Scheme of Study

BS Physics

Department of Physics (ULM)

University of Lakki Marwat, Lakki Marwat, KPK.

HOD Physics, ULM

Director Academics
ULM

Semester I

Course Code	Course Title	Crd Hrs	Pre-Requisite
EW-101	English-I	3	
AH-105	Islamic History	3	
NS-101	Everyday Science	3	
NS-107	ICT	3	
SS-120	Introduction to Sociology	3	
QR-104	Introduction to Statistics	3	
Total Credit Hrs		**18**	

Semester II

Course Code	Course Title	Crd Hrs	Pre-Requisite
NS-120	Introduction to Physics	**3**	
QR-101	Basic Mathematics	3	
AH-120	Constitutional Law	3	
SS-113	Introduction to Economics	3	
ENG-121	English II	3	
Civ-110	Islamic Studies	3	
Total Credit Hrs		**18**	

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Semester III

Course Code	Course Title	Crd Hrs	Pre-Requisite
ENG-231	English III	3	
Civ-120	Pakistan Study	**3**	
PHY-101	Mechanics	**4**	
MATH-21	Calculus I	**3**	
PHY102	Electricity & Magnetism	**4**	
PHY101L	Lab-I (Mechanics)	**1**	
Total Credit Hrs		**18**	

Semester IV

Course Code	Course Title	Crd Hrs	Pre-Requisite
MATH-214	Calculus II	3	
PHY-203	Waves and Oscillations	**3**	
PHY-204	Heat &Thermodynamics	**3**	
PHY-205	Modern Physics	**3**	
PHY-351	Mathematical Methods of Physics-I	**3**	
PHY-102L	Lab-II (Electricity and Magnetism)	**1**	Electricity and Magnetism

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Total Credit Hrs		**16**	

Semester V

Course Code	Course Title	Crd Hrs	Pre-Requisite
PHY-321	Electrodynamics-I	3	
PHY-311	Classical Mechanics	3	
PHY-391	Electronics	3	Modern Physics
PHY-103L	Lab-III (Heat, Wave and Sound)	1	
PHY-352	Mathematical Methods of Physics-II	3	Mathematical Methods of Physics-I
PHY-331	Quantum Mechanics-I	3	
Total Credit Hrs		**16**	

Semester VI

Course Code	Course Title	Crd Hrs	Pre-Requisite
PHY-322	Electrodynamics-II	3	Electrodynamics-I
PHY-432	Quantum Mechanics-II	3	Quantum Mechanics-I
PHY-392	Optics	3	
PHY-372	Statistical Physics	3	
PHY-104L	Lab-IV (Optics)	1	

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PHY-433	Atomic and Molecular Physics	3	
Total Credit Hrs		**16**	

Semester VII

Course Code	Course Title	Crd Hrs	Pre-Requisite
PHY-441	Solid State Physics-I	3	
PHY-493	Nuclear Physics	3	
PHY-105L	Lab-V (Electronics)	2	Electronics
PHY-	Elective-I	3	
PHY-	Elective-II	3	
PHY-106L	Lab-VI (Modern Physic)	2	Modern Physic
PHY-	Project/Thesis (Starts)	------	
Total Credit Hrs		**16**	

Semester VIII

Course Code	Course Title	Crd Hrs	Pre-Requisite
PHY-442	Solid State Physics-II	3	Solid State Physics-I
PHY-	Elective-III	**3**	
PHY-	Elective-IV	**3**	

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PHY-500	Research Project/Subject	**3**	
PHY-	Elective-IV	**3**	
Total Credit Hrs		**15**	

Total Credit Hrs: 132

Elective course

Sr No	Course Code	Subject Tilte	Credit Hrs
01	PHY-501	LASER	03
02	PHY-502	Density Functional Theory	03
03	PHY-503	Introduction to Photonics	03
04	PHY-504	Digital Electronics	03
05	PHY-505	Method of Experimental Physics	03
06	PHY-506	Introduction to Material Science	03
07	PHY-507	Introduction to Nano Science and Nanotechnologies	03
08	PHY-508	Environmental Physics	03
09	PHY-509	Introduction Plasma Physics	03
10	PHY-510	Introduction to Particle Physics	03
11	PHY-511	Electronic Materials and Devices	03
12	PHY-512	Computational Physics and Simulation	03

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NS- 120 **INTRODUCTION TO PHYSICS** **Credit Hrs: 03**

Course outline:

Introduction to Physics: Explore fundamental physics concepts, scientific notations, dimensional analysis, linear relationships and quadratic relationships.

Vectors: Describe types of vectors and the process to add, subtract and multiply vectors. Understand how to get a resultant vector and perform vector operations using components.

Kinematics: Differentiate between displacement and distance and speed and velocity. Determine acceleration using slope of speed and explain projectile, free fall and uniform circular motion.

Force and the Laws of Motion: Examine Newton's Laws of Motion. Explain the differences between mass, inertia and weight and describe action and reaction force pairs. Describe friction, inclined plane, the spring constant and centripetal force.

Work and Energy in Physics: Apply the work-energy theorem and describe relationship between kinetic and potential energy. Examine gravitational potential energy, conservative forces and power.

Linear Momentum in Physics: Describe the impulse-momentum change equation and apply the momentum conservation principle. Discuss elastic and inelastic collisions and isolated systems and find the centre of gravity.

Waves, Sound and Light: Define vibrations and explore wave parameters, electromagnetic waves and pitch and volume in sound waves. Discuss reflection, resonance, color, diffraction and the Doppler Effect.

Thermodynamics in Physics: Explore the relationship between temperature and heat, phase changes and heat transfer. Describe thermal expansion, the ideal gas law, entropy and the first and second laws of thermodynamics.

Electrostatics: Understand electric charge, force fields and Coulomb's Law. Solve parallel-plat capacitor problems and describe electric potential.

Recommended Books

1. College Physics by Raymond A. Serway and Chris Vuille, Volume 10, Publisher: Cengage Learning (2014)
2. University Physics by George Arfken, Academic Press (2012)
3. Fundamentals of Physics by Haliday & Resnick Walker.

NS- 101 EVERYDAY SCIENCE Credit Hrs: 03

Course outline:

Introduction, History of Science, Achievements of some giants of Science in Chronological order, Islamic Science, Contribution of Muslim Scientists, Famous muslim scientist, Nature of science, Scientific method, impact of science on society. Introduction, The origin, The Big Bang, The structure, the galaxies, solar system, The sun, the moon, the earth,structure of the earth, earth atmospheres, the green house effect, global warming, ozone depletion, acid rain, stattelites, earthquake, eclipses, the mystery of Stonehenge, day-night and seasons, volcanoes, minerals, glossary of cosmology Introduction and sources of energy, Fossil Fuels, Major oil producing countries, Global search of Crude oil, Petroleum products, natural gas, hydel power or hydro-electric power, solar energy, nuclear energy, the nuclear reactor, heavy water, nuclear safety, nuclear fusion, energy coversion, radiation and living things, Ceramics, Semi-conductors, Communications systems, Laser, Telescope, Camera, Fertilizers, Nanotechnology, Plastics, Computer, Brain, Heart, Tissues, Epithelial Cell, Origin of Modern Humans, Pest Control, Protein, Vertebrate, Invertebrate, Liver, Enzymes, Organisms (Common to all living things), Blood Group system. Plants, Seed, Flower, Gene, Evolution Laws, Nucleic Acid (DNA and RNA), Diseases and Threats to Living organism:

Swine flow, Hepatitis, Dengue fever, Corona virus, SARS (Severe acute respiratory syndrome virus), Plants and Crop Diseases (Rust, Smut, Late Blight, Canker).

Recommended Books:

1. Exploring physical science 1977 by walter A. Thurber
2. Exploring Life science 1975 by walter A. Thurber
3. Encyclopedic Manual of everyday science, Author, Dr. Rabnawaz Samo Publisher; Maktab e Faridi.

PHY- 101 Mechanics Credit Hrs: 04

Course outline:

Vectors Overview: Vectors and scalars, Vector operators, coordinate systems and Unit Vectors, Vector – Magnitude and direction, Vector decomposition into components

Kinematics: position, velocity and acceleration, constant acceleration, vector description of motion in 2D, projectile motion.

Newton's Laws: Newton's Laws of motion, force laws, constraint forces and free body diagrams for gravity, contact forces, tension and springs, Friction.

Circular Motion: Circular motion, velocity and angular velocity, uniform circular motion, tangential and radial acceleration, period and frequency of uniform circular motion. Newton's second law and Circular motion, Universal Law of gravitation.

Drag Forces, Constrains and Continuous Systems: Pulleys and constraints, Massive rope, continuous systems and Newton's second law as a differential equation, Resistive forces, capstan, drag force in fluids, free fall with air drag.

Momentum and Impulse: Momentum and Impulse, External and Internal forces and the change in momentum of a system, system of particle. Conservation of momentum, constancy of momentum and isolated systems, momentum changes and non-isolated systems, center of mass, translational motion of the center of mass.

Continuous mass Transfer: Relative velocity and recoil, reference frames, continuous mass transfer, momentum and flow of mass

Kinetic Energy and Work: The concept of energy and conservation of energy, kinetic energy, work, work energy theorem, power, work and scalar product, work done by a non-constant force along arbitrary path, work kinetic energy theorem in 3D, conservation of energy, conservative and non-conservative forces.

Potential Energy and Energy conservation: Changes in potential energy of a system, changes in potential energy and zero point of potential energy, mechanical energy and conservation of mechanical energy, change of mechanical energy for closed system with internal non-conservative forces, dissipative forces: friction, potential energy diagrams.

Collision Theory: Types of collision, Elastic collisions, center of mass reference frame.

Rotational Motion: Motion of a rigid body, two-dimensional rotational kinematics, moment of inertia, Torque, static equilibrium, rotational dynamics.

Angular momentum: Angular momentum of a point particle, angular momentum of a rigid body about a fixed axis, Torque and angular impulse.

Rotations and Translations -Rolling: Rolling Kinematics, rolling dynamics, rolling kinetic energy and angular momentum, gyroscopes

Recommended Books:

1. Halliday, D. Resnick, Krane, Physics, Vol. I & II, John Wiley, 5th ed. 1999.
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.
6. Classical Mechanics: MIT 8.01" by Peter Dourmashkin

EW-101: English I: Reading & Writing Skills Chrs:03

Course Description:

The course is designed to help students take a deep approach in reading and writing academic texts which involve effective learning strategies and techniques aimed at improving the desired skills. The course consists of two major parts: the 'reading section' focuses on recognizing a topic sentence, skimming, scanning, use of cohesive devices, identifying facts and opinions, guess meanings of unfamiliar words. The 'writing section' deals with the knowledge and use of variousgrammatical components such as, parts of speech, tenses, voice, narration, modals etc. in practical contexts.

Course Contents

Reading Skills: Identifying Main Idea / Topic sentences, Types of Reading Skills: skimming, scanning, extensive and intensive, Active and Passive Reading, Strategies for Improving Reading Skills, Finding Specific and General Information Quickly, Distinguishing Between Relevant and Irrelevant InformationAccording to Purpose for Reading, Recognizing and Interpreting Cohesive Devices, Distinguishing Between Fact and Opinion, Reading Comprehension

Writing Skills: Sentence patterns and structures, Phrase, clause, Parts of Speech, Tenses: meaning and use, Modals, Use of active and passive voice, Reported Speech, Writing good sentences, Error Free writing, Paragraph writing with topic sentence

Recommended Books:

1. Howe, D. H, Kirkpatrick, T. A., & Kirkpatrick, D. L. (2004). *Oxford English for undergraduates*. Karachi: Oxford UniversityPress.
2. Eastwood, J. (2004). *English Practice Grammar* (New edition withtests and answers). Karachi: Oxford University Press.
3. Murphy, R. (2003). *Grammar in use.* Cambridge: CambridgeUniversity Press.

