Semester II

Course Title	Credit hours	Category
Arabic	2(2-0)	General
Quantitative Reasoning-I	3(3-0)	General
Expository Writing	3(3-0)	General
Calculus-I	3(3-0)	Major
Introduction to Linear Algebra	3(3-0)	Interdisciplinary
Electricity and Magnetism	3(3-0)	Major
Physics Lab-II	1(0-1)	Major
Understanding of Quran – II	1(0-1)	General
Total		***19(17-2)***

GEN-3201 Arabic 2(2-0)

Objectives of the Course	۱۔ طلباء کو عربی زبان کی علوم اسلامیہ میں اہمیت سے آگاہ کرنا ۲۔ طلباء کو علم صرف اور نحو کے بنیادی قواعد سے آگاہ کرنا تاکہ اسلامی علوم سے کما حقہ استفادہ کیا جا سکے ۳۔ طلباء کو علم صَرف کے بنیادی اصولوں سے آگاہ کرنا ۴۔ قرآن مجید سے قواعد عربیہ کی عملی مشق کروانا۔

Week	Lecture No.	قواعد	عملی مشق	
Week 1	Lecture 1	• اسم کی پہچان • هُوَ، هُ °م، ...ضمائز منفصلہ	• تعوّذ اور سورۃ الفاتحۃ (4-1) • سورۃ الفاتحۃ (5-7)، تکبیر، ثناء، تسبیحات	
	Lecture 2	• لِ، مِ °ن، عَ °ن، مَعَ..حروف جار • فعل ماضی: فَعَلَ	• تشہد، درود، دعا • سورۃ الإخلاص	
Week 2	Lecture 3	• فعل مضارع: یَ °فعَلُ	• سورۃ الفلق	**Quiz # 01**
	Lecture 4	• فعل امر، فاعل، مفعول، فعل	• سورۃ النّاس	
Week 3	Lecture 5	• نَصَرَ، عَبَدَ	• سورۃ النصر	

	Lecture 6	• ضَرَبَ، ظَلَمَ، **سَمِعَ، عَلِمَ**	• سورة الكافرون	
Week 4	Lecture 7	• كمزور أفعال: وَهَبَ، وَعَدَ	• سورة البقرة: 1-5	**Assignment# 01**
	Lecture 8	• كمزور أفعال: قَالَ، زَادَ	• سورة البقرة: 6-١٠	
	Lecture 9	اَمَرَ: ہمزہ والے اَفعال	• سورة البقرة:11–13	
	Lecture 10	یکساں حروف والے افعال: ظَنَّ، ظَلَّ	• سورة البقرة: 14–١٩	
	Lecture 11	نُصِرَ، جُعِلَ: فعل مجهول	• سورة البقرة: 19–20	
	Lecture 12	وُعِدَ، أُمِرَ: فعل مجهول	• سورة البقرة: 21–22	
Week 8	Midterm			
Week 8	Lecture 13	• مزيد في: حَاسَبَ	• سورة البقرة:23-25	
	Lecture 14	• مزيد في: أَسْلَمَ، إِخْتَلَفَ	• سورة البقرة: 26-٢٩	
Week 9	Lecture 15	• مزيد في: إِسْتَغْفَرَ	• سورة البقرة: 30	
	Lecture 16	• مزيد في: تَدَبَّرَ، تَدَارَسَ، إِنْقَلَبَ	• سورة البقرة: 31-٣٥	
Week 10	Lecture 17	• مزيد في: وَلّى	• سورة البقرة: 36-37	
	Lecture 18	• مزيد في: نَادَى، اَقَامَ	• سورة البقرة: 38-٤٢	
Week 11	Lecture 19	• مزيد في: اِتَّقِي، اِسْتَقَامَ	• سورة البقرة: 43-46	**Quiz # 02**
	Lecture 20	• مؤنث ضمائر	• سورة البقرة: 47-٥٠	
Week 12	Lecture 21	• مؤنث فعل کا ٹیبل	• سورة البقرة: 51-53	**Assignment #02**
	Lecture 22	• مؤنث فعل کا ٹیبل، تثنیه (د ٹیبل	• سورة البقرة: 54-٥٧	
Week 13	Lecture 23	• فعل مجهول (مزيد في) عُلِّمَ، أُنْزِلَ	• سورة البقرة: 58-59	
	Lecture 24	• فعل: كَرُمَ، م اور فعل مضارع	• سورة البقرة: 60-٦١	
Week 14	Lecture 25	• لَم اور مضارع مزيد في افعال	• سورة البقرة: 62	
	Lecture 26	• لَنْ اور فعل مضارع ,اسم مكان	• سورة البقرة: 63-٦٦	

Week15	Lecturer 27	• اسم مکان• جمع تکسیر ، جمله اسمیه	سورة البقرة• ۷۰-67	
	Lecturer 28	• جملہ فعلیہ	• سورة البقرة: ۷۱-73	
Week 16		• مضاف، مضاف الیه، موصوف، صفت	• سورة البقرة: 74	
Week 17	**Terminal**			

Gen-3202 Quantitative Reasoning-I 3(3-0)

Course Objectives:

Introduction, understanding of the basic mathematical and statistical tools, and real-life applications of quantitative reasoning.

Course Outlines:

Numerical Literacy: Number system and basic arithmetic operations; Units and their conversions, dimensions, area, perimeter and volume; Rates, ratios, proportions and percentages; Types and sources of data; Measurement scales; Tabular and graphical presentation of data; Quantitative reasoning exercises using number knowledge.

Fundamental Mathematical Concepts: Basics of geometry (lines, angles, circles, polygons etc.); Sets and their operations; Relations, functions, and their graphs; Exponents, factoring and simplifying algebraic expressions; Algebraic and graphical solutions of linear and quadratic equations and inequalities; Quantitative reasoning exercises using fundamental mathematical concepts.

Fundamental Statistical Concepts: Population and sample; Measures of central tendency, dispersion and data interpretation; Rules of counting (multiplicative, permutation and combination); Basic probability theory; Introduction to random variables and their probability distributions; Quantitative reasoning exercises using fundamental statistical concepts.

Recommended Books:

1. Quantitative Reasoning: Tools for Today's Informed Citizen by Bernard L. Madison, Lynn and Arthur Steen.
2. Quantitative Reasoning for the Information Age by Bernard L. Madison and David

M. Bressoud.

3. Fundamentals of Mathematics by Wade Ellis.
4. Quantitative Reasoning: Thinking in Numbers by Eric Zaslow.
5. Thinking Clearly with Data: A Guide to Quantitative Reasoning and Analysis by Ethan Bueno de Mesquita and Anthony Fowler.
6. Using and Understanding Mathematics: A Quantitative Reasoning Approach by Bennett, J. O., Briggs, W. L., & Badalamenti, A.
7. Discrete Mathematics and its Applications by Kenneth H. Rosen.
8. Statistics for Technology: A Course in Applied Statistics by Chatfield, C.
9. Statistics: Unlocking the Power of Data by Robin H. Lock, Patti Frazer Lock, Kari Lock Morgan, and Eric F. Lock.

GEN-3203 Expository Writing 3(3-0)

Course Objectives: The course is developed with the aim to enable the students to meet their real life communication needs by

- Helping them learn and understand basic concepts of communication process
- Practically implementing theoretical aspects in the real life situations

Course Contents:

What is Communication?

- Process of communication, effective steps of communication, basic communication skills

Paragraph Writing;

- Practice in writing a good, unified and coherent paragraphs
- Paragraph writing leading towards the writing of five to seven paragraphs long essay
- Stages of writing (brain storming, researching, drafting and editing)
- Methods of writing (cause and effect, problem solutions, comparison and contrast)

Essay Writing;

- Basic structure of essay, topic sentence, supporting sentence, concluding sentence, thesis statement
- Unity and Coherence, Introduction and Conclusion

CV and Job Application;

- Preparing a Curriculum Vitae
- Writing a formal job application

Translation Skills;

- Urdu to English

(Practice at advanced level)

Study Skills;

- Skimming and scanning, intensive, extensive and speed reading
- Summary and precis writing

- Comprehension (at advanced level)
- (sQ3R and Sq4r methods)

Academic Writing;

- Letter/ Memo writing, Minutes of Meeting, use of Dictionary, Library and Internet

Presentation Skills;

- Personality development (emphasis on content, style and pronunciation)
- Preparation stage, audience analysis, handling and asking questions, managing time, handling non-verbal means, feedback

Academic Writing;

- How to write a research proposal for research paper/term paper?
- How to write a research paper/ term paper?
- (Emphasis on style, content, language, form, clarity , consistency)

Report Writing;

- Technical Report writing
- Progress report writing
- Preparation and planning

E-mail writing;

- Creating e-mail account
- Writing and sending e-mails

Preparing for Interview and Research proposal/ research paper defense

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

- Writing. Intermediate by Marie-Christine Boutin, Suzanne Brinand and Francoise Grellet. Oxford Supplementary Skills. Fourth Impression 1993. ISBN 019 435405 7 Pages 45-53 (note taking).
- 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 Langan
   - Study Skills by Richard York.

d) Speaking

1. Ellen, K. 2002. Maximize Your Presentation Skills: How to Speak, Look and Act on Your Way to the Top
2. Hargie, O. (ed.) Hand book of Communications Skills
3. Mandel, S. 2000. Effective Presentation Skills: A Practical Guide Better Speaking

4. Mark, P. 1996. Presenting in English. Language Teaching Publications

MATH-3204 **Calculus-I** **3(3-0)**

Course Objective:

This course extends the Study of calculus to multivariable functions, including partial differentiation, multiple integration, and vector calculus.

