)*. Oxford University Press.
2. Kanetkar, Y. (2004). *Basic programming in C++ (Latest ed.)*. BPB Publications.

**CS-104**  **Object Oriented Programming**

**Credit Hours:** 4(3+1)

**Prerequisites:** Programming Fundamentals

**Course Description:** This course discusses the object oriented model in programming. Students taking this course would have already taken a course on programming. This will help build good quality software using object-oriented techniques

**Aims and Objectives:** When students complete this course, they will be able to:

* Understand the importance of OOP as compared to Structured Programming.
* Understand the basic constructs of a C++ program.
* Define a problem and implement its solution using classes and objects.
* Effectively use and implement OOP analysis and design.
* Understand object-oriented programming features in C++.
* Understand object-oriented concepts and how they are supported by C++.
* Gain some practical experience of C++.

**Course Contents:** Object Oriented Programming (OOP) and its Significance as a Modeling Technique. Comparison of Structured Programming and OOP, Classes and Objects in C++, Abstraction, New User Defined Data Types, Creating Objects from Classes, Accessing Member, Access Specifiers, Member Functions, Defining Member Functions, Constructors and Properties, Default Constructor, Constructor Overloading, Copy Constructor, Deep Copy, Shallow Copy, Destructors, “this” Pointer, Constant Member Function, Static Variables, Accessing Static Data Member, Static Member Function, Comparison of Global Variables and Static Variable, Arrays of Objects, Pointer to Objects Templates, Function Templates, Class Templates, Data Encapsulation and Abstraction, Importance of Data Encapsulation and Abstraction, Correctly Using the Access Modifiers, Friend Functions, Composition, Aggregation, Operator Overloading, Overloading Assignment Operator, Friend Function and Operator Overloading, Unary Operators Overloading, Inheritance and Importance, Inheritance in C++, Comparison of Overloading and Overriding, Hierarchy of Inheritance, Types of Inheritance, Private Inheritance, Protected Inheritance Multiple Inheritance Problem in Multiple Inheritance, Polymorphism and Importance, Virtual Functions, Static Binding, Dynamic Binding, Abstract Classes and Concrete Classes, Virtual Destructors, Virtual Functions and Pure Virtual Functions, Virtual Functions Usage, Dynamic Dispatch, Namespaces and Using Namespaces, Memory Management and Importance, Memory Areas(Heap, Stack), Use of new Operator, malloc() and calloc() Functions Calls.

## Recommended Books

1. Deitel, P., Deitel, H. (2016). *C++ How to Program (Latest ed.)*. Prentice Hall.
2. Laurence, P. (2017). *C++: The Ultimate Crash Course to Learning the Basics of C++ (Latest ed.).*Prentice Hall.

## Bibliography

1. Lafore, R. (2005). *Object-oriented programming in C (Latest ed.)*. Indianapolis, Ind: Sams.
2. Kanetkar, Y. (2004). *Basic programming in C++ (Latest ed.)*. BPB Publications.

**CS-122**  **DATA STRUCTURES AND ALGORITHMS**

**Credit Hours:** 4(3+1)

**Prerequisites:** Programming Fundamentals

**Course Description:** The purpose of this course is to provide the students with solid foundations in the basic concepts of programming: data structures and algorithms. The main objective of the course is to teach the students how to select and design data structures and algorithms that are appropriate for problems that they might encounter. This course is also about showing the correctness of algorithms and studying their computational complexities. This course offers the students a mixture of theoretical knowledge and practical experience.

**Aims and Objectives:** Students successfully completing this course should be able to:

* + Be familiar with basic techniques of algorithm analysis.
	+ Be familiar with writing recursive methods.
	+ Master the implementation of linked data structures such as linked lists and binary trees.
	+ Be familiar with several sub-quadratic sorting algorithms including quicksort, mergesort and heapsort.

**Course Contents:** Introduction and Overview, Abstract Data Type, Arrays, Stacks(Push and Pop), Infix, Postfix and Prefix, Basic Operations, Queues(Insertion, Deletion, De-queues), Heap, Lists, Linked Lists, Searching(Binary and Sequential), Sorting, Sorting and Hashing, Recursion, Trees, Linked Lists Implementation, Binary Trees, B-Trees, Trees Traversal, Basic Operations, Traversals Sets, Graph, Representation of Directed and Undirected Graphs, Traversals, Minimum Cost Spanning Tree, Complexity(Space and Time).

## Recommended Books

1. Miller, B. N., & Ranum, D. L. (2011). *Problem Solving with Algorithms and Data Structures Using Python (2nd Ed.)*. Franklin, Beedle & Associates Inc.
2. Lambert, K. (2014). *Fundamentals of Python: Data Structures (Latest ed.)*. Nelson Education.

CS-122 **OPERATING SYSTEMS**

**Credit Hours:** 4(3+1)

**Prerequisites:** Programming Fundamentals, Data Structure and Algorithms

**Course Description:** This course will introduce the core concepts of operating systems, such as processes and threads, scheduling, synchronization, memory management, file systems, input and output device management and security. The course will consist of assigned reading, weekly lectures, a midterm and final exam, and a sequence of programming assignments. The goal of the readings and lectures is to introduce the core concepts. The goal of the programming assignments is to give students some exposure to operating system code. Students are expected to read the assigned materials prior to each class, and to participate in in-class discussions.

**Aims and Objectives:** When students complete this course, they will be able to:

* + To understand the services provided by and the design of an operating system.
	+ To understand what a process is and how processes are synchronized and scheduled.
	+ To understand different approaches to memory management.

**Course Contents:** Introduction & Overview, Computer Organization, Interrupts, Components of Operating System, Processes & PCB, Process Creation, Process Management, Processes, Process States, Process State Models, Inter-Process Communication, Process Scheduling, Threads, Synchronization Issues, Busy Waiting Algorithm &Bakery Algorithm, TSL & Priority Inversion, Semaphores, Classical Synchronization Problems, Dead Locks, Deadlock Detection, Deadlock recovery, Deadlock Avoidance, Deadlock Prevention, Memory management, Real Memory Organization and Management, Virtual Memory Organization: Paging, Segmentation, Virtual Memory Management: Placement, Replacement, and Fetch Strategies Input Output Management, File System.

## Recommended Books

1. Silberschatz, A., Galvin, P. B., Gagne, G., & Silberschatz, A. (2012). *Operating system concepts (9th Ed.)*. John Wiley & Sons.

## Bibliography

1. Ritchie,C. (2003). *Operating Systems (4th Ed.)*. BPB Publications.

**CS-124**  **DATABASE SYSTEMS**

**Credit Hours:** 4(3+1)

**Prerequisites:** Data Structures and Algorithms

**Course Description:** Establish proficiency in the fundamental concepts of database systems and the database system development life cycle of an enterprise database.. It discusses the theoretical foundations of database architecture, Relational Algebra and Relational calculus. This course also focuses on the principles, design and implementation of multi-user databases and its applications in client/server environment.

**Aims and Objectives:** When students successfully complete this course, they will be able to:

* + Understand intricacies involved in the design and implementation of a database system.
	+ Have in-depth knowledge of entity-relationship (ER) modeling
	+ Demonstrate competence with the fundamental tasks involved in gathering and analyzing user requirements, build conceptual, logical, and physical data models that reflect the organization’s requirements.
	+ Apply normalization techniques.
	+ Query a relational DBMS to create and maintain databases in a client server environment.

**Course Contents:** Introduction to database systems, The Relational Data Model, Relational Algebra and Relational Calculus, Database environment, Database Management System, Conceptual database modeling using the entity-relationship model and Enhanced Entity- Relationship modeling, Schema quality through the study of functional dependencies and normalization, Logical and Physical Database Design, The SQL (DDL, DML, and DCL), Database application development, data integrity, constraints (entity integrity, referential integrity, domain integrity etc. ), Database Transaction Management.

## Recommended Books

1. Connolly, T. M., & Begg, C. E. (2014). *Database Systems: A Practical Approach To Design, Implementation And Management (6th Ed.*). Addison Wesley Publishing Company.

## Bibliography

1. Ramakrishnan, R., & Gehrke, J. (2003). *Database Management Systems (3rd Ed.)*. WCB/McGraw Hill.
2. Elmasri, R., & Navathe, S.B. (2016). *Fundamentals of Database Systems (Global Ed.)*. Pearson Education Limited.
3. Hoffer, J., Venkataraman, R., & Topi, H. (2015). *Modern database management (Latest ed.)*. Prentice Hall Press.
4. Silberschatz, A., Korth, H. F., & Sudarshan, S. (2002). *Database system concepts (4th Ed.)*. New York: McGraw-Hill.

## Electronics Courses

## ELE- 102 CIRCUIT ANALYSIS

**Credit Hours:** Four 4(3+1)

**Course Outlines**

Electric current, electromotive force (voltage), resistance, conventional current, Ohm’s law, work, energy,

power, conductance, efficiency, real and ideal sources, Kirchhoff’s voltage and current laws, voltage-divider rule, current-divider rule, series and parallel connected sources, series and parallel connected resistor capacitor and inductor networks, bridges, voltage and current source conversions, mesh analysis, nodal analysis, superposition theorem, Thevenin’s theorem, Norton’s theorem, maximum power transfer theorem, capacitance and capacitors, inductance and inductors, alternating current fundamentals, principle and operation of transformers, Resonant circuits, filter networks. transmission parameters, hybrid parameters, interconnection of two two-port networks.

**Lab Outlines**

Study of Kirchhoff’s current and voltage laws, current divider rule, voltage divider rule, superposition theorem, Thevenin’s theorem, Norton’s theorem, maximum power transfer theorem, simulation of basic electronic circuits using PSPICE. Frequency domain analysis and Bode plots, network analysis in sdomain, two port networks, circuit analysis techniques using PSPICE or other software.

**Recommended Books**

1. Thomas L.Floyd, Latest Edition, “Principles of Electronic Circuits” Prentice Hall. 2009
2. Edward Hughes, “Electrical and Electronic Technology”, 9th Revised Edition, Prentice Hall, 2005.
3. William H. Hayt, Jack Kemmerly, and Steven M. Durbin, “Engineering Circuit Analysis”, 7th Edition, McGraw-Hill, 2006.
4. Muhammad H. Rashid, “Introduction to PSpice Using OrCAD for Circuits and Electronics”, 3rd Edition, Prentice Hall, 2003.

**ELE- 101 ELECTRONICS**

**Credit Hours:** Four 4(3+1)

**Course** **Outlines**

Introduction to electronics, diodes: *pn* junction diode, forward and reverse characteristics of a diode, ideal diode, practical diode, equivalent circuit of a diode, current equation of a diode, diode as a switch. Types of diodes: Schottky diode, zener diode, tunnel diode, varactor diode, LED, laser diode. Applications of diodes: Half- and full-wave rectifiers, clipper and clamper circuits, voltage multipliers. Bipolar junction transistor: Operation, *npn* and *pnp* transistors, unbiased transistor, DC biasing of a transistor, static characteristics, DC circuit analysis, load line, operating point and bias stabilization. Transistor as an amplifier. Transistor biasing configurations: Common emitter, common base, common collector. Field- effect transistor. FET biasing techniques: Common drain, common source and common gate, fixed bias and self-bias configurations, voltage divider biasing. Universal JFET bias curve. Darlington pair.

**Lab** **Outlines**

The emphasis is first on understanding the characteristics of basic circuits that use resistors, capacitors, diodes, bipolar junction transistors and field-effect transistors. The students then use this understanding to design and construct more complex circuits such as rectifiers, amplifiers and power supplies.

