SHAHEED BENAZIR BHUTTO WOMEN UNIVERSITY
PESHAWAR

REVISED CURRICULUM FOR BS-PHYSICS
SESSION 2014-18 & 2015-19

DEPARTMENT OF PHYSICS

SHAHEED BENAZIR BHUTTO WOMEN UNIVERSITY
PESHAWAR
DEPARTMENT OF PHYSICS

SCHEME OF STUDIES OF BS PHYSICS (SESSION- 2013 ONWARDS)

S.NO	SEMESTER	COURSE TITLE	COURSE CODE	CREDIT HOURS	PREREQUISITE
1.	1st	English-I	PH – 311	2 (2,0)	
2.		Pakistan Studies	PH – 312	2 (2,0)	
3.		Mathematics – I	PH – 313	3 (3,0)	
4.		Introduction to Computers	PH – 314	3 (2,1)	
5.		Mechanics – I	PH – 315	3 (3,0)	
6.		Statistics	PH – 316	3 (3,0)	
7.		Lab-I	PH – 317	2 (0,2)	
			Total Credit Hours (Theory, Labs)	**18 (15,3)**	

S.NO	SEMESTER	COURSE TITLE	COURSE CODE	CREDIT HOURS	PREREQUISITE
8.	2nd	English-II	PH – 321	2 (2,0)	
9.		Islamic Studies	PH – 322	2 (2,0)	
10.		Mathematics-II	PH – 323	3 (3,0)	
11.		Waves & Oscillations	PH – 324	3 (3,0)	
12.		Mechanics – II	PH – 325	3 (3,0)	
13.		Heat & Thermodynamics	PH – 326	3 (3,0)	
14.		Lab-II	PH – 327	2 (0,2)	
			Total Credit Hours (Theory, Labs)	**18 (16, 2)**	

S.NO	SEMESTER	COURSE TITLE	COURSE CODE	CREDIT HOURS	PREREQUISITE
15.	3rd	English-III	PH – 431	2 (2,0)	
16.		Mathematics-III	PH – 432	3 (3,0)	
17.		Electricity & Magnetism-I	PH – 433	3 (3,0)	
18.		Optics	PH – 434	3 (3,0)	
19.		Introduction to Computer Languages Basic &C	PH – 435	3 (3,0)	
20.		Lab-III	PH – 436	3 (0,3)	
			Total Credit Hours (Theory, Labs)	**17 (14, 3)**	

S.NO	SEMESTER	COURSE TITLE	COURSE CODE	CREDIT HOURS	PREREQUISITE

21.	**4th**	Mathematics-IV	PH – 441	3 (3,0)	
22.		Electricity & Magnetism-II	PH – 442	3 (3,0)	
23.		Electronics & Modern Physics	PH – 443	3 (3,0)	
24.		Introduction to Softwares	PH – 444	2 (2,0)	
25.		Material Science	PH – 445	2 (2,0)	
26.		Lab-IV	PH – 446	3 (0,3)	
			Total Credit Hours (Theory, Labs)	**16 (13, 3)**	

S.NO	SEMESTER	COURSE TITLE	COURSE CODE	CREDIT HOURS	PREREQUISITE
27.	**5th**	Mathematical Methods of Physics-I	PH – 551	3 (3,0)	
28.		Classical Mechanics-I	PH – 552	2 (2,0)	
29.		Electrodynamics-I	PH – 553	3 (3,0)	
30.		Atomic & Molecular Physics	PH – 554	3 (3,0)	
31.		Environmental Physics	PH – 555	3 (3,0)	
32.		Lab-V	PH – 556	3 (0,3)	
			Total Credit Hours (Theory, Labs)	**17 (14, 3)**	

S.NO	SEMESTER	COURSE TITLE	COURSE CODE	CREDIT HOURS	PREREQUISITE
33.	**6th**	Mathematical Methods of Physics-II	PH – 561	3 (3,0)	
34.		Classical Mechanics-II	PH – 562	2 (2,0)	
35.		Thermal & Statistical Physics	PH – 563	3 (3,0)	
36.		Electrodynamics-II	PH – 564	3 (3,0)	
37.		Computational Physics	PH – 565	3 (3,0)	
38.		Lab-VI	PH – 566	3 (0,3)	
			Total Credit Hours (Theory, Labs)	**17 (14, 3)**	

S.NO	SEMESTER	COURSE TITLE	COURSE CODE	CREDIT HOURS	PREREQUISITE
39.	**7th**	Solid State Physics-I	PH – 671	2 (2,0)	
40.		Nuclear Physics-I	PH – 672	2 (2,0)	
41.		Quantum Mechanics-I	PH – 673	3 (3,0)	
42.		Electronics-I Analogue Circuit Analysis & Design-I	PH – 674	3 (3,0)	
43.		Laser Physics	PH – 675	3 (3,0)	
44.		Lab-VII	PH – 676	3 (0,3)	
			Total Credit Hours (Theory, Labs)	**16 (13, 3)**	

S.NO	SEMESTER	COURSE TITLE	COURSE	CREDIT	PREREQUISITE

			CODE	HOURS	
45.	**8th**	Solid State Physics-II	PH – 681	2 (2,0)	
46.		Nuclear Physics-II	PH – 682	2 (2,0)	
47.		Quantum Mechanics-II	PH – 683	3 (3,0)	
48.		Electronics-II Analogue Circuit Analysis & Design-II	PH – 684	3 (3,0)	
49.		Functional Materials	PH – 685	2 (2,0)	
50.		Project/TWO ELECTIVE COURSES	PH – 699	6/3+3	
			Total Credit Hours (Theory, Labs)	**18 (12, 4)**	
					Total Credit Hours of Program: 137 (Theory, Labs): (113, 24)

List of Elective Subjects

S.No	Course Codes	Electives	Credit Hours
1.	PH-675	Introduction to Plasma Physics	3
2.	PH-676	Introduction to Material Science	3
3.	PH-677	Environmental Physics	3
4.	PH-678	Renewable energy Resources	3
5.	PH-679	Computer Simulations in Physics	3
6.	PH-683	Computational Physics	3
7.	PH-684	Methods of Experimental Physics	3
8.	PH-685	Introduction to Lasers Physics	3
9.	PH-686	Electronic Materials & Devices	3
10.	PH-687	Functional Material	3
11.	PH-688	Introduction to Nanoscience & Nanotechnology	3

SHAHEED BENAZIR BHUTTO WOMEN UNIVERSITY
PESHAWAR
DEPARTMENT OF PHYSICS

DETAILED COURSE OUTLINE OF PHYSICS
BS (4-YEARS PROGRAM)

SEMESTER-I

Course Name: English-I	**Course Code:** PH – 311
Course Structure: Lectures: 2	**Credit Hours:** 2
Prerequisites: None	

Course Introduction

The usefulness of English Language cannot be denied. It enriches our thought and culture, and provides us with the most important international vehicle of expression. It has opened for us several doors of light and knowledge, for it is the Lingua Franca of the world and the language of science, technology, commerce and diplomacy. Without English we shall be handicapped in our advancement and our progress will be seriously retarded in several important spheres of life. To give it up means putting the hands of the clock back by more than a century, to take several steps backwards, to surrender ground which has been gained through persistent toil and labour, to lose the front seat in international forums and to miss the opportunity of having a direct impact on the other people's minds.

Course Objectives

The objectives of the course are:

1. To build the sound vocabulary of the students
2. To improve the linguistic skills of the students
3. Enhance language skills and develop critical thinking.

Intended Learning Outcomes

Students will be able: to express their ideas in a coherent manner, speak English with correct pronunciation, read and comprehend the written material, understand the class lectures easily.

Course Outline

Basics of Grammar
Parts of speech and use of articles
Sentence structure, active and passive voice

Practice in unified sentence
Analysis of phrase, clause and sentence structure
Transitive and intransitive verbs
Punctuation and spelling
Comprehension
Answers to questions on a given text
Discussion
General topics and every-day conversation (topics for discussion to be at the discretion of the teacher keeping in view the level of students)
Listening
To be improved by showing documentaries/films carefully selected by subject teachers
Translation skills
Urdu to English
Paragraph writing
Topics to be chosen at the discretion of the teacher
Presentation skills
Introduction
Note: Extensive reading is required for vocabulary building

Recommended Books
1. **Functional English**
a) Grammar
1. Practical English Grammar by A.J. Thomson and A.V. Martinet. Exercises 1. Third edition. Oxford University Press. 1997. ISBN 0194313492
2. Practical English Grammar by A.J. Thomson and A.V. Martinet. Exercises 2. Third edition. Oxford University Press. 1997. ISBN 0194313506
b) Writing
1. Writing. Intermediate by Marie-Christine Boutin, Suzanne Brinand and Francoise Grellet. Oxford Supplementary Skills. Fourth Impression 1993. ISBN 0 19 435405 7 Pages 20-27 and 35-41.
c) Reading/Comprehension
1. Reading. Upper Intermediate. Brain Tomlinson and Rod Ellis. Oxford Supplementary Skills. Third Impression 1992. ISBN 0 19 453402 2.
d) Speaking

Course Name: Pakistan Studies	**Course Code:**PH-312
Course Structure: Lectures: 2	**Credit Hours:** 2
Prerequisites: None	

Course Introduction

An introduction to the history of Pakistan is studied with reference to the history of pre independence period and then what were the reforms after the independence of Pakistan. The subject also discusses the different presidential eras and what contributions were

made by different rulers in various fields of nation's development. This is a history-related course with the goal to introduce the student to basic history. Students will be presented with material, which will give them a broad base of understanding of their nation history. Contemporary issues will also be discussed as well as the history of nation's changes which have occurred over the past one hundred years.

Course Objectives

Upon completion of this subject the students will be able to:

- Learn about the historical revolutions that led to freedom
- Understand the great works and study what steps their leaders had taken to free the nation
- The aims and goals of establishing a Muslim state
- What reform their leaders have made to develop the state

Intended Learning Outcomes

Students will have knowledge of the history and present status of Pakistan

Course Contents

1. **Historical Perspective**
a. Ideological rationale with special reference to Sir Syed Ahmed Khan, Allama Muhammad Iqbal and Quaid-i-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.
2. **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. Burki, Shahid Javed. *State & Society in Pakistan,* The Macmillan Press Ltd 1980.

2. Akbar, S. Zaidi. *Issue in Pakistan's Economy.* Karachi: Oxford University Press, 2000.
3. S.M. Burke and Lawrence Ziring. Pakistan‟s Foreign policy: An Historical analysis. Karachi: Oxford University Press, 1993.
4. Mehmood, Safdar. *Pakistan Political Roots & Development.* Lahore, 1994.
5. Wilcox, Wayne.*The Emergence of Banglades.,* Washington: American Enterprise, Institute of Public Policy Research, 1972.

Course Name: Mathematics-I	**Course Code:** PH-313
Course Structure: Lectures: 3	**Credit Hours:** 3
Prerequisites: None	

Course Objectives

The course is designed to:

- Give the basic knowledge of Mathematics and prepare the students not majoring in mathematics.
- Understand the use of the essential tools of basic mathematics;
- Apply the concepts and the techniques in their respective discipline;

Course Outline

Preliminaries: Real-number system, complex numbers, introduction to sets, set operations, functions, types of functions. *Matrices:* Introduction to matrices, types, matrix inverse, determinants, system of linear equations, Cramer‟s rule.
Quadratic Equations*:* Solution of quadratic equations, qualitative analysis of roots of a quadratic equations, equations reducible to quadratic equations, cube roots of unity, relation between roots and coefficients of quadratic equations.
Sequences and Series*:* Arithmetic progression, geometric progression, harmonic progression. **Binomial Theorem***:* Introduction to mathematical induction, binomial theorem with rational and irrational indices.
Trigonometry: Fundamentals of trigonometry, trigonometric identities.

Recommended Books

1. Dolciani MP, Wooton W, Beckenback EF, Sharron S, *Algebra 2 and Trigonometry*, 1978, Houghton & Mifflin,
2. Boston (suggested text)
3. Kaufmann JE, College *Algebra and Trigonometry*, 1987, PWS-Kent Company, Boston Swokowski EW, *Fundamentals of Algebra and Trigonometry* (6th edition), 1986, PWS-Kent Company, Boston.

Course Name: Introduction to computers	**Course Code:** PH-314
Course Structure: Lectures: 3	**Credit Hours:** 3
Prerequisites: None	

1. Overall Aim of the Course

- The overall aim of the course is to provide an understanding of the basic concepts of computer, Number System focuses on the impact of computers on businesses and society, emphasizes applications of technology, and helps develop information retrieval techniques.
- Students will learn fundamental concepts of computer hardware and software and become familiar with a variety of computer applications, including word processing, spreadsheets, databases, and multimedia presentations.
- They will learn how to access and connect to the Internet and learn to know different services on internet and describe different types of websites.

2. Intended Learning Outcomes of Course (ILOs):

a. Knowledge and Understanding:

- ***By the end of the course, student should***

- Be able to identify computer hardware and peripheral devices
- Become familiar with software applications
- Understand file management
- Accomplish creating basic documents, worksheets, presentations and databases
- Describe and understand different levels of computer languages
- Describe uses of the Internet.
- Demonstrate proficiency in the use of email.

a. Intellectual Skills

By the end of the course, students should be able to:

- Compare different types of computer
- Comparing Analyze basic components of computers and their usage
- Recognize and interpret different categories of computer and their applications
- Ability to use internet efficiently.
- Ability to create a Simple Web page.
- Ability to produce well formatted documents, results, presentations using office automation tools.

b. Professional and Practical Skills

Having successfully completed the course, students will be able to:

- To use computer efficiently
- Accomplish creating basic documents, worksheets, presentations in office automation tool.

- To use electronic mail and will be able to explore the web

b. **General & Transferable Skills:**

By the end of the course, students should be able to:

- Understands the fundamentals of computer systems. The representation of data, an introduction to processors and memory, input and output, operating systems, Networks.
- Work in groups and team in labs
- Use computer and internet to retrieve information and knowledge.

Course Outline

Number Systems, Binary Numbers, Boolean Logic,History computer system, Basic machine organization, Von Neumann Architecture, Algorithm definition, design, and implementation, Programming paradigms and languages, Graphical programming, Overview of software Engineering and Information Technology, Operating System, Compiler, Computer networks and Internet, Computer Graphics, AI, Social and legal issues.

Recommended Books

1. Computers: Information technology in Perspective,9/e by Lrry Long and Nancy Long.

2. Prentice Hall, 2002/ISBN:0130929891

3. An Invitation to Computer Science, Schneider and Gersting, Brooks/Cole Thomson Learning, 2000

4. Computer Science: An overview of Computer Science, Sherer

Course Name: Mechanics-I	**Course Code:** PH-315
Course Structure: Lectures: 3	**Credit Hours:** 3
Prerequisites: A Level Physics and F.Sc. (Physics + Math)	

Course Objective

The course involves the study of vector analysis, practical dynamics, work ,power,energy,it gives the students the basic knowledge of vectors, scalar vector & scalar triple product, gradient of scalar, divergence &curl of a vector, divergence & flux of vector field, divergence & stokes theorem, dynamics of uniform circular motion, equation of motion, derivation using constant & time dependent forces, drag forces, terminal velocity, pseudo forces, work done by constant & variable forces, work energy theorem, conservation of energy, law of conservation of energy in a system of particle system ,generalization of many particle system, center of mass,momentum,elastic & inelastic collision.

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Intended Learning Outcomes of course

(a) Knowledge & Understanding

On successful completion of this course the students will be able to

- Give the basic concept of vectors & scalars, divergence & stokes theorem, work & energy, system of particles, momentum, collision & conservation laws.
- Uses of above concepts in daily life in scientific way.

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(b) **Intellectual/cognitive skills**.

