Scheme of Studies

Associate Degree in Science
Combination-I
(Double Math & Physics)

Semester-I

Sr.No	Course Code	Course Title	Crd. Hrs		
			Theory	Lab.	Total
1	ENG-1107	Functional English (C1)	3	0	3
2	ISL-1112/ ETH/1112	Islamic Studies/Ethics (C2)	2	0	2
3	MAT-1115	Calculus-I (Ma1, F1)	3	0	3
4	PHY-1101	Mechanics (P1, M1)	3	1	4
5	ARA-1101	Arabic (C3)	3	0	3
		Total	14	1	15

ENG-1107   **ENGLISH-I (Functional English)**   **Credit Hrs: 03**

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. 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

3. 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 35-4

4. Reading. Upper Intermediate. Brain Tomlinson and Rod Ellis. Oxford Supplementary Skills. Third Impression 1992. ISBN 0 19 453402 2.

ISL-1112   **ISLAMIC STUDIES**   **Credit Hrs: 03**

Fundamental of Islam, Tauheed: Arguments for oneness of God, impact of Tauheed on human life, place of man in the universe, purpose of creation, textual study of Surah al- Rehman and Surah al-Furqan, Prophethood, need for prophet, characteristics of a prophet, finality of prophethood, seerat; life of prophet as embodiment of Islamic ideology, faith in hereafter aakhrat, effects of belief on worldly life.Ibadah: Concepts of Ibadah, Salat, Saom, Zakat, Hajj and jehad. The Holy Quran: Its revelation and compilation, The authencity of the text, Hadith: Its need, authenticity and importance. Consensus (Ijma), analogy (Qiyas). Sources of Knowledge: Islamic approach to institution, Reason and experience. Revelation Wahi as a souce knowledge. Moral and social Philosophy of Islam: The concept of good and evil, Akhlaq -e- Hasna with special reference to surah Al- Hujrat, Professional Ethics Kasb-e- Halal. Islamic Political Principles: Salient feature of the Islamic state, Madina character, Responsibilities of the Head of the state, Rights and Duties of Citizens. Economics Oder of Islam: Right to property, System of Taxation, Distribution of Wealth Zakat and Ushar, Interest Free Economy Shirakat and Muzarabat. Islam as Living Force: Application of Islam Teaching to Socio- Economic Development in the 20th Century.

RECOMMENDED BOOKS
1. Muhanmmad, H. "Emergence of Islam", IRI, Islamabad.

2. Muhanmmad, H. "Muslim Conduct of State"

3. Muhanmmad, H. 'Introduction to Islam

5. Hussan, H. H. "An Introduction to the Study of Islamic Law" leaf Publication Islamabad, Pakistan.

6. Hasan, A. "Principles of Islamic Jurisprudence" Islamic Research Institute, International Islamic University, Islamabad (1993)

7. Mir, W. 1982. "Muslim Jurisprudence and the Quranic Law of Crimes"

Islamic Book Service.

8. Bhatia, H.S. 1989. "Studies in Islamic Law, Religion and Society" Deep & Deep Publications New Delhi.

9. Muhammad, Zia-ul-Haq.2001. "Introduction to Al Sharia Al Islamia" Allama Iqbal Open University, Islamabad.

MAT-1115   **CALCULUS-I**   **Credit Hrs: 03**

Introduction, real numbers, intervals, absolute values and its properties, coordinates planes and graphs, lines, functions, operation on functions, graph of functions, shifting of graph limits, continuity, graphical and analytical approach. The derivatives, geometrical meanings of derivatives, tangent lines and rate of changes. Derivatives of Trigonometric functions, inverse trigonometric functions, the chain rules, implicit differentiation, differential derivative of hyperbolic, inverse hyperbolic, logarithmic, exponent function, first order differential equation and application, increase and decrease, concavity relative extrema, first and second derivatives test, Maximum and minimum of a function, applied maximum and minimum problem, L' hospital rules integration, basic rules of integration, formula of integration, integration by parts, by substitutions, partial fraction definite integrals, Riemann sur theorems of definite integral, first and second fundamental theorems of calculus definite integral with property areas between curves, Disk and washer, volumes by cylindrical shell and slicim length of plane curves, Area of surface of revolution, First order differential equation and applications, Roll's theorem, mean values theorem and its application, improper integral, convergent and divergence of integrals, straight line in R3, Planes, Cylindrical and Spherical coordinate surfaces, cylinders and cones, sphere, spherical trigonometry.