**Recommended** **Books**

1. Robert Boylestad and Louis Nashelsky, “Electronic Devices and Circuit Theory”, 9 thEdition, Prentice Hall, 2006.
2. Robert Painter, “Introductory Electronic Devices and Circuits: Electron Flow Version”, 7 th Edition, Prentice Hall, 2006.
3. Thomas L. Floyd, “Electronic Devices”, 9 thedition. Prentice Hall, 2011.

## ELE- 103 DIGITAL LOGIC DESIGN-I

**Credit Hours:** Four 4(3+1)

**Course** **Outlines**

Basic concepts and tools to design digital hardware consisting of both combinational and sequential logic circuits, logic gates, combinational logic design, Encoders, Decoders, Multiplexers, Demultiplexers, code converters, sequential circuits and logic design, Different types of Flip Flops and its applications, D Flip Flop, J-K Flip Flop, RS Flip Flop, State Machine, Designing of synchronous and asynchronous counters, up-down counters, ring counters, random counters, Shift registers and its types. Serial in-parallel out, serial in-serial out, parallel in-serial out, parallel in parallel out.Bus organized computer systems.

**Lab** **Outlines**

Basic logic gates; circuits such as MUX/DEMUX, encoder/decoder, arithmetic logic unit (ALU); Counters and shift registers.

**Recommended** **Books**

1. Thomas L. Floyd, “Digital Fundamentals”, 6 thedition. Pearson Education, 1996
2. Malvino Brown, “Digital Computer Electronics”, 3 rdEdition, McGraw-Hill,1995
3. Morris Mano and Charles R. Kime, “Logic and Computer Design Fundamentals”, 3 rdEdition, Prentice Hall, 2003.
4. Roger L Tokheim, “Digital Electronics: Principles and Applications”, Student Text with Multi SIM CD-ROM, 6thEdition, McGraw-Hill, 2002.

**ELE-104 Amplifiers and Oscillators**

**Credit Hours:** Four 4(3+1)

**Course** **Outlines**

Amplifier analysis: Transistor as an amplifier, hybrid model of a transistor, small-signal analysis, large- signal analysis, gain calculation of single-stage amplifier, cascading, multistage gain calculations. Classification of amplifiers on the basis of biasing: Class A amplifier, class B amplifier, class AB amplifier, class C amplifier, push-pull amplifier, complementary symmetry amplifier. Classification of amplifiers on the basis of coupling: RC-coupled amplifier, transformer-coupled amplifier, direct-coupled amplifier. Classification of amplifiers on the basis of frequency: Audio-frequency amplifier, radio- frequency amplifier, tuned amplifiers. Feedback: Feedback concept, feedback amplifiers, voltage feedback amplifier, current feedback amplifier. Effect of feedback on frequency response. Practical amplifier considerations: Input and output impedance, amplifier loading, impedance matching. Oscillators: Basic theory, tank circuit, damped and undamped oscillations, phase-shift oscillator, Colpitts oscillator, Hartley oscillator, Wein Bridge oscillator, Clap oscillator.

**Lab** **Outlines**

Transistor curve tracer, introduction to PSPICE and AC voltage dividers, characterization and design of emitter and source followers, characterization and design of AC variable-gain amplifier, design of test circuits for BJTs and FETs, design of FET ring oscillators, design and characterization of emitter-coupled transistor pairs, tuned amplifier and oscillator, design of oscillators.

**Recommended** **Books**

1. Thomas L. Floyd, “Electronics Fundamentals: Circuits, Devices, and Applications”, 6 thEdition, 2004, Prentice Hall.
2. Thomas L. Floyd and David Buchla, “Basic Operational Amplifiers and Linear Integrated Circuits”, 2nd Edition, Prentice Hall, 1999.
3. Robert Boylestad and Louis Nashelsky, “Electronic Devices and Circuit Theory”, 9 thEdition, Prentice Hall, 2006.

## ELE- 109 ANALOG & DIGITAL COMMUNICATIONS

**Credit Hours:** Four 4(3+1)

**Course** **Outlines**

Basic definitions; modulation and de-modulation techniques: amplitude, angle, pulse modulation, digital modulation techniques; information theory; error detection and correction; multiplexing techniques; noise and its effects on signal transmission; BER performance of various modulation techniques under noisy environment.

**Lab** **Outlines**

Design and study of low-power AM and FM transmitters and receivers. Study of different signals behavior and its analysis-using computer simulated experiments and receivers. Study and construction of different digital communication systems. Multiplexing and Demultiplexing using digital ICs, line coding, design and construction and study of digital carrier systems. Study of TV system, Telephone system, digital switching systems.

**Recommended** **Books**

1. B. P. Lathi, “Modern Digital and Analog Communication Systems”, 3 rdEdition, Oxford University Press,1998.
2. Leon W. Couch, “Digital and Analog Communication Systems”, 7 thEdition, Prentice Hall, 2007
3. John G. Proakis and Masoud Salehi, “Communication Systems Engineering”, 2 ndEdition, Prentice Hall, 2002.

# **English Courses**

# **ENG-101 English-I (Listening and Speaking)**

**Credit Hours:** 3

**Course Description:**

This course focuses on listening and speaking: the former gives students an exposure to the accent, and stress and intonation patterns of different native and non-native speakers, while the latter is a practice of what they listen to. Both are equally important in bringing about an improvement in learners‘ language proficiency in an academic or/and non-academic settings. Through audio-visual aids, pen and paper exercises, and interactive sessions in the class, students improve their listening and speaking skills and build their vocabulary.

By the end of the course, students will be able to listen, comprehend, and speak more proficiently. They will also be able to communicate effectively and efficiently with their peers and teachers.

# Course Contents:

* + Listening for Gist, Specific Information, Global Meaning
	+ Asking For Information And Directions
	+ Making Statements
	+ Giving Instructions, Descriptions, Reasons
	+ Discussion Skills
	+ Narration

# Recommended Reading:

1. Helgesen, Marc & Steven Brown. *Active Listening Building Skills for Understanding.* Cambridge: Cambridge University Press, 1994.
2. Klippel, Friederike. *Keep Talking.* Cambridge: Cambridge University Press, 1984.
3. Gough, Chris. *English Vocabulary Organizer.* Stamford: Thomson Corporation, 2002.

# Further Reading:

1. Wallwork, Adrican. *Discussions: A-Z.* Cambridge: Cambridge University Press, 1997.
2. Ford, Martyn & Dave King. *For Real! English in Everyday Situations.* London: Mary Glasgow Magazines, 2003.
3. Gammidge, Mick. *Speaking Extra.* Cambridge: Cambridge University Press, 2005

**ENG-102 English-II (Speaking and Reading)**

**Credit Hours:** 3

# Course Description:

English-II builds on English-I and moves from Listening and Speaking to Speaking and Reading. This course focuses on speaking activities and reading exercises. It introduces students to various written texts, which they have to comprehend, interpret, and discuss with their peers in the classroom.

By the end of the course, students will be able to speak and read rationally and effectively.

# Course Contents:

* + Questions and Answers
	+ Understanding Reading, Discussions, and Decisions
	+ Stories and Scenes
	+ Presentations

# Recommended Reading:

1. Klippel, Friederike. *Keep Talking.* Cambridge: Cambridge University Press, 2008.
2. Dainty, Peter. *Newspaper Articles to Get Teenagers Talking*. Glasgow: Mary Glasgow Magazines, 2006.
3. Greenall, Simon & Michael Swan. *Effective Reading*. Cambridge: Cambridge University Press, 2002.

# Further Reading:

1. Ediger, Anne & Cheryl Pavlik. *Reading Connections: Skills and Strategies for Purposeful Reading.*

 Oxford: Oxford University Press, 2000.

1. Brancard, Ruth & Jeanne Hind. *Ready to Read.* Oxford: Oxford University Press, 1989.

**Geography Courses**

**GEOG-101 FUNDAMENTALS OF GEOGRAPHY**

**Credit Hours 3(2+1)**

**Learning objectives:** To make the student understand about the subject of Geography

**Course outline**

* Introduction and Definitions of Geography
	+ Scope of the subject
	+ Roots of the discipline and basic geographic concepts
	+ The evolution of geography from ancient to modern period
	+ Branches of Geography and its relations with other disciplines.
* Five Major Themes of Geography
	+ Location: Absolute and relative
	+ Place: Physical and anthropogenic characteristics
	+ Interaction of different processes
	+ Movement
	+ Region
* Earth as a planet its celestial positions, shape and size.
	+ Rotation and revolution and related phenomena
	+ Earth’s Satellite Moon
	+ Lunar and Solar Eclipses
* Positions on Map and Globe,
	+ Geographical coordinates and its characteristics,
	+ World time zones standard and local time
* A glance at the Globe: distribution of land and water
* Introduction of Lithosphere, Hydrosphere, Atmosphere and Biosphere

**Lab. Work:** Study of maps, atlases and different types of models to understand various Geographical Phenomena.

**Field Visit:** to show the characteristics of places and man-environment interaction.

**Books Recommended**

Christopherson, R.W. (2000), Geo-systems, Prentice-Hall, Inc, USA.

De Blij, H. J and Muller, P.O. (1996), Physical Geography of the Global Environment, USA, John Wiley and Sons Inc.

Fraser, C. (1993) Unlocking the five themes of Geography. Globe Book Company, New Jersey.

Gabler, R.E, Sager, R.J and Wise, D.L. (1997), Essentials of Physical Geography, Saunders College Publishing, New York

Mcliveen, J.F.R. (1992), Fundamentals of Weather and Climate, Prentice Hall New Jersey

Strahlar, A.N., Strahlar, A.H. (2004), Physical Environment, John Wiley. New York

Stringer, E.T. (2004), Modern Physical Geography, New York: John Wiley.

Taylor, J. (1993), Integral Physical Geography, London Longman

Thompson, R.D. et al. (1986), Process in Physical Geography, London, Longman.

Thurman, H.V. & Mexrill (1996), Essentials of Oceanography, Menson, London

**GEOG-102 PHYSICAL GEOGRAPHY**

**Credit Hours 3(2+1)**

**Learning objectives:** To create an understanding about the characteristics of four spheres of the earth, and the processes which are bringing changes in these spheres.

**Course outline:**

* Introduction
	+ Definition, scope and major branches
	+ Realms of the physical environment
* Lithosphere
	+ Internal structure of earth
	+ Rocks–origin, formation and types: Igneous, Sedimentary and Metamorphic Rocks
	+ Plate tectonics, mountain building forces
	+ Geomorphic processes – endogenic and exogenic processes and their resultant landforms
	+ Earthquakes and volcanic activity, folding and faulting
	+ Weathering, mass wasting, cycle of erosion, erosion and deposition
	+ Landforms produced by running water, ground water, wind and glaciers
* Atmosphere
	+ Composition and structure of atmosphere
	+ Atmospheric temperature and pressure,
	+ Global circulation and wind systems
	+ Cyclones and other disturbances
	+ Atmospheric moisture and precipitation
	+ Air masses and fronts
* Hydrosphere
	+ Hydrological cycle
	+ Ocean composition, morphology
	+ Temperature, salinity and other characteristics of ocean water
	+ Movements of the ocean water; waves, currents and tides
* Biosphere
	+ Eco-systems
	+ Formation and types of soils

**Lab. Work:** Identification of rocks and minerals, study and identification of landforms using Satellite imageries and Topographic Sheets. Construction and applications of models showing various types of landforms. Observation and recording of weather data from a mini weather station.