AH-105 Islamic History (Compulsory) CHrs: 03

Objectives:

This course is aimed at:

- To provide basic information about Islamic History
- To provide basic information to the students about the life of the Holy Prophet Hazrat Muhammad (S.A.W).
- To inform the students about the administrative system of Califat e Rashida period.
- To inform the students about the rule and administrative system of Umayyad period, Abbasids period and Muslims in Spain.
- To enhance understanding of the students regarding Islamic Culture and Civilization.
- To enhance skills of the students for understanding of issues related to faith and religious life.
- To communicate historical knowledge effectively and pursue higher studies in History and related fields.

Course Contents:

Part. 1 Life of the Holy Prophet Hazrat Muhammad (S.A.W)

1. Land and Geography of Arabia
2. Conditions of Arabia at the advent of Islam
3. Makki Life of the Holy Prophet (S.A.W)
   - 3.1 Parentage, Birth and Early Childhood
   - 3.2 Harb ul Fujjar, Half fu Fazool, Nikah and Re-Construction of Kaba
   - 3.3 Baasat e Nabvi, Preeching of Islam and Hostility of Quraish
   - 3.4 Emigration to Abyssinia 1st and 2nd , Aam ul Huzn, Pledge of Aqba 1st and 2nd
   - 3.5 Hijrat e Madina
4. Madni Life of the Holy Prophet (S.A.W)
   - 4.1 Causes, Events and Importance of Hijrat e Madina
   - 4.2 Charter of Madina
   - 4.3 Gazwat e Nabvi, Treaty of Hudaibiya and Conquest of Makkah
5. Last Sermon of the Holy Prophet (S.A.W)
6. Seerat tu Nabi (S.A.W)

Part. 2 Rashidun' Period

1. Hazrat Abu Bakr Saddiq (R. A)
2. Hazrat Umar Farooq (R. A)
3. Hazrat Usman (R. A)
4. Hazrat Ali (R. A)
5. Administration system and main Features of Rashidun Period

Part. 3 Umayyads' Period

1. Hazrat Amir Mu'awiya (R. A)
2. Yazed and Karbala incident
3. Hazrat Abdullah bin Zubair (R. A)
4. Marwan and Abdul Malik bin Marwan
5. Walid bin Abdul Malik and Sulaiman bin Abdul Malik
6. Hazrat Umar bin Abdul Aziz (R. A)
7. Later Rulers of Umayyad Dynasty
8. Administration under Umayyads and causes of their downfall

Part. 4 Abbasids' Period

1. As-Safah and Abu Jafr Al-Mansoor
2. Hadi, Mahdi, Haroon ur Rashid
3. Amin, Mamoon and Moatasim
4. Later Rulers of Abbasids' Dynasty
5. Administration under Abbasids and causes of their downfall
6. Crusades and Sultan Salah ud Din Ayubi
7. Muslims in Spain
8. Administration and Causes of the downfall of Muslims in Spain

Recommended Books:

- Islamic History (P-I and P-II). Published by KP Textbook Board Peshawar.
- Dr. Hameed du Din. "Tareekh e Islam".
- Mazar ul Haq. "History of the Arabs".
- Shah Moeen ud Din. "Tareek e Islam".
- تاریخ الخلفاء (اردوترجمہ)-----علامہ جلال الدین سیوطی
- خلافت اندلس ---------نواب ذوالقدر جنگ
- تاریخ اندلس --------مولانا ریاست علی ندوی
- تاریخ اسلام ----------اکبر شاہ خان نجیب آبادی
- تاریخ الامم والملوک (اردوترجمہ)---ابن جریر طبری

SS-120: Introduction to Sociology CHrs: 03

Course Contents

Fundamental of Sociology: Nature, Scope, and subject matter of Sociology, Brief historical development of Sociology, Society and community, Relationship with other social sciences like Economic, Political Science, History, Psychology, and Anthropology, Social interaction processes (Cooperation, Competition, Conflict, Accommodation, Acculturation, and Assimilation), Social Groups, Definition and Functions, Types of Social Groups (In and out group, Primary and Secondary groups, Reference groups. Formal and informal Groups and Pressure groups).

Social Institutions: Definition, Structure and Function of the following Institutions: Family, Religion, Education, Economics, Political Inter-relationship among various social institutions. Cultural and Related Concepts: Definition and aspects of culture, Material and non-material culture, Ideal and real culture, Elements of culture, Beliefs, values, norms (folkways, mores, laws),Organization of culture, Traits, complexes, and patterns, other related concepts, Cultural relativism, Sub-Culture and ethnocentrism

Socialization and Personality: Role and Status, Socialization, Culture and Personality

Deviance and Social Control: Definition and types of deviance, Formal and informal methods of social control.

Social Stratification: Determinants of Social Stratification (Caste, Class, Ethnicity, Power, Prestige and Authority), Social Mobility, Definition and types, Dynamics of social mobility

Social and Cultural Change: Definition of social change, Dynamics of social change (Education, Innovation, Industrialization, Urbanization and Diffusion). Resistance to change.

Recommended Books:

1. Horton Paul B. and Hunt, Chester L (1990), Sociology Singapore: McGraw Hill Book Company.
2. Sociology 1 by Allama Iqbal Open University, Islamabad
3. Sociology 2 by Allama Iqbal Open University, Islamabad
4. Taga, Abdul Hameed (2000) An Introduction. New York: Harper and Rows
5. Betrnad, Alvin L. (1969). Basic Sociology-An Introduction to Theory and Methods, New York; Appleton Century Crofts.
6. Curran, Jr.(1977).Introductory sociology: A basis Self Instructional Guide
7. Hafeez, Sabeeha (1990), The Changing Pakistan Society. Karachi: Royal Book company, Zaibunisa Street, Sadar.
8. Horton Paul B. and Hunt, Chester I.. (1990) Sociology singapore.Macgraw Hill Book Company.
9. Merrii, F.E., (latest ed,), Sociology and Culture. N.J. Englewood Cliffs.
10. Philips, Bernard (1990). Sociology-Form Concepts to Practice. New York: McGraw Hill Book Company Inc.
11. Rao, C. Nshaukar (1990), Sociology, New Delhi: S.C Chand and Company Ltd.

QR-104 Introduction to Statistics CHrs:3

Course Contents

Basic of Statistics: Introduction to Statistics, Scope and importance of statistics, Meaning of Statistics according to the subject, Branches of Statistics, Population and sample, Parameter and Statistic, Variable and Constant, Discrete and continuous variable

Data and its types (Qualitative and Quantitative), Scales of measurements (Nominal, Ordinal, Interval and Ratio), Diagrams and graphs, imple and Multiple bar chart, Histogram, Pie chart.

Frequency distribution (FD): Definition of frequency distribution, Steps in construction of frequency distribution.

Measures of Central Tendency: Arithmetic mean, Real life examples for group and ungroup data, Uses of Median, Applications of Median for simple and frequency data, The Mode, Uses of Mode, Applications of Mode for simple and frequency data.

Measures of Dispersion: Definition and types of dispersion, Range, grouped and ungrouped data Coefficient of range, Standard deviation, variance and Co-efficient of variance

Probability: Definition of probability, Objective and Subjective probability, Experiment and random experiment, sample space and sample point, Event, simple and composite events, Mutually exclusive and independent events, Calculation of probability relative to dice, coins and balls.

Sampling: Sampling and sampling distribution, Probability and non-probability sampling.

Estimation: Definition of Estimation, Estimator and Estimate, Definition of Point and Interval Estimation.

Hypothesis Testing: Hypothesis, Statistical Hypothesis and Testing of Hypothesis, Simple and Composite hypothesis, Steps of hypothesis testing, Definition of Student t-test, Properties oft-test, and Real life examples of t-test for single population mean.

Regression and Correlation: Definition of Regression, Estimated regression line

Solution of Real life Problems for simple regression.

Correlation: Definition of Correlation, Pearson correlation co-efficient, Solution of Real life Problems

Recommended Books

1. Statistical Theory Part-I and Part-II BySherMohummadChaudary, Carwan Publisher.
2. Statistics 4th Edition, "Schaum's Outline Series, McGRAW-HILL
3. Basic Concepts and Methodology for the Health SciencesByWayne W. Daniel
4. Wayne W. D., (2005). Biostatistics: A foundation for Analysis in the health sciences. Wiley series in Probability and Statistics

5. Earl K. Bowem& Martin starr: Basic Statistics for Business and Economics.

ICT-107 Information and Communication Technologies CHrs:03

COURSE 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.
- Send email messages and navigate and search through the internet

Course outline:

Data and Information, Information Processing Cycle, Introduction to Computer, Components of a Computer, Advantages and Disadvantages of Using Computers. Categories of Computers, Computer Applications in Society.

Input Devices: Types of Input, Input for Smart Phones, Game Controllers, Digital Cameras, Voice Input, Video Input, Scanners and Reading Devices, Biometric Input, Printers, Nonimpact Printers, Impact Printers, Speakers, Headphones, Data Projectors. Interactive Whiteboards.

Storage Devices: 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.

Memory: Data Representation, Memory Sizes, Types of Memory, RAM, Cache, ROM, Flash Memory, Primary and Secondary Memory , Data Communication.,

Internet, World Wide Web

Networks, Internet and Searching Techniques, E-Learning, Freelancing , Enterprise Computing, Computer Security Risks, Viruses

Introduction to MS Word, MS Excel, MS PowerPoint

QR-101 Basic Mathematics CHrs: 03

Course outline:

Numbers systems: Real Numbers, Complex numbers, the integers, Rules for addition, Rules for multiplication, Even and odd integers; divisibility. Rational numbers, Multiplicative inverses, Addition and multiplication, Real numbers: positivity, Powers and roots, Inequalities, the complex plane, Polar form.

Linear and Quadratic Equations: Equations in two unknowns, Equations in three unknowns, Quadratic Equations,

Functions: Definition of a function, Polynomial functions, Graphs of functions, Exponential function.

Determinants Matrices: Determinants of order, Properties of 2 X 2 determinants, Determinants of order 3, Properties of 3 X 3 determinants.

Differentiation: Fundamentals, Derivatives by Definitions, Power Rule, Properties of Derivatives, Product and Division Rules

Integration: Fundamentals, Basic Integrations, Product Rule

Geometry: Distance and Angles, the Pythagoras theorem. **Area and Applications**, Area of a disc of radius circumference of a circle of radius r, **Coordinates and Geometry,** Coordinate systems, Distance between points, Equation of a circle

Segments, Rays, and Lines: Segments, Rays, Lines, Ordinary equation for a line

Trigonometry: Radian measure, Sine and cosine, The graphs, The tangent.