RECOMMENDED BOOKS
1. Calculus and analytical Geometry, by Thomas & Finny. 10th Edition. 2. Calculus & Analytical Geometry, by Howard anton, 7th Edition
3. Calculus & Analytical Geometry, by S.M. Yosuf.
4. Calculus & Analytical Geometry, by SkowSky. 6th Edition.

PHY-1101   **MECHANICS**   **Credit Hrs: 04**
Objectives:
The main objective of this course is to understand the different motions of objects on a macroscopic scale and to develop simple mathematical formalisms to analyze such motions. This is a calculus-based introductory course with maximum emphasis on applying the acquired knowledge to solving problems.
Motion in One, Two and Three Dimensions: Position & Displacement, Velocity and Acceleration, Motion under Constant Acceleration, Projectile Motion, Uniform Circular Motion, Relative Velocity and Acceleration in One and Two Dimensions, Inertial and Non-Inertial Reference Frames.
Newton's Laws: Newton's Laws of Motion and their Applications, Newton's Law of Gravitation, Gravitational Potential Energy, Escape Velocity, Satellite Orbits & Energy, Work done by Constant

and Variable Forces: Gravitational and Spring Forces, Power, Conservative and Non-Conservative Forces, Work and Potential Energy, Isolated Systems and Conservation of Mechanical Energy.

Work and Kinetic Energy: Work done by Constant and Variable Forces, Work Done by External Forces including Friction, and Conservation of Energy.

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

Rotational Motion: Rotation about a fixed Axis, Angular Position, Angular Displacement, Angular Velocity and Angular Acceleration, Rotation under Constant Angular Acceleration, relationship between Linear and Angular Variables, Rotational Inertia, Parallel-axis Theorem, Torque and Newton's Law for Rotation, Work and Rotational Kinetic Energy, Power, Rolling Motion, Angular Momentum for a single Particle and a System of Particles, Conservation of Angular Momentum, Static Equilibrium involving Forces and Torques, Determination of moment of inertia of various shapes i.e. for disc, bar and solid sphere.

Angular Momentum: Angular Velocity, Conservation of angular momentum, effects of Torque and its relationship with angular momentum.

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

Special Theory of Relativity: Introduction to Special theory of relativity, Inertial and non-inertial frame, Postulates of Relativity.

Recommended Books

1. D. Halliday, R. Resnick and J. Walker, "Fundamentals of Physics", John Wiley & Sons, 9th ed. 2010.

2. R. A. Serway and J. W. Jewett, "Physics for Scientists and Engineers", Golden Sunburst Series, 9th ed. 2015.

3. R. A. Freedman, H. D. Young, and A. L. Ford (Sears and Zeemansky), "University Physics with Modern Physics", Addison-Wesley-Longman, 14th International ed. 2015

4. D. C. Giancoli, "Physics for Scientists and Engineers, with Modern Physics", Addison-Wesley, 4th ed. 2014.

ARA-1101   **ARABIC**   **Credit Hrs: 03**

الاول الدرس

* الفاظ عربی۔ال معانی اسمائے اشارات ان كا كا استعمال، یں مثال فعل اسم، ف ی حرف، كا فات، تعريـ ت
مثال یں

* كلمات، استفهام كـ نعم، كابل، استعمال و كلمـ ام

ی الثان الدرس

* الفاظ معانی ر ضمائ ی سامك راق ضمائ متصلہ ی جملوں عرب'مين استعمال، اشق م

الثالثا الدرس

* الفاظ معانی يس، لال يست، ل فی حروف ذ كی فات عري كلمـ و ت ام كر ب اضافی فـ، عريـ كلمـت ام
'، عربی جملے، رجمہ مشق ت