Having knowledge of this course, the student will be able to

- Understand vector & scalar operation
- . Understand dynamics of uniform circular motion.
- Understand constant, variable & pseudo forces.
- Understand projectile motion

Understand work, work energy theorem, system particles.

Course Outline

Vector Analysis: Review of 'Vector in 3 dimensions and Operations, Direction Cosines, Spherical polar coordinates, Vector and scalar triple product, gradient of a scalar, Divergence and curl of a vector. Physical significance of each type: Divergence and Flux of a vector field, curl and line integral (mutual relation), Vector identities, Divergence Theorem, Stokes' Theorem: Derivation, Physical importance and applications to specific cases, Converting form differential to integral forms.

Particle Dynamics: Dynamics of Uniform, circular motion the banked curve. Equations of motion, Deriving kinematics equations x (t), v (t) using integrations, Constant and variable forces and special examples. Time dependent forces: Obtaining x (t), v (t) for this case using integration method. Effect of drag forces on motion: Applying Newton's Laws to obtain v (t) for the case of motion with time dependent (Integration approach) drag (viscous) forces, terminal velocity. Projectile motion with and without air resistance, Non- inertial frames and Pseudo forces, Qualitative discussion to develop understanding. Calculation of pseudo forces for simple cases (linearly accelerated reference frames), Centrifugal force as an example of pseudo force, Coriolis force.

Work, Power and Energy: Work done by a constant force, work done by a variable force (1-2 dimension): Essentially a review of grade-XII concepts use of integration technique to calculate work done (e.g. in vibration of a spring obeying Hook's Law), Obtaining general expression force (2-dimensional case) and applying to simple cases e.g. pulling a mass at the end of a fixed string against gravity. Work energy theorem. General proof of work energy theorem: Qualitative Review of work energy theorem. Derivation using integral calculus, basic formula and applications. Power, Energy changes with respect to observers in different inertial frames. Conservation of Energy in 1, 2, and 3 dimensional conservative systems. Conservative and non- Conservative forces: Conservation of energy in a system of particles: Law of conservation of total energy of an isolated system. Systems of Particles: Two particles systems and generalization to many particle systems: Centre of mass: Its position velocity and equation of motion. Centre of mass of solid objects; calculation of center of mass of solid objects, for example uniform rod, cylinder, sphere using integral calculus, Momentum Changes in a system of variable mass, derivation of basic equation, application to motion of a rocket. Elastic collisions: Elastic collisions, conservation of momentum during collision in one two dimensions, inelastic collisions in center of mass reference frame (one and two dimensions), simple applications of obtaining velocities in the center of mass frame.

Recommended Books

1. Physics by Halliday, Resnick and Walker: 8th Edition

Course Name: Statistics	**Course Code:** PH-316
Course Structure: Lectures: 3	**Credit Hours:** 3
Prerequisites: None	

Course Objectives

The course aims at enabling the students to understand the basic statistical tools for research and economic models development.

The course covers basic concepts, descriptive statistics, probability, random variables, probability distributions, parameter estimation, hypothesis testing, linear correlation, linear regression, contingency tables, and analysis of variance. Applications are made to business, social sciences, and natural/physical sciences

Intended Learning Outcomes

a. **Knowledge and understanding:**
   i. Learn about early development of statistics.
   ii. Explain the role and importance of statistics in Physics.

b. **Intellectual skills**
   i. Understand the basic qualities of central tendency, dispersion, hypotheses etc.

c. **Professional and practical skills**
   i. Use of Statistics in research.
   ii. Interpret test scores.

d. **General and transferable skills**
   i. Apply and interpret various statistical methods.

Course Outline

Unit 1. What is Statistics?
Definition of Statistics, Population, sample Descriptive and inferential Statistics, Observations, Data, Discrete and continuous variables, Errors of measurement, Significant

digits, Rounding of a Number, Collection of primary and secondary data, Sources, Editing of Data. Exercises.

Unit 2. Presentation of Data

Introduction, basic principles of classification and Tabulation, Constructing of a frequency distribution, Relative and Cumulative frequency distribution, Diagrams, Graphs and their Construction, Bar charts, Pie chart, Histogram, Frequency polygon and Frequency curve, Cumulative Frequency Polygon or Ogive, Historigram, Ogive for Discrete Variable. Types of frequency curves. Exercises.

Unit 3. Measures of Central Tendency

Introduction, Different types of Averages, Quantiles, The Mode, Empirical Relation between Mean, Median and mode, Relative Merits and Demerits of various Averages. properties of Good Average, Box and Whisker Plot, Stem and Leaf Display, definition of outliers and their detection. Exercises.

Unit 4. Measures of Dispersion

Introduction, Absolute and relative measures, Range, The semi-Inter-quartile Range, The Mean Deviation, The Variance and standard deviation, Change of origin and scale, Interpretation of the standard Deviation, Coefficient of variation, Properties of variance and standard Deviation, Standardized variables, Moments and Moments ratios. Exercises.

Unit 5. Probability and Probability Distributions.

Discrete and continuous distributions: Binomial, Poisson and Normal Distribution. Exercises

Unit 6. Sampling and Sampling Distributions

Introduction, sample design and sampling frame, bias, sampling and non-sampling errors, sampling with and without replacement, probability and non-probability sampling, Sampling distributions for single mean and proportion, Difference of means and proportions. Exercises.

Unit 7. Hypothesis Testing

Introduction, Statistical problem, null and alternative hypothesis, Type-I and Type-II errors, level of significance, Test statistics, acceptance and rejection regions, general procedure for testing of hypothesis. Exercises.

Unit 8. Testing of Hypothesis- Single Population

Introduction, Testing of hypothesis and confidence interval about the population mean and proportion for small and large samples, Exercises

Unit 9. Testing of Hypotheses-Two or more Populations

Introduction, Testing of hypothesis and confidence intervals about the difference of population means and proportions for small and large samples, Analysis of Variance and ANOVA Table. Exercises

Unit 10. Testing of Hypothesis-Independece of Attributes

Introduction, Contingency Tables, Testing of hypothesis about the Independence of attributes. Exercises.

Unit 11. Regression and Correlation

Introduction, cause and effect relationships, examples, simple linear regression, estimation of parameters and their interpretation. r and R^2. Correlation. Coefficient of linear correlation, its estimation and interpretation. Multiple regression and interpretation of its parameters. Examples

Recommended Books

1. Walpole, R. E. 1982. “Introduction to Statistics”, 3rd Ed., Macmillan Publishing Co., Inc. New York.

2. Muhammad, F. 2005. “Statistical Methods and Data Analysis”, Kitab Markaz, Bhawana Bazar Faisalabad.

Course Name: Lab-I	**Course Code:** PH-317
Course Structure: Labs: 2	**Credit Hours:** 2
Prerequisites: A Level Physics and F.Sc. (Physics + Math)	

Course Objectives

The objective of the course is to provide an opportunity to the students to deals with the experimental errors and the general instructions for the performance of different experiments, to
get description of several apparatus which would be helpful in enabling the students to handle the laboratory apparatus and to take measurements.

Intended Learning Outcomes of Course (ILOs):

- **Knowledge and Understanding:**

By the end of the course, student will be able to

Demonstrate the knowledge and broad understanding of the practical aspect of the topics included in the course outlines. They should be able to describe and analyze quantitatively processes, relationships and techniques relevant to the topics included in the course outline.

- **Intellectual /Cognitive Skills**

By the end of the course, students will be able to

Apply the ideas and techniques gained to solve general classes of problems. They will be able to write down and, where appropriate, either prove or explain the underlying basis of physical laws relevant to the course topic, and discuss their applications.

- **Professional and Practical Skills**

Having successfully completed the course, students will be able to:

Use the physical knowledge to analyze a suitable technique to solve the problem. They will also be able to use basic laboratory equipments.

- **General & Transferable Skills:**

On successful completion of the course the students will be able to

- Work as a part of team to produce reports.
- Work as a part of team to find a solution for practical problems and projects.
- Write structural reports.
- Make oral communication skills by making reports presentation.

Course Outline

List of Experiments:

1. Modulus of Rigidity by Static & Dynamic method (Maxwell‟s needle, Barton‟s Apparatus).
2. To study the damping features of an oscillating system using simple pendulum of variable mass.
3. Measurement of viscosity of liquid by Stoke‟s / Poiseulli‟s method.
4. Surface tension of water by capillary tube method.
5. To determine the value of “g” by compound pendulum / Kater‟s Pendulum.
6. To study the dependence of Centripetal force on mass, radius, and angular velocity of a body in circular motion.
7. Investigation of phase change with position in traveling wave and measurement of the velocity of sound by C.R.O.
8. Determination of moment of inertia of a solid/hollow cylinder and a sphere etc.
9. To study the conservation of energy (Hook‟s law).

Note: At least five experiments to be performed.

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DETAILED COURSE OUTLINE OF PHYSICS
BS (4-YEARS PROGRAM)

SEMESTER-II

COURSE NAME: English – II	**COURSE CODE:** PH-321
COURSE STRUCTURE: Lectures: 2	**CREDIT HOURS:** 2
PREREQUISITES: None	

Course Objectives

To develop good English writing, language usage and reading skills. To appreciate the importance of business communication and to develop understanding of communication concepts, principles, theories and problems. To develop good oral communication and presentation skills.

- In this rapidly changing world communication has become very vital and important. Every time we have to contact each other for many reasons and without communication either for ourselves or on the behalf of the organization we cannot make progress in any sphere of life.
  "The persons we seek must have strong oral and written communication skills".
- From Chief Financial Officer to Product Manager, from Senior Economist to Personnel Analyst, from Senior Sales Representative to Petroleum Buyer – these positions will be filled by people who can communicate well.
- Focus will be on oral communication and presentation of students in the class in developing communication skills. As we all know, every message, whether verbal or nonverbal, communicates something about our values & ethics. Thus, this course will also instruct the students the means to anticipate and analyze the ethical dilemmas they will face on the job/practical life. Taking an ethical position on the face of pressures and temptations requires more than courage – it really requires strong communication skills. Enable the students to meet their real life communication needs.

Intended Learning Outcomes:

After the completion of this course students will be able to improve their four basic skills

(reading, writing, speaking and listening), thus there will be fluent in their written and spoken English

Course Contents

1. **Paragraph writing:** Practice in writing a good, unified and coherent paragraph
2. **Essay writing** : Introduction
3. **CV and job application:** Translation skills- Urdu to English
4. **Study skills:** Skimming and scanning, intensive and extensive, and speed reading, summary and précis writing and comprehension
5. **Academic skills:** Letter/memo writing, minutes of meetings, use of library and internet
6. **Presentation skills**
   Personality development (emphasis on content, style and pronunciation)
   Note: documentaries to be shown for discussion and review

Recommended Books

Communication Skills

a. Grammar

1. Practical English Grammar by A.J. Thomson and A.V. Martinet. Exercises 2. Third edition. Oxford University Press 1986. ISBN 0 19 431350 6.

b. Writing

1. Writing. Intermediate by Marie-Chrisitine Boutin, Suzanne Brinand and Francoise Grellet. Oxford Supplementary Skills. Fourth Impression 1993. ISBN 019 435405 7 Pages 45-53 (note taking).
2. Writing. Upper-Intermediate by Rob Nolasco. Oxford Supplementary Skills. Fourth Impression 1992. ISBN 0 19 435406 5 (particularly good for writing memos, introduction to presentations, descriptive and argumentative writing).

c. Reading

1. Reading. Advanced. Brian Tomlinson and Rod Ellis. Oxford Supplementary Skills. Third Impression 1991. ISBN 0 19 453403 0.
2. Reading and Study Skills by John

COURSE NAME: Islamic Studies	**COURSE CODE:** PH – 322

COURSE STRUCTURE: Lectures: 2	**CREDIT HOURS:** 2
PREREQUISITES: None	

Course Objectives

This course is aimed at:

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

Intended Learning Outcomes

Student will have knowledge of basic teaching of Islam.

Course Contents

Introduction to Quranic Studies

1. Basic Concepts of Quran
2. History of Quran
3. Uloom-ul -Quran

Study of Selected Text of Holy Quran

1. Verses of Surah Al-Baqra Related to Faith(Verse No-284-286)
2. Verses of Surah Al-Hujrat Related to Adab Al-Nabi (Verse No-1-18)
3. Verses of Surah Al-Mumanoon Related to Characteristics of faithful (Verse No-1-11)
4. Verses of Surah al-Furqan Related to Social Ethics (Verse No.63-77)
5. Verses of Surah Al-Inam Related to Ihkam(Verse No-152-154)

Study of Selected Text of Holy Quran

1. Verses of Surah Al-Ihzab Related to Adab al-Nabi (Verse No.6,21,40,56,57,58.)
2. Verses of Surah Al-Hashar (18,19,20) Related to thinking, Day of Judgment
3. Verses of Surah Al-Saf Related to Tafakar,Tadabar (Verse No-1,14)

Seats of Holy Prophet (S.A.W) I

1. Life of Muhammad Bin Abdullah (Before Prophet Hood)
2. Life of Holy Prophet (S.A.W) in Makkah
3. Important Lessons Derived from the life of Holy Prophet in Makkah

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

1. Life of Holy Prophet (S.A.W) in Madina
2. Important Events of Life Holy Prophet in Madina
3. Important Lessons Derived from the life of Holy Prophet in Madina

Introduction To Sunnah

1. Basic Concepts of Hadith
2. History of Hadith
3. Kinds of Hadith
4. Uloom –ul-Hadith
5. Sunnah & Hadith
6. Legal Position of Sunnah

Selected Study from Text of Hadith

Introduction To Islamic Law & Jurisprudence

1. Basic Concepts of Islamic Law & Jurisprudence
2. History & Importance of Islamic Law & Jurisprudence
3. Sources of Islamic Law & Jurisprudence
4. Nature of Differences in Islamic Law
5. Islam and Sectarianism

Islamic Culture & Civilization

1. Basic Concepts of Islamic Culture & Civilization
2. Historical Development of Islamic Culture & Civilization
3. Characteristics of Islamic Culture & Civilization
4. Islamic Culture & Civilization and Contemporary Issues

Islam & Science

1. Basic Concepts of Islam & Science
2. Contributions of Muslims in the Development of Science
3. Quranic & Science

Islamic Economic System

1. Basic Concepts of Islamic Economic System
2. Means of Distribution of wealth in Islamic Economics
3. Islamic Concept of Riba
4. Islamic Ways of Trade & Commerce

Political System of Islam

1. Basic Concepts of Islamic Political System
2. Islamic Concept of Sovereignty
3. Basic Institutions of Govt. in Islam

Islamic History

1. Period of Khlaft-E-Rashida
2. Period of Ummayyads
3. Period of Abbasids

Social System of Islam

1. Basic Concepts Of Social System Of Islam
2. Elements Of Family
3. Ethical Values Of Islam

Recommended Books

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

COURSE NAME: Mathematics – II	**COURSE CODE:** PH – 323
COURSE STRUCTURE: Lectures: 3	**CREDIT HOURS:** 3
PREREQUISITES: Mathematics – I(Algebra)	

Course Objectives

To prepare the students with the essential tools of geometry to apply the concepts and the

techniques in their respective disciplines.

Course Outline

Geometry in Two Dimensions*:* Cartesian-coördinate mesh, slope of a line, equation of a line, parallel and perpendicular lines, various forms of equation of a line, intersection of two lines, angle between two lines, distance between two points, distance between a point and a line.
Circle: Equation of a circle, circles determined by various conditions, intersection of lines and circles, locus of a point in various conditions.
Conic Sections*:* Parabola, ellipse, hyperbola, the general-second-degree equation

Recommended Books

1. Abraham S, Analytic Geometry, Scott, Freshman and Company, 1969
2. Kaufmann JE, College *Algebra and Trigonometry*, 1987, PWS-Kent Company,
3. Boston Swokowski EW, *Fundamentals of Algebra and Trigonometry* (6th edition), 1986, PWS-Kent Company,
4. Boston Thomas GB, Finney AR, *Calculus* (11th edition), 2005, Addison-Wesley, Reading, Ma, USA

Course Name: Waves and Oscillations	**Course Code:** PH – 324
Course Structure: Lectures: 3	**Credit Hours:** 3
Prerequisites: A Level Physics and F.Sc. (Physics + Math)	

Course Objectives

The objective of this course is to provide a basic understanding of the laws of vibrations and waves.