### Field visits: Ground truthing and identification of various types of rocks, fluvial, glacial, desert landform, soils types. Visit to any suitable area to observe and appreciate the characteristics of physical features Mountainous, Plains, Plateaus, Deserts and Coastal areas.

Visit to any national park/biosphere reserves; Soil Survey of Pakistan, Geological Survey of Pakistan,

**Books Recommended:**

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| --- |
| King, C. A. M. (1980) Physical Geography, Basil Blackwell, Oxford. |
| Mcliveen, J. F. R. (1992) Fundamentals of Weather and climate, Prentice Hall, New Jersey. |
| Monkhouse, F. J. (1996) Principles of Physical Geography, Hodder & Stoughton, London. Peterson, J. F., Sack, D. & Gabler, R. E. (2011) Physical Geography, Brooks Cole. |
| Scott, R. C. (1996) Introduction to Physical Geography, West Publishing Co, New York.  |
| Small, R. J. (1989) Geomorphology and Hydrology, Longman, London. |
| Strahler, A. (2013) Introduction to Physical Geography, John Wiley & Sons, New Jersey.Strahlar, A. N., Strahlar, A. H. (2004) Physical Environment, John Wiley, New York. |
| Stringer, E. T. (2004) Modern Physical Geography, John Wiley, New York. |
| Thornbury, W. D. (2004) Principles of Geomorphology, John Willy & Sons, New York. |
| Thurman, H. V. & Trujillo, A. P. (2013) Essentials of Oceanography, Prentice-Hall, Inc, New York. |

**GEOG-104 MAP WORK**

**Credit Hours 3(2+1)**

**Learning Objective:** To train students in map drawing, reading and its use for geographical analysis

**Course outline:**

* Introduction to Maps
* Essential elements of map
* Classification and types of map
* Principles and methods of map making, reading and reproduction
* Scale: types and their use, construction
* Grid reference, coordinate system and indexing methods
* Enlargement and reduction of maps
* Map projections: types, main principles, choice of projection characteristics and uses
* Graphic/Mathematical construction of Cylindrical, Conical and Zenithal projections
* A study of the Survey of Pakistan maps:
	+ Historical development of survey and mapping in Pakistan
	+ Numbering system
	+ Physical and cultural features to be described and interpreted
* Interpretation of weather maps of Pakistan

**Lab work**: to work with maps in understanding scale it relationship with maps area, distance calculation of area on the map; symbolization process; work on the contour line, drawing of valley profiles, calculation of gradient. Record of practical.

**Field visits:** Visit to Survey of Pakistan and Pakistan Meteorological Department.

**Books recommended:**

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| Carey, H. H. (1983) How to Use Maps and Globes, Franklin Watts, New York.Guljan, R. & Mushtaq, R. (1974) Map Projection, Oxford University Press, Oxford.Kraak, M. J. & Ormelling, F. J. (1996) Cartography: Visualization of Spatial Data Harlow, Longman. |
| Robinson, A. H. (2002) Elements of Cartography, John Willey & Sons, New York. |
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**GEOG-101 GEOGRAPHY OF PAKISTAN**

**Credit Hours 3(2+1)**

**Learning Objective:** This course attempts to impart knowledge regarding the relationship between man and physical, socio-economic and cultural environment including land, population, human settlements, resources and related human activities with special reference to Pakistan,.

**Course outline:**

* Introduction and genesis of Pakistan
* Geo-strategic position of Pakistan
	+ Location and geographical significance
	+ Geo-political importance
	+ Administrative setup
* Land and Physical Environment:
	+ Physiography
	+ Climate and climatic regions
	+ Hydrology
	+ Soils and vegetation
* The People
	+ Population characteristics: structure, composition and distribution
	+ Population change
	+ Urbanization
* Economy
	+ Agriculture (crops and livestock). Irrigation
	+ Power and mineral resources
	+ Industries
	+ Trade
	+ Tourism
* Transport and Communication
* Major challenges of Pakistan
	+ - Water, power, security and environmental issues

**Lab. Work:** Survey, data collection and presentation on different thematic maps

**Field visits:** To identify various physical regions and study of at least one region’s land use, urban structure, mining area, national parks, industrial areas and various rural and urban settlements and other natural resources.

**Books recommended:**

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| --- |
| Ahmad, K. S. (1978) Geography of Pakistan, Oxford University Press, Oxford. |
| Burkey, J. S. (1991) Pakistan the continuing search for Nationhood, Western Press Oxford, UK. |
| Davidson, A. P. & Ahmad, M. (2003) Privatization and the Crisis of Agricultural ExtensionDichter, D. (1967) Geography of N-W.F.P, Oxford University Press, Oxford. |
| Hameed, A. (1972) Study of the Middle Indus Basin, San Francisco State College, San Francisco. |
| Khan, F. K. (1991) Geography of Pakistan, Oxford University Press, Karachi |
| Spate, O. H. K. (latest edition) India and Pakistan, Methuen, New York., London  |
| Tayyeb, A. (1973) A Political Geography of Pakistan, Oxford University Press. Oxford. |

**Islamiyat Courses**

**ISL-101 (ISLAMIC STUDIES) ISLAMIYAT**

**Credit Hours:** Two (2)

**Objectives:**

This course is aimed at:

1. To provide Basic information about Islamic Studies
2. To enhance understanding of the students regarding Islamic Civilization
3. To improve Students skill to perform prayers and other worships
4. To enhance the skill of the students for understanding of issues related to faith and religious life.

**Detail of Courses**

**Introduction to Quranic Studies**

1) Basic Concepts of Quran

2) History of Quran

3) Uloom-ul -Quran

**Study of Selected Text of Holly Quran**

1) Verses of Surah Al-Baqra Related to Faith (Verse No-284-286)

2) Verses of Surah Al-Hujrat Related to Adab Al-Nabi

(Verse No-1-18)

3) Verses of Surah Al-Mumanoon Related to Characteristics of faithful (Verse No-1-11)

4) Verses of Surah al-Furqan Related to Social Ethics (Verse No.63-77)

5) Verses of Surah Al-Inam Related to Ihram (Verse No-152-154)

**Study of Sellected Text of Holly Quran**

1) Verses of Surah Al-Ihzab Related to Adab al-Nabi (Verse No.6, 21, 40, 56, 57, 58.)

2) Verses of Surah Al-Hashar (18, 19, 20) Related to thinking, Day of Judgment

3) Verses of Surah Al-Saf Related to Tafakar,Tadabar (Verse No-1,14)

**Seerat of Holy Prophet (S.A.W) I**

1) Life of Muhammad Bin Abdullah (Before Prophet Hood)

2) Life of Holy Prophet (S.A.W) in Makkah

3) Important Lessons derived from the life of Holy Prophet in Makkah

**Seerat of Holy Prophet (S.A.W) II**

1) Life of Holy Prophet (S.A.W) in Madina

2) Important Events of Life Holy Prophet in Madina

3) Important Lessons derived from the life of Holy Prophet in Madina

**Introduction to Sunnah**

1) Basic Concepts of Hadith

2) History of Hadith

3) Kinds of Hadith

4) Uloom –ul-Hadith

5) Sunnah & Hadith

6) Legal Position of Sunnah

**Selected Study from Text of Hadith**

**Introduction to Islamic Law & Jurisprudence**

1) Basic Concepts of Islamic Law & Jurisprudence

2) History & Importance of Islamic Law & Jurisprudence

3) Sources of Islamic Law & Jurisprudence

4) Nature of Differences in Islamic Law

5) Islam and Sectarianism

**Islamic Culture & Civilization**

1) Basic Concepts of Islamic Culture & Civilization

2) Historical Development of Islamic Culture & Civilization

3) Characteristics of Islamic Culture & Civilization

4) Islamic Culture & Civilization and Contemporary Issues

**Islam & Science**

1) Basic Concepts of Islam & Science

2) Contributions of Muslims in the Development of Science

3) Quranic & Science

**Islamic Economic System**

1) Basic Concepts of Islamic Economic System

2) Means of Distribution of wealth in Islamic Economics

3) Islamic Concept of Riba

4) Islamic Ways of Trade & Commerce

**Political System of Islam**

1) Basic Concepts of Islamic Political System

2) Islamic Concept of Sovereignty

3) Basic Institutions of Govt. in Islam

**Islamic History**

1) Period of Khlaft-E-Rashida

2) Period of Ummayyads

3) Period of Abbasids

**Social System of Islam**

1) Basic Concepts of Social System of Islam

2) Elements of Family

3) Ethical Values of Islam

**Reference Books:**

1. Hameed ullah Muhammad, “Emergence of Islam” , IRI, Islamabad
2. Hameed ullah Muhammad, “Muslim Conduct of State”
3. Hameed ullah Muhammad, ‘Introduction to Islam
4. Mulana Muhammad Yousaf Islahi,”
5. Hussain Hamid Hassan, “An Introduction to the Study of Islamic Law” leaf Publication Islamabad, Pakistan.
6. Ahmad Hasan, “Principles of Islamic Jurisprudence” Islamic Research Institute, International Islamic University, Islamabad (1993)
7. Mir Waliullah, “Muslim Jrisprudence and the Quranic Law of Crimes” Islamic Book Service (1982)
8. H.S. Bhatia, “Studies in Islamic Law, Religion and Society” Deep & Deep Publications New Delhi (1989)
9. Dr. Muhammad Zia-ul-Haq, “Introduction to Al Sharia Al Islamia” Allama Iqbal Open University, Islamabad (2001)

**Mathematics-A Courses**

**MATH-101 CALCULUS-I**

**Credit Hours:** Three (3)

**Prerequisites:** Knowledge of Intermediate Calculus

**Specific** **Objectives** **of** **Course:** Calculus serves as the foundation of advanced subjects in all areas of mathematics. This is the first course of calculus. The objective of the course is to introduce students to the fundamental concepts of limit, Continuity, differential and integral calculus of functions of one variable.

**Course** **Outline:**

Equations and Inequalities: Solving linear and quadratic equations linear inequalities, division of polynomials, synthetic division, Roots of a polynomial, rational roots, Viete relations, Descartes rule of signs. Solutions of equations with absolute value sign, Solution of linear and non-linear inequalities with absolute value sign.

Functions and Graphs: Domain and range of a function examples polynomial, rational, piecewise defined functions, absolute value functions, and evaluation of such functions. Operations with functions: sum, product, quotient and composition Graphs of functions: linear, quadratic, piecewise defined functions,

Lines and systems of equations**:** Equation of a straight line, slope and intercept of a line, parallel and perpendicular lines, Systems of linear equations, solution of system of linear equations. Nonlinear systems: at least one quadratic equation.

Limits, and continuity: Functions, limit of a function, Graphical approach, Properties of limits, Theorems of limits, Limits of polynomials, rational and transcendental functions, Limits at infinity, infinite limits, one-sided limits, Continuity.

Derivatives: Definition, techniques of differentiation, Derivatives of polynomials and rational, exponential, logarithmic and trigonometric functions, The chain rule, Implicit differentiation, Rates of change in natural and social sciences, Related rates, Linear approximations and differentials, Higher derivatives, Leibnitz's theorem.

Applications of derivatives: Increasing and decreasing functions, Relative extrema and optimization, First derivative test for relative extrema, Convexity and point of inflection, The second derivative test for extrema. Curve sketching. n value theorems. Indeterminate forms and L. Hopitals rule, Inverse functions and their derivatives.

