BS Physics Program Scheme of Studies (2019-2023)

Codes	Course Title	Credit Hour
Semester 1		
PHY-301	Mechanics-I	3 (3 – 0)
PHY-303	Waves and Oscillations	3 (3 – 0)
MTH-323	Calculus and Analytical Geometry	3 (3 – 0)
CSI-321	Introduction to Computing Applications	3 (3 – 0)
ISL-321	**Islamic Studies**	**2 (2 – 0)**
ISL-322	**Ethics (For Non-Muslims only)**	**2 (2 – 0)**
ENG-321	Functional English	3 (3 – 0)
MTH-111	Basic Mathematics – I (Deficiency Course for F.Sc Pre-Medical)	3 (3 – 0)
	Total	**17/20**
Semester 2		
PHY-302	Mechanics-II	3 (3 – 0)
PHY-304	Heat and Thermodynamics	3 (3 – 0)
PHY-306	Introduction to Programming for Physicists	3 (3 – 0)
MTH-324	Multivariable and Integral Calculus	3 (3 – 0)
PST-321	Pakistan Studies	2 (2 – 0)
ENG-322	English Comprehension and Composition	3 (3 – 0)
MTH-112	Basic Mathematics – II (Deficiency Course for F.Sc Pre-Medical)	3 (3 – 0)
	Total	**17/20**
Semester 3		
PHY-401	Electricity and Magnetism-I	3 (3 – 0)
PHY-403	Modern Physics-I	3 (3 – 0)
MTH-405	Differential Equations-I	3 (3 – 0)
MTH-429	Introduction to Metric and Topological Spaces	3 (3 – 0)

ENG-421	Communication Skills	3 (3 – 0)
PHY-407	**Mechanics, Heat & Vibrations Lab Course**	**3 (0 – 3)**
	Total	**18**
Semester 4		
PHY-402	Electricity and Magnetism-II	3 (3 – 0)
PHY-404	Modern Physics-II	3 (3 – 0)
MTH-406	Differential Equations-II	3 (3 – 0)
PHY-408	**Optics and Modern Physics Lab Course**	**3 (0 – 3)**
MTH-424	Linear Algebra	3 (3 – 0)
CHM-321	**Introductory Chemistry**	**4 (3 – 1)**
	Total	**19**
Semester 5		
PHY-501	Methods of Mathematical Physics-I	3 (3 – 0)
PHY-503	Classical Mechanics	3 (3 – 0)
PHY-505	Electrodynamics-I	3 (3 – 0)
PHY-507	Electronics-I	3 (3 – 0)
PHY-509	Relativity and Cosmology	3 (3 – 0)
PHY-511	**Electromagnetism Lab Course**	**3 (0 – 3)**
	Total	**18**
Semester 6		
PHY-502	Methods of Mathematical Physics-II	3 (3 – 0)
PHY-504	Quantum Mechanics-I	3 (3 – 0)
PHY-506	Nuclear Physics-I	3 (3 – 0)
PHY-508	Electrodynamics-II	3 (3 – 0)
PHY-510	Electronics-II	3 (3 – 0)
PHY-512	**Atomic and Nuclear Physics Lab Course**	**3 (0 – 3)**
	Total	**18**

Semester 7		
PHY-601	Quantum Mechanics-II	3 (3 – 0)
PHY-603	Nuclear Physics-II	3 (3 – 0)
PHY-605	**Statistical Mechanics**	**3 (3 – 0)**
PHY-607	Solid State Physics-I	3 (3 – 0)
PHY-609	Particle Physics-I*	3 (3 – 0)
PHY-611	Advanced Electronics*	3 (3 – 0)
PHY-613	Environmental Physics-I*	3 (3 – 0)
PHY-615	Health and Medical Physics-I*	3 (3 – 0)
PHY-617	Climatology and Meteorology-I*	3 (3 – 0)
PHY-619	**Computational Materials Physics***	**3 (3 – 0)**
PHY-621	**Electronics Lab Course**	**3 (0 – 3)**
	Total	**18/15****
Semester 8		
PHY-602	Plasma Physics	3 (3 – 0)
PHY-604	Computational Physics	3 (3 – 0)
PHY-606	Solid State Physics-II	3 (3 – 0)
PHY-608	Laser and Optics	3 (3 – 0)
PHY-610	Particle Physics-II*	3 (3 – 0)
PHY-612	Advanced Electronics Lab Course*	3 (0 – 3)
PHY-614	Environmental Physics Lab Course*	3 (0 – 3)
PHY-616	Health and Medical Physics -II*	3 (3 – 0)
PHY-618	Climatology and Meteorology-II*	3 (3 – 0)
PHY-620	**Computational Materials Physics Lab Course***	**3 (0 – 3)**
PHY-629	**Seminar (Research)**	**1 (0 – 1)**
PHY-630	Thesis**	6 (0 - 6)

PHY-631	Project***	3 (0 –3)
	Total	**16/19****

Note: * One optional subject to be chosen in 7th and 8th semester.

** Thesis will be allotted in the 7th semester. However, the credit hours for thesis will only count towards the 8th semesters.

*** Projects may be opted in lieu of option-II of the subject already taken by the student in 7th semester.

+ Internship may be offered to students during summer vacations as optional activity.

BS Physics Program Scheme of Studies (2019-2023)

1st Semester

PHY-301	Mechanics-I	3 (3 – 0)

Vectors in 3-dimensions & fundamental operations, Stoke's theorem, Gauss's Divergence theorem, Dynamics of Uniform circular motion, The Conical pendulum, The Rotor, The Banked curve, Equations of motion, Time-dependent forces, Velocity-dependent forces, Non-Inertial frames & Pseudo forces, projectile motion, Work done by constant & variable forces (one, & two dimension cases), K.E & the work-energy theorem, general proof of work-energy theorem, power, conservative forces, P.E, one-dimensional conservative system, Two & many particle system, calculation of c.m. of different objects, Linear momentum of Particle & system of particles, conservation of linear momentum, system of variable mass, Rocket equation, collision, impulse and momentum, Elastic and inelastic collisions in one dimension & two dimensions, centre of mass reference frame.

Recommended Books:

1. Halliday, Resnick and Walker, 2011. Fundamental of Physics 9th Ed. John Wiley and Sons Inc, New York.
2. Resnick, Halliday and Krane, 2002. Physics Vol. I, 5th Ed. John Wiley and Sons Inc, New York.
3. Sears, Zemansky and Young, 2000. University Physics 8th Ed. Addison-Wesley, Reading (MA), USA.
4. Alonso and Finn, 1999. Physics. Addison-Wesley, Reading (M.A), USA

PHY-303	Waves and Oscillations	3 (3 – 0)

S.H.M & its applications, Energy consideration in SHM, SHM & uniform circular motion, combinations of Harmonic motion, Damped harmonic motion, Forced Oscillation & Resonance, Mechanical Waves, Traveling waves, wave speed , wave equation, Power & intensity in wave motion, principle of superposition, standing waves, Interference of waves, Beats, Doppler effect, visible light , speed of light in matter, double slit interference, intensity in Double slit interference, adding waves using phasors, interference from thin film, Single slit diffraction, Intensity in single slit diffraction using phasors, diffraction at circular aperture, diffraction grating, x-ray Diffraction, Polarization by Reflection, & Double Refraction, Polarization states, Rotation of Plane Polarization.

Recommended Books:

1. Halliday, Resnick and Walker, 2011. Fundamental of Physics 9th Ed. John Wiley and Sons Inc, New York.
2. Resnick, Halliday and Krane, 2002. Physics Vol. I, 5th Ed. John Wiley and Sons Inc, New York.
3. Sears, Zemansky and Young, 2000. University Physics 8th Ed. Addison-Wesley, Reading (MA), USA.
4. Alonso and Finn, 1999. Physics. Addison-Wesley, Reading (M.A), USA

MTH-323	Calculus and Analytical Geometry	3 (3 – 0)

Course Outline:
Complex Numbers, DeMoivre's Theorem and its Applications, Simple Cartesian Curves, Functions and Graphs, Symmetrical Properties, Curve Tracing, Limit and Continuity, Differentiation of Functions. Derivative as Slope of Tangent to a Curve and as Rate of Change, Application to Tangent and Normal, Linearization, Maxima/Minima and Point of Inflexion, Taylor and Maclaurin Expansions and their convergence; Integral as Anti-derivative, Indefinite Integration of Simple Functions. Methods of Integration: Integration by Substitution, by Parts, and by Partial Fractions, Definite Integral as Limit of a Sum, Application to Area, Arc Length, Volume and Surface of Revolution.

Reference Materials:

1. Calculus and Analytical Geometry, Swokowski Olinick. Pence. 1994. 6th edition.
Brooks/Cole Publishers. 2. Calculus, 7th edition.2002.
2. John Wiley and Sons (WIE).

3. 3. Calculus, William, E. Boyce .Richard, C. Diprima. John Wiley & Sons, ISBN: 0471093335.
4. Calculus and Analytical Geometry10thedition. Thomas, F. John Wiley and Sons.
5. Advanced Engineering Mathematics, 7th edition. Erwin, K. 1993. John Wiley & Sons Inc.

CSI-321	Introduction to Computing Applications	3 (2 – 1)

Number Systems, Binary numbers, Boolean logic, History computer system, basic machine organization, Von Neumann Architecture, Algorithm definition, design, and implementation, Programming paradigms and languages, Graphical programming, Overview of Software Engineering and Information Communication Technology, Operating system, Compiler, DBMS, Computer networks and internet, WWW, web mail applications, Computer graphics, AI, Viruses and Anti-Viruses, Use of office productivity tools, such as word processors, spreadsheets, presentation applications, etc., Social, Ethical, Professional and Legal Issues, and overview of the complete program of studies in computing and its structure.

Suggested Text Book:

Introduction to Computers by Peter Norton, 6th Edition, McGraw-Hill SiE, ISBN 0-07-059374-4.

Reference Material:

1. Computers: Information Technology in Perspective, 9/e by Larry Long and Nancy Long, Prentice Hall, 2002/ISBN: 0130929891.
2. An Invitation to Computer Science, Schneider and Gersting, Brooks/Cole Thomson Learning, 2000.
3. Information System Today by Leonard Jessup, Joseph Valacich.
4. Computers Today by Suresh K. Basandra.

Computer Science: An overview of Computer Science, Sherer

ISL-321	**Islamic Studies**	**2 (2 – 0)**

Course Contents are attached at the end of scheme of studies

ISL-322	**Ethics (For Non-Muslims only)**	**2 (2 – 0)**

Course Contents are attached at the end of scheme of studies

ENG-321	Functional English	3 (3 – 0)

- Introducing ourselves
- Describing things
- Getting and giving information
- Recounting past events
- Talking about facts and opinions
- Agreeing and disagreeing
- Compare and Contrast
- Cause and effect
- Using your imagination
- Reporting
- Writing Essays
- Presentation skills
- Assessment

MTH-111	Basic Mathematics – I (Deficiency Course for F.Sc Pre-Medical)	3 (3 – 0)

Preliminaries: Real and complex numbers, Introduction to sets, set operations, functions, types of functions. Matrices: Introduction to matrices, types of matrices, inverse of matrices,

determinants, system of linear equations, Cramer's rule. Quadratic equations: Solution of quadratic equations, nature of roots of quadratic equations, equations reducible to quadratic equations. Sequence and Series: Arithmetic, geometric and harmonic progressions. Permutation and combinations: Introduction to permutation and combinations, Binomial Theorem: Introduction to binomial theorem. Trigonometry: Fundamentals of trigonometry, trigonometric identities. Graphs: Graph of straight line, circle and trigonometric functions.

RECOMMENDED BOOKS

1. 1. Thomas, Calculus, 11th Edition. Addison Wesley publishing company, 2005.
2. H. Anton, I. Bevens, S. Davis, Calculus, 8th edition, Jhon Willey & Sons, Inc. 2005.
3.Hughes-Hallett, Gleason, McCallum, et al, Calculus Single and Multivariable, 3rd Edition. John Wiley & Sons, Inc. 2002.
4. Swokowski. E. W., 'Fundamentals of Algebra and Trigonometry', Latest Edition.
5. Kaufmann. J. E., 'College Algebra and Trigonometry', PWSKent Company, Boston, Latest Edition.

2nd Semester

PHY-302	Mechanics-II	3 (3 – 0)

Rotational dynamics, Relation between Linear & angular variables, K.E of Rotation & Rotational Inertia of Solid bodies, Torque acting on a particle, Parallel & Perpendicular axes theorem, combined Rotational & translational motion, rolling without slipping, Angular momentum of a Particle & system of Particles, Relation between torque & angular momentum. Conservation of angular momentum, spinning top, stability of spinning objects, Newton's law of universal gravitation, gravitational effects of spherical distribution of matter, gravitational P.E, Gravitational field & Potential, Motion of planets & satellites, Kepler's laws, Energy consideration in planetary & satellite motion, Bulk Properties of matter, Hook's Law , Types of elasticity, variation of pressure in earth's atmosphere, surface tension, general concepts of fluid flow, Bernoulli's equations, viscosity, Poiseuille's law.

Recommended Books:

1. Halliday, Resnick and Walker, 2011. Fundamental of Physics 9th Ed. John Wiley and Sons Inc, New York.
2. Resnick, Halliday and Krane, 2002. Physics Vol. I & II, 5th Ed. John Wiley and Sons Inc, New York.
3. Sears, Zemansky and Young, 2000. University Physics 8th Ed. Addison-Wesley, Reading (MA), USA.
4. Alonso and Finn, 1999. Physics. Addison-Wesley, Reading (M.A), USA.

PHY-304	Heat and Thermodynamics	3 (3 – 0)

Macroscopic properties of a gas and the ideal gas law, The ideal gas model, Kinetic calculations of pressure, Kinetic interpretation of the temperature, Work done on an ideal gas, The internal energy of an ideal gas, intermolecular forces, Statistical distributions and the mean values, Mean free path, The distribution of molecular speeds, The distribution of energies, The internal energy of an ideal gas, Brownian motion, Heat, The mechanical equivalent of heat, Heat capacity and specific heat, Heat of transformation, Heat capacities of solids, Heat capacities of an ideal gas, The first law of thermodynamics, Applications of the first law, The transfer of heat, Reversible and irreversible process, Heat engines and the second law, Refrigerators and the second law, The Carnot cycle, Carnot's theorem and the second law, The thermodynamic temperature scale, Entropy: Reversible process, Entropy : Irreversible Process, Entropy and the second law, Zeroth law, , Maxwell's thermodynamics relations, TDS equations, Clapeyron's equation, entropy and second law of thermodynamics, temperature scale, entropy, low temperature physics. Thermoelectricity, Seabeck effect, Peltier effect, thermocouple.

Recommended Books:

1. Halliday, Resnick and Walker, 2011. Fundamental of Physics 9th Ed. John Wiley and Sons Inc, New York.
2. Resnick, Halliday and Krane, 2002. Physics Vol. I & II, 5th Ed. John Wiley and Sons Inc, New York.
3. Sears, Zemansky and Young, 2000. University Physics 8th Ed. Addison-Wesley, Reading (MA), USA.
4. Alonso and Finn, 1999. Physics. Addison-Wesley, Reading (M.A), USA.