Intended Learning Outcomes
By the end of the course the students should be able to:

- To understand the basics of waves, mechanism of wave production, propagation and interaction with other waves
- apply the laws of simple harmonic motion to various oscillating systems such as pendulum, the LC circuit,
- relate the driving force with aspects of resonance and to comprehend the driven simple harmonic motion; perform calculations of normal modes for coupled oscillators;
- deduce the 1D wave equation for a uniform continuous string; understand

superposition of waves of same and different frequency;

- Comprehend waves in gasses and solids.
- use of basic concept of waves in their application in daily life

Course Outline

Harmonic Oscillations:
Simple harmonic oscillation (SHM), Obtaining and solving the basic equations of motion x (t), v (t), a(t). Longitudinal and transverse Oscillations, Energy considerations in S.H.M. Application of SHM, Torsional oscillator, Physical pendulum, simple pendulum, SHM and uniform circular motion, combinations of Harmonic motions: Lissajous patterns. Damped Harmonic Motion: Equation of damped harmonic motion, Quality factor, discussion of its solution, forced oscillations and resonance Equation of forced oscillation, discussion of its solution, examples of resonance.
Waves in Physical Media: Mechanical waves, Traveling waves, Phase velocity of traveling waves; Sinusoidal waves, Group speed and dispersion, Waves speed, Mechanical analysis, Transfer, wave equation, Discussion of solution. Power and intensity in wave motion, Derivation & Discussion, Principle of superposition (basic ideas), Interference of waves, standing waves. Phase changes on reflections, natural frequency, resonance
Sound: Beats Phenomenon, Analytical treatment.
Light: Nature of light, Visible light (Physical characteristics). Light as an Electro-magnetic wave: Speed of light in matter, Physical aspect, path difference, phase difference etc.
Interference: Coherence of sources, Double slit interference, analytical treatment. Adding of Electromagnetic waves using phasors. Interference from thin films, Newton's rings (analytical treatment). Febry-Perot Interferometer: Working and analytical treatment, Fresnels Biprism and its use.
Diffraction: Diffraction at single slit, Intensity in single slit diffraction using phasor treatment and analytical treatment using addition of waves. Douse slit interference & diffraction combined, Diffraction at a circular aperture. Diffraction from multiple slits: Discussion to include width of the maxima. Diffraction grating: Discussion, use in spectrographs. Dispersion and resolving power of gratings. Introduction to Holography

Recommended Books

Physics by Halliday, Resnick and Walker: 8th Edition

Course Name: Mechanics-II	**Course Code:** PH – 325
Course Structure: Lectures: 3, Labs: 0	**Credit Hours:** 3
Prerequisites: A Level Physics and F.Sc. (Physics + Math)	

Course Objective

The course involves the study of Rotational Dynamics, Angular Momentum, Special Theory of Relativity.

Intended Learning Outcomes of course

(c) Knowledge & Understanding

On successful completion of this course the students will be able to

- Give the basic concept of rotational dynamics, moment of inertia & combined rotational and transnational motion.
- Know about the Angular Velocity, universal Gravitational Law, and motion of planets and Kepler's equation of planetary motion.
- Know about Bulk Properties of Matters: Elastic Properties of Matter, Special Theory of Relativity.
- **Intellectual/cognitive skills**.

Having knowledge of this course, the student will be able

- To find the moment of inertia of various shapes.
- To understand the properties of matter.
- To understand Fluid Static's.
- To understand Inertial and non-inertial frame, Postulates of Relativity, The Lorentz transformation.

Course Outline

Rotational Dynamics: Relationships between linear & angular variables, scalar and vector form, Kinetic energy of rotation, Moment of Inertia, Parallel axis theorem, Perpendicular axis: Prove and illustrate, apply to simple cases. Determination of moment of inertia of various shapes i.e. for disc, bar and solid sphere, rotational dynamics of rigid bodies, equations of rotational motion and effects of application of torques, combined rotational and transnational motion, rolling without slipping.

Angular Momentum: Angular Velocity, conservation of angular momentum, effects of torque and its relation with angular momentum, Stability of spinning objects, Discussion with examples, the spinning top, effects of torque on the angular momentum, processional motion. Gravitation: Gravitational effect of a spherical mass distribution, mathematical treatment, gravitational potential energy, develop using integration techniques, calculation of escape velocity, gravitational field & potential, universal Gravitational Law, radial and transversal velocity and acceleration, motion of planets and Kepler's equation of planetary motion, motion of satellites, energy considerations in planetary and satellite motion, qualitative discussion on application of gravitational law to the Galaxy. Bulk Properties of Matters: Elastic Properties of Matter, Physical basis of elasticity, Tension, Compression & shearing, Elastic Modules' Elastic limit. Poisson's ratio, Relation between three types of elasticity, Fluid Static's, Variation of Pressure in fluid at rest and with height in the atmosphere, Surface Tension, Physical basis; role in formation of drops and bubbles, Viscosity, Physical basis, obtaining the Coefficient of viscosity, practical example of viscosity, fluid flow through a cylindrical pipe (Poisenillie's law).

Special Theory of Relativity: Inertial and non-inertial frame, Postulates of Relativity, The Lorentz Transformation, Derivation, Assumptions on which inverse transformation derived, Consequences of Lorentz transformation, Relativity of time, Relativity of length, Relativity of mass, Transformation of velocity, variation of mass with velocity, mass energy relation and its importance, relativistic momentum and Relativistic energy, (Lorentz invariants) $E_2' = c_2 p_2 + m_{o2} c_4$.

Recommended Books

Physics by Halliday, Resnick and Walker: 8th Edition

Course Name: Heat and Thermodynamics	**Course Code:** PH – 326
Course Structure: Lectures: 3	**Credit Hours:** 3
Prerequisites: A Level Physics and F.Sc. (Physics + Math)	

Course Objectives

The objective of the course is to provide an opportunity to develop insight into the key principles and applications of Heat & Thermodynamics, and their relevance to current developments in physics.

- **Intended Learning Outcomes of Course (ILOs):**

Knowledge and Understanding:

By the end of the course, student will be able to

Demonstrate the knowledge and broad understanding of Heat & Thermodynamics. They should be able to describe and analyze quantitatively processes, relationships and techniques relevant to the topics included in the course outline.

- **Intellectual /Cognitive Skills**

By the end of the course, students will be able to

Apply the ideas and techniques gained to solve general classes of problems. They will be able to write down and, where appropriate, either prove or explain the underlying basis of physical laws relevant to the course topic, and discuss their applications.

- **Professional and Practical Skills**

Having successfully completed the course, students will be able to:

Use the physical knowledge to analyze a suitable technique to solve the problem. They will also be able to use basic laboratory equipments.

Course Outline

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, Qualitative description. Diffusion, Conduction and viscosity.

Heat and Temperature:

Temperature, Kinetic theory of the ideal gas, Work done on an ideal gas, Review of previous concepts. Internal energy of an ideal gas: Equipartition of energy. Intermolecularforces. Qualitative discussion. Van der Waals equation of state.

Thermodynamics:

Review of previous concepts. First law of thermodynamics and its applications to adiabatic, isothermal, cyclic and free expansion. Reversible and irreversible processes, Second Law of thermodynamics, Carnot theorem, Carnot engines. Heat engine. Refrigerators. Calculation of efficiency of heat engines. Thermodynamic temperature scale: Absolute zero: Entropy, Entropy in reversible process, Entropy in irreversible process. Entropy & second law. Entropy & 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, Liquification of gases, Joule-Thomson effect and its equations. Thermoelectricity, Thermocouple, Seabeck‟s effect, Peltier‟s effect, Thomson effect.

Recommended Books

1. J. F. Lee and F. W. Sears, Thermodynamics, Addison-Wesley 1954.
2. A. J. Pointon, Introduction to Statistical Physics, Longman 1967.
3. M. W. Zemansky, Heat and Thermodynamics, 3rd Edition, McGrawHill, 1951.
4. Reif, Statistical Physics, Berkley Physics series, McGraw Hill 1965.
5. M. M. Abbott, Schaum's Outline of Thermodynamics, McGraw-Hill Professional Book Group, 1995.

Course Name: Lab-II	**Course Code:** PH – 327
Course Structure: Labs: 2	**Credit Hours:** 2
Prerequisites: A Level Physics and F.Sc. (Physics)	

Course Objectives

The objective of this course is to make the students able to apply practically their knowledge in modern physics , electronics and Heat & Thermodynamics .

Intended Learning Outcomes of Course (ILOS)

Knowledge and Understanding,

On successful completion of this course the students will be able to:

i. Apply their knowledge of techniques studied in modern physics.
ii. Apply their knowledge of circuits studied in electronics.
iii. Apply their knowledge to understand the relation between heat energy and electrical energy.

Course Outline

List of Experiments:

1. To determine thermal Emf and plot temperature diagram.
2. Determination of temperature coefficient of resistance of a given wire.
3. Determination of "J" by Callender – Barnis method.
4. The determination of Stefan‟s constant.
5. Calibration of thermocouple by potentiometer.
6. To determine frequency of AC supply by CRO.
7. To determine Horizontal/Vertical distance by Sextant.
8. The determination of wavelength of Sodium –D lines by Newton‟s Ring.
9. The determination of wavelength of light/laser by Diffraction grating.
10. Determination of wavelength of sodium light by Fresnel‟s bi-prism.
11. The determination of resolving power of a diffraction grating.
12. The measurement of specific rotation of sugar by Polarimeter and determination of sugar concentration in a given solution.
13. To study the combinations of harmonic motion (Lissajous figures).
14. To study the parameters of waves (Beats phenomenon).
15. To determine the Thermal conductivity of good and bad conductors using Lee‟s and Searl‟s apparatus.
16. To study the laws of vibration of stretched string using sonometer.
17. To determine the stopping potential by photo cell.

Recommended Books

1. D. H. Marrow, Selected Experiments in Physical Sciences, Longman.
2. Nelkon and Ogborn, Advanced Level Practical Physics, Heimann Educational Books
3. Nolan and Bigliani, Experiments in Physics, Surjeet Pub Ind.
4. C. K. Bhattacharya, University Practical Physics, CBS Publishing

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DEPARTMENT OF PHYSICS

DETAILED COURSE OUTLINE OF PHYSICS
BS (4-YEARS PROGRAM)

SEMESTER-III

Course Name: English-III	**Course Code:** PH – 431
Course Structure: Lectures: 2	**Credit Hours:** 2
Prerequisites:	

Course Introduction

The usefulness of English Language cannot be denied. It enriches our thought and culture, and provides us with the most important international vehicle of expression. It has opened for us several doors of light and knowledge, for it is the Lingua Franca of the world and the language of science, technology, commerce and diplomacy. Without English we shall be handicapped in our advancement and our progress will be seriously retarded in several important spheres of life. To give it up means putting the hands of the clock back by more than a century, to take several steps backwards, to surrender ground which has been gained through persistent toil and labour, to lose the front seat in international forums and to miss the opportunity of having a direct impact on the other people's minds.

Course Objectives

The objectives of the course are:

1. To build the sound vocabulary of the students
2. To improve the linguistic skills of the students
3. Enhance language skills and develop critical thinking.

Intended Learning Outcomes

Students will be able: to express their ideas in a coherent manner, speak English with correct pronunciation, read and comprehend the written material, understand the class lectures easily.

Course Outline

Presentation skills:
Essay writing
Descriptive, narrative, discursive, argumentative
Academic writing
How to write a proposal for research paper/term paper
How to write a research paper/term paper (emphasis on style, content, language, form, clarity, consistency)
Technical Report writing
Progress report writing
Note: Extensive reading is required for vocabulary building

Recommended Books

Technical Writing and Presentation Skills

a) Essay Writing and Academic Writing
   1. Writing. Advanced by Ron White. Oxford Supplementary Skills. Third Impression 1992. ISBN 0 19 435407 3 (particularly suitable for discursive, descriptive, argumentative and report writing).
   2. College Writing Skills by John Langan. Mc=Graw-Hill Higher Education. 2004.
   3. Patterns of College Writing (4th edition) by Laurie G. Kirszner and Stephen R. Mandell. St. Martin's Press.

b) Presentation Skills

c) Reading
   The Mercury Reader. A Custom Publication. Compiled by norther Illinois University. General Editiors: Janice Neulib; Kathleen Shine Cain; Stephen Ruffus and Maurice Scharton. (A reader which will give students exposure to the best of twentieth century literature, without taxing the taste of engineering students).

Course Name: Mathematics III	**Course Code:** PH – 432
Course Structure: Lectures: 3	**Credit Hours:** 3
Prerequisites: Mathematics I & II	

Course Objectives

To prepare the students with the essential tools of calculus to apply the concepts and the techniques in their respective disciplines.

Course Outline

Preliminaries*:* Real-number line, functions and their graphs, solution of equations involving absolute values, inequalities.
Limits and Continuity*:* Limit of a function, left-hand and right-hand limits, continuity, continuous functions.
Derivatives and their Applications: Differentiable functions, differentiation of polynomial, rational and transcendental functions, derivatives.
Integration and Definite Integrals*:* Techniques of evaluating indefinite integrals, integration by substitution, integration by parts, change of variables in indefinite integrals.

Recommended Books

1) Anton H, Bevens I, Davis S, *Calculus: A New Horizon* (8th edition), 2005, John Wiley, New York
2) Stewart J, *Calculus* (3rd edition), 1995, Brooks/Cole (suggested text)
3) Swokowski EW, *Calculus and Analytic Geometry*, 1983, PWS-Kent Company, Boston Thomas GB, Finney AR, *Calculus* (11th edition), 2005, Addison-Wesley, Reading, Ma, USA

Course Name: Electricity and Magnetism-I	**Course Code:** PH – 433
Course Structure: Lectures: 3	**Credit Hours:** 3
Prerequisites: Intermediate with Physics and Math or A level Physics	

Course Objectives

Develop understanding the concepts in electricity and magnetism, reinforce general problem solving skills and reinforce conceptual understanding through the use of problem solving skills.

Aims

- To help students to understand the basic properties and applications of the electric field, magnetic field, electric circuits and the mathematics necessary to achieve this understanding.
- To introduce and then develop the transferable, practical and computational skills that are required by practising physicist, through laboratory bench work, computing and communication exercises.

Intended Learning Outcomes

- Students will understand the theoretical and experimental background of electricity and magnetism, and will appreciate their general physical significance and applications, will be achieved by assessments.
- Students be able to carry out numerical calculations and to solve problems in connection with these topics, will be achieved by assessments.
- Use of mathematics (including calculus) in solving problems will be achieved by assessments.

- Perform practical work and keep accurate accounts of it, including professionally maintained records of purpose, methodology, and results.
- Communicate the process and results of practical work in formal, written presentations. Enter, manipulate, and present data with the aid of computer tools.
- Develop algorithms and write simple computer program, at a level sufficient to assist in laboratory work.

Course Outline

Electric Field:
Field due to a point charge due to several point charges. Electric dipole. Electric field of continuous charge distribution e.g Ring of charge, disc of charge, infinite line of charge. Point charge in an electric field. Dipole in an electric field, Torque and energy of a dipole in uniform field. Electric flux: Gauss's law (Integral and differential forms) and its application. Charge in isolated conductors, conductor with a cavity, field near a charged conducting sheet. Field of infinite line of charge, field of infinite sheet of charge, field of spherical shell and field of spherical charge distribution.