Integration: Anti derivatives and integrals. Riemann sums and the definite integral, Properties of Integral, The fundamental theorem of calculus, the substitution rule.

**Recommended** **Books:**

1. G. Thomas, “*Calculus”,* 11th Edition. Addison Wesley Publishing Company, 2005
2. H. Anton, I. Sevens, S. Davis, “*Calculus”,* 8th Edition, John Wiley & Sons, Inc. 2005
3. Hughes-Hallett, Gleason, McCallum, et al, “*Calculus* *Single* *and* *Multivariable”,* 3rd Edition, John Wiley & Sons, Inc, 2002.
4. Frank A. Jr, Elliott Mendelson, “*Calculus”,* Schaum's outlines series, 4th Edition, 1999
5. C.H. Edward and E.D Penney, “*Calculus* *and* *Analytics* *Geometry”,* Prentice Hall, Inc. 1988
6. E. W. Swokowski, “*Calculus* *with* *Analytic* *Geometry”,* PWS Publishers, Boston, Massachusetts, 1983.
7. M. Liebeck, “*A* *Concise* *introduction* *to* *pure* *Mathematics”,* CRC Press, 2011.
8. A. Kaseberg, “*Intermediate* *Algebra”,* Thomson Brooks/cole, 2004

MATH-102 CALCULUS-II

**Credit Hours:** Three (3)

**Prerequisites:** Calculus I

**Specific** **Objectives** **of** **course:** This is second course of Calculus. As continuation of Calculus I, it focuses on techniques of integration and applications of integrals. The course also aims at introducing the students to infinite series, parametric curves and polar coordinates

**Course** **Outline:**

Techniques of integration**:** Integrals of elementary, hyperbolic, trigonometric, logarithmic and exponential functions, Integration by parts, substitution and partial fractions, Approximate integration, Improper integrals. Gamma functions.

Applications of integrals: Area between curves, average value, Volumes, Arc length, Area of a surface of revolution, Applications to Economics, Physics, Engineering and Biology.

Infinite series: Sequences and series, Convergence and absolute convergence. Tests for convergence, divergence test, integral test, p-series test, comparison test, limit comparison test, alternating series test, ratio test, root test. Power series, Convergence of power series., Representation of functions as power series, Differentiation and integration of power series, Taylor and Maclaurin series Approximations by Taylor polynomials.

Conic section, parameterized curves and polar coordinates, Curves defined by parametric equations, Calculus with parametric curves**:** tangents, areas, arc length. Polar coordinates. Polar curves, tangents to polar curves, Areas and arc length in polar coordinates.

**Recommended** **Books:**

1. G. Thomas, “*Calculus”,* 11th Edition. Addison Wesley Publishing Company, 2005
2. H. Anton, I. Sevens, S. Davis, “*Calculus”,* 8th Edition, John Wiley& Sons, Inc. 2005
3. Hughes-Hallett, Gleason, McCallum, et al, *Calculus* *Single* *and* *Multivariable,* 3 rdEdition.
4. John Wiley & Sons, Inc. 2002.
5. Frank A. Jr, Elliott Mendelson, “*Calculus”,* Schaum's outlines series, 4th Edition, 1999
6. C.H. Edward and E.D Penney, “*Calculus* *and* *Analytics* *Geometry”,* Prentice Hall, Inc. 1988
7. E. W. Swokowski, “*Calculus* *with* *Analytic* *Geometry”,* PWS Publishers, Boston,
8. Massachusetts, 1983.
9. M. Liebeck, “*A* *Concise* *introduction* *to* *pure* *Mathematics”,* CRC Press, 2011
10. A. Kaseberg, “*Intermediate* *Algebra”,* Thomson Brooks/COLE, 2004
11. J. Stewart, “Calculus early transcendental”, 7 thEdition, Brooks/COLE, 2008.

##

## MATH-109 ORDINARY DIFFERENTIAL EQUATIONS

**Credit Hours:** Three (3)

**Prerequisites:** Calculus I

Specific Objectives of course: To introduce students to the formulation, classification of differential equations and existence and uniqueness of solutions. To provide skill in solving initial value and boundary value problems. To develop understanding and skill in solving first and second order linear homogeneous and non-homogeneous differential equations and solving differential equations using power series methods.

**Course** **Outline:**

Preliminaries: Introduction and formulation, classification of differential equations, existence and uniqueness of solutions, introduction of initial value and boundary value problems

First order ordinary differential equations: Basic concepts, formation and solution of differential equations. Separable variables, Exact Equations, Homogeneous Equations, Linear equations, integrating factors. Some nonlinear first order equations with known solution, differential equations of Bernoulli and Ricaati type, Clairaut equation, modeling with first-order ODEs, Basic theory of systems of first order linear equations, Homogeneous linear system with constant coefficients, Nonhomogeneous linear system

Second and higher order linear differential equations: Initial value and boundary value problems, Homogeneous and non-homogeneous equations, Superposition principle, homogeneous equations with constant coefficients, Linear independence and Wronskian, Non-homogeneous equations, undetermined coefficients method, variation of parameters, Cauchy-Euler equation,

Modeling. Sturm-Liouville problems: Introduction to eigen value problem, adjoint and self adjoint operators, self adjoint differential equations, eigen values and eigen functions, Sturm- Liouville (S-L) boundary value problems, regular and singular S-L problems, properties of regular S-L problems

Series Solutions: Power series, ordinary and singular points, existence of power series solutions, power series solutions, types of singular points, Frobenius theorem, existence of Frobenius series solutions, solutions about singular points, The Bessel, modified Bessel Legendre and Hermite equations and their solutions.

**Recommended** **Books:**

1. Dennis G. Zill and Michael R., “Differential equations with boundary-value problems”, 5th
2. Edition Brooks/Cole, 1997.
3. William E. Boyce and Richard C. Diprima', “Elementary differential equations and
4. boundary value problems”, Seventh Edition John Wiley & Sons, Inc
5. V. I. Arnold, “*Ordinary* *Differential* *Equations”,* Springer, 1991.
6. T. Apostol, “*Multi* *Variable* *Calculus* *and* *Linear* *Algebra”,*2nd ed., J. Wiley and sons. 1997.

## MATH-105 LINEAR ALGEBRA

**Credit Hours:** Three (3)

**Prerequisites:** Calculus I

Specific objectives of course: linear algebra is the study of vector spaces and linear transformations. The main objective of this course is to help students learn in rigorous manner, the tools and methods essential for studying the solution spaces of problems in mathematics, engineering, the natural sciences, and social sciences and development mathematical skills needed to apply these to the problems arising within their field of study; and to various real wold problems.

**Course** **Outline:**

System of Linear Equations: Representation in matrix form. Matrices. Operations on matrices. Echelon and reduced echelon form. Inverse of a matrix (by elementary row operations) Solution of linear system. Gauss-Jordan method. Gaussian elimination.

Determinants: Permutations of order two and three and definitions of determinants of the same order. Computing of determinants. Definition of higher order determinants. Properties. Expansion of determinants.

Vector Spaces: Definition and examples., subspaces. Linear combination and spanning set. Linearly Independent sets. Finitely generated vector spaces. Bases and dimension of a vector space. Operations on subspaces, Intersections, sums and direct sums of subspaces. Quotient Spaces

Linear mappings: Definition and examples. Kernel and image of a linear mapping. Rank and nullity Reflections, projections^ and homotheties. Change of basis. Eigenvalues and eigenvectors Theorem of Hamilton-Cayley.

Inner product Spaces: Definition and examples. Properties. Projection. Cauchy inequality. Orthogonal and orthonormai basis. Gram Schmidt Process. Diagonalization.

**Recommended** **Books:**

1. Ch. W. Curtis, “*Linear* *Algebra”,* Springer 2004.
2. T. Apostol, “*Multi* *Variable* *Calculus* *and* *Linear* *Algebra”,* 2nd ed., John Wiley and sons, 1997
3. H. Anton, C. Rorres , “*Elementary* *Linear* *Algebra:* *Applications* *Version”,* 10 thEdition, John Wiley and sons, 2010.
4. S. Friedberg, A. Insel, “Linear Algebra”, 4 thEdition, Pearson Education Canada, 2003.

S. I. Grossman, “*Elementary* *Linear* *Algebra”,* 5 lhEdition, Cengage Learning, 2004

## Pakistan Studies Courses

## PST- 101 Pakistan Studies

**Credit Hours:** Four (2)

**Course Objectives**

The course framework is issue-oriented. It has many dimensions, the historical and ideological background of Pakistan the process of governance and national development as well as the issues arising in the modern, age and posing challenges to Pakistan. The course has been designed with a vision that Pakistan Studies should open a window to future.

**Course Outline**

**Historical Perspective**

1. Ideological rationale with special reference to Sir Syed Ahmed Khan, Allama Muhammad Iqbal and Quaid-i-Azam Muhammad Ali Jinnah.
2. Factors leading to Muslim separatism
3. People and Land
4. Indus Civilization
5. Muslim advent
6. Location and Geo-Physical features.

**Government and Politics in Pakistan**

**Political and constitutional phases**

1947-58, 1958-71, 1971-77, 1977-88, 1988-99, 1999 onward

**Contemporary Pakistan**

1. Economic institutions and issues
2. Society and social structure
3. Ethnicity
4. Foreign policy of Pakistan and challenges
5. Futuristic outlook of Pakistan

**Suggested Readings**

1. Burki, Shahid Javed. *State & Society in Pakistan,* The Macmillan Press Ltd 1980.
2. Akbar, S. Zaidi. *Issue in Pakistan’s Economy.* Karachi: Oxford University Press, 2000.
3. S.M. Burke and Lawrence Ziring. Pakistan’s Foreign policy: An Historical
4. Analysis. Karachi: Oxford University Press, 1993.
5. Mehmood, Safdar. *Pakistan Political Roots & Development.*Lahore, 1994.
6. Wilcox, Wayne.*The Emergence of Banglades.,* Washington: American Enterprise, Institute of Public Policy Research, 1972.
7. Mehmood, Safdar. *Pakistan Kayyun Toota,* Lahore: Idara-e-Saqafat-e-Islamia, Club Road, nd.
8. Amin, Tahir. *Ethno - National Movement in Pakistan,* Islamabad: Institute of Policy Studies, Islamabad.
9. Ziring, Lawrence. *Enigma of Political Development.* Kent England: WmDawson & sons Ltd, 1980.
10. Zahid, Ansar. *History & Culture of Sindh.* Karachi: Royal Book Company, 1980.
11. Afzal, M. Rafique. *Political Parties in Pakistan,* Vol. I, II & III. Islamabad: National Institute of Historical and cultural Research, 1998.
12. Sayeed, Khalid Bin. *The Political System of Pakistan.* Boston: Houghton Mifflin, 1967.
13. Aziz, K.K. *Party, Politics in Pakistan,* Islamabad: National Commission on Historical and Cultural Research, 1976.
14. Muhammad Waseem, Pakistan Under Martial Law, Lahore: Vanguard, 1987.
15. Haq, Noor ul. *Making of Pakistan: The Military Perspective.* Islamabad: National Commission on Historical and Cultural Research, 1993.

## Physics Courses

## PHY- 102 MECHANICS

**Credit Hours:** Four (4)

**Objectives:** The main objective of this course is to understand different motions of objects on macroscopic scale and to develop simple mathematical formalisms to analyze such motions. This is a calculus-based introductory course with maximum emphasis on applying the acquired knowledge to solving problems.

**Basic Concepts:** Units and Dimensions, SI Units, Inter-conversion of Units; Scalars and Vectors, Adding Vectors: Graphical as well as Component Method, Multiplying Vectors: Dot and Cross Products.