FUNCTIONS AND GRAPHS:

Algebraic, trigonometric, exponential, and logarithmic functions; composition and inverse functions; simple parametric equations.

LIMITS AND CONTINUITY:

Concept of limits, continuity, and differentiability of physical functions.

DERIVATIVES:

Definition and interpretation as rate of change and slope; basic differentiation rules; derivatives of trigonometric, exponential, and logarithmic functions.

APPLICATIONS OF DERIVATIVES IN PHYSICS:

Tangent and normal lines, velocity and acceleration, related rates, local extrema, motion under gravity, and optimization in physical systems.

TECHNIQUES OF DIFFERENTIATION:

Product, quotient, and chain rules; implicit differentiation.

MEAN VALUE THEOREM AND L'HÔPITAL'S RULE:

Simplified approach and applications in motion and limits.

INTRODUCTION TO INTEGRATION:

Indefinite integrals as antiderivatives, definite integrals as area under the curve, and the Fundamental Theorem of Calculus.

APPLICATIONS OF INTEGRATION:

Displacement from velocity, work done by a variable force, area between curves, and simple rectilinear motion problems.

Recommended Books

1. Calculus: Early Transcendental" by Howard Anton, Irl Bivens and Stephen Davis
2. Calculus: Early Transcendental" by James Stewart
3. Calculus Volume 1" by Edwin Herman and Gilbert Strang
4. Thomas, *Calculus*, 11th Edition. Addison Wesley Publishing Company, 2005

MATH-3205 **Introduction to Linear Algebra** **3(3-0)**

Course Objective:

Basic understanding of matrices, vector space, and linear transformations.

Course Contents:

Vectors and Linear Combinations, Lengths and Dot Products, Matrices, Vectors and Linear Equations, The Idea of Elimination, Elimination Using Matrices, Rules for Matrix Operations, Inverse Matrices, Elimination, Transposes and Permutations, Spaces of Vectors, The Null space, The Rank and the Row Reduced Form, The Complete Solution to $Ax = b$, Independence, Basis and Dimension, Dimensions of the Subspaces, Orthogonality of the Subspaces, Projections, Orthogonal Bases and Gram-Schmidt, The Properties of Determinants, Permutations and Cofactors, Cramer's Rule, Inverses, and Volumes, Introduction to Eigenvalues, Diagonalizing a Matrix, Symmetric Matrices, Positive Definite Matrices, Similar Matrices, Singular Value Decomposition, The Idea of a Linear Transformation, The Idea of a Linear Transformation, The Matrix of a Linear Transformation. .

Recommended Books:

1. Introduction to Linear Algebra" by Gilbert Strang, 5th Edition
2. Linear Algebra for Everyone" by Gilbert Strang, September 2020
3. Linear Algebra and Learning from Data" by Gilbert Strang, 2019

PHY-3206 **Electricity and Magnetism** **3(3-0)**

Course Objectives

1. To give the concept of the electric field, electrical potential, and dielectrics
2. To understand the DC circuits
3. To know the effect of the magnetic field and the basic magnetic properties of materials

Course Contents:

Electric Field:

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

Electric Potential:

Potential due to a point charge, potential due to a collection of point charges, and potential due to a dipole. The electric potential of a continuous distribution. Field as the gradient or derivative of potential. Potential and field inside and outside an isolated conductor.

Capacitors and dielectrics:

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

Magnetic Field Effects and Magnetic Properties of Matter:

Magnetic force on a charged particle and on a current. Recall the previous results. Do not derive. Torque on a current loop. Magnetic dipole: Energy of magnetic dipole in the field, Lorentz Force, 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).

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.

Alternating Current Circuits:

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

Recommended Books:

1. F. J. Keller, W. E. Gettys, M. J. Skove *Physics Classical and Modern (2nd edition)*, McGraw-Hill, Inc., 1993.
2. A.D. Halliday, R. Resnick, K. S. Krane Physics (Vol-II), John Wiley & Sons, Inc., 1992.
3. D. N. Vasudeva Magnetism and Electricity, S. Chand & Co., 1959.
4. J. A. Edminister Schaum's Outline Series; Theory and Problems of Electromagnetism, McGraw-Hill Book Co., 1986.

PHY-3207 **Physics Lab-II** **1(0-1)**

Course Objectives

To develop the understanding of students in measuring thermal and optical parameters, and to remove the fear of students using various gadgets in the laboratory.

List of experiments:

1. To determine the frequency of the AC supply by Melde's experiment.
2. To determine the frequency of the AC supply by an electric sonometer
3. To study the combinations of harmonic motion (Lissajous figures).
4. To study the parameters of waves (the beats phenomenon).
5. To determine the frequency of the AC supply by the CRO
6. The determination of the wavelength of Sodium -D lines by Newton's Ring.
7. Determination of the wavelength of sodium light by Fresnel's biprism.
8. The determination of the resolving power of a diffraction grating.
9. Study of the parameters of a wave, i.e., amplitude, phase, and time period of a complex signal by CRO.
10. Specific rotation of cane-sugar solution with Laurent's half-shade polarimeter

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

UOQ 3208 Understanding of Quran –II Credit hours: 1(0-1)

Course book: معلم القرآن از ڈاکٹر عبید الرحمن بشیر (جلد 3 تا 5)

Week	Lecturer (1.5hours)	Units	Lesson	Assignments/home Task	Linguistic Rules
1	1	6	6	قرآنی آیات کا ترجمہ اور تفہیم	فعل مضارع صیغہ جمع مذکر غائب
	2	6	7-8	قرآنی آیات کا ترجمہ اور تفہیم	فعل مضارع صیغہ جمع مذکر غائب
2	3	6	9-10	قرآنی آیات کا ترجمہ اور تفہیم	فعل مضارع واحد مذکر مخاطب و جمع مذکر مخاطب
	4	6	11-12	قرآنی آیات کا ترجمہ اور تفہیم	فعل مضارع واحد متکلم
3	5	6	13	قرآنی آیات کا ترجمہ اور تفہیم	فعل مضارع جمع متکلم
	6	6	14-15	قرآنی آیات کا ترجمہ اور تفہیم	لام نہی
4	7	6	16-17	قرآنی آیات کا ترجمہ اور تفہیم	شرطیہ اور مصدر مؤول
	8	6	18-19	قرآنی آیات کا ترجمہ اور تفہیم	لام تعلیل ، لام جحود
5	9	6	20-21	قرآنی آیات کا ترجمہ اور تفہیم	اسم مفعول ، فعل مضارع مجہول

	10	6	Revision unit 6		
6	11	Unit 7	1(sec 1-3)	قرآنی آیات کا ترجمہ اور تفہیم	فعل ماضی واحد مذکر غائب
	12	7	1(sec 4-5)	قرآنی آیات کا ترجمہ اور تفہیم	فعل ماضی واحد مذکر غائب
7	13	7	1(sec 5-6)	قرآنی آیات کا ترجمہ اور تفہیم	فعل ماضی واحد مذکر غائب
	14	7	1(sec 7-9)	قرآنی آیات کا ترجمہ اور تفہیم	فعل ماضی واحد مذکر غائب
8	15	7	Revision	قرآنی آیات کا ترجمہ اور تفہیم	فعل ماضی واحد مذکر غائب
	16	7			
9	17	7	2(sec 1-2)	قرآنی آیات کا ترجمہ اور تفہیم	فعل ماضی جمع مذکر غائب
	18	7	2(sec 3)	قرآنی آیات کا ترجمہ اور تفہیم	فعل ماضی جمع مذکر غائب
10	19	7	2(sec 4-5)	قرآنی آیات کا ترجمہ اور تفہیم	فعل ماضی جمع مذکر غائب
	20	7	2(sec 6-7)	قرآنی آیات کا ترجمہ اور تفہیم	فعل ماضی جمع مذکر غائب
11	21	7	3(sec 1-2)	قرآنی آیات کا ترجمہ اور تفہیم	فعل ماضی جمع متکلم
	22	7	3(sec 3)	قرآنی آیات کا ترجمہ اور تفہیم	فعل ماضی جمع متکلم
12	23	7	3(sec 4)	قرآنی آیات کا ترجمہ اور تفہیم	فعل ماضی جمع متکلم
	24	7	3(sec 5)	قرآنی آیات کا ترجمہ اور تفہیم	فعل ماضی جمع متکلم
13	25	7	4(sec 1-2-3)	قرآنی آیات کا ترجمہ اور تفہیم	فعل ماضی جمع مذکر مخاطب
	26	7	4(sec 4-5)	قرآنی آیات کا ترجمہ اور تفہیم	فعل ماضی جمع مذکر مخاطب
14	27	7	5-6	قرآنی آیات کا ترجمہ اور تفہیم	فعل ماضی واحد متکلم ، واحد مخاطب
	28	7	7	قرآنی آیات کا ترجمہ اور تفہیم	فعل ماضی واحد مؤنث غائب
15	29	7	8	قرآنی آیات کا ترجمہ اور تفہیم	فعل ماضی مجہول واحد
	30	7	9	قرآنی آیات کا ترجمہ اور تفہیم	فعل ماضی مجہول جمع
16	31	Unit 8	1-4	قرآنی آیات کا ترجمہ اور تفہیم	فعل امر مفرد
	32	8	5-8	قرآنی آیات کا ترجمہ اور تفہیم	فعل امر جمع