PHY-306	Introduction to Programming for Physicists	3 (3 – 0)

Introduction to programming, Significance of computers in the present physical sciences scenario, Software and hardware domains, Scientific computing, high and low level languages, flow charts, scientific programming languages, C/C++ and other scientific Programming language: memory management in C++, structure of C++ program, Generic form, Header files, Constants, Local variables, Input/output statements, Simple program, Variables, Data types, variables, Operators, Loops, Break, Continue, If and if-else statements, Conditional operator, Switch statement, Flags and conditional testing, One-dimensional arrays, Multi-dimensional arrays, String manipulation functions, Arrays as lists, Sorting, Searching, functions, built-in and user defined functions, file system, pointer, inheritance, polymorphism, C++ for scientific programming. Lab work.

Recommended Books:

1. Deitel H M and P J Deitel, 2012, *C++ How to Program, 8/e, Early Objects Version*, Prentice Hall
2. Robert Lafore , 2002, Object-oriented Programming in C++, Ed. 4th, SAMS publishers.
3. Robert L, TURBO C++, 1991, Waite Group.
4. Harrison S P and G Steele Jr. 1987, C: A Reference Manual, Prentice-Hall.
5. Peter Norton, Introduction to computers, 6th Ed., McGraw Hill International Edition.

MTH-324	Multivariable and Integral Calculus	3 (3 – 0)

Prerequisites: Calculus and Analytical Geometry Objectives: The goals are to develop the skills to have ground knowledge of multivariate calculus and appreciation for their further computer science courses. Course Outline: Functions of Several Variables and Partial Differentiation. Multiple Integrals, Line and Surface Integrals. Green's and Stoke's Theorem. Fourier Series: periodic functions, Functions of any period P-2L, Even & odd functions, Half Range expansions, Fourier Transform. Laplace Transform, Z-Transform

Reference Material:

1. James Stewart, Multivariable Calculus, 6th edition, 2007, Cengage Learning publishers.
2. Swokowski, Olinick and Pence, Calculus and Analytical Geometry, 6th edition, 1994, Thomson Learning EMEA, Ltd.
3. Bernard Kolman, William F. Trench, Elementary Multivariable Calculus, 1971, Academic Press.
4. Howard Anton, Albert Herr, Multivariable Calculus, 5th edition, 1995, John Wiley.

PST-321	Pakistan Studies	2 (2 – 0)

Historical Perspective, Ideological rationale with special reference to Sir Syed Ahmed Khan, Allama Muhammad Iqbal and Quaid-i-Azam Muhammad Ali Jinnah, Factors leading to Muslim separatism, People and Land, Indus Civilization, Muslim advent, Location and geo-physical features, Government and Politics in Pakistan, Political and constitutional phases, 1947-58, 1958-71, 1971-77, 1977-88, 1988-99, 1999 onward, Contemporary Pakistan, Economic institutions and issues, Society and social structure, Ethnicity, Foreign policy of Pakistan and challenges, Futuristic outlook of Pakistan.

Recommended Books

1. Akbar, S. Zaidi. 2000. *Issue in Pakistan's Economy.* Karachi: Oxford University Press
2. Afzal, M. Rafique. 1998.*Political Parties in Pakistan,* Vol. I, II & III. Islamabad: National Institute of Historical and cultural Research
3. Mehmood, Safdar. 1994. *Pakistan Political Roots & Development.* Lahore,
4. S.M. Burke and Lawrence Ziring.1993 Pakistan's Foreign policy: An Historical analysis. Karachi: Oxford University Press,.

5. Haq, Noor ul. *Making of Pakistan:* 1993. *The Military Perspective.* Islamabad: National Commission on Historical and Cultural Research,
6. Muhammad Waseem, 1987 Pakistan Under Martial Law, Lahore: Vanguard
7. Burki, Shahid Javed. 1980 *State & Society in Pakistan,* The Macmillan Press Ltd.
8. Ziring, Lawrence. 1980 *Enigma of Political Development.* Kent England: WmDawson & sons Ltd,.
9. Zahid, Ansar. 1980. *History & Culture of Sindh.* Karachi: Royal Book Company
10. Aziz, K.K. *Party,* 1976. *Politics in Pakistan,* Islamabad: National Commission on Historical and Cultural Research,
11. Wilcox, Wayne.*The Emergence of Banglades.,* Washington: American Enterprise, Institute of Public Policy Research, 1972.
12. Mehmood, Safdar. *Pakistan Kayyun Toota,* Lahore: Idara-e-Saqafat-e-Islamia, Club Road, nd.
13. Amin, Tahir. *Ethno - National Movement in Pakistan,* Islamabad: Institute of Policy Studies, Islamabad.
14. Sayeed, Khalid Bin. 1967. *The Political System of Pakistan.* Boston: Houghton Mifflin,

ENG-322	English Comprehension and Composition	3 (3 – 0)

Introductory lecture on English Composition + Comprehension, Discussion on managing your time, Time managing techniques, time saving tips, Essay Writing Topics, Analyzing your time, Becoming a more successful learner, Principles of learning + memory, Types of memory (long term memory + short term memory) Lecture/Discussion on Essay writing, topics three topics for essay composition, 4th topic of essay, techniques for effective reading, improving your ability to concentrate, Excluding distractions, focusing your attention, Essay writing topics, discussion on current situation (topics) 5th topic effective reading habits, developing physical reading skills, developing a positive approach to reading, revision of previous contents /syllabus, Pre reading, demonstration of pre reading, how to pre read articles and chapter, Limitation of pre reading, what does pre reading accomplish, Comprehension skills, understanding sentences, complete and incomplete sentences, Indentifying core parts in complicated sentences, Punctuation, An aid to sentence comprehension , Understanding paragraph, Three essential elements of paragraph, How to identify topic, how to find main idea, text book underlining and marking, How to underline textbooks, marking a text book, study reading for academic disciplines, distinction b/w reading and study, Developing A classic system SQ3R, Developing your own study system, Note- taking techniques, how to take lecture notes, how to edit your notes, participation in class discussion, preparing for exams, preparing written Assignments and Research papers, Vocabulary development, effective use of context, skimming & scanning techniques,

Recommended Books

1. College Reading + Study skills by Kathleen T.MC Whorter
2. High School English Grammar by WREN & Martin

MTH-112	Basic Mathematics – II (Deficiency Course for F.Sc Pre-Medical)	3 (3 – 0)

Preliminaries: Real Numbers and the Real Line, Functions and their graphs: Polynomial Functions, Rational Functions, Trigonometric Functions, and Transcendental Functions. Slope of a Line, Equation of a Line, Solution of equations involving absolute values, Inequalities. Limits and Continuity: Limit of a Function, Left Hand and Right Hand Limits, Continuity, Continuous Functions. Derivatives and its Applications: Differentiation of Polynomial, Rational and Transcendental Functions, Extreme Values of Functions. Integration and Indefinite Integrals: Integration by Substitution, Integration by Parts, Change of Variables in Indefinite Integrals. Least-Squares Line.

RECOMMENDED BOOKS

1. Thomas, Calculus, 11th Edition. Addison Wesley publishing company, 2005.

2. H. Anton, I. Bevens, S. Davis, Calculus, 8th edition, Jhon Willey & Sons, Inc. 2005.

3.Hughes-Hallett, Gleason, McCallum, et al, Calculus Single and Multivariable, 3rd Edition.

John Wiley & Sons, Inc. 2002.

4. Frank A.Jr, Elliott Mendelson, Calculus, Schaum's Outline Series, 4th edition, 1999.

5. E. W. Swokowski, Calculus and Analytic Geometry PWS Publishers, Boston, 1983.

6. John H. Mathews, Numerical Methods for Mathematics Science and Engineering,

Prentice-Hall, Second Edition 1992.

3rd Semester

PHY-401	Electricity and Magnetism-I	3 (3 – 0)

Electric charge, coulombs law, Electric field, continuous charge distributions, image charges, electric dipole, Gauss's Law and its applications, electric potential, electric properties of materials, capacitor, dielectric, capacitors in circuits, energy stored in capacitors, electric polarization, Gauss's Law for dielectrics, electric current, current density and Ohm's law, equation of continuity, DC circuits, analysis of circuits, electric fields in circuits, resistance in circuits, energy transfers in a circuit, RC circuits, magnetism, magnetic force on a charged particle, magnetic torque due to currents, magnetic dipole, Biot-Savart Law and its applications, Ampere's law and its applications, Gauss' law for magnetism, origin of atomic and nuclear magnetism, magnetization, magnetic materials: diamagnetic, paramagnetic, ferroamagnetic. Induced magnetic fields and displacement current.

Recommended Books:

1. Halliday, Resnick and Walker, 2011. Fundamental of Physics, 9th Ed , John Wiley and Sons Inc, New York,.
2. Griffiths D, 2003, Introduction to Electrodynamics, Prentice Hall.
3. Resnick, Hlliday and Krane, 2002, Physics Vol II, Ed. 5th, John Wiley and Sons Inc, New York.
4. Sears, Zemansky and Young, 2000, University Physics Ed. 11th, Addison-Wesley, reading (MA), USA.

PHY-403	Modern Physics-I	3 (3 – 0)

Thermal radiation (black body radiation), quantization of energy, The photoelectric effect, Einstein's photon theory, the Compton effect, line spectra, wave behavior of particles, Testing de Broglie's hypothesis, waves, wave packets and particles, Heisenberg's uncertainty principle, wave function, Schrodinger equation, trapped particles and probability densities, the correspondence principle, dual nature of matter (waves and particles). The atomic structure of hydrogen. Bohr's theory, angular momentum of electrons, electron spin, X-ray spectrum, lasers, discovering the nucleus, basic nuclear properties, radioactive decay. Measuring ionizing radiation, natural radioactivity and nuclear reaction. Energy from the nucleus, nuclear fission. Nuclear reactor, thermonuclear fusion. Controlled thermonuclear fusion.

1. Halliday, Resnick and Walker, 2011. Fundamental of Physics, 9th Ed , John Wiley and Sons Inc, New York,.
2. Raymond A. Serway and John W. Jewett, January 11, 2010, 8th Edition, Physics for Scientists and Engineers with Modern Physics.
3. Demtroder. W, 2005. *Atoms, Molecules and Photons*, publisher: Springer
4. Foot C.J., 2005. *Atomic Physics 1st Ed,* Oxford University Press
5. H. Haken and H.C. 2004, *The Physics of Atoms and Quanta, 7th Ed,* Wolf, publisher: Springer
6. Bransden B.H, and Joachain 2003. *Atoms and Molecules* 2nd Ed. publisher: Pearson Education.
7. Beiser, A 2002, Concepts of Modern Physics. 6th Ed. McGraw-Hill, USA.
8. Halliday Resnick, and Krane, 2002. Physics Vol. II, 5th Ed, John Wiley and Sons Inc, New York

MTH-405	Differential Equations-I	3 (3 – 0)

Differential Equations and their classification, Formation of Differential Equations, Initial values and boundary values Problem, Separation of Variables. Homogenous Differential Equations, Exact Differential Equations, Differential equations reduceable to homogenous form, Linear Differential Equations of 1st Order, Bernonlli's Equations,Ricatti and Clairaut Differential Equations, Differential Equations Reduced to Separable Variables

and Linear Forms. Orthogonal Trajectories. Applications of First Order Differential Equations.

RECOMMENDED BOOKS

1. Zill D G, Cullen M.R. Differential Equations with Boundary-Value Problems (3rd Edition), 1997, PWS Publishing Co.
2. Eisgolts L, Differential Equations and the Calculus of Variations, 1970, Mir Publishers Moscow.
3. Jerri A.J Introduction to Integral Equations with Applications, 1985, Marcel Dibber New York.
4. Muhammad Amin, Mathematical Methods, 2007, IlmiKitabKhana Lahore.

MTH-429	Introduction to Metric and Topological Spaces	3 (3 – 0)

Distance in R2 metric, definition of metric and metric space, examples, balls, diameters, open & closed ball, open set & close set. interior points and interior of a set, exterior points and exterior of a set, closure of a subset, limit points, neighbourhood points, boundary points, sequences and their convergence complete space, Basic notions of set theory, set operations, extended set operations and indexed families of sets. relations, equivalence relations, partition, ordering relations, function as relations, topological spaces; subspaces and relative topology, open sets, closed sets, neighbourhood, interior, exterior boundary and limit points, base and sub base.

RECOMMENDED BOOKS:

1. G.F. Simon, Introduction to Topology and Modern Analysis, 1963, McGraw Hill Book Company, New York.
2. J. Willard, General Topology, Addison-Wesley Publishing Company, London.
3. E. Kreyszig, Introduction to Functional Analysis with Applications, 1978, John Wiley and Sons.
4. W. Rudin, Functional Analysis, McGraw Hill Book Company, New York.
5. N. Dunford and J. Schwartz, Linear Operators (Part-I General Theory), Interscience Publishers, New York.

ENG-421	Communication Skills	3 (3 – 0)

- Oral presentation skills (prepared and unprepared talks)
- Preparing for interviews (scholarship, job, placement for internship, etc.)
- Writing formal letters
- Writing different kinds of applications (leave, job, complaint, etc.)
- Preparing a Curriculum Vitae (CV), (bio-data)
- Writing short reports

Recommended Readings:

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.

PHY-407	**Mechanics, Heat and Vibrations Lab Course**	**3 (0 – 3)**

1. Measurement of Oscillation period of the pendulum as a function of the angle of oscillation Φ of the oscillation plane for two different pendulum lengths.
2. Projectile motion: (a) To determine the range as a function of the angle of inclination. (b) To determine the maximum height of projectile as a function of angle of inclination. (c) To determine the range / height as a function of initial velocity of projectile.
3. To determine the value of 'g' be compound pendulum (Kater's Pendulum).
4. To determine Horizontal/Vertical distance by Sextant.
5. To determine the frequency of A.C supply by Melde's experiment.
6. To determine the modulus of rigidity of a flat spiral spring.
7. To determine the modulus of rigidity of a wire by solid cylindrical rod.
8. Surface tension of water by capillary flow method.

Recommended Books:-

1. Kraftmakers, Y. 2007. Experiments and demonstrations in Physics, World Scientific Publishing Co. Ltd.
1. Isenberg, C. 1996. Physics Experiments and Projects for students (Physics experiments & Projects). Taylor and Francis, USA.

4th Semester

PHY-402	Electricity and Magnetism-II	3 (3 – 0)

Faraday's Law of Electromagnetic induction, review of emf, Lenz's Law, Induced electric fields, Inductance, Inductance of a Solenoid and Toroid. Transients, LR Circuits, Growth and Decay of current, Energy stored in a magnetic field, Energy density, Electromagnetic Oscillation, Qualitative and Quantitative analysis, Forced electromagnetic oscillations and resonance, Alternating current, AC current in resistive, inductive and capacitive elements, single loop RLC circuit, acceptor and rejecter circuits, Power in A.C circuits, Summarizing the electro-magnetic equations, Induced magnetic fields & displacement current, Maxwell's equations, Maxwell equations in a medium, dielectrics and magnetic materials, e.m spectrum, generating an electro-magnetic wave, Traveling waves and Maxwell's equations, energy transport and the Poynting Vector, Propagation of electromagnetic waves in conducting media and in ionized gases, reflection and transmission at normal and oblique incidence, absorption and dispersion of electromagnetic waves in a conductor.

