SYLLABUS 2016

UNDERGRADUATE PROGRAM IN PHYSICS

DEPARTMENT OF PHYSICS
FACULTY OF MATHEMATICS AND NATURAL SCIENCES
UNIVERSITAS INDONESIA
2016

Course : Basic Mathematics 1

Code / Credit / Pre-req. : UIST601110 / 2 SKS / -

Objective:

To explain the basic concept of one variable calculus and get used to solve calculus application problems

Subjects:

Introduction: real number system, inequality and absolute value; One variable function: definitions and variety, graph (Cartesian), function operation; Limit: definitions and limit theorems, continuity; Transcendent function, differential: definitions, geometry meaning, differential formulas, chain rule, high rank differentiation, implicit differentiation, application of differential: maximum and minimum, mean value theorem; Integral: definitions, certain and uncertain integral, basic calculus theorem, basic characteristic of integral, integration techniques, application of integral: area and volume of rotational object.

Bibliography:

1. D. Varberg & E.S Purcell, 9th ed, *Calculus*, Prentice-Hall, 2007.
2. G.B Thomas & R.L Finney, *Calculus and Analytic Geometry*, 9th ed, Addison-Wesley, 1996.

Course : Statistical Methods

Code / Credits / Pre-req. : SCMA601200 / 2 SKS / -

Objective:

To explain the basic concepts of statistics and its applications

Subjects:

Probability, conditional probablity; Random variable and probability distribution; Introduction to distribution: random discrete variable probability distribution (binomial distribution, Poisson distribution, hyoergeometric distribution), random continuous variable probability distribution (normal distribution), sampling, post limit theorem, chi square distribution, T distribution, F distribution; Statistical Interferences: interval evaluation and hypothesis testing for one population and two population; Chi square test: independence test, homogenity test, suitability test; Simple linear regression; one way variance analysis.

Bibliography:

1. R. E. Walpole, R. H. Myers, S.L. Myers & K.Ye. *Probability & Statistics for Engineers and Scientists*, 7th ed, Prentice Hall International Edition, 2002.
2. J. T. Mc Clave & F. H. Dietruch., *Statistics*, 9th ed., Prentice Hall, 2003.
3. R. A. Johnson, & G. K. Bhattacharyya, *Statistics: Principles and Methods*, 3rd ed., John Willey & Sons, 1996.

Course : Basic Physics

Code / Credit / Pre-req. : SCFI601110 / 2 SKS / -

Objective:

To explain the basic concepts of Physics and its application in daily life, including mechanical, thermodynamic, electromagnetic, wave and optics.

Subjects:

Law of object motion, translation and rotation motion, mechanical energy conservation law, momentum, energy, static and dynamic fluid, heat, expansion, heat transportation, thermodynamic, heat engine, mechanical vibration, sound, electricity, electric capacity, electric current, magnetization, electromagnetic wave, light, optic, modern physics, atom.

Bibliography:

1. Ostdiek, *Inquiry into Physics 7th Edition*, John Wiley & Sons, Inc., 2013.
2. Cutnell and Johnson, *Physics 9th*, Wiley, 2012
3. E. R. Huggins, *Physics 2000*, Moose Mountain Digital Press 2000.

Course : Mechanics and Heat

Code / Credit / Pre-req. : SCFI601114 / 4 SKS / -

Objective:

After finishing this course, students are expected to be able to solve simple and well defined physical problem in mechanic and thermodynamic, first year students are expected to apply the concept and principles of mechanic and thermodynamic in daily life and formulate the solution.

Subjects:

Unit, physical quantities and vector, linear one dimensional motion, two and three dimensional motion, Newton Law and its application, Work and kinetic energy, potential energy and its conservation, momentum, impulse and collision, rigid body rotation, rotational dynamic, equilibrium and elasticity, gravity, fluids mechanic, temperature, heat, kinetic theory of gasses, Thermodynamic 1st law, heat engine, entropy, and Thermodynamic 2nd law.

Bibliography:

1. Halliday, Resnick, dan Walker, *Principles of Physics 10th Edition*, Wiley, 2014.
2. Serway Jewett, *Physics for Scientists and Engineers 9th Edition*, Thomson Brooks/Cole, 2014.
3. Giancoli, *Physics for Scientists and Engineers 7th Edition*, Pearson, 2014

Course : Basic Mathematics 2

Code / Credit / Pre-req : SCMA601111 / 4 SKS / Basic Mathematics 1

Objective:

To explain the concept of parametric function, infinite sequance and series, and many variable calculus.

Subjects:

Parametric function, polar coordinate, area in polar coordinate; function in vector, curvature (R^2 and R^3); integral application: curve length and rotational object surface area; uncertain form (L'Hospital) and improper integral; real infinite series and sequence; many variables function: limit, continuity, partial derivative, differentiation, vector differential, tangent plane, maximum and minimum; double and triple integral, Jacobian.

Bibliography:

1. D. Varberg and E.S Purcell, *Calculus*, 9th ed, Prentice-Hall, 2007.
2. G.B Thomas and R.L Finney, *Calculus and Analytic Geometry*, 9th ed, Addison-Wesley, 1996.

Course : Mathematical Methods in Physics 1

Code / Credit / Pre-req. : SCFI602214 / 3 SKS / Basic Mathematics 1

Objective:

To apply mathematical methods in form of vector analysis, tensor analysis, and ordinary differential equation to second order linear differential equation in Physical problems.

Subjects:

Vector differential (gradient, divergence, curl, and Laplacian), vector integral, Gauss and Green Theorem, Stokes Theorem, tensor operation delta Kronecker and Levi-civita, ordinary first order differential equation, exact differential equation, ordinary second order differential equation, Laplace transformation, Delta Dirac function.

Bibliography:

1. M.L. Boas, *Mathematical Methods in the Physical Sciences*, 3rd Ed, John Wiley and Sons, 2006.
2. G.B. Arfken and H.J. Weber, *Mathematical Methods for Physicists*, 5th Ed, Hartcourt Academic Press, 2001.

Course : Electricity and Magnetism

Code / Credit / Pre-req. : SCFI601115 / 3 SKS / Mechanics and Heat

Objective:

After finishing this course, first year students are expected to be able to apply electromagnetic principles and concepts to a simple-well-defined basic physics problems, also be able to formulate the solution.

Subjects:

Electric charge and field, Gauss Law, Electric potential, Capacitor and Dielectric, Electric current, Resistance and direct current, Magnetic field and Magnetic force, Magnetic field source, Electromagnetic induction, inductance, electromagnetic oscillation, Alternative current, Maxwell equation.

Bibliography:

1. Halliday, Resnick, dan Walker, *Principles of Physics 10th Edition*, Wiley, 2014.
2. Serway Jewett, *Physics for Scientists and Engineers 9th Edition*, Thomson Brooks/Cole, 2014.
3. Giancoli, *Physics for Scientists and Engineers 7th Edition*, Pearson, 2014

Course : Vibrations, Waves and Optics

Code / Credit / Pre-req. : SCFI601116 / 3 SKS / Mechanics and Heat

Objective:

After finishing this course, first year students are expected to be able to apply principles and concepts of vibration, wave and optics, to a simple-well-defined basic physics problems, also be able to formulate the solution.

Subjects:

Simple Harmonic Motion, Damped Harmonic Motion, Mechanical Wave, Sound, Superposition, Standing Wave, Maxwell Equation, Electromagnetic Wave, Basic properties and Propagation of Light, Light Polaritation, Reflection and Refraction, Light Waves Interference, Light Waves Diffraction, Optic Geometry, Optic-based Equipment.

Bibliography:

1. Halliday, Resnick, dan Walker, *Principles of Physics 10th Edition*, Wiley, 2014.
2. Serway Jewett, *Physics for Scientists and Engineers 9th Edition*, Thomson Brooks/Cole, 2014.
3. Giancoli, *Physics for Scientists and Engineers 7th Edition*, Pearson, 2014

Course : Laboratory Work of Basic Physics 1

Code / Credit / Pre-req. : SCFI601121 / 1 SKS / Physics of Mechanics and Heat, Statistical Methods

Objective:

To calculate, make graph, analyze and conclude based on basic physics experiments, including Mechanics and Heat, in order to explaining the basic physics concepts through the experiment and theory.

Subjects:

Measurements techniques; Mechanics: Inertia, Free Fall Motion, Density of Liquids, Coefficient of Fraction, Collision, Swing Twist, Viscosity of Liquids, Young Modulus, Mathematical Swing, Surface Tension, hardness test; Heat: linear expansion coefficient, thermal conductivity, calorimeter, Joule constant, solar collector, ideal gasses law, Newton coolant, radiation constant, radiation absorption.

Bibliography :

1. Buku Pedoman Praktikum Fisika Dasar, UPP IPD, edisi ke-3, 2010.
2. Giancoli, DC., Physics: Principle with Applications, 6th ed., Prentice Hall, 2005.

Course : General Biology

Code / Credit / Pre-req. : SCBI601112 / 2 SKS / -

Objective:

To explain the basic concepts of biology comprehensively and and connecting the basic concepts with other disciplines, especially with disciplines in the same field like chemistry, physics, and mathematics. To explain about diversity in Indonesia and the conservation effort. To explain the important role of human as a manager of environment, to build cooperation behavior and work as a team in solving problems especially environmental problems, and to build honesty, independently, and creative behavior.

Subjects:

Basic concepts of biology including characteristics of life, biology of cell, inheritance, evolution, biodiversity, structure and function of animal, structure and function of plants, biodiversity in Indonesia, and interaction between human with other living creature and environment, principles of ecology, conservation, and biotechnology.