Electric Potential:

Capacitors and dielectrics:
Capacitance, calculating the electric field in a capacitor. Capacitors of various shapes, cylindrical, spherical etc. and calculation of their capacitance. Energy stored in an electric field. Energy per unit volume. Capacitor with dielectric, Electric fieldof dielectric. An atomic view. Application of Gauss's Law to capacitor with dielectric.

D C Circuits:
Electric Current, current density J, resistance, resistivity ρ, and conductivity, σ, Ohm‟s Law, energy transfer in an electric circuit. Equation of continuity. Calculating the current in a single loop, multiple loops, voltages at various elements of a loop. Use of Kirchhoff's 1st & 2nd law, Thevenin theorem, Norton theorem and Superposition theorem, Growth and Decay of current in an RC circuit and their analytical treatment.

Magnetic Field Effects and Magnetic Properties of Matter:
Magnetic force on a charged particle, magnetic force on a current, Recall the previous results. Do not derive. Torque on a current loop. Magnetic dipole: Energy of magnetic dipole in field. Discuss quantitatively, Lorentz Force with its applications in CRO. Biot-Savart Law: Analytical treatment and applications to a current loop, force on two parallel current changing conductors. Ampere's Law, Integral and differential forms, applications to solenoids and toroids. (Integral form), Gauss's Law for Magnetism: Discuss and develop the concepts of conservation of magnetic flux, Differential form of Gauss‟s Law. Origin of Atomic and Nuclear magnetism, Basic ideas. Bohr´s Magneton. Magnetization, Defining M, B, μ. Magnetic Materials, Paramagnetism, Diamagnetism, Ferromagnetism - Discussion. Hysteresis in Ferromagnetic materials.

Recommended Books

1. F.J.Keller, W.E.Gettys,M.J.Skove Physics Classical and Modern (2nd edition), McGraw-

Hill, Inc., 1993
2. A. F.Kip Fundamentals of Electricity and Magnetism (2nd Ed.), McGraw-Hill Book Co., 1969.
3. D. Halliday, R. Resnick, K. S. Krane Physics(Vol-II), JohnWilley & sons, Inc., 1992.
4. D. N. Vasudeva Magnetismand Electricity, S. Chand & Co., 1959.
5. J. A. Edminister Schaum‟sOutline Series; Theory and Problems of Electromagnetism, M cGraw-Hill Book Co., 1986.

Course Name: Optics	**Course Code:** PH – 434
Course Structure: Lectures: 3	**Credit Hours:** 3
Prerequisites: Intermediate with Physics and Math or A level Physics	

Course Objectives

This course involves the study of concepts of geometrical optics,polarization,Interference & diffraction

Intended Learning Outcomes

(a) Knowledge & understanding

By the end of the course, students should be able to,

- Understand the lenses, mirrors & aberration.
- Understand about polarization.
- Understand about the interference phenomena
- Understand about diffraction.

e. **General and transferable skills**

On successful completion of this course the student should be able
-work as a part of a team to produce reports
-work as a part of a team to find a solution for practical problems & projects

- Making oral communication skills by making report presentation

Course Outline

Geometrical Optics

Geometrical optics and its laws, sign convention, Refraction at a spherical surface, lens formula, lens formula by deviation method, two lens systems, Aberrations, Review of topics related to chromatic aberration, Chromatic aberration, Eye pieces, Fibre optics.

Polarization

Plane elliptically and circularly polarized light, Production of each type and their uses, Malus law, Polarizing angle and Brewster law, Uni-axial crystals, Induced optical effects, Optical

activity in liquids

Interference

Far field approximation, Analytical treatment of interference phenomenon, point source and extended source, Typical cases of interference phenomena, (thin films, Fabry Perot & Michelson interferometer, Fresnel‟s bi prism), Holography.

Diffraction

Huygen‟s principle, Fraunhaufer diffraction, Fresnel diffraction, Diffraction by a single slit, Diffraction pattern of a rectangular aperture, Diffraction pattern of a circular aperture, Resolving power of lenses, Double slit diffraction pattern, Diffraction grating, Dispersing properties of prism and grating, X-ray diffraction, neutron and electron diffraction. Study of Fourier theorem and its analysis, Application to grating, Diffraction applications.

Recommended Books

1. E. Hecht, Optics, Addison – Wesley Publishing Company 1987.
2. D. Halliday, R. Resnick, K. S. Krane, Physics, John Willey & sons, Inc., 1992.

Course Name: Introduction to Computer languages –Basic & C	**Course Code:** PH – 435
Course Structure: Lectures: 3	**Credit Hours:** 3

Prerequisites: Introduction to Computer

Course Objectives

At the end of the course the students will be able to;

- Describe and understand different levels of computer languages
- Solve different problems through computer programming

Course Outline

Overview of computers and programming. Overview of language for e.g. C language. Basics of structured and Modular programming. Basic Algorithms and problem solving, development of basic algorithms, analyzing problem, designing solution testing designed solution, Fundamental programming constructs, translation of algorithms to programmes, data types, control structures, functions, arrays, records, files, testing programmes.

Recommended Books

1. Problem Solving and Program Design in C/6E Hanley & Koffman Addison-Wesley | Published: 02/06/2009.

2. C How to program, 5/E (Harvey and Paul) Deitel & Deitel, ISBN-10:0132404168 isbn-13:9780132404167 Publisher: Prentice Hall Copyright: 2007

Course Name: Lab-III	**Course Code:** PH – 436
Course Structure: Labs: 3	**Credit Hours:** 3
Prerequisites: Intermediate with Physics and Math or A level Physics	

Course Objectives

The objective of this course is to help the students to be able to apply practically their knowledge in modern physics and electronics.

Intended Learning Outcomes of Course (ILOS)

Knowledge and Understanding,

On successful completion of this course the students will be able to:

i. Apply their knowledge of techniques studied in modern physics.

ii. Apply their knowledge of circuits studied in electronics.

List of Experiments:

1. Measurement of resistance using a Neon flash bulb and condenser.
2. Conversion of a galvanometer into Voltmeter & an Ammeter.
3. To study the characteristics of Photo emission and determination of Plank‟s constant using a Photo cell.
4. Calibration of an Ammeter and a Voltmeter by potentiometer.
5. Charge sensitivity of a ballistic galvanometer.
6. Comparison of capacities by ballistic galvanometer.
7. To study the B.H. curve & measure the magnetic parameters.
8. Measurement of low resistance coil by a Carey Foster Bridge.
9. Resonance frequency of an acceptor circuit.
10. Resonance frequency of a Rejecter Circuit.
11. Study of the parameter of wave i.e. amplitude, phase and time period of a complex signal by CRO.
12. Measurement of self/mutual inductance.
13. Study of electric circuits by black box.
14. To study the network theorems (Superposition, Theveinin, Norton).
15. To study the application of Lorentz force by CRO.

Note: At least eight experiments to be performed.

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DEPARTMENT OF PHYSICS

DETAILED COURSE OUTLINE OF PHYSICS
BS (4-YEARS PROGRAM)

SEMESTER-IV

Course Name: Mathematics-IV	**Course Code:** PH – 441
Course Structure: Lectures: 3	**Credit Hours:** 3
Prerequisites: Mathematics-I, II & III	

Course Objective

- To prepare the students, with the essential tools of algebra to apply the concepts and the techniques in their respective disciplines.
- To prepare the students, not majoring in mathematics, with the essential tools of calculus to apply the concepts and the techniques in their respective disciplines

Course Outline

1. Preliminary calculus.
   - Differentiation

Differentiation from first principles; products; the chain rule; quotients; implicit differentiation; logarithmic differentiation; Leibnitz' theorem; special points of a function; theorems of differentiation.

- Integration

Integration from first principles; the inverse of differentiation; integration by inspection; sinusoidal function; logarithmic integration; integration using partial fractions; substitution method; integration by parts; reduction formulae; infinite and improper integrals; plane polar coordinates; integral inequalities; applications of integration.

2. Complex numbers and hyperbolic functions

- The need for complex numbers
- Manipulation of complex numbers

  Additions and subtraction; modulus and argument; multiplication; complex conjugate; division
- Polar representation of complex numbers

  Multiplication and division in polar form
- de Moivre's theorem

  Trigonometrical identities; finding the nth roots of unity; solving polynomial

equations
- Complex logarithms and complex powers
- Applications to differentiation and integration
- Hyperbolic functions

Definitions; hyperbolic-trigonometric analogies; identities of hyperbolic functions; solving hyperbolic equations; inverses of hyperbolic functions; calculus of hyperbolic functions

3. Series and limits
- Series
- Summation of series

Arithmetic series; geometric series; arithmetico-geometric series; the difference method; series involving natural numbers; transformation of series
- Convergence of infinite series

  Absolute and conditional convergence; convergence of a series containing only real positive terms; alternating series test
- Operations with series
- Power series

Convergence of power series; operations with power series
- Taylor series

  Taylor's theorem; approximation errors in Taylor series; standard Maclaurin series
- Evaluation of limits

Partial differentiation
- Definition of the partial derivative
- The total differential and total derivative
- Exact and inexact differentials
- Useful theorems of partial differentiation
- The chain rule
- Change of variables
- Taylor's theorem for many-variable functions
- Stationary values of many-variable functions
- Stationary values under constraints

5. Multiple integrals
- Double integrals
- Triple integrals
- Applications of multiple integrals

  Areas and volumes; masses, centers of mass and centroids; Pappus' theorems; moments of inertia; mean values of functions
- Change of variables in multiple integrals

  Change of variables in double integrals;

6. Vector algebra
- Scalars and vectors

- Addition and subtraction of vectors
- Multiplication by a scalar
- Basis vectors and components
- Magnitude of a vectors
- Multiplication of vectors
  Scalar product; vector product; scalar triple product; vector triple product
- Equations of lines and planes
  Equation of a line; equation of a plane
- Using vectors to find distances
  Point to line; point to plane; line to line; line to plane
- Reciprocal vectors

7. Matrices and vector spaces

- Vectors spaces

Basic vectors; the inner product; some useful inequalities

- Matrices
- The complex and Hermitian conjugates of a matrix
- The determinant of a matrix

- Special square matrices

- The inverse of a matrix
- The rank of a matrix
- Simultaneous linear equations
  N simultaneous linear equations in N unknowns

  Diagonal; symmetric and antisymmetric; orthogonal; Hermitian; unitary normal
- Eigen vectors and eigen values
  Of a normal matrix; of Hermitian and anti-Hermitian matrices; of a unitary matrix; of a general square matrix
- Determination of eigen values and eigen vectors
  Degenerate eigen values

8. Vector calculus

- Differentiation of vectors
  Composite vector expressions; differential of a vector
- Integration of vectors
- Space curves
- Vector functions of several arguments
- Surfaces
- Scalar and vector fields
- Vector operators
  Gradient of a scalar field; divergence of a vector field; curl of a vector field
- Vector operator formulae

Vector operators acting on sums and products; combinations of grad, div and curl

• Cylindrical and spherical polar coordinates

Cylindrical polar coordinates; spherical polar coordinates

Recommended Books

1. *Anton H, Calculus: A New Horizon (6th edition), 1999, John Wiley, New York*
2. *Stewart J, Calculus (3rd edition), 1995, Brooks/Cole*
3. *Thomas GB, Finney AR, Calculus (10th edition), 2002, Addison-Wesley, Reading, M USA*
4. *Zia-ul-Haq, Calculus and Analytic Geometry, 1998 The Caravan Book Hou Lahore.*
5. *Ervin Kreyszig, Advanced Engineering Mathematics(latest edition),John Wiley and Sons*
6. *S.M.Yusuf Mathematical Methods 1996, Ilmi Kitab Khana Kabir Street, Urdu Baz Lahore.*
7. *Karamat H. Dar,Irfan ul Haq and M. Ashraf Jagga, Mathematical Techniques. 3rd editi 1998, The Caravan Book House, Lahore.*

Course Name: Electricity & Magnetism-II	**Course Code:** PH – 442
Course Structure: Lectures: 3	**Credit Hours:** 3
Prerequisites: Electricity & Magnetism-I	

Course Objective

- To understand the laws of electromagnetic induction
- To understand the AC circuits
- To know the generation and propagation of Electromagnetic waves

Intended Learning Outcomes

- Students will understand the theoretical and experimental background of electricity and magnetism, and will appreciate their general physical significance and applications.
- Students be able to carry out numerical calculations and to solve problems in connection with these topics.

Course Outline

Inductance:

Faraday‟s Law of Electromagnetic Induction, Review of emf, Faraday Law and Lenz‟s Law, Induced electric fields, Calculation and application using differential and integral form, Inductance, “Basic definition”. Inductance of a Solenoid, Toroid. LR Circuits, Growth and Decay of current, analytical treatment. Energy stored in a magnetic field, Derive. Energy density and the magnetic field. Electromagnetic Oscillation, Qualitative discussion.

Quantitative analysis using differential equations. Forced electromagnetic oscillations and resonance.

Alternating Current Circuits:

Alternating current, AC current in resistive, inductive and capacitative elements. Single loop RLC circuit, Series and parallel circuits i.e. acceptor and rejector, Analytical expression for time dependent solution. Graphical analysis, phase angles. Power in A.C circuits: phase angles, RMS values, power factor.

Electro-Magnetic Waves (Maxwell's Equations):

Summarizing the electro- magnetic equations, (Gauss's law for electromagnetism, Faraday Law, Ampere's Law). Induced magnetic fields & displacement current. Development of concepts, applications. Maxwell's equations, (Integral & Differential forms) Discussion and implications. Generating an electro-magnetic wave. Travelling waves and Maxwell's equations. Analytical treatment; obtaining differential form of Maxwell's equations, obtaining the velocity of light from Maxwell's equations. Energy transport and the Poynting Vector. Analytical treatment and discussion of physical concepts.

Recommended Books:

1. F. J. Keller, W. E. Gettys, M. J. Skove Physics Classical and Modern (2nd edition), McGraw-Hill, Inc., 1993.
2. A. F. Kip Fundamentals of Electricity and Magnetism(2nd Ed.), McGraw-Hill Book Co., 1969.
3. D. Halliday, R. Resnick, K.S. Krane Physics(Vol-II), John Willey & sons, Inc., 1992.
4. D. N. Vasudeva Magnetism and Electricity, S. Chand & Co., 1959.
5. J. A. Edminister Schaum‟sOutline Series; Theory and Problems of Electromagnetism, McGraw-Hill Book Co., 1986.

Course Name: Electronics and Modern Physics	**Course Code:** PH – 443
Course Structure: Lectures: 3	**Credit Hours:** 3
Prerequisites: Intermediate with Physics and Math or A level Physics	

Course Objectives

1. To give the concept of modern physics
2. To know the nuclear structure and radioactivity
3. To know some nuclear reactions and production of nuclear energy
4. To give basic understanding of Plasma and LASER

Intended Learning Outcomes

At the completion of this course, students will be able to:

- Define the shortcoming of classical physics and describe the need for modifications to classical theory.
- Describe the Special Theory of Relativity
- Solve problems using time dilation and space contraction
- Describe the wave particle duality of light
- Investigate the nature and structure of the atom to develop the four forces of nature
- Define a de Broglie or matter wave
- Apply the laws of wave mechanics to develop the Schrodinger equation
- Develop the mathematics required to solve a one dimensional Schrodinger equation system

Course Outline

Electronics:
Basic crystal structure, free electron model, energy band in solid and energy gaps, p-type, n-type semiconductor materials, p-n junction diode, its structure. characteristics and application as rectifiers. Transistor, its basic structure and operation, transistor biasing for amplifiers, characteristics of common base, common emitter, common collector, load line, operating point, hybrid parameters (common emitter), Transistor as an amplifier (common emitter mode), Positive & negative feedback R.C. Oscillators, Mono stable multi- vibrator (basic),Logic gates OR, AND, NOT, NAND, NOR and their basic applications.