السادس الدرس

* واحد، جمع جمع ی سامك اق اور یں مثال واعدم قـ جمع مكسر اور یں، مثال مشق

السابع الدرس

* فعل ماضی، تعریف کلمات، کل فعل کی ماضی میں قواعد فعل و ماضی،مثل،امشق

الدرس الثامن

* فعل، فعل مضارع کلمات کل فعل، مضارع و امثلہ قواعد فعل، مضارع۔مکالمہ مشق

الدرس التاسع

* فعل مصنف و کلمات کل مصنف و امثلہ قواعد فعل فعل مصنف و۔یں مثال مشق

الدرس العاشر

* فعل، فعل صحیح، فعل معتل کلمات کل فعل، صحیح فعل، معتل۔یں مثال قواعد مشق

الدرس الحادی عشر

* مذکر مونث کلمات رکمذکر مونث،۔یں مثال اسماء، تہخمسہ الشق

الدرس الثانی عشر

* اعداد و امثلہ قواعد اعداد و عقود و امثلہ

الدرس الثالث ہعشر

* مہای اور کان ا ا کتعمال س ما ایک و امثلہ

الدرس الرابع ہعشر

* اسم فاعل، کلمات کے ،یں مثال جملے

الدرس الخامس ہعشر

* اعضاء الجسم، جملے یں مثال م

الدرس السادس ہعشر

* کلمات و امثلہ

الدرس السابع ہعشر

* اسم یہ جملہ و فعل یہ جملہ

الدرس الثامن ہعشر

* حروف، الہجاء حروف مَدہ حروف حلقی، حروف شمسیہ، قمریہ مخارج الحروف

الدرس التاسع ہعشر

* اشدید۔ذاتارہمخ دُعا، اجمل ما الضیاء، الممر تہضد

پاکستان اسلام آباد اسلام یونی یورسٹی اوپن اقبال علامہ بال العربیہ۔اللسان بُک ٹیکسٹ

Semester-II

Sr.No	Course Code	Course Title	Crd. Hrs		
			Theory	Lab.	Total
1	PHY-1218	Heat & Thermodynamics (E1)	3	0	3
2	COM-1205	Introduction to Computer (C4)	2	1	3
3	MAT-1215	Calculus-II (Ma2, F2)	3	0	3
4	PHY-1202	Electricity & Magnetism (P2, M2)	3	1	4
5	ENG-1207	Composition & Comprehension (C5)	3	0	3
		Total	14	2	16

PHY-1218   **HEAT AND THERMODYNAMICS**   **Credit Hrs: 03**

Objectives:
To understand the fundamentals of heat and thermodynamics.

Basic Concepts and Definitions in Thermodynamics: Thermodynamic system, Surrounding and Boundaries. Types of systems. Properties and state of the substance: Equilibrium, Mechanical and Thermal Equilibrium. Processes and Cycles: Isothermal, Isobaric and Isochoric. Zeroth Law of Thermodynamics and its Consequences. The state of the system at Equilibrium.

Heat and Temperature: Temperature, Kinetic theory of ideal gas, Work done on an ideal gas, Review of previous concepts. Internal energy of an ideal gas: Equipartition of Energy, Intermolecular forces, Qualitative discussion, The Virial expansion, The Van der Waals equation of state.

Thermodynamics: First law of thermodynamics and its applications to adiabatic, isothermal, cyclic and free expansion, Reversible and irreversible processes, Second law of thermodynamics, Carnot theorem and Carnot engine, Heat engine, Refrigerators, Calculation of efficiency of heat engines, Thermodynamic temperature scale: Absolute zero, Entropy, Entropy in reversible process, Entropy in irreversible process, Entropy and Second law of thermodynamics, Entropy and Probability, Thermodynamic Functions: Internal energy, Enthalpy, Gibb's functions, Entropy, Helmholtz functions, Maxwell's relations, TdS equations, Energy equations and their applications, Low Temperature Physics, Joule-Thomson effect and its equations, Thermoelectricity: Thermocouple, Seabeck effect, Peltier effect, Thomson effect, Introduction to statistical mechanics, Maxwell distribution.

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

COM-1205   **INTRODUCTION TO COMPUTING**   **Credit Hrs: 03**

Brief history of computers and their applications, Major, components of a computer (CPU and Memory, Data storage devices, Input/Output devices), Software (Standards, Application software, System software, Standard options, Windows, Linux and Macintosh) Computers Networks, Telecommunication basics, The Internet and the World Wide Web, Web Pages, Intro to Information Systems in Business, Office automation tools, Word processing, Graphic packages, Databases and Spreadsheets, Current trends in research and future prospects, Legal and moral aspects of Computer Science, Presentation Software etc.