Bibliography:

1. Campbell, N.A. & J.B. Reece., L.A.Urry., M.L. Chain., S.A. Wasserman., P.V. Minorsky., D. Ferry., and R.B. Jackson, *Biology* 9th ed., Pearson Education, Inc., San Fransisco, 2010.
2. Johnson, G.B, *The living world*, Wm.C. Brown Publishers, Dubuque, 1995.
3. Starr, C. & R. Taggart, *Biology*: *The unity and diversity of life* 8th ed., Wadsworth Publishing Company, Belmont, 1998.

Course : Basic Chemistry 1

Code / Credit / Pre-req. : SCCH601101 / 2 SKS / -

Objective:

To explain about matters and its components, properties of matters and its transformation, history of development of atom theories and electron configuration, using stoichiometry, chemical reaction and mole concept in explaining the properties of matters and its transformation.

Subjects:

Matters and its transformation, components of atom, ion and molecules, atomic electronic structure, stoichiometry, main chemical reaction, kinetic gas theory, solution and colligative, thermochemistry, field integration, integrated science.

Bibliography:

1. L. Brown and Bursten, *Chemistry: The Central Science,* Prentice Hall, NJ,
2. Silberberg, *Chemistry: The Molecular Nature of Matter and Change,* Mc-Graw Hill, 5ed.
3. J.E. Brady, *General Chemistry: Principles & Stucture*, John Wiley & Sons

Course : Mathematical Methods in Physics 2

Code / Credit / Pre-req. : SCFI602215 / 4 SKS / Basic Mathematics 2, Mathematical Methods in Physics 1

Objective:

To apply mathematical methods in form of complex variable function, Fourier series, and calculus variation in Physics problems.

Subjects:

Complex function, Cauchy-Riemann theorem, Laurent series, Cauchy contour integral, Residue theorem, conformal mapping, Fourier series and coefficient, Dirichlet condition, Parseval theorem, minimum area, Hamilton principle (least action principle), Euler-Lagrange equation with problems.

Bibliography:

1. M.L. Boas, *Mathematical Methods in the Physical Sciences*, 3rd Ed, John Wiley and Sons, 2006.
2. G.B. Arfken and H.J. Weber, *Mathematical Methods for Physicists*, 5th Ed, Hartcourt Academic Press, 2001.

Course : Mathematical Methods in Physics 3

Code / Credit / Pre-req. : SCFI602216 / 3 SKS / Basic Mathematics 2, Mathematical Methods in Physics 1

Objective:

To apply mathematical methods in form of special functions and partial differential equation in Physics problems.

Subjects:

Error function, Gamma function, Beta function, Stirling formula, Legendre equation, Rodrigues formula, Legendre series, isolated Legendre polynomial, Bessel equation, Second kind Bessel function, Hermite function, Laguerre function, separation variable method in partial differential equation, Poisson equation, Green function, Integral transformation method.

Bibliography

1. M.L. Boas, *Mathematical Methods in the Physical Sciences*, 3rd Ed, John Wiley and Sons, 2006.
2. G.B. Arfken and H.J. Weber, *Mathematical Methods for Physicists*, 5th Ed, Hartcourt Academic Press, 2001.

Course : Laboratory Work of Basic Physics 2

Code / Credit / Pre-req. : SCFI601122 / 1 SKS / Laboratory Work of Basic Physics 1

Objective:

To calculate, make graph, analyze and conclude based on basic physics experiments, including Electricity, Magnetism and Optics, in order to explaining the basic physics concepts through the experiment and theory.

Subjects:

Electricity – Magnetism: electrolysis, Wheatsone Bridge, Kirchoff Law, Earth Magnetic Field, Temperature Coefficient, AC – RLC circuit, inner resistance, transformer, Ohmic Materials, RC transient circuit, diode; Optics: Polarimeter, Optic Geometry on lens, Photometry, refractive index of prism, spectrometer, Newton Rings, grid diffraction, standing wave.

Bibliography:

1. Buku *Pedoman Praktikum Fisika Dasar*, UPP IPD, edisi ke-3, 2010.
2. Giancoli, DC, *Physics: Principle with Applications*, 6th ed., Prentice Hall, 2005.

Course : Modern Physics

Code / Credit / Pre-req. : SCFI602117 / 3 SKS / Electricity and Magnetism, Vibrations, Waves, and Optics, Basic Mathematics 2, Mathematical Methods in Physics 1

Objective:

To formulate the solution of a well-defined-simple modern physics problem, including relativity, wave-particle dualism, quantum physics, atom and molecules and statistical physics.

Subjects:

Special relativity theory: photon-particle dualism: particle-like behavior, electromagnetic wave and wave-like behavior, matters; Quantum Mechanics; Physics of Atoms; Hydrogen atom Model, 3D Hydrogen Atom and many-electrons Atoms; Molecules; Statistical Physics.

Bibliography:

1. S. P. Thornton & A. Rex, , Modern Physics 3rd ed., Thomson Brooks/Cole, 2006.
2. K. Krane, Modern Physics 3rd ed, Wiley, 2012.
3. R. Harris, Modern Physics 2nd ed., Pearson, 2008.
4. J. Bernstein, P. M. Fishbane, and S. Gasiorowicz, Modern Physics, Prentice Hall, 2000.

Course : Thermodynamics

Code / Credit / Pre-req. : SCFI602112 / 3 SKS / Electricity and Magnetism, Vibrations, Waves, and Optics, Basic Mathematics 2, Mathematical Methods in Physics 1

Objective:

To explain the basic concept of Thermodynamics (0^{th} law to 3^{rd} law of Thermodynamics) from empirical point of view and the mathematical formulation, and their application on thermodynamic systems.

Subjects:

Concept of Equilibrium and 0^{th} law of Thermodynamics, equation of state, 1^{st} law of Thermodynamics and its consequences, entropy and 2^{nd} law of thermodynamics, combination of 1^{st} and 2^{nd} law of Thermodynamics, Thermodynamics potential and 3^{rd} law of thermodynamics, application of thermodynamics on some simple system, kinetic theory, transport phenomena, statistical thermodynamics, application of statistic on some system of gasses.

Bibliography:

1. F. W. Sears and L. G. Salinger, *Thermodynamics, Kinetic Theory, and Statistical Thermodynamics* 3^{rd} Ed., Addison-Wesley Publishing Company, 1975

Course : Electronics I

Code / Credit / Pre-req. : SCFI602311 / 3 SKS / Electricity and Magnetism

Objective:

To understand discrete electronic principles: Power supply, diode, bipolar transistor, field effect transistor and operational amplifier, and be able to apply the concepts in electronic building system.

Subjects:

Power supply, semiconductor, theory of diode and the circuits, diode for specific needs, bipolar-junction transistor (BJT), pre-voltage transistor, basic transistor amplifier circuit, voltage amplifier, junction field effect transistor (JFET), MOSFET, Basic structure of operational amplifier (Op-Amp) and its properties, linear Op-Amp circuits: Inverting and non-inverting amplifier, summing amplifier, DC imperfections, differential amplifiers, instrumentation amplifiers, voltage-controlled current sources (VCCS), Op-Amp operation with single supply, active filters, nonlinear Op-Amp circuits: Comparators, Integrators, Differentiators, Active Diode Circuits, directional oscillators and power supply.

Bibliography:

1. A. P. Malvino and D. J. Bates, Electronic Principles, 8th edition, McGraw-Hill Book Co., 2015
2. T.L. Floyd and D.M. Buchla, Analog Fundamentals; A System Approach, Pearson Prentice-Hall, 2013

3. L. M. Faulkenberry, An Introduction to Operational Amplifier, with Linear Applications, 2nd edition, John Wiley & Sons, 1982.

Course : Laboratory Work of Electronics 1

Code / Credit / Pre-req. : SCFI602321 / 1 SKS / Electricity and Magnetism, Laboratory Work of Basic Physics 1

Objective:

To apply discrete electronic principles and operational amplifier: diode, transistor, Field Effect Transistor (FET), Op-Amp to analyze and building electrical circuit.

Subject:

Using measurement tools and testing electrical circuit, diode; properties, application, and Zenner, Transistor; transistor circuits, application and FET properties, OP-Amp properties; Inverting Op-Amp, non-inverting Op-Amp and Op-Amp as adder, Mathematic operation circuit using Op-Amp; inverting, scaling and Adder-Subtracter Amplifier, Active Filter Op-Amp-based; differentiator, integrator, low-pass and high pass filter, nonlinear Op-Amp, sensor circuit and its amplifier Op-Amp-based, Project Assignment and Project presentation.

Bibliography:

1. A. P. Malvino, D. J. Bates, *Experiments Manuals for Electronic Principles*, 7th ed, McGraw-Hill Co., 2006.
2. A. P. Malvino, D. J. Bates, *Electronic Principles*, 8th ed, McGraw-Hill Book Co., 2015.

Course : Elementary Linear Algebra

Code / Credit / Pre-req. : SCMA601120 / 2 SKS / -

Objective:

To explain the basic concept of linear algebra by focusing on computing/calculation.

Subjects:

Linear equation; determinant; vector in R^2 and R^3; Euclid space; general vector space.

Bibliography:

1. Howard Anton, *Elementary Linear Algebra*, 9thed., John Wiley, 2005.
2. Paul R. Halmos, *Finite Dimensional Vector Spaces*, Springer Verlag, New York, 1987.

Course : Basic Chemistry 2
Code / Credit / Pre-req. : SCCH601103 / 2 SKS / Basic Chemistry 1

Objective :

To describe the simple equation of chemical reaction rate, the phenomenon of acid-bases reaction, the changing of mass and energy which occur to chemical reaction system (Equilibrium, thermodynamics, and electro-chemistry), to understand existence of natural element, characteristics (metal, non-metal, and radioactive) and how to apply on daily activity and industry.