Origin of Quantum Theory:
Black body radiation, Stefan Boltzman, Weins and Planck‟s law, consequences. The quantization of energy, Photoelectric and Compton effect, Line spectra, Explanation using quantum theory.

Wave Nature of Matter:
Wave behaviour of particle (wave function etc.) its definition and relation to probability of particle, D‟ Broglie hypothesis and its testing, Davisson-Germer Experiment and J.P. Thomson Experiment, Wave packets and particles, localizing a wave in space and time.

Atomic Physics:
Bohr‟s theory (review), Frank-Hertz experiment, energy levels of electron, Atomic spectrum, Angular momentum of electrons, Vector atom model, Orbital angular momentum. Spin quantization, Bohr‟s Magnetron. X-ray spectrum (continuous and discrete) Moseley‟s law, Pauli‟s Exclusion principle and its use in developing the periodic table.

Recommended Books

1. Robert M Eisberg, Fundamentals of Modern Physics, John Wiley & Sons 1961
2. Sanjiv Puri, Modern Physics, Narosa Publishing House, 2004.
3. Paul A. Tipler and Ralph A. Llewellyn, Modern Physics 3rd edition, W H Freeman and Company 2000.
4. Arthur Beiser, Concepts of Modern Physics (fifth edition) McGraw-Hill 1995.
5. Robert M. Eisberg andRobert Resnick, Quantum Physics of Atoms, molecules, Solids, Nuclei and Particles, 2nd edition, John Wiley & Sons, 2002.
6. D. Halliday, R. Resnick, K. S. Krane, Physics, John Willey & sons, Inc., 1992.

WEEK#	TOPICS

Course Name: Introduction to Softwares	**Course Code:** PH – 434
Course Structure: Lectures: 2	**Credit Hours:** 2
Prerequisites: Intro to computer programming (C- Language)	

Course Objectives

- To give a concept of Mathematica and MATLAB.
- To give practice in programming.
- To make the students able to plot a relationship between different physical quantities by using Mathematica and MATLAB.
- To make the students able to solve numerical problems by using Mathematica.

Course Outline

Mathematica:
What it is and what it can do; structure of Mathematica; symbols, exact numbers, and machine numbers; lists, vectors, and matrices.
Working with Mathematica:
Numerical calculations, symbolic calculations and graphics. Importing and exporting information.
MATLAB:
"Matrix Laboratory". Matlab syntax, workspace, variables. Script M-files, IO, control flow, debugging, and profiling tools. Object-oriented programming. Matlab applications.

Recommended Books

1. A Physicist´s guide to Mathematica,2nd Ed., by Patrick T. Tam.
2. An Introduction to Modern Mathematical Computing:With Mathematica, Springer
3. Numerical Computing with MATLAB, by Cleve Moler
4. A Guide to MATLAB for Beginners and Experienced Users by Brain R. Hunt, Ronald L. Lipsman & Jonathon M. Rosenberg.

Course Name: Materials Science	**Course Code:** PH – 445
Course Structure: Lectures: 2	**Credit Hours:** 2
Prerequisites: None	

Course Introduction
This course involves study of inter atomic bonds, crystallography, General classification of materials, physical, chemical & mechanical properties of materials.

Intended Learning Outcomes Knowledge and understanding:

On successful completion of course the student should be able to

- Understand about the inter atomic bonds & how to solve problems.
- Get knowledge about crystallography in detail.
- Understand the difference between metals, ceramics, polymers & composites.
- Understand the physical, chemical & mechanical properties of materials.

f. **General and transferable skills**

On successful completion of this course the student should be able

-work as a part of a team to produce reports

-work as a part of a team to find a solution for practical problems & projects

- Making oral communication skills by making report presentation.

Course Outline

Chapter 1. Interatomic Bonds: Introduction, Interaction between atoms, the ionic bond, the covalent bond, the metallic bond, the van der Waals bonds, mixed bonding, numerical problems.

Chapter 2. Crystallography: Basic ideas, the space lattice and basis, the five 2-D Bravais nets and fourteen 3-D Bravais lattices, other ways to define a unit cell, crystal growth and the related techniques, numerical problems.

Chapter 3. General Classification of Materials: Metals, ceramics, polymers, composites, applications, numerical problems.

Chapter 4. Physical and Chemical Properties of Materials: Phase transformation temperatures, Density, specific gravity, thermal conductivity, resistivity, numerical problems.

Chapter 5. Mechanical Properties of Materials: stress-strain behaviour, Young modulus, elastic deformation, plasticity, compressive, shear and torsional deformation, numerical problems.

Recommended Books

1. Moulson, A. J. and Herbert, J. M. “Electro-ceramics: Materials, Properties, and Applications”. John and Wiley and Sons, 2003.
2. Pillai, S. O, Pillai, Sivakami, “Rudiments of Materials Science”. New Age International (P) Limited Publishers, New Delhi, 2005.
3. Chung, Deborah D. L. “Applied Materials Science” Chapman and Hall/CRC Press LLC, New York, Washington D. C. 2001.
4. Callister, Jr W. D. “Fundamentals of Materials Science and Engineering”. 5th Ed. John Wiley & Sons, Inc. New York, 2001.
5. Gersten J. I. and Smith F. W. “The Physics and Chemistry of Materials” John Wiley & Sons, Inc. New York, 2001.

Course Name: Lab-IV	**Course Code:** PH – 446
Course Structure: Lectures: 3	**Credit Hours:** 3
Prerequisites: FSC level Physics and Electricity and Magnetism I	

Course Objectives

1. To develop understanding and uses of electronic devises including GATS, Transistors.
2. To understand the behaviour of nuclear radiation including beta and gama radition.

Course Outline

List of Experiments:

1. Determination of e/m of an electron.
2. Determination of ionization potential of mercury.
3. Characteristics of a semiconductor diode (Compare Si with Ge diode
4. Setting up of half & full wave rectifier & study of following factors
5. Smoothing effect of a capacitor
6. Ripple factor & its variation with load.
7. Study of regulation of output voltage with load.
8. To set up a single stage amplifier & measure its voltage gain and band width.
9. To set up transistor oscillator circuit and measure its frequency by an oscilloscope.
10. To set up and study various logic gates (AND, OR, NAND etc.) using diode and to develop their truth table.
11. To set up an electronic switching circuit using transistor LDR and demonstrate its use as a NOT Gate.
12. Characteristics of a transistor.
13. To study the characteristic curves of a G. M. counter and use it to determine the absorption co-efficient of β-particle in Aluminum.
14. Determination of range of α-particles.
15. Mass absorption coefficient of lead for γ-rays using G.M counter.
16. Use of computer in the learning of knowledge of GATE and other experiments.

Recommended Books

1. G L Squires, Practical Physics, 3rd Edition, Cambridge University Press
2. Nolan and Bigliani, Experiments in Physics, Surjeet Pub Ind.

3. C K Bhattacharya, University Practical Physics, CBS Publishing.

SHAHEED BENAZIR BHUTTO WOMEN UNIVERSITY
PESHAWAR
DEPARTMENT OF PHYSICS

DETAILED COURSE OUTLINE OF PHYSICS
BS (4-YEARS PROGRAM)

SEMESTER-V

Course Name: Mathematical Methods of Physics -I	**Course Code:** PH – 551
Course Structure: Lectures: 3	**Credit Hours:** 3
Prerequisites: General Mathematics	

Course Objectives

- To develop the mathematical background of student in vectors, tensors, matrices and some of their uses in the world of physics
- The main objective of this course is to provide the student with a repertoire of mathematical methods that are essential to the solution of advanced problems encountered in the fields of applied physics and engineering.
- In addition, this course is intended to prepare the student with mathematical tools and techniques that are required in advanced courses offered in the applied physics and engineering programs.

Intended Learning Outcomes

At the end of the course the students will be able to;

- demonstrate usefulness of this techniques in 'real world' problems, thereby helping students to master other core subjects (classical mechanics, electrodynamics, quantum mechanics, ...)
- to develop problem solving skills and research attitude,
- to prepare students for the *Ph.D. qualifying exams* .
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Course Outline

Curvilinear Coordinates and Tensors: Curvilinear coordinate system, gradient, divergence and curl in the curvilinear coordinate system, Cartesian, spherical and cylindrical coordinate systems, covariant and contra-variant tensors algebra, quotient rule.
Matrices: Linear vector spaces, determinants, matrices, eigenvalues and eigenvectors of matrices, orthogonal matrices, orthogonalization, Gram-Schmidt orthogonalization, Hermitian matrices, similarity transformations, diagonalization of matrices, Hilbert spaces.
Complex Variables: Functions of a complex variable, Cauchy-Riemann conditions and analytic functions, Cauchy integral theorem and integral formula, Taylor and Laurent series, Calculus of residue, Complex integration.

Special Functions: Bessel functions and Hankel functions, Spherical Bessel functions, Legendre polynomials, associated Legendre polynomials, spherical harmonics, Laguerre polynomials, Hermite polynomials.
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 equation.

Recommended Books

1. M.L. Boas, 'Mathematical Methods in Physical Sciences', John Wiley & Sons, New York (1989).
2. C. Wa Wong, 'Introduction to Mathematical Physics', Oxford University 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 Jersey (1992)

Course Name: Classical Mechanics-I	**Course Code:** PH – 552
Course Structure: Lectures: 2	**Credit Hours:** 2
Prerequisites: Mechanics-I & II	

Course Objectives

- To develop the basic knowledge of classical world using the laws of Physics
- To develop the understanding of two bodies central force problems
- To give understanding of kinematics and dynamics of rigid bodies
- Development of Hamiltonian equation and use of canonical transformation in classical physics

Intended Learning Outcomes

a. Knowledge and Understanding.

On successful completion of this course the students will be able to:

- Deal with complex physics problems using the Lagrangian and Hamiltonian formalism.
- Better appreciate the formulation of quantum mechanics and field theory in terms of these two formalisms.

b. Intellectual/Cognitive Skills

Students should be able to :
Apply the basic principles of classical mechanics to interpret daily observations related to Physics.

Course Outline

Elementary Principles:

Brief Survey of Newtonian mechanics of a system of particles, constraints, Alembert's principle, Lagrange's equation and its applications. Virtual work.

Variational Principles:

Calculus of variation and Hamilton's principle, Derivation of Lagrange's equation from Hamilton's principle.

Two Body Central Force Problem:

Low and least action, two body problem and its reduction to one body problem. Equation of motion and solution for one body problem, Kepler's Laws Laboratory and centre of mass systems, Rutherford scattering.

Kinematics of Rigid Body Motion:

Orthogonal transformations, Eulerian angles, Euler's theorem, The coriolis force.

Recommended Books

1. H. Goldstein,'Classical Mechanics', 2nd. Edn., Addison Wesley, Reading, Massachusetts (1980).
2. V.I. Arnold, Mathematical Methods of Classical Mechanics Springer verlag, New York (1980).
3. S.N. Rasband, 'Dynamics', John Wiley & Sons, New York (1983).
4. R.A. Matzner & L.C. Shepley, 'Classical Mechanics', Prentice Hall Inc., London (1991).
5. N.M.J. Woodhouse, 'Introduction to Analytical Dynamics', Oxford Science Publications, Oxford (1987).

Course Name: Electrodynamics I	**Course Code:** PH – 553
Course Structure: Lectures: 3	**Credit Hours:** 3
Prerequisites: None	

Course Objectives

To help students to understand the basic properties and applications of the electric field, magnetic field, electric circuits and the mathematics necessary to achieve this understanding. To introduce and then develop the transferable, practical and computational skills that are required by practising physicist, through laboratory bench work, computing and communication exercises.

Intended Learning Outcomes

- Students will understand the theoretical and experimental background of electricity and magnetism, and will appreciate their general physical significance and applications.
- Students be able to carry out numerical calculations and to solve problems in connection with these topics
- Students will be able to use mathematics (including calculus) in solving problems,

Course Outline

Fundamental Concepts: Recapitulation of the fundamental concepts, Induction B, Magnetic intensity H, Maxwell's equations in differential and integral forms, Poynting theorem and energy conservation.
Boundary value Problems: Poisson and Lap lace's equations in spherical and cylindrical coordinates, conducting sphere in a uniform electric field, cylindrical harmonics. Electrical images: a point charge near a conducting plane, a point charge and conducting sphere, line charge and line image.
Static Electromagnetic Fields: Electrostatic fields in several dielectric media, Magneto static fields of magnetized matter, Magnetostatic field of stationary current, Magnetization current.
Time Dependent Electromagnetic Fields: Maxwell's equations for quasi stationery fields, Potentials of a rapidly varying field, Fields of uniformly moving and accelerated charges, Radiation from an accelerated charge, Field of oscillating magnetic fields, Multiple fields, expansion of emf .

Recommended Books

1.Reitz & Milford; 200: Foundation of Electromagnetic Theory Addison Wesley.

2. Ohanion, H. e.; 1988: Classical Electrodynamics. Allyn & bacon Inc., Massachusetts

3. Y.K. Lim; 1986: Introduction to Classical Electrodynamics, World Scientific Publishing Co. Lt., Singapore..

4. P.e. Lorrain & D.R. Corson, 1978: Electromagnetic Fields and Waves. W.H. Freeman & Co., New York.

5. C.R. Paul & S.A. Nasar, 1987: Introduction to Electromagnetic Fields. McGraw Hill Book Company, Singapore.

6. A.M. Portis, 1978 : Electromagnetic Fields. John Wiley & Sons, New York.

Course Name: Atomic and Molecular Physics	**Course Code:** PH – 554
Course Structure: Lectures: 3	**Credit Hours:** 3
Prerequisites: (Modern Physics), (Quantum Mechanics)	

Course Objective

- To review the existing theories of atomic structure
- To introduce the experimental proof of quantization
- To introduce the use of Schrodinger Equation in real system like Hydrogen atom
- To understand the Molecular spectrum
- To understand the LASER production and Operation

Intended Learning Outcomes

At the end of the course the students will be able to**;**

- Explain the existing theories of atomic structure
- Explain the use of Schrodinger Equation in real system like Hydrogen atom
- Explain different phenomena quantum mechanically

Course Outline

Atomic Physics: Review of Bohr's theory and Summerfield theory, Frank-Hertz experiment, Stern-Gerlach experiment, Schrodinger equation for Hydrogen atom, quantum numbers, radioactive transitions, selection rules, normal Zeeman effect, many body atoms, Pauli exclusion Principle, spin-orbit coupling, LS coupling, Hartee method, X-ray spectra.

Molecular Spectra: Ionic and covalent bonding, diatomic molecular rotational, vibrational, and electronic spectra, polyatomic molecules, black-body radiation, Einstein coefficient and simulated emission, pumping schemes, characteristics of laser beams, resonators, different types of lasers.

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. Longrnans, London

3. Eisberg, R and Resnick, R; 1985: Quantum Physics of Atoms, Molecules, Solids, Nuclei and Particles, 2nd Edition. John Wiley and Sons.

4. Laud, B. 8; 1991: Lasers and Non-linear Optics, 2nd Edition. Wiley Eastern Limited. New Delhi.

5. Koichi, S.; 1983: Introduction to laser's Physics. Springer verlag.

Course Name: ENVIRONMENTAL PHYSICS	**Course Code:** PH – 555
Course Structure: Lectures: 3	**Credit Hours:** 3
Prerequisites: Physics (FSc)	

Course Objective

- To become familiar with the essentials of environment and Global climate
- To learn to use spectroscopy for environments.

Intended Learning Outcomes

At the end of the course the students will be able to;

- aquire basic knowledge within selected environmental topics
- ask critical questions and perform scientifically based evaluations about current important environmental subjects
- perform calculations within the selected environmental topics
- on their own be able to obtain information from external sources needed to

answer a given question related to the selected environmental topics

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 equipments. Measurement of temperature, air humidity, surface wind velocity, Radiation balance, precipitation, Atmospheric Pressure, automatic weather stations.