Reference Book

1. SERGE LANG, ADDISON -WESLEY PUBLISHING COMPANY Reading, Massachusetts, Menlo Park, California • London Don Mills, Ontario

SS-113 Introduction Economics CHrs:3

Course Objectives

- This course discusses the basic principles of micro and macroeconomics. This course provides the student with a solid grounding in economic principles and familiarize him or her with the institutions and policies that influence economic activity. For those who elect to major in economics, these courses provide the base upon which subsequent courses will build.

- First Introduction to microeconomics studies the economy from the perspective of individual consumers and producers who interact in a market setting. It shows how their choices influence the production and distribution of goods and services and considers the criteria that can be used to assess these outcomes. The course also studies how government intervention can affect the behavior of consumers, producers, and workers and alter market out-comes.
- Second Macroeconomics describes the overall behavior of the economy. In macroeconomics the basic principles of macroeconomics and basic concepts of national income accounting i-e GDP, GNP, NNP, PI, DPI, GDP Deflator etc.
- This also highlights the concepts of money, functions of money, inflation, CPI, impact of inflation on economy and the role of government in an economy

Recommended Books

1. Fundamentals of Economics Part 1 for Intermediate Classes By Habib Ullah Vaseer, edition 2015-2016, Farhan Publishers
2. Samuelson and Nordhaus: Economics 19th edition
3. Welcome to Economics (McConnell) AP Edition, 19th Edition
4. Economic Theory. Vol 2,(2000) by Hussain Ch. M. The carvan press; (Lahore)
5. Walter Nicholson: Micro Economics Theories: Basic Principles and Extensions, 10th Edition.
6. Mankiw, G–Principles of Economics- latest edition.
7. Samulson and Nordrons - Economics –latest edition

Civ-110 **Constitutional Law** **CHrs:03**

Course Contents:

The following concepts shall be covered with special reference to the constitutions of United Kingdom and United States of America:

This course shall cover the nature, sources and fundamental principles of the United Kingdom and the United States Constitutions. The course will examine the remarkable unwritten constitution of the UK, the Separation of Powers, Rule of Law, Parliamentary Supremacy and the Independence of Judiciary under the British constitutional conventions. The course apart from other aspects will cover the concepts of federalism, separation of powers, the functions of the Congress and the legislative procedure, the election of the President and the judicial review under the US Constitution. To understand these concepts with reference to the UK and US constitutions, the following contents order shall be followed:

1. **British Political System**
    a. Nature of the Constitution
    b. Nature of the Conventions in British Constitution
    c. The Institution of Monarchy: Role, Power & Functions and Importance.
    d. The British Legislature: The Structure and Powers & Functions of the British Parliament, the Concept of Parliament Supremacy & Ministerial Responsibility.
    e. The British Executive; Cabinet and the Prime Minister.
    f. The Law-Making Process and Rule of Law
    g. Committee System in UK
    h. British Judicial System
2. **US Political System**
    a. Nature of the Constitution
    b. Nature of the US Federation
    c. The Theory of Separation of Powers and Check and Balance
    d. The American Legislature: Structure and Powers & Functions of US Congress.
    e. The US Executive: Election, Role and Powers & Functions of the US President
    f. Committee System in US
    g. The US Supreme Court: Structure and Powers & Functions
    h. Judicial Review

Recommended Books:

1. Modern Constitutions by Mazhar Ul Haq, 2017
2. America's Constitution by Akhil Reed Amar, 2005
3. World Constitutions by S.L Kelly
4. British Politics by F. N Forman and N. D.J Baldwin, 1991.
5. American Government: Institutions and Politics, 3rd edition by G.Q. Wilson,
6. Parliamentary Government in England by Harold J. Laski, 1960.
7. Political Institutions in Europe by J. M. Colomer, 1996.
8. Major Foreign Powers, New York: Harcourt, Brace & World, INC, 1967.
9. Comparative Constitutional Law by Hamid Khan & M.W. Rana
10. Introduction to the Study of the Law of the Constitution by Dicey
11. Elgar Encyclopedia of Comparative Law by J.M. Smits.

EW-121 Composition Writing (English II) CHrs: 03

The course focuses on the basic strategies of composition and writing skills. Good writing skills not only help students obtain good grades but also optimize their chances to excel in professional life. The course includes modes of collecting information and arranging it in appropriate manner such as chronological order, cause and effect, compare and contrast, general to specific etc. It enables the students to write, edit, rewrite, redraft and proofread their own document for writing effective compositions. Because of the use of a significant amount of written communication on daily basis, sharp writing skills have always been valued highly in academic as well as professional spheres.

Course Contents:

Writing Process: Invention, Generating Ideas (collecting information in various forms such as mind maps, tables, lists, charts etc), Identifying Audience, Purpose, and Message.

Ordering Information: Chronology for a narrative**,** Stages of a process, From general to specific and vice versa, From most important to least important, Advantages and disadvantages, Comparison and contrast, Problem solution pattern

Drafting: Free Writing, Revising, Editing.

Paraphrasing: Cohesion and Coherence, Cohesive Devices, Paragraph unity, Summary and Precise Writing, Creative Writing, Essay Writing.

Developing a thesis, organizing an essay, writing effective introduction and conclusion, different types of essays, use of various rhetorical modes including exposition, argumentation and analysis.

Recommended Books:

1. Goatly, A. (2000). Critical Reading and Writing: An Introductory Course. London: Taylor & Francis
2. Hacker, D. (1992). A Writer's Reference. 2nd ed. Boston: St. Martin's
3 Hamp-Lyons, L. & Heasley, B. (1987). Study writing: A course in written English for academic and professional purposes. Cambridge: Cambridge University Press.
4 Howe, D. H, Kirkpatrick, T. A., & Kirkpatrick, D. L. (2004). Oxford English for Undergraduates. Karachi: Hamidullah, Dr. (2000), *Islamic Notion of conflict of Laws*, Dawah Academy, Islamabad.

MATH-221 CALCULUS-II Credit Hrs: 03

Course Content:

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.

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, roots test. Power series. Convergence of power series. Representation of functions as power series. Differentiation and integration of power series. Taylor and McLaurin 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. Thomas, Calculus, 11th Edition. Addison Wesley Publishing Company, 2005
2. H. Anton, I. Bevens, S. Davis, "Calculus, (Early Transcendental)", (9th edition), John Wiley, New York, 2009.
3. J Stewart, Calculus (7th edition), Brooks/Cole 2011

ENG-231: English III: Communication and Presentation Skills CHrs: 03

Description:

For professional growth and future development, effective presentation skills and interactive and interpersonal communicativeskills are very important. This course offers methods, techniques, and drills significant and useful in optimising communication and presentation skills of the learners, enabling them to face divergent groups of audience with poise and confidence. The course has beendivided into modules relating to the essentials, contents, gestures, technology, and variety associated with communication and presentations skills. The presentation skills part focuses on preparing students for long-life skill of preparing and giving presentations. Communication is a vital part of our daily routine. The communication skills part focuses on developing good communication skills among students.

Course Contents

1. Introduction

- Components of Communication
- Types of Communication
- Understanding the purpose of Communication
- Analyze the Audience
- Communicating with words as well as with body language
- Writing with a Purpose
- Barriers to Communication

2. Presentation skills
3. Delivering your presentation
4. Speaking with Confidence
5. Communicating Effectively
6. Job Interviews and Communicating Skills
7. Communicating with Customers
8. Communication in a Team

Recommended Readings:

1. Carnegie, Dale. ( ). *How to Win Friends & Influence People*.
2. Giblin, Les. *Skill with People*.
3. Newton, Paul. *How to communicate effectively*.

Civ:120 **Pakistan Studies** **CHrs:03**

Course Contents:

Introduction/Objectives:

To develop vision of historical perspective, government, politics,

Study the process of governance, national development, issues arising in the modern age and posing challenges to Pakistan.

Course Outline

1. **Historical Perspective**

a. Ideological rationale with special reference to Sir Syed Ahmed Khan, Allama Muhammad Iqbal and Quaid-e-Azam Muhammad Ali Jinnah.

b. Factors leading to Muslim separatism

c. People and Land

i. Indus Civilization

ii. Muslim advent

iii. Location and geo-physical features.

1. Government and Politics in Pakistan

Political and constitutional phases:

a. 1947-58

b. 1958-71

c. 1971-77

d. 1977-88

e. 1988-99

f. 1999 onward

3. **Contemporary Pakistan**

a. Economic institutions and issues

b. Society and social structure

c. Ethnicity

d. Foreign policy of Pakistan and challenges

e. Futuristic outlook of Pakistan

Recommended Books:

1. Afzal, M. Rafique. Political Parties in Pakistan, Vol. I, II & III. Islamabad: National Institute of Historical and cultural Research, 1998
2. Akbar, S. Zaidi. Issue in Pakistan's Economy. Karachi: Oxford University Press, 2000.
3. Amin, Tahir. Ethno - National Movement in Pakistan, Islamabad: Institute of Policy Studies, Islamabad.
4. Aziz, K.K. Party, Politics in Pakistan, Islamabad: National Commission on Historical and Cultural Research, 1976.
5. Burki, Shahid Javed. State & Society in Pakistan, the Macmillan Press Ltd 1980.
6. Haq, Noor ul. Making of Pakistan: The Military Perspective. Islamabad: National Commission on Historical and Cultural Research, 1993.
7. Mehmood, Safdar. Pakistan Kayyun Toota, Lahore: Idara-e- Saqafat-e-Islamia, Club Road, nd.
8. Mehmood, Safdar. Pakistan Political Roots & Development. Lahore, 1994.

9. Muhammad Waseem, Pakistan Under Martial Law, Lahore: Vanguard, 1987.
10. S.M. Burke and Lawrence Ziring. Pakistan's Foreign policy: An Historical analysis. Karachi: Oxford University Press, 1993.
11. Sayeed, Khalid Bin. The Political System of Pakistan. Boston: Houghton Mifflin, 1967.
12. Wilcox, Wayne. The Emergence of Bangladesh., Washington: American Enterprise, Institute of Public Policy Research, 1972.
13. Zahid, Ansar. History & Culture of Sindh. Karachi: Royal Book Company, 1980.
14. Ziring, Lawrence. Enigma of Political Development. Kent England: WmDawson & sons Ltd, 1980.

PHY-311 Classical Mechanics Credit Hrs: 03

Course Contents:

Review of Newtonian Mechanics: Frame of reference, orthogonal transformations, angular velocity and angular acceleration, Newton's laws of motion, Galilean transformation, conservation laws, systems of particles, motion under a constant force, motions under variable force, time-varying mass system.

The Lagrange Formulation of Mechanics and Hamilton Dynamics: Generalized co- ordinates and constraints, D-Alembert's principle and Lagrange's Equations, Hamilton's principle, integrals of motion, non-conservative system and generalized potential, Lagrange's multiplier method, the Hamiltonian of a dynamical system, canonical equations, canonical transformations, Poisson brackets, phase space and Liouville's theorem.

Central Force Motion: The two-body problem, effective potential and classification of orbits, Kepler's laws, stability of circular orbits, hyperbolic orbits and Rutherford scattering, center of mass co-ordinate system, scattering cross-sections.

Motion in Non- inertial Systems: Accelerated translational co -ordinate system, dynamics in rotating co-ordinate system, motion of a particle near the surface of the earth.

The Motion of Rigid Bodies: The Euler angles, rotational kinetic energy and angular momentum, the inertia tensor, Euler equations of motion, motion of a torque-free symmetrical top, stability of rotational motion.

