ETERNAL UNIVERSITY
BARU SAHIB

SYLLABUS

DOCTOR OF PHILOSOPHY - PHYSICS

DEPARTMENT OF PHYSICS

AKAL COLLEGE OF BASIC SCIENCES

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PROGRAMME STRUCTURE

Ph.D. PHYSICS

SEMESTER- I

S.No.	Course Code	Course Title	Theory	Tutorial	Practical
Optional Courses (Any two courses taking one from each option)					
Option-1					
1.	PHY-601	Advanced Nano Physics	3	1	0
2.	PHY-602	Advanced Condensed Matter Physics	3	1	0
3.	PHY-603	Advanced Quantum Mechanics	3	1	0
4.	PHY-608	Renewable Energy Sources and Technologies	3	1	0
Option-II					
5.	PHY-604	Advanced Materials Science	3	1	0
6.	PHY-605	Advanced Computational Physics	3	1	0
7.	PHY-606	Advanced Optoelectronics	3	1	0
8.	PHY-610	Advanced Materials and Energy Devices	3	1	0
Compulsory Courses					
9.	PHY-609	Research Methodology	3	0	0
10.	PHY-607	Seminar	0	1	0
11.	PHY-701*	Dissertation	0	0	5

***Non - Credit Course**

SEMESTER- II

S. No. Course Title

1. Comprehensive Examination (Will be evaluated satisfactory/unsatisfactory)
2. Synopsis writing
3. Approval of synopsis by Research Committee (Synopsis Seminar)

III, IV, and V & VI SEMESTER

Including Semester-II onwards, the student will undertake his/her research work (PHY-701*) by taking 15 credit hours in each semester. The major advisor will evaluate his/her work in each semester and clear the credit hours by evaluating satisfactory/unsatisfactory credits depending upon the work undertaken by the student during the semester.

Examination Schedule: As applicable to other postgraduate courses of Eternal University.

Total Credits: 12 + 80* = 92

Option - 1

PHY-601 :: Advanced Nano Physics

(Semester-I)

L+T+P	:	**3+1+0**	Mid Sessional exam	:	**30**
Credits:	:	**4**	Quiz +Assignment	:	**10**
Contact hours	:	**56**	End-semester exam	:	**60**

Unit	Contents	Lectures
I	Introduction: History of nanoscience, definition of nanometer, nanoscience and nanotechnology; popular and scientific prospective of nanotechnology, classification of nanomaterials, density of states for 0-D, 1-D, 2-D, and 3-D materials, Quantum confinement, superlattices, band offsets, quantum transport in nanoclusters/ quantum dots	12
II	Structure determination by X-ray diffraction, reciprocal lattice, structure factor, size effect on X-ray diffraction, single domain nature and superparamagnetism in magnetic nanoparticles, magnetoresistance: GMR, TMR, CMR, optical properties and electronic structure of nanomaterials, luminescence from nanoparticles, electronic structure of nanomaterials and Fermi surfaces, Raman spectroscopy of nanoparticles, thermodynamics of nanomaterials: change in melting point	13
III	Synthesis Techniques for the preparation of nanoparticles; Bottom up approach: sol-gel synthesis, hydrothermal growth, thin film growth (i.e. CVD, PVD), Top-down approach: ball milling, micro fabrication, lithography.	10
IV	Size effect on shape of materials, size effect on electronic properties- magic number, grain boundary effect, semiconductor nanoparticles; Plasmonic nanoparticles, localized surface plasmon resonance, surface plasmon polariton, Nanoelectronics: Quantum hall effect, single molecule electronics, Coulomb blockade effect, spintronics, nanophotonics.	12
V	Carbon Nano Structures: Fullerenes, C60, C80 SWNT and MWNT; Nanocomposites: Metal-Metal nanocomposites, Polymer-Metal nanocomposites, Ceramic nanocomposites.	9

S. No.	Reference Books
1	Nanotechnology: Principles and Practices: Sulabha K Kulkarni, Springer: Capital rd Publishing company, 3 ed., 2014.
2	Introduction to nanotechnology: Charles P Poole Jr., Frank J Owens, John Wiley and Sons, 2003.
3	Nanoscience and Nanotechnology: M S Ramachandra Rao, Shubra Singh, Wiley India, 2016.
4	Nanostructured Materials: Wei, Ying, Y Jackie, Academic Press Inc. New York, 2001.
5	Nanotechnology- Molecularly Designed Materials: GM Chow, KE Gonsalves, American Chemical Society, 1996.
6	Nanoparticles and Nanostructured Films–Preparation, Characterization and Application: JHFendler, Wiley, 1998.
7	Physics of Low-Dimension Semiconductors: JH Davies, Cambridge Univ. Press, 1998.