Semester IV

GEN-4401 Introduction to Sociology Credit Hours: 2(2-0)

Objectives: The course is designed to introduce the students with sociological concepts and the discipline. The focus of the course shall be on significant concepts like social systems and structures, socio-economic changes and social processes. The course will provide due foundation for further studies in the field of sociology.

Course Outline

Unit I: Introduction

a. Definition, Scope, and Subject Matter
b. Sociology as a Science
c. Historical back ground of Sociology

Unit II: Basic Concepts

a. Group, Community, Society
b. Associations
    i. Non-Voluntary
    ii. Voluntary
c. Organization
    i. Informal
    ii. Formal
d. Social Interaction
    i. Levels of Social Interaction
    ii. Process of Social Interaction
        1. Cooperation
        2. Competition
        3. Conflict
        4. Accommodation
        5. Acculturation and diffusion
        6. Assimilation
        7. Amalgamation

Unit III: Social Groups

a. Definition & Functions

b. Types of social groups
    i. In and out groups
    ii. Primary and Secondary group
    iii. Reference groups
    iv. Informal and Formal groups
    v. Pressure groups

Unit IV: Culture

a. Definition, aspects and characteristics of Culture
    i. Material and non-material culture
    ii. Ideal and real culture

b. Elements of culture
   i. Beliefs
   ii. Values
   iii. Norms and social sanctions

c. Organizations of culture
   i. Traits
   ii. Complexes
   iii. Patterns
   iv. Ethos
   v. Theme

d. Other related concepts
   i. Cultural Relativism
   ii. Sub Cultures
   iii. Ethnocentrism and Xenocentrism
   iv. Cultural lag

Unit V: Socialization & Personality

a) Personality, Factors in Personality Formation
b) Socialization, Agencies of Socialization
c) Role & Status

Unit VI: Deviance and Social Control

a) Deviance and its types
b) Social control and its need
c) Forms of Social control
d) Methods & Agencies of Social control

Unit VII: Collective Behavior

a) Collective behavior, its types
b) Crowd behavior
c) Public opinion
d) Propaganda
e) Social movements
f) Leadership

Recommended Books:

1. Anderson, Margaret and Howard F. Taylor. 2001. *Sociology the Essentials*. Australia: Wadsworth.
2. Brown, Ken 2004. *Sociology*. UK: Polity Press
3. Gidden, Anthony 2002. *Introduction to Sociology*. UK: Polity Press.
4. Macionis, John J. 2006. 10th Edition *Sociology* New Jersey: Prentice-Hall
5. Tischler, Henry L. 2002. *Introduction to Sociology* 7th ed. New York: The Harcourt Press.
6. Frank N Magill. 2003. *International Encyclopedia of Sociology*. U.S.A: Fitzroy Dearborn Publishers
7. Macionis, John J. 2005. *Sociology* 10th ed. South Asia: Pearson Education
8. Kerbo, Harold R. 1989. *Sociology: Social Structure and Social Conflict.* New York: Macmillan Publishing Company.

9. Koening Samuel. 1957. *Sociology: An Introduction to the Science of Society*. New York: Barnes and Nobel..
10. Lee, Alfred Mclung and Lee, Elizabeth Briant 1961. *Marriage and The family.*New York: Barnes and Noble, Inc.
11. Leslie, Gerald et al. 1973. *Order and Change: Introductory Sociology*Toronto: Oxford University Press.
12. Lenski, Gevbard and Lenski, Jeam. 1982. *Human Societies*. 4th edition New York: McGraw-Hill Book Company.
13. James M. Henslin. 2004. *Sociology: A Down to Earth Approach*. Toronto: Allen and Bacon.

GEN-4402 Ideology and Constitution of Pakistan Credit Hours: 2(2-0)

Course Objectives

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

1. Demonstrate enhanced knowledge of the basis of the ideology of Pakistan with special reference to the contributions of the founding father of Pakistan.
2. Demonstrate fundamental knowledge about the Constitution of Pakistan 1973 and its evolution with special reference to state structure.
3. Explain about the guiding principles on rights and responsibilities of Pakistan citizens as enshrined in the Constitution of Pakistan 1973.

Course Contents

1. **Introduction to the Ideology of Pakistan:**
   - Definition and significance of ideology.
   - Historical contest of the creation of Pakistan (with emphasis on socio-political religious and cultural dynamics of British India between 1857 till 1947).
   - Contributions of founding fathers of Pakistan of Pakistan in the freedom movement including but not limited to Allama Muhammad Iqbal, Muhammad Ali Jinnah., etc.
   - Contributions of women and students in the freedom movement for separate homeland for Muslims of British India.
2. **Two-Nation Theory:**
   - Evolution of the Two-Nation Theory (Urdu-Hindi controversy, Partition of Bengal, Simla Deputation 1906, Allama Iqbal's Presidential Address 1930, Congress Ministries 1937 Lahore Resolution 1940).
3. **Introduction to the Constitution of Pakistan:**
   - Definition and importance of a constitution.
   - Ideological factors that shaped the Constitution(s) of Pakistan (Objectives Resolution 1949).
4. **Constitution and State Structure:**
   - Structure of Government (executive, legislature, and judiciary).

- Distribution of powers between federal and provincial governments.
- 18th Amendment and its impact on federalism.

5. **Fundamental Right, Principles of Policy and Responsibilities:**
   - Overview of fundamental rights guaranteed to citizens by the Constitution of Pakistan 1973 (Articles 8-28).
   - Overview of Principles of Policy (Articles 29-40).
   - Responsibilities of the Pakistan citizens (Article 5).
6. **Constitutional Amendments:**
   - Procedures for amending the Constitution.
   - Notable Constitutional amendments and their implications

Recommended Books

1. "The Idea of Pakistan" by Stephen P. Cohen.
2. "Ideology of Pakistan" by Javed Iqbal.
3. "The Struggle for Pakistan" by I.H. Qureshi.
4. "Pakistan the Formative Phase" by Khalid Bin Sayeed.
5. "Pakistan: Political Roots and Development" by Safdar Mahmood.
6. "Ideology of Pakistan" by Sharif-ul-Mujahid.
7. "The Struggle for Pakistan: A Muslim Homeland and Global Politics" by Ayesha Jala.
8. "Jinnah, Pakistan and Islamic Identity: The Search for Saladin" by Akbar S. Ahmed.
9. "The Making of Pakistan: A Study in Nationalism" by K.K. Aziz.
10. "Pakistan: A New History" by Lan Talbot.
11. "Pakistan in the Twentieth Century: A Political History" by Lawrence Ziring.
12. "The Constitution of Pakistan 1973". Original.
13. "Constitutional and Political Development of Pakistan" by Hamid Khan.
14. "The Parliament of Pakistan" by Mahboob Hussain.
15. "Constitutional Development in Pakistan" by G.W. Choudhury.
16. "Constitution-Making in Pakistan: The Dynamics of Political Order" by G.W. Choudhury.

GEN-4403 **Entrepreneurship** **Credir Hr. 2(2-0)**

Objective:

By the end of this course, students shall have:

1. Knowledge of fundamental entrepreneurial concepts, skills and process.
2. Understanding on different personal, social and financial aspects associated with entrepreneurial activities.
3. Basic understanding of regulatory requirements to set up an enterprise in Pakistan, with special emphasis on export businesses;
4. Ability to apply knowledge, skills and competencies acquired in the course to develop a feasible business plan.

Course Contents:

1. **Introduction to Entrepreneurship:**
   - Definition and concept of entrepreneurship.

- Why to become an entrepreneur?
- Entrepreneurial process.
- Role of entrepreneurship in economic development.