Recommended Books:

1. Serway, Raymond A. and Jerry S. Faughn, 2003, College physics, 6th ed, Brooks/Cole Publishin
2. Resnick, Hlliday and Krane. 2002, Physics, Vol II, 5th Ed. John Wiley and Sons Inc, New York
3. Feynman R.P, R.B Leighton and M.Sands. The Fyenman Lectures of Physics; Electromagnetism and matter. Addison Wesley.
4. Griffiths D. 1989, Introduction to Electrodynamics. Prentice Hall.
5. Lorrain P and D.Corson. Electromagnetic Fields and Waves, 2nd Ed. Freeman publications.

PHY-404	Modern Physics-II	3 (3 – 0)

Review of Bohr's theory, Summerfeld model, Frank Hertz Experiment, Stern Gerlach Experiment, quantum numbers, radiactive transition, selection rules, Zeeman Effect (normal and anomalous Zeeman Effect, The Stark Effect, Pauli exclusion principle, Spin orbit coupling LS coupling, JJ coupling, X-ray spectra. Molecular spectra, Ionic and covalent bonding, diatomic molecular-rotational, vibrational and electronic spectra, polyatomic molecules, black body radiation, Einstein co-efficient (A and B coefficients) and stimulated emission, pumping schemes, characteristics of laser, different types of lasers, laser applications. The fine structure of hydrogen, Helium, the ground state of helium, excited states of helium, transitions in helium.

Recommended Books:

1. Halliday Resnick, and Walker, 2011. Fundamental of Physics, 9th Ed , John Wiley and Sons Inc, New York,.
2. Demtroder. W, 2005. *Atoms, Molecules and Photons*, publisher: Springer
3. Foot C J. 2005, *Atomic Physics 1st Ed,* Oxford University Press.
4. Haken H and H.C. 2004, *The Physics of Atoms and Quanta, 7th Ed,* Wolf, publisher: Springer
5. Beiser, A 2002, Concepts of Modern Physics. 6th Ed. McGraw-Hill, USA.
6. Bransden B H, and Joachain 2003. *Atoms and Molecules* 2nd Ed. publisher: Pearson Education.
7. Halliday Resnick, and Krane, 2002. Physics Vol. II, 5th Ed, John Wiley and Sons Inc, New York

MTH-406	Differential Equations-II	3 (3 – 0)

Higher Order Differential Equations:
Initial and Boundary value problem, Existence of a unique solution,Homogeneous DEs', Linear Dependence and Independence, Wronskian and non-homogeneous Linear Differential Equation.Non-Homogenous Differential Equations with constant Coefficient, D & Inverse D-1, Operators, General & Particular Integrals. Cauchy-Eluer's equations, Reduction of order, Method of Variation of Parameter's, Exact Linear Equations, System of Linear Differential Equations. Power Series Solutions of first order Differential Equations. Laplace and Inverse Transformations with simple Application to Differential Equation.

RECOMMENDED BOOKS

1. Zill D G, Cullen M.R. Differential Equations with Boundary-Value Problems (3rd Edition), 1997, PWS Publishing Co.
2. Eisgolts L, Differential Equations and the Calculus of Variations, 1970, Mir Publishers Moscow.
3. Jerri A.J Introduction to Integral Equations with Applications, 1985, Marcel Dibber New York.
4. Muhammad Amin, Mathematical Methods, 2007, IlmiKitabKhana Lahore.

PHY-408	**Optics and Modern Physics Lab Course**	**3 (0 – 3)**

1. Characteristic x-rays of Molybdenum
2. Specific rotation of cane – sugar solution with Laurent's half shade polarimeter.
3. Ionization potential of mercury / Neon.
4. e/m Experiment (determination of charge to mass ratio of electron)
5. X-ray investigation of crystals
6. Characteristic curves of a solar cell.
7. Plank's constant using photocell method.
8. Wave length of sodium light using a diffraction grating.

Recommended Books.

1. Leimbach G, 2005. Physics Laboratory experiment, Germany.
2. Demtroder.W. 2005. Atoms, Molecules and Photon, Springer.
1. Beiser, A 2002, Concepts of Modern Physics. 6th Ed. McGraw-Hill, USA.

MTH-424	Linear Algebra	3 (3 – 0)

Vectors, Vector Spaces, Matrices & Determinants, Cofactor and Inverse, Rank, Linear Independence, Solution of system of Linear systems, Positive Definite matrix, Linear Transformations, Operations on matrices, Inner products, orthgonality and least squares, Eigenvalue & Eigenvectors. Applications to Systems of Equations and to Geometry, Singular Value Decomposition.

RECOMMENDED BOOKS

1. Bernard Kolman, David Hill, Elementary Linear Algebra with Applications, 9th edion, Prentice Hall PTR, 2007.
2. Gilbert Strang, Strang, Brett Coonley, Andy Bulman-Fleming, Andrew Bulman-Fleming, Strang's Linear Algebra And Its Applications, 4th edition, Brooks/Cole, 2005
3. Howard Anton, Chris Rorres, Elementary Linear Algebra: Applications Version, 9th edition, Wiley, 2005.
4. David C. Lay, Linear Algebra and Its Applications, 2

nd edition, Addison-Wesley, 2000.

CHM-321	**Introductory Chemistry**	**4 (3 – 1)**
Will be provided soon		
5th Semester		
PHY-501	Methods of Mathematical Physics-I	3 (3 – 0)

Vector operations, Physical significance of DEL operator, Gauss's divergence theorem, Green's theorem, Stokes's theorem, Orthogonal curvilinear coordinates system, Gradient, Divergence, Curl and Laplacian in orthogonal curvilinear coordinates, Spherical polar and Cylindrical coordinates systems. Complex numbers, Euler's formula, De Moivre's theorem, elementary functions, analytic functions of complex variables, Cauchy-Riemann equation, harmonic functions, complex integration, Cauchy's theorem, Cauchy's integral formula, Taylor and Laurent series, Contour integrals, singularities and residues, residue theorem, branch points and integrals of multivalued functions. Tensors Analysis and applications.

Recommended Books:

1. Arfken G.B and H.J Weber, F.E Harris, 2012, 7th Edition, Mathematical Methods for Physicists, A. Press, New York.
2. Dass H.K, R. Verma, 2011, 6th Edition, Mathematical Physics, S. Chand& Company Ltd. New Delhi.
3. Kreyszig E. 2011, 10th Edition, Advanced Engineering Mathematics. Wiley, New York.
4. Collins R.E, 2011, 2nd Edition, Mathematical Methods for Physicists and Engineers, Dover Publications.
5. Tang K.T, 2010, 2nd Edition, Mathematical Methods for Engineers and Scientists 2, Springer.
6. Spiegel M.R 2009, 1st EditionAdvanced Mathematics for Engineers and Scientists, Schaum's outlines series, McGraw Hill.
7. Riley K F, M P Hobson and S J Bence. 2006, 3rd Edition, Mathematical Methods for Physics and Engineering, Cambridge University Press, Cambridge.

PHY-503	Classical Mechanics	3 (3 – 0)

Historical development of classical mechanics, Newtonian mechanics of single particle & system of particles, constraints, generalized coordinates, D'Alembert's Principle , Derivation of Lagrange's equations, simple applications of the lagrangian formulation, Hamilton's Principle, Techniques of the calculus of variation, Derivation of Lagrange's equation from Hamilton's principle, Applications of Hamilton's principle, shortest distance between two points in a plane and space, minimum surface of revolution, the Brachistochrone problem, conservation theorem , Two body central force problem & its reduction to the equivalent one body problem, Kepler's law as an inverse square law problem, Differential equation for the orbits and the different shapes of the orbit, planetary orbits & their equations, Legendre transformations and its applications, Derivation of Hamilton's equation of motion, Hamiltonian, cyclic coordinates, Routh's Procedure, The equations & examples of canonical transformations, Poisson's brackets & their properties, Poisson's brackets & other canonical invariants, Poisson's theorem, invariance of Poisson's bracket under canonical transformation.

Recommended Books:

1. Goldstein H, P Charle and J L Safko. 2001, Classical Mechanics. Addison-Wesley.
2. Hand L N and J.D Finch. 1998, Analytical Mechanics. Cambridge University Press, Cambridge.
3. Barger V D and M G Olsson. 1995, Classical Mechanics. McGraw-Hill, New York.
4. Landau L D and E M Lifshitz. Mechanics. 1960, Pergamon, Oxford.
5. Classical Mechanics by J.W. Leech Methuen and Co. Ltd., London, 1958.

PHY-505	Electrodynamics-I	3 (3 – 0)

Electric dipole, Electric field and electric potential at a point due to dipole, mutual interaction energy of two dipoles, Force and Couple on the dipole placed in an external electric field, *Dielectrics:* Polarization and polarization density vector, surface and volume charge densities due to polarization, electric field inside the dielectric, electric susceptibility and dielectric constant, *Poisson and Laplace equations* both for dielectric and space, Solution to Laplace equation in Cartesian, spherical and cylindrical coordinates, Uncharged conducting and dielectric sphere in uniform electric field, Electrostatic Images, Point charge near an infinite grounded

conducting plane, Electric potential, electric field intensity and surface charge density in case of point charge and conducting sphere.*Electric current:* nature of electric current, current density, equation of continuity, Ohm's law, steady current in media without source of e. m. f., Approach to electrostatic equilibrium, *Magnetic properties of steady current:* Current carrying element, Force on current carrying conductor, Biot-savart law and their applications, Ampere's circuital law and their applications, Magnetic vector and scalar potential, Magnetic field of a distant circuit, *Magnetic properties of matter*: Magnetization vectors M, Magnetic current densities due to surface and volume currents and vector potential, Magnetic field due to the magnetized material, Magnetic scalar potential and pole density, Magnetic intensity vector H, Relation between H and M, Field equation, Magnetic susceptibility and permeability, Boundary conditions on the field vectors.

Recommended Books:

1. Bo Thide, 2011, The Electromagnetic filed theory 2nd Ed.
2. Martin Dressed, 2002, Electrodynamics of solids (optional properties of electron in matter), 1st Ed. Cambridge University, Press.
3. Griffiths D.J. 1999, Introduction to Electrodynamics, 3rd Edition
4. John R. Reitz, 1992, Foundations of Electromagnetic Theory, 4th Edition

PHY-507	Electronics-I	3 (3 – 0)

Liner network analysis; superposition, Thevenin, Norton and Mill man's theorems, Electronics: the p-n junction, Bias the p-n junction diode, diode, characteristics of diode, different models and types of diodes, half-wave and full-wave rectifier, full-wave bridge rectifier, capacitor, inductive, and πR filters, Clipping and clamping circuits, Zener voltage regulators, regulated power supply, varactor diodes, Optical diodes, Light emitting Diodes. Bipolar junction transistor (BJT), transistor characteristics, biasing circuits such as base bias, emitter bias, voltage-divider bias, feedback bias circuits, amplifier classifications, common emitter amplifier, the emitter followers, the common base amplifier. RC-coupled amplifiers, Power amplifiers, (class A, class B amplifiers, class C amplifier), introduction to Junction field-effect transistors (JFET), JFET biasing circuits, the common source follower, introduction to MOSFET.

Recommended Books:

1. Floyd, T. L. 2010. Electronic Devices 9TH Ed. Prentice-Hall Intern. Inc., Englewood Cliffs (USA).
2. Nashelsky, L. & Robert, L. B. 2009. Electronic Devices and Circuit Theory 10TH Ed. Prentice-Hall Intern. Inc., Englewood Cliffs (USA).
3. Malvino, A. P. 2008. Electronic Principles. 7TH Ed. Glencoe-McGraw-Hill Book Co.
4. Grob, B. 2003. Basic Electronics 9TH Ed. McGraw-Hill.

PHY-509	Relativity and Cosmology	3 (3 – 0)

Special Relativity, Galilean relativity, Einstein's postulates of special relativity. Consequences of special relativity. Michelson-Morley experiment, Lorentz transformations, consequences of Lorentz transformations (the relativity of length, the relativity of time, concept of simultaneity) Relativistic Mechanics, Transformation of relativistic velocities, addition of relativistic velocities, Relativity of mass, Force equation in relativity, rest mass ,KE and total energy, conservation of energy and momentum, the conversion of mass to kinetic energy in Uranium Fission, pair production and annihilation, The Cerenkov Effect and Cerenkov radiation, Einstein's mass-energy relationship and its practical examples, particle of Zero rest mass, Relativistic Doppler Effect, Aberration of Light, Tachyons, structure of space time, Geometry of space time, Minkowski space time tensors, the light cone, and four vectors (position four vector, four velocity, four momentum, four force). General relativity, Gravity as a Geometry, The equivalence principle, clocks in a gravitation field, space time is curved, geodesics, the geodesic equation, equation of geodesic deviation, Einstein field equation Manifolds and coordinates, curves and surfaces, tensor fields, metric tensor. Cosmology cosmological redshift, Hubble's law, microwave background, the Big Bang, Theory, Historical background of universe, stars , neutron stars, pulsars , black holes, quasars, singularity, measuring the distance to stars, concept of open, closed and flat universe, dark matter(MACHOs and WIMPs-)

Recommended Books:

1. James B. 2005, An Introdu ing to Einstein's General Relativity. Hartle Pearson Education.
2. Beiser A. 2002. 6th E. Perspectives of Modern Physics. McGraw-Hill.

3. Resnick, Halliday and Krane. 2002, Physics Vol. I, 5th Ed. John Wiley and Sons Inc, New York.
4. McComb W D. 1999, Dynamics and Relativity. Oxford University Press.
5. Inverno R.D. Introducing Einstein's Relativity.1992, Oxford University Press.
6. Narlikar J V. 1989, Introduction to Cosmology. Cambridge University Press.

PHY-511	**Electromagnetism Lab Course**	**3 (0 – 3)**

1. To determine the resistance of various DC conductors by recording their current/voltage characteristics.
2. To study the internal resistance and matching in various voltage sources and draw their power diagrams.
3. Establishment of relationship between electrostatic force and charge, electrostatic force and distance between charges and to determine the electric constant using Coulomb's Law / image charge.
4. To study the ferromagnetic hysterisis of a two ring-shaped iron cores by continuous adjustable direct current and to determine the remanence and coersive field strength.
5. Investigation of induced current and voltage in secondary coil of a transformer as a function of number of turns and current flowing in the primary coil.
6. To determine the inductance and phase displacement of coil (single, parallel and series formations) in AC circuit as a function of frequency of voltage source.
7. To determine the capacitance and phase displacement of capacitor (single, parallel and series formations) in AC circuit as a function of frequency of voltage source.
8. To determine the dielectric constants of different materials.
9. To study the ripple of the output voltage of various rectifier circuits as a function of the load current strength and the charging capacitance.
10. To study the frequency response of simple RC filters by point-by-point measurements and the sweep displayed on the oscilloscope.
11. To investigate the filter characteristics as a function of frequency of a coil, a capacitor, an Ohmic resistance and combinations of these components and to determine the phase displacement of the filters as a function of frequency.
12. To study the behavior of RLC series and parallel circuit and determination of its resonance frequency. (Optional: To determine the dielectric constant using RLC series circuit.)