Option – 1
PHY-602 :: Advanced Condensed Matter Physics
(Semester-I)

L+T+P	:	**3+1+0**	First sessional exam	:	**30**
Credits:	:	**4**	Quiz +Assignment	:	**10**
Contact hours	:	**56**	End-semester exam	:	**60**

Unit	Contents	Lectures
I	Linear and nonlinear dielectric properties of Materials: dielectric constants and Polarization mechanisms, linear dielectric materials, capacitors and insulators, C-V characterization, Clausius- Mosotti relation; piezo, pyro- and ferro-electricity. Dielectric constant and its significance- Piezo electric and ferro electric materials.	12
II	Theory of Magnetism: Dia- and para-magnetism in materials, Pauli paramagnetism, Exchange interaction. Heisenberg Hamiltonian- mean field theory; Ferro-, ferri- and anti-ferromagnetism; spin waves, Bloch T- law. Superconductivity: Flux quantization, Macroscopic Quantum interference, Cooper Pairing, Energy gap, BCS theory; Ginzburg-Landau theory; high temperature superconductors.	12
III	Optical properties and optical transition; Optical Processes and Excitons: Optical reflectance (Kramers- Kronig relations, electronic interband transitions); Excitons, Raman effect in crystals (Brillouin scattering, Polariton scattering). Transport Theory: Electronic transport from classical kinetic theory; Introduction to Boltzmann transport equation; electrical and thermal conductivity of metals; thermoelectric effects; Hall effect and magnetoresistance, quantum hall effect.	13
IV	Many electron theory: Introduction to many-electron wave function, Hartree-Fock theory, Second quantization formalism; Interactions of Electrons and Phonons with Photons, Excitons and Polaritons; Hubbard Model, Mott insulator, Kondo effect.	11
V	Defects and Disorder in Solids: Basic concepts in point defects, line defects, planner defects and dislocations; Soft condensed Matter: Qualitative discussion of Colloids, Polymers, Gels, Liquid crystals.	8

S. No.	Reference Books
1	Introduction to Solid State Physics: C Kittel, Wiley, New York, 2005.
2	Quantum Theory of Solids: C Kittel, Wiley New York, 1987.
3	Principles of the Theory of Solids : J Ziman, Cambridge University Press, 1972.rd
4	Solid State Physics : H Ibach, H Luth, Springer, Berlin, 3 ed., 2002.
5	A Quantum Approach to Solids: PL Taylor, Prentice-Hall, Englewood Cliffs, 1970.
6	Intermediate Quantum Theory of Solids: AOE Animalu, East-West Press, New Delhi, 1991.
7	Solid State Physics: Ashcroft, Mermin, Reinhert & Winston, Berlin, 1976.
8	Quantum approach to condensed matter physics, Taylor and Heinonen, Cambridge.

Option - 1
PHY-603 :: Advanced Quantum Mechanics
(Semester-I)

L+T+P	:	**3+1+0**	Mid Sessional exam	:	**30**
Credits:	:	**4**	Quiz +Assignment	:	**10**
Contact hours	:	**56**	End-semester exam	:	**60**

Unit	Contents	Lectures
I	Solutions of Schrondinger Equation for 1-D and 3-D square wells and potential barriers, H-atom, harmonic oscillator in matrix mechanics; problems related to particle in a box and tunneling through a barrier, orbital, spin and total angular momentum operator, their eigenvalues and eigenvectors, spherical Harmonics, addition of angular momenta, C.G. coefficients.	12
II	Approximation Methods: Non-degenerate and degenerate perturbation theory and application to anharmonic oscillator, variational method with application to ground state of harmonic oscillator and hydrogen atom, General expression for the probability of transition from one state to another, constants and harmonic perturbation.	8
III	Time Dependent Perturbation: General expression for the probability of transition from one state to another, Fermi's golden rule and its application to radiative transition in atoms, Selection rules for emission and absorption of light. Scattering Theory: Scattering amplitude and cross-section, Partial wave analysis and application to simple cases; Integral form of scattering equation, Born approximation validity. The optical theorem.	12
IV	Relativistic Quantum Mechanics: The Klein-Gordon equation. The Dirac equation. Dirac matrices, spinors. Magnetic Moment and Spin of electron; Positive and negative energy solutions, physical interpretation. Non relativistic limit of the Dirac equation.	8
V	Identical Particles: Symmetric and antisymmetric wave functions: Bosons and Fermions. Summarization postulates, Pauli's exclusion Principle, Spin-statistics connection, self consistent field approximation: Slater determinant, Hartree Fock method.	8
VI	Quantum Field Theory: Preliminaries: why QFT? Classical Field Theory; Lagrangian formulation; Action for a scalar field; Symmetries and conservation laws, Noether's theorem; Quantum equation for field, Canonical quantization of scalar field; Dirac Field; Fock space and particle number representation.	8