Recommended Books

. Egbert Booker and Rienk Van Gron Belle, Environmental Physics, 2nd ed. John Wiley and sons. 1999.
1. 2. Physics of Environmental and Climate, Guyot Praxis Publication. 1998.

Course Name: Lab-V	**Course Code:** PH – 556
Course Structure: Lectures: 3	**Credit Hours:** 3
Prerequisites: None	

Course Objective

1. To expose the students to advance level experimentation in Physics
2. To make them familiar to such experiments whose out come can be used in developing future research capabilities and teaching skills.

3. To make the students confident in their studies by showing and measuring parameter which they have used in theoretical work.

Course Outline

List of Experiments:

1. To study the characteristics of a Geiger-Muller counter and to examine the attenuations of beta particles in Al-and Pb foils.
2. Measurement of the half-life of a radio nuclide. To study the pulse-height as a function of the H.H.T. in a scintillation counter.
3. Measurement of the spectrum of gamma rays from a radioisotope. Shielding and attenuation of gamma rays.
4. To study the characteristics of a solid-state detector and use it to measure the spectra of alpha and beta particles.
5. Use of a Lithium-drifted Ge-counter for gamma spectroscopy and to compare its performance with that of a NA l-detector.
6. AC circuits and dielectric constants of water and ice.
7. Radio frequency measurement. Skin-effect etc.
8. Experiments with transmission lines.
9. Measurement of characteristic impedance. Velocity. Standing wave ratio, etc.

SHAHEED BENAZIR BHUTTO WOMEN UNIVERSITY
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DEPARTMENT OF PHYSICS

DETAILED COURSE OUTLINE OF PHYSICS
BS (4-YEARS PROGRAM)

SEMESTER-VI

Course Name: Mathematical Methods of Physics-II	**Course Code:** PH – 561
Course Structure: Lectures: 3	**Credit Hours:** 3
Prerequisites: PH-551	

Course Objective

To give basic understanding of group theory and complex variables used in physics

Intended Learning Outcomes

At the end of the course the students will be able to ;

- Explain a mathematical relationship between different physical quantities
- demonstrate usefulness of this techniques in 'real world' problems, thereby helping students to master other core subjects (classical mechanics, electrodynamics, quantum mechanics, ...)
- develop problem solving skills and research attitude,
- to prepare students for the Ph.D. qualifying exams

Course Outline

Group Theory: Introduction to groups, group representation, invariant subgroups and factor groups, discrete groups Dihedral groups, continuous groups-O groups, SU(2) groups, Lie groups

Integral Transforms: The integral transforms, Fourier transform, Convolution theorem, Parseval's theorem, elementary Laplace transform and its applications

Boundary Value Problems and Green's Functions: Boundary value problems in Physics, Non-homogeneous boundary value problems and Green's functions, Green's functions for one-dimensional problems, Eigen function expansion of Green's function, construction of Green's functions in higher dimensions .

Recommended Books

1. M.L. Boas, 'Mathematical Methods in Physical Sciences', John Wiley & Sons, New York (1989).

2. C. Wa Wong, 'Introduction to Mathematical Physics', Oxford University 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 Jersey (1992)

Course Name: Classical Mechanics-II	**Course Code:** PH – 562
Course Structure: Lectures: 2	**Credit Hours:** 2
Prerequisites: Classical Mechanics-I	

Course Introduction

This course involves study of Rigid body equation of motion, Hamilton equation of motion and Canonical transformation. It gives the students the basic knowledge of angular momentum, tensors and dyadic, Euler's equations, legendre transformation, Hamilton equations, Examples of canonical transformation, Lagrange and Poisson brackets, Liouville's theorem.

Course Objectives

- To give understanding of kinematics and dynamics of rigid bodies
- Development of Hamiltonian equation and use of canonical transformation in classical physics

Intended Learning Outcomes

On successful completion of this course the students will be able to:

- Give the basic concept of rigid body and Hamilton equation of motion, angular momentum, tensors and dyadic, Legendre and Canonical transformation, Lagrange and Poisson bracket.
- Uses of above concepts in daily life in a scientific way.

Course Outline

Rigid Body Equation of Motion:
Angular momentum, Tensors and dyadics, Moment of inertia, Rigid body problems and Euler's equations.
Hamilton Equation of Motion:
Legendre transformation and Hamilton equations of motion, Conservation theorems.
Canonical Transformations:
Examples of canonical transformations, Lagrange and Poisson brackets, Liouville's theorem.

Recommended Books

1. H. Goldstein,'Classical Mechanics', 2nd. Edn., Addison Wesley, Reading, Massachusetts (1980).
2. V.I. Arnold, Mathematical Methods of Classical Mechanics Springer verlag, New York

(1980).
3. S.N. Rasband, 'Dynamics', John Wiley & Sons, New York (1983).
4. R.A. Matzner & L.C. Shepley, 'Classical Mechanics', Prentice Hall Inc., London (1991)..
5. N.M.J. Woodhouse, 'Introduction to Analytical Dynamics', Oxford Science Publications, Oxford (1987).

Course Name: Thermal and Statistical Physics	**Course Code:** PH – 563
Course Structure: Lectures: 3	**Credit Hours:** 3
Prerequisites: FSc Physics and Heat and Thermodynamics	

Course Objectives

- To develop the understanding of thermal properties by using statistical means in thermodynamics
- Development of various statistics like Boltzmann Statistics, Bose – Einstein statistics and Fermi- Dirac Statistics
- To develop the understating of lattice dynamics in solid materials.

Intended Learning Outcomes

By the end of the course successful students are expected to be able to:

- Utilise the terms and basic methods of Statistical Physics.
- Derive expressions for the variation of various properties of macroscopic amounts of material.
- Appreciate the different statistics arising from distinguishable and indistinguishable particles and relate these to the behaviour of solids and gases.
- Calculate and manipulate Partition Functions and to derive Thermodynamic state functions analytically in some specific cases.
- Analyse the distinction between Fermi-Dirac, Bose-Einstein and Maxwell-Boltzmann statistics, and the origin of these differences.
- Summarise non-classical behaviours such as Electron Degeneracy pressure and Bose-Einstein Condensation.

Course Outline

Equilibrium Thermodynamics:
Basic postulates, fundamental equations and equations of state, response functions Maxwell's relation, reduction of derivatives.

Elements of Probability Theory:
Probabilities, distribution functions, statistical interpretation of entropy, Boltzmann H-theorem.
Formulation of Statistical Methods:
Ensembles, counting of states (in classical and quantum mechanical systems, examples) partition function, Boltzmann distribution. Formation of Micro-canonical, canonical and grand canonical partition function.
Partition Function:
Relations of partition function with thermodynamic variables, examples (collection of simple harmonic oscillators, Pauli and Van Vleck paramagnetics, Theorem of equipartition of energy.
Statistical Systems:
Maxwell-Boltzmann, Bose-Einstein, Fermi-Dirac statistical systems. Examples of thermodynamics of these systems; Black body radiations, Gas of electrons in solids.
Statistical Mechanics of Interacting Systems:
Lattice vibrations in solids; Van der Waals Gas: mean field calculation; Ferromagnets in Mean Field Approximation.
Advanced Topics:
Fluctuations, Bose-Einstein Condensation, Introduction to density matrix approach.

Recommended Books

1. F. Mandl, Statistical Physics, ELBS/JohnWilley, 2nd Ed. 1988.
2. F. Reif, Fundamentals of Statistical and Thermal Physics, Mc. Graw Hill, 1965.
3. A.J. Pointon, Introduction to Statistical Physics, Longman 1967.
4. C. Kittel, Elements of Statistical Physics, John Wiley 1958.

Course Name: Electrodynamics -II	**Course Code:** PH – 564
Course Structure: Lectures: 3	**Credit Hours:** 3
Prerequisites: Electrodynamics-I	

Course Objective

The objective of this course is give the students a basic concept of the behavior or properties of the electromagnetic waves.

Course Outline

Reflection Refraction of Electromagnetic Waves: Laws of reflection and refraction, Fresnel's formula, Total reflection, Refraction in a conducting media, Reflection from a conducting surface.
Propagation of Plane Electromagnetic Waves: Monochromatic waves and plane waves, forced oscillation of an electronic oscillator, scattering by a bound electron, dispersion in dilute medium and dense media, dispersion in metallic conductor, group velocity, Lorentz's Gauge and Coloumb's.
Skin Effect and Wave Guides: Higher frequency current in a semi- infinite conductor, internal impedance at high frequencies, waves guided by parallel plane conductor, transmission by a rectangular wave guide, , power transfer and attenuation, wave guides as cavity resonators, Q of a cavity resonator, waves guided by dielectrics, optical wave guides .

Electrodynamics and Special Relativity: Covariance of Maxwell's equations, Principle of Lorentz transformation and applications, the four vector systems, Transformation of electromagnetic field vectors and potentials, The Doppler effect, Covariant formulation of Physical laws and vacuum electrodynamics, The Lorentz force, Motion of a charge in electromagnetic field, Electromagnetic Momentum Energy tensor.

Recommended Books

1. Reitz & Milford; 200: Foundation of Electromagnetic Theory Addison Wesley .

2. Ohanion, H. e.; 1988: Classical Electrodynamics. Allyn & bacon Inc., Massachusetts

3. Y.K. Lim; 1986: Introduction to Classical Electrodynamics, World Scientific Publishing Co. Lt., Singapore..

4. P.e. Lorrain & D.R. Corson, 1978: Electromagnetic Fields and Waves. W.H. Freeman & Co., New York.

5. S. C.R. Paul & S.A. Nasar, 1987: Introduction to Electromagnetic Fields. McGraw Hill Book Company, Singapore.

6. A.M. Portis, 1978 : Electromagnetic Fields. John Wiley & Sons, New York.

Course Name: Computational Physics	**Course Code:** PH – 565
Course Structure: Lectures: 3	**Credit Hours:** 3
Prerequisites: Intro. To Computer Programming	

Course Objectives

- Introduction of computer languages
- To know the use of computer in numerical anlysis
- Computer simulation and modeling

Intended Learning Outcomes

The objective of this course is to familiarize the students with the study and development of computational techniques and numerical algorithms leading to computer simulations of various physical processes.

Course Outline

Numerical Methods: Numerical Solutions of equations: Regression and interpolation, Numerical integration and differentiation. Error analysis and techniques for elimination of systematic and random errors.
Modeling & Simulations: Conceptual models, The mathematical models, Random numbers

and random walk, Doing Physics with random numbers, Computer simulation, Relationship of modeling and simulation. Some systems of interest for physicists such as Motion of Falling objects, Kepler's problems, Oscillatory motion, Many particle systems, Dynamic systems, Wave phenomena, Field of static charges and current, Diffusion, Populations genetics etc.

Recommended Books

1. M. L. De Jong, 'Introduction to Computational Physics', Addison Wesley Publishing Company Inc., Massachusetts (1991).
2. S.T. Koonini, Computational Physics', The Benjamin/Coming Publishing Inc., California (1986).
3. P.K. Macheown & D.J. Merman, Computational Techniques in Physics' Adm Hilger, Bristol (1987).
4. H. Gould & J. Tobochnik, 'An Introduction to Computer Simulation Methods', Addison Wesley Publishing Company, Rading Massachusetts(1988).
6. S.C. Chapra & R.P. Chanle, 'Numerical Methods for Engineers with Personal Computer Applications, McGraw Hill Book Company, New York (1965)
7. R.A. Matzner & L.C. Shepley, 'Classical Mechanics', Prentice Hall Inc., London (1991).
8. N.M.J. Woodhouse, 'Introduction to Analytical Dynamics', Oxford Science Publications.

Course Name: Lab-VI	**Course Code:** PH – 566
Course Structure: Lectures: 3	**Credit Hours:** 3
Prerequisites: Lab-I, II, III & IV	

Course Objectives

- To expose the students to advance level experimentation in Physics.
- To make them familiar to such experiments whose out come can be used in developing future research capabilities and teaching skills.
- To make the students confident in their studies by showing and measuring parameter which they have used in theoretical work.

Course Outline

List of Experiments:
1. To study the characteristics of a Geiger-Muller counter and to examine the attenuations of beta particles in Al-and Pb foils.
2. Measurement of the half-life of a radio nuclide. To study the pulse-height as a function of the H.H.T. in a scintillation counter.
3. Measurement of the spectrum of gamma rays from a radioisotope. Shielding and attenuation of gamma rays.
4. To study the characteristics of a solid-state detector and use it to measure the spectra of alpha and beta particles.
5. Use of a Lithium-drifted Ge-counter for gamma spectroscopy and to compare its performance with that of a NA l-detector.

6. AC circuits and dielectric constants of water and ice. 7. Radio frequency measurement. Skin-effect, etc. 8. Experiments with transmission lines. 9. Measurement of characteristic impedance. Velocity. Standing wave ratio, etc.

SHAHEED BENAZIR BHUTTO WOMEN UNIVERSITY
PESHAWAR
DEPARTMENT OF PHYSICS

DETAILED COURSE OUTLINE OF PHYSICS
BS (4-YEARS PROGRAM)

SEMESTER-VII

Course Name: Solid State Physics-I	**Course Code:** PH – 671
Course Structure: Lectures: 2	**Credit Hours:** 2
Prerequisites: Quantum Mechanics , Electricity & Magnetism I & II, Heat and Thermodynamics, Statistical Physics.	

Course Objectives

- To develop a basic knowledge of crystallography
- To understand the x-ray diffraction in crystal investigation
- To understand the binding forces in crystalline material
- To develop the understanding of lattice dynamics and its uses in derivation of theories of specific heat
- To understand the behavior of free electrons in metals and Fermi Energy.

Intended Learning Outcomes

At the end of the course the students will be able to;

- Explain the structure of crystalline materials & the basic forces responsible for shapes of these materials.
- Calculate structure of unknown crystals by using x-ray diffraction.

Course Outline

Structure of Solids

Lattices and basis, Symmetry operations, Fundamental types of lattice, Position and orientation of planes in crystals, Simple crystal structures, Atomic potential, space groups and binding forces.

Crystal diffraction and reciprocal lattice:

Diffraction of X-rays, Neutrons and electrons from crystals, Bragg‟s law, Reciprocal lattice, Reciprocal lattice to sc, bcc, fcc, orthorhombic and hexagonal crystals, Laue method, rotating crystal method, Powder methods, Scattered wave amplitude, Ewald construction and Brillouin zone, Fourier analysis of the basis.

Recommended Books

1. C. Kittle, Introduction to Solid State Physics, 7th Ed. By, Kohn Wiley, 1996.

2. N. M. W. Ashcroft and N. D. Mermin, Solid State Physics, Holt, Rinehart & Winston, 1976,
3. S. R. Elliott, The Physics and Chemistry of Solids, Wiley, 1998.
4. M.A. Omar, Elementary Solid State Physics, Pearson Education 2000.
5. H.M. Rosenberg, The Solid State, 3rd Edition, Oxford Science Publications 1990.
6. M.A. Wahab, Solid State Physics, Narosa Publishing House, 1999.

Course Name: Nuclear Physics-I	**Course Code:** PH – 672
Course Structure: Lectures: 2	**Credit Hours:** 2
Prerequisites: Modern Physics and Electronics	

Course Objective

- To understand the nuclear structure using different nuclear models
- To understand the nature of nuclear forces
- To give understanding of radioactivity and nuclear reactions

Intended Learning Outcomes

The student should be able to:

- show insight into the fundamental properties of the atomic nucleus, both the experimental and theoretical parts of the nucleus' structure and dynamics.
- understand the different processes that determine the amounts of different elements in our solar system.
- evaluate various nuclear applications in medisine and energy.