**Motion in One, Two and Three Dimensions:** Position & Displacement; Velocity and Acceleration; Motion under Constant Acceleration; Projectile Motion; Uniform Circular Motion; Relative Velocity and Acceleration in One and Two Dimensions; Inertial and Non-Inertial Reference Frames

**Newton’s Laws:** Newton’s Laws of Motion and their Applications Involving some Particular Forces including Weight; Normal Force; Tension; Friction; and Centripetal Force; Newton’s Law of Gravitation; Gravitational Potential Energy; Escape Velocity; Kepler’s Laws; Satellite Orbits & Energy

**Work and Kinetic Energy:** Work done by Constant and Variable Forces; Gravitational and Spring Forces; Power; Conservative and Non-conservative Forces; Work and Potential Energy; Isolated Systems and Conservation of Mechanical Energy; Work done by External Forces including Friction, Conservation of Energy

**System of Particles:** Motion of a System of Particles and Extended Rigid Bodies; Center of Mass and Newton’s Laws for a System of Particles; Linear Momentum; Impulse; Momentum & Kinetic Energy in One- and Two-Dimensional Elastic and Inelastic Collisions

**Rotational Motion:** Rotation about a Fixed Axis; Angular Position; Angular Displacement; Angular Velocity and Angular Acceleration; Rotation under Constant Angular Acceleration; relationship between Linear and Angular Variables; Rotational Inertia; Parallel-axis Theorem; Torque and Newton’s Law for Rotation; Work and Rotational Kinetic Energy; Power; Rolling Motion; Angular Momentum for a single Particle and a System of Particles; Conservation of Angular Momentum; Precession of a Gyroscope; Static Equilibrium involving Forces and Torques; Rotational inertia of various shapes i.e. for a disc, bar and solid sphere; Elasticity; Stress; Strain and Properties of Materials

**Angular Momentum:** Angular Velocity; Conservation of angular momentum; effect of Torque and its relation with angular momentum

**Simple Harmonic Motion (SHM):** Amplitude; Phase; Angular Frequency; Velocity and Acceleration in SHM; Linear and Angular Simple Harmonic Oscillators; Energy in SHM; Simple Pendulum; Physical Pendulum; SHM and Uniform Circular Motion.

**Fluid Mechanics:** Static Fluids and Pressure; Archimedes’ Principle; Fluid Dynamics; Equation of Continuity and Bernoulli’s Principle

**Recommended Books:**

1. D. Halliday, R. Resnick and J. Walker, “Fundamentals of Physics”, John Wiley & Sons, 9th ed. (2010).
2. R. A. Serway and J. W. Jewett, “Physics for Scientists and Engineers”, Golden Sunburst Series, 8th ed. (2010).
3. R. A. Freedman, H. D. Young, and A. L. Ford (Sears and Zeemansky), “University Physics with Modern Physics”, Addison-Wesley-Longman, 13th International ed. (2010).
4. F. J Keller, W. E. Gettys and M. J. Skove, “Physics: Classical and Modern, McGraw Hill, 2nd ed. (1992).
5. D. C. Giancoli, “Physics for Scientists and Engineers, with Modern Physics”, Addison-Wesley, 4th ed., (2008).

**PHY- 103 Lab-I**

**Credit Hours:** One (1)

**Mechanics and Fluids:** Experiments with pendulums, stop watches, one-dimensional motion and verification of Newton's laws of motion, measurement of forces, speed, acceleration and linear momentum, collisions and conservation of momentum, impacts, free fall and acceleration due to gravity, gyroscopes, rotational motion, conservation of angular momentum, friction, static and dynamic equilibrium, compound pendulum, rolling motion along inclined planes, simple harmonic motion, masses attached to springs and Hooke's law, damped motion and the regimes of damping (over-damped, under-damped and critically damped), pressure in fluids, experiments demonstrating continuity, Bernoulli's principle, buoyancy and Archimedes's principle, Atwood machine, fluid viscosity, surface tension.

**Recommended Books:**

1. A. C. Melissinos and J. Napolitano, “Experiments in Modern Physics”, Academic Press, 2nd ed. (2003).
2. J. H. Moore, C. C. Davis, M. A. Coplan, and S. C. Greer, "Building Scientific Apparatus", Cambridge University Press, 4th ed. (2009).
3. J. R. Taylor, "An Introduction to Error Analysis: The Study of Uncertainties in Physical Measurements", University of Science Books, 2nd ed. (1996).
4. L. Kirkup and R. B. Frenkel, “An Introduction to Uncertainty in Measurement”, Cambridge University Press, (2006).
5. G. L. Squires, "Practical Physics", Cambridge University Press, 4th ed. (2001).
6. Y. Tsividis, "A First Lab in Circuits and Electronics", John Wiley (2001).

## PHY- 104 ELECTRICITY & MAGNETISM

**Pre-requisite:** Mechanics

**Credit Hours:** Four (4)

**Objectives:** The main objective of this course is to understand the Physics of Electromagnetism and to develop simple mathematical formalisms to analyze the electromagnetic fields. This is a calculus-based introductory course with maximum emphasis on applying the acquired knowledge to solving problems.

**Electrostatics:** Electric Charge; Conductors and Insulators; Coulomb’s Law; Electric Fields due to a Point Charge and an Electric Dipole; Electric Field due to Charge Distribution; Electric Dipole in an Electric Field; Electric Flux; Gauss’ Law and its Applications in Planar; Spherical and Cylindrical Symmetry

**Electric Potential:** Equipotential Surfaces; Potential due to a Point Charge and a Group of Point Charges; Potential due to an Electric Dipole; Potential due to Charge Distribution; Relation between Electric Field and Electric Potential Energy

**Capacitors and Capacitance:** Parallel Plate; Cylindrical and Spherical capacitors; Capacitors in Series and Parallel; Energy Stored in an Electric Field; Dielectrics and Gauss’ Law

**DC Circuits:** Electric Current and Current Density; Resistance and Resistivity; Ohm’s Law; Power in Electric Circuits; Semiconductors and Superconductors; Work; Energy and EMF; Resistances in Series and Parallel; Single and Multi-loop Circuits; Kirchhoff’s Rules; RC Circuits; Charging and Discharging of a Capacitor

**Magnetic Field and Magnetic Force:** Sources of Magnetic Field; Magnetic Force on a Moving Charge; Crossed Electric and Magnetic Fields and their Applications; Hall Effect; Magnetic Force on a Current Carrying Wire; Torque on a Current Loop; Magnetic Dipole Moment; Magnetic Field Due to a Current; Force between two Parallel Currents; Biot-Savart Law: Magnetic Field due to a Current, Long Straight Wire, Solenoids and Toroids, Ampere’s Law; A Current-carrying Coil as a Magnetic Dipole; Inductance; Faraday’s Law of Induction; Lenz’s Law; Induction and Energy Transfer; Induced Electric Fields; Inductors and Inductance; Self Inductance; RL Circuits; Energy Stored in a Magnetic Field; Energy Density; Mutual Induction

**Alternating Fields and Currents:** LC Oscillations; Damped Oscillations in an RLC circuit; Alternating Currents; Forced Oscillations; Resistive, Capacitive, and Inductive Loads; RLC series Circuit; Power in AC Circuits; Transformers; Gauss’ Law for Magnetism; Induced Magnetic Fields; Displacement Current; Spin & Orbital Magnetic Dipole Moment; Diamagnetism; Paramagnetism; Ferromagnetism and Hysteresis.

**Recommended Textbooks:**

1. D. Halliday, R. Resnick and J. Walker, “Fundamentals of Physics”, John Wiley & Sons, 9th ed. (2010).
2. R. A. Serway and J. W. Jewett, “Physics for Scientists and Engineers”, Golden Sunburst Series, 8th ed., (2010).
3. R. A. Freedman, H. D. Young, and A. L. Ford (Sears and Zeemansky), “University Physics with Modern Physics”, Addison-Wesley-Longman, 13th International ed., (2010).
4. F. J Keller, W.E.Gettys and M.J.Skove, “Physics: Classical and Modern", McGraw Hill, 2nd ed., (1992).
5. D. C. Giancoli, “Physics for Scientists and Engineers, with Modern Physics”, Addison-Wesley, 4th ed., (2008).

**PHY- 105 Lab-II**

**Credit Hours:** One (1)

**Electricity and Magnetism:** Static charge and electric fields, direct and alternating currents, electrical measurement instrumentation (voltmeters, ammeters, power supplies, variable transformers, cathode ray oscilloscope, electrometer), passive electronic components (resistors, capacitors, inductors), measurement of resistance, capacitance and inductance, electromagnetic induction, inductors and transformers, motors, magnetic fields due to currents and permanent magnets, ferromagnetism and ferroelectricity, determination of hysteresis curves, determination of Curie point, magnetic susceptibility and its temperature dependence, dielectric properties measurement, mapping of magnetic fields using Hall sensors, experiments on noise, properties of the light bulb.

**Recommended Books:**

1. A. C. Melissinos and J. Napolitano, “Experiments in Modern Physics”, Academic Press, 2nd ed. (2003).
2. J. H. Moore, C. C. Davis, M. A. Coplan, and S. C. Greer, "Building Scientific Apparatus", Cambridge University Press, 4th ed. (2009).
3. J. R. Taylor, "An Introduction to Error Analysis: The Study of Uncertainties in Physical Measurements", University of Science Books, 2nd ed. (1996).
4. L. Kirkup and R. B. Frenkel, “An Introduction to Uncertainty in Measurement”, Cambridge University Press, (2006).
5. G. L. Squires, "Practical Physics", Cambridge University Press, 4th ed. (2001).
6. Y. Tsividis, "A First Lab in Circuits and Electronics", John Wiley (2001).

## PHY- 107 HEAT AND THERMODYNAMICS

**Pre-requisites:** Mechanics

**Credit Hours:** Four (4)

**Objective(s):** To understand the fundamentals of heat and thermodynamics

**Heat and Temperature:** Heat and Work; Unit of work; Work Done at the Moving Boundary of a Simple Compressible System; Heat Transfer Mechanisms; Thermometers; Temperature and the Statistical definition of Temperature; Kinetic theory of Ideal gas; Work done on an Ideal gas; Internal energy of an Ideal gas; Equipartition of Energy; Intermolecular forces; The Virial expansion; The Van der Waals equation of state.

**Basic Concepts of Thermodynamics:** Thermodynamic Systems; Surrounding and Boundaries; Type of Systems; Macroscopic and Microscopic description of System; Properties and State of the substance; Extensive and Intensive variables; Equilibrium, Mechanical and Thermal Equilibrium; Processes and Cycles (Isothermal, Isobaric Isochoric and adiabatic); Zeroth Law of Thermodynamics; Consequence of Zeroth law of Thermodynamics; Criteria of thermo-dynamical equilibrium.

**Thermodynamics:** First law of thermodynamics and its applications to adiabatic, isothermal, cyclic and free expansion; Reversible and irreversible processes; Second law of thermodynamics; Carnot theorem and Carnot engine; Heat engine; Refrigerators; Calculation of efficiency of heat engines; Thermodynamic temperature scale, Absolute zero, Entropy, Entropy in reversible process; Entropy in irreversible process; Entropy and second law of thermodynamics; Entropy and Probability; Thermodynamic potentials; Maxwell’s relations; TdS equations, Energy equations and their applications; Intrinsic and mutual stabilities of single component system; Conditions of stabilities; The Lech-atelier Braun Principle; First order Phase transition; Discontinuities of Volume and Entropy; Second Order Phase Transition; Low Temperature Physics; Joule-Thomson effect and its equations; Thermoelectricity; Thermocouple, Seebeck's effect; Peltier’s effect; Thomson effect.