S. No.	Reference Books
1	Quantum Mechanics: Concepts and Applications: NouredineZettili , Wiley, India, 2edition, 2016
2	A Text book of Quantum Mechanics, PM Mathews, K Venkatesan, Tata McGraw Hill, Newnd Delhi, 2 ed., 2004.
3	Modern Quantum Mechanics: JJ Sakurai, Addison Wesley, Reading, 2004.
4	Quantum Mechanics: VK Thankappan, New Age, New Delhi, 2004.
5	Quantum Mechanics: JL Powell, B Crasemann, Narosa, New Delhi, 1995.
6	Quantum Physics: S Gasiorowicz, Wiley, New York, 3rd ed. 2003.

Option - 1
PHY-608 :: Renewable Energy Sources and Technologies
(Semester-I)

L+T+P	:	**3+1+0**	Mid-sessional exam	:	**30**
Credits:	:	**4**	Quiz +Assignment	:	**10**
Contact hours	:	**56**	End-semester exam	:	**60**

Unit	Contents	Lectures
I	Introduction: Classification of Energy Sources, Production alternatives and reserves of energy sources in the world and in India; Need of renewable energy sources, energy security and energy conservation, Energy and its environmental impacts, Distributed generation.	8
II	Solar Energy: Solar radiation outside the earth's atmosphere and at the earth's surface, Instruments for measuring Solar radiation and Sunshine, Solar radiation geometry. Solar thermal technologies and their applications: Fundamentals of solar thermal conversion, Device for thermal collection and storage, thermal applications: water heating, drying, distillation, space heating, space cooling and refrigeration, cooking, power generation.	13
III	Solar photovoltaic technologies and their applications: Fundamentals of photovoltaic energy conversion, Formation of energy bands, direct and indirect transition semi-conductors, charge carrier and their motion in semiconductors, types of solar cells, description and principle of working of solar cell, open circuit voltage and short circuit current, fill factor, power conversion efficiency, difference between single crystalline, polycrystalline and amorphous silicon solar cells, photo-electrochemical solar cells, dye-sensitized solar cells, perovskite solar cells, elementary ideas of tandem solar cells	13
IV	Hydrogen Energy and its technological applications: Environmental considerations, solar hydrogen through photo electrolysis and photocatalytic process, physics of material characteristics for production of solar hydrogen. Storage processes, solid state hydrogen storage materials, structural and electronic properties of storage materials, new storage modes, safety factors, use of hydrogen as fuel in vehicles and electrical power generation, hydride batteries.	13
V	Other sources and related technologies: Wind energy, wave energy, ocean thermal energy conversion (OTEC).	9

S. No.	Reference Books
1.	Solar Energy: SP Sukhatme, Tata McGraw-Hill, New Delhi, 2008.
2.	Solar Cell Devices: Fonash, Academic Press, New York, 2010.
3.	Fundamentals of Solar Cells, Photovoltaic Solar Energy: Fahrenbruch, Bube, Springer,Berlin, 1983.
4.	Photoelectrochemical Solar Cells: Chandra, New Age, New Delhi.