RECOMMENDED BOOKS

1. Meta, Toledo, Roman, Schaum's Outline of Introduction to Computer Science, McGraw Hill, Book Company, 2000

2. Kelly, Julia, Nelson, Stephan L., Office XP The Complete Reference, McGraw Hill Book Company, 2001.

3. Joseph, Rubin, Excel 2007, CPA Company, 2007

4. Michael, Halvorson, Microsoft XP 2000, Microsoft Press Washington, 2007.

MAT-1215   CALCULUS-II   Credit Hrs: 03

Sequences, Monotone sequences, convergence of sequence, infinite series, partial sum, convergence test Alternating sequence, conditional convergence, Power series Taylor's and Maclaurin's series, differential and integration of series. Arc length in polar, Cartesian, parametric curves, surface area, area in polar and Cartesian form of curves. Area of revolution in polar and Cartesian forms. Conversion of systems, Unit tangent and normal Vectors, Curvature and radius of Curvature, Motion along a curve. Function of several variables, homogeneous function Euler theorem, Partial derivatives, Laplace equation. Differentiability and chain rules, Tangent planes, total differential, Directional Derivatives Gradient of two functions Function of n- Variables maxima and minima of two functions Lagrange Multipliers Double integral, triple integrals Centroid, center of Gravity, Total mass. Triple integrals, Jacobians, triple integrals in cylindrical and Spherical coordinates. Introduction to conic section, rotation of axes, Parabola, Ellipse, Hyperbola, Sketching of conics Volumes of Surfaces, complex numbers: DeMoivre's theorem and its applications, Complex functions, analytical functions, harmonic and conjugate, harmonic functions, Cauchy- Rehmunn equations (in Cartesian and polar coordinates). Line integrals, Green's theorem, Cauchy' theorem, Chauchy's integral formula, singularities, poles, residues and contour integration and applications.

RECOMENDED BOOKS
1. Calculus & Analytical Geometry, by Thomas & Finny, 10th Edition
2. Calculus & Analytical Geometry, by Howard Anton, 7th Ed
3. Calculus & Analytical Geometry, by S.M. Yousaf
4. Calculus & Analytical Geometry, by Skowsky, 6th Edition.

PHY-1202   ELECTRICITY AND MAGNETISM   Credit Hrs: 04
Objectives:
The main objective of this course is to understand the Physics of Electromagnetism and to develop simple mathematical formalisms to analyze the electromagnetic fields and interactions. This is a calculus-based introductory course with maximum emphasis on applying the acquired knowledge for solving problems.

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

Electric Potential: Equipotential Surfaces, Potential due to a Point Charge and a Group of Point Charges, Potential due to an Electric Dipole, Potential due to a Charge Distribution, Relation between Electric Field and Electric Potential Energy, Dielectrics and Gauss' Law (1 week).

DC Circuits: Electric Current and Current Density, Resistance and Resistivity, Ohm's Law, Power in Electric Circuits, Semiconductors and Superconductors, Work, Energy, and EMF,

Magnetic Field and Magnetic Force: Magnetic Force on a Current Carrying Wire, Torque on a Current Loop, Magnetic Dipole Moment, Magnetic Field Due to a Current, Force between two Parallel Currents, Ampere's Law, Biot- Savart Law, Magnetic Field due to a Current, Long Straight Wire carrying Current, Solenoids and Toroids, A current-carrying Coil as a Magnetic Dipole, Inductance, Faraday's Law of Induction, Lenz's Law, Induction and Energy Transfers, Induced Electric Fields, Inductors and Inductances, Self-Inductance, RL Circuits, Energy Stored in a Magnetic Field, Energy Density, Mutual Induction.

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

Recommended Textbooks

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

Semester-III

Sr. No	Course Code	Course Title	Crd. Hrs		
			Theory	Lab.	Total
1	PS-2317	Pakistan Studies (C6)	2	0	2
2	MAT-2301	Mechanics-I (Ma3. M3)	3	0	3
3	PHY-2303	Waves and Oscillation (P3,M4)	3	1	4
4	MAT-2315	Linear Algebra (Ma4, M5)	3	0	3
5	ENG-2307	Communication Skills (C7)	3	0	3
6	STA-2320	Statistics (E2)	3	0	3
		Total	17	1	18

PS-2317   **PAKISTAN STUDIES**   **Credit Hrs: 02**

An overview of the British Rule in the sub-continent, two nation theory & role of Sir Sayyed for the revival of Muslims, major political organization (congress muslim league), Constitutional reforms, Constitutional & political struggle (separate electrolate, Lucknow Pact), Tehrik –e-Khilafat, Nehru Report, Jinnah's 14 point, e-Allah Abad Address 1930, Round table conferences, Election of 1937 and Congress Minstries, Pakistan Moment (194047), Crips proposal 1942, Wavell plane and shimla conference 1945, Election of 1945-46, Cabinet mission plan 1946, 3rd June plane and Red cliff award, Pakistan's Immediate Problems: Administrative problems, problems of Refuges, Problems of Accession of states(Kashmir, Hyderabad, June Garh), Distribution of Assets, Canal Water dispute, political and constitutional Development, Hurdles of Constitution Making, 1956 constitution, Islamic clauses) 1962 constitution (Islamic clauses) and Ayub Era, Yahya Regime and first General election 1970, Bhutto in power 1973 constitution (Islamic clauses), Zia government steps for Islamization, Era of Democracy (1988-1999), Pakistan's foreign policy: Relations with USA, Soviet union, Relations with neighboring countries (India, china, Iran, Afghanistan), Relations with Saudi Arabia and Turkey, Pakistan and International Organizations (UNO, OIC, ECO,SAARC), M.D. Zafar, Pakistan studies, Aziz Book Depot Urdu Bazzar Lahore.