2. **Entrepreneurial Skills:**
   - Characteristics and qualities of successful entrepreneurs (including stories of successes and failures).
   - Areas of essential entrepreneurial skill and ability such as creative and critical thinking, innovation and risk taking abilities etc.
3. **Opportunity Recognition** and **Idea Generation:**
   - Opportunity identification, evaluation and exploitation;
   - Innovative idea generation techniques for entrepreneurial ventures.
4. **Marketing and Sales**
   - Target market identification and segmentation;
   - Four P's of Marketing.
   - Developing a marketing strategy.
   - Branding.
5. **Financial Literacy:**
   - Basic concepts of income, savings and investments.
   - Basic concepts of assets, liabilities and equity.
   - Basic concepts of revenue and expenses.
   - Overview of cash-flows.
   - Overview of banl‹ing products including Islamic modes of financing.
   - Sources of funding for startups (angel financing, debt financing, equity financing etc.).
6. **Team Building for Startups:**
   - Characteristics and features of effective teams.
   - Team building and effective leadership for startups
7. **Regulatory Requirements to Establish Enterprises in Pakistan:**
   - Types of enterprises (e.g., sole proprietorship; partnership; private limited companies etc.).
   - Intellectual property rights and protection.
   - Regulatory requirements to register an enterprise in Pakistan, with special emphasis on export firms.
   - Taxation and financial reporting obligation.

Suggested Reading

1. "Entrepreneurship: Successfully Launching New Ventures" by Bruce R. Barringer and R. Duane Ireland.
2. "Entrepreneurship: Theory, Process, and Practice" by Donald F. Kuratko.
3. "New Venture Creation: Entrepreneurship for the 21st Century" by Jeffry A. Timmons, Stephen Spinelli Jr., and Rob Adams.
4. "Entrepreneurship: A Real-World Approach" by Rhonda Abrams.
5. "The Lean Startup: How Today's Entrepreneurs Use Continuous Innovation to Create Radically Successful Businesses" by Eric Ries.
6. Effectual Entrepreneurship" by Stuart Read, Saras Sarasvathy, Nick Dew, Robert Wiltbank, and Anne-Valerie Ohlsson.

MATH-4404 ORDINARY DIFFERENTIAL EQUATIONS Credir Hrs. 3(3-0)

Course Objectives:

1. Understand physical systems that can be described by differential equations
2. Understand the practical importance of solving differential equations
3. Understand the differences between initial value and boundary value problems (IVPs and BVPs)
4. Appreciate the importance of establishing the existence and uniqueness of solutions
5. Recognize an appropriate solution method for a given problem
6. Classify differential equations.
7. Real-life applications of differential equations.

Course Contents:

First Order Differential Equations: Linear Equations, Method of Integrating Factors, Separable Equations, Modeling with First Order Equations, Differences between Linear and Nonlinear Equations, Autonomous Equations and Population Dynamics, Exact Equations and Integrating Factors, The Existence and Uniqueness Theorem. Second Order Linear Equations: Homogeneous Equations with Constant Coefficients, Solutions of Linear Homogeneous Equations, The Wronskian, Complex Roots of the Characteristic Equation, Repeated Roots, Reduction of Order, Nonhomogeneous Equations, Method of Undetermined Coefficients, Variation of Parameters. Higher Order Linear Equations: General Theory of nth Order Linear Equations, Homogeneous Equations with Constant Coefficients, The Method of Undetermined Coefficients, The Method of Variation of Parameters. Series Solutions of Second Order Linear Equations: Solutions About Ordinary Points, Solutions About Singular Points, Special Functions, Bessel's Equation, Legendre's Equation.

Recommended Books:

1. Elementary Differential Equations and Boundary Value Problems" by William E. Boyce and Richard C. DiPrima
2. Differential Equations with Boundary-Value Problems" by Dennis G. Zill

MATH-4405 Mathematical Computing Credit Hrs. 3(3-0)

Course Objectives:

This course introduces students to mathematical computing using software tools, with a focus on Mathematica. Students will learn how to use computational techniques to solve mathematical problems and visualize mathematical concepts.

Course Contents:

1. **Introduction to Mathematical Computing**
    - Overview of computational tools in mathematics
    - Introduction to Mathematica interface and basic functionalities
2. Symbolic Manipulation
    - Performing algebraic manipulations using Mathematica
    - Simplification, expansion, and factorization of expressions
    - Solving equations symbolically
3. Numerical Methods and Approximations
    - Numeric evaluation of mathematical expressions
    - Solving equations numerically using iterative methods
    - Approximation techniques: Taylor series, truncation, and rounding errors
4. Plotting and Visualization
    - Creating 2D and 3D plots of functions and data
    - Customizing plot appearance and labels
    - Visualizing mathematical concepts and relationships
5. Calculus with Mathematica
    - Computing derivatives and integrals symbolically
    - Applications of calculus: optimization, area, and volume
6. Linear Algebra and Matrix Computations
    - Manipulating matrices and vectors using Mathematica
    - Solving systems of linear equations
    - Eigenvalues and eigenvectors
7. Differential Equations
    - Solving ordinary differential equations (ODEs) symbolically and numerically
    - Systems of ODEs and initial value problems
8. Programming in Mathematica
    - Introduction to programming concepts in Mathematica
    - Defining functions, loops, and conditional statements

- Creating custom computational tools

9. Mathematica Applications in Various Mathematical Fields

- Exploring applications in calculus, linear algebra, discrete mathematics, and more
- Symbolic and numerical solutions to real-world mathematical problems

Recommended books:

1. A Beginner's Guide to Mathematica" by David McMahon and Daniel M. Topa
2. The Student's Introduction to Mathematica" by Bruce Torrence and Eve A. Torrence
3. Hands-on Start to Wolfram Mathematica and Programming with the Wolfram Language" by Cliff Hastings, Kelvin Mischo, and Michael Morrison

PHY-4406: Modern Physics and Electronics Credit Hrs. 3(3-0)

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 the production of nuclear energy
4. To give a basic understanding of Plasma and LASER

Course Contents

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 & and negative feed-back R.C. Oscillators, Monostable multi- vibrator (basic), Logic gates OR, AND, NOT, NAND, NOR and their basic applications.

Origin of Quantum Theory:

Black body radiation, Stefan Boltzmann, Wien's, and Planck's law, consequences, the quantization of energy, photoelectric and Compton Effect, Line spectra, explanation using quantum theory.

Wave Nature of Matter:

Wave behavior of particle **(**wave function etc.), its definition and relation to the probability of particle, de 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 electrons, 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 and Robert 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.

PHY-4407 Physics Lab-IV Credit Hrs. 1(0-1)

List of Experiments:

1. To develop an understanding and uses of electronic devices, including GATS, Transistors.
2. Determination of ionization potential of mercury.
3. Characteristics of a semiconductor diode (Compare Si with Ge diode)
4. Setting up of half and full wave rectifier & and study of following factors
    i. Smoothing effect of a capacitor
    ii. Ripple factor & its variation with the load.
    iii. Study of regulation of output voltage with load.
5. To set up a single-stage amplifier & and measure its voltage gain and bandwidth.
6. To set up a transistor oscillator circuit and measure its frequency with an oscilloscope.
7. To set up and study various logic gates (AND, OR, NAND, etc.) using diode and to develop their truth table.
8. To set up an electronic switching circuit using transistor LDR and demonstrate its use as a NOT Gate.
9. Characteristics of a transistor.
10. Use of computers in the learning of knowledge of GATE and other experiments.

Recommended Books:

1. G L Squires, Practical Physics, 3rd Edition, Cambridge University Press

2. 2. Nolan and Bigliani, Experiments in Physics, Surjeet Pub Ind.
C K Bhattacharya, University Practical Physics, CBS Publishing.

Semester-VI

PHY-5601: Lab-VI (Solid State Physics) Credit Hrs. 3(1-2)

Course objectives:

The aim of this course is to develop the understanding of students in measuring the thermal and optical parameters and to remove the fear of students using various gadgets in the laboratory. The course objectives are:

1. To make the students confident in their studies by showing and measuring parameters that they have used in theoretical work.

2. To make them familiar with such experiments whose outcome can be used in developing future research capabilities and teaching skills?

List of Experiments

1. To study some aspects of ferromagnetism by drawing a B-H curve.
2. To investigate the Hall Effect in semiconductors or in metals and to draw the graph between Hall voltage and current.
3. To verify Bragg's law for X-ray diffraction by using the rock salt crystal.
4. To expose the Van-Laue pattern of LiF on X-ray film
5. To determine the dielectric constant of a solid by capacitor method.
6. (a) To study the characteristics of the photocell.
   (b) To study the characteristics of a thermistor.
7. To determine the energy gap in Silicon or Germanium.
8. To find the crystal structure of graphite by electron diffraction.
9. To study luminescence.
10. To study the thermoelectric effect by using the heat pump.
11. To study the crystal lattice structure of tungsten by Field emission Microscope.
12. To measurement the resistivity & conductivity of metals & non-metals.
13. To study the characteristics of superconductors.