Option - 2
PHY-604 :: Advanced Materials Science
(Semester-I)

L+T+P	:	**3+1+0**	Mid Sessional exam	:	**30**
Credits	:	**4**	Quiz +Assignment	:	**10**
Contact hours	:	**56**	End-semester exam	:	**60**

Unit	Contents	Lectures
I	Crystal structure: crystalline and non-crystalline materials; classification of crystals; Bravais lattices; symmetry in crystals, point groups and space groups, glide planes and screw axes; crystal directions and crystal planes, linear and planner densities of atoms in a lattice, packing factor, radius ratio, some special crystal structure (HCP, DC, NaCl, ZnS, CsCl); Braggs law, extinction rule, systematic absences, space group notations, reciprocal lattice, zones and zone axes; liquid crystals and quasi crystals.	12
II	Chemical bonding in solids: covalent, ionic, metallic, van der waals and hydrogen bonds; Phase transitions, magnetic materials, dielectric materials, high T_c superconductors, nanomaterials, alloys, semiconductors, polymers, ceramics, composites, solar energy materials, imperfection in a crystal, points defects, line defects, planner defects dislocations.	11
III	Synthesis techniques of materials: single crystal growth (zone refining, epitaxial growth, melt- spinning and quenching methods); chemical route synthesis (sol-gel, co-precipitation); thin film preparation techniques: CVD, PVD, PLD; synthesis of nanomaterials: top down and bottom up approaches of synthesis of nano-structured materials, advanced materials in 3D printing.	12
IV	Materials characterization techniques-I (Basic principal and application): X-ray diffraction (XRD), Raman spectroscopy, X-ray photoelectron spectroscopy (XPS), scanning tunneling microscopy (STM), atomic force microscopy (AFM), transmission electron microscopy (TEM), scanning electron microscopy (SEM).	11
V	Materials characterization techniques-II (Basic principal and application): Inferred (IR) spectroscopy, Ultraviolet-Visible (UV-Vis) spectroscopy, Dielectric spectroscopy, vibrating sample magnetometer (VSM), superconducting quantum interference device (SQUID).	10

S.No.	Reference Books
1	Materials Science: MS Vijaya, G. Rangarajan, Tata McGraw-Hill, New Delhi, 2004.
2	Materials science and Engineering: V. Raghavan, Prentice-Hall Pvt. Ltd.
3	Thin Solid Films: K. L Chopra
4	Elements of X-ray diffraction: B. D. Cullity, Addison-Wesley Publishing Co.
5	Elements of crystallography: M. A. Azaroff
6	Materials Characterization Techniques: Sam Zhang, Lin Li, Ashok Kumar

Option-2
PHY-605 :: Advanced Computational Physics

L+T+P	:	**3+1+0**	Mid Sessional exam	:	**30**
Credits	:	**4**	Quiz +Assignment	:	**10**
Contact hours	:	**56**	End-semester exam	:	**60**

Unit	Contents	Lectures
I	Concepts of deterministic and stochastic simulation methods, limitations of simulational physics, percolation, percolation threshold, cluster labeling, critical exponents, fractal dimension, regular fractals and self similarity, fractal growth processes. One particle system moving in a spring potential.	8
II	Monte Carlo Method (Stochastic Methods): Random walk on one, two and three dimensional lattices, self-avoiding walk, microcanonical ensemble (Case Study: one dimensional ideal gas, ising Model, heat flow), Canonical ensemble (Metropolis method, classical ideal gas, ising model, hard rods); isothermal-isobaric ensemble, grand canonical ensemble.	12
III	Molecular Dynamics (Deterministic Methods): Molecular Dynamics as deterministic simulation, integration schemes (euler, predictor corrector, verlet), calculating thermodynamic quantities, organization of simulation; microcannonical ensemble molecular dynamics, canonical ensemble molecular dynamics, isothermic-isobaric ensemble molecular dynamics (case study: simulation of a system of monoatomic particle system using lennard jones potential); Brief discussion of Anderson scheme and Nose scheme.	14
IV	Symbolic Computing: Symbolic Computing Systems, Basic symbolic mathematics, computer calculus, Linear systems, Non-linear systems, Differential equations, Computer graphics, Dynamics of a flying sphere. Basics of Mathematica: numerical computations, algebraic computations, calculus, graphics, Procedural programming High Performance Computing: The basic concept, High performance computing systems Parallelism and Parallel computing, Data parallel programming, Distributed computing and message passing, Some current applications.	14
V	Computing Hardware Basics: Memory and CPU, Components: Memory Hierarchy, The Central Processing unit, CPU Design: RISC, CPU Design; Vector Processing, Virtual Memory, Programming for virtual memory, Programming for Data Cache.	8