RECOMMENDED BOOKS
1. Sheikh Muhammad Rafique, Pakistan studies, urdu Bazar Lahore 2. Sheikh Muhammad Rafique, History of Pakistan, urdu Bazar Lahore.

Course Code: MAT-2301   **Title:** Mechanics-I   **Credit Hrs:** 03

Course Outline:
Forces: Fundamental concepts and principles, Newtonian Mechanics, Inertial-non-inertial frames, Resultant of several concurrent forces, The parallelogram law of forces, Resolution of a forces, triangle of forces, Lamy's theorem, polygon of forces, Conditions of equilibrium for a particle, External and internal forces, principle of transmissibility, Resultant of like and unlike parallel forces, Moment of forces about a point, Varigon's theorem, Moment of a couple, equivalent couples, composition of couples, Reduction of coplanar forces to a force or a couple

Friction: Dry friction and fluid friction, Laws of dry friction, coefficients of friction, angle of friction, Equilibrium of a particle on a rough inclined plane, Particle on a rough inclined plane acted on by an external force, Conditions for sliding or titling

Virtual Work: Principle of virtual work, Problems involving tensions and thrust.

Text and Reference Books:

1. *A. Bedford and W. Fowler, Dynamics Engineering Mechanics, Addision-Wesley, Reading, USA.*
2. *T. L. Chow, Classical Mechanics, John Wiley and Sons, New York, 1995.*
3. *H. Goldstein, Classical Mechanics, 2nd Edition, Addison Wesley, Reading, Ma, USA, 1980.*
4. *J. B. Marion, Classical Dynamics of Particles and Fields, 2nd Edition, Academic Press, New York, 1970.*
5. *J. R. Taylor, Classical Mechanics, University Science Books, 2005.*

PHY-2303   **Waves and Oscillations**   **Credit Hrs: 03**

Objectives:
Objective(s): To develop a unified mathematical theory of oscillations and waves in physical systems.

Simple and Damped Simple Harmonic Oscillation: Mass-Spring System, Simple Harmonic Oscillator Equation, Complex Number Notation, LC Circuit, Simple Pendulum, Quality Factor, LCR Circuit. Forced Damped Harmonic Oscillation: Steady-State Behavior, Driven LCR Circuit, Transient Oscillator Response, Resonance. Coupled Oscillations: Two Spring-Coupled Masses, Two Coupled LC Circuits, Three Spring Coupled Masses, Normal Modes, Atomic and Lattice Vibrations.
Transverse Waves: Transverse Standing Waves, Normal Modes, General Time Evolution of a Uniform String, Phase velocity, Group Velocity.
Longitudinal Waves: Spring Coupled Masses, Sound Waves in an Elastic Solid, Sound Waves in an Ideal Gas.
Traveling Waves: Standing Waves in a Finite Continuous Medium, Traveling Waves in an Infinite Continuous Medium, Energy Conservation, Transmission Lines, Reflection and Transmission at Boundaries, Electromagnetic Waves.
Wave Pulses: Fourier series and Fourier Transforms, Bandwidth, Heisenberg's Uncertainty Principle.
Multi-Dimensional Waves: Plane Waves, Three-Dimensional Wave Equation, Laws of Geometric Optics, Waveguides, Cylindrical Waves.
Interference and Diffraction of Waves: Double-Slit Interference, Single-Slit Diffraction.

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

MAT-2315   **LINEAR ALGEBRA**   **Credit Hrs: 03**

System of Linear Equations: Basic concepts. Standard matrix form, Inverse of matrix, Matrix operations, Elementary row and column operation Echelon & Reduce Echelon form System of homogeneous & non- homogeneous linear equations (Gauss Elimination and Gauss- Jordan). Application of linear equations, Linear Dependence & Independence sets of vectors, Linear Transformations. Vector spaces: Definitions, Properties of vector spaces, vector spaces and subspaces, Basic, Dimensions of vector space, Eigen vector & Eigen value, Characteristic Equations, Eigen vectors and Linear Transformations, Inner Product, Length and Orthogonality sets, Gram Schmidt process, Inner Product Spaces.