PHY-5602: Quantum Mechanics-I Credit Hrs. 3(3-0)

Course objectives

1. Introduction to Quantum mechanical operators. Eigen values and its formulism
2. Understanding the behavior of quantum mechanical particles and development of the Schrodinger equation in one and three-dimensions
3. To apply Schrodinger Equation to find the potential problems
4. Determination of angular momentum of a quantum mechanical particle and application of Schrodinger equation for spherical symmetric system.

Course Outlines:

OPERATORS AND EIGENFUNCTIONS

Review of concepts of classical mechanics, State of a system, Properties of the one- dimensional

potential function, Postulates of Quantum mechanics, operators, Linear operators, Eigenfunctions and Eigenvalues, Expectation values of observable, The operator formalism in quantum mechanics, orthogonal systems, completeness of Eigen functions, Hermitian operator, Simultaneous Eigen functions and the commutator, The parity operator, The fundamental commutation rule, Ehrenfest theorem, Correspondence principle.

FORMULATION OF QUANTUM MECHANICS

Wave-particle duality, Wave Packets, Heisenberg uncertainty relations, Time evolution of a system, Uncertainty principle and the related Gedenken experiment, Wave function for a free particle, Schrodinger equation, Interpretation of wave function, Probability density and probability current,

APPLICATION OF SCHRODINGER EQUATION

Application of Schrodinger equation for one-dimensional problems, Potential step, Potential barrier and tunneling, rectangular potential-well, three-dimensional square well potential, linear harmonic oscillator.

SPHERICALLY SYMMETRIC SYSTEMS

Separation of Schrodinger equation in Cartesian coordinates, Central potentials, The Schrödinger equation for spherically symmetric potentials, Degeneracy, Angular momentum, Many-particle system, The hydrogen atom.

Recommended Books:

1. R.L. Liboff, 'Introductory Quantum mechanics', Addison Wesley Publishing Company, Reading Mass. (1980).
2. B.H. Bransden & C.J. Joachain, 'Introduction to Quantum Mechanics' Longman Scientific & Technical London (1990).
3. J.S. Townsend, 'A Modern Approach to Quantum Mechanics', McGraw Hill Book Company, Singapore (1992).
4. W. Greiner, 'Quantum Mechanics: An Introduction', Addison Wesley Publishing Company, Reading Mass. (1980).
5. Bialynicki-Birula, M. Cieplak & J. Kaminski, 'Theory of Quanta', Oxford University Press, New York (1992).

PHY-5603: Methods of Mathematical Physics-II Credit Hrs. 3(3-0)

Course objectives

The aim of this course is to acquaint the student with the techniques of the Fourier series and integral transform and their basic role in different physical applications. The goal of the course is to introduce some of the main ideas of differential equations and provide an opportunity for students to make use of these course contents in scientific applications.

Course Contents:

FOURIER SERIES

Definition of Fourier series, Example of Fourier Series, Fourier sine and Cosine Series, Complex Form of Fourier Series, pointwise and mean convergence of Fourier series, Applications of Fourier

series

FOURIER TRANSFORM

Integral transforms, Fourier transforms of derivatives, Fourier sine transform, Fourier Cosine transform, Fourier transformation of generalized functions, Fourier transform and its properties, the connection between Laplace and Fourier transforms, Laplace Transform, its properties, and applications.

SPECIAL FUNCTIONS

Partial differential equations of theoretical Physics, Separation of variables, Singular points, Series solutions, Frobenius's method, non-homogenous equation, Gamma function (definitions and simple properties), Beta function, Spherical harmonics, Dirac delta function and its properties, Green's Functions.

Recommended Books:

1. G. Arfken, Mathematical Physics, Academic Press 2nd Ed. (1970).
2. E. Butkov, Mathematical Physics, Addison-Wesley 1968.
3. Pipes and Harvill, Applied Mathematics for Engineers and Physicists, McGraw Hill, 1971.
4. Sadri Hassani, Mathematical Physics A Modem Introduction to Its Foundations, Springer-Verlag (2002)
5. N. M. Temme, Special Function, An Introduction to the Classical Functions of Mathematical Physics,John Wiley and Sons (1996)
6. M. R. Speigel, Complex Variables Schaum's Outline Series, McGraw Hill (1979).
7. E. D. Rainville, Special Functions, Macmillan and Company (1971)
8. 2. G. E. Andrews, R. Askey, and R. Roy, Special Functions, Cambridge University Press, (2000)
9. J. W. Brown and R. V. Churchill, Fourier series, and Boundary Value Problems, McGraw Hill (2006).
10. H.K. Dass, R. Verma, Mathematical Physics, S. Chand Company Pvt. Ltd. 7th Ed. New Delhi (2014).

PHY-5604: Electromagnetic Theory-II Credit Hrs. 3(3-0)

Course Objectives

The objectives of this course are:

1. To develop knowledge of the propagation, reflection, and refraction of electromagnetic waves
2. To Familiarize the students with Maxwell's Equations and their physical significance
3. To develop the knowledge of propagation of Plane electromagnetic waves and Poynting vector

Course Outlines:

INDUCED ELECTROMOTANCE AND MAGNETIC ENERGY

Faraday's induction law, Induced Electromotance in a moving system, Inductance and induced

electromotance, Energy Stored in a Magnetic field, Self – Inductance for a volume distribution of current, Magnetic force between two currents, and Magnetic Torque.

MAGNETIC MATERIALS

Magnetic dipole moment $\boldsymbol{\mu_m}$ The magnetic polarization Vector **M**, Magnetic susceptibility, Magnetic materials, and their classification, The magnetic induction B from polarized magnetic Material at an exterior point, at an Interior point, magnetic field intensity H, Ampere's Law in magnetic materials, Ferro magnets and Hysteresis, Boundary conditions.

ELECTROMAGNETIC WAVES:

Waves in one-dimension, Electromagnetic waves in vacuum, Electromagnetic waves in matter, Absorption, and dispersion, and Guided waves.

MAXWELL'S EQUATIONS And PROPAGATION OF PLANE ELECTROMAGNETIC WAVES IN MATTER:

Maxwell's equation in differential and integral forms, The Poynting Vector, The E and H Vectors in homogeneous, isotropic Linear and Stationary media, Propagation of plane electromagnetic Wave in Non-Conducting and Conducting Media, Propagation of plane electromagnetic waves in Ionized Gases.

Recommended Books:

1. D. J. Griffiths, An introduction to Electrodynamics, Prentice Hall, 3rd edition (1984)

Reference Books:

1. P.C. Lorrain & D.R. Corson, 'Electromagnetic Fields and Waves', W.H. Freeman & Co., New York (1978).
2. D. J. Griffiths, An introduction to Electrodynamics, Prentice Hall, 3rd edition (1984)
3. C.R. Paul & S.A. Nasar, 'Introduction to Electromagnetic Fields, McGraw Hill Book Company, Singapore (1987).
4. Electromagnetism with applications, Lorrain and Corson, W.H. Freeman & Co., New York (1978).
5. C.R. Paul & S.A. Nasar, 'Introduction to Electromagnetic Fields, McGraw Hill Book Company, Singapore (1987).
6. H.C. Ohanion, 'Classical Electrodynamics', Allyn & Bacon Inc., Massachusetts (1988).
7. A.M. Portis, 'Electromagnetic Fields', John Wiley & Sons, New York (1978).

PHY-5605: Nuclear Physics-I Credit Hrs. 3(3-0)

Course Objectives

1. The nuclear structure is in contrast with the atomic structure.
2. The experimental techniques and detectors used to study matter/radiation and their interaction.
3. Radioactive growth, decay, and related parameters.
4. Energy-releasing reactions, when they are possible/not possible, power generation via nuclear process (fission and fusion).

5. The fundamentals of nuclear and particle physics aspects, which are important to modern applications (Medicine, Engineering, Biotechnology etc.).
6. Fundamental particles and their interactions (strong, weak and electromagnetic).
7. The useable knowledge of physics behind the nuclear concepts.

Course Contents

BASIC PROPERTIES

Proton-electron theory of the nucleus, Proton-neutron theory of the nucleus, Size, Mass, Binding energy, Dipole and quadruple moments (electric) parity, and statistics of nuclei.