Subjects :

Chemical Kinetics, Chemical Equilibrium, Acids and Bases, chemical thermodynamics, Electrochemistry, the chemistry of metal and its processing, the chemistry of non-metal, nuclear chemistry, integrated field, integrated science

Bibliography :

1. L. Brown and Bursten, *Chemistry: The Central Science,* Prentice Hall, NJ,
2. Silberberg, *Chemistry: The Molecular Nature of Matter and Change,* Mc-Graw Hill, 5ed.
3. J.E. Brady, *General Chemistry: Principles & Stucture*, John Wiley & Sons

Course : Vibrations and Waves
Code / Credit / Pre-req. : SCFI602118 / 2 SKS / Electricity and Magnetism, Vibrations, Waves, and Optics, Mathematical Methods in Physics 2, Mathematical Methods in Physics 3

Objective :

To apply the theory and principle of vibration and wave on solving the physics of vibration and wave problems

Subjects :

Simple, damped, and forced harmonic motions : coupled oscillation, transverse waves, longitudinal waves, waves on transmission Lines.

Bibliography :

1. H.J. Pain, *The Physics of Vibrations and waves,* 3rd edition John Wiley &Son
2. French, A. P. *Vibrations and Waves*. New York, N.Y, W.W. Norton & Company, . ISBN: 9780393099362
3. Iain G, Main, *Vibrations and Waves in Physics,* Cambridge University Press, ISBN: 9780521447010

Course : Classical Mechanics

Code / Credit / Pre-req. : SCFI602113 / 4 SKS / Electricity and Magnetism, Vibrations, Waves, and Optics, Mathematical Methods in Physics 2, Mathematical Methods in Physics 3

Objective :

To apply the theory of classical mechanics on solving dynamics physics problem

Subjects :

Newtonian mechanics – single particle, Gravitation, Non-linear vibrations. Some methods of calculus variation, Lagrangian Mechanics, Hamilton's principal, central force, dynamics of a system particle, motion in Non-inertial reference frame, rigid body dynamics.

Bibliography :

1. S.T. Thornton and J.B. Marion, *Classical Dynamics of Particles and Systems*, 5th ed, Thomson Brooks/Cole, 2004.
2. V. Barger and M. Olsson, *Classical Mechanics: A Modern Perspective*, 2nd ed, McGraw-Hill, 1995.

Course : Electromagnetic Field 1

Code / Credit / Pre-req. : SCFI602114 / 3 SKS / Electricity and Magnetism, Vibrations, Waves, and Optics, Mathematical Methods in Physics 2, Mathematical Methods in Physics 3

Objective :

To apply the concept of time-independent electromagnetic field (static and steady) on solving the questions of physics related to electric and magnetic.

Subjects :

Electrostatic, problem-solution of electrostatic, electrostatic field in dielectric medium, electrostatic energy, electric current, magnetic field from steady current, the magnetic characteristic of matter, magnetic energy, electromagnetic induction

Bibliography :

1. J.R. Reitz, F.J. Milford, and R.W. Christy, *Foundations of Electromagnetic Theory*, 4^{th} edition, Addison Wesley, 1993.
2. J. Vanderlinde, *Classical Electromagnetic Theory* 2^{nd} ed, Kluwer Academics Publishers, 2005.
3. R. K. Wangness, *Electromagnetic Fields*, Willey, 1986

4. H. J. W. M. Kirsten, Electrodynmics *: An Introduction Including Quantum Effects*, World Scientific, 2004.
5. D.J. Griffiths, *Introduction to Electrodynamics*, 3rd edition, Prentice Hall, 1999.

Course : Laboratory Work of Advanced Physics

Code / Credit / Pre-req. : SCFI602122 / 1 SKS / Modern Physics

Objective :

To do the simple experiment of modern physics and analyze the result.

Subjects :

Hall effect experiment : to calculate Hall coefficient of a material, Photoelectric effect experiment, Planck coefficient in blackbody radiation, Zeeman effect, Franck-Hertz experiment, the calculation of the charge t- mass ratio of the electron in cathode ray deflection experiment, the experiment of gamma-ray absorption and Geiger – Muller detector, the experiment of Michelson interferometer, thermal conductivity in metal using newton method, Millikan experiment in charge electron measurement, Stefan Boltzmann experiment in emissivity of radiator surface, and the experiment of Faraday rotation to calculate Verdet coefficient.

Bibliography :

1. J.P Holman, *Experimental Method for Engineers*, 7th ed., McGraw-Hill Book,Inc,. 2001
2. Ogawa Seiki, *Instruction Manual: Franck-Hertz demonstration*, OGAWA SEIKI, Tokyo Central PO Box No.1618 Tokyo,Japan, 1987.
3. Ogawa Seiki, *Instruction Manual: e/m Demonstration Apparatus*, OGAWA SEIKI, Tokyo Central PO Box No.1618 Tokyo Japan, 1987
4. Leybold-Heraeus, *Physics Experiment*, vol. 1,2 & 3, Leybold GmBH, 1986.
5. Krane,Kenneth, *Modern Physics*, 2nd ed., Mc Graw Hill, 1996.
6. H.D. Resnick dan J. Walker, *Fundamental of Physics,* 6th ed., John Wiley & Son, Inc, 2001.
7. Pasco *Heat conduction Apparatus*, Instruction Manual 012-09189A, www.pasco.com, 2012.
8. Teach Spin, *Faraday Rotation*, *Guide to the experiment*, Teach Spin.Inc., Tri-Main Centre-Suite 409, 2495 Main Street.Buffalo, NY 14214-2153, 2012.

Course : Electronics 2

Code / Credit / Pre-req. : SCFI602312 / 3 SKS / Electronics 1

Objective :

To understand the principles of digital electronics and able to apply its method in designing the latest electronics system.

Subjects :

Introduction of digital electronics, number system in digital, basic logic gates, introduction to digital electronics design with VHDL. Programmable logic device : CPLDs, FPGAs with VHDL design, combination logic circuits and reduction techniques : Boolean algebra, Karnaugh map, Quine McCluskey tabular method, arithmetic circuit, IC with MSI circuit design : decoder, encoders, Multiplexers and Demultiplexers, magnitude comparators, digital electronic families (DTL, TTL, CMOS, ECL), characteristic and their interfacing, Flip-flop and its application : shift registers, Asynchronous (Ripple) Counter, Synchronous (Parallel) Counter, Algorithmic State Machines (ASM) or Finite Sate Machine (FSM), Multivibrator and Timer 555, ADC and DAC, microprocessor fundamentals and The 8501 microcontroller.

Bibliography :

1. W. Kleitz, Digital Electronics, A Practical Approach, 9th edition, Prentice Hall, 2012.
2. R. J. Tocci, N.S. Widmer, G.L. Moss, Digital Systems; Principles and Applications, Pearson Prentice-Hall, 2015.
3. J. Bignell, R. Donovan, Digital Electronics, 5th edition, Delmar Cengage Leraning, 2006.

Course : Laboratory Work of Electronics 2

Code / Credit / Pre-req. : SCFI602322 / 1 SKS / Electronics 1, Laboratory Work of Electronics 1

Objective :

To apply the principles of digital electronics for analyzing and designing digital electronics circuit system.

Subjects :

Basic logic-gates circuit, combinational digital electronics circuits, applying Boolean algebra and Karnaugh map, encoder, decoder, multiplexer, de-mutiplexer, flip-flop counter, shift register, arithmetic circuit, VDHL for combinational circuit, VHDL for encoder, decoder, multiplexer, Demultiplexer, flip-flop and counter, VHDL for FSM, project, and presentation.

:Bibliography :

1. W. Kleitz, Digital Electronics, A Practical Approach, 9th edition, Prentice Hall, 2012.
2. R. J. Tocci, N.S. Widmer, G.L. Moss, Digital Systems; Principles and Applications, Pearson Prentice-Hall, 2015.

Course : Computational Physics

Code / Credit / Pre-req. : SCFI602021 / 4 SKS / Mathematical Methods in Physics 2. Mathematical Methods in Physics 3

Objective :

To apply the basics of programming algorithm and numerical method using software Matlab/Octave/Scilab or kind of, to finish physical problems in algebra or calculus form.

Subjects :

Introduction to programming algorithms, introduction to Matlab/Octave/Scilab, the introduction of matrix and matrices operation numerically, solution of root function theory using bisection method, False-Position and Newton-Raphson, solution of linier equation using gauss elimination method, LU decomposition and Jacobi iteration, fitting using least-square method, lagrangian interpolation, and cubic spline, solution of eigenvalue by using square and QR methods, first and second order numerical differential using Quadrature: Gauss-Lagrange, solution of differential equation with initial condition by Euler and Runge-Kutta order 4 method, solution of ordinary and partial differential equation (elliptic, parabolic, and hyperbolic) with boundary conditions using finite-difference approximation method.

Bibliography :

1. R.L Burden dan J. Douglas Faires, Numerical Analisys, 9^{th}, Cengage Learning, 2015
2. A. Gilat dan V. Subramaniam, Numerical Methods for Scientists and Engineers, 3th, John Wiley & Sons, 2014
3. A. Quarteroni, F. Saleri, P. Gervasio, Scientific Computing with Matlab and Octave, 3th, Springer, 2010
4. S. J. Chapra dan R.P. Canale, Numerical Methods for Engineers, 6^{th}, Mc. Graw Hill, 2009

Course : Electromagnetic Field 2

Code / Credit / Pre-req. : SCFI603115 / 3 SKS / Electromagnetic field 1, Mathematical Methods in Physics 2, Mathematical Methods in Physics 3

Objective :

To apply the concept and principle in electromagnetic field time-dependent on solving physics problem that involve electromagnetic interaction,

Subjects :

Maxwell equation, continuity equation, tensor of energy and momentum, poynting vector, gauge transformation, electromagnetic wave, reflection and refraction, wave guide, Lienard-Wiechert Potential, fields of moving charge, dipole radiation, radiation of accelerated charge, special relativity, and covariant form of Maxwell equation,.