S.No.	Reference Books
1	Computer Simulation Methods: Heermann, Springer Verlag.
2	Computational Physics: RH Landau, MJ Paez, John Wiley & Sons.
3	Computer Simulation Methods in Theoretical Physics: DW Heermann, Springer Verlag.
5	A First Course in Scientific Computing: Symbolic, Graphic, and Numeric Modeling Using Maple, Java, Mathematica, and Fortran90: R H Landau, Princeton University Press.
6	Monte Carlo methods in statistical physics & The Monte Carlo method in condensed matter physics: K Binder, Springer, 1986/1992.
7	An Introduction to Computer Simulation Methods, Applications to Physical Systems: Harvey Gould, Jan Tobochnik, 2nd/3rd ed.
8	Understanding Molecular Simulations: Frankel, Smit, Elsevier, 2nded.

Option- 2
PHY-606 :: Advanced Optoelectronics
(Semester-I)

L+T+P	:	**3+1+0**	Mid Sessional exam	:	**30**
Credits:	:	**4**	Quiz +Assignment	:	**10**
Contact hours	:	**56**	End-semester exam	:	**60**

Unit	Contents	Lectures
I	Optical materials; electron-hole recombination, band gap engineering, Light interaction with materials-transparency and opacity, refraction and refractive index, reflection, absorption and transmission. Carrier generation and recombination processes, Carrier transport, drift, diffusion, equation of state.	11
II	Principle of laser actions: spontaneous and stimulated emission and absorption, the condition for the laser action, Types of laser, Semiconductor lasers; Theory of Laser action in Semiconductors, condition for gain, The threshold conditions for oscillations, rates of spontaneous and stimulated emission, effect of refractive index, calculation of the gain coefficients, relation of the gain coefficient to current density.	13
III	Semiconductor Injection Laser: Efficiency, Stripe geometry LED materials, commercial LED materials, LED construction, Response time of LED's, LED derive circuitry.	6
IV	Basic Electronic Devices; p-n junction their application in solar cells and light emitting diodes. MOS devices and Transistors. Organic electronics - Thin Film Transistors, Light Emitting Diodes, Solar cells. Lasers, Optical Communications, Optical Sensors and Photonics Integrated Circuits, fundamental principles of photonics and light-matter interactions.	12
V	Waveguides switches and modulators and other devices of integrated optics; Modulator of light – definition, Light modulators in photonics, need of external light modulators, Parameters of electromagnetic wave, Classification of effects utilized in waveguide modulators. The physical effects of light modulation, Four types of light modulators, applications of optical modulators, Laser chirp, Electro-optical effect: change of phase, Optical switch (photonic switch) – definition.	14

S. No.	Reference Books
1	Optical communication systems: John Gowar, Prentice Hall of India Pvt.Ltd., NeDelhi,1987.
2	Physics of Solids, C. A. Wert and R.M. Thomson, McGraw-Hill Book Company, 1970 or later 9.
3	Optoelectronics-An Introduction: J Wilson, JFB Hawkes, Prentice Hall International, 2 ed.,1989.nd
4	Solid State Electronic Device, Streetman, Ben, G, Streetman, Prentice Hall, inc., N.J. USA, 1980
5	Electrical Properties of Materials, L. Solymar and D. Walsh, Oxford University press, 1998. 8.
6	ADVANCED OPTOELECTRONICS, Wrocław University of Technology file:///C:/Users/ACBS/Downloads/Patela_Advanced_Optoelectronics.pdf

Option- 2
PHY-610:: Advanced Materials and Energy Devices
(Semester-I)

L+T+P	:	**3+1+0**	Mid Sessional exam	:	**30**
Credits:	:	**4**	Quiz +Assignment	:	**10**
Contact hours	:	**56**	End-semester exam	:	**60**