Recommended Books:

1. T. L. Chow, "Classical Mechanics", John Wiley, 1995.
2. T. Kibble and F. Berkshire, "Classical Mechanics", World Scientific, 5th ed. 2004.C
3. Classical Mechanics, H. Goldstein, 3rd Ed., Addison Wesley Reading, Massachusetts, 2006
4. Classical Dynamics of Particles and System, Jerry B. Marian, Stephen T. Thornton, 4th Ed., Harcourt Brace & Company, 1995.
5. Classical Mechanics, A. Douglas Davis, Academics Press, 1986HEME

PHY-391 Electronics Credit Hrs: 03

Course Contents:

The Semiconductor Diode: Metals, insulators and semiconductors, Conduction in Silicon and Germanium, The forbidden energy gap, n and p type semiconductors, the junction diode, diode voltage-current equation, Zener diodes, light emitting diodes, photodiodes, capacitance effects in the pn junction.

The Diode as Rectifier and Switch: The ideal diode model, the half wave rectifier, the full wave rectifier, the bridge rectifier, measurement of ripple factor in the rectifier circuit, the capacitor filter, the ∏ filter, the ∏-R filter, the voltage doubling rectifier circuit, rectifying AC voltmeters, diode wave clippers, diode clampers.

Circuit Theory and Analysis: Superposition theorem, Thevenin's Theorem, Norton's Theorem, Model for circuit, one port and two-port network, Hybrid parameter equivalent circuit, Power in decibels.

The Junction Transistor as an Amplifier: Transistor voltage and current designations, the junction transistors, the volt-ampere curve of a transistor, the current amplification factors, the load line and Q point, the basic transistor amplifiers, the common emitter amplifier, the trans- conductance gm, performance of a CE amplifier, relation between Ai and Av, the CB amplifier, the CC amplifier, comparison of amplifier performance.

DC Bias for the Transistor: Choice of Q point, variation of Q point, fixed transistor bias, the four resistor bias circuit, design of a voltage feedback bias circuit, Common emitter, common collector, common base biasing.

Field Effect Transistor: What is /field effect transistor, JFET: Static characteristics of JFET, Metal oxide semiconductor Field Effect Transistor (MOSFET of IGFET): enhancement and depletion mode, FET biasing techniques, Common drain, common source and common gate, fixed bias and self-bias configurations, Universal JFET bias curve, Darlington pair.

Operational Amplifiers: The integrated amplifier, the differential amplifier, common mode rejection ratio, the operational amplifier, summing operation, integration operation, comparator, milli-voltmeter.

Recommended Books

1. Imillman & c.Chalkaias , 'integrated Electronic ' ,McGraw hill Block Company , Singapore (Latest Edition)
2. T.L.Floyd , "electronic device", Merril Publishing company Columbus (1988)
3. A.P .Malvino , "electronic principle" , TATA McGraw Hill ,New Delhi (1980)
4. D.B.Bell , "Electronics devices &Circuits" ,Reston Publishing Company Inc, Virginia (1980)
5. C.J.Savant Jr.M.S .Roden, G.L.Carpenter, "Electronic Design Circuits & Systems", The B Engamin /Cummings Publishing Co, California (1991).
6. Larry D Jons, Principles and applications of Digital Electronics, Mic-Millian Publishing company, 1993.
7. Digital system design and microprocessor J.C. Bortie (NBF).
8. Mic-Millian, Micro electron, Megraw Hill.
9. Digital Logic and computer Design Morris Mono, 1995 Prentic Hall.
10. Tochim, Digital Electronics (1999).

11. Barrey B. Bery, Intel UPS architecture, Programming and interfacing, Printic Hall (1998).

PHYS-321 ELECTRODYNAMICS-I Credit Hrs: 03

Course Contents:

Differential/integral calculus; Orthogonal coordinate systems (Cartesian/cylindrical/ spherical); Electrostatics in free space: Electrostatic force/field/potential/energy for discrete (a single point charge/a collection of point source charges) and continuous (line/surface/volume) charge distributions, Divergence/curl of E, Electrostatic boundary conditions (on E, V, and D), Conductors, Capacitors; Boundary value problems: Solutions of Laplace's equation for various symmetries (Cartesian/ cylindrical/spherical), Method of Images for various symmetries; Electric monopole/ dipole/quadrupole/octopole etc., Electric dipole moment for line/surface/volume charge; Electrostatics in matter: Polarization P, Bound surface/volume charge, Electric displacement D, Gauss's law for D & P−differential/integral forms and its uses/applications, Electric susceptibility/permittivity/relative permittivity; Electric line/surface/volume currents I/K/J, Equation of continuity.

Recommended Books:

1. D. J. Griffiths "Introduction to Electrodynamics", Prentice Hall, USA,3rd ed.(1999).
2. D. K. Cheng, "Field and Wave Electromagnetics", Addison Wesley, USA 2nd ed. (1983).
3. H. A. Haus and J. R. Melcher, "Electromagnetic Fields and Energy", Prentice Hall, USA,1sted. (1989).
4. Classical Electromagnetic Theory, by Jack Vanderlinde, Kluwer Academic, USA,2nd ed., (2004).
5. P. Lorrain and D. R. Corson, "Electromagnetic Fields and Waves", W. H. Freeman, USA,3rd ed. (1988).
6. J. R. Reitz, F. J. Milford, R. W. Christy,"Foundations of Electromagnetic Theory", Narosa, India,3rded. (1998).
7. Electronic Principles by A.P. Malvino, Tata McGraw Hill, New Delhi (1988).

PHYS-322 ELECTRODYNAMICS-II Credit Hrs: 03

Course Contents:

Electrodynamics: Electromotive force: Ohm's law, electromotive force, motional emf, electromagnetic induction: Faraday's law, the induced electric field, inductance, energy in magnetic fields, Maxwell's equations: electrodynamics before Maxwell, how Maxwell fixed Ampere's law, Maxwell's equations, magnetic charges, Maxwell's equations in matter, boundary conditions. Conservation Laws: Charge and energy: the continuity equation, Poynting's theorem, momentum: Newton's third law in electrodynamics, Maxwell's stress tensor, conservation of momentum, angular momentum. Electromagnetic Waves: Waves in one dimension: the wave equation, sinusoidal waves, boundary conditions, reflection and transmission, polarization,

electromagnetic waves in vacuum: the wave equation for E and B, monochromatic plane waves, energy and momentum in electromagnetic waves, electromagnetic waves in matter: propagation in linear media, reflection and transmission at normal incidence, reflection and transmission at oblique incidence, absorption and dispersion: electromagnetic waves in conductors, reflection at a conducting surface, the frequency dependence of permittivity, guided waves: wave guides, the waves in a rectangular waveguide.

Recommended Books:

1. D.J. Griffiths,"Introduction to Electrodynamics", Prentice Hall, USA, 3rd ed. (1999).
2. David K. Cheng, "Field and Wave Electromagnetics", Addison Wesley, USA,2nd ed. (1983).
3. M.N.O. Sadiku, "Elements of Electromagnetics",Oxford University Press,5th ed. 2009.
4. H.A. Haus and J.R. Melcher, "Electromagnetic Fields and Energy", Prentice Hall, USA, 1st ed. (1989).
5. J,Vanderlinde, "Classical Electromagnetic Theory", Kluwer Academic, USA, 2nd ed. (2004).
6. P. Lorrain and Dale R. Corson, "Electromagnetic Fields and Waves", W. H. Freeman, USA,3rd ed. (1988).

PHYS-392 OPTICS Credit Hrs: 03

Course Contents:

Huygens' Principle, Fermat's Principle, Laws of Reflection and Refraction, Refraction at a Spherical Surface, Thin Lenses, Newtonian Equation for a Thin Lens. Ray Transfer Matrices, Thick Lens, Significance of System Matrix Elements, Cardinal Points of an Optical System with examples, Optical Instruments including Simple Magnifiers, Telescopes and Microscopes, Chromatic and Monochromatic Aberrations, Spherical Aberrations, Coma, Distortion, Stops, Pupils, Windows. Superposition & Interference: Standing Waves, Beats, Phase and Group Velocities, Two-Beam and Multiple-Beam Interference, Thin Dielectric Films, Michelson and Fabry-Perot Interferometers, Resolving Power, Free-Spectral Range. Jones Matrices, Production of Polarized Light, Dichroism, Brewster's Law, Birefringence, Double Refraction. Fraunhofer Diffraction: from a Single Slit, Rectangular and Circular Apertures, Double Slit, Many Slits, Diffraction Grating, Dispersion, Resolving Power Blazed Gratings. Fresnel Diffraction: Zone Plates, Rectangular Apertures, Cornu's Spiral Coherence & Holography: Temporal Coherence, Spatial Coherence, Holography of a Point object and an Extended Object Laser Basics: Stimulated Emission, Population Inversion, Resonators, Threshold and Gain, Multi-layered Dielectric Films.

Recommended Books:

1. F. Pedrotti, L. S. Pedrotti, L. M. Pedrotti, "Introduction to Optics",3rd ed.Pearson Prentice Hall, (2007).
2. E. Hecht and A. Ganesan, "Optics", 4 th ed. Dorling Kindersley, (2008).
3. M. V. Klein, T. E. Furtak, "Optics", 2nd ed. John Wiley, (1986).
4. K. K Sharam, "Optics: Principles and Applications", Academic Press,(2006).
5. C. A. Bennett, "Principles of Physical Optics", John Wiley, (2008).

PHYS-102 ELECTRICITY AND MAGNETISM Credit Hrs: 04

Course Contents:

Electric charge (properties/quantization/conservation), Coulombs law in free space, Electric field due to discrete/continuous charges distributions, Electric dipole, Electric flux, Gauss's law and its applications, Electric potential due to discrete/continuous charges distributions, Work and Electric potential energy, Capacitors and capacitance, Capacitance for various geometries, Capacitance with Dielectrics, Electric Current, current density, Resistance and resistivity, Microscopic and macroscopic forms of Ohm's Law, Energy transfer in electric circuit, Power in electric circuits, Calculating current in a single loop and multiple loop by using Kirchhoff laws, Circuit analysis, Growth and decay of current in RC-circuits and its analytical treatment. Magnetic field, Magnetic forces on a single point charge/current carrying conductor, Torque on a current carrying loop and magnetic dipole, Biot & Savart Law and its analytical treatment and application, Ampere's law and its applications, Electromagnetic induction and its laws, Inductance, Inductance for various configurations, LR circuits, Growth and decay of current in RL circuits, Electromagnetic Oscillation (Qualitative and Quantitative analysis using differential equations), Forced electromagnetic oscillations and resonance, Alternating current circuits, Single loop RLC circuits (series and parallel), Power in AC circuits and phase angles, Maxwell's equations (integral/differential forms), Electromagnetic waves, Poynting vector, Magnetic properties of materials.

Recommended Books:

1. D. Halliday, R. Resnick and K. S. Krane, "Fundamentals of Physics", John Wiley & Sons Inc., 5th Ed. (2003).
2. R. A. Freedman,H. D. Young and A. L. Ford(Seers and Zemansky's),"University Physics", Pearson Education Inc, 11th (2006).
3. D. C. Giancoli, "Physics for Scientist and Engineers with Modern Physics", 2nd ed. Prentice Hall Inc. (1988).