Bibliography :

1. J.R. Reitz, F.J. Milford, and R.W. Christy, *Foundations of Electromagnetic Theory*, 4th edition, Addison Wesley, 1993.
2. J. Vanderlinde, *Classical Electromagnetic Theory* 2nd ed, Kluwer Academics Publishers, 2005.
3. Roald K Wangness, Electromagnetic Fields, Willey, 1986
4. Harald J W Muler Kirsten, Electrodynmics : An Introduction Including Quantum Effects, World Scientific, 2004
5. D.J. Griffiths, *Introduction to Electrodynamics*, 3rd edition, Prentice Hall, 1999.

Course : Statistical Physics

Code / Credit / Pre-req. : SCFI603110 / 4 SKS / Thermodynamics, Mathematical Methods in Physics 2, Mathematical Methods in Physics 3

Objective :

To apply the statistics principles, quantum mechanics theory, and semi-classical approximation toward systems which are consisted of many particles, to give microscopic explanation to macroscopic principles and phenomena, the generally know thermodynamics, and to provide simulation procedure, systematically microscopic to predict various thermodynamics characteristics of a system. Gases interaction, density of state, relativistic system, blackbody radiation, Planck distribution, Debye model, Bose-Einstein model, Bose-Einstein condensate, fermion, Pauli paramagnetism, landau diamagnetism, phase transition, liquid-gas transition, Ising model, mean-field theory, Landau theory, first-order phase transition, second-order phase transition, Landau-Ginzburg theory.

Subjects :

Microcanonical ensemble, canonical ensemble, chemical potential, classical partition function, equipartition energy, the Gibbs paradox and entropy, ideal gas on the grand canonical ensemble, Maxwell distribution, diatomic gas, interaction of gas, density of state, Relativistic system, black body radiation, Planck distribution, model Debye, Bose-Einstein distribution, Bose-Einstein condensation, fermion, paramagnetism Pauli, diamagnetism Landau, phase transition, liquid-gas transition, Ising model, the average field theory, Landau Theory, the transition phase of the first order, the transition phase of the second order, Landau-Ginzburg theory

Bibliography :

1. Reif, *Fundamentals of Statistical and Thermal Physics*, McGraw-Hill Book Company, 1985.
2. M. Guenault, *Statistical Physics*, Routledge, 1988.

Course : Quantum Mechanics 1

Code / Credit / Pre-req. : SCFI603110 / 4 SKS / Elementary Linear Algebra, Mathematical Methods in Physics 2, Mathematical Methods in Physics 3

Objective :

To explain the basic ideas of quantum mechanics and to apply on systems of simple quantum and atom such as hydrogen

Subjects :

Blackbody radiation, photoelectric effect, Compton scattering, wave-particle duality, Bohr atom, de Broglie wave, correspondence principle, wave packet, Heisenberg uncertainty principle, Schrödinger equation, wave function, normalization, expectation value, operator, commutation relation, stationer state, eigenvalue and eigenfunction, linier operator, Hermiticity, expansion theorem, the normalization of free wave, parity, degeneration, Dirac notation, representation, one-dimensional potential problems, simple harmonic oscillator and ladder operator, alteration of time-dependent expectation value, time-dependent operator, Schrödinger and Heisenberg model, N-particle system, central force, three-dimension Schrödinger equation, angular momentum, atom such as hydrogen.

Bibliography :

1. S. Gasiorowicz, *Quantum Physics* 2nd Ed., John Wiley & Sons, Inc., 1996.
2. A. Goswami, *Quantum Mechanics* 2nd Ed., Wm. C. Brown Publishers, 1997.

Course : Introduction to Nuclear Physics

Code / Credit / Pre-req. : SCFI603118 / 3 SKS / Modern Physics

Objective :

To explain the characteristic of atom, nuclear process, and the benefit of nuclear physics.

Subject :

Rutherford Scattering, nuclear Characteristics, binding energy, biding fraction, surface effect, separation energy, nuclear radius, the formulation of semi-empiric mass, nuclear spin, nuclear-electric moment, nuclear-magnetic moment, nuclear instability, radioactivity, nuclear models, nuclear force, particle physics, fundamental interaction, quark model, nuclear astrophysics, accelerator, detector, nuclear reactor, the benefit of nuclear physics.

Bibliography :

1. P. E. Hodgson, E. Gadioli, E. Gadioli Erba, *Introductory Nuclear Physics*, Oxford U. Press, 2000.
2. W. E. Meyerhof, *Elements of Nuclear Physics*, McGraw-Hill Book Co., 1989.

Course : Introduction to Solid State Physics

Code / Credit / Pre-req. : SCFI603117 / 3 SKS / Modern Physics

Objective :

To formulate the solution of modern physics problem related to solid state and well-defined

Subject :

Solid state structure, solid state vibration/phonon, electronic structure, superconductivity, magnetism, dielectric, ferroelectric

Bibliography :

1. R. K. Puri dan V. K. Babbar, Solid State Physics, S. Chand & Company Ltd, 1997
2. C. Kittle, *Introduction to Solid State Physics* 8th Ed., Wiley, 2005.
3. J. R. Hook and H. E. Hall, *Solid State Physics* 2nd Ed, Wiley, 1991.
4. S. P. Thornton dan A. Rex, , *Modern Physics* 3rd Ed., Thomson Brooks/Cole, 2006.
5. K. Krane, *Modern Physics* 3rd Ed, Wiley, 2012.
6. R. Harris, *Modern Physics* 2nd Ed., Pearson, 2008.
7. J. Bernstein, P. M. Fishbane, and S. Gasiorowicz, *Modern Physics*, Prentice Hall, 2000.

Course : Quantum Mechanics 2

Code / Credit / Prereq. : SCFI603116 / 3 SKS / Quantum Mechanics 1

Objective :

To explain the implication of charged particle interaction with electromagnetic field, spin theory, and perturbation theory for solving non-relativistic quantum mechanics problems.

Subject :

The interaction of charged particle with electromagnetic field, gauge transformation, minimal coupling, matrix, spin, basis and representation mechanics, additional of angular momentum, Clebsch-Gordan coefficient, Spectroscopic notation, parity and the orbital angular momentum, time-independent perturbation theory, non-degenerate and degenerate, the real hydrogen atom, helium atom, the structure of atom, molecule, time-dependent perturbation theory, scattering theory, density matrix, pure and mixed state.

Bibliography :

1. S. Gasiorowicz, *Quantum Physics*, John Wiley & Sons, Inc., 1996.
2. A. Goswami, *Quantum Mechanics 2nd Ed.*, Wm. C. Brown Publishers, 1997.

Course : Physics of Energy

Code / Credit / Pre-req. : SCFI602116 / 2 SKS / Introduction to Nuclear Physics, Thermodynamics

Objective :

To explain all of the energy source types, especially renewable energy

Subjects :

The utilization of source energy generally; fission nuclear energy, fusion nuclear energy, coal energy, oil and gas; water energy, micro hydro energy, tidal energy, wave energy, OTEC (Ocean Thermal Energy Conversion); biomass energy, biogas energy, thermal solar energy, solar cell energy, wind energy horizontal axis, wind energy vertical axis, geo-thermal energy, synthetic energy. Energy audit; co-generation.

Bibliography :

1. Abdul Kadir, *Energi*, UI Press.1982.
2. John A. Duffie and William A. Beckman. *Solar Engineering of Thermal Processes*, John Willey and Sons.1980.
3. Sze, S. M. *Physics of Semiconductor Devices*, John Willey and Sons. 1981
4. Journals about energy.

Course : Physics of Measurements

Code / Credit / Pre-req. : SCFI603310 / 2 SKS / Electronics 2

Objective :

To explain the theory and principle of physical measurements to do research experimentally in the laboratory

Subjects :

Measurement system (architecture, error, measurement standard), noise and coherent interference in measurement, principles of physical sense, sensor characteristic, DC Null measurement, AC Null Measurement, signal conditioning, digital technique in mechanics measurement, read out and data processing, examples of measurement system.

Bibliography :

1. Jacob Fraden, Handbook of Modern Sensors: Physics, Designs, and Applications., 3ed, Springer-Verlag New York, Inc. 2004.
2. T. G. Beckwith, R. D. Marangoni, dan J. H. Lienhard V, *Mechanical Measurements (I. Fundamentals of Mechanical Measurement, II. Applied Mechanical Measurements)*, Addison-Wesley Publishing Company, 5ed , 1993.
3. Robert B. Northrop, Introduction to Instrumentation and Measurements, Taylor & Francis, 2ed , 2005.

Course : Seminar

Code / Credit / Pre-req. : SCFI604101 / 2 SKS / at least completed 112 SKS

Objective :

To explain how to write research proposal and thesis based on UI's rule and scientific journal and to do a good scientific presentation

Subjects :

Research project

Bibliography :

1. Decision letter of rector UI No. 628/SK/R/UI/2008 about handbook for thesis writing for Universitas Indonesia Student, June, 16 2008.
2. Summary form of thesis, Library of Universitas Indonesia, Desember 2012
3. R. Weissberg dan S. Buker, *Writing Up Research; Experimental Research, Report Writing for Students of English*, Prentice-Hall, Inc, 1990.

Course : Undergraduate Thesis

Code / Credit / Pre-req. : SCFI604102 / 6 SKS / at least completed 114 SKS

Objective :

To write thesis and scientific journal, and to defend the presentation at the final seminar project

Subjects :

Research project

Bibliography :

1. Decision letter of rector UI No. 628/SK/R/UI/2008 about handbook for thesis writing for Universitas Indonesia Student, June, 16 2008.
2. UI Rector Decree number 2276/SK/R/UI/2013, about the Organization of the Undergraduate Program at the University of Indonesia, November 1, 2013.
3. The decision letter of the Dean of the SCIENCE FACULTY UI number 111/UN2. F3. D/HKP. 19/2014, about the completion of the categorization Guidelines 8 September 2014.
4. The procedure of collecting the final project (Thesis) S1, S2 and S3 (thesis) (Dissertation), Bibliography of the University of Indonesia, December 2012

Concentration of Theoretical Nuclear and Particle Physics

Course	: Classical Field Theory
Code / Credit / Pre-req.	: SCFI603414 / 4 SKS / Electromagnetic Field I, Classical Mechanics

Objective :

To Describes the fundamental classical fields, apply the covariant in the Lagrangian formulation of classical field, as well as using the mathematics of curved space-time geometry (non-Euclid) to analyze the gravitational field within the framework of general relativity as the curvature of space time phenomenon.