RADIOACTIVITY

Introduction to radioactivity, Laws of radioactive disintegrations, Half and mean life of radioactive isotopes, Natural radioactive series. The stability of heavy nuclei against alpha emission, Theories of alpha decay (Classical and Quantum mechanical), Alpha-particle spectra, Measurements of alpha-particle energies and velocities, Introduction to the classical theory of beta decay, The beta decay, The velocity and energy of beta-particles, Beta-particles spectra, Neutrino Hypothesis Fermi theory of beta-decay, Parity violation in beta-decay, Electron capture, introduction to Gamma decay, Multipolority of gamma-radiations, Measurements of Gamma rays energies: Using NaI(Tl) detector,

NUCLEAR REACTIONS

Conservation laws of nuclear- reactions, Q-value and threshold energy, Theory of Compound Nucleus, Nuclear cross-section, Reaction induced by photons, Protons, Deuterons, and alpha particles,

PARTICLE DETECTORS AND ACCELERATORS

Passage of charged particles through matter, Energy loss and stopping power, G.M counter, Proportional counter, Ionization chamber, Semiconductor Detector, Scintillation counter, Linear accelerator, Betatron, Cyclotron

Books Recommended:

1. Irving Kaplan, Nuclear Physics, Addison-Wesley Publishing Co., 2002.
2. Evans, The atomic nucleus, McGraw Hill, 1965.
3. E. Segre, Nuclei and particles, The Benjamin/ Cummings publishing company, 2nd Edition, 1982.

PHY-5606: Solid State Physics -I Credit Hrs. 3(3-0)

Course Objectives

The course will provide a valuable theoretical introduction and an overview of the fundamental applications of the physics of solids. This course includes a theoretical description of crystal and electronic structure, lattice dynamics, and optical properties of different materials. The objectives of this course are to enhance the knowledge of Solid State Physics with an emphasis on the following concepts:

1. Crystallography

2. Bonding
3. X-ray diffraction, Reciprocal lattice
4. Phonons, Dispersion relations for Phonons
5. Heat Capacities and the semiconducting properties of Solids.
6. Electrical Properties of solids

Course Contents:

CRYSTAL STRUCTURE

Lattices (Bravais and non-Bravais lattices), Primitive and non-primitive unit cell, Wigner- Seitz unit cell, Symmetry and symmetry operations, Miller indices and planes, Classification of lattices, 2-dimensional and 3-dimensional lattices, (NaCl, CsCl, ZnS and diamond lattices).

CRYSTAL DIFFRACTION

Bragg's law, Reciprocal Lattice, Diffraction conditions, Von-Laue equation, Ewald's Sphere, Brillouin zones, Experimental techniques of X-ray diffraction (Laue method, Rotating crystal method, Powder method)

CRYSTAL BINDING

Review of chemical bondings, Covalent bonding, Metallic bonding, Hydrogen bonding, Ionic bonding, cohesive energy of ionic crystals, Van-der-Waals bonding, Van-der-Waals London interaction.

LATTICE VIBRATIONS AND THERMAL PROPERTIES OF SOLID

Dispersion relation of phonons for one-dimensional Mono-atomic and Diatomic linear lattices, Quantization of Elastic Waves Phonons, -Phonon Momentum. Lattice heat capacity, Dulong and Petit Law for the specific heat of solids, Einstein Model of specific heat of solids, Debye model of specific heat of solids with high and low-temperature limitations

FREE AND NEARLY FREE ELECTRON MODELS

Energy levels and density of orbital in one dimension, Hall effect, Nearly free electron model, Origin of the energy gap, Magnitude of the energy gap, Bloch functions, Kronig- penney model, the structure of Brillouin zones, Reduced zone scheme, periodic zone scheme, and extended zone scheme.

Recommended Books

1. C. Kittel, Introduction to Solid State Physics, John Wiley & Sons 8th.ed., (2005)
2. R. J Elliot and A. F. Gibson; ELBS and Macmillan, An Introduction to Solid State Physics and its Applications,
3. M. A. Omar, Elementary Solid State Physics, Pearson Education 2000.
4. N. M. W. Ashcroft and N. D. Mermin, Solid State Physics, Holt, Rinehart & Winston, 1976.
5. J. S. Blackmore; W. B. Saunders, Solid State Physics,
6. Ziman, Principle of Solid State Physics, Cambridge University.
7. H. E. Hall John, Solid State Physics, ELBS, and John Wiley & Son.
8. M.A. Wahab, Solid State Physics, Narosa Publishing House, 1999.

SCHEME OF STUDIES FOR B.S. 8th PHYSICS

Semester-VIII		
Course Code	Course Title	Credit hours
PHY-6801	Lab-VIII (Modern Physics)	3(0- 3)
PHY-6802	Statistical Mechanics and Thermal Physics	3(3-0)
PHY-6803	Computational Physics	3(2-1)
Elective Advance Course-II Code	Elective Advance Course-II (See Below)	3(3-0)
PHY-6800 OR Optional Course Code	Thesis OR Optional Course	As per nature 3(3-0)
PHY-6807	Comprehensive Viva	S/U
Total		***15***
Elective Advance Course-II (Semester-VIII)		
PHY-6804	Electronics, Elective-II	3(3-0)
PHY-6805	Solid State Physics, Elective-II	3(3-0)
PHY-6806	Nuclear Physics, Elective-II	3(3-0)
Optional Courses (Semester-VIII)		
PHY-6808	Radiation and Medical Physics	3(3-0)
PHY-6809	Experimental Plasma Physics	3(3-0)
PHY-6810	Introduction To Particle Physics	3(3-0)
PHY-6811	Computer Simulation	3(2-1)

Note: Student can choose one optional paper from the list given above, each in 7th and 8th semester, as an alternative of thesis. This option shall be related to the availability of qualified staff and their decision shall be taken in staff meeting which is supposed to be held two week before the commencement of semester.

Semester-VIII

PHY-6801: Lab-VIII (Modern Physics) Credit Hrs: 3(3-0)

Aims and objectives:

The aim of this course is to expose the students to advance level experimentation in Physics. The course objectives are:

1. To make them familiar to such experiments whose outcome can be used in developing future research capabilities and teaching skills?
2. To make them familiar to such experiments whose outcome can be used in developing future research capabilities and teaching skills?

List of Experiments

1. Michelson's Interferometer
   (i) To measure the wavelength of sodium light
   (ii) To measure the difference of wavelength
   (iii) To measure the thickness of the thin films.
2. To study of parameters of Laser beam.
3. To measure the Planck's constants by photoelectric apparatus.
4. To measure the Planck's constants by hydrogen discharge spectrum.
5. To determine the ratio of e/m of electron by J. J. Thomson's method.
6. To verify the quantization of energy band by Franck - Hertz experiments.
7. To determine the (g) factor by Electron spin Resonance (ESR).
8. To find the fine structure of one electron spectrum or two electron spectrum.

PHY-6802: Statistical Mechanics and Thermal Physics Credit Hrs: 3(3-0)

Aims and objectives

The aim of this course is to present the fundamental ideas and methods of statistical mechanics and thermodynamics, and to develop these ideas through simple examples. The course goals are:

1. Explain the laws of thermodynamics in their various forms and explain their physical significance.
2. Derive and state Maxwell's relations and apply them to problems in thermodynamics.
3. State the thermodynamic potentials and recognize the most appropriate potential for application to a particular problem.
4. Derive and state the Boltzmann, Fermi-Dirac and Bose-Einstein distributions.
5. To know the key links between thermodynamics and statistical mechanics and apply these to problems.
6. Be able to explain the importance and significance of the partition function, and be able to construct partition functions for systems and extract thermodynamic properties from them.

Outlines:

THERMAL PHYSICS

Review of laws of thermodynamics, Maxwell's Relations Thermodynamic potentials, Criteria of Thermodynamical equilibrium, Intrinsic and mutual Stabilities of single component systems, conditions of Stabilities. The Lechatelier Braun Principle, First order phases transition, Discontinuities of volume and entropy. Second order phase transition, Kinetic theory of gases.

STATISTICAL MECHANICS

Fundamental principles, Mean values and Probability distribu- tions Statistical ensemble, Probability and entropy relation- ship,Liouville's theorem, Statistical concept of temperature, Entropy and free energy, Micro canonical, Macro-canonical and grand canonical ensembles, Macro & Micro states, Maxwell's Boltzman statistics and its application to (i) equipartition of energy, (ii) Harmonic oscillator, (iii) Richardson's equation for thermonic emission (iv) Paramagnetism, Quantum statistical mechanics-basic facts of quantum mechanics, Heisenberg uncertainty principle and Bose Einstein statist- ics; its application to black body radiation, Pauli exclusion principle and Fermi-Dirac statistics; its application to electron gas, Specific heat of electron gas, Thermonics emission ,Kinetic methods and transport theory, Boltzman transport equation and its application,

Recommended Books

1. C. Kittel and H. Kroemer,Thermal Physics,W. H. Freeman and Co New York 2nd edition (1980).
2. Raj Kumar Pathria, Statistical Mechanics, Pergamon P., 2nd edition (India, 1996)
3. F. H. Grawford, Heat Thermodynamics and Statistical Physics , Harcourt, Brace & World, 6th edition 1963.
4. F. Rief, Statistical Physics, Mcgraw-Hill Inc., Volume. 5, (2008).
5. F. Rief, McGraw Hill, Fundamental of statistical and thermal Physics, Waveland Pr. Inc, (1965).
6. Kerson Huang, Introduction to Statistical Physics, Taylor and Francis Alpha Science Intl Ltd., Volume 51 (2000).
7. Tanaka, Methods of statistical Physics, Tomoyasu Tanaka 1st Edition (2002).
8. H. B. Callen, Thermodynamics and an Introduction to Thermo statistics, Wiley, Volume 22 (1985).
9. Gugenheim, An Introduction to Applied Statistical Thermodynamics, Wiley, 2nd Edition (1950).
10. Zemansky, Heat and Thermodynamics, McGraw-Hill, Inc., 6th Edition (1997)

PHY-6803: Computational Physics Credit Hrs: 3 (2-1)

Aims and Objectives

This course is intended to give an introduction to main computational tools, techniques and methods used in contemporary physics. Student will practice writing, compiling, and running computer programs, together with analysis of results, and presentation of their results as scientific reports. The main objective of this course is to develop the programming skill of the students and it also focus on practical methods for solving physics problems.