Recommended Books:

1. Kraftmakers, Y. 2007. Experiments and demonstrations in Physics, World Scientific Publishing Co. Ltd.
2. David J. Griffiths, Introduction to Electrodynamics, 3rd Edition
3. Isenberg, C. 1996. Physics Experiments and Projects for students (Physics experiments & Projects). Taylor and Francis, USA.

6th Semester

PHY-502	Methods of Mathematical Physics-II	3 (3 – 0)

Fourier Analysis, Fourier cosine and sine series, change of interval, Fourier integral, complex form of Fourier series, Fourier transform, Fourier transform of derivatives, Laplace transform, Inverse Laplace Transform, Convolution theorem, Initial boundary value problem, Laplace transform of derivatives. Physical significance along with examples of Fourier and Laplace transforms. Special functions, Hermite, Laguerre, Legendre and associate Legendre polynomial. Bessel function, Neumann function, and spherical Bessel function, Gamma function. Nonhomogeneous equations- Green's function, Green's function in terms of Eigen-function, the Sturm-Liouville problem, Green's function for Dirac Delta functions,

Recommended Books:

1. Arfken G.B and H.J Weber, F.E Harris, 2012, 7th Edition, Mathematical Methods for Physicists, A. Press, New York.
2. Dass H.K, R. Verma, 2011, 6th Edition, Mathematical Physics, S. Chand& Company Ltd. New Delhi.
3. Kreyszig E. 2011, 10th Edition, Advanced Engineering Mathematics. Wiley, New York.
4. Collins R.E, 2011, 2nd Edition, Mathematical Methods for Physicists and Engineers, Dover Publications.
5. Tang K.T, 2010, 2nd Edition, Mathematical Methods for Engineers and Scientists 2, Springer.

6. Spiegel M.R 2009, 1st EditionAdvanced Mathematics for Engineers and Scientists, Schaum's outlines series, McGraw Hill.
7. Riley K F, M P Hobson and S J Bence. 2006, 3rd Edition, Mathematical Methods for Physics and Engineering, Cambridge University Press, Cambridge.

PHY-504	Quantum Mechanics-I	3 (3 – 0)

Review of concepts of classical mechanics, The state of a system, Dynamical variables and operators, Linear vector space, orthogonal systems, linear transformations, matrices, change of basis, Hilbert space, Commuting and noncommuting operators, Heisenberg uncertainty relations, Functions and expectation values, Dirac notation, Hermitian operators, Symmetry principles and conservation laws, Orbital angular momentum, Spin, The eigenvalues and eigen functions of L2 and Lx, Matrix representation of angular momentum operators, Addition of angular momenta. Properties of one dimensional potential functions, Solutions of Schrödinger equation for free particles, the potential barrier problems, The linear harmonic oscillator, Particle in a box. Schrödinger Equation in Three Dimensions, Separation of Schrodinger equation in Cartesian coordinates, Central potentials, The free particle, Three dimensional square well potential, The hydrogen atom, Three dimensional isotopic oscillator.

Recommended Books:

1. Zettli N. 2009, Quantum Mechanics Concepts and applications. J Willy.
2. Bransden B H and Joachain C J. 1990, Introductory Quantum mechanics. Longman Scientific & Technical London.
3. Greiner W.1980, An Introduction Quantum Mechanics. Addison Wesley Publishing Company, Reading Massachusetts.
4. Liboff, R.L. 1980. "Introductory quantum Mechanics", by Addison Wesley Publishing Company, Reading Massachusetts,

PHY-506	Nuclear Physics-I	3 (3 – 0)

Nuclear mass, size, nuclear spin, Nuclear Binding energy, magnetic dipole moments, electric quadruple moments, parity and statistics. Observed phenomenon of radio activity, explanation of α-decay: Absorption, Range, Ionization and Stopping power of alpha particles, theory of alpha decay, Fermi theory of β-decay, theory of γ-decay, energetic of γ-decay, Nuclear isomerism, Internal conversion, Mossbauer Effect, Yukawa meson theory of nuclear forces, properties of nuclear forces, n-p and p-p scattering at low energies. Passage of charged particles through matter, Ionization chamber, proportional counter, GM counter, scintillation counter, semi-conductor detector, bubble chamber. Linear accelerator, van de Graff generator, Synchrocyclotron, proton synchrotron, betatron, photographic emulsion.

Recommended Books:

1. Zhang, Z..M, B.K. Tsai and G. Machin. 2010. Experimental Methods in Physical Science Vol. 2, Academic Press, USA.
2. Alejandro Garcia and Ernest M. Henley, (2007). Subatomic Physics, by publisher: World Scientific Publishing.
3. B R Martin, 2006. Nuclear and Particle Physics, publisher: New York: Wiley
4. David, W.I.F., K. Shankland, L.B McK usker and C. Baerloche. 2006. Structure Determination from Powder Diffraction Data. Oxford University Press, New York.
5. Hanlon, J. F. 2003. A User Guide to Vacuum Technology. John Wiley and sons, USA.
6. Kaplan Irving Nuclear Physics, latest edition.
7. lilley John 2001 Nuclear physics: Basic concepts and applications,
8. Povh B, Rith K, Scholz C and Zetsche F, 2006, Particles and Nuclei: an Introduction to the Physical Concepts, 5th Edition, publisher: Berlin Springer,.
9. S. Krane Kenneth. 1995. "Introducing Nuclear Physics,

PHY-508	Electrodynamics-II	3 (3 – 0)

Maxwell's equations, Differential form of Faraday law of electromagnetic induction, Maxwell correction of

Amper's law and displacement current, Electromagnetic energy vector (Poynting vector), Wave equations for scalar and vector potential, Gauge transformations, Lorentz gauge and Coulombs gauge, Retarded scalar and vector potentials, Wave equations for *E* and *H*, Time dependent wave equation, Plane electromagnetic waves in a conducting and non-conducting media, Linear and circular polarization. *Electromagnetic wave in matter*: Propagation in linear media, Reflection and Transmission at the boundary of non-conducting media (Normal and Oblique incidence), Reflection at conducting surface, Frequency dependence of permittivity, *Radiation:* Electric and Magnetic dipole, Power radiated by a point charge, Radiation reaction, *Electrodynamics and Relativity:* Einstein's Postulates, Geometry of Relativity, Lorentz Transformations, Proper time and velocity, Relativistic energy, momentum, kinematics, and electrodynamics, Magnetism as a relativistic phenomenon.

Recommended Books:

1. Griffiths D.J. 1999, Introduction to Electrodynamics, 3rd Edition
2. John R. Reitz, 1992, Foundations of Electromagnetic Theory, 4th Edition

PHY-510	Electronics-II	3 (3 – 0)

An overview of operational amplifiers (op-amp), the differential amplifier, the inverting and non-inverting amplifiers, op-amp frequency response, negative feedback, comparators, integrators and differentiators, Instrumentation amplifier, Log and Antilog amplifiers, Constant current source, Current to Voltage and Voltage to Current converters, phase shift oscillators, the Wienbridge oscillator, the Colpitts & Hartley oscillators, the crystal oscillator, Schmitt triggers, the 555 timer, monostable, bistable, and astable multi vibrators, switching circuits, introduction to thyristors, silicon-controlled rectifiers, diacs and triacs, Number systems, digital circuits, Logic gates and Boolean algebra, arithmetic circuits, flip flops and latches, binary counters, Analog to Digital and Digital to analog conversion circuits.

Recommended Books:

1. Floyd T L. 2010, Electronic Devices 9TH Ed. Prentice-Hall Intern. Inc., Englewood Cliffs (USA).
2. Floyd, T. L. 2010, Digital Fundamentals 10TH Ed. Prentice-Hall Intern. Inc., Englewood Cliffs (USA).
3. Tocci R J. 2010, Digital Systems: Principles and Applications 11TH Ed. Prentice-Hall Intern. Inc., Englewood Cliffs (USA).
4. Malvino, A P. 2008, Electronic Principles. 7TH Ed. Glencoe-McGraw-Hill Book Co.
5. Nashelsky, L and L B Robert. 2009, Electronic Devices and Circuit Theory 10TH Ed. Prentice-Hall Intern. Inc., Englewood Cliffs (USA).

PHY-512	**Atomic and Nuclear Physics Lab Course**	**3 (0 – 3)**

The candidate must perform at least Eight experiments from the list given below. 50% weightage must be given to viva-voce about apparatus, theory of experiments and estimation of errors.

1. To Expose the students to advance level experimentation in Physics
2. To make them familiar to such experiments where outcome can be used in developing future research capabilities and teaching skills
3. To make the students confident in their studies by showing and measuring parameters mostly used in their theoretical work.
1. To study the characteristics curves of GM counter.
2. To determine the absorption coefficient of lead for Gamma Rays using GM counter assembly.
3. To determine the maximum energy of Beta Particles using GM counter assembly.
4. To determine the range of an Alpha Particle and guess its energy using empirical relations using GM counter assembly.
5. To measure the half life of a radioactive nuclide.
6. To study of Random processes and fluctuations in Random processes (Gaussian distribution curve) using GM counter assembly.
7. To study radioactive equilibrium using Cs^{137}/Ba^{137} mini generator using GM counter assembly.
8. Demonstration of Interaction of Radiations with matter using absorber kit using GM counter assembly.
9. Verification of inverse square law using GM counter assembly.

10. To study the wave characteristics of an electron. (electron diffraction experiment.)
11. Determination of Planck's constant using He-Neon laser, and compare its results with Photo cell method.
12. Determination of velocity of light using He-Neon laser and compare it with other standard methods.

Recommended Books:

1. Gray T S. Applied Electronics (John-willey and Sons)
2. Higgings R J. Experimental Electronics (Mc Graw Hill)
3. Mark H and N.T Olson. Experiments in Modern Physics (Mc Graw Hill)
4. Melissienson A C. Experiments in Modern Physics (Academic)
5. Squares G L. Practical Physics 3rd Ed. Cambridge University Press.

7 Semester

PHY-601	Quantum Mechanics-II	3 (3 – 0)

Matrix representation of operators, digitalization, Identical Particles, Second Quantization, Indistinguishability of identical particles, Systems of identical particles, Quantum dynamics of identical particle systems, statistics, Symmetry of states, Fermions, Bosons. Time evolution of a system, Schrödinger and Heisenberg pictures, Time independent perturbation theory for non-degenerate and degenerate levels, Time dependent perturbation theory, Variational method, The WKB approximation and its applications. Theory of Scattering, Scattering experiments and cross sections, Potential scattering, the method of partial waves, The Born's approximation

Recommended Books:

1. Bransden B H and C J Joachain. 1990, Introductory Quantum mechanics, Longman Scientific & Technical London.
2. Greiner W. 1980, An Introduction Quantum Mechanics, Addison Wesley Publishing Company, Reading Massachusetts.
3. Liboff, R.L. 1980. Introductory quantum Mechanics, Addison Wesley Publishing Company, Reading Massachusetts,
4. Zettli N. 2009, Quantum Mechanics Concepts and applications, J Willy.

PHY-603	Nuclear Physics-II	3 (3 – 0)

Types of nuclear reaction, Conservation laws of nuclear reaction, Q-values of nuclear reaction, threshold energy, transmutation by photons, protons, deuterons and α-particles, direct reactions, compound nuclear theory of nuclear reactions, limitation of compound nucleus, excited states of nucleus, bound and virtual energy levels, level width, cross-section for nuclear reactions, Breit-wigner formula. Liquid drop model, Semi-empirical mass formula, volume and surface energies, Shell model: magic numbers and closed shells, spin – orbit interaction, Collective nuclear model, nuclear deformations. The production and detection of neutrons, Fission and Fusion Reactions, discovery of nuclear fission, fission products, Bohr-wheeler theory of nuclear fission, mass and energy distribution of fission fragments, Description of nuclear fusion process, D-D and D-T reactions, Fusion processes in sun and stars, Nuclear fission and fusion as a source of energy, Basic of nuclear reactors, controlled nuclear fusion.

Recommended Books:

1. Henley E M and A Garcia.2007, *Subatomic.* World Scientific Publishing.
2. David, W.I.F., K. Shankland, L.B McK usker and C. Baerloche. 2006. Structure Determination from Powder Diffraction Data. Oxford University Press, New York.
3. Martin B R. 2006, *Nuclear and Particle Physics.* New York: Wiley.
4. Povh B, K Rith, C Scholz and F Zetsche, 2006, *Particles and Nuclei: an Introduction to the Physical Concepts* 5th Edition. Berlin Springer.
5. Hanlon, J. F. 2003. A User Guide to Vacuum Technology. John Wiley and sons, USA.
6. Krane K S, 1995, *Introducing Nuclear Physics.*.
7. Lilley J. 2001, *Nuclear physics: Basic concepts and applications.*

8. *Nuclear Physics*, by Irving Kaplan latest edition.
9. Zhang, Z..M, B.K. Tsai and G. Machin.

PHY-605	**Statistical Mechanics**	**3 (3 – 0)**

Laws of thermodynamics, thermodynamic variables, reversible adiabatic changes. Entropy, Microstates and macrostates, ensembles and ensemble averaging, approach to equilibrium. Classical probability, Statistical probability, binomial and Gaussian probability distributions, central limit theorem. Microcanonical systems, quantum state, entropy and equilibrium in a microcanonical system, Canonical ensemble, partition function, entropy in canonical system, Boltzmann distribution, thermodynamical averages, applications to single particle, factorization of partition function.Equipartition theorem, free energy and its minimization, Gibbs and Helmholtz free energy and applications. Maxwell distribution of molecular speeds, classical probability of a state, Maxwell-Boltzmann probability distribution, density of states in k-space, distribution of speeds in a classical gas. Black body radiation, Rayleigh-Jeans theory, Planck distribution, free energy of a photon gas, Stefan-Boltzmann formula, phonons. Systems with variable number of particles, chemical potential, grand canonical ensemble, relation to thermodynamic variables. Identical particles, fermions and bosons, partition function for identical particles, semi-classical approximations, identical particles localized on a lattice, thermodynamic properties of a Fermi gas, Bose condensation

Recommended Books:

1. Gould H and J Tobochnik.2010, Thermal and Statistical Physics, Princeton University Press.
2. Huang K.2001, Introductory Statistical Physics, 1st Ed. CRC
3. Bowley R and M. Sanchez. 2000, Introductory Statistical Mechanics, 2nd Ed. Clarenden Press, Oxford,
4. Kittel C and H. Kroemer, 1980, Thermal Physics, second edition, W. H. Freeman.