RECOMMENDED BOOKS
1. Linear algebra and its application (3rd edition) by David C. Lay.
2. Advance Engineering Mathematics by Ervin KAREYZIG, 9th Edition.
3. Elementary Linear Algebra (8th edition) by ANTON.

ENG-2307   ENGLISH-III (Communication Skills)   Credit Hrs: 03

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

RECOMMENDED BOOKS
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.

2. 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).

3. 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).

4. Reading. Advanced. Brian Tomlinson and Rod Ellis. Oxford Supplementary Skills.

Third Impression 1991. ISBN 0 19 453403 0. 5. Reading and Study Skills by John Langan
6. Study Skills by Riachard Yorky.

STA-2320   PROBABILITY AND STATISTICS   Credit Hrs: 03

Objective:
This course is to introduce the notions of probability and statistics to enable students to apply in the deferent fields of actions in physics. The concepts of data preparation and analysis is the key feature of this course.

What is Statistics? Definition of Statistics, Population, sample Descriptive and inferential Statistics, Role of statistics in physics, 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. 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, Histogram, Ogive for Discrete Variable. Types of frequency curves.
Exercises. Measures of Central Tendency: Introduction, Deferent types of Averages, Quintiles, 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. 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. 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. Probability

and Random Variable.: Introduction to probability, sample Space, Events, Lows of probability with their applications, Conditional probability, dependent and independent events, Bays theorem and its applications. Random variable discrete and continuous random variable with their application. Mathematical Expectation, Mean, Variance etc. Statistical Packages and data analysis. SPSS software, Data analysis on excel and E Views etc.

Recommended Books:

1. R.E. Walpole, Introduction to Statistics. Macmillan Publishing Co., Inc. New York, 3rd Ed, 1982.
2. F. Muhammad, Statistical Methods and Data Analysis, Kitab Markaz, Bhawana Bazar Faisalabad, 2005.
3. B L Agarwal, Basic Statistics? New Age International, 2006. 4. Carver, Nash, Doing Data Analysis with SPSS version 14.

Semester-IV

Sr. No	Course Code	Course Title	Crd. Hrs		
			Theory	Lab.	Total
1	MAT-2402	Mechanics-II (Ma5, M6)	3	0	3
2	MAT-2403	Ordinary Differential Equations (Ma6, M7)	3	0	3
3	PHY-2404	Modern Physics (P4, M8)	3	1	4
4	MAT-2404	Matric Space and Number Theory (Ma7, M9)	2+2	0	4
5	*SUB-2499 MAS-2415 COM-2405	Project Or Mathematical Statistics Or Programming Fundamental	4 or	4	4
		Total	17	1	18

*SUB (MAT or PHY)

Course Code: MAT-2402   **Title:** Mechanics-II   **Credit Hrs:** 03

Course Outline:

Kinematics: Rectilinear motion of particles. Uniform rectilinear motion, uniformly accelerated rectilinear motion. Curvilinear motion of particle, rectangular components of velocity and acceleration. Tangential and normal components. Radial and transverse components. Projectile motion. **Kinetics:** Work, power, kinetic energy, Conversation Laws (conservative force fields. Conservation of energy Conservation of linear and angular momentum), impulse, torque. Non-conservative forces. **Simple Harmonic Motion:** The simple harmonic oscillator, period, frequency. Resonance and energy. The damped harmonic oscillator, over damped, critically damped and under damped. Motion, forces and vibrations. **Central Forces and Planetary Motion:** Central force fields, Properties of Central Force Field, Equations of motion, potential energy, orbits. Kepler's law of planetary motion. Apsides and apsidal angles for nearly circular orbits. Motion in an inverse square field.

Planer Motion of Rigid Bodies: Introduction to rigid and elastic bodies, degree of freedom, translations, rotations, instantaneous axis and center of rotation, Rotation of a rigid body about a fixed axis, moments and products of inertia. Parallel and perpendicular axis theorem.