PHYS-372 STATISTICAL PHYSICS Credit Hrs: 03

Course Outlines:

Review of thermodynamics: Mathematical formulation of first and second law of thermodynamics, Maxwell's relation, Reduction of derivatives, General conditions of equilibrium. Partition Function: Partition Function, Relations of partition function with thermodynamical variables, examples (collection of simple harmonic oscillators, Half spin paramagnet. Basic Principles of statistical Mechanics: Microscopic and macroscopic states, Phase Space, Ensemles, Liouvillie theorem, Formation of Micro canonical, Canonical and Grand canonical partition function.

Maxwell distribution of molecular speed: Probability of the particle in quantum state, Density of states in k-space, single particle density of states in energy, Maxwell-Boltzman Distribution Function, Validity of Maxwell-Boltzman statistics, Evaluation of constants α and β, Maxwell Speed distribution function. Theory of ideal Fermi System: Fermi-Dirac Distribution Function, Examples of the Fermi system (free electron theory of metals, Electrons in stars, electrons in white dwarf stars). Theory of Bose System: Bos-Einstein Distribution Function, Black body radiation, the photon gas, ideal bose gas model of liquid helium, Einstein's model of vibration in solids, Debye's model of vibration in solids.

Advanced Topics: Fluctuations, Bose-Einstein Condensation, Introduction to density matrix approach.

Recommended Books:

1. F. Reif, "Fundamentals of Statistical and Thermal Physics", Waveland PrInc, (2008).
2. W. Brewer, F. Schwabl, "Statistical Mechanics", Springer, 2nd ed. (2006).
3. T. L. Hill, "Statistical Mechanics", World Scientific Publishing Company,(2004).
4. K. Huang, "Statistical Mechanics", John Wiley, 2nd ed. (1987).

PHYS-204 HEAT AND THERMODYNAMICS Credit Hrs: 03

Course Contents:

Basic Concepts and Definitions in Thermodynamics, Properties and state of the substance, Extensive and Intensive properties, Equilibrium, Mechanical and Thermal Equilibrium, Processes and Cycles: Isothermal, Isobaric and Isochoric., Zeroth Law of Thermodynamics, Consequence of Zeroth law of, Thermodynamics. The state of the system at Equilibrium, Heat and Temperature: Temperature, Kinetic theory of ideal gas, Work done on an ideal gas, Internal energy of an ideal gas: Equipartition of Energy, Intermolecular forces, Qualitative discussion, The Virial expansion, The Van der Waals equation of state. 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 Functions: Thermodynamic functions (Internal energy, Enthalpy, Gibb's functions, Entropy, Helmholtz functions), Maxwell's relations, TdS equations, Energy equations and their applications. Low Temperature Physics, Joule-Thomson effect and its equations. Thermoelectricity: Thermocouple,

Seabeck'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 Legvaian equation, Qualitative description.

Recommended Books:

1. B. N. Roy, "Principles of Modern thermodynamics",Institute of Physics, London (1995).
2. D. Halliday, R. Resnick K. S. Krane, "Fundamentals of Physics", John Wiley & Sons Inc., 5th Ed. (2003).
3. M. W. Zemansky, Heat and Thermodynamics, McGraw Hill, 7th ed. (1997).
4. M. Sprackling, "Thermal Physics", McMillan (1991).

PHYS-203 WAVES AND OSCILLATIONS Credit Hrs: 03

Course Contents:

Harmonic Oscillator Equation, Complex Number Notation, Simple Pendulum, Transverse Waves: Transverse Standing Waves, Normal Modes, General Time Evolution of a Uniform String, Phase velocity, Group Velocity. Longitudinal Waves: Spring Coupled Masses, Sound Waves in an Elastic Solid, Sound Waves in an Ideal Gas, Traveling Waves: Standing Waves in a Finite Continuous Medium, Traveling Waves in an Infinite Continuous Medium, Energy Conservation, Reflection and Transmission at Boundaries, Electromagnetic Waves, Wave Pulses: Multi-Dimensional Waves: Plane Waves, Three-Dimensional Wave Equation, Waveguides, Cylindrical Waves, Interference and Diffraction of Waves: Double-Slit Interference, Single-Slit Diffraction.

Recommended Books:

1. J. Pain, "The Physics of Vibrations and Waves", John Wiley, 6th ed. 2005.
2. P. French, "Vibrations and Waves", CBS Publishers (2003).
3. F. S. Crawford, Jr., "Waves and Oscillations", Berkeley Physics Course,Vol. 3, McGraw-Hill, 1968.
4. A. Hirose, and K. E. Lonngren, "Introduction to Wave Phenomena",Krieger Publications, 2003.

PHYS-205 MODERN PHYSICS CREDIT Hrs: 03

Course Contents:

Motivation for Non--Classical Physics: Quantum interference, black body radiation and ultraviolet catastrophe, Planck's quantization. Photoelectric effect, Compton effect, production and properties of X-rays, diffraction of X-rays, concept of matter waves, de Broglie relationship, electrons are waves, electron diffraction, particulate nature of matter, contributions of Faraday (atoms exist), Thomson (electron exists), Rutherford (nucleus exists) and Bohr (quantization of energies inside

an atom), wave packets and wave groups, dispersion, Heisenberg uncertainty principle, direct confirmation of quantization through Franck-Hertz experiment and spectroscopy, working of electron microscopes. Quantum Mechanics in One Dimension: The concept of a wave function, time independent Schrodinger equation and interpretation of the equation, solving the Schrodinger equation for a free particle, for a particle inside an infinite box, relationship between confinement and quantization, working of a CCD camera. Concept of tunneling, reflection and transmission of wave functions from barriers, applications: radioactivity, scanning tunneling microscope, decay of black holes. The Hydrogen atom, orbitals, angular momentum and its quantization, orbital magnetism, Zeeman effect, concept of spin, Pauli's exclusion principle, Building of the periodic table, magnetic resonance and MRI, why is iron magnetic? White dwarfs and neutron stars. From Atoms to Molecules and Solids: Ionic bonds, covalent bonds, hydrogen bonds, molecular orbitals, how crystals are different from amorphous solids? Why and how do metals conduct electricity? Bands in solids, semiconductors, introduction to ED's and lasers, in traducing graphene. Nuclear Structure: Size and structure of nucleus, nuclear forces, radioactivity and nuclear reactions, radiocarbon dating.

Recommended Books:

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

PHY- 351 Mathematical Methods of Physics-I Credit Hrs: 03

Course Contents:

Vector Analysis:

Review of vectors Algebra, Vector operations, Physical significance of DEL operator, Line integrals, Surface and Volume Integrals, Gradient of a scalar, Divergence of a vector , Directional derivatives and gradients, Curl of a vector , Gauss's divergence theorem, Green's theorem, Vector differentiation and gradient, Vector integration, , Stokes's Curl theorem, , Cartesian coordinates systems, Polar coordinates systems, Spherical polar and Cylindrical coordinates systems.

Matrices:

Determinants, Matrices, Linear vector spaces, orthogonal matrices, Hermitian matrices, Unitary Matrices, Orthogonalization, Eigenvalues and eigenvectors of matrices, , Similarity transformations, Diagonalization of matrices.

Complex Variables:

Complex numbers , Functions of a complex variable, analytic functions of complex variables, De Moivre's theorem, Taylor and Laurent series, Cauchy Riemann conditions and analytic functions, Cauchy integral theorem, Cauchy integral formula, Euler's formula, harmonic functions, complex integration, Contour integrals, singularities and residues, residue theorem.

Recommended Books:

6. G. Arfken, Mathematical Physics, 2nd ed, Academic Press, 1970.
7. Dass H.K, R. Verma, 2011, 6th Edition, Mathematical Physics, S. Chand& Company Ltd. New Delhi.
8. E. Butkov, Mathematical Physics, Addison-Wesley 1968.
9. Pipes and Harvill, Applied Mathematics for Engineers and Physicists, McGraw Hill, 1971.
10. M. L. Boas, Mathematical Methods in Physical Sciences, John Wiley & Sons, New York (1989)
11. M. R. Speigel, Complex Variables Schaum's Outline Series, McGraw Hill 1979

PHY-352 Mathematical Methods of Physics-II Credit Hrs: 03

Course Contents:

Differential Equations in Physics: First and second order linear differential equations, partial differential equations in theoretical physics, separation of variables, homogeneous differential equations, Frobenius series solution of differential equations, second solution, non-homogeneous differential equations Special Functions: Bessel functions and Hankel functions, Spherical Bessel functions, Legendre polynomials, associated Legnedre polynomials, spherical harmonics, Laugerre polynomials, Hermite polynomials Fourier Series: Definition and general properties, Fourier series of various physical functions, Uses and application of Fourier series.

Integral Transforms: The integral transforms, Fourier transform, Convolution theorem, Parseval's theorem, elementary La place transform and its applications Boundary Value Problems and Green's Functions: Boundary3 value problems in Physics, Non-homogeneous boundary value problems and Green's functions, Green's functions for one-dimensional problems, Eigenfunction expansion of Green's function, construction of Green's functions in higher dimensions.

Recommended Books:

1. M.L. Boas, 'Mathematical Methods in Physica Sciences', Jhon Wiley & Sons, New York (1989).
2. C. Wa Wong, 'Introduction to Mathematical Physics', OxfordUniversity Press, New York (1991).
3. Hassani, 'Foundations of Mathematical Physics', Prentice Hall International Inc., Singapore.
4. Chattopadhyay, 'Mathematical Physical', Wiley Eastern Limited, New Delhi, (1990).
5. H. Cohen, 'Mathematics for Scientists & Engineers' Prentice Hall International Inc., New Jewrsey (1992)
6. Essential mathematical methods for Physicists, Webber and Arfken

PHY-331 Quantum Mechanics-I Credit Hrs: 03

Course Contents:

Energy the Hamiltonian and angular momentum, The state of a system, Properties of the one dimensional positional function, The works of Planck Black body radiation, The work of Einstein The photo electric effect, The work of Bohr. A Quantum theory of atomic states, Waves versus particles, The De Broglie hypothesis and the Davison-Gamer Experiment, The work of Heisenberg, The work of Born. Probability waves, Observable and operators, Measurement in Quantum Mechanics, The State Function and Expectation values, Time Development of the state function, Particle in a box, The Bohr correspondence principle, Dirac Notation, Hilbert space, Hermitian Operators, Properties of Hermitian operators, The superposition principal, Commutator relations and the uncertainty principal, Schrodinger wave equation, Time department and time independent, One dimensional positional step problem, The rectangular barrier (tunneling), The finite positional well.