PHY-607	Solid State Physics-I	3 (3 – 0)

Crystal structure in 2D and 3D, fundamental types of lattices, index system for crystal planes, simple crystal structures, X-ray diffraction, Braggs law, Ewald Construction, reciprocal lattice, Diffraction of waves by crystals, scattered wave amplitude, Brillouin zones, crystal binding and elastic constants, Classification of Solids, ionic crystals, covalent crystals, Ionic Radii, II-VI and III-V compounds, Molecular crystals, metals, Cohesive energy, The Lenard Jones Potential, Density, Cohesive energy and Bulk Modulus of crystalline solids, The Madelung constant, Cohesion in Covalent crystals, elastic waves in cubic crystals. Brief Introduction to Defects in Solids, Color Center, Vibration of crystals with monatomic basis, two atoms per primitive basis, quantization of elastic waves, normal vibration modes and phonon, phonon momentum, inelastic scattering by phonons, Phonon heat capacity, lattice heat capacity, Einstein and Debye models.

Recommended Books:

1. M. Ali Omer, 2009 "Elementary Solid State Physics", 6th Edition. D. Kindersley Pvt.Ltd.
2. H. Ibach, H. Luth, 2009 " Solid State Physics:An introduction to the principles of material science" 4th Edition by Springer.
3. C. Kittle, 2004 "Introduction to Solid State Physics", 8th Edition by John Wiley and Sons Inc.

PHY-609	Particle Physics-I*	3 (3 – 0)

Particle Classification, Quantum numbers, leptons, hadrons, baryons, mesons, quarks. The fundamental interactions the electromagnetic coupling, the strong coupling, the weak coupling. Symmetry Transformation and Conservation Laws: Translation in space, rotation in space, the group SU (2) , systems of identical particles, parity, isospin charge conjugation, time reversal, G parity, CPT theorem. The Electromagnetic Filed: Gauge invariance and Maxwell's equations, polarization ad photon spin, angular momentum, parity and C parity of the photon. The Klein-Gordan Equation: Non relativistic quantum mechanics, Lorentz covariance and 4 vector notation, the Klein Gordon equation, the Feynman-Stuckelberg interpretation of E < O solutions, non

relativistic perturbation theory (brief review), rules for scattering amplitudes in the Feynman-Stukelberg approach. The Dirac Equation: Covariant form of the Dirac Equation, Dirac γ-matrices, conserved current and the adjoint equation, free particle spinors, anti particles, normalization of spinors and the completeness relations, bilinear covariant, zero mass fermion, the two-component neutrino.

Books Recommended:

1. Burcham, E.E. and Jobes, M., J. (1995) "Nuclear and Particle Physics", Longman.
2. Das, A. and Ferbel, T. , (1994) "Introduction to Nuclear and Particle Physics", Johan Wiley and Sons.
3. Williams", W.S.C. (1993) "Nuclear and Particle Physics, Oxford University Press.
4. Gottfired, K. and Weisskopt, F. (1986) "Concepts of Particle Physics", vol. 1, Oxford University Press.
5. Griffiths, D. (1987). "Introduction of elementary Particles", , John Wiley and Sons.

PHY-611	Advanced Electronics*	3 (3 – 0)

Number Systems and codes, Logic Gates and Boolean algebra, Combinational logic, Sum of products form, Karnaugh maps method, Digital arithmetic operations and circuits, multiplexer and demultiplexers,decoders encoders, Sequential logic, Flip Flops, Synchronous Logic, basic binary ripple counter, modulus counters, BCD counter, synchronous/asynchronous counter, counter, parallel counters, up-down counter application as digital time (clock) shift registers, semi conductor, memory elements (simple concept), Digital Computer,Concept of computer system (CPU, input & output devices, computer networking, software system and simulation software) and micro-processor, Communication systems, Modulation and Demodulation, Classification of signals, Analysis and transmission of signals, Amplitude modulation, Angle/Phase and Frequency modulations, Pulse code modulation.

Recommended Books:

1. Floyd, T. L. 2010. Digital Fundamentals 10^{TH} Ed. Prentice-Hall Intern. Inc., Englewood Cliffs (USA).
2. Tocci, R. J. 2010. Digital Systems: Principles and Applications 11^{TH} Ed. Prentice-Hall Intern. Inc., Englewood Cliffs (USA).
3. Lathi, B. P. 2009. Modern Digital and Analog Communication Systems 4^{TH} Ed. Oxford University Press.
4. Mano, M. M. 2002. Digital Design 4^{TH} Ed. Prentice-Hall Intern. Inc., Englewood Cliffs (USA).

PHY-613	Environmental Physics-I*	3 (3 – 0)

The economic system, living in green house, enjoying the sun, Transport of matter, Energy and momentum, the social and political context. Black body radiation, The emission spectrum of sun, The transition electric dipole moment, The Einstein Coefficients, Lambert – Beer's law, The spectroscopy of bio-molecules, Solar UV and life, The ozone filter. The energy Balance, (Zero-dimensional Greenhouse Model), elements of weather and climate, climate variations and modeling. Diffusion, flow in rivers, ground water. Flow equations of fluid Dynamics, Turbulence, Turbulence Diffusion, Gaussian plumes in air, Turbulent jets and planes the concept of sound, sound pressure level, frequency & propagation, sound level, measuring transient noise, the acoustic environment, Hazardous effects of noise, noise control., Radioactive decay law, sources of radiation, Interaction of Radiation with matter, Measuring Radiation, Nuclear Fuel Cycle, Sources of Radioactive waste, Health Hazards, Radioactive waste management.

Recommended Books:

1. Booker E and R V G Belle. 1999, Environmental Physics. 2nd ed. John Wiley and sons. 1999.
2. Grasseur G P. 1999, Atmospheric Chemistry & Global Change. 1^{st} Ed. Publisher: Oxford).
3. John M.Wallace. 1997, Atmospheric Science. 1st Ed. Publisher: Academic Press.
4. Physics of Environmental and Climate, Guyot Praxis Publication, 1998.

PHY-615	Health and Medical Physics-I*	3 (3 – 0)

Interactions of lionizing Radiation with Matter: Introduction; Beta-rays, range-energy relationship, mechanism of energy loss, Ionization and excitation, Bremsstrahlung, Alpha, rays, Rang-energy relation – ship, Energy

transfer, Gamma-rays, exponential absorption, interaction mechanism, Pair production. Compton scattering, photoelectric absorption, photodisintegration, Combined effect, Neutrons, Production classification, interaction, Scattering, Absorption. Radiotherapy: Introduction, The development of radiotherapy, Radio therapeutic aims, External beam therapy, Brach therapy, unsealed source therapy, Requirements for accuracy and precision, Quality assurance, The role of medical physics. Medical Imaging: Diagnostic X-rays, Production of X-rays, Absorption of x-ray to other planes, Partial volume effect, Artifacts, Contrast agent in conventional radiography and CT, Diagnostic Ultrasound, Doppler effect, radionuclide imagine, positron emission tomography (PET), Magnetic resonance imagining (MRI), Contrast agents for MRI.

Recommended Books:

1. Forty R. 2010,ICFA, Instrumentation School.
2. RIEGLER W. 2008,CERN, Academic Training Course.
3. Joran C. 2003, CERN, summer student lecturers.
4. Cember H. 1996, Introduction to Health Physics. 3rd Ed. McGraw Hill, New York.
5. Williams J R and D I Thwaits, 1993, Radiotherapy Physics. Oxford University Press, New York.
6. Armstrong P and L Martin. Diagnostic Imaging 4th Ed. Blackwell Science Ltd.
7. Bushong S C. 1993, Radiologic Science of Technologists. 5th Ed. Mosby.
8. Greening J R. 1985, Fundamentals of Radiation Dosimetry. 2nd Ed. Adam Hilger Ltd., Bristol

PHY-617	Climatology and Meteorology-I*	3 (3 – 0)

Synoptic Meteorology: Composition & structure of atmosphere, ICAO standard atmosphere, weather elements, Air mass classification, Thermodynamic characteristics, General Circulation.Atmospheric thermodynamics, First law of thermodynamics and enthalpy; adiabatic processes and potential temperature. The second law of thermodynamics; entropy' thermodynamics of water vapour and moist air' thermodynamic properties of the water substance' phase transition of water' water vapour and most air' Clausious- Clapaeyron's equation; Aerological diagram' selection of coordinates' choice of diagrm; analysis of tephigram. Methods of surface observations & codes: Reading of routine observation, barometric corrections & reduction, reading, setting * maintenance of thermometers, surface codes, aeronautical codes (Speci & Metar). Dynamic Meteorology: Circulation & vorticity, stokes theorem, vorticity equation, Rossby waves. Meteorological Instruments: Meterorological instruments used in thermometry, barometry, hygrometery, rainfall & snowfall measurement, wind measurement, cloud measurement, evaporation measurement, visibility measurement, sunshine measurement. Introduction to weather radar system, introduction to radiosonde equipment.

Recommended Books:

1. Vonstorch H. 2001, Statistical Analysis in Climate Research. 1st Ed. Publisher: Cambridge.
2. Brasseur G P, 1999, Atmospheric Chemistry & Global Change (Publisher: Oxford), 1st Edition.
3. Morgan M, 1991, Meteorology 3rd Ed. (Publisher: MacMillion),
4. Hougton, 1985, Hand Book of applied Meterology, 1st Ed. Publisher: Wiley
5. Hidore O. 1984, Climatology 1st ed. (Publisher: Merrill).
6. Haltiner and Martin. 1957, Dynamical & Physical Meteorlogy 1st Ed. (Publisher: McGraw Hill).
7. Carlson. 1981, Tropical Meterology, 1st Ed. Publisher: The Pennsylvania State University.

PHY-619	**Computational Materials Physics***	**3 (3 – 0)**

Classification of Bravais lattices and crystal structures, reciprocal lattice and reciprocal space, total energy, relationship between structural and thermodynamic properties, the electronic structure of solids, band structure, electronic states in materials and physical properties which can be derived from them. The elementary quantum many-body problem, Schrödinger equation, ground state energy, wave function methods, Hartree method, Hartree-Fock method, exchange and correlation effects, Density Functional Theory (DFT), Thomas-Fermi approximation, Hohenberg-Kohn theorems, Kohn-Sham equation, exchange-correlation functionals, local density approximation, generalized gradient approximation, self-interaction correction, hybrid functionals. Bloch's theorem, the tight binding method, pseudopotentials method, augmented plane wave method, linearized augmented plane wave plus local orbitals method. Survey of the available DFT codes, computer implementation of DFT codes, carrying out large scale computations using preexisting electronic structure codes in Linux environment.

Recommended Books:

1. Sholl, D. S. and Steckel, J. A. 2009. Density Functional Theory: A Practical Introduction. 1st Edition, JohnWiley & Sons, USA.

2. Tilley, R. J. D. 2013. Understanding Solids: The Science of Materials. 2nd Edition, John Wiley & Sons, USA.

3. Martin, R. M. 2008. Electronic Structure – Basic Theory and Practical Methods. Vol. 1. 1st Edition, Cambridge University press, UK.

4. Ashkroft, N. W. and Mermin, N. D. 2011. Solid State Physics. Reprint, Cengage Learning, USA. 5. Kittle, C. 2004. Introduction to Solid State Physics. 8th Edition. John Wiley & Sons, USA.

6. Hergert, W., Ernst, A. and Däne, M. (ed). 2004. Computational Materials Science: From Basic Principles to Material Properties. Springer, USA.

PHY-621	**Electronics Lab Course**	**3 (0 – 3)**

1. Design and measure the equivalent resistance and capacitance of parallel series resistive and capacitive circuits respectively.
2. Design a full-wave rectifier and study its output without and with a capacitor filter.
3. Design a full-wave rectifier and study its output with a π filter.
4. Design a regulated power supply using Zener diode and study its regulation.
5. Design clipper and clamping circuits and study the output wave shapes.
6. Design circuits for logic gates (NOT, OR, NOR, AND, NAND, XOR) using discrete components.
7. Design a CE amplifier and study its frequency response. Determine its low- and upper-limit frequencies and also the bandwidth.
8. Design a common source FET amplifier and determine its input and output impedance.
9. Design an RC phase-shift oscillator and determine its frequency by Lissajous figures.
10. Design an astable multi vibrator and determine its frequency.
11. Design a transformer-coupled class A power amplifier and determine its ac power delivered to the load and percent efficiency.
12. Design inverting and non-inverting amplifiers using operational amplifiers using 741 IC's.
13. Design differentiator and integrator circuits and study output wave shapes using 741 IC's.
14. Design Half adder and full adder circuits
15. Design half subtractor and Full Subtractor circuits.

Recommended Books:

1. Floyd, T. L. 2010. Electronic Devices 9TH Ed. Prentice-Hall Intern. Inc., Englewood Cliffs (USA).
2. Malvino, A. P. 2008. Electronic Principles. 7TH Ed. Glencoe-McGraw-Hill Book Co.
3. Nashelsky, L. and Robert, L. B. 2009. Electronic Devices and Circuit Theory 10TH Ed. Prentice-Hall Intern. Inc., Englewood Cliffs (USA).
4. Grob, B. 2003. Basic Electronics 9TH Ed. McGraw-Hill.

8th Semester

PHY-602	Plasma Physics	3 (3 – 0)

Introduction. Occurrence of plasmas in nature. Definition of plasma. Concept of temperature. Debye shielding. The plasma parameter. Criteria for plasma. Applications of plasma physics. Single-particle motions in electromagnetic field. Uniform and nonuniform E and B fields. Time-varying E and B fields. Fluid description of plasma. Wave propagation in plasma. Derivation of dispertion relations for simple electrostatic and electromagnetic modes. Introduction to Controlled Fusion: Basic nuclear fusion reactions, reaction rates and power density, radiation losses from plasmas, operational conditions.

Recommended Books:

1. Bittencourt J A, 2004 Fundamentals of Plasma Physics" (second Edition) INPE.
2. Krall N A and A W Trivelpiece, 1986 Principles of Plasma Physics" by (McGraw-Hill).
3. Glasstone S and R H.Lovberg, 1975 Controlled Thermonuclear Reactions (D.Van Nestrand).
4. CHEN F F, 1974 Introduction to Plasma Physics and control fusion, (Plenum).

PHY-604	Computational Physics	3 (3 – 0)

Introduction, Scientific programming methodology, Scientific programming languages, Numerical solutions of ODEs, Euler Method, Numerical errors and instabilities, Euler Improved Method, Runge Kutta 4th order Method, Adaptive integration technique, Runge Kutta Fehlberg Method. Numerical quadrature, Riemann's Sum, Trapezoidal Rule, Simpson's 1/3 Rule, Simpson's 3/8 Rule. Random number, Random walk, introduction to Monte Carlo techniques, Monte Carlo Integration and Cubatures. Numerical Solution of Nonlinear Equations f(x) = 0. Numerical Solution of Linear System of equations, Gauss Jordan Method, Jacobi Method, Gauss Seidel iterative Method. Numerical solutions of PDEs, Finite elements method, Laplace equation, Heat Equation, Explicit and Implicit methods, Crank-Nicholson Scheme, Wave equation. Interpolation and data fitting, Polynomial interpolation, Newton's Polynomial, Newton-Gregory Forwards Polynomial, Lagrange Interpolating polynomial, Chi square fitting, Linear Fit. Computer algebra and Introduction to MATHEMATICA, Introduction to MATLAB. Algorithm development using C++. Simulation techniques and computer graphics, computational techniques in investigating and visualizing fundamental physics.