Course Outline

History:
Starting from Bacqurel‟s discovery of radioactivity to Chedwick‟s neutron.
Basic Properties of Nucleus*:* Nuclear size, mass, binding energy, nuclear spin,magnetic dipole and electric quadrupole moment, parity and statistics.
Nuclear Forces: Yukawa's theory of nuclear forces. Nucleon scattering, charge independence and spin dependence of nuclear force, isotopic spin.
Nuclear Models*:* Liquid drop model; Fermi gas model, Shell model; Collective model.
Theories of Radioactive Decay:
Theory of Alpha decay and explanation of observed phenomena, measurement of Beta ray energies, the magnetic lens spectrometer, Fermi theory of Beta decay, Neutrino hypothesis, theory of Gamma decay, multipolarity of Gamma rays, Nuclear isomerism.
Nuclear Reactions:
Conservation laws of nuclear reactions, Q-value and threshold energy of nuclear reaction, energy level and level width, cross sections for nuclear reactions, compound nucleolus

theory of nuclear reaction and its limitations, direct reaction, resonance reactions, Breit-Wigner one level formula including the effect of angular momentum.

Recommended Books

1. Segre, Nuclei and Practicles, Bejamin, 1977.
2. Kaplan, Nuclear Physics, Addison-Wisely, 1980.
3. Green, Nuclear Physics, McGraw Hill, 1995.
4. Kenneth S. Krane, Introducing Nuclear Physics, 1995.
5. B. Povh, K. Rith, C. Scholtz, F. Zetsche, Particle and Nuclei, 1999.

Course Name: Quantum Mechanics-I	**Course Code:** PH – 673
Course Structure: Lectures: 3	**Credit Hours:** 3
Prerequisites: FSc Physics and Modern Physics & electronics	

Course Objectives

- Understanding the behaviour of quantum mechanical particle and development of Schrodinger equation in one and three dimensions
- introduction to Quantum mechanical operators and determination of angular momentum of a quantum mechanical particle

Intended Learning Outcomes

a. Knowledge and Understanding,

On successful completion of this course the students will be able to:

- Have a working knowledge of the foundations, techniques and key results of quantum mechanics.
- Understand the basic concepts and principles of quantum mechanics. The Schrodinger equation, the wave function and its physical interpretation, time evolution, expectation values, uncertainty, approximations.

b. Intellectual/Cognitive Skills

By the end of the course, the students:

- Are expected to come equipped with basic mathematical skills that will be crucial throughout the course, such as complex numbers and functions, differentiation and integration.
- Give concise physical interpretation and discussions of the mathematical solutions.

Course Outline

Quantum Mechanics of One Dimensional Problems:

Review of concepts of classical mechanics, State of a system, Properties of one dimensional potential functions, Functions and expectation values, Dirac notation, Hermitian operators, Solutions of Schrodinger equation for free particles, The potential barrier problems, The linear harmonic oscillator, Particle in a box.

Formalism of Quantum Mechanics:
The state of a system, Dynamical variables and operators, Commuting and non- commuting operators, Heisenberg uncertainty relations, Time evolution of a system, Schrodinger and Heisenberg pictures, Symmetry principles and conservation laws.
Angular Momentum:
Orbital angular momentum, Spin, The eigenvalues and eigen functions of L2 and Lz, Matrix representation of angular momentum operators, Addition of angular momenta.
Schrodinger Equation in Three Dimensions:
Separation of Schrodinger equation in cartesian coordinates, Central potentials, The free particle, Three dimensional square well potential, The hydrogenic atom, Three dimensional isotopic oscillator.

Recommended Books

1. B.H. Bransden & C.J. Joachain, 'Introduction to Quantum Mechanics' Longman Scientific & Technical London (1990).
2. J.S. Townsend, 'A Modern Approach to Quantum Mechanics', McGraw Hill Book Company, Singapore (1992).
3. W. Greiner, 'Quantum Mechanics: An Introduction', Addison Wesley Publishing Company, Reading Mass. (1980).
4. R.L. Liboff, 'Introductory Quantum mechanics', Addison Wesley Publishing Company, Reading Mass. (1980).
5. Bialynicki-Birula, M. Cieplak & J. Kaminski, 'Theory of Quanta', Oxford University Press, New York(1992).
6. W. Greiner, 'Relativistic Quantum Mechanics', Springer Verlag, Berlin (1990).
7. F. Schwable,'Quantum Mechanics', Narosa Publishing House, New Delhi (1992).
8. David J. Griffiths, Introduction to Quantum Mechanics, PRENTICE Hall, Int.,Inc.

Course Name: Electronics -I: Analog Circuit Analysis and Design-I	**Course Code:** PH – 674
Course Structure: Lectures: 3	**Credit Hours:** 3
Prerequisites:	

Course Introduction
This course involves study of Transistor circuits, Field effect transistor, multistage amplifier, operational amplifier& oscillators.

Course Objectives

- To develop the understanding of different electronic circuit elements and devices like diode, transistors, amplifiers, oscillators and voltage regulators used in daily life alliances
- To understand the day to day electronic devices.

Intended Learning Outcomes
On successful completion of course the student should be able to

- How to design a circuits

- understand about the working of transistors.
- understand the AC circuits
- understand the operational amplifier & its working.
- understand about the oscillators & its working.

Course Outline

Transistor Circuits: Bipolar transistors: parameters and ratings, Ebers-Moll, Hybrid-p and h,z and y-parameter models, Switching circuits, Biasing and stability, Common emitter, common base and common collector amplifiers, Frequency response, power class A,B, and C amplifiers, Field Effect transistors: Junction FET, Metal Oxide FET, operation and construction Biasing, Common source and common drain amplifiers, frequency response, Multistage Amplifiers; RC coupled and direct coupled stages, The differential amplifiers, Negative feedback, Tuned R.F Voltage amplifiers, I-F Amplifiers and automatic gain control; Operational amplifiers: Ideal op-amps, Simple op-amp arrangements, its data and sheet parameters, Non inverting and inverting circuits, feedback and stability, op-amp applications; comparators, summing, active fitters, Integrator and Differentiator, Instrumentation amplifier. Oscillators: Armstrong, Hartley Colpitt´s phase shift and 555 timer oscillators.

Recommended Books

1. Millman, J &. Halkias, C. *C.;* Integrated Electronics; McGraw Hill Book company, Singapore.

2. Floyed, T. L.; 1996: Electronic Devices; Merrill publishing Company Columbus (1988)

3. Bell, D. B; 1980: Electronic devices & Circuits; Reston publishing company inc; Virginia

4. CJ Savant Jr. M.S. Roden, G.L Carpenter, Electronic Design Circuit & Systems. The Benjamin/Cummings Publishing Co' California (1991)

5. Lewin, D; 1985: Design of Logic systems. Van nostrand Reinhold (UK).

6. Mano, M. M.; 1995: Digital Design. Printice-Hall, New Jersey.

Course Name: LASER Physics	**Course Code:** PH – 675
Course Structure: Lectures: 3	**Credit Hours:** 3
Prerequisites: Quantum Mechanics I and Atomic Physics	

Course Objectives

- Develop fundamental concepts about lasers
- Learn the principles of spectroscopy of molecules and semi-conductos
- Understand the optical resonators and laser system.
- Applications of lasers

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: Monochromaticity, 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 Nonradiative 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 in a 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: Homojunction 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, Plenum Press New York & London (1992).
2. J. Eberly and P. Milonni, Lasers, Wiley, New York. (Latest Edition). Scully and Zubairy, Quantum Optics, Cambridge University Press (1997).
3. A.E. Siegman, Laser, University, Science Books Mill Valley, C.A. (1986).
4. H. Haken, Laser Theory, Springer, Berlin (Latest Edition).
5. W. T. Silfvast, Laser Fundamentals, latest edition.

Course Name: LABORATORY-VII	**Course Code:** PH – 676
Course Structure: Practical: 3	**Credit Hours:** 3

Course Objectives

- To expose the students to advance level experimentation in Physics.
- To make them familiar to such experiments whose outcome can be used in developing future research capabilities and teaching skills.
- To make the students confident in their studies by showing and measuring parameter which they have used in theoretical work.

Course Outline

List of Experiments:

1. Measurement of the total neutron cross-section

2. To prove the Rutherford law of scattering of charged particles.

3. Measurement of the spectrum of gamma rays from a radioisotope (e.g.Cs) and study of their photoelectric and Compton absorption.

4. Source strength of C060 by gamma coincidence methods.

5. Determination of the constituents of substance by activation analysis.

6. To examine the characteristics of a Solid-State detector and to use it for alpha and beta Spectroscopy and compare the results with those obtained by a scintillation counter.

7. . The use of an analogue computer for solving differential equations.

8. To examine the stopping-power of various substances for thermal neutrons.

9. Determination of Planck's constant (h) by using the photoelectric effect.

10. Determination of the charge on an electron (e) by Millikan's method.

11. The Frank-hertz experiment (Measurement of excitation potential of Hg).

12. Determination of the Rydberg constant from the spectrum of hydrogen.

13. Fabry-Perot interferometer used as a gas refractometer.

14. To study the Zeeman effect for a line in the spectrum of helium.

15. Experiments with microwaves. Study of their optical properties.

16. Electron spin resonance (E.S.R.) by microwave absorption.

17. Nuclear magnetic resonance (N.M.R.) of protons in water.

18. The study of the Mossba uer effect.

19. The measurement of Hall effect in germanium and silicon.

20. To build a medium or short-wave transmitter.

21. Measurement of the conductivity of Si and Ge as a functions of temperature.

22. To determine the energy gap in silicon and Germanium.

23. Drift mobility. (Shockley-Haynes experiments for Germanium, demonstrating transistor

action).

24. Simple diode manufacture and point-contact transistor.

Note: At least 12 experiments to be performed.

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PESHAWAR
DEPARTMENT OF PHYSICS

DETAILED COURSE OUTLINE OF PHYSICS
BS (4-YEARS PROGRAM)

SEMESTER-VIII

Course Name: Solid State Physics-II	**Course Code:** PH – 681
Course Structure: Lectures: 2	**Credit Hours:** 2
Prerequisites: Solid State Physics-I	

Course Objective

a. To understand the Lattice heat capacity
b. To understand the crystal defects and their importance
c. To give basic understanding of Lattice Vibrations.

Intended Learning Outcomes

At the end of the course the students will be able to;

- Explain the Thermal conductivity and resistivity
- Understand the importance of crystal defects in daily life.

Course Outline

Phonons and Lattice Vibrations:
Lattice heat capacity, classical model, Einstein model, Enumeration of normal models, Density of state in one, two and three dimensions, Debye model of heat capacity, Comparison with experimental results, Thermal conductivity and resistivity, Umklapp processes.
Crystal Defects: Types of crystal defects in detail.

Recommended Books

1. C. Kittle, Introduction to Solid State Physics, 7th Ed. By, Kohn Wiley, 1996.
2. N. M. W. Ashcroft and N. D. Mermin, Solid State Physics, Holt, Rinehart & Winston, 1976,
3. S. R. Elliott, The Physics and Chemistry of Solids, Wiley, 1998.
4. M.A. Omar, Elementary Solid State Physics, Pearson Education 2000.
5. H.M. Rosenberg, The Solid State, 3rd Edition, Oxford Science Publications 1990.
6. M.A. Wahab, Solid State Physics, Narosa Publishing House, 1999.

WEEK#	**TOPICS**

Course Name: Nuclear Physics-II	**Course Code:** PH – 682
Course Structure: Lectures: 3	**Credit Hours:** 3
Prerequisites: Nuclear Physics-I	

Course Objective

a. To understand the nuclear structure using different nuclear models
b. To understand the nature of nuclear forces
c. To give understanding of radioactivity and nuclear reactions

Intended Learning Outcomes

At the successful completion of the course the students will be able to;

- Explain the difference between Fermi gas model and Collective model
- understand the properties of Charged Particle Accelerators
- understand the importance of different types of nuclear reactors
- have the basic concept of elementary particles

Course Outline

Charged Particle Accelerators:
Van de Graaff generator; Cyclotron; Synchrocyclotron; Betatron; Electron-Synchrotrons; Proton-synchrotron; Alternating-gradient Synchrotron; Linear Accelerator.
Nuclear Radiation Detection and Measurements:
Interaction of nuclear radiation with matter; photographic emulsions; Gas-filled detectors; Scintillation counters and solid-state detectors; Cloud chambers, Bubble chambers.
Elementary
Reactor Physics: Nuclear fission and its characteristics, Energy release. Fission products, The chain reaction, Controlled fission reactions, Types of nuclear reactors (Power and Research), Detailed study of PWR and CANDU type reactors.
Elementary Particles:
Strong, electromagnetic and weak interactions, Conservation laws, violation of parity conservation in weak interactions, neutrino and anti-neutrino, Director evidence of anti-neutrino, muons. The mean life of Muons, Spin and magnetic moment of muons, The pions, Spin and mean life of charged and neutral points, The Strange particles, K-mesons, Hyper sons and hyper fragments.

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)

Course Name: Quantum Mechanics-II	**Course Code:** PH – 683
Course Structure: Lectures: 3	**Credit Hours:** 3
Prerequisites: Quantum Mechanics-I	

Course Objective

- to understand the use of approximation in Quantum mechanics
- to understand the theory of scattering and interaction of quantum systems with radiation
- to understand the basics of relativistic quantum mechanics

Intended Learning Outcomes

On successful completion of this course the students will be able to:

- Have a working knowledge of the foundations, techniques and key results of quantum mechanics.
- Understand the basic concepts and principles of quantum mechanics. The Schrodinger equation, the wave function and its physical interpretation, time evolution, expectation values, uncertainty, approximations.

Course Outline

Approximate Methods: Time independent perturbation theory for non-degenerate levels and degenerate levels, the variational method, the WKB approximation, time dependent perturbation theory.
Identical Particles and Second Quantization: Indistinguishability of identical particles, systems of identical particles, quantum dynamics of identical particle systems, statistics, symmetry of states, fermions, bosons.
Theory of Scattering: Scattering experiments and cross sections, potential scattering, the method of partial waves, the Born's approximation.
Relativistic Quantum Mechanics: Schrodinger relativistic equation, probability and current densities, Klein-Gordon equation and hydrogen atom, Dirac relativistic equation.

Recommended Books

1. B.H. Bransden & C.J. Joachain: Introduction to Quantum Mechanics' Longman Scientific & Technical London (1990).

2. S. Townsend, 'A Modern Approach to Quantum Mechanics\, McGraw Hill Book Company Singapore (1992)
3. W. Greiner, 'Quantum Mechanics: An Introduction', Addison Wesley Publishing Company, Reading Massachausetts (1980).
4. R.L. Liboff, 'Introductory Quantum Mechanics', Addison Wesley Publishing Company, Reading Massachusetts (1980).
5. Bialynicki-Birula, M. Cieplak & J. Kaminski, Theory of Quanta, Oxford University Press, New York (1992).
6. W. Greiner, 'Relativistic Quantum Mechanics', Springer Verlag. Berlin (1990).
7. F. Schwable, 'Quantum Mechanics', Narosa Publishing House, New Delhi (1992)
8. David J. Griffiths, Introduction to Quantum Mechanics. Prentice-Hall
9. S. Gasiorowiz, Quantum Physics. John Wiley and Sons Inc. Singapore

Course Name: Electronics –II Digital Circuit Analysis & Design-II	**Course Code:** PH – 684
Course Structure: Lectures: 3	**Credit Hours:** 3
Prerequisites:	

Course Objectives
This course involves study of concepts & component of electricity & meagnetism.
Course Objective
It provides understanding of electromagnetic induction, the function of AC circuits, the generation, propagation of waves & the Maxwell's equation electromagnetism.
Intended Learning Outcomes
On successful completion of course the student should be able to

- understand the laws of electromagnetic induction
- understand electromagnetic oscillation.
- understand the AC circuits
- understand the RLC series & parallel circuits
- know the generation & propagation of electromagnetic waves
- Development of concepts, application Maxwell equation .