**Introduction to Statistical Mechanics:** Statistical distribution and mean values; Mean free path and microscopic calculations of mean free path; Distribution of Molecular Speeds; Distribution of Energies; Maxwell distribution; Maxwell Boltzmann energy distribution; Internal energy of an ideal gas; Brownian Motion Langevin equation,

**Recommended Books:**

1. M. W. Zemansky, “Heat and Thermodynamics”, Mc Graw Hill, 7th ed. (1997).
2. M. Sprackling, “Thermal Physics” McMillan (1991).
3. B. N. Roy, “Principle of Modern Thermodynamics”, Institute of Physics, London (1995).
4. D. Halliday, R. Resnick and K. Krane, “Physics”, John Wiley, 5th ed. (2002).
5. D. Halliday, R. Resnick and J. Walker, “Fundamentals of Physics”, John Wiley, 9th ed. (2010).

**PHY-108 Lab-III**

**Credit Hours:** One (1)

**Heat:** Calorimetry, heat transfer, Newton's cooling under ambient and forced convection and radiation, measurement of temperature using Si diodes, thermistors, thermocouples and RTD's, black bodies, heat pumps and heat engines, investigation of gas laws and laws of thermodynamics, thermal conductivity by pulsed heating of a metal rod, measurement of latent heats and specific heat capacities, temperature control using proportional-integral-derivative (PID) schemes, thermal expansion and its measurement using strain gauges.

**Waves and Oscillations, Sound:** Resonance in a stretched string, normal modes of oscillation, dispersion relations for mono- and di-atomic lattices, coupled oscillators, nonlinear oscillations exemplified by resistance-inductance-diode circuits, magnetic pendulums, accelerometers, measurement of the speed of sound under conditions of varying temperature, solitons, Lorentz pendulum, waves in water, beats, superposition of harmonic motion (Lissajous patterns), sonometer.

**Recommended Books:**

1. A. C. Melissinos and J. Napolitano, “Experiments in Modern Physics”, Academic Press, 2nd ed. (2003).
2. J. H. Moore, C. C. Davis, M. A. Coplan, and S. C. Greer, "Building Scientific Apparatus", Cambridge University Press, 4th ed. (2009).
3. J. R. Taylor, "An Introduction to Error Analysis: The Study of Uncertainties in Physical Measurements", University of Science Books, 2nd ed. (1996).
4. L. Kirkup and R. B. Frenkel, “An Introduction to Uncertainty in Measurement”, Cambridge University Press, (2006).
5. G. L. Squires, "Practical Physics", Cambridge University Press, 4th ed. (2001).
6. Y. Tsividis, "A First Lab in Circuits and Electronics", John Wiley (2001).

## PHY- 110 MODERN PHYSICS

**Pre-requisites:** Mechanics, Electricity and Magnetism

**Credit Hours:** Three (3)

**Objective(s):** To understand the non-classical aspects of Physics, applications of Quantum Physics in micro-scale, atomic and molecular structure and processes

**Contents:** Introduction to Relativity; Particle properties of waves; Wave properties of particles; Wave-Particle duality; Atomic Structure; Introduction to Quantum mechanics; Quantum Theory of Hydrogen Atom; Many Electron Atoms; Molecules

**Recommended Books:**

1. A. Beiser, “Concepts of Modern Physics”, McGraw-Hill, 6th ed. (2002).
2. P. A. Tipler and Ralph A. Llewellyn, “Modern Physics”, W H Freeman and Company 6th ed. (2012).
3. R. A. Serway, C.J. Moses and C.A. Moyer, “Modern Physics”, Brooks Cole, 3rd ed. (2004).
4. R. M. Eisberg and R. Resnick, “Quantum Physics of Atoms, molecules, Solids, Nuclei and Particles”, John Wiley, 2nd ed. (2002).

**PHY-111 Lab-IV**

**Credit Hours:** One (1)

**Optics (basic and advanced) and Spectroscopy:** Sources of light including bulbs, light emitting diodes, laser diodes and gas lasers, experiments demonstrating optical phenomena such as interference, diffraction, linear motion, reflection, refraction, dispersion, Michelson interferometry, measurement of refractive index using interferometry, measurement of the speed of light, diffraction gratings and multiple-slit interference, thin film interference and Newton's rings, use of digital cameras for optics experiments, mode structure of lasers, use of spectrometers and monochromators, wavelength tuning of laser diodes, rainbows, emission spectroscopy of low-pressure gases (hydrogen), alkali spectra and fine structure, hyperfine structure of rubidium, vibrational spectrum of nitrogen, Lambert-Beer's law, optical polarization, magneto-optical Faraday rotation.

**Recommended Books:**

1. A. C. Melissinos and J. Napolitano, “Experiments in Modern Physics”, Academic Press, 2nd ed. (2003).
2. J. H. Moore, C. C. Davis, M. A. Coplan, and S. C. Greer, "Building Scientific Apparatus", Cambridge University Press, 4th ed. (2009).
3. J. R. Taylor, "An Introduction to Error Analysis: The Study of Uncertainties in Physical Measurements", University of Science Books, 2nd ed. (1996).
4. L. Kirkup and R. B. Frenkel, “An Introduction to Uncertainty in Measurement”, Cambridge University Press, (2006).
5. G. L. Squires, "Practical Physics", Cambridge University Press, 4th ed. (2001).
6. Y. Tsividis, "A First Lab in Circuits and Electronics", John Wiley (2001).

**Statistics Courses**

**STAT-102 INTRODUCTION TO STATISTICS**

**Credit Hours:** Three (3)

**Pre-Requisite: Nil**

**Course Outline:**

The nature and scope of the Statistics. Organizing of Data, classification of data, Graphs and Charts: Stem-and leaf diagram, Box and Whisker plots and their interpretation. Measures of Central Tendency and Dispersion: Their properties, usage, limitations and comparison. Calculations for the ungrouped and grouped data. Measures of Skewness and Kurtosis and Distribution shapes. Probability Concepts, Addition and Multiplication rules, Bivariate frequency tables, joint and marginal probabilities, Conditional probability and independence, Bayes’ rule.

**Books Recommended**

1. Spiegel, M.R., Schiller, J.L. and Sirinivasan, R.L. (2000) “Probability and Statistics”, 2nd ed. Schaums Outlines Series. McGraw Hill. NY.
2. Clark, G.M and Cooke, D. (1998), “A Basic Course in Statistics” 4th ed, Arnold, London.
3. Walpole, R.E., Myers, R.H and Myers, S.L. (1998), “Probability and Statistics for Engineers and Scientist” 6th edition, Prentice Hall, NY.
4. Mclave, J.T., Benson, P.G. and Snitch, T. (2005) “Statistics for Business & Economics” 9th ed.Prentice Hall, New Jersey.
5. Weiss, N,A.(1997), “Introductory Statistics” 4th ed. Addison-Wesley Pub. Company, Inc.
6. Chaudhry, S.M.and Kamal, S. (1996), “Introduction to Statistical Theory” Parts I & II, 6th ed, Ilmi Kitab Khana, Lahore, Pakistan.

**STAT-110 INTRODUCTION TO PROBABILITY DISTRIBUTIONS**

**Credit Hours:** Three (3)

**Pre-Requisite:** Introduction to Statistics

**Course Outline:**

Discrete Random Variables, Probability Distribution, Mean and Variance of a discrete random variable Bernaulli trials. Properties, applications and fitting of Binomial, Poisson, Hypergeometric. Negative Binomial and Geometric distributions. Continuous Random Variable, probability density function and its properties. Normal Distribution and its properties, Standard Normal Curve, Normal approximation to Binomial and Poisson distributions.

**Books Recommended**

1. Spiegel, M.R., Schiller, J.L. and Sirinivasan, R.L. (2000) “Probability and Statistics”, 2nd ed. Schaums Outlines Series. McGraw Hill. NY.
2. Clark, G.M. and Cooke, D. (1998), “A Basic Course in Statistics” 4th ed, Arnold, London.
3. Walpole, RE., Myers, R.H and Myers, S.L. (1998), ‘Probability and Statistics for Engineers and Scientist” 6th edition, Prentice Hall, NY.
4. Mclave, J.T., Benson, P.G. and Snitch, T. (2005) “Statistics for Business & Economics” 9t ed, Prentice Hall, New Jersey.
5. Weiss, N.A.(1997), “Introductory Statistics” 4th ed. Addison-Wesley Pub. Company, Inc.
6. Chaudhry. S.M.and Kamal, S. (1996), “Introduction to Statistical Theory” Parts I & II, 6th ed, Ilmi Kitab Khana, Lahore, Pakistan.

**STAT-103 BASIC STATISTICAL INFERENCE**

**Credit Hours:** Three (3)

**Pre-Requisite:** Introduction to Probability Distributions

**Course Outline:**

Distribution of sample mean and central limit theorem. Estimation: Point Estimation. Desirable Properties of a Good Estimator. Interval Estimation. interval Estimation of population mean. Large and small sample confidence intervals for Population Mean. Nature of Hypothesis Testing and Types of errors. Hypothesis Testing for Population Mean and variance. Inferences for Two Population Means. Large-sample inferences for Two Populations using Independent Samples. Inferences for the Mean of Two Normal Populations using Independent Samples (variances are assumed Equal/Not Equal). Inference for Two Populations Mean using Paired Samples. Inferences for Population Proportions. Confidence Intervals and hypothesis Testing for Population Proportion. Inferences for Two Populations Proportions using independent Samples, Estimation of sample size. Chi-Square Procedure. Chi-Square Goodness-of fit Test. Chi-Square Independence Tests.

**Books Recommended**

1. Spiegel, MR., Schiller, J.L. and Sirinivasan, R.L. (2000) “Probability and Statistics’, 2nd ed. Schaums Outlines Series. McGraw Hill. NY.
2. Clark, G.M. and Cooke, D. (1998), “A Basic Course in Statistics” 4th ed, Arnold, London.
3. Mclave, J.T., Benson P.G. and Snitch, T. (2005) “Statistics for Business & Economics” 9th Prentice Hall New Jersey.
4. Walpole, RE., Myers, R.H. and Myers, S.L. (1998), “Probability and Statistics for Engineers and Scientist” 6th edition, Prentice Hall, NY.
5. Weiss, N.A. (1997), “Introductory Statistics” 4th ed. Addison-Wesley Pub. Company, Inc.
6. Chaudhry, S.M. and Kamal, S. (1996), “Introduction to Statistical Theory” Part I, II, 6th ed, Ilmi Kitab Khana, Lahore, Pakistan.

**STAT-104 INTRODUCTION TO REGRESSION ANALYSIS OF EXPERIMENTAL DESIGN**

**Credit Hours:** Three (3)

**Pre-Requisite:** Basic Statistical Inference

**Course Outline:**

Concepts of Regression and Correlation, Simple Linear regression, Inference regarding regression parameters, Linear correlation: simple, partial and multiple correlation. Inference regarding correlation coefficient, Coefficient of determination. One-Way and Two-Way Analysis of Variance, Design of Experiments, Basic Principles of Design of Experiments, Description, Layout and Analysis of Completely Randomized Design, Randomized Complete Block Design and Latin Square Design. Multiple Comparisons (LSD and Duncan’s test). Introduction to Non-Parametric Statistical Methods,

**Books Recommended**

1. Clark, G. M. and Kempson, R. E. (1997), “Introduction to the Design & Analysis of Experiment” Arnold London.
2. Walpole, P.E., Myers R.H., Myers S.L. (1998), “Probability and Statistics for Engineers and Scientists”, 7th ed. Prentice Hall.
3. Weiss, N.A, (1997), “Introductory Statistics” 4th ed. Addison-Wesley Pub.Company, Inc.
4. Chaudhry, S.M., and Kamal, S., (1996), “Introduction to Statistical Theory” Part I, II,

6th ed, Ilmi Kitan Khana, Lahore, Pakistan.