Text and Reference Books

1.   *A. Bedford and W. Fowler, Dynamics Engineering Mechanics, Addision-Wesley, Reading, USA.*
2.   *T. L. Chow, Classical Mechanics, John Wiley and Sons, New York, 1995.*
3.   *H. Goldstein, Classical Mechanics, 2nd Edition, Addison Wesley, Reading, Ma, USA, 1980.*
4.   *J. B. Marion, Classical Dynamics of Particles and Fields, 2nd Edition, Academic Press, New York, 1970.*
5.   *J. R. Taylor, Classical Mechanics, Null Edition, University Science Books, 2005.*

MAT-2403   DIFFERENTIAL EQUATIONS   Credit Hrs: 03

Introduction to ODEs (physical motivation), First order ODEs (separate variables, homogeneous equations, exact equations, linear equations, Bernoulli equation and other examples), applications of first order ODEs linear and non-linear, linear differential equations of higher order (initial value and boundary value problems, linear dependence and independence, solutions of linear equations, constructing a second solution from a known solution, homogeneous linear equations with constant coefficients, undetermined coefficients, variation of parameters), applications of second order ODEs (simple harmonic equation, damped and forced oscillators, electrical circuits and springs), differential equations with variable coefficients (Cauchy-Euler equation, power series solution of differential equation- solutions about ordinary and singular points-Legendre's and Bessel's equations as examples), Laplace transform (Laplace transform and its inverse properties, use in solving differential equations, Dirac function).

RECOMENDED BOOKS
1. D. G. Zill and M. R. Cullen, Differential equations with boundary value problems, 3rd Ed., National Book Foundation.
2. E. Kreyszig, Advanced engineering mathematics, Jhon Wiley, 8th

3. K. F. Riley, M. P. Hobson and S. J. Bence, Mathematical Methods for Physicists, Cambridge University Press 2006.

PHY-2407   **MODERN PHYSICS**   **Credit Hrs: 03**

Objectives:
To understand the non-classical aspects of Physics, the emphasis is on the applications of Quantum Physics on microscopic-scale Physics, atomic and molecular structure and processes.

Motivation for Non-Classical Physics: Quantum interference, blackbody radiation and ultraviolet catastrophe, Planck's quantization.
Waves-Particle Duality: Photoelectric effect, Compton effect, production and properties of X-rays, diffraction of X-rays, concept of matter waves, de Broglie relationship, electrons are waves, electron diffraction, particulate nature of matter, contributions of Faraday (atoms exist), Thomson (electron exists), Rutherford (nucleus exists) and Bohr (quantization of energies inside an atom), wave packets and wave groups, dispersion, Heisenberg uncertainty principle, direct confirmation of quantization through Franck-Hertz experiment and spectroscopy, working of electron microscopes.
Quantum Mechanics in One Dimension: The concept of a wave function, time independent Schrodinger equation and interpretation of the equation, solving the Schrodinger equation for a free particle, for a particle inside an infinite box, relationship between confinement and quantization, Concept of tunneling, reflection and transmission of wave functions from barriers
Quantum Mechanical in Three Dimensions: Angular momentum and its quantization, orbital magnetism, Zeeman Effect, concept of spin, Pauli's exclusion principle, Introduction to semiconductors, LED's and Lasers.
Nuclear Structure: Size and structure of nucleus, nuclear forces, radioactivity and nuclear reactions, radiocarbon dating. Introduction to theory of relativity.
Recommended Books:
1. R.A. Serway, C.J. Moses and C.A. Moyer, "Modern Physics", Brooks Cole, 3rd ed. 2004.
2. Paul A. Tipler and Ralph A. Llewellyn, "Modern Physics", W H Freeman and Company 6th ed. 2012.
3. Arthur Beiser, "Concepts of Modern Physics", McGraw-Hill, 6th ed. 2002.
4. R. M. Eisberg and R. Resnick, "Quantum Physics of Atoms, molecules, Solids, Nuclei and Particles", John Wiley, 2nd ed. 2002.

Course Code: MAT-2404   Title: Metric Space and Number Theory   Credit Hrs: 2+2

Course Outline Metric Space: Preliminary Concepts, Definition and Examples of Metric Spaces, Open and Closed Spheres and Sets, Convergent Sequences, Cauchy Sequences, Cantor's Intersection Theorem, Complete Metric Spaces, Dense and Nowhere Dense Subsets, Continuous and Uniform Continuous Functions and Their Properties,
Course Outline Number Theory: Divisibility, Euclidean Algorithm, GCD and LCM of two Integers, Properties of Prime Numbers, Fundamental Theorem of Arithmetic (UFT), Congruence Relation, Residue System, Euler's Phi-Function, Solution of System of Linear Congruence, Congruences of Higher Degree, Chinese Remainder Theorem, Fermat's Little Theorem, Wilson's