Course Outline

Review: Number systems, the binary system, binary coded decimals, ASCII, Gray etc., error-detecting and correcting codes, parity in codes, logic circuits and symbols, digital circuits, data representation and transmission
Principles of switching algebra: Boolean algebra, switching algebra, derivation and classification of switching function, cubic notation for Boolean function, Design of combinational switching circuits: combinational switching circuits, minimization of switching equations, by K map, design examples: elementary level circuits such as binary half and full adders, decoder, encoder minimization, minimization of multiple input

circuits and design examples. Sequential switching circuits: Flip-flops, shift register, counters, *AID* and *DI*A converters, linear sequential circuits, Design of Sequential circuits: reduction of internal states, examples of state minimization, incompletely specified state tables. Extraction of maximum compatibles, state assignment, state assignment using partition principle, decomposition of sequential systems, tutorial problems.

Recommended Books

1. Millman, J &. Halkias, C. *C.;* Integrated Electronics; McGraw Hill Book company, Singapore.

2. Floyed, T. L.; 1996: Electronic Devices; Merrill publishing Company Columbus (1988)

3. Bell, D. B; 1980: Electronic devices & Circuits; Reston publishing company inc; Virginia
4. CJ Savant Jr. M.S. Roden, G.L Carpenter, Electronic Design Circuit & Systems. The Benjamin/Cummings Publishing Co' California (1991)
5. Lewin, D; 1985: Design of Logic systems. Van nostrand Reinhold (UK).

6. Mano, M. M.; 1995: Digital Design. Printice-Hall, New Jersey. Course Title: Thermodynamics Statistical

Course Name: Functional Materials	**Course Code:** PH – 685
Course Structure: Lectures: 2	**Credit Hours:** 2

Course Objectives

This course involves study of introduction to the functions materials, Dielectrics, pyroelectrics,piezoelectric, Ferroelectrics, Electro optics materials.

Intended Learning Outcomes

Knowledge and understanding:

On successful completion of course the student should be able to

- Understand the electrical properties of materials..
- Understand about dielectrics & types to solve numerical problems.
- Understand about piezoelectric materials & Ferroelectrics
- Understand about Electro optics materials.

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General and transferable skills

On successful completion of this course the student should be able

-work as a part of a team to produce reports

-work as a part of a team to find a solution for practical problems & projects

- Making oral communication skills by making report presentation.

Course Outline

1. Chapter 1. Introduction to the functions of materials: Classification of materials on the basis of electrical properties, stimuli and the corresponding functions of different materials, applications, numerical problems.
Chapter 2. Dielectrics: Introduction, polarization and polarizability, types of dielectric materials, spontaneous and remanent polarization, four mechanisms/factors contributing to the net polarizability of a functional material. Clausius-Mossotti expression, applications, numerical problems.
Chapter 3. Pyroelectrics: Key concepts, Infrared (IR) detection, practical applications, numerical problems.
Chapter 4. Piezoelectrics: Historical background and fundamental crystallography, piezoelectric constants, Lead Zirconate Titanate (PZT), $BaTiO_3$ (BT), $Ag(Nb,Ta)O_3$ (ANT) and the related piezoelectrics, applications, numerical problems.
Chapter 5. Ferroelectrics: Fundamental concepts, classification of ferroelectrics, Lead Zirconate Titanate (PZT), $BaTiO_3$ (BT), Lead Magnesium Niobate (PMN) as ferroelectrics, Lead-free alternatives and future trends, applications, numerical problems.
Chapter 6. Electro-Optic Materials: Basic ideas / background, Lead Lanthanum Zirconate Titanate (PLZT) as a classic Electro-optic material, applications, numerical problems.

Recommended Books

1. Moulson, A. J. and Herbert, J. M. "Electro-ceramics: Materials, Properties, and Applications". John and Wiley and Sons, 2003.
2. Pillai, S. O, Pillai, Sivakami, "Rudiments of Materials Science". New Age International (P) Limited Publishers, New Delhi, 2005.
3. Gersten J. I. and Smith F. W. "The Physics and Chemistry of Materials" John Wiley & Sons, Inc. New York, 2001.
4. Hidayat Ullah Khan, thesis on "Phase Transition s in Li-doped $Ag(Nb_xTa_{1-x})O_3$ perovskite ceramics". Department of Materials Science and Engineering, The University of Sheffield, UK. Available at the Department of Physics, University of Peshawar.
5. Gersten J. I. and Smith F. W. "The Physics and Chemistry of Materials" John Wiley & Sons, Inc. New York, 2001.

Course Name: Research Project	**Course Code:** PH – 686
Course Structure: Practical: 4	**Credit Hours:** 4

Course Outline

Research project on any topic related to the field of PHYSICS. Followed by a Viva on the research project by external examiners.

BS-PHYSICS
ELECTIVE COURSES

Course Code	
Course Title	Introduction to Plasma Physics
Credit Hours	03
Remarks	Elective
Recommended Books	1. F. F. Chen, "Introduction to Plasma Physics", 2nd ed. Plenum, 1995. 2. D. A. Gurnett and A. Bhattacharjee, "Introduction to Plasma Physics: with space and laboratory application", Cambridge University Press, 2005. 3. T. J. M. Boyd and J. J. Sanderson, "The Physics of Plasmas", Cambridge University Press, 2003.
Course Description	
Introduction: Occurrence of plasma, Concept of temperature, Debye shielding, the plasma parameter, Criteria for plasma.	

Course Code	
Course Title	Introduction to Material Science
Credit Hours	03
Remarks	Elective
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. 4. http://www.msm.cam.ac.uk/teaching/index.php, 5. http://www.doitpoms.ac.uk/
Course Description	

Atomic Structure of Materials, Imperfections in Solids, Microstructure, Mechanical Behavior of Materials, Polymers.

Course Code	
Course Title	Environmental Physics
Credit Hours	03
Remarks	Elective
Recommended Books	1. E.t Booker and R. Van Grondelle, "Environmental Physics", John Wiley, 3rd ed. 2011. 2. G. Guyot, "Physics of Environment and Climate", John Wiley, 1998.
Course Description	
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.

Course Code	
Course Title	Renewable energy Recourses
Credit Hours	03
Remarks	Elective
Recommended Books	1. J. W. Twidell and A. D. Weir; Renewable Energy Resources; E & F.N. Spon. Ltd. London. (1986). 3. M. Iqbal; An Introduction to Solar Radiation: Academic Press, Canada. (1983). 4. S. Roberts, A Practical Guide to Solar Electricity, Prentice Hall Inc. USA, (1991). 5. M. A. Green; Solar Cells, Operating Principles, Technology, and system Application: Prentice Hall, In USA, (1982). 6. T. J. Jansen, Solar Engineering Technology; Prentice Hall Inc. USA, (1985). 7. V. D. Hunt, Wind Power, A Book on Wind Energy Conversion System; Litton Educational Publishing Inc. (1981). 8. E. C. Price, P. N. Cheremisinoff; Biogas, Production and Utilization; Ann Arbor Science, USA, (1981). 9. I. Campbell, Biomass, Catalysts and liquid fuels; Technonic Publishing Co. Inc. USA, (1983).
Course Description	
Energy Scenarios: Importance of energy, world primary energy sources, energy deman	

supplies, reserves, growth in demand, life estimates, and consumption pattern conventional energy sources: oil, gas, coal, hydro, nuclear etc.

Energy & Environment: Emission of pollutants from fossil fuels and their damagi effects, and economics impact; Renewable energy and its sustainability. Renewab Scenarios: Defining renewable, promising renewable energy sources, their potenti availability, present status, existing technologies and availability.

Solar Energy: Sun-Earth relationship, geometry, sun path and solar irradiance, sol spectrum, solar constant, atmospheric effects, global distribution, daily and season variations, effects of till angle, resource estimation, extraterrestrial, global, direct, diffus radiation, sun shine hours, air mass, hourly, monthly and annual mean, radiation on t surface, measuring instruments.

Solar Thermal: Flat plate collectors, their designs, heat transfer, transmission through glas absorption transmission of sun energy, selective surfaces, performance, and efficiency; lo temperature applications: water heating, cooking, drying, desalination, their designs ar performance; concentrators, their designs, power generation, performance and problems.

Photovoltaics: PV effect, materials, solar cell working, efficiencies, different types of sol cells, characteristics, (dark, under illumination), efficiency limiting factors, power, spectr response, fill-factor, temperature effect; PV systems, components, packing fractio modules, arrays, controllers, inverters, storage, PV system sizing, designing, performan and applications.

Wind: Global distribution, resource assessment, wind speed, height and topographic effect power extraction for wind energy conversion, wind mills, their types, capacity, propertie wind mills for water lifting and power generation, environmental effect.

Hydropower: Global resources, and their assessment, classification, micro, mini, small ar large resources, principles of energy conversion; turbines, types, their working ar efficiency for micro to small power systems; environmental impact.

Biogas: Biomass sources; residue, farms, forest. Solid wastes: agricultural, industrial ar municipal wastes etc; applications, traditional and non-traditional uses: utilization proces gasification, digester, types, energy forming, Environment issues. Resources availabilit digester, their types, sizes, and working, gas production, efficiency; environmental effects;

Geothermal: Temperature variation in the earth, sites, potentials, availability, extracti

techniques, applications; water and space heating, power generations, problem environmental effects.

Waves and Tides: Wave motion, energy, potentials, sites, power extraction, ar transmission, generation of tides, their power, global sites, power generation, resour assessment, problems, current status and future prospects.

Hydrogen Fuel: Importance of H_2 as energy carrier, Properties of H_2, productio hydrolysis, fuel cells, types, applications, current status and future prospects.

Nuclear: Global generations of reserves through reprocessing and breeder reactors, grow rate, prospects of nuclear fusion, safety and hazards issue.

Energy Storage: Importance of energy storage, storage systems, mechanical, chemica biological, electrical, fuel cells etc.

Course Code	
Course Title	Computer Simulations in Physics
Credit Hours	3
Remarks	Elective
Recommended Books	1. T. Pang, "An Introduction to Computational Physics", Cambridge University Press, 2008. 2. R. Landau, M. Paez, C. Bordeianu, "A Survey of Computational Physics", Princeton University Press, 2008
Course Description	
Programming for Scientific Computation: unix/linux basics, the editingcoding-compiling-debugging-optimizing-visualizing-documenting production chain, Fortran95. **Numerical Programming:** Functions: approximation and fitting, Numerical calculus. Ordinary differential equations, Matrices, Spectral analysis, Partial differential equations. **Modeling and Simulation:** Molecular dynamics simulations, modeling continuous media Monte Carlo simulations. **Project:** A project will be chosen by the student in consultation with the instructor. Selection of the project should be done soon after the module on modelling and simulation starts and continue over the course of the rest of the semester. The final part of	

the course is reserved for presentation of preliminary and final results.

Course Code	
Course Title	Computational Physics
Credit Hours	3
Remarks	Elective
Recommended Books	1. M. L. De Jong, ”Introduction to Computational Physics”, Addison Wesley, 1991. 2. S. T. Koonini, “Computational Physics”, the Benjamin-Cummings, 1985 3. H. Gould, J. Tobochnik and W. Christian, “An Introduction to Computer Simulation Methods”, Addison Wesley, 3rd ed. 2006. 4. S. C. Chapra and R. P. Chanle, ”Numerical Methods for Engineers with Personal Computer Applications”, McGraw-Hill,1990. 5. S. C. Chapra, “Applied Numerical Methods with MATLAB for Engineers and Scientists”, McGraw-Hill, 2nd ed. 2006.
Course Description	
Computer Languages: A brief introduction of the computer languages like Basic, C. Pascal etc. and known software packages of computation **Numerical Methods:** Numerical Solutions of equations, Regression and interpolation, Numerical integration and differentiation. Error analysis and technique for elimination of systematic and random errors **Modeling & Simulations:** Conceptual models, the mathematical models, Random numbers and random walk, doing Physics with random numbers, Computer simulation, Relationship of modeling and simulation. Some systems of interest for physicists such as Motion of Falling objects, Kepler's problems, Oscillatory motion, Many particle systems,	

Dynamic systems, Wave phenomena, Field of static charges and current, Diffusion, Populations genetics etc.

Course Code	
Course Title	Methods of Experimental Physics
Credit Hours	3
Remarks	Elective
Recommended Books	1. F. James, "Statistical Methods in Experimental Physics World Scientifi Company, 2nd ed. 2006. 2. M. H. Hablanian, "High-Vacuum Technology", Marc Dekker, 2nd ed.1997 3. P. Bevington and D. K. Robinson, "Data Reduction and Err Analysis for Physical Science", McGraw-Hill, 3rd ed. 2002 4. S. Tavernier, "Experimental Techniques in Nuclear ar Particle Physics",Springer, 2010. 5. J. B. Topping, "Errors of Observations and Their Treatment Springer, 4th ed. 1972.
Course Description	
Vacuum Techniques, Radiation Detection and Measurement, Sensor Technology, Electronics and Electronic Instruments, Computer Introduction: Introduction to computers, Data Analysis.	

Course Code	
Course Title	Introduction to Laser Physics
Credit Hours	3
Remarks	Elective
Recommended Books	1. W.T selfvast, "Laser Fundamentals", Cambridge University Press, 2nd ed.(2008). 2. O. Sevelto, "Principles of Lasers", Springers, 5th ed.(2009) 3. J. Hecht Understanding lasers: an entry-level guide, New York: IEEE Press(1994).

	4. K. Thyagarajan, A.K Ghatak. "Laser Theory and Applications" New Jersey Prentice Hall. (1995).
Course Description	
Introductory concepts, energy levels of molecules and semiconductors, Radiation & thermal equilibrium, population inversion & gain, laser systems, laser applications.	

Course Code	
Course Title	Electronic Materials & Devices
Credit Hours	3
Remarks	Elective
Recommended Books	1. R. F. Pierret, "Semiconductor Device Fundamentals", Addison Wesley, 2nd ed. 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.
Course Description	
Semiconductor Fundamentals, Device Fabrication Processes, *PN* Junction and Bipolar Junction Transistor, Dielectric Materials, Optoelectronic Devices, Magnetism and Magnetic Materials.	

Course Code	
Course Title	Functional Materials
Credit Hours	3
Remarks	Elective
Recommended Books	1. Moulson, A. J. and Herbert, J. M. "Electro-ceramics:

	Materials, Properties, and Applications". John and Wiley and Sons, 2003. 2. Pillai, S. O, Pillai, Sivakami, "Rudiments of Materials Science". New Age International (P) Limited Publishers, New Delhi, 2005. 3. Gersten J. I. and Smith F. W. "The Physics and Chemistry of Materials" John Wiley & Sons, Inc. New York, 2001. 4. Hidayat Ullah Khan, thesis on "Phase Transition s in Li-doped Ag(NbxTa1-x)O3 perovskite ceramics". Department of Materials Science and Engineering, The University of Sheffield, UK. Available at the Department of Physics, University of Peshawar. 5. Gersten J. I. and Smith F. W. "The Physics and Chemistry of Materials" John Wiley & Sons, Inc. New York, 2001.
Course Description	
Introduction to the functions of materials, Dielectrics, Pyroelectrics, Piezoelectrics, Ferroelectrics, Electro-Optic Materials.	

Course Code	
Course Title	Introduction to Nanoscience & Nanotechnology
Credit Hours	3
Remarks	Elective
Recommended Books	1. S. Lindsay, "Introduction to Nanoscience", Oxford University Press, 2009. 2. C. Binns, "Introduction to Nanoscience and Nanotechnology (Wiley Survival Guides in Engineering and Science)", Wiley, 2010.
Course Description	
Introduction, Quantum Effects, Surfaces and Interfaces, Material Properties, Tools and Instrumentation, Fabricating Nano Structures, Electrons in Nano Structures, Molecular	

Electronics, Nano Materials Nano Biotechnology, Nanotechnology the Road Ahead.

Note:
In addition to the above, the universities can offer any elective which they feel necessary subject to the availability of resources.