Subjects :

The Lorentz transformation, algebra and tensor calculus, a formulation of covariant electromagnetic field Maxwell, Lagrangian formulation, and the principle system for Minimum continuous Action (field), the equations of Euler-Lagrange to scalar fields and Maxwell field (Klein-gordon), Noether's theorem, the energy-momentum tensor, transformation gauge, invariance gauge symmetry for Abelian and non-Abelian, the inertial mass of the equivalence of gravitational mass, field tensor and tensor calculus on manifolds is flat, the metric tensor, Christoffel symbol, covarian derivatives, the geodesic equation, curvature of the Riemann tensor, the Ricci tensor, Einstein equations for the gravitational field, the Schwarzschild solution, the Reissner-Nordstrom solution, de Sitter and anti-de Sitter black hole, topics, topics in cosmology.

Bibliography :

1. Lewis H. Ryder, *Introduction to General Relativity*, Cambridge University Press ,2009.
2. Sean M. Carroll, S*pacetime and Geometry: Introduction to General Relativity*, Addison-Wesley, 2004.
3. Moshe Carmeli, *Classical Fields: General Relativity and Gauge Theories*, John-Wiley and Sons,1982.

Course : Advanced Computational Physics

Code / Credit / Pre-req. : SCFI603416 / 3 SKS / Computational Physics

Objective:

To apply numerical approaches, making micro-programming algorithm, and translates them into a computer program using the programming language Fortran, or equivalent, to solve the problems of physics.

Subjects :

Search roots function, the completion of system of equations linear, fittings with the methods least-square, interpolation, numerical integration, solving an equation differential ordinary and partial with the boundary conditions, eigenvalue problem solving by using power method, the secular equation method.

Bibliography :

1. P. L. DeVries, *A First Course in Computational Physics*, John Wiley &Sons, Inc., New York, 1994.
2. W. H. Press, *et. al.*, *Numerical Recipes in Fortran 77*, 2nd Ed., CambridgeUniversity Press, New York, 1992. (online / free download: http://www.nrbook.com/a/bookfpdf.php)
3. R. H. Landau & M. J. Paez, *Computational Physics: Problem Solving with Computers*, John Wiley & Sons, Inc., New York, 1997.
4. S. E. Koonin, *Computational Physics*, Addison-Wesley Publishing Co., Inc.,Redwood City, 1986.

Course : Nuclear and Particle Physics

Code / Credit / Pre-req. : SCFI603415 / 4 SKS / Quantum Mechanics 1, Introduction to Nuclear Physics

Objective:

To understand phenomena and the concept of the basis of nuclear physics and particle.

Subjects :

nuclear and particle physics experiments: measurements of mass and geometry of the core, types of particle detectors, particle accelerators and current status; nuclear physics: the Rutherford scattering, nuclear phenomena (global properties from the core), core models (microscopic model types and collective), nuclear radiation (alpha decay, beta and gamma); particle physics: properties and interaction of elementary particles, the concept of symmetry and transformation-discrete transformations in particle physics, the standard model for particle physics, the standard model predictions of confrontation with the experimental data, the model beyond the standard model of particle physics.

Bibliography:

1. A. Das and T. Ferbel, *Nuclear and Particle Physics*, World Scientific, 2003.
2. B. Povh, K. Rith, C. Scholz, F. Zetsche, *Particle and Nuclei, An Introduction to Physical Concepts*, Springer-Verlag, 2006.

Course : Relativistic Quantum Mechanics

Code / Credit / Pre-req. : SCFI604411 / 4 SKS / Quantum Mechanics 1

Objective :

To Apply the concepts and formulas of relativistic quantum mechanics to the problems of nuclear and particle.

Subjects :

review of non-relativistic quantum mechanics, Dirac operators, harmonic oscillator, $\hat{a}$ and $\hat{a}^\dagger$, Dirac delta functions, theory of interference do not depend of time, the oscillator is not harmonious, time dependent disorder theory, Fermi's the golden rule, the cross section scattering of Rutherford, relativistic notation, a natural unit, Maxwell's equations in the form of the relativistic wave equation, free photons, minimal substitution as well as its use to obtain the equation of the Lorentz force equation of free particles, the Mandelstam variables s , t, and u, as well as cross-symmetry, Klein-Gordon equation, solutions free particles, charged particle in an electromagnetic field A^μ , Scattering Amplitude two point particle without the spin with the electromagnetic field A^{μ}, scattering amplitude two point particles without the spin, Compton scattering point particle without spin, the cross-section scattering particle Coulomb point latitude without spin, Feynman rule for Coulomb scattering point particles without spin, Dirac equation and the Dirac matrices γ^{μ} , properties and algebra the Dirac matrices γ^{μ}, current opportunities and density for particle Dirac, Dirac equation for a free particle Dirac, interpretation for negative energy, particle scattering amplitude the Dirac field electromagnetic with A^{μ} , Coulomb scattering amplitude two particle Dirac, Coulomb scattering cross section of the latitude of the two particle Dirac, Feynman rules for particle Scattering of Dirac, Compton Dirac particles.

Bibliography :

1. J. D. Bjorken and S.D. Drell, *Relativistic Quantum Mechanics*, McGraw-Hill, 1964.
2. F. Halzen and A. D. Martin, *Quarks and Leptons*, John Wiley & Sons, 1984.

Course : Scattering Theory

Code / Credit / Pre-req. : SCFI603412 / 3 SKS / Quantum Mechanics 1, Introduction to Nuclear Physics

Objective:

To describe the scattering process using nonrelativistic quantum mechanics.

Subjects :

scattering kinematics, scattering wave function, scattering amplitude, cross section, the Born approximation, the Lippmann-Schwinger equation, propagator, scattering matrix, partial-wave technique, phase shift, density matrix, spin observables, numerical steps to solve the Lippmann-Schwinger equation for T-matrix.

Bibliography :

1. A. S. Davydov, *Quantum Mechanics*, 2nd Ed., Pergamon Press, 1976.
2. W. Glöckle, *The Quantum Mechanical Few-Body Problem*, Springer-Verlag, 1983.
3. R. L. Liboff, *Introductory Quantum Mechanics*, 2nd Ed., Addison-Wesley, Reading,Massachusetts ,1992.
4. M. E. Rose, *Elementary Theory of Angular Momentum*, Wiley, New York, 1957.

Mata kuliah : Quantum Field Theory

Code / Credit / Pre-req. : SCFI604413 /4 SKS / Relativistic Quantum Mechanics

Objective:

To explains the basic concepts and apply the practical formulation of quantum field theory in simple problems in nuclear and particle physics.

Subjects :

Equations of Euler-Lagrange equations for particles, Euler-Lagrange formalism to field, Hamiltonian formalism, Noether's theorem, quantization of harmonic oscillator, quantization of scalar field, the normal arrangement, space Fock, particles and anti-particles, propagator, the Dirac field quantization, projection operator, S-matrix, field interact, evolution operator, Wick's theorem, Feynman diagrams, the rate of decay, cross section , quantize the electromagnetic field, the invariant teralocal, electron-positron scattering, the scattering of Compton, discrete symmetry of the CPT, the electromagnetic form factors, renormalization Ward-Takahashi identity.

Bibliography:

1. A. Lahiri and P.B. Pal, *A First Book of Quantum Field Theory*, 2^{nd} ed., Alpha Science Intl. Publ., 2005.
2. L.H. Ryder, *Quantum Field Theory*, 2^{nd} ed., Cambridge Univ. Press, 1996.
3. S.M. Bilenky, *Introduction to Feynman Diagrams*, Pergamon Press, 1974.

Course : Theory of Angular Momentum

Code / Credit / Pre-req. :SCFI604414 / 4 SKS / Quantum Mechanics 2

Objective :

To explain the concepts related to the angular momentum and apply it to systems that have angular momentum.

Subjects :

Operators and transformations unitary, diagonalization the exponential form of the operator, the definition of angular momentum, eigenvalue relations commutation and commutes, the physical interpretation of angular momentum, angular momentum, the sum of two angular momentum, definitions of Clebsch-Gordan coefficients, relations on Clebsch-Gordan coefficients, calculation of coefficients of Clebsch-Gordan, symbols of 3j, 6j, and 9j, operator rotation and properties of ortogonalism harmonic functions of balls, iredusibel tensor, the Wigner-Eckart theorem, the sum of the two angular momentum, Racah coefficients, Maxwell's equations and multipole field in the form sferis, static interactions, and interaction of spin 1/2, application of nuclear systems, emissions of alpha particles by nuclei.

Bibliography :

1. M. E. Rose, *Elementary Theory of Angular Momentum*, Dover Books on Physics, Reprint edition, 2011.
2. R. Edmonds, *Angular Momentum in Quantum Mechanics*, Princeton University Press, Reissue edition,1996.
3. A. de-Shalit and I. Talmi, *Nuclear Shell Theory*, Dover Publications , 2004.