Recommended Books:

1. Richard L. Liboff, 4th Edition, Person Education Introductory Quantum Mechanics,
2. Nouredine Zettli, John Wiley & Son, 2001Quantum Mechanics, Concepts and Application,
3. B.H. Bransden & C.J. Joachain: Introduction to Quantum Mechanics' Longman Scientific & Technical London (1990).
4. J. S. Townsedn, 'A Modern Approach to Quantum Mechanics\, McGraw Hill Book Company, Singapore (1992).
5. W. Greiner, 'Quantum Mechanics: An Introduction', Addison Wesley Publishing Company, Reading Massachausetts (1980).
6. R.L. Liboff, 'Introductory Quantum Mechanics', Addison Wesley Publishing Company, Reading Massachusetts (1980).
7. Bialynicki-Birula, M. Cieplak & J. Kaminski, Theory of Quantua', Oxford University Press, New York (1992).
8. W. Greiner, 'Relativistic Quantum Mechanics', Springer Verlag. Berlin (1990).
9. F. Schwable, 'Quantum Mechanics', Narosa Publishing House, New Delhi (1992)
10. David J. Griffths, Introduction to Quantum Mechanics. Prentice-Hall
11. S. Gasiorowiz, Quantum Physics. John Wiley and Sons Inc. Singapore

PHYS-432 QUANTUM MECHANICS-II Credit Hrs: 03

Course Contents:

Addition of Angular Momenta: Total angular momentum in classical mechanics, total angular momentum in quantum mechanics, addition of two spin ½ angular momenta, addition of two arbitrary angular momenta, Clebsch-Gordon coefficients, addition of spherical harmonics, vector operators, Wigner-Eckart theorem, electric Multi-pole moments, Evolution of two angular momenta J1 and J2 coupled by an interaction aJ1 . J2.Stationary Perturbation Theory: Description

of the method, perturbation of non-degenerate level, perturbation of a degenerate level, one-dimensional harmonic oscillator subjected to a perturbing potential, interaction between the magnetic dipoles of two spin ½ particles, Van der Waals forces, volume effect and The influence of the spatial extension of the nucleus on the atomic levels, vibrational method, energy bands of electrons in solids, a simple example of the chemical bond: The ion Applications of Perturbation Theory to Atomic Systems: fine and hyperfine structure of atomic levels in hydrogen, Calculation of the mean values of the spin-orbit coupling in the 1s, 2s and 2p levels, hyperfine structure And the Zeeman effect for muonium and positronium, Stark effect Approximation Methods for Time-Dependent Problems: Statement of theproblem, approximate solution of the Schrodinger equation, An importantspecial case: Sinusoidal or constant perturbation, Interaction of an atom withelectromagnetic waves, linear and non-linear response of a two-level system subjected to a sinusoidal perturbation, Oscillations of a system between two discrete states under the effect of a resonant perturbation.

Recommended Books:

1. R.L. Liboff, "Introductory Quantum mechanics", Addison Wesley Publishing Company, Reading Mass. (1980).
2. N. Zettili, "QUANTUM MECHANICS: Concepts and Applications" JOHN WILEY & SONS (2001)
3. J.S. Townsend "A Modern Approach to Quantum Mechanics" McGraw Hill Book Company, Singapore (1992).
4. W. Greiner, "Quantum Mechanics: An Introduction", Addison Wesley Publishing Company, Reading Mass. (1980).
5. Bialynicki-Birula, M. Cieplak, J. Kaminski "Theory of Quantua", Oxford University Press, New York (1992).
6. W. Greiner, "Relativistic Quantum Mechanics", SpringerVerlag, Berlin (1990).
7. F.S. Narosa "Quantum Mechanics", Publishing House, New Delhi (1992).
8. Gasiorowicz, "Quantum Physics", John Wiley & Sons, Inc., Singapore, (2003).
9. D. J. Griffiths, "Introduction to Quantum Mechanics", PRENTICE Hall, Int., Inc, (2005).

PHYS-441 SOLID STATE PHYSICS-I Credit Hrs: 03

Course Outlines:

Crystal structure in 2D and 3D, fundamental types of lattices, index system for crystal planes, simple crystal structures, X-ray diffraction, Braggs law, reciprocal lattice, Diffraction of waves by crystals, scattered wave amplitude, Brillouin zones, crystal binding and elastic constants, Classification of Solids, ionic crystals, covalent crystals, Ionic Radii, II-VI and III-V compounds, Molecular crystals, metals, Cohesive energy, The Lenard Jones Potential, Density, Cohesive energy and Bulk Modulus of crystalline solids, The Madelung constant, Cohesion in Covalent crystals, elastic waves in cubic crystals. Vibration of crystals with monatomic basis, two atoms per

primitive basis, quantization of elastic waves, normal vibration modes and phonon, phonon momentum, inelastic scattering by phonons, Phonon heat capacity, lattice heat capacity, Einstein and Debye models, Somerfield model of free electron theory, Energy levels in one dimension, free electron gas in three dimensions, DC and AC electrical conductivity of metals

Recommended Books:

1. C. Kittle, "Introduction to Solid State Physics", John Wiley & Sons, Inc. 7th ed. (2005).
2. N.W. Ashecroft, N. David Mermin "Solid state physics", CBS Publishing Asia Ltd. (2003).
3. J.S. Blakemroe, "Solid State Physics", Cambridge University Press (1991).
4. M.A. Omar "Elementary solid state physics",(2003).
5. N.G.Szwachi and T.Szwacka "Basic elements of crystallography", (2010)
6. R.K.Puri and V.K.BabbarSolid State Physics and electronics", (2007)

PHY-442 Solid State Physics-II Credit Hrs: 03

Course outline:

Transport Properties of Solids: Motion of electron in bands, Effective mass, Electrical conductivity of metals, electrical Conductivity of localized electrons, Boltzmann equation.

Defects in Crystals: Crystal imperfections, Thermodynamics of Point defects, Schottky and Frenkel defects, color centres, Dislocations in Solids, Burgers vectors, edge dislocation, Screw dislocation Slip and plastic deformation, Stacking faults and grain Boundaries, Strength of Crystals, Diffusion and Fick's law Dielectrics and Ferroelectrics: Maxwell Equations, Polarization, Dielectric Constant and Dielectric Polarizability, Susceptibility, Electronic Polarizablity, Clausius-Mossotti Relation, Structural Phase Transitions, Langevin theory of Dia and Paramagnetism, Ferro-magnetism, Domain theory, Weiss theory of Ferromagnetism, Magnetic relaxation and resonance phenomena.

Semiconductors and Superconductivity: Intrinsic Semiconductors, Extrinsic semiconductors, Band structure, Energy Gap, Donor and acceptor Level, Hall Effect, Superconductivity-an introduction, zero resistivity and Meissner effect, Diamagnetism, susceptibility, Critical field, temperature and current, Type-I and type-II superconductors, BCS theory, electron-phonon-electron interaction via lattice deformation, ground state of superconductors, Cooper pairs, Coherence length, the origin of energy gap, London equations (electrodynamics), London penetration depth, thermodynamics of superconductors, entropy and the Gibbs free energy, Josephson effect, superconductors applications.

Recommended Books Texts:

1. C. Kittle, Introduction to Solid State Physics, 7th edition 1996, John Wiley.
2. S.O.Pillai, Solid State Physics, New Age International Pub. 2003.
3. W.T. Read Jr. Dislocations in crystals, McGraw Hill, 1991.

4. C.M. Kachaava, Solid State Physics, Tata McGraw Hill. Co. New Delhi, 1989.
5. J.R. Christman, Solid State Physics, John Wiley & Sons, New York, 1988.
6. H.E. Hall, Solid State Physics, John Wiley & Sons, New York, 1982.
7. A. Guinier & R. Jullien, The Solid State, Oxford University Press, Oxford, 1989.

PHY-443 Atomic and Molecular Physics Credit Hrs: 03

Course outline:

Nuclear Atom, Rutherford's Scattering formula, Electron Orbits, Atomic spectra, The Bohr's atom, Energy levels and spectra, Origin of line spectra, Correspondence Principle, Nuclear motion, Atomic excitation, Laser, Wave function, Wave equation, Time dependant and Time independent Schrödinger equation, Harmonic oscillator, Schrödinger equation for Hydrogen Atom, Separation of variables, Quantum Numbers, Electron Probability Density, Radiative transitions, Selection rules, Zeeman effect, Electron spin, Strern-Gerlach experiment, Pauli Exclusion Principle, Symmetric and anti-symmetric wave functions, Periodic table, atomic structure, Explanation of Periodic table, Spin orbit coupling, Total angular momentum, LS coupling, JJ coupling, Term symbols, X-ray spectra, Discrete X-ray spectra, Continuous X-ray Spectra, Auger effect.

Molecular bond, Electron sharing, H2+ molecular ion, Hydrogen molecule, complex molecules, Rotational energy levels, Rotational spectra, Vibrational energy levels, Vibrational spectra, Vibration – Rotation spectra, Electron spectra of molecules

Recommended Books:

1. Anne, P. T.; 1988: Spectroscopics, 2nd edition Chapman
2. Bransden, B. H. and Joachain, C. J.; 1983: Physics of Atoms and Molecules. Longmans, London.
3. Eisberg, R. and Resnick, R.; 1985: Quatum Physics of Atoms, Molecules, Solids, Nuclie and Prtaicles, 2nd Edition. John Wiley and Sons.
4. Laud, B. B.; 1991: Lasers and Non-linear Optics, 2nd Edition. Wiley Eastern Limited. New Delhi
5. Koichi, S.; 1983: Introduction to laser's Physics. Springer verlag
6. Beiser, A. 1987: Concepts of Modern Physics. 4th edition. McGraw-Hill Book Company

PHY-493 Nuclear Physics Credit Hrs: 03

Course outline:

Nuclear Decay and Radioactivity: The basis of theory of radioactive disintegration, the disintegration constant, the half-life and the mean life, successive radioactive transformation, radioactive equilibrium, the natural radioactive series, units of radioactivity.

Alpha Decay: Why alpha decay occurs, Basic alpha decay process, the velocity and energy of alpha particle, Abortion of alpha particles: Range, ionization, and stopping power, Alpha decay

systematic, Theory of alpha decay emission, Angular momentum and parity in alpha decay, Alpha decay spectroscopy

Beta Decay: Energy release in beta decay, Fermi theory of beta decay, The experimental test of Fermi theory, Angular momentum and parity selection rules, Neutrino Physics, Double beta decay, Beta-delayed nucleon emission, Gamma decay: Energetic of gamma decay, Classical electromagnetic radiation, Transition to quantum mechanics.

Nuclear Fission: Why Nuclear Fission, Characteristics of nuclear fission, Energy in fission, Fission and nuclear structure, Controlled fission reaction, Fission reactors, Radioactive fission products.

Nuclear Fusion: Basic nuclear fusion process, Characteristic of fusion, Solar fusion, Controlled fusion reactor.

Recommended Books:

1. K.S. Krane 'Introductory Nuclear Physics' John-Wiley (1987).
2. D. Evans 'The Atomic Nucleus' McGraw-Hill (1955).
3. W.E. Meyerhof 'Elements of Nuclear Physics' McGraw-Hill (1989).
4. B.L. Cohen 'Comcepts of Nuclear Physics' McGraw-Hill (1971).
5. L. Kaplan 'Nuclear Physics' Addison-Wesely (1979).
6. R. E. Lapp and H.L. Andrews 'Nuclear Radiation Physics' Prentice-Hall (1972).
7. H. A. Enge 'Introduction to Neclear Physics' Addison-Wesley (1969)

PHYS-000 DIGITAL ELECTRONICS Credit Hrs: 03

Course outline:

Review of Number Systems: Binary, Octal and Hexadecimal number system, their inter-conversion, concepts of logic, truth table, basic logic gates. Boolean Algebra: De Morgan's theorem, simplification of Boolean expression by Boolean Postulates and theorem, K-maps and their uses. Don't care condition, Different codes. (BCD, ASCII, Gray etc.). Parity in Codes. IC Logic Families: Basic characteristics of a logic family. (Fan in/out, Propagation delay time, dissipation, noise margins etc. Different logic based IC families (DTL, RTL, ECL, TTL, CMOS).Combinational Logic Circuit: Logic circuits based on AND – OR, OR-AND,NAND, NOR Logic, gate design, addition, subtraction (2's compliments, half adder, full adder, half subtractor, full subtractor encoder, decoder, PLA. Exclusive OR gate. Sequential Logic Circuit: Flip-flops clocked RS-FF, D-FF, T-FF, JK-FF, Shift Register, Counters (Ring, Ripple, up-down, Synchronous) A/D and D/A Converters. Memory Devices: ROM, PROM, EAPROM, EE PROM, RAM, (Static and dynamic) Memory mapping techniques Micro Computers: Computers and its types, all generation of computers, basic architecture of computer, micro processor (ALU, UP

Registers, Control and Time Section). Addressing modes, Instruction set and their types, Discussion on 8085/8088, 8086 processor family, Intel Microprocessor Hierarchy Micro-controller/ Embedded System: Introduction to Embedded and microcontroller based systems, The Microprocessor and microcontroller applications and environment, microcontroller characteristics, features of a general purpose microcontroller, Microchip Inc and PIC microcontroller, Typical Microcontroller examples:, Philips 80C51 & 80C552 and Motorola68Hc05/08, interfacing with peripherals.