Recommended Books:

1. Harvey M. Deitel and Paul J. Deitel, 2012, *C++ How to Program, 8/e, Early Objects Version*, Prentice Hall
2. Richard Fitzpatrick, 2011, *Introduction to Computational Physics*, University of Texas.
3. Paul L. Devries and Javier E. Hasbun, 2010, *A First Course in Computational Physics*, John Willey and Sons. N.Y..
4. R. H. Landau, M. J. Paez and C. C. Bordieanu , 2007, *Computational Physics: Problem solving with Computers*, Ed. 2nd, Wiley VCHVerlag GmbH & Co KgaA.
5. Andi Klein and Alexander Godunov, 2006, *Introductory Computational Physics*, Cambridge University Press.
6. William H. Press, Brian P. Flannery, Saul A. Teukolsky, and William T, 1998, *Numerical Recipes: The Art of Scientific Computing*, Vetterling Cambridge University Press.

PHY-606	Solid State Physics-II	3 (3 – 0)

Solid state problem, Born-Oppenheimer approximation, free electron approximation, density of states, Fermi Dirac distribution, k-space, concept of Fermi energy and the Fermi surface, free electron description of Heat capacity, electrical conductivity of metals, Hall effect, Nearly free electron model, origin of the energy gap, , Bloch functions, motion of electrons in electron in a periodic potential, crystal momentum, effective mass, physical interpretation of the effective mass, Augmented Plane Wave method, Semiconductors, intrinsic and extrinsic semiconductors, intrinsic carrier concentration, mobility, impurity conductivity donor states, acceptor states, thermal ionization of donors and acceptors, simple description pf pn-junction and rectification, Transistors, Semiconductors heterostructure and outline of solid state lasers, Diamagnetism and Paramagnetism, Larmor Diamagnetism, Adiabatic Diamagnetism, Pauli Paramagnetism, Conduction electrons Diamagnetism, introduction to superconductivity. Qualitative aspects of BCS Theory.

Recommended Books:

1. M. Ali Omer, 2009 "Elementary Solid State Physics", 6th Edition. D. Kindersley Pvt. Ltd.
2. H. Ibach, H. Luth, 2009 " Solid State Physics:An introduction to the principles of material science" 4th Edition by Springer.
3. C. Kittle, 2004 "Introduction to Solid State Physics", 8th Edition by John Wiley and Sons Inc.

PHY-608	Laser and Optics	3 (3 – 0)

Review of quantum mechanics, interaction of radiation with matter,Spontaneous and stimulated emission, absorption, cavity, gain medium, population inversion, threshold condition, Three and four level laser, pumping

mechanisms, properties of a laser beam, Modes of a rectangular cavity, Raleigh-Jeans and Planck radiation formula, mode density, homogeneous and inhomogeneous broadening of atomic transitions, amplitude fluctuations and spiking, Rate equation approach to Laser theory, stationary solution, time-dependent solution, lasing condition, hole burning effect, Matrix formulation of Geometrical optics , optical resonators, Q-switching and mode locking, active and passive mode-locking, fresnal number, types of laser, laser applications

Recommended Books:

1. Svelto O. 2010, Principles of Lasers. 5th Ed. Springer New York Dordrecht Heidelberg London.
2. Hooker S and C Webb. 2010, Laser Physics Oxford University Press, Inc. New York.
3. Abramczyk H. 2005, .Introduction to laser spectroscopy. Elsevier.
4. Silfvast W T. 2004, Laser Fundamentals. Cambridge University Press.

PHY-610	Particle Physics-II*	3 (3 – 0)

Hadrons Spectroscopy: Formation experiments, particle wave formalism and the optical theorem, the Breit-Winger resonance formula, baryon resonances, phase space considerations, production experiments. The Quark Model: The group SU (3), quarks, hadrons (baryons, mesons in quark model, heave meson spectroscopy, the quarkonium model. The Standard Model (qualitative treatment only): Unification of weak and electromagnetic interactions Glashow-Salam-Weinberg Model. Electrodynamics of spinless particles: An "electron" in an electromagnetic field A", "spinless" electron – muon scattering, the cross section in terms of the invariant amplitude M, the decay rate in terms of M, "spinless" electron – electron scattering, electron – positron scattering: and application of crossing, invariant variables, the origin of the propagator. Electrodynamics of Spin ½ Particles: An electron interacting with an electromagnetic field A" , Moller scattering e- e- □ e-e- the process e- μ- □ e- μ- trace theorems and properties of y matrices., e- μ- scattering and the process e- e- □ μ+ μ- helicity conservation at high energies, survey of e- e+ □ e- e+ , μ- μ+ , e- μ- □ e- μ- in the laboratory frame; kinematics relevant to the parton model, photons, polarization vectors, more on propagators, the electron propagator, the photon propagator, massive vector particles, real and virtual photons, Compton scattering γ e- □ γ e- pair, annihilation e+ e- □ γγ, the + ive prescription for propagators, Eeynman rules QED.

Books Recommended:

1. Burcham, E E and M J Jobes.1995, Nuclear and Particle Physics. Longman.
2. Das A. and T Ferbel. 1994, Introduction to Nuclear and Particle Physics. Johan Wiley and Sons.
3. Williams W S C. 1993, Nuclear and Particle Physics. Oxford University Press
4. Gottfired K and F Weisskopt.1986, Concepts of Particle Physics. Vol. 1, Oxford University Press.
5. Griffiths, D. (1987). Introduction of elementary Particles. John Wiley and Sons.

PHY-612	Advanced Electronics Lab Course*	3 (0 – 3)

1. Design of UJT relaxation oscillator of a variable frequency, measure frequency and amplitude of the out put.
2. Design RF transistor oscillator, Convert into a transmitter, detect the transmitted wave by a radio receiver (Both for AM & FM).
3. Design and study the application of operational amplifier, (current to voltage converter instrumentation amplifier, buffer, voltage clamp, low and high pass filter, half wave rectifier etc.).
4. Design and study the Low/High pass active filters using 741 IC.
5. Design and study the application of 555 timers IC (mono-stable, astable and bi-stable multi-vibrators).
6. Design a fixed and self bias transistor binary and triggering of binary, using IC's construct and study RS, JK (Master stave), T and D flip-flops.
7. Design and study of a half and full adder with different Boolean expression using IC's.
8. Synchronous and asynchronous BCD counters, Memory shift register with IC's.
9. Frequency counter and optional digital clock.
10. Design and construct and analog to digital and digital to analog converters using IC's.
11. Design and study of decoder, encoder, multiplexer and de-multiplexer circuits and compare the input out put waveforms.
12. To construct and understand an operation of arithmetic logic unit and study of different arithmetic logic operations.
13. To construct and study of data storage and retrieved using semiconductor memory and understand the process of fetching an instruction and its operand with ALU.

14. Using microprocessor trainer's study of microprocessor application working form host personal computers.
15. Design of Digital Clock.

Recommended Books:

1. Floyd T L. 2010, Digital Fundamentals 10TH Ed. Prentice-Hall Intern. Inc., Englewood Cliffs (USA).
2. Lathi B P. 2009, Modern Digital and Analog Communication Systems 4TH Ed. Oxford University Press.
3. Tocci R J. 2010, Digital Systems: Principles and Applications 11TH Ed. Prentice-Hall Intern. Inc., Englewood Cliffs (USA).
4. Mano M M. 2002, Digital Design 4TH Ed. Prentice-Hall Intern. Inc., Englewood Cliffs (USA).

PHY-614	Environmental Physics Lab Course*	3 (0 – 3)

Students are required to study the functioning and data analysis obtained from various machines used in Atmospheric & Environmental Physics. The students have to work in some agencies where these facilities are available. The details of the activities performed in this lab are as under.

1. Solid Aerosols / soils sample collections
2. Physio chemical & mechanical properties of solid aerosols / soils samples.
3. Qualitative & Quantitative analysis solid aerosols / soils samples.
4. Morphological & texture analysis of solid aerosols / soils samples.
5. Climatological data analysis with respect to global warming & global cooling (whether trends)

Recommended Books:

1. Zhang, Z..M, B.K. Tsai and G. Machin. 2010. Experimental Methods in Physical Science Vol. 2, Academic Press, USA.
2. David W I F, K Shankland, L.B McK usker and C Baerloche. 2006, Structure Determination from Powder Diffraction Data. Oxford University Press, New York
3. "The status of Climate Variation in Pakistan & Its Impact", by SMRC. No. 10 SAARC Met. Research Centre, 1st Edition 2004..
4. Hanlon, J. F. 2003. A User Guide to Vacuum Technology. John Wiley and sons, USA.
5. Grasseur G P, 1999, Atmospheric Chemistry & Global Change (Publisher: Oxford), 1st Edition.
6. Vonstorch H. 2001, Statistical Analysis in Climate Research. 1st Ed. Publisher: Cambridge.
7. Thompson R D. 1997, Applied Climatology. 1st Ed. Publisher: Routledge.
8. Hougton, 1985, Hand Book of applied Meterology, 1st Ed. Publisher: Wiley

PHY-616	Health and Medical Physics -II*	3 (3 – 0)

Radiation Dosimetry: History of Absorbed Dose, Stochastic and Non-stochastic quantities, units for absorbed Dose, Absorbed Dose Calorimeters, Exposure and its measurements. The free-air chamber, Exposure measurement with calibrated cavity chamber. The concept of Kerma, absorbed Dose in air, Absorbed dose in other Materials, Factors converting Exposure to Absorbed Dose to wake, High energy calibrations. The Bragg-Gray Cavity theory. Methods of Dosimetry: Calorimeters, Ionization chambers, chemical Dosimetry, Thermo luminescence Dosimetry (TLD), Photographic Dosimeter, Scintillation Detectors, other Dosimetric Systems. Health Physics: Cardinal principles of radiation protection, minimize time, Maximize distance, Maximize shielding, Time, Distance and shielding, Maximum permissible dose, whole-body occupational exposure, whole-body non-occupational exposure, partial body occupational exposure, X-ray and pregnancy, Basic radiation safety criteria, effective dose-equivalent, allowable limit on intake (ALI), inhaled radioactivity, derived air concentration, Gastrointestinal tract, Basis of radiation safety regulations

Recommended Books:

1. Forty R. 2010,ICFA, Instrumentation School.
2. RIEGLER W. 2008,CERN, Academic Training Course.

3. Joran C. 2003, CERN, summer student lecturers
4. Cember H. 1996, Introduction to Health Physics. 3rd Ed. McGraw Hill, New York.
5. Williams J R and D I Thwaits, 1993, Radiotherapy Physics. Oxford University Press, New York.
6. Armstrong P and L Martin. Diagnostic Imaging 4th Ed. Blackwell Science Ltd.
7. Bushong S C. 1993, Radiologic Science of Technologists. 5th Ed. Mosby.
8. Greening J R. 1985,Fundamentals of Radiation Dosimetry. 2nd Ed. Adam Hilger Ltd., Bristol

PHY-618	Climatology and Meteorology-II*	3 (3 – 0)

Climatology: Climatic elements; principles of climate classification; world climate classification; climates of Asia; climates of the sub-continent; the climate of Pakistan. Climate Change: Meteorological factors affecting climate; greenhouse gases; El-Nino, La-Nina. Tropical Meteorology: Tropical general circulation, Diurnal variations of meteorological elements in the tropics, A survey of low-latitude weather disturbances easterly waves' intertropical convergence zone. Monsoons, Tropical cyclones, structure and formation of cyclones. Aviation Meteorology: meteorological aspects of flight planning's, aviation hazards and their association with synoptic patterns, aircraft icing, turbulence, fog, thunderstorms, dust storms, low-level vertical wind shear, jet stream formation & structure.

Recommended Books:

1. Vonstorch H. 2001, Statistical Analysis in Climate Research. 1st Ed. Publisher: Cambridge.
2. Brasseur G P, 1999, Atmospheric Chemistry & Global Change (Publisher: Oxford), 1st Edition.
3. Morgan M, 1991, Meteorology 3rd Ed. (Publisher: MacMillion),
4. Hougton, 1985, Hand Book of applied Meterology, 1st Ed. Publisher: Wiley
5. Hidore O. 1984, Climatology 1st ed. (Publisher: Merrill).
6. Carlson. 1981, Tropical Meterology, 1st Ed. Publisher: The Pennsylvania State University.
7. Haltiner and Martin. 1957, Dynamical & Physical Meteorlogy 1st Ed. (Publisher: McGraw Hill).

PHY-620	**Computational Materials Physics Lab Course***	**3 (0 – 3)**

Students are expected to systematically understand the use of an electronic structure code in laboratory for predicting basic properties of crystalline materials: geometrical, electronic, optical and magnetic properties. In doing so students will learn how to assess the reliability of the predicted properties by comparing their results with data available in scientific literature. Students are also required to compile and submit their findings in form of a lab report at the end of semester. The details of the activities performed during this lab course are as under.

1. To visualize and manipulate crystallographic data and determine structural properties using software for crystalline and molecular structure (VESTA or XCrySDen).

2. To contract and visualize unit cells of solid structures using data obtained from Crystallographic Information File (CIF).

3. To study the effect of density functional theory calculations parameters like k points, energy cutoff etc. on the calculated physical properties.

4. To test the performance of standard exchange-correlation functionals of DFT in determining structural properties of solids.

5. To determine the preferred crystal structure of an elemental solid using DFT calculations and comparing results with available literature.

6. To determine the relative stability of a binary or ternary semiconductor in different crystal structures from total energy calculations.

7. To structurally optimize a binary or ternary semiconductor material and determine its opto-electronic properties.

8. To construct and simulate point defects in solids using the supercell approach.

9. To construct and simulate slab structure of semiconductor material for density functional theory calculations

for determining surface energies and adsorption of atoms.

10. To reproducing physical properties of a selected binary or ternary solid reported in scientific literature.

Recommended Books:

1. Sholl, D. S. and Steckel, J. A. 2009. Density Functional Theory: A Practical Introduction. 1st Edition, JohnWiley & Sons, USA.
2. Tilley, R. J. D. 2013. Understanding Solids: The Science of Materials. 2nd Edition, John Wiley & Sons, USA.
3. Martin, R. M. 2008. Electronic Structure – Basic Theory and Practical Methods. Vol. 1. 1st Edition, Cambridge University press, UK.
4. Ashkroft, N. W. and Mermin, N. D. 2011. Solid State Physics. Reprint, Cengage Learning, USA. 5. Kittle, C. 2004. Introduction to Solid State Physics. 8th Edition. John Wiley & Sons, USA.
6. Hergert, W., Ernst, A. and Däne, M. (ed). 2004. Computational Materials Science: From Basic Principles to Material Properties. Springer, USA.