Concentration of Materials Physics

Course : Introduction to Materials Science

Code / Credit / Pre-req. : SCFI603511 / 3 SKS / Modern Physics

Objective :

To explain the basics of materials science and the application of physics to solve common problems in the field of material

Subjects :

Overview of materials science, types of materials, process-nature relationship-material structure, material structure (structure: macro, micro, sub, crystal and electronic structure of atoms); bonding of atoms in the crystal, the binding energy; the unit cell; allotropy; directions and crystal planes; defects in the crystal; material: metals and alloys, ceramics, polymers, composites, electronic and magnetic materials

Bibliography :

1. W.D. Callister, Jr. *Materials Science and Engineering: An Introduction,* 7th Ed, John Wiley & Sons, Inc., 2007.
2. L.H. Van Vlack, *Materials Science for Engineers*, 6th Ed, Addison-Wesley Pub. Co., Bab 1 – 7, 1975.
3. Donald R. Askeland, *The Science and Engineering of Materials*, 2nd S.I. Ed, Chapman & Hall, 1990.

Course : Research Methods of Materials

Code / Credit / Pre-req. : SCFI603514 / 2 SKS / Modern Physics

Objective :

To understand different methods and equipment for fabrication material and explain important results from material testings

Subjects :

Overview of the lab work material, the principle stoichiometry in design composition material, knowing preparation techniques material: the integration of mechanical, solidification, sol gel, high power sonication: Laboratory work activities include the design and manufacture as well as ferroelectric and ferromagnetic material testing.

Bibliography :

1. C. Suryanarayana and M. Grant Norton, *X-Ray Diffraction A Practical Approach*, Plenum Press, New York and London, 1998.
2. C. Suryanarayana, *Mechanical alloying and milling*, Progress in Materials Science 46, Pergamon Press, Elsevier Science Ltd., 2001.
3. Publication related scientific of sol gel rocess and ultrasonic.

Course : Ceramics Physics

Code / Credit / Pre-req. : SCFI604512 / 3 SKS / Introduction to Material Science

Objective :

To explain the effects of the physical natures of chemical bonding, diffusion and the electrical conductivity, properties of glass, sintering, mechanical properties, thermal properties, dielectric properties, magnetic properties, and optical properties of ceramic materials.

Subjects :

Effects on the physical nature of chemical bonding, diffusion and electrical conductivity, formation, structure, and properties of glass, solid sintering, liquids sintering, and grain growth, mechanical properties, thermal properties, dielectric properties, magnetic properties and optical properties.

Bibliography :

1. M. W. Barsoum, *Fundamentals of Ceramics*, Inst. of Publishing, 2003.
2. W.D Kingery, H.K. Bowen dan D.R. Uhlmann, *Introduction to Ceramics*, John Wiley & Son 1976.

Course : Composite Materials

Code / Credit / Pre-req. : SCFI604513 / 3 SKS / Introduction to Material Science

Objective :

To explains the basics of composites and their applications, matrix and reinforcement, the selection of matrix material and reinforcement, reinforcement-matrix interface, and mechanical properties of composite isotropic.

Subjects :

Introduction, various types of composites and his application, various types of matrix and reinforcement, matrix and reinforcement materials selection, interface matrix - reinforcement, mechanical properties of composite isotropic and Rule of Mixtures, as well as the anisotropic model introduction in fiber amplifier is not interrupted.

Bibliography :

1. R. F. Gibson, *Principle of Composite Material Mechanics*, McGraw-Hill Book Co., Int. Ed, 1994.
2. D. Hull, *An Introduction to Composite Materials*, Cambridge University Press, 6^{th}. Ed., 1992.
3. Scientific publication related composite.

Course : Thermodynamics of Materials

Code / Credit / Pre-req. : SCFI603513 / 3 SKS / Introduction to Material Science

Objective:

To explain the principle thermodynamics in the material to understand response material against the effects of treatment thermal.

Subjects :

The Law thermodynamics; property relationships; the equilibrium, electrochemistry, solution and the introduction of diagram the phase, defective solids , surface and interface , diffusion and kinematics reaction.

Bibliography :

1. D. R. Gaskell, *Thermodynamics Material*, McGraw Hill, 1981.
2. D. V. Ragone, *Thermodynamics of Materials*, Vol. I, John Wiley & Sons, Inc., 1995.
3. J. Bevan Ott dan J. Boerio-Goates, *Chemical Thermodynamics* , Elsevier, 2000.

Course : Methods of Materials Characterization

Code / Credit / Pre-req. : SCFI603515 / 4 SKS / Introduction to Material Science

Objective :

To Explains physics principle on various instruments test material and apply various raw method for testing and characterization materials and be able to process data for the amount of the decline in various material properties

Subjects :

Basic principle X-Ray, XRD, XRF, TEM, SEM, EDS, DTA, TGA, DSC, UTM, Impact Test, LPSA, AAS, ESR. Permeameter, VSM. Various testing standards (including ASTM E 975-95), phase identification material, heat capacity, heat conductivity, programme APD, Match and GSAS, mechanical properties testing and standardization, and application of ultrasonic, radiography and its application, *Eddy Current* techniques and applications, diffraction optical and applications, magnetic properties and standardization.

Bibliography :

1. B.D. Cullity, *Introduction to X-Ray Diffraction*, Addition Wesley, 1978
2. P.J. Goodhew dan F.J. Humphreys, *Electron Microscopy and Analysis*, Taylor & Francis, 1988
3. ASM Handbook Volume 10, *Materials Characterization*, ASM International, 1992
4. Puclications related scientific and material characterization methods.

Course : Phase Transformation of Materials

Code / Credit / Pre-req. : SCFI604511 / 3 SKS / Introduction to Material Science

Objective :

Students are expected to know the principle of the preparation of the material mainly metal and inorganic materials and alloy generally as well as the process of the formation of the phase materials, primarily through the process of thermal; understanding the phenomena that occur in materials for thermal applications include the problem of diffusion and phase transformation kinetics; understand the principles and application of the phase diagram, a diagram of the TTT diagram of IT and or CCT (Continuous Cooling Transformation) as well as the technique of determination of the fraction of the phase transformation. This study will hopefully improve the analysis of the research results in the processing of students associated with phase transformation in material issues.

Subjects :

The sense of Composition in Material and the principle of Stoichiometry in the preparation of materials, the concept of Thermodynamics in Liquid-solid Phase Transformation, Phase Diagrams/balance, Transformation and Diffusion Without diffusion, Phase transformation kineti , Readout and processing of Data, examples of measurement system design.

Bibliography :

1. D.A. Porter and K.F. Easterling, Phase Transformation in Metals and Alloys, Van Nostrand Reinhold, New York, 1981.
2. A.K. Jena and M.C. Chaturvedi, Phase Transformations in Materials, Prentice Hall, New Jersey, 1982.
3. Lecture notes/PPT Phase Transformation from internet; Publications related to the kinetics of phase transformations

Course : Materials Properties

Code / Credit / Pre-req. : SCFI603512 / 3 SKS / Introduction to Material Science

Objective :

To explain some general material properties and importantly includes mechanical properties, physical and chemical properties, electrical properties, ionic and magnetic.

Subjects :

Mechanic Properties: *stress – strain* concept, the elastics deformation, plastic, dislocation and *strengthening mechanism*, *failure*; Electrical Nature, Ionic and Magnetic: conductivity, resistivity, semi conductivity, dielectric, magnetism and superconductivity; Physical and Chemical properties: thermal, optic, corrosion, and material degradation.

Bibliography :

1. W.D. Callister, Jr. *Materials Science and Engineering: An Introduction,* 7th Ed, John Wiley & Sons, Inc., 2007
2. L.H. Van Vlack, *Materials Science for Engineers*, 6^{th} Ed, Addison-Wesley Pub. Co., Bab 1 – 7, 1975
3. Donald R. Askeland, *The Science and Engineering of Materials*, 2^{nd} S.I. Ed, Chapman & Hall, 1990.
4. Scientific publications related to the properties of materials

Course : Internship in Materials Physics

Code / Credit / Pre-req. : SCFI604514 / 2 SKS / Introduction to Materials Science

Objective :

To apply the material in lectures, theories and insights for learning on campus against the real applications are implemented in the field both in industry, research, services etc. Provide initial supply before students get into the world of work.

Subjects :

introduction of the mechanism of implementation Practice for student field work of Particular of Materials Science (PKLM), introduction to the place PKLM, K3 system applied and placement on the designated departments, preparation of the design of the program implementation, the determination of PKLM topics and topics for reports, data collection activities and the study of literature, a review of the implementation of PKLM, analyze the data and information obtained, additional more detailed data collection, analysis and experimentation if needed preparation of the draft report, PKLM, conducting literature reviews, and discussion are comprehensive, PKLM activity reporting & presentation

Bibliography :

Concentration of Condensed Matter Physics

Course : Spectroscopy 1

Code / Credits / Pre-req : SCFI603613 / 3 Credits/ Modern Physics, Vibrations and Waves, Electromagnetic Field 1, Classical Mechanics

Objective:

To explain the atomic and molecular spectroscopy methods, including spectroscopy rotation, vibration, electronic and analyze the results of spectroscopic experiments, as well as a review to the elements and surface spectroscopy

Subjects:

Interaction of electromagnetic waves (theory and experiments methods), rotational spectroscopy, vibrational spectroscopy, electron spectroscopy, atomic spectroscopy and analyzing surface spectroscopy.

Bibliography:

1. Collin N Banwell and Elaine M McCash, Fundamentals of Molecular Spectroscopy, 4th Ed., McGraw-Hill Book Co.,Singapore, 1995.
2. J. Michael Hollas, *Modern Spectroscopy* 4th Ed., John Wiley& Sons, Ltd., Chichester, 2004.
3. James W Robinson, Eillen M Skelly Frame, George M Frame II, Undergraduate Instrumental Analysis 6th. Ed., Marcell Dekker, New York, 2005.
4. David W. Ball, *The Basic of Spectroscopy,* SPIE Publications, Washington, 2001.