Recommended Books:

1. M. M. Mono, "Digital Logic and Computer Design", Prentice Hall, (1995).
2. R. Tokheim, "Digital Electronics", McGraw Hill, 7th ed. (2007).
3. B.B. Brey, "The Intel Microprocessors: Architecture, Programming andInterfacing", Merril, 2nd ed. (1991).
4. T.L. Floyd, "Electronics Fundamentals: Circuits, Devices andApplications", Prentice Hall, 8th ed. (2009).
5. T. Wilmshurst, "The Design of Small-Scale Embedded Systems",Palgrave, (2001).

PHYS-000 Method of Experimental Physics Credit **HRS: 03**

Course outline:

Vacuum Techniques: Gas Transport: Throughout, Pumping Speed, Pump down Time Ultimate pressure. Fore-Vacuum Pumps: Rotary Oil pumps, sorption pumps. Diffusion pumps, sorption pumps (High Vacuum). Production of ultrahigh vacuum, Fundamental concepts, guttering pumps, Ion pumps, Cryogenic pumps, Turbo molecular pumps. Measurement of total pressure in Vacuums Systems, Units pressure ranges, Manometers, Perini gauges, The McLoad gauges, Mass spectrometer for partial measurement of pressure, Design of high Vacuum system, Surface to Volume ratio, Pump Choice, pumping system design. Vacuum Components, Vacuum valves, vacuum Flanges, Liquid Nitrogen trap, Mechanical feed through & Electrical feed through Leak detection: Basic consideration, leak detection equipment, Special Techniques and problems, Repair Techniques, Radiation Detection and Measurement: GM tubes, scintillation detector, channeltron, photo multipliers, neutron detectors, alpha/beta detectors, x-rays/gamma detectors, cosmic rays detectors, Spectrographs and Interferometers, Sensor Technology: Sensors for temperature, pressure displacement, rotation, flow, level, speed, rotation position, phase, current voltage, power magnetic field, tilt, metal, explosive and heat, Electronics and Electronic Instruments: Operational amplifiers, summing amplifiers, difference amplifiers, Differentiators, Integrators, Logarithmic amplifiers, current to voltage converter, Spectroscopy amplifiers, charge sensitive pre-amplifiers, Coincidence circuits, Isolators, Ramp Generators, and single channel

analyzer. Power supplies, Signal Generators, Counters, Multichannel analyzer, Lock in Amplifiers, Boxcar averages, Computer Introduction: Introduction to computers, GPIB Interface, RS 232.Interfacing, DA/AD conversion, Visual c/visual Basic, Data Analysis: Evaluation of measurement: Systematic Errors, Accuracy, Accidental Errors, Precision, Statistical Methods, Mean Value and Variance, Statistical Control of Measurements, Errors of Direct measurements, Rejection of data, Significance of results, Propagation of errors, preliminary Estimation, Errors of Computation. Least squares fit to a polynomial, Nonlinear functions, Data manipulation, smoothing, interpolation and extrapolation, linear and parabolic interpolation.

Recommended Books:

1. F. James, "Statistical Methods in Experimental Physics", World Scientific Company, 2nd ed. 2006.
2. M. H. Hablanian, "High-Vacuum Technology", Marcel Dekker, 2nd ed.1997.
3. P. Bevington and D. K. Robinson, "Data Reduction and Error Analysis forPhysical Science", McGraw-Hill, 3rd ed. 2002.

PHYS- 000 INTRODUCTION TO NANO SCIENCE AND NANOTECHNOLOGIES Credit Hrs: 03

Course outline:

Introduction: Feynman talks on small structures, Nano scale dimension, Course goals and objectives, Quantum Effects: Wave particle duality, Energy quanta, Uncertainty principle, De Broglie relation, Quantum Dots, Moore's law, tunneling, Surfaces and Interfaces: Interfaces, Surface chemistry and physics, Surface modification and characterization, Thin Films, Sputtering, Self assembled films, Material Properties: Subatomic physics to chemical systems, types of chemical bonds, solid state physics / Material properties, Tools and Instrumentation: STM, AFM, Electron Microscopy, Fluorescence, methods, Synchrotron Radiation, Fabricating Nano Structures: Lithography (photo and electron beam), MBE, Self-assembled masked, FIB, Stamp technology, Nano junctions, Electrons in Nano Structures: Variation in electronic properties, free electron model, Bloch's theorem, Band structure, Single electron transistor, Resonant tunneling, Molecular Electronics: Lewis structures, Approach to calculate Molecular orbitals, Donor Acceptor properties, Electron transfer between molecules, Charge transport in weakly interacting molecular solids, Single molecule electronics, Nano Materials: Quantum dots, nano wires, nano photonics, magnetic nanostructures, Nano thermal devices, Nano fluidic devices, biomimetic materials, Nano Biotechnology: DNA micro-arrays, Protein and DNA Assembly, Digital cells, genetic circuits, DNA computing, Nanotechnology the Road Ahead: Nanostructure innovation, Quantum Informatics, Energy solutions.

Recommended Books:

1. E.L. Wolf: Nanophysics and Nanotechnology,
2. An introduction to Modern Concept in Nanoscience, Wiley VCH, (2004)
3. A. Ratner, D. Ratner, "Nanotechnology: A Gentle Introduction to the Next Big Idea", Prentice Hall Professional, (2003).
4. J I Goldstein et al, Scanning Electron Microscopy and X-ray Microanalysis, Kluwer Academic/Plenum Publishers, (2003).
5. S. Lindsay, "Introduction to Nanoscience", Oxford University Press, (2009).
6. C. Binns, "Introduction to Nanoscience and Nanotechnology' Wiley(2010).

PHYS-000 INTRODUCTION TO PHOTONICS Credit Hrs: 03

Course outline:

Guided Wave Optics: Planar slab waveguides, Rectangular channel waveguides, Single and multi-mode optical fibers, waveguide modes and field distributions, waveguide dispersion, pulse propagation Gaussian Beam Propagation: ABCD matrices for transformation of Gaussian beams, applications to simple resonators Electromagnetic Propagation in Anisotropic Media: Reflection and transmission at anisotropic interfaces, Jones Calculus, retardation plates, polarizers Electro-optics and Acousto-optics: Linear electro-optic effect, Longitudinal and transverse modulators, amplitude and phase modulation, Mach-Zehnder modulators, Coupled mode theory, Optical coupling between wave guides, Directional couplers, Photoelastic effect, Acousto-optic interaction and Bragg's diffraction, Acousto-optic modulators, deflectors and scanners Optoelectronics: p-n junctions, semiconductor devices: laser amplifiers,injection lasers, photoconductors, photodiodes, photo detector noise.

Recommended Books:

1. B. E. A. Saleh and M. C. Teich, "Fundamentals of Photonics", John Wiley,2nd ed. (2007).
2. J-M. Liu, "Photonic Devices", Cambridge University Press, (2009).
3. A. Yariv and P. Yeh, "Photonics: Optical Electronics in Modern Communications", Oxford University Press, (2006).
4. E. Hecht, "Optics", Addison-Wesley, 4th ed. (2001).

PHYS-000 INTRODUCTION TO MATERIALS SCIENCE Credit Hrs: 03

Course outline:

Atomic Structure of Materials: The packing of atoms in 2-D and 3-D, unit cells of the hexagonal close packing (hcp) and cubic closed packing (ccp) structures, interstitial structures, density computation, lattices and symmetry elements, indexing lattice directions and lattice planes,

interplanar spacing, lattices and crystal systems in 3-D, symmetry, crystallographic point groups and space groups, Bragg's law and the intensities of Bragg reflections, Imperfections in Solids: Vacancies, impurities, dislocations, interfacial defects, bulk or volume defects, atomic vibrations, Microstructure and microscopy, pressure vs. temperature phase diagrams, temperature vs. composition phase diagrams, equilibrium, thermodynamic functions, variation of Gibbs energy with temperature and composition, general features of equilibrium phase diagrams, solidification, diffusion mechanisms, nucleation of a new phase, phase diagrams of Fe-C system and other important alloys, materials fabrication, Mechanical Behavior of Materials: Normal stress and normal strain, shear stress and shear strain, elastic deformation, plastic deformation, Young's modulus, shear modulus, Poisson's ratio, elastic strain energy, thermal expansion, estimate of the yield stress, dislocations and motion of dislocations, slip systems, dislocations and strengthening mechanisms, fracture mechanics, ductile fracture, brittle fracture, Griffith criterion, ductile fracture, toughness of engineering materials, the ductile-brittle transition temperature, cyclic stresses and fatigue, creep, Polymer basics, polymer identification, polymer molecules, additional polymerization, step growth polymerization, measurement of molecular weight, thermosetting polymers and gels, rubbers and rubber elasticity, configuration and conformation of polymers, the glassy state and glass transition, determination of T_g, effect of temperature and time, mechanical properties of polymers, case studies in polymer selection and processing, Biomaterials: Introduction to biomaterials, materials selection, biopolymers, structural polysaccharides, hard materials, biomedical materials.

Recommended Books:

1. W. D. Callister, "Materials Science and Engineering: An Introduction", Wiley, 7th ed. (2006).
2. W. D. Callister and D. G. Rethwisch "Fundamentals of Materials Science and Engineering: An Integrated Approach", Wiley, 4th ed. (2012).
3. J. F. Shackelford, "Introduction to Materials Science for Engineers", Prentice Hall, 7th ed. (2008).