Outlines:

INTRODUCTION TO COMPUTING

Introduction (What is computational physics?), Tools of computational physics, Overview of Computer Fortran Languages (90/95), Programming Fundamentals (Comments, statements, blocks, identifiers, keywords, literals, Primitive data types, Variables, Operators, Operator Precedence), Control Structures (if, else, switch, while, do-while, for, break, continue, return), Arrays in Fortran, Function, File structure

NUMERICAL METHODS

Numerical Solutions of equations, Regression and interpolation, Numerical integration and differentiation.Error analysis and technique for elimination of systematic and random errors.

APPLICATION TO PHYSICS

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.C. Chapra & R.P. Chanle, 'Numerical Methods for Engineers with Personal Computer Applications, McGraw Hill Book Company, New York (1965
3. S.T. Koonini, Computational Physics', The Benjamin/Coming Publishing Inc., California (1986).
4. P.K. Macheown & D.J. Merman, Computational Techniques in Physics' Adm Hilger, Bristol (1987).
5. H. Gould & J. Tobochnik, 'An Introduction to Computer Simulation Methods', Addison Wesley Publishing Company, Rading Massachusetts (1988).

PHY-6804: Elective-II (Electronics) Credit Hrs: 3(3-0)

Aims and Objectives

To familiarize the students with basic concepts of various number base systems, signed and unsigned binary representation and arithmetic, karnaugh's map, analysis and design of simple combinational circuits, implementation of complex Boolean functions using decoders and multiplexers, latches, flip-flops, edge triggering, state diagrams, state tables, counters and registers with parallel and serial shift operations.

Outlines:

COMBINATIONAL LOGIC CIRCUIT

Introduction to Karnaugh Map, Truth table to Karnaugh Map, Sample design proceduire, Code Converter logic design, Special Code converter units, Quine Mc-Clusky Method. Basic Adder Circuit, Adder Unit, Basic Techniques of Addition/Subtraction, Adder and Subtractor Circuitry, Arithmetic Operation, Trouble shooting digital system.

SWITCHING CIRCUITS LOGIC FAMILIES

Switching properties of semi-conductor Devices, TTL Logic Family and its characteristics, CMOS Logic Family and its characteristics, TTL driving CMOS, CMOS driving TTL Troubleshooting

SEQUENTIAL LOGIC CIRCUIT

Shift Register Parallel Data Transfer, Serial Data Transfer, Serial Parallel Data Transfer Register, Basic Binary Ripple counter, Modulus Counters, Asynchronous and Synchronous counters, Analog-Digital Conversion, DAC, ADC, Multiplexing, Demultiplexing, and Troubleshooting.

MEMORY CIRCUITS AND MAGNETIC STORAGE DEVICES

General Memory Description, ROM, PROM,EPROM,E2PROM,Flash Memory RAM Magnetic storage Techniques, Magnetic Disk Storage, Floppy Disk Operation, Magnetic Tape.

MICROPROCESSOR BASICS:

Basic Microprocessor Units, Basic Microprocessor Architecture and Busses, Basic Instruciton Cycle, Interfacing Microprocessor Busses, Different Addressing techniques, basic interrupt processing and hardware interrupts, Detail of 8085/8088 Microprocessor.

APPLICATION OF MICROPROCESSOR:

Traffic light controller, Dc motor controler, Step moter controller, Digital/Analog Conversion control, Analog/ Digital Conversion.

Recommended Books

1. Floyd l. Thomos, Digital Fundamentals Tata McGraw-Hill, 8th Edition.(2003)
2. Nashelsky L, Introduction to Digital Technology Prentice Hall, 2nd Edition,.(2000)
3. Tocci Ronald L. Daigitla System, Norwell, MA: Kluwer, 3rd Edition.(2001)
4. Kip R. Irvine, Assembly Language for Intel Based Computers, Prentice Hall, 4th edition, (2002).
5. Brey, Microprocessor Peripherals, Prentice Hall., 2nd Edition(1989).
6. Barry B & Brey, The Intel microprocessors, Prentice-Hall, 8th edition.(2008)

PHY-6805: Elective-II (Solid State Physics) Credit Hrs: 3(3-0)

Aims and Objectives

This course includes theoretical description and properties of different materials based on the classical and quantum physics principles. A considerable attention is devoted to superconductivity, not only because superconductors are a part of the research interest of to a number of worldwide groups, but mostly because they illustrate a number of important concepts in the solid state physics. The students are expected to develop a deeper understanding of some fundamental practical tools of physics of solids necessary to comprehend all the forth coming more advance courses.

Outlines:

DIELECTRICS AND FERROELECTRICS

Macroscopic electric field, Depolarization field, E1Local electric field at an atom, Lorentz fields E2, Field of dipoles insides cavity E3, Dielectric Constant and polarizatability, Electronic polarizability, Ferroelectric crystals, Classification of ferroelectric crystals, Polarization catastrophe.

DIAMAGNETISM AND PARAMAGNETISM

Langevin diamagnetism equation, Paramagnetism, Quantum theory of paramagnetims, Rare earth ions, Hund rules, Iron groups ions, Crystal field splitting, Quanching of the orbital angular momentum, Cooling by adiabatic demagnetization of paramagnetic salt, Nuclear demagnetization, Paramagnetic susceptibility of conduction electrons.

FEROMAGNETISM

Feromagnetic order, Curic point and exchange integral, Temperature dependence of the saturation magnetization, Saturation magnetization at absolute zero, Magnons, Thermal excitation of magnons.

DEFECTS IN SOLIDS

Lattice vacancies, Diffusion, Metals, Colour-centers, F-centers, Other centers in alkali halides, Shear strength of single crystals slip, Dislocations, Burgers Vectors, Stress field of dislocations, Low angle grain bounderies.

SUPERCONDUCTIVITY

Occurrence of Superconductivity, Destruction of Superconductivity by Magnetic fields, Meissner effect, Thermodynamics of the superconducting transition, London equation, Coherence length, BCS Theory of superconductivity, Flux quantization in a superconducting ring, Type II superconductors, Vortex state, Estimation of HC1 and HC2 ,Single particle Tunneling, Josephson superconductor tunneling, DC Josephson effect, AC Josephson effect.

Recommended Books

1. C. Kittel, Introduction to Solid State Physics, John Wiley & Sons 8th.ed., (2005)
2. R. J Elliot and A. F. Gibson; ELBS and Macmillan, An Introduction to Solid State Physics and its Applications.
3. M. A. Omar, Elementary Solid State Physics, Pearson Education 2000.
4. N. M. W. Ashcroft and N. D. Mermin, Solid State Physics, Holt, Rinehart & Winston, 1976.
5. M.A. Wahab, Solid State Physics, Narosa Publishing House, 1999.
1. K.H. Bennemann and J.B. Ketterson, Superconductivity, Volume-1 Springer publication (2008)

PHY-6806:Elective-II (Nuclear Physics) Credit Hrs: 3(3-0)

Aims and objectives

PHY-6407 is an Elective course with one prerequisite; PHY-5203. It is an interesting and ambitious course with intention to introduce the students

1. To neutronPhysics, interaction cross-section including absorption and scattering with emphasis on fission and resonance.
2. To mass and energy distribution of fission products, released energies, its control and nuclear reactors.
3. To the nature of nuclear force, its strength and range in comparison with electromagnetic force.
4. To different nuclear models with respect to different nuclear phenomenon.
5. To various aspects of matter related to elementary particles, a standard model of interactions and consequences of exchange in the mediation of forces.

Outlines:

NEUTRON PHYSICS

Production of neutrons, Detection of neutrons, the interaction of neutron with matter in Bulk, Thermal neutrons, Neutron reactions and cross-section, the diffusion of thermal neutron, Scattering.

NUCLEAR FISSION AND FUSION

Discovery of fission, Types of fission, Theory of fission (Bohr and Whealer's theory), Weizeker mass formula, Mass and energy distribution in fission, Controlled fission reaction, Fission Reactors, Fission Explosive, Basic Fusion reaction, Characteristics of fusion

NUCLEAR FORCES

Introduction, Deuteron (Properties of Nuclear force, Ground state of Deuteron No Excited S-states, Exited states of the deuteron). Yukawa theory of nuclear forces, saturation on Nuclear forces (Exchange forces, isotopic spin formulism), Scattering cross sections, Neutron-Proton scattering at low energy, Proton-Proton scattering at low energy, Similarity between (n-n) and (p-p) forces.