Course : Solid State Physics I

Code / Credit / Pre-req : SCFI603611 / 4 Credits/ Quantum Mechanics 1, Statistical Physics, Introduction to Solid State Physics

Objective:

To explain the concept of the state of crystalline solids, the motion of electrons and vibrations of the atoms in the crystal, as well as their implications in forming the unique properties of solids

Subjects:

The properties of transport of solids (energy dispersion relations, energy bands, effective mass theory, the phenomenon of transport, thermal transport, scattering of electrons and phonons, the phenomenon of magneto-transport, two-dimensional electron gas, quantum wells and semiconductor superlattices, transport in low dimensional systems , implantation and RBS), optical properties (fundamental relations for optical phenomena, Drude-theory, interband transitions, the joint density of states and the critical points, the absorption of light in solids).

Bibliography:

1. C. Kittel, *Introduction to Solid State Physics* 8th Ed., John Wiley& Sons, Inc., New York, 2005.
2. J. R. Hook and H. E. Hall,*Solid State Physics* 2nd Ed., John Wiley & Sons, Chichester, 1991.
3. N. W. Ashcroft and N. D. Mermin, *Solid State Physics,* Saunders College Publishing, Philadelphia, 1976
4. H. Ibach and H. Lüth, *Solid-State Physics* 4th Ed., Springer, New York, 2009

Course : Spectroscopy 2

Code / Credit / Pre-req : SCFI604611 / 3 Credits / Introduction to Solid State Physics, Quantum Mechanics 1,Vibrations and Waves, Thermodynamics

Objective:

Explain the magnetic spectroscopy method, electron spin resonance and nuclear, as well as Mossbauer spectroscopy, mass spectroscopy, chromatography, scanning tunneling spectroscopy, thermal analysis and analyzing the results of the spectroscopic experiments.

Subjects:

Characterization analytical material with thermal radiation and electromagnetic interaction with the external field and the particles and methods of experiments, spectroscopic magnetic spectroscopy electron spin resonance (ESR) spectroscopy resonance nuclear spin (NMR) spectroscopy Mossbauer, mass spectroscopy, chromatography (GC and HPLC) , scanning tunneling spectroscopy and thermal analysis.

Bibliography:

1. James W Robinson, Eillen M Skelly Frame, George M Frame II, Undergraduate Instrumental Analysis 6th. Ed., Marcell Dekker, New York, 2005.
2. Collin N Banwell and Elaine M McCash, Fundamentals of Molecular Spectroscopy, 4th Ed., McGraw-Hill Book Co., Singapore, 1995.
3. D.R. Vij, *Handbook of Applied Solid State Spectroscopy,* Springer, New York, 2006.
4. T. Hatakeyama, Z. Liu (Eds.), *Handbook of Thermal Analysis,* John Wiley and Son, Inc.,New York, 1998.
5. G. Gauglitz dan T. Vo-Dinh (Eds.), *Handbook of Spectroscopy,* Wiley-VCH Verlag GmbH & o, KGaA, Wienheim, 2003.

Course : Advanced Laboratory

Code/ Credits/ Pre-req : SCFI603622 / 4 Credits / Quantum Mechanics 1, Statistical Physics, Introduction to Solid State Physics

Objective:

To apply the skills of theoretical/ computational and/or experimental in a small research project on a topic from the field of condensed matter physics

Subjects:

Topics of theoretical / computational: the calculation of the structures of the energy bands using a variety of methods (tight-binding, linear combination of atomic orbitals, density functional theory, etc.), the calculation of various physical properties of solids (density state, conductivity optics, etc.), using the techniques of Green functions; Experimental topics: measurement and analysis of optical spectroscopy, ferromagnetic hysteresis, ferroelectric hysteresis, etc.

Bibliography:

1. Scientific journals / books in the field of physics and condensed matter physics that support and corresponding about research topics

Course : Advanced Computational Physics

Code / Credits / Pre-req : SCFI603416 / 3 Credits / Computational Physics

Objective:

To apply numerical approaches, making micro-programming algorithm, and translates them into a computer program using the programming language "'Fortran" or equivalent, to solve the problems of physics.

Subjects:

Finding root function, solving the system of linear equations, fitting with the least-squares method, interpolation, numerical integration, solving the ordinary differential equations and partial with the boundary conditions, solving eigenvalue problem by using the power method, the secular method equation.

Bibliography:

1. P. L. DeVries, *A First Course in Computational Physics*, John Wiley &Sons, Inc., New York, 1994.
2. W. H. Press, *et. al.*, *Numerical Recipes in Fortran 77*, 2nd Ed., CambridgeUniversity Press, New York, 1992. (online / free download: http://www.nrbook.com/a/bookfpdf.php)
3. R. H. Landau & M. J. Paez, *Computational Physics: Problem Solving withComputers*, John Wiley & Sons, Inc., New York, 1997.
4. S. E. Koonin, *Computational Physics*, Addison-Wesley Publishing Co., Inc.,Redwood City, 1986.

Course : Solid State Physics 2

Code/ Credits/ Pre-req : SCFI603612 / 4 Credits / Quantum Mechanics 1, Statistical Physics, Introduction to Solid State Physics

Objective:

To explain the latest phenomena in solids and mechanisms that lie behind them

Subjects:

Optical properties of solids (area with wider frequency, impurity and exciton, luminescence and photoconductivity, optical studies of lattice vibrations, non-linear optics, amorphous semiconductors), the magnetic properties of solids (the angular momentum, magnetic effect in free atoms , diamagnetic and paramagnetic of bound electrons, diamagnetic and paramagnetic of nearly free electrons, magneto-oscillatory and the Landau level, quantum Hall effect, magnetic ordering and magnetic devices)

Bibliography:

1. C. Kittel, *Introduction to Solid State Physics* 8th Ed., John Wiley& Sons, Inc., New York, 2005.
2. J . R. Hook and H. E. Hall,*Solid State Physics* 2nd Ed., John Wiley& Sons, Chichester, 1991.
3. N. W. Ashcroft and N. D. Mermin, *Solid State Physics,* Saunders College Publishing, Philadelphia, 1976
4. H. Ibach and H. Lüth, *Solid-State Physics* 4th Ed., Springer, New York, 2009

Course : Capita Selection of Condensed Matter

Code/ Credits/ Pre-req : SCFI604613/ 3 Credits/ Quantum Mechanics 1, Statistical Physics, Introduction to Solid State Physics

Objective :

To explain the latest phenomena in condensed matter physics and its applications for the technology of the future, including the concepts, the analytical and the numerical methods for calculating physical quantities associated.

Subjects :

Strong electron correlation system, nanoscience, mesoscopic system, analytical and numerical method such as Green's functions, linear response theory, the average of field approach in static and dynamic, etc.

Bibliography :

1. Scientific journals / books in the sphere of physics and condensed matter physics

Course (Optional) : Green's Function Method in Condensed Matter Physics

Code/ Credits/ Pre-req : SCFI603614 / 2 Credits / Mathematical Physics 1, Mathematical Physics 2, Mathematical Physics 3

Objective :

To explain the use of Green's functions to solve the problem of quantum mechanical electron system and / or other quasiparticles-in solids, as well as calculating the various magnitudes associated properties of solids.

Subjects :

Why Green function is required, construction and formulation of Green's functions, common approaches, the calculation of density of state, linear response theory, optical conductivity calculations, random phase approach, electron-electron interactions, Hubbard models, phonons and electron-phonon interaction, magnetism.

Bibliography :

1. G. Rickayzen, *Green's Functions and Condensed Matter*, Academic Press, 1980.
2. S. Doniach and E.H. Sondheimer, *Green's Functions for Solid State Physicists*, Imperial College Press, 1998.
3. Gerald D. Mahan, *Many-Particle Physics* 3rd Ed, Kluwer Academic/Plenum Publishers, 2000.

Concentration of Instrumentation Physics

Course : Embedded System

Code/ Credits/ Pre-req : SCFI604713/ 3 Credits/ Electronics 2

Objective :

To explain the design principles of embedded systems, real-time operating systems, and its programming and be able to apply them in the design of embedded system applications.

Subjects :

Introduction to Embedded Systems: Embedded System definition, examples of embedded systems, microprocessors and microcontrollers; microcontroller architecture; memory organization; The minimum system microcontroller based; sets of instructions; Parallel Input / Output; interrupts; Counters and Timers; Analog to Digital Converter (ADC) and Digital to Analog Converter (DAC); Interfacing External Memory; Interfacing External Peripherals and Devices; Serial Data Communication: USART, SPI, I2C, 1-Wire; Multi-tasking and Real-time Operating Systems (RTOS); Connectivity and Networking: USB, Bluetooth, Zigbee, Controller Area Network (CAN).

Bibliography :

1. Mazidi, M.A., Naimi, S., *The AVR Microcontroller and Embedded Systems Using Assembly and C*, Prentice Hall, 2011.
2. Barnett, R. H. , Cox, S., O'Cull, L., *Embedded C Programming and The Atmel AVR*, 2nd edition, Thomson Delmar Learning, 2007.
3. Noergaard, T., *Embedded Systems Architecture: A Comprehensive Guide for Engineers and Prgrammers*, Newnes Elsevier, 2005.

4. Catsoulis, J., *Designing Embedded Hardware*, O'Reilly, 2005.

Course : Computer-Based Data Acquisition

Code / Credits / Pre-req : SCFI604714/ 2 Credits / Electronics 2

Objective :

To explain various basic technique for data acquisition using LabVIEW software or programming language based computer.

Subjects :

The introduction of data acquisition system based computers, the introduction of graphical programming with LabVIEW, Input - Output on the computer system, the techniques - techniques of signal conditioning, conversion Signal Analog to Digital (ADC) and Digital to Analog (DAC), the data communication system of serial and parallel, example - a simple example of the acquisition of computer-based design techniques.

Bibliography :

1. Cotfas, P.A., Cotfas, D.T., Ursutiu, D. and Samoila, C., *NI ELVIS Computer-Based Instrumentation*, NTS, 2012
2. Travis, J. , and Kring, J. LabVIEW for Everyone, 3rd Ed. , Prentice Hall, 2006
3. Sumathi, S. and Surekha, P., *LabVIEW based Advanced Instrumentation Systems*, Springer, 2007.