Unit	Contents	Lectures
I	Introduction to advanced materials: theories and physical mechanisms, concept of Fermi-energy, work function and electron affinity, equilibrium and non-equilibrium condition, linear and nonlinear characteristics.	7
II	Interaction between materials of different chemical origin; organic and inorganic species; motifs and functions, bio-functional structure, carbon based materials: ACs, graphene, CNTs, MWNTs, conjugates and nano-conjugates of conductive polymers, copolymers, and their hybrid electrode materials, Organic and inorganic hole and electron transport materials, their efficiency and properties.	13
III	Concept of energy production and storage; Emerging trends in LEDs and optoelectronic devices; Electrochemical capacitors and supercapacitors: principle, design and development, efficiency and properties, performance and applications; piezoelectric and pyro-electric devices; photo-chromic and electro-chromic devices.	11
IV	Magneto-hydrodynamics and magnetic fluids; Rechargeable batteries; Solar batteries and solar charger; Solar cells: organic, inorganic and dye sensitized; Advanced solar cell concepts and technologies (Porous Si layer transfer, Metal induced crystallization, etc.). Amorphous silicon thin-film (and/or flexible) technologies, multi-junction (tandem) solar cells, stacked solar cells, conjugated polymers, organic/plastic/flexible solar cells.	13
V	Hydrogen production and storage using hybrid materials; Pb-acid Nickel-metal hydride (Ni-MH), NiCd-alkaline battery, Ni-iron, Li/Na-ion, Mg-ion, Li/Na-S batteries, Metal-air battery, battery maintenance and safety precautions, application of phase-change materials for energy conservation, Fuel cells: SOFC, PEFC, PAFC, MCFC design, development and properties.	12

S. No.	Reference Books
1	Advanced Materials: Physics, Mechanics and Application; Shun-Hsyung Chang; Springer, 2014.
2	Energy Storage Devices for Electronic Systems; Nihal Kularatna; Academic Press, 2014
3	Graphene-based Energy Devices; Rashid bin Mohd Yusoff; Wiley, 2015
4	Future Solar Energy Devices; Mihaela Girtan; Springer, 2017
5	Handbook of Advanced Materials: Enabling New Designs; James K. Wessel; Wiley 2004.
7	Nanomaterials in Energy Devices; Jun Hieng Kiat; CRC Press, 2017.
8	Thin-film crystalline silicon solar cells: Physics and technology, R. Brendel, Wiley-VCH, Weinheim, 2003.

PHY-609 :: Research Methodology
(Semester-I)

L+T+P	:	**3+0+0**	Mid Sessional exam	:	**30**
Credits:	:	**3**	Quiz +Assignment	:	**10**
Credit hours	:	**42**	End-semester exam	:	**60**

Unit*	Contents	Lectures
I	History, myths and ethnic practices; need, importance and impact of research; types of research; research process.	3
II	Synopsis writing: Selecting research problem; formulation of research projects; survey of literature; research infrastructure; experimental designs; sampling designs; recording of observations ; measurement and scaling techniques; GLPs.	4
III	Formulation and types of hypothesis; collection, maintenance, storage and analysis of data; measures of central tendencies and relationships and error analysis; tests of significance.	6
IV	Compilation and presentation of results, Writing of manuscripts; research reports and thesis; organization of reference material using endnote; bibliography; plagiarism; IPR and patent application, entrepreneurship.	6
V	Financial support and various funding agencies; Multidisciplinary and multi-institutional research; writing research proposal for external funding.	3
VI	Computer and informatics; introduction; word processing, excel, power point presentation; graph and figure plotting; web browsing; information resources and various databases.	6
VII	Demonstration of departmental research activities and instrumentation	7
VIII	Writing a review article on topic of interest or suggested by research committee	7

*Unit I-VI: Common for all streams. Unit VII-VIII: Offered by Concerned Department

S. No.	Reference Books
1.	Research Methodology-Methods and Techniques: C R Kothari, New Age International, 2nd ed., 2004.
2.	Research Methodology: A Step by Step Guide for Beginners: R Kumar, Pearson Education, 2nd ed., 2005.
3.	Research Methodology in the Medical and Biological Sciences: P Laake, H Benestad, B Olsen, Elsevier, 1st ed., 2007.
4.	Research Methodology: C Murthy, Vrinda Publications, 1st ed., 2009.
5.	Research Methodology For Biological Sciences: N Gurumani, MJP Publishers, 1st ed., 2013.

PHY-607 :: Seminar
(Semester-I)

L:T:P:	:	**0+0+1**			
Credits:	:	**1**	Viva-voce	:	**25**
Credit hours	:	**14**	Presentation	:	**25**

Description
Students are required to submit a synopsis on the allotted topic and have to make a presentation in front of advisory committee and M.Sc. Students. Students are expected to provide latest facts and updated information by consulting latest editions of textbooks, reference books, monographs and peer-reviewed national & international research journals.