Theorem and Applications, Primitive Roots and Indices, Integers Belonging to a Given Exponent (mod p), Primitive Roots of Prime and Composite Moduli, Indices

Text and Reference Books

1. C. W. Patty, *Foundation of Topology*, 2nd Edition, The Jones and Bartlett Publishers, 2009.
2. J. Dugundji, *Topology,* W.M. C. Brown Publisher, 1990.
3. E. Kreyszig, *Introductory Fundamental Analysis with Applications,* John Wiley and Sons, 1978.
4. M. O. Searcoid, *Metric Spaces*, 2007 Edition, Springer, 2006.
5. P. K. Jain, *Metric Spaces,* 2nd Edition, Alpha Science Intl Ltd, 2004.
6. *G. A. Jones and J. M. Jones, Elementary Number Theory, Springer-Varlog, London Limited, 1998.*
7. *M. B. Nathanson, Methods in Number Theory, Springer-Verlag, New York, 2000.*
8. *A.N. Parshin and I.R. Shafarevich, Number Theory-I, Fundamental Problems, Ideas and Theories, Springer-Veriag, Berlin Heidelberg, 1995.*
9. *K. H. E. Rosen, Elementary Number theory and its Applications, 4th Edition, Addison Wesley, Reading, Ma, USA, 2000.*
10. *T. Andreesco and D. Andrica, Number theory, 2009 Edition, Birkhauser, 2009.*

Course Code: MAS-2415   **Title: Mathematical Statistics**   **Credit Hrs: 03**

Course Outline: The postulates of probability, Some elementary theorems, Addition and multiplication rules, Baye's rule and future Baye's theorem, Random variables and probability functions, Uniform, Bernoulli and Binomial distribution, Hypergeometric and geometric distribution, Negative binomial and Poisson distribution, Uniform and exponential distribution, Gamma and beta distributions, Normal distribution, Moments and moment generating functions Moments of binomial, hypergeometric, Poisson, gamma, beta and normal distributions

Text and Reference Books

1. M. H. De-Groot and M. J. Schervish, *Probability and Statistics,* 3rd Edition, Addison Wesley, 2002.
2. A. Papoulis, *Probability, Random Variables, and Stochastic Processes,* 3rd Edition, Mc-Graw Hill, 1991.
3. T. Sincich, *Statistics by Examples,* Dellen Publishing Company, 1990.
4. A. S. Hirahi. *A Course in Mathematical Statistics,* 4th Edition, Ilmi Kitab Khana, Lahore, Pakistan, 2012.
5. S. M. Chaudhry and S. Kamal, *Introduction to Statistical Theory Part-II,* Ilmi Kitab Khana, Lahore, Pakistan, 2012.

COM-2405   PROGRAMMING FUNDAMENTALS   Credit Hrs: 03

Computer programming, principles of structured and modular programming, overview of structured programming languages, algorithms and problem solving, program development, analyzing problem, designing algorithm/solution, testing designed solution, translating algorithms into programs, fundamental programming constructs, data types, basics of input and output, selection and decision (If, If-rlse, Nested If-else, Switch statement, and Condition operator), repetition (While and For Loop, Do-while Loops), break statement, continue statement, control structures, functions, arrays, pointers, records, files, (Input/Output), testing and debugging.

RECOMMENDED BOOKS
1. C how to program, Paul Deitel and Harvey Deitel, Prentice Hall; 7th Ed. (2012) 2. Programming in C, Stephen G. Kochan, Addison-Welley Professional; 4th Ed. (2013)
3. Java how to program, Paul Deitel and Harvey Deitel, Prentice Hall; 9th Ed. (2011) 4. C++ how to program, Paul Deitel and Harvey Deitel, Prentice Hall; 9th Ed. (2013).

ENG-2301   ENGLISH-II   Credit Hrs. 03
Objectives: To enable the students to write a research paper / technical report in a succinct manner according to a specified format.

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, Note: Extensive reading is required for vocabulary building

Recommended Books:

1. R. White, Writing. Advanced, Oxford Supplementary Skills. Third Impression 1992. (Particularly suitable for discursive, descriptive, argumentative and report writing).

2. J. Langan. College Writing Skills, McGraw-Hill Higher Education. 2004.

3. L. G. Kirszner and S. R. Mandell. Patterns of College Writing, 4th edition St. Martin's Press.

4. The Mercury Reader. A Custom Publication. Compiled by northern Illinois University. General Editors: Janice Neulib; Kathleen Shine Cain; Stephen Ru↵us and Maurice Scharton.