**STAT-105 STATISTICAL PACKAGES**

**Credit Hours:** Three (3)

**Pre-Requisite:** Introduction to Statistics and Introduction to Probability Distributions

**Course Outline:**

Introduction to Minitab, data manipulation in Minitab, graphical representation in Minitab, Qualitatively and Quantitative data presentation and analyzing data in Minitab, Programming in Minitab Introduction of SPSS, data manipulation in SPSS, simple arithmetic in SPSS, SPSS function related to probability distributions, SPSS modules, simple graphing in SPSS. Analysis using SPSS syntax programming. (Use of SPSS, Minitab, Matlab, Statistica is based upon the availability of Software)

**Books Recommended**

1. Ryan, Barbara F.: Joiner, Brian L. and Cryer, Jonathan D. (2005) MINITAB Handbook, 5th Edition, Duxbury Press, California.
2. Delwiche, Lora D. and Slaughter Susan J. (1998) The Little SAS Book A Primer, 2nd Ed, SAS institute, North Carolina.
3. Norusis. Marija (2006) SPSS 14.0 Guide to Data Analysis, Prentice Hall, New Jersey.
4. SPSS (2006) SPSS 14.0 Base User’s Guide, , Prentice Hall, New Jersey.
5. Marques do Sd, Joaquim P. (2003) Applied Statistics using SPSS, STATISTICA and MATLAB

**Zoology Courses**

**ZOO-104 ANIMAL DIVERSITY-1 (INVERTEBRATES)**

**Credit Hours:** **4(3+1)**

**Course Objectives**:

1. To provide the knowledge of evolutionary/phylogenetic relationship (from simple to the complex organisms).
2. To impart the basic taxonomic characteristics and classification of all the invertebrate phyla.
3. To provide understanding of body organization, Feeding and Digestive system; Other Organ System;
4. To provide the description of mode of Reproduction and Development
5. To provide the information of their economic and ecological importance

**Course Learning Outcomes**:

This course will be based on following outcomes:

1. Acquire the basic concepts of invertebrates with explanation of evolutionary origin and diversification.
2. Understand invertebrate organismal concepts in laboratory and field.
3. Demonstrate major evolutionary innovations for invertebrates with functional importance.
4. Understand how reproduction and development occured and able to breed animal in the laboratory/field
5. Analyze economic and ecological importance of invertebrates.

**Course Contents:**

Note: The minimum details of the titles in the content must be of the principal book Zoology by Miller and Harley. This must be kept in view in teaching and assessments.

1. **INTRODUCTION**
	1. Classification of Organisms:
	2. Evolutionary Relationships and Tree Diagrams: Patterns of organization.
2. **ANIMAL-LIKE PROTISTS: THE PROTOZOA**
	1. Evolutionary perspective; Life within a single plasma Membrane;
	2. Symbiotic Life-styles.
	3. Protozoon Taxonomy; (up to Phyla, subphyla and super Classes, wherever applicable).
	4. Pseudopodia and Amoeboid Locomotion; Cilia and other pellicular structure;
	5. Nutrition; Genetic Control and Reproduction; Symbiotic ciliates;
	6. Further Phylogenetic Consideration.
3. **MULTICELLULAR AND TISSUE LEVELS OF ORGANIZATION**
	1. Evolutionary Prespective:
	2. Origins of Multicellularity; Animal Origins.

**Phylum Porifera**

a. Characteristics and classification. Cell Types, Body Wall, and Skeletons;

1. Water Current and Body Forms;
2. Maintenance Functions, Reproduction.

**Phylum Cnidaria (Coelenterate)**

1. Characteristics and classification. The body Wall and Nematocysts: Alteration of Generations;
2. Maintenance Functions; Reproduction and
3. Classification up to Class.

**Phylum Ctenophore;**

a. Characteristics, body organization

1. **THE TRIPLOBLASTIC AND WITH ACOELOMATE BODY PLA**

**PHYLUM PLATYHELMINTHES**

1. Evolutionary Perspective; Classification up to class;
2. The Free-Living Flatworms and the Tapeworms, adaptive modification for parasitic life style

**Phylum Numerate;** Characteristics, body organization

**Phylum Gastrotrich**; Characteristics, body organization

1. **PSEUDOCOELOMATE BODY PLAN**

**PHYLUM ASCHELMINTHS**

a. Evolutionary perspective; General Characteristics; Classification up to order with External Features;

* 1. Feeding and Digestive system; Other Organ System; Reproduction and Development

including Phylum **Rotifera,** Phylum **Nematoda** and Phylum **Kinorhyncha**.

* 1. Some Important Nematode Parasites of Humans;
1. **PHYLUM MOLLUSCA**
	1. Evolutionary perspective; Relationship to other animals; Origin of the Coelom;
	2. Molluscan Characteristics, Classification up to class. The Characteristics of Shell and Associated Structures,
	3. Feeding, Digestion, Gas Exchange, Locomotion,
	4. Reproduction and Development, Other maintenance Functions and Diversity in Gastropods,

Bivalves and Cephalopods:

1. **PHYLUM ANNELIDA**
	1. The Metameric Body Form; Evolutionary perspective; Relationship to other animals,
	2. Metamerism and Tag-matization, Classification up to Class. External Structure and Locomotion,
	3. Feeding and the Digestive system, Gas Exchange and Circulation,
	4. Nervous and Sensory Functions, Excretion,
	5. Regeneration, Reproduction and Development, in Polychaeta, Oligochaeta and Hirudinea,

 Further Phylogenetic Consideration.

1. **PHYLUM ARTHROPODA:**
	1. Evolutionary Perspective: Classification and Relationship to other Animals;
	2. Metamerism and Tagmatization;
	3. The Exoskeleton; Metamorphosis;
	4. Classification up to Class; Further Phylogenetic Consideration.

**The Hexapods and Myriapods:**

a. Evolutionary Perspective: Classification up to class. External Structure and Locomotion,

* 1. Nutrition and the Digestive system, Gas Exchange, Circulation and Temperature Regulation,
	2. Nervous and Sensory Functions, Excretion, Chemical Regulation,
	3. Reproduction and Development in Hexapoda,
	4. Insects Behavior, Insect and Human;
1. **PHYLUMECHINODERMS**
	1. Evolutionary Perspective: Relationship to other Animals; Echinoderm Characteristics; Classification up to class.
	2. Maintenance Functions, Regeneration,
	3. Reproduction, and Development in Asteroida, Ophiuroidea, Echinoidea, Holothuridea and Crinoidea;

**SOME LESSER-KNOWN INVERTEBRATES**;

a. The Lophophorates, Entoprocts, Cycliophores, and Cheatognaths.

**Practical:**

**Note:** Classification of each members of each phylum upto order withadaptions in relation to habitat of the specimen. Preserved Specimen and or colored projection slide and or CD ROM projection of computer must be used.

1. Study of Euglena, Amoeba, Endameba, Plasmodium, Trypanosome, Paramecium as representative of animal like Protists.
2. Study of prepared slides of sponges, spicules of songes, and their various body forms. Study of representatives of classes of Phylum Porifera.
3. Study of principal representatives of classes of Phylum Coelenterate.
4. Study of principal representatives of classes of Phylum Platyhelminthes.
5. Study of representatives of phylum Rotifer, Phylum Nematode.
6. Study of principal representatives of classes of Phylum Mollusca.
7. Study of principal representatives of classes of Phylum Annelida.
8. Study of principal representatives of classes of groups of Phylum Arthropoda
9. Study of representatives of classes of phylum Echinodermta.
10. Preparation of permanent mount of Leucosolenia, Obelia, Hydra, Proglottid of Tapeworm, Parapodia of Nereis and Daphnia. Drawing and labeling.
11. Preparation of permanent slide of mouthpart of insects (after dissection). Drawing and labeling.
12. How to make grade-wise series for preparation of temporary and permanent slides.

**Recommended Principal Reference Book:**

1. Miller, A.S. and Harley, J.B. ; 1999 , 2002., 2007, 2009, 2012 & 2016 Zoology, 4th , 5th, 6th, 7th, 8th , 9th& 10th Edition (International), Singapore : McGraw Hill.

**Additional Readings:**

1. Hickman, C.P., Roberts, L.C/, AND Larson, A., 2018. INTEGRATED PRINCIPLES OF ZOOLOGY, 15th Edition (International), Singapore: McGRAW-Hill.
2. Hickman, C.P., Roberts, L.C/, AND Larson, A., 2007. INTEGRATED PRINCIPLES OF ZOOLOGy, 12th& 13th Edition (International). Singapore: McGraw-Hill.
3. Pechenik, J.A., 2015. BIOLOGY OF INVERTEBRATES, 7th Edition, (International), Singapore: McGraw-Hill.
4. Kent, G. C. and Miller, S., 2001. COMPARATIVE ANATOMY OF VERTEBRATES New York: McGraw-Hill.
5. Campbell, N.A., 2002; BIOLOGY 6th Edition, Menlo Park, California; Benjamin Cummings Publishing Company, Inc.

**BOOKS FOR PRACTICAL**

1. Miller, S.A., 2002. GENERAL ZOOLOGY LABORATORY MANUAL. 5th Edition (International), Singapore : McGraw-Hill.
2. Hickman, C.P. and Kats, H.L., 2000. Laboratory Studies in integrated principal of zoology. Singapore : McGraw-Hill.

**ZOO-105 ANIMAL DIVERSITY-I1 (CHORDATES)**

**Credit Hours 4(3+1)**

**Course Objectives**

The objectives of the course are:-

1. To enable them to understand the Taxonomic characteristics of protochordates and chordates To impart knowledge about the phylogenetic relationships of protochodates and various classes of chordates.
2. To develop critical thinking about phlogeny of chordates with respect to their physiological adaptations, behavior and ecology.

**Course Learning Outcomes:**

Upon successful completion of the course, the student will be able to:

1. **ACQUIRE** the basic knowledge of Taxonomic characteristics ofchordates.
2. **UNDERSTAND** the phylogenetic relations and diversity of Pisces,amphibians, reptiles and mammals.
3. **ANALYZE** the process of micro evolution within chordates .
4. **DEMONSTRATE** individually Phylogentic relationships of chordatesand their diversity.