Suggested Journals			
S. No.	**Name of the research journal/database**	**Publisher**	**Website**
1.	Journal of Applied Physics	AIP	http://scitation.aip.org/content/aip/journal/jap
2.	Applied Physics Letters	AIP	http://scitation.aip.org/content/aip/journal/apl
4.	Physical Review B	APS	https://journals.aps.org/prb/
5.	Physical Review Letters	APS	http://journals.aps.org/prl/
6.	Journal of Magnetism and Magnetic Materials	Elsevier	http://www.journals.elsevier.com/journal-of-magnetism-and-magnetic-materials/
7.	Journal of Alloys and Compounds	Elsevier	http://www.journals.elsevier.com/journal-of-alloys-and-compounds/
8.	Current Applied Physics	Elsevier	http://www.journals.elsevier.com/current-applied-physics/
9.	Journal of Superconductivity and Novel Magnetism	Springer	http://www.springer.com/materials/journal/10948
10.	Nano Letters	ACS	https://pubs.acs.org/journal/nalefd
11.	ACS Nano	ACS	https://pubs.acs.org/journal/ancac3
12.	Advanced Materials	Wiley-VCH	https://onlinelibrary.wiley.com/journal/15214095
13.	Advanced Functional Materials	Wiley-VCH	https://onlinelibrary.wiley.com/journal/16163028
14.	Nanoscale	RSC	https://pubs.rsc.org/en/journals/journalissues/nr#!recentarticles&adv
15.	Renewable Energy	Elsevier	https://www.journals.elsevier.com/renewable-energy
16.	Solar Energy Materials and Solar Cells	Elsevier	https://www.journals.elsevier.com/solar-energy-materials-and-solar-cells/
17.	Solar Energy	Elsevier	https://www.journals.elsevier.com/solar-energy/
18.	Applied Thermal Engineering	Elsevier	https://www.journals.elsevier.com/applied-thermal-engineering

Databases: Scopus, UGC Care list, Google Scholar, Research Gate: Elsevier/Science Direct, Springer Link, AIP, APS, ACS, RSC etc.

PHY-701 :: Dissertation
(Semester- I, II, III, IV, and V & VI)

L:T:P : **0+0+80**
Credits: : **80**
Credit hours : **1120**

Description
Dissertation will carry marks for continuous assessment, dissertation write-up, its presentation and viva-voce. This will be evaluated at the end of each semester. Students will work on a research topic assigned to him/her by their supervisor/mentor with a purpose to develop a collective approach to study, analyze and solve the problem. Students are required to collect, analyze the data and submit their dissertation.

Suggested Journals

S. No.	Name of the research journal/database	Publisher	Website
1.	Journal of Applied Physics	AIP	http://scitation.aip.org/content/aip/journal/jap
2.	Applied Physics Letters	AIP	http://scitation.aip.org/content/aip/journal/apl
4.	Physical Review B	APS	https://journals.aps.org/prb/
5.	Physical Review Letters	APS	http://journals.aps.org/prl/
6.	Journal of Magnetism and Magnetic Materials	Elsevier	http://www.journals.elsevier.com/journal-of-magnetism-and-magnetic-materials/
7.	Journal of Alloys and Compounds	Elsevier	http://www.journals.elsevier.com/journal-of-alloys-and-compounds/
8.	Current Applied Physics	Elsevier	http://www.journals.elsevier.com/current-applied-physics/
9.	Journal of Superconductivity and Novel Magnetism	Springer	http://www.springer.com/materials/journal/10948
10.	Nano Letters	ACS	https://pubs.acs.org/journal/nalefd
11.	ACS Nano	ACS	https://pubs.acs.org/journal/ancac3
12.	Advanced Materials	Wiley-VCH	https://onlinelibrary.wiley.com/journal/15214095
13.	Advanced Functional Materials	Wiley-VCH	https://onlinelibrary.wiley.com/journal/16163028
14.	Nanoscale	RSC	https://pubs.rsc.org/en/journals/journalissues/nr#!recentarticles&adv
15.	Renewable Energy	Elsevier	https://www.journals.elsevier.com/renewable-energy
16.	Solar Energy Materials and Solar Cells	Elsevier	https://www.journals.elsevier.com/solar-energy-materials-and-solar-cells/
17.	Solar Energy	Elsevier	https://www.journals.elsevier.com/solar-energy/
18.	Applied Thermal Engineering	Elsevier	https://www.journals.elsevier.com/applied-thermal-engineering

Databases: Scopus, UGC Care list, Google Scholar, Research Gate: Elsevier/Science Direct, Springer Link, AIP, APS, ACS, RSC etc.