NUCLEAR MODELS

Introduction, Fermi gas model, Liquid drop model, Shell model, evidence for the existence of magic numbers, Extreme single particles model (square well potential,

Harmonic oscillator, Spin-orbit potential), Individual (independent) particle model, Prediction of shell model, Collective nuclear model.

ELEMENTARY PARTICLE

Introduction, Classification of elementary particles, Kleen-Grodon equation, Symmetric form of the Kleen-Grodon equation, Dirac Equation, Symmetric form of Dirac Equation, Dirac Sea, Spin of Dirac particles.

Books Recommended

1. Kenneth Krane, Introduction to Nuclear Physics, John Wiley & Sons, 2nd Edition, 1987.
2. Evans, The atomic nucleus, McGraw Hill, 1965.
3. E. Segre, Nuclei and particles, Benjamin/ Cummings Publishing Co., 2nd Edition, 1982.
4. William J. Price, Nuclear radiation and Deduction, McGraw Hill New York, 1964.
5. H. Enge, Introduction to Nuclear Physics, Addison Wesley Publishing Co., 1981.

OPTIONAL COURSES (SEMESTER-VIII)

PHY-6808: Radiation and Medical Physics Credit Hrs: 3(3-0)

Aims and Objectives

The course will demonstrate to the student the theoretical background, mode of operation and practical application of systems designed to image either anatomy or physiological function using ionising radiation. It will also introduce the student to the methods by which images can be processed and assessed. The course objectives are:

1. To impart knowledge on the sources of radiation that can be used in clinical imaging and to develop the understanding of the interactions that are likely to take place in the patient and detector.

2. To impart knowledge and understanding on the detectors commonly used in X-ray and gamma ray imaging.
3. To impart knowledge on the more recently developed sensors that may in the future find applications.
4. To impart knowledge on systems those are used in gamma ray imaging.
5. To develop understanding in how image contrast can be improved in X-ray imaging.
6. To develop skills in simple calculations that deal with contrast in X-ray imaging.
7. To develop understanding of the parameters used to describe images.

Outlines:

INTRODUCTION

Radiation, Background Radiations, Natural Background Radiations, Cosmic radiations, Terrestrial Radiation, Human Caused Background Radiation, Ionization Radiation, Non Ionizing Radiation, Interaction of Radiation with matter, Biological Effects of radiation, Effects of Radiations used in Medical, Uses of ionizing radiation, Biological and medical applications of ionizing radiation.Radiation hazards and methods of control.

X-RAYS AND EFFECTS

Introduction of X-rays ,Discovery of X-rays ,Production of X-rays , Characteristics of X- rays, Application of X-rays (Engineering, Radiology(medical) , Environment , Medicine), Medical Uses of X-rays, Harmful Effects of Radiation, CAT scanning.

MONITORING OF RADIATIONs

Detectors, Active Detectors, Passive Detectors, Solid State Nuclear Tracked Detectors (SSNTDs), Ionization Chamber, Semiconductor Dosimeter, Film Badges, Geiger Muller Counter (G.M Counter), Scintillation Counters, Thermo luminescent Dosimeter.

CLINICAL DOSIMETRY

Thermoluminscent Dosimeter, General Requirements for TLD Materials, Advantages and disadvantages of thermoluminescent dosimeter, Application of TLDs, Types of TLDs,Calcium fluoride TLDs, Lithium FlourideTLDs, Personal dosimetry .

MEDICAL APPLICATION AND DOSE MEASUREMENTS,

Introduction of Dose measurement, Types of doses, units of dose measurements, Dose measurement in diagnostic x-rays and therapeutic x rays, safty of x-rays, Interaction of X-photons with patients, radiographic contrast. Film as an X-ray image receptor.Digital image receptors.Scatter reduction.Image resolution.Image intensifiers. Equipment used for radiodiagnosis, conventional radiographic, dental, fluoroscopic and X-ray CT. Computed radiography andQuality assurance of X-ray equipment.

TLDs READER SYSTEM

TLD Dectoters(Reader), Calibration and Dose Verification, Anealing procedure of TLDs, Heating the Dosimeter, Photomultiplier Tube PMT, Pre-Operational Checks of thermoluminscent reader, Stability Check of thermoluminscent Reader.

RADIATION DECTECTION, PROTECTION AND INSTUMENTATION

Basic concepts of radioactivity, Principles of radiation detectors and their common properties, , Radiation spectroscopy, Nuclear electronics, Various types of dosimeters, Basic concept of dosimetry, Dose calibrator, Collimation of radiation; Radiation protection standards, Basic principles for control of external and internal exposures and absorbed dose estimation, Protection against radiation from brachytherapy sources, Nuclear regulatory commission

regulations, Health Physics instrumentation personal dosimetry, Early medical treatment of radiation injuries, Radioactive waste management in hospitals, Quality control and quality assurance of radiotherapy instrumentation.

Books Recommended

1. John R. Cameron , Medical Physics,. John Willy and sons (1997)
2. William J.Price, Nuclear Radiation and Detection , Mcgraw Hill New York (1964)
3. J.R Albright, Atomic and nuclear physic , 2nd edition, Mcgraw Hill New York, (1993)
4. John R. Lamarsh, Introduction to Nuclear Engineering, Third Edition, Prentice Hall (2001),
5. Herman Cember, Introduction to Health Physics , Third Edition, Mc. Graw-Hill Inc. (2003).
6. Ionising Radiations (Medical Exposure) Regulations [IR (ME) R], 2000.

PHY-6809: Experimental Plasma Physics Credit Hrs: 3(3-0)

Aims and Objectives

This course provides Basic concepts and experimental techniques used to measure the properties and behavior of gaseous and solid-state plasmas. Experimental techniques include probe measurements of plasma parameters, microwave resonances, electron scattering, architecture of glow discharges, and determination of plasma temperature using atomic physics effects. The goals of this course are:

1. To provide the students with an understanding of plasma generation techniques.
2. To provide an understanding of the optical emission and probe diagnostic techniques used to characterize plasma.

Outlines:

PLASMA GENERATION

Energy storage and transfer for high temperature plasma generation and current drive techniques. Z-pinch, θ-pinch, and plasma focus devices. Cold plasma generation, characteristics of DC glow discharge, RF discharges and cold plasma reactors.

PROBES FOR PLASMA DIAGNOSTICS

Rogowski coil, high voltage probe, magnetic probe, Langmuir probe, voltage loops and Mirnov coils.

CHARGED PARTICLE AND NEUTRON DIAGNOSTICS

Faraday cups and solid state nuclear track detectors for detection and analysis of charged particles, Time-resolved and time-integrated neutron measurement.

X-RAY DIAGNOSTICS OF PLASMAS

X-ray emission from plasmas, absorption filters and their selection, time-resolved x-ray detectors, pinhole imaging camera, estimate of plasma electron temperature.

PLASMA SPECTROSCOPY

Radiative processes in plasmas, Collisional processes in plasmas, statistical plasma models, plasma optical spectroscopy, and evaluation of plasma parameters.

Recommended Books

1. J. Reece Roth, Industral Plasma Engineering, Institute of Physics Publishing Bristol (2000).
2. I. H. Hutchinson, Principles of Plasma Diagnostics, Cambridge University Press New York (1999).
3. A. H. Siedle and L. Adams, Handbook of Radiation Effects, Oxford University Press (2002).
4. F. F. Chen and J. P. Chang, Kluwer, Principles of Plasma Processing, Academic/ Plenum Publishers New York (2003).
5. H.ans R. Griem, Principles of Plasma Spectroscopy, Cambridge University Press (1997).
6. J. A. Bittencourt. Pergamon, Fundamentals of Plasma Physics, Press Oxford (1995).
7. Orlando Auciello and Daniel L. Flamm, Plasma Diagnostics, Academic Press Boston (1989).
8. John Wesson, Tokamaks, Clarendon Press Oxford (2004).

Recommended books:

1. MATLAB, An Introduction with Applications, 4th ed. by A. Gilat (Wiley, New York, NY, 2011). QA297.G48 2011 This one is good to learn the nuances of Matlab more so than physics.
2. A First Course in Computational Physics by P. L. DeVries (Second Edition, Sudbury, Mass.: Jones and Bartlett Publishers, 2011). QC52.D48x 2011 Seven chapters – Intro, function and roots, interpolation and approximations, numerical integration, ODE, Fourier analysis, PDE. All in Matlab. This one looks good.
3. Computational Physics by N. Giordano and H. Nakanishi, second edition (Pearson Prentice Hall, Upper Saddle River, NJ, 2006). QC20.7.E4G56 2006

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