PHY-629	**Seminar (Research)**	**1 (0 – 1)**
PHY-630	Thesis **	6 (0- 6)
PHY-631	Project***	3 (0 –3)

Note: * One optional subject to be chosen in 7th and 8th semester.
** Thesis will be allotted in the 7th semester. However, the credit hours for thesis will only count towards the 8th semesters.
*** Projects may be opted in lieu of option-II of the subject already taken by the student in 7th semester.
+ Internship may be offered to students during summer vacations as optional activity.

کورس کوڈISL-321

Islamic Studies (Compulsory)

اسلامیات(لازمی)

Title	Description
Semester	

Nature of Course	Compulsory Course. C-4
No. of Credit Hours	
Objectives	طلبہ کو قرآن و حدیث سے استفادہ کے قابل طلبہ کے قلوب و اذہان میں قرآن و سنت کی روح اور علم کو راسخ کرنا طلبہ میں اسوہ ختم المرسلین صلی اللہ علیہ و سلم کی اتباع اور حب رسول کا جذبہ پیدا کرنا اسلام کی بنیادی تعلیمات کا فہم آسان بنانا اور طلبہ کی اسلامی بنیادوں پر تربیت کرنا امت مسلمہ کو درپیش عصر جدید کے چیلنجز سے طلبہ کو آگاہ کرنا اور انہیں اس قابل بنانا کہ وہ ان سے عہدہ برآہوسکیں۔

Sr. No.	Title	Description
1	القرآن الکریم	مطالعہ قرآن مجید کی ضرو رت و اہمیت قرآن مجید کا اجمالی تعارف اور اعجاز تراجم و تفاسیر کا مختصر تعارف منتخب قرآنی آیات کا لفظی و با محا ورہ تر جمہ و تشریح قرآن مجید کی مندرجہ ذیل آیات کا ترجمہ و تشریح کریں (i) (سورۃ البقرۃ:آیات 1تا 5و4 28 تا286) ایمانیات۔ (ii) (سورۃالاحزاب :آیات: 56,40,33,32,21,6تا59) (تخصصات نبویہ: اسوہ حسنہ، ختم نبوت، مقامِ رسا لت ، ناموسِ رسا لت، ازواجِ النبیؐ۔ (iii) (الفتح :آیت:. 29)(رسالتِ محمدیہ اور خصا ئصِ اصحاب رسول ؐ) (iv) (سورۃ الصف :آیات:1 تا 14) (بشارت بعثت ختم المر سلین ،ہجرت،جہاد، نصرت اور غلبہ دین) (v) (سورۃ الحجرات: آیات: 1 تا 18) (ادب نبوی و معا شرتی احکام) (vi) (سورۃالانعام : آیات : 151 تا 153)۔(حقوق العباد)۔ (vi) (سورۃالفرقان: آیات: 63 تا 77)۔(آداب معا شرت)۔
2	الاحادیث النبویۃ	مطالعہ حدیث کی ضرورت و اہمیت اقسام حدیث اور وحی الہی حدیث کی امہات الکتب کا مختصر تعارف
3		درج ذیل احا دیث نبویہ کا لغوی و با محا ورہ ترجمہ اورتشر یح 1۔عَنْ عُمَرَ بْنِ الْخَطَّا بِ رَضِیَ اللہ عَنْہُ قَالَ سَمِعْتُ رَسُوْل اللہِ صَلَّی اللہُ عَلَیْہِ وَسَلَّم یقُوْ لُ: اِنَّمَا الاعْمَالُ بِا لنِّیاتِ، وَ اِنَّمَا لِامْرِیءٍ مَانَوٰی ، فَمَنْ کَا نَتْ ھِجْرَتُہ، اِلٰی اللہِ وَرَسُوْلِہٖ فَھِجْرَتہ، اِلَی اللہِ وَرَسُوْلِہٖ۔ وَ مَنْ کَا نَتْ ھِجْرَتُہ، اِلٰی دُ نْیا یصِیْبُھَا ، اَو امْرَأۃ یتَزَوَّجُھَا فَھِجْرَتُہ، اِلیٰ مَا ھَاجَرَ اِلَیْہِ (صحیح بخاری :1) 2۔عَنْ عُثْمَانَ بْنِ عَفَّا نٍ رَضِیَ اللہ عَنْہُ عَنِ النَّبِیِّ صَلَّی اللہُ عَلَیْہِ وَسَلَّمَ قَالَ: خَیْرُ کُمْ مَنْ تَعَلَّمَ الْقُرْآنَ وَعَلَّمَہ،(صحیح بخاری ، حدیث نمبر۵۰۲۷) 3۔عَن ما لِک بنِ اَنَسٍ رَضِیَ اللہ عَنْہُ قَالَ : قَال رَسُوْلُ اللہِ صَلَّی اللہُ عَلَیْہِ وَسَلَّمَ: تَرَ کْتُ فِیْکُمْ اَمْرَیْنِ لَنْ تَضِلُّوْا مَا تَمَسَّکْتُم بِھِمَا کِتَا بُ اللہِ وَسُنَّۃُ رَسُوْلِہ (رواہ مالک فی المؤطا مر سلا) 4۔عَنْ عَبْدِاللہِ بْنِ عُمَرَرَضِیَ اللہُ عَنْہُمَا قَالَ : قَالَ رَسُوْلُ اللہِ صَلَّی اللہُ عَلَیْہِ وَسَلَّم بُنِی الْاِ سْلَامُ عَلٰی خَمْسٍ شَھَادَۃِ اَنْ لَّآاِلٰہ اِلَّااللہُ وَاَنَّ مُحَمَّدًا عَبْدُہ'وَرَسُوْلُہ' وَ اِقَا مِ الصَّلٰوۃِ وَاِیْتَآءِ الزَّکٰوۃِ وَحَجِّ الْبَیْتِ وَصَوْمِ رَمَضَانَ (صحیح مسلم :113) 5۔عَن عُمَرَ بنِ الْخَطَّابِ رَضِیَ اللہ عَنْہُ قَالَ بَیْنَمَا نَحْنُ عِنْد رَسُوْلِ اللہِ صَلَّی اللہُ عَلَیِ وَسَلَّمَ ذَاتَ یوْمٍ اِذ طَلَعَ عَلَیْنَا رَجُلُ، شَدِیْدُ بیا ضِ الثِّیابِ شَدِیْدُ سَوَادِ الشَّعْرِ لایرَی عَلَیْہِ اَثَرُ السَّفَرِ وَمَا یعْرِفُہ، مِنَّا اَحَد حَتّٰی جَلَسَ اِلَی النَّبِیِّ صَلَّی اللہُ عَلَیْہِ وَسَلَّمَ فَاَسْنَدَ رُکْبَتَیْہِ اِلٰی رُکْبَتَیْہِ وَ وَضَعَ کَفَّیْہِ عَلیٰ فَخِذیہِ وَقَا لَ: یا مُحَمَّدُ اَخْبِرْنِیْ

عَنِ الْإِسْلَامِ؟ فَقَالَ رَسُوْلُ اللهِ صَلَّى اللهُ عَلَيْهِ وَسَلَّمَ: الإِسْلَامُ اَنْ تَشْهَدَ اَنْ لَا اِلٰهَ اِلَّا اللهُ وَاَنَّ مُحَمَّداً رَّسُوْلُ اللهِ صَلَّى اللهُ عَلَيْهِ وَسَلَّمَ وَتُقِيْمَ الْصَّلٰوةَ وَتَؤ تِيَ الزَّكٰوةَ وَتَصُوْمَ رَمَضَانَ وَتَحُجَّ الْبَيْتَ اِنِ اسْتَطَعْتَ اِلَيْهِ سَبِيْلاً ،قَا لَ صَدَقْتَ، قَالَ فَعِجْنَا لَه، يسْأَلُه، وَيصَدِّ قُه، ،قَا لَ: فَاَخْبِرْنِيْ عَنِ الْإِيْمَانِ؟ قَالَ اَنْ تُؤ مِنَ بِا للهِ وَ مَلٰئِكَتِهٖ وَكُتُبِهٖ وَرُسُلِهٖ وَالْيَوْمِ الاخِرِ وَتُؤ مِن بِالْقَدْرِ خَيْرِهٖ وَشَرِّه ، قَا لَ صَدَقْتَ، قَا لَ:فَاَخْبِرْنِيْ عَنِ الْإِحْسَانِ؟ قَالَ :اَنْ تَعْبُدَ اللهَ كَاَنَّكَ تَرَاهُ فَاِنْ لَّمْ تَكُنْ تَرَاهُ فَاِنَّهٗ يرَا كَ،قَا لَ:فَاَخْبِرْنِيْ عَنِ السَّاعَةِ؟ قَالَ: مَا الْمَسْؤُلُ عَنْهَا بِأَعْلَمَ مِنَ السَّا ئِلِ، قَا لَ:فَاَخْبِرْنِيْ عَنِ اَمَارَاتِهَا ؟ قَالَ: اَنْ تَلِدَ الاَمَةُ رَبَّتَهَا وَ أَنْ تَرَى الْحُفَاةَ الْعُرَاةَ الْعَالَةَ رِعَاءَ الشَّاءِ يتَطَا وَلُوْنَ فِيْ الْبُنْيَانِ، قَالَ: ثُمَّ انْطَلَقَ، فَلَبِثَ مَلِياً ثُمَّ قَالَ لِيْ: يا عُمَرُ أَ تَدْرِيْ مَنِ السَّا ئِل؟ قُلْتُ اَللهُ وَرَسوْلُه، اَعْلَمُ، قَالَ فَاِ نَّه، جِبْرِيْلُ اَتَاكُمْ يعَلِّمُكُمْ دِيْنَكمْ (رواه مسلم : 93)		
6- عَنْ شِبْرُمَةَ ابْنِ مَعْبَدٍ رَضِىَ الله عَنْهُ قَالَ: قَالَ رَسُوْلُ اللهِ صَلَّى اللهُ عَلَيْهِ وَسَلَّم مُرُوْا الصَّبِيَّ بِالصَّلٰوة اِذا بَلَغ سَبْعَ سِنِيْنَ وَ اِذَا بَلَغَ عَشْرَ سِنِيْنَ فَاضْرِبُوْا عَلَيْهَا اَخرَجَه اَبُوْدَاوُدَ وَ التِّرْمِذِيُّ وَلَفْظُه' عَلِّمُوْا الصَّبِيَّ الصَّلٰوةَ اِبْنَ سَبْعِ سِنِيْنَ وَاضْرِبُوْا عَلَيْهَا ابْنَ عَشرة (صحيح بخارى،ترمذى:407) ٧-عَنْ مُعَا وِيةَ رَضِىَ الله عَنْهُ قَالَ: قَالَ رَسُوْلُ اللهِ صَلَّى اللهُ عَلَيْهِ وَسَلَّم مَنْ يرِد اللهُ بِهٖ خَيْراً يفَقِّههُ فِى الدِّيْنِ (رواه البخارى :3116) 8-عَنْ اَبىْ هُرَيْرَةَ رَضِىَ الله عَنْهُ قَالَ: قَالَ رَسُوْلُ اللهِ صَلَّى اللهُ عَلَيْهِ وَسَلَّمَ مَنْ سَلَك طَرِيْقاً يلْتَمِسُ فِيْهِ عِلْمًا سَهَّلَ اللهُ بِهٖ طَرِيْقًا اِلَى الْجَنَّةِ وَمَا اجْتَمَعَ قَوْمٌ فِيْ بَيْت مِّنْ بُيُوْتِ اللهِ يَتْلُونَ كِتَابَ اللهِ وَيَتَدَارَسُوْنَ بَيْنَهُمْ اِلَّا نَزَلَتْ عَلَيْهِم السَّكِيْنَةُ وَغَشِيَتْهُمُ الرَّحْمَةُ وحَفَّتْهُم الْمَلٰئِكَةُ وَذَكَرَهُمُ اللهُ فِيْ مَنْ عِنْدَه وَمَنْ بَطَّابِهٖ عَمَلُه' لَم يُسْرِعْ بِهٖ نَسَبُه(رواه مسلم) 9-عَنْ اَبِىْ هُرَيْرَة رَضِىَ اللهُ عَنْهُ قَالَ كَانَ رَسُوْلُ اللهِ صَلَّى اللهُ عَلَيْهِ وَسَلَّم يَقُوْلُ اَللّٰهُمَّ اِنِّىْ اَعُوْذُبِكَ مِنَ الْاَرْبَع مِنْ عِلْمٍ لَّا يَنْفَعُ وَ مِنْ دُعَاءٍ لا يُسْمَعُ وَ مِنْ قَلْب لَايَخْشَعُ وَمِن نَفْسٍ لَاتَشْبَع ۔ (رواه مسلم و احمد ،سنن ابن ما جه :250) 10-عَنِ ابْنِ مَسْعُوْدٍ رَضِىَ اللهُ عَنْهُ عَنِ النَّبِيِّ صَلَّى اللهُ عَلَيْه وَسَلَّمَ قَالَ:لَا تَزُوْلُ قَدَمَا اْبنِ اٰدَمَ يَوْمَ الْقِيٰمَةِ مِنْ عِنْدِ رَبِّه حَتّٰى يُسْئَا لُ عَنْ خَمْسٍ: عَنْ عُمرِه فِيْمَا اَفنَاهُ وَعَنْ شَبَابِه فِيمَا أَبْلا هُ وَ عَنْ مَالِه مِنْ اَيْنَ اِكْتَسَبَه وَ فِيْمَآ اَنْفَقَه وَمَاذَا عَمِلَ فِيْمَا عَلِم.(جامع الترمذى:2416)		4
11-عَنْ عَبْدِاللهِ رَضِىَ اللهُ عَنْهُ قَالَ: قَالَ رَسُوْلُ اللهِ صَلَّى اللهُ عَلَيْهِ وَسَلَّمَ طَلَبُ كَسبِ الْحَلَا لِ فَرِيْضَة بَعْدَ الْفَرِ يْضَةِ (شعب الايمان بيهقى) 12- عَنْ اَبِىْ سَعِيْدٍ رَضِىَ اللهُ عَنْهُ عَنِ النَّبِيِّ صَلَّى اللهُ عَلَيْهِ وَسَلَّمَ قَالَ اَلتَّا جِرُ الصَّدُوْقُ الْاَ مِيْنُ مَعَ النَّبِيِّيْنَ وَ لصِّدِّيْقِيْنَ وَالشُّهَدَاء (جامع تر مذى:1209) 13-عَنْ اَبِىْ هُرَيْرَةرَضِىَ اللهُ عَنْهُ اَنَّ رَسُوْلَ الله صَلَّى اللهُ عَلَيْهِ وَسَلَّم قَالَ: أَ تَدْرُوْنَ مَا الْمُفْلِسُ؟ قَالُوْا اَلْمُفْلِس فِيْنا مَنْ لاَّدِرْهَم لَه' وَلَا مَتَاعَ فَقَالَ:اِنَّ الْمُفْلِسَ مِن اُمَّتِىْ مَن يَّأْتِىْ يَوْمَ الْقِيٰمَةِ بِصَلاةٍ وَصِيَامٍ وَزَكٰاةٍ وَ يَأْتِىْ قَدْ شَتَمَ هٰذَا وَقَذَفَ هٰذَا وَاَكَلَ مَال هٰذَا وَسَفَكَ دَمَ هٰذَا وَضَرَبَ هٰذَا فَيُعْطٰى هٰذَا مِنْ حَسَنَاتِهٖ فَاِنْ فُنِيَتْ حَسَنَاتُه' قَبْلَ اَنْ يُّقضٰى مَا عَلَيْهِ اُخِذَ مِنْ خَطَايَاهُم فَطُرِحَت عَلَيْهِ ثُمَّ طُرِحَ فِى النَّارِ-(رواه مسلم، كتاب البرّ:6579) 14-عَنْ اَبِى الدَّرْدَآءِ رَضِىَ اللهُ عَنْهُ اَنَّ النَّبِىَّ صَلَّى اللهُ عَلَيْهِ وَسَلَّمَ قَالَ : مَا شَىْءٍ اَثْقَلَ فِيْمِيْزَانِ ا لْمُؤْمِنِ يَوْمَ الْقِيٰمَة مِنْ خُلُقٍحَسَنٍ فَاِنَّ اللهَ تَعَالٰى يَبْغِضُ الْفَاحِشَ الْبَذِىَّ (ترمذى:2002) 15- عَنِ ابْنِ عَبَّاسٍ رَضِىَ اللهُ عَنْهُ اَنَّ النَّبِىَّ صَلَّى اللهُ عَلَيْهِ وَسَلَّمَ قَالَ:اَرْبَع مَنْ اُعْطِيَهُنَّ فَقَدْ اُعْطِىَ خَيْرَ الدُّنْيا وَالْاٰخِرَةِ قَلْبًا شَاكِرًا وَّلِسَا ناً ذَاكِرًا وَّ بَدنًا عَلَى الْبَلَآء صَابِرًا وَّزَوْجَةً لا تَبْغِيْهِ حُوْبًا فِيْ نَفْسِهَا وَمَالِهٖ (سنن نسا ئى، كنز العمال :43409)		5