PHYS-000 LASERS Credit Hrs: 03

Course outline:

Introductory Concepts: Spontaneous Emission, Absorption, Stimulated Emission, Pumping Schemes, Absorption and Stimulated Emission Rates, Absorption and Gain Coefficients, Resonance Energy Transfers. Properties of Laser Beam: Mon chromaticity, Coherence, Directionality, Brightness Spectroscopy of Molecule and Semiconductors: Electronic Energy

Levels, Molecular Energy Levels, Level Occupation at Thermal Equilibrium, Stimulated Transition, Selection Rules, Radiative and Non-radiative Decay, Semiconductor Optical Resonators: Plane Parallel (Fabry-Perot) Resonator, Concentric(Spherical) Resonator, Confocal, Resonator, Generalized Spherical Resonator, Ring Resonator, Stable Resonators, Unstable Resonators. ,Matrix Formulation of Geometrical Optics, Wave Reflection and Transmission at a Dielectric Interface, Stability Condition Standing and Traveling Waves ina two Mirror Resonator, Longitudinal and Transverse Modes in a Cavity, Multilayer Dielectric Coatings, Fabry-Perot Interferometer. Small Signal Gain and Loop Gain Pumping Processes: Optical pumping: Flash lamp and Laser, Threshold Pump Power, pumping efficiency, Electrical Pumping: Longitudinal Configuration and Transverse Configuration, Gas Dynamics Pumping, Chemical Pumping, Continuous Wave (CW) and Pulsed Lasers: Rate Equations, Threshold Condition and Output Power, Optimum Output Coupling, Laser Tuning, Oscillation and Pulsations in Lasers, Q-Switching and Mode-Locking Methods, Phase Velocity, Group Velocity, and Group-Delay Dispersion, Line broadening, Lasers Systems: Solid State Lasers: Ruby Laser, Nd: YAG &Nd: Glass Lasers and Semiconductor Lasers: Homo junction Lasers Double-Heterostructure lasers, Gas lasers: Helium Neon laser, CO2 laser, Nitrogen Laser and Excimer Lasers, Free-Electron and X-Ray Lasers, Laser Applications: Material Processing: Surface Hardening, Cutting, Drilling, Welding etc, Holography, Laser Communication, Medicine, Defense Industry, Atmospheric Physics.

Recommended Books:

1. O. Svelto, “Principles of Lasers”, Springer, 5th ed. (2009).
2. J. Eberly and P. Milonni, “Lasers Physics”, John Wiley, 2nd ed. (2010).
3. M. O. Scully and M. S. Zubairy, “Quantum Optics”, Cambridge University Press, 1997.
4. W. T. Silfvast, “Laser Fundamentals”, Cambridge University Press, 2nd ed. (2008).
5. W. M. Steen, J. Mazumder and K. G. Watkins, “Laser Material Processing”, Springer, 4th ed. (2010).

PHYS-000 PARTICLE PHYSICS Credit Hrs: 03

Course outline:

Particle Classification, Quantum numbers, leptons, hadrons, baryons, mesons, quarks, The Fundamental Interactions, The electromagnetic coupling, the strong coupling, the weak coupling, Symmetry Transformation and Conservation Laws, Translation in space, rotation in space, the group SU (2), systems of identical particles, parity, iso-spin charge conjugation, time reversal, G parity, CPT theorem, The Electromagnetic Field, Gauge invariance and Maxwell’s equations,

polarization ad photon spin, angular momentum, parity and C parity of photon, Hadron Spectroscopy, Formation experiment, partial wave formalism and the optical theorem, the Breit-Wigner resonance formula, baryon resonances, phase space considerations, production experiments, The Quark Model, The group SU (3), quarks, hadrons baryons, mesons in quark model, heave meson spectroscopy, the quarkonium model, The Standard Model (qualitative treatment only), Unification of weak and electromagnetic interactions Glashow-Salam-Weinberg Model.

Recommended Books:

1. J.D.Bjorken and S.D Drell, "Relatvistic Quantum Mechanics", McGraw Hill, (1995).
2. F. Halzen, and A.D.Martin , "Quarks and Leptons", John-Wiley and Sons. (1984).
3. Riazuddin and Fayyazuddin, "Quantum Mechanics", World Scientific, (1990).
4. D.Griffiths, "Introduction to Elementary Particles", John-Wiley and Sons, (1987).

PHYS-000 PLASMA PHYSICS Credit Hrs: 03

Course outline:

Basics of Surface Science: Surface reactions, Heterogeneous catalysis, Semiconductor technology, Corrosion, Nanotechnology, Surface Structure and Reconstruction: Electronic Structure of Surfaces: Band structure of metals, insulators and semiconductors, Fermi level, Screening, Work Function, Surface States, Electron Affinity, Ionization Potential, Surface Chirality, Thermodynamics of Surfaces, Equilibrium Crystal Shape, Quantum confinement of Electrons at Surfaces: Interference of Electron Waves, Quantum size effects, Quantum wells, Mechanical Quantum Wells, Quantum Wires, Chemist's Approach, Bonds to Bands, Surface Dynamics: Nucleation and growth of nanostructures and films Surface Magnetism and magnetic imaging, Diamagnetism, Paramagnetism, Anti-Ferromagnetism, Magnetism in thin films, , Magnetic Force Microscopy (MFM).Surface Study Techniques: Surface Sensitivity and specificity Auger Electron Spectroscopy (AES), X-Ray Photo-electron Spectroscopy, Scanning Tunneling Microscopy (STM), Photovoltaic and Organic Electronics: Different types of semiconductors(organic, inorganic, conjugated polymers), intra-molecular bonding, Van der Waals, electronic properties, polarization effects, Field effect Transistors, basics of excitonic solar cells.

Recommended Books:

1. A. Zangwill, "Physics at Surfaces", Cambridge University Press, (1988).
2. D. P. Woodruff and T. A. Delchar, "Modern Techniques of SurfaceScience", Cambridge University Press, 2nd ed. (1994).
3. D. Briggs and M. P. Seah, "Practical Surface Analysis", Vol-I, John Wiley,2nd ed. (1990).

4. J. B. Hudson, “Surface Science, an Introduction”, Wiley-Interscience,(1998).
5. H. Luth, “Surfaces and Interfaces of Solids”, Springer-Verlag, 2nd ed.(1993).
6. M. Prutton, “Introduction to Surface Physics”, Oxford University Press,(1994).
7. R. I. Masel, “Principles of Adsorption and Reaction on Solid Surfaces”,Wiley-Interscience, (1996).

PHYS-000 ELECTRONIC MATERIALS AND DEVICES Credit Hrs: 03

Course outline:

Semiconductor Fundamentals: Composition, purity and structure of semiconductors, energy band model, band gap and materials classification, charge, effective mass and carrier numbers, density of states, the Fermi function and equilibrium distribution of carriers, doping, n and p-type semiconductors and calculations involving carrier concentrations, EF etc., temperature dependence of carrier concentrations, drift current, mobility, resistivity and band bending, diffusion and total currents, diffusion coefficients, recombination-generation, minority carrier life times and continuity equations with problem solving examples, Device Fabrication Processes: Oxidation, diffusion, ion implantation, lithography, thin-film deposition techniques like evaporation, sputtering, chemical vapor deposition (CVD), epitaxy etc. PN Junction and Bipolar Junction Transistor: Junction terminology, Poisson’s equation, qualitative solution, the depletion approximation, quantitative electrostatic relationships, ideal diode equation, non-idealities, BJT fundamentals, Junction field effect transistor, MOS fundamentals, the essentials of MOSFETs, Dielectric Materials, Optoelectronic and spintronics devices Magnetism and Magnetic Materials, data storage devices.

Recommended Books:

1. R. F. Pierret, “Semiconductor Device Fundamentals”, Addison Wesley, 2nded. (1996).
2. N. Braithwaite, and G. Weaver, “Electronic Materials”, MA: Butterworth, 2nd ed. (1990).
3. S. O. Kasap, “Electronic Materials and Devices”, McGraw-Hill, 3rd ed. (2005).
4. R. C. O'Handley, “Modern Magnetic Materials: Principles and Applications”, Wiley Inter-Science, (1999).
5. D. Jiles, “Introduction to Magnetism and Magnetic Materials”, Chapman &Hall, 2nd ed. (1998).

PHYS-000 ENVIRONMENTAL PHYSICS Credit Hrs: 03

Course outline:

Introduction to the Essentials of Environmental Physics: The economic system, living in green house, enjoying the sun, Transport of matter, Energy and momentum, the social and political context, Basic Environmental Spectroscopy: Black body radiation, The emission spectrum of sun,

The transition electric dipole moment, The Einstein Coefficients, Lambert – Beer's law, The spectroscopy of bi-molecules, Solar UV and life, The ozone filter, The Global Climate: The energy Balance, (Zero-dimensional Greenhouse Model), elements of weather and climate, climate variations and modeling, Transport of Pollutants: Diffusion, flow in reverse, ground water. Flow equations of fluid Dynamics, Turbulence, Turbulence Diffusion, Gaussian plumes in air, Turbulent jets and planes, Noise: Basic Acoustics, Human Perceptions and noise criteria, reducing the transmission of sound, active control of sound, Radiation: General laws of Radiation, Natural radiation, interaction of electromagnetic radiation and plants, utilization of photo synthetically active radiation, Atmosphere and Climate: Structure of the atmosphere, vertical profiles in the lower layers of the atmosphere, Lateral movement in the atmosphere, Atmospheric Circulation, cloud and Precipitation, The atmospheric greenhouse effect, Topo Climates and Micro Climates: Effects of surface elements in flat and widely unduling areas, Dynamic action of seliq. Thermal action of selief, Climatology and Measurements of Climate Factor: Data collection and organization, statistical analysis of climatic data, climatic indices, General characteristics of measuring equipment. Measurement of temperature, air humidity, surface wind velocity, Radiation balance, precipitation, Atmospheric Pressure, automatic weather stations.

Recommended Books:

1. E. Booker and R. Van Grondelle, "Environmental Physics", John Wiley, 3rd ed. (2011).
2. G. Guyot, "Physics of Environment and Climate", John Wiley, (1998).

PHYS-101L LAB-I (MECHANICS) Credit Hrs: 01

Course outline:

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 (overdamped, underdamped and critically damped), pressure in fluids, experiments demonstrating continuity, Bernoulli's principle, buoyancy and Archimedes' principle, Atwood machine, fluid viscosity, surface tension.

PHYS-103L LAB-II (ELECTRICITY AND MAGNETISM) Credit Hrs: 01

Course outline:

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

PHYS-102L LAB-III (Heat, Wave and Sound) Credit Hrs: 01

Course outline:

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, blackbodies, 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 PID (proportional-integralderivative) schemes, thermal expansivity and its measurement using strain gauges. Waves and Oscillations, Sound: Resonance in a stretched string, normal modes of oscillation, dispersion relations for mono and diatomic lattice, 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, pendulum, waves in water, beats, super-positions of harmonic motion (Lissajous patterns), sonometer.

PHYS-104L LAB-IV (Optics) Credit Hrs: 01

Course outline:

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.

PHYS-105L LAB-V (ELECTRONICS) Credit Hrs: 02

Course outline:

Electronics: DC voltages and current measurement, simple DC circuits, generating and analyzing time-varying signals, opamps and comparators, amplifier design, RC transients, filters, frequency response, LC circuits, resonance, transformers, diodes, modulation and radio reception, MOSFET characteristics and applications, principles of amplification, bipolar transistors and amplifiers, digital logic circuits, gates and latches, D-flip flops and shift registers, JK flip-flops and ripple counters.

PHYS-106L LAB-VI (MODERN PHYSICS) Credit Hrs: 02

Course outline:

- Photoelectric effect,
- Frank- Hertz's quantization of energy levels,
- Determination of Planck's constant (e.g. using a light bulb),
- Verification of Moseley's law using X-ray fluorescence,
- Compton effect • Millikan's experiment for determination of charge of electron
- Measurement of electrical conductivity by two-probe and four-probe methods, band gap estimation of intrinsic and extrinsic semiconductors, carrier lifetimes and mobilities, Hall effect and its application in measuring magnetic fields, thermoelectric effects.