**Course Outline:**

1. **Protochordates**
	1. Classification of protochordates.
	2. Structure, anatomy and organ systems of Acorn worms, Urochodates and Cephalochodates
	3. Reproduction; life histories and metamorphosis of protochodates.
	4. Phylogenetic relationships.
2. **Fishes**:
	1. Vertebrate Success in Water.
	2. Phylogenetic relationships of Pisces.
	3. Classification of Chondrichthyes, Osteichthyes, Dipnoi and Holocephalli
	4. Locomotory adaptations, nutrition and the digestive system, circulation, gas exchange, nervous and sensory functions, excretion and osmoregulation, reproduction and development of Chondrichthyes (Scoliodon) and Osteichthyes (*Cyprinus carpio* and *Wallago attu*).
3. **Amphibians**:
	1. The first terrestrial vertebrates. Characteristics of amphibians
	2. Phylogenetic relationships.
	3. Classification of amphibians and characteristics of order Caudata, Gymnophiona, and Anura.
	4. Structure and locomotory adaptations,nutrition and the digestive system, circulation, gas exchange, temperatureregulation, nervous and sensory functions, excretion and
	5. Osmoregulation, reproduction, development, and metamorphosis of caudate, anura and Gymnophiona.
4. **Reptiles**:
	1. The First Amniotes and cladistic interpretation of the amniotic lineage. General characteristics of reptiles.
	2. Characteristics of OrderTestudines or Chelonia, Rhynchocephalia, Squamata, and Crocodilia
	3. Adaptations in external structure and locomotion, nutrition and the digestive system, circulation, gas exchange, and temperature regulation, nervous andsensory functions, excretion and osmoregulation, reproduction and development of helonia, squamata, Rhynchocephalia and crocodilian.
	4. Further phylogenetic considerations.
5. **Birds**:
	1. Classification,Feathers, flight and endothermy.
	2. Phylogenetic relationships; ancientbirds and the evolution of flight.
	3. Diversity of modern birds.
	4. Adaptation in external structure and locomotion, nutrition and the digestive system,circulation, gas exchange, and regulation, nervous and sensory systems,excretion and osmoregulation, reproduction and development.
	5. Migrationand navigation.

1. **Mammals**:
	1. Classification, Specialized teeth, endothermy, hair and viviparity.
	2. Diversity of mammals.
	3. Adaptations in external structure and locomotion, nutrition andthe digestive system, circulation, gas exchange, and temperature regulation,nervous and sensory functions, excretion and osmoregulation, behavior,reproduction and development.

**Practical**

1. Classification and study of lab specimens of hemichordates, fishes, amphibians, reptiles, birds and mammals.
2. Visit to PMNH for the study of diversity of chordates.

**Text and Reference Books:**

1. Campbell, N.A. Biology. 9th Ed. 2011. Menlo Park, California Benjamin/Cummings Publishing Company, Inc.
2. Miller, S.A. and Harley, J.B. 2010. Zoology, 8th Edition (International) Singapore: McGraw Hill.
3. Miller, S.A. 2002. General Zoology Laboratory Manual. 5th Ed. (International), Singapore: McGraw Hill.
4. Hickman, C.P., Roberts, L.S. and Larson, A. Integrated Principlesof Zoology, 14th Edition (International), 2009. Singapore: McGraw-Hill.
5. Pechenik, J.A. Biology of Invertebrates, 4th Edition (International), 2000. Singapore: McGraw Hill.

**ZOO-106 ANIMAL FORM AND FUNCTION-I**

**Credit Hours:** **4(3+1)**

**Course Objectives:**

**The Objectives of the courses are:**

1. To teach about animals’ diversity adapted in different strategies for performance of their similar functions through modifications in body parts in past and present times.
2. To impart understanding of diverse strategic structural adaptations in each of the functions of integumentary, skeletal, muscular, nervous and sensory, endocrine, circulatory and respiratory systems for effective survival in their specific conditions.
3. To understand the organ systems, their specialization and coordination with each other and constantly changing internal and external environment, inside and outside the animal’s body.
4. To embrace the phenomena in basic structure of each system that determines its particular function.

**Course Learning Outcomes:**

1. **Acquire** the concept that for the performance of a function for exampleexchange of respiratory gases the different forms are adapted in t environments e.g. gills in aquatic and lungs in terrestrial environment.
2. **Understand** that diverse forms adapted to perform the same functionsare because of the different past and present conditions.
3. **Solve** of emergence of diversity of forms for the performance of similarfunction.
4. **Analyze** the requirements of diverse forms for the performance of similarfunction in their past and present needs.
5. **Evaluate** the adaptations in forms for its efficiency in managing thefunction in differing situations in the past and present times.
6. **Demonstrate** that a form is successfully adapted to perform a functionadequately and successfully.

**Course Outline:**

1. **Protection, Support, and Movement:**
	1. Protection: the integumentary system of invertebrates and vertebrates;
	2. Movement and support: the skeletal system of invertebrates and vertebrates;
	3. Movement: non-muscular movement; an introduction to animal muscles; the muscular system of invertebrates and vertebrates
2. **Communication I:**
	1. Nerves: Neurons: structure and function.
3. **Communication II:**
	1. Senses: Sensory reception: baroreceptors, chemoreceptors, georeceptors, hygroreceptors, phonoreceptors, photoreceptors, proprioceptors, tactile receptors, and thermoreceptors of invertebrates
	2. Lateral line system and electrical sensing, lateral-line system and mechanoreception, hearing and equilibrium in air and water, skin sensors of mechanical stimuli, sonar, smell, taste and vision in vertebrates.
4. **Communication III:**
	1. The Endocrine System and Chemical Messengers: Chemical messengers: hormones chemistry; and their feedback systems; mechanisms of hormone action
	2. Hormones with principal function each of porifera, cnidarians, platyhelminthes, nemerteans, nematodes, molluscs, annelids, arthropods, and echinoderms invertebrates; an overview of the vertebrate endocrine system; endocrine systems of vertebrates, endocrine systems of birds and mammals
5. **Circulation and Immunity**:
	1. Internal transport and circulatory systems in invertebrates
	2. Characteristics of invertebrate coelomic fluid, hemolymph, and blood cells transport systems in vertebrates; characteristics of vertebrate blood, blood cells and vessels; the hearts and circulatory systems of bony fishes, amphibians, reptiles, birds and mammals; the human heart: blood pressure and the lymphatic system; immunity: nonspecific defenses, the immune response

**Practicals:**

1. Study of insect chitin, fish scale, amphibian skin, reptilian scales, feathers and mammalian skin.
2. Study and notes of skeleton of Labeo (*Labeo rohita)*, Frog (*Hoplobatrachus tigerinus*), Varanus (*Varanus bengalensis)*, fowl*(Gallus* *gallus domesticus)* andrabbit (*Oryctolagus cuniculus)*.

Note: Exercises of notes on the adaptations of skeletons to their function must be done.

* 1. Earthworm or leech; cockroach, freshwater mussel, Channa or Catlacatla or Labeo or any other local fish, frog, pigeon and rat or mouse and rabbits dissections as per availability.
1. Study of heart, principal arteries and veins in a representative vertebrate (dissection of representative fish/mammals).

**Books Recommended:**

1. Pechenik, J.A. 2013. Biology of Invertebrates, 4th Ed. (International), Singapore: McGraw-Hill.

1. Hickman, C.P., Roberts, L.S., Larson, A. 2004. Integrated Principlesof Zoology, 11th Ed. (International), Singapore: McGraw-Hill.
2. Miller, S.A. and Harley, J.B. 2002. Zoology, 5th Ed. (International), Singapore: McGraw-Hill.
3. Campbell, N.A. 2002. Biology, 6th Ed. Menlo Park, California: Benjamin/Cummings Publishing
4. Kent, G.C., Miller, S. 2001. Comparative Anatomy of Vertebrates. New York: McGraw-Hill.
5. Hickman, C.P., Kats, H.L. 2000. Laboratory Studies in Integrated Principles of Zoology. Singapore: McGraw-Hill.

**ZOO-107 ANIMAL FORM AND FUNCTION-II**

**Credit Hours:** **4(3+1)**

**Course Objectives:**

**The Objectives of the courses are:**

1. To teach about animals’ diversity adapted in different strategies’ for performance of their similar functions through modifications in body parts in past and present times.
2. To impart understanding of diverse strategic structural adaptations in each of the functional systems of nutrition, excretion, osmoregulation and reproduction and development for effective survival in their specific conditions.
3. To understand the organ systems, their specialization and coordination with each other and constantly changing internal and external environment, inside and outside the animal’s body.
4. To embrace the phenomena in basic structure of each system that determines its particular function.

**Course Learning Outcomes:**

1. **Acquire** the concept that for the performance of a function for exampleexchange of respiratory gases the different forms are adapted in t environments e.g. gills in aquatic and lungs in terrestrial environment.
2. **Understand** that diverse forms adapted to perform the same functionsare because of the different past and present conditions.
3. **Solve** of emergence of diversity of forms for the performance of similarfunction.
4. **Analyze** the requirements of diverse forms for the performance ofsimilar function in their past and present needs.
5. **Evaluate** the adaptations in forms for its efficiency in managing thefunction in differing situations in the past and present times.
6. **Demonstrate** that a form is successfully adapted to perform a functionadequately and successfully.

**Course Outline:**

1. **Nutrition and Digestion:**
	1. Evolution of nutrition; the metabolic fates ofnutrients in heterotrophs; digestion
	2. Animal strategies for getting and usingfood, diversity in digestive structures of invertebrates.
	3. Themammalian digestive system: gastrointestinal motility and its control
	4. Oralcavity, pharynx and esophagus, stomach, small intestine: main site ofdigestion; large intestine; role of the pancreas in digestion; and role of theliver and gallbladder in digestion.
2. **Temperature and Body Fluid Regulation:**
	1. Homeostasis and Temperature Regulation; The Impact of Temperature on Animal Life; Heat Gains and Losses; Some Solutions to Temperature Fluctuations; Temperature Regulation in Invertebrates, Fishes, Amphibians, Reptiles, Birds and Mammals; Heat Production in Birds and Mammals
	2. Control of Water and Solutes (Osmoregulation and Excretion); Invertebrate and Vertebrate
	3. Excretory Systems; How Vertebrates Achieve Osmoregulation; VertebrateKidney Variations; Mechanism in Metanephric Kidney Functions. Reproduction and Development
3. **Reproduction:**
	1. Asexual reproduction in invertebrates;advantages and disadvantages of asexual reproduction;
	2. Sexual reproduction in invertebrates; advantages and disadvantages of sexual reproduction; sexual reproduction in vertebrates; reproductive strategies; examples of reproduction among various vertebrate classes;
	3. The humanmale reproductive system: spermatogenesis, transport and hormonal control, reproductive function;
	4. The human female reproductive system: folliculogenesis, transport and hormonal control, reproductive function;hormonal regulation in gestation; prenatal development and birth: theplacenta; milk production and lactation.

**Practical:**

1. Study of excretory system in an invertebrate and a vertebrate representative (Model).
2. Study of dissection system in invertebrate and a vertebrate representative (Dissection).=
3. Dissection and study of male and female reproductive system in vertebraes and invertebrates.

Note: Prepared slides and preserved specimen and/or projection slidesand/or CD ROM computer projections may be used.

**Books Recommended**

1. Pechenik, J.A. 2013. Biology of Invertebrates, 4th Ed. (International), Singapore: McGraw-Hill.

1. Hickman, C.P., Roberts, L.S., Larson, A. 2004. Integrated Principlesof Zoology, 11th Ed.

 (International), Singapore: McGraw-Hill.

1. Miller, S.A., Harley, J.B. 2002. Zoology, 5th Ed. (International),Singapore: McGraw-Hill.
2. Campbell, N.A. 2002. Biology, 6th Ed. Menlo Park, California:Benjamin/Cummings

 Publishing Company, Inc.

1. Kent, G.C., Miller, S. 2001. Comparative Anatomy of Vertebrates. NewYork: McGraw-Hill.
2. Hickman, C.P., Kats, H.L. 2000. Laboratory Studies in IntegratedPrinciples of Zoology.

 Singapore: McGraw-

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