6		16-عَنْ اَبِیْ هُرَیرَۃَ رَضِیَ اللهُ عَنْہُ قَال قَالَ:رَسُوْلُ صَلَّی اللهُ عَلَیْہِ وَسَلَّم : اِجْتَنِبُوْا السَّبْعَ المُوْبِقَاتِ،قَالُوا یا رَسُوْلَ اللهِ وَمَا ھُنَّ قَالَ:اَلشِّرْکُ ُ بِا للهِ وَالسِّحْرُ وَقَتْلُ النَّفْسِ الَّتِیْ حَرَّمَ اللهُ اِلاَّ بِالْحَقِّ وَاَکْلُ الرِّبوٰا وَاَکلُ مَالِ الیتِیْمِ وَالتَّوَلّی یوْمَ الزَّحْفِ وَ قَذْفُ الْمُحْصَنَاتِ الْمُؤمِنَاتِ الْغَافِلاَتِ (متفق علیہ) ۱۷-عَنْ اَبِیْ سَعِیْدِ الْخُدْرِی رَضِیَ اللهُ عَنْہُ قَالَ سَمِعْتُ رَسُوْلَ اللهِ صَلَّی اللهُ عَلَیْہِ وَسَلَّم یَقُوْلُ مَنْ رَّای مِنْکُمْ مُنْکَرًا فَلْیُغَیِّرْہُ بِیَدِہٖ فَا نْ لَّمْ یَسْتَطِع فَبِلِسَانِہٖ فَاِنْ لَّمْ یَسْتَطِعْ فَبِقَلْبِہٖ وَذٰلِکَ اَضْعَفُ الْاِیْمَانِ (رواہ مسلم:۱۷۷) 18-عَنْ اُسَامۃَ بْنِ زَیْدٍ رَضِیَ اللهُ عَنْہُ قَالَ:قَالَ رَسُوْلُ اللهِ صَلَّی اللهُ عَلَیْہِ وَسَلَّم یُجَاءُ بِرَجُلٍ یَوْمَ الْقِیٰمَۃِ فَیُلْقٰی فِی النَّا رِفَتَنْدَلِقُ اَقْتَابُہٗ فِیْ النَّارِ فَیَطْحَنُ فِیْھَاکَطَحْنِ الْحِمَارِ بِرَحَاہُ فَیَجْتَمِع اَھْلُ النَّارِ عَلَیْہِ فَیَقُوْلُوْنَ اَیْ فُلان مَا شَانُکَ الیْسَ کُنْتَ تَاْمُرُنَا بِالْمَعْرُوْفِ وَتَنْھٰنَاعَنِ الْمُنْکَرِ؟قَالَ کُنْتُ ا مُرُکُمْ بِالْمَعْرُوْف وَلاَ ا تِیْہِ وَاَنَھَاکُمْ عَنِالْمُنْکَرِوَا تِیہْ ِ (بخاری:۳۲۶۷) 19-عَنْ اَنَسٍ رَضِیَ اللهُ عَنْہُ قَالَ رَسُوْلُ اللهِ صَلَّی اللهُ عَلَیْہِ وَسَلَّم وَالَّذِیْ نَفْسِیْ بِیَدِہٖ لَایُؤْمِنعَبْدٌ حَتّٰی یُحِبَّ لِاَ خِیْہِ مَا یُحِبُّ لِنَفْسِہٖ.(رواہ مسلم:۱۷۰) 20-وَعَنِ النُّعْمَانِ بْنِ بَشِیْرٍ رَضِیَ اللهُ عَنْہُ قَالَ قَالَ رَسُوْلُ اللهِ صَلَّی اللهُ عَلَیْہِ وَسَلَّم تَرَی الْمُؤْمِنِیْنَ فِیْ تَرَاحُمِھِمْ وَتَوَادِّھِمْ وَتَعَاطُفِھِمْ کَمَثَلِ الْجَسَدِ اِذَا اشْتَکٰی عُضْوٌ تَدَاعٰی لَہٗ سَائِرُ الْجَسَدِ بِالسَّھَرِوَالْحُمّٰی (متفق علیہ، بخاری : 6011)
7		21-عَنْ عَبْدِاللهِ ابْنِ عُمَرَرَضِیَ اللهُ عَنْہُما قَالَ قَالَ رَسُوْلُ اللهِ صَلَّی اللهُ عَلَیْہِ وَسَلَّم اَلاَ کُلُّکُمْ رَاعٍ وَکُلُّکُمْ مَسْئُوْلٌ عَنْ رَّعِیتِہٖ فَالْاِمَامُ الاعظم الَّذِیْ عَلَی النَّاس ِرَاعٍ وَھُوَمَسْئُوْل عَنْ رَّعِیَّتِہٖ وَالرَّجُلُ رَاعٍعَلٰی اَھْلِ بَیْتِہٖ وَھُوَمَسْئُوْلٌ عَنْ رَّعِیَّتِہٖ وَالْمَرْاَۃُ رَاعِیَۃٌ عَلٰی بَیْتِ زَوْجِھَا وَوَلَدِہٖ وَھِیَ مَسْئُولَۃٌ عَنْھُمْ وعَبْدُ الرَّجُلِ رَاعٍ عَلٰی مَالِ سَیِّدِہٖ وَ ھُوَمَسْئُوْلٌعَنْہُ اَلاَ فَکُلُّکُمْ رَاعٍ وَکُلُّکُمْ مَسْئُوْلٌ عَنْ رَعِیَّتِہٖ (بخاری:۷138 و ترمذی:۱۷05) 22-عَنْ اَبِیْ ھُرَیْرَ ۃَ رَضِیَ اللهُ عَنْہُ قَالَ، قَالَ رَسُوْلُ اللهِ صَلَّی اللهُ عَلَیْہِ وَسَلَّمَ: مَثَلِیْ وَ مَثَلُ الْاَنْبِیاءِ کَمَثَلِ قَصَرٍ أَحْسَنَ بُنْیا نہُ ، تُرِکَ مِنْہُ مَوْ ضَعِ لَبِنَۃٍ، فَطَا فَ بِہالنَّظَّا رُ یتَعَجَّبُوْنَ مِنْ حُسْنِ بَنَا ئِہٖ اِلَّا مَوْ ضَعِ تِلْکَ اللَّبِنَۃِ، فَکُنْتَ اَنَا سَدَدْتُ مَوْ ضَعَ اللَّبِنَۃَ، خُتِمَ لِیَ الْبُنْیانَ وَخُتِمَ بِی الرُّسُلُ وَ فِیْ رِوَایۃٍ: فَاَنَا اللَّبِنَۃُ وَاَنَا خَا تَمُ النَّبِیِّینَ۔ (رواہ البخاری :3535) 23-عَنِ اَنَسٍ رَضِیَ اللهُ عَنْہُ عَنِ النَّبِیِّ صَلَّی اللهُ عَلَیْہِ وَسَلَّمَ قَالَ: اَرْحَمُ أُمَّتِیْ بِأُمَّتِیَاَبُوْ بَکْرٍ وَ اَشَدُّ ھُمْ عُمَرُ وَ اَصْدَ قُھُمْ حَیا ئً عَثْمَانُ، وَأَقْضَاھُمْ عَلِیٌّ وَ اَفْرَضُھُمْ زَیْدُ بْنُ ثَا بِتٍ، وَ أَقْرَءُ ھُمْ أُبَیُّ بْنُ کَعْبٍ وَ لِکُلِّ أُمَّۃٍ أَمِیْن وَ أَمِیْنُ ھٰذِہِ الْأُمَّۃِ أَبُوْ عُبَیْدَۃَ بْنُ الْجَرَّاحِ ۔(رواہ احمد والتر مذی ، مشکوۃ المصا بیح ، باب منا قب العشرۃ) 24-عَنْ اَبِیْ بَکرَۃَ رَضِیَ اللهُ عَنْہُ قَالَ: رَاَیت رَسُوْل اللهِ صَلَّی اللهُ عَلَیْہِ وَسَلَّم عَلَی الْمِنْبَرِ وَالْحَسَنُ بْنُ عَلِیٍّ اِلٰی جَنْبِہٖ وَھُوَ یقْبِلُ عَلَی النَّاسِ مَرَّۃً وَعَلَیْہِ اُخْرٰی وَیقُوْلُ: اِنَّ ابْنِیْ ھٰذا سَیِّد وَ لَعَلَّ اللهَ أنْ یصْلِحَ بِہٖ بَیْنَ فِئَتَیْنِ عَظِیْمَتَیْنِ مِنَ الْمُسْلِمِیْنَ(بخاری:۲۷04) 25-وَعَن عِمْرَانَ بْنِ حُصَیْنٍ رَضِیَ اللهُ عَنْہُ قَال قَالَ:رَسُوْلُ اللّٰہِصَلَّی اللهُ عَلَیْہِ وَسَلَّم : خَیْرُ أُمَّتِیْ قَرْنِیْ ثُمَّ الَّذِیْنَ یلُوْنَھُمْ،ثُمَّ الَّذِیْنَ یلُوْنَھُم-------(متفق علیہ بخاری:3650) 26-عَنْ جَا بِرِبْنِ عَبْدِ اللهِ رَضِیَ اللهُ عَنْہُ قَالَ: خَطَبَنَا رَسُوْلُصَلَّی اللهُ عَلَیْہِ وَسَلَّمَ فِیْ وَسْطِ اَیامِ التَّشْرِیْقِ خُطْبَۃَ الْوَدَاعِ فَقَالَ: یاَیھَا النَّاسُ:اِنَّ رَبَّکُمْ وَاحِد ،وَاِنَّ اَبَاکُمْ وَاحِد اَلَالا فَضْلَ لِعَرَبِی عَلٰی عَجَمِی وَلَا لِعَجَمِی عَلٰی عَرَبِیّ، وَلَا لِاَ حْمَرَعَلٰی اَسْوَدَ وَلَلا لِاَسْوَدَ عَلٰی اَحْمَرَ اِلَّا بِالتَّقْوٰی۔اِنَّ اَکْرَمَکُمْ عِنْدَ اللهِ اَتْقٰکُمْ، اَلَا ھَلْ بَلَّغْتُ؟ قَا لُوْا بَلٰی یا رَسُوْ لَ اللهِ، قَالَ: فَلْیبَلِّغُ الشَّا ھِدُ الْغَائِب فَلْیبَلِّغُ الشَّا ھِدُ الْغَائِب۔(البیھقی، شعب الایمان، باب فی حفظ اللسان، فصل فی حفظ اللسان عن الفخر با لأباء)
8		مطالعہ سیر ت کی ضرو رت و اہمیت ۔ اردو کتب سیرت کا تعارف

9	سیر ت النبی صلی اللہ علیہ وسلم	نبی کر یم صلی اللہ علیہ وسلم کی حکمت انقلاب۔ ہجرت، میثاق مدینہ، صلح حدیبیہ، خطبہ حجۃ الوداع
10		تزکیہ نفس اور تعمیر سیرت و شخصیت کانبو ی منہاج اور عملی نمو نے۔ صحابہ کرام ، امہات المومنین
11		تشکیل اجتماعیت و معاشرت اور اسو ہ حسنہ ۔
12		(الف) اسلامی تہذیب و ثقا فت کے خصا ئص۔ توحید،روحا نیت، تصور مسؤلیت، انسانی عظمت و مساوات اور عالمگیر اخوت۔
13	اسلامی تہذیت وثقا فت	(الف) اسلامی تہذیب و ثقا فت کے خصا ئص۔ عدل اجتماعی، اخلاقی اقدار ، انسا نی حقوق، روا داری، اعتدال و توازن
14		(ب) اسلامی تہذیب و ثقا فت کے عا لمی اثرات
15		(ج) مغربی تہذیب و ثقا فت اور اسلام: اسلام اور امن عالم تہذیبوں کے تصادم کے نظریہ کا تنقیدی جا ئزہ

ISL-322 کورس کوڈ:

Ethics (For Non Muslims)

اخلاقیات (برائے غیر مسلم طلبہ)

Title	Description
Semester	
Nature of Course	
No. of Credit Hours	
Objectives	To promote the moral values in society To make the students avoide evils and do virtues To create the awareness in the students

Sr. No.	Title	Description

	Defination and scope of ethics	Relation of ethics to psychology, metaphysics and religion . A brief review of major theories of the maoral standard The standard as law The standard as Happiness The standard as Perfection
	promotion of moral values	Promotion of moral values in society through family& various educational and cultural institutions ,concept of good and evil , freedom and responsibility,Various theories of punishment.
	Ethical teachings	Ethical teachings of world religions with special referenc to Hinduism, Christianty, Budhism, Judaism and Islam.
	Ethical percepts from Quranic sayings	Ethical percepts from Quranic sayings of the Holy Prophet (Peace be upon him) Islam's attitude towards minorities.
	Books Recommended	Relevant portions of the following books: J.S Mackenzio! A Manual of Ethics. Herol H.Titus! Ethics for To-day. B.A Dar! Quranic Ethics. Proceeding of to Islamic Colloquium, Lahore 1957. Islamic state: Abu-ul-Ala Madudi.