Course : Sensors and Actuators 1

Code / Credit / Pre-req : SCFI603711/ 2 Credits / Electronics 2

Objective :

To explain the working principle of sensors and actuators, selecting and choosing the right sensors and actuators for specific uses, and applying it to a monitoring and measurement of physical quantities.

Subjects :

Temperature sensors (Thermistors, Resistance temperature sensors, Silicon resistive sensors, Thermoelectric sensors, PN junction temperature sensors, and optical temperature sensors), Mechanics Sensors (pressure sensors, flow sensors, level sensors), definitions, classifications, and characteristic of actuator like electric and hydraulic actuator.

Bibliography :

1. Webster, John G., *The Measurement, Instrumentation and Sensors Handbook*, CRC Press, 1999.

2. Fraden, J. , *GAIP Handbook of Modern Sensors, Physics, Designs and Applications*, J American Institute of Physics, 2004.
3. Beckwith, T. G. , Marangoni, R. D. dan J. H. Lienhard V, *Mechanical Measurements (I. Fundamentals of Mechanical Measurement, II. Applied Mechanical Measurements)*, Addison-Wesley Publishing Company, 6^{ed} , 2006.

Course : Instrumentation Physics 1

Code / Credits / Pre-req : SCFI603712/ 2 Credits / Electronics 2

Objective :

To explain the basic principles of instrumentation system.

Subjects :

Types of instrumentation, modeling of instrumentation systems, RLC Meter, Lock-In Amplifier, Impedance meters, Bioimpedance Analyzer, Spectrum Analyzer, Vector Network Analyzer

Bibliography :

1. Boyes, Walt, *Instrumentation Reference Book, 3rd Ed,* Butterworth – Heinemann, 2003.
2. Webster, John G., *Measurement Instrumentation and Sensor Handbook,* CRC Press, 1999.

Course : Control Systems

Code / Credits / Pre-req : SCFI603716 / 4 Credits / Electronics 2

Objective :

To analyze and design control systems for continuous linear systems.

Subjects :

Analysis of Control Systems : introduction to the concept of feedback and control system, the Laplace transform, the transfer function of linear system, linearized the nonlinear system, mathematical modeling system, the system of mechanical and electrical, block diagram model, graph model of flow signal, state variables model, the analysis of signal error, the sensitivity of the control system feedback to the variation of the parameter control, Signal interference in the feedback control system, control the transient response of the system, the error at steady state (steady state error), system performance in second-order, effect of the third pole and zero in response of second-order system, the performance index of the control system, the simplification of the linear system, analyzing the system stability of open loop and closed loop, testing the stability of the system using the method of characteristic functions and Ruth Hurwitz methods; Design of Control Systems: the concept of root locus, design parameter control using root locus method, Determination of PID parameters with the trial and error method, the identification process for the open-loop stable system, the determination of PID parameters to the method: Direct Synthesis, Inter Model Control, the performance index system , Ziegler Nichols, Cohen Coon and curves reaction; performance analysis of the frequency response of the system using Bode and Nyquist plots, the design of the control system Pi, PID, Lead, lag and Lead Lag, designing feedback systems with state variable.

Digital Control Systems

Bibliography :

1. Dorf, Richard C., and Bishop, Robert H., *Modern Control System*, Prentice Hall, 2011
2. Golnaraghi, Farid., and Kuo, Benjamin C., *Automatic Control System*, John Wiley & Son., 2010.
3. Seborg, Dale E., Edgar, Thomas F., and Mellichamp, Duncan A., *Process Dynamics and Control*, John Wiley & Son., 2004.

Course : Laboratory Work of Control System

Code/ Credits/ Pre-req : SCFI603726 / 1 Credits / Electronics 2

Objective :

To apply the principles of process control system for the identification and design of simple linear continuous system of a process that has a quick response and slower over time.

Subjects :

The introduction of a control system and programming language Matlab and LabVIEW, the representation of system using transfer function, state variables including linearization technique system, the system responds to a variety of standard signals, and its control techniques, determining PID parameters by methods 1. Trial and Error, 2. Direct synthesis, 3. Nichols Zieler reaction curve. Its application to control system of DC motor, inverted pendulum control, HVAC (heating, ventilation and air conditioning).

Bibliography :

1. Dorf, Richard C., and Bishop, Robert H., *Modern Control System*, Prentice Hall, 2011
2. Golnaraghi, Farid., and Kuo, Benjamin C., *Automatic Control System*, John Wiley & Son., 2010.

3. Seborg, Dale E., Edgar, Thomas F., and Mellichamp, Duncan A., *Process Dynamics and Control*, John Wiley & Son., 2004.
4. Quanser, *QNET DC Motor Trainer, QNET Rotary Pendulum Trainer, QNET Heating and Ventilation Trainer*, 2009

Course : Laboratory Work of Embedded System

Code / Credits / Pre-req : SCFI604723 / 1 Credits / Electronics 2

Objective :

To apply the design principles of embedded system, operating and programming systems; to analyze and design the applications of embedded systems.

Subjects :

The introduction of minimum system microcontroller and programming in Assembly language and C language; Parallel Input / Output; interrupts; Counters and Timers; Analog to Digital Converter (ADC) and Digital to Analog Converter (DAC); Interfacing External Peripherals and Devices: LCD, Keypad, Relay, DC Motor, Stepper Motor, Servo Motor, Real Time Clock (RTC); Serial Data Communication: USART, SPI, I2C, 1-Wire; Connectivity and Networking: USB, Controller Area Network (CAN)

Bibliography :

1. Mazidi, M.A., Naimi, S., *The AVR Microcontroller and Embedded Systems Using Assembly and C*, Prentice Hall, 2011.
2. Barnett, R. H. , Cox, S., O'Cull, L., *Embedded C Programming and The Atmel AVR*, 2nd edition, Thomson Delmar Leraning, 2007.
3. Noergaard, T., *Embedded Systems Architecture: A Comprehensive Guide for Engineers and Prgrammers*, Newnes Elsevier, 2005.
4. Catsoulis, J., *Designing Embedded Hardware*, O'Reilly, 2005.

Course : Sensors and Actuators 2

Code / Credits / Pre-req : SCFI603713/ 2 Credits / Sensors and Actuators 1

Objective :

To explain sensors and actuators technology, selecting and choosing the best sensors and actuators for specific uses, and to apply it to monitoring and measured the physical quantities and chemistry quantities.

Subjects :

The optical sensor (Infrared and pyroelectric, UV, Visible, image sensor), a magnetic sensor (Magnetogalvanic Sensors, Magnetoresistive Sensors, Inductive and Eddy Current Sensor), biological sensors (Biosensors), pneumatic actuators, piezoelectric actuators, thermal bimorphs

Bibliography :

1. Webster, *The Measurement, Instrumentation and Sensors Handbook*, A CRC Handbook Publihed in Cooperation with IEEE Press, 1999.
2. J. Fraden, *GAIP Handbook of Modern Sensors, Physics, Designs and Applications*, J American Institute of Physics, 2004.
3. Beckwith, T. G. , Marangoni, R. D. dan J. H. Lienhard V, *Mechanical Measurements (I. Fundamentals of Mechanical Measurement, II. Applied Mechanical Measurements)*, Addison-Wesley Publishing Company, 6^{ed} , 2006.

Course : Laboratory Work of Sensors and Actuators

Code / Credits / Pre-req : SCFI603723/ 1 Credits / Sensors and Actuators 1

Objective :

To design the electrical circuits for applications of sensor and actuators and used it for monitoring and measuring the physical quantities, making calculations, charts, analysis and conclusions based on experimental results and explains the physics concepts through experimentation and theory.

Subjects :

The design of electronic circuits and measured using temperature sensors, pressure sensors, flow sensors, level sensors, proximity sensors, load sensors, light sensors, magnetic sensors, chemical sensors, electric actuators, hydraulic actuators, and pneumatic actuators.

Bibliography :

1. Departemen Fisika FMIPA UI, Buku Panduan Praktikum Sensor dan Aktuator
2. Webster, John G., *The Measurement, Instrumentation and Sensors Handbook*, A CRC Handbook Publihed in Cooperation with IEEE Press, 1999.
3. Fraden, J., *GAIP Handbook of Modern Sensors, Physics, Designs and Applications*, J American Institute of Physics, 2004.

4. Beckwith, T. G. , Marangoni, R. D. dan J. H. Lienhard V, *Mechanical Measurements (I. Fundamentals of Mechanical Measurement, II. Applied Mechanical Measurements)*, Addison-Wesley Publishing Company, 6ed , 2006.

Course : Digital Signal Processing

Code/ Credits/ Pre-req : SCFI604715/ 4 Credits / Modern Physics, Mathematical Methods of Physics 2, Electronics 2

Objective :

To explain the processing of digital system and able to perform signal processing in a discrete time domain and discrete frequencies, as well as applying for a digital filter applications.

Subjects :

The introduction of signal-system, the conversion of analog signals to digital signals and vice versa, discrete-time signal, Transformation Z and its application to systems of linear time invariant (LTI), the analysis of signal frequency continuous time, frequency analysis of discrete-time signal, Fourier transform for discrete-time signal, filter concept, FIR digital filter, IIR.

Bibliography :

1. Kehtarnavas, N., *Digital Signal Processing System Design: LabVIEW-Based Hybrid Programming*, Academic Press, 2008.
2. Ingle, V.K., and Proakis, J.G., *Digital Signal Processing using Matlab*, Cengage Learning, 4th Ed., 2012.
3. Oppenheim, A.V. and Schafer, R.W., *Discrete-Time Signal Processing (3rd Ed),* Prentice Hall, 2009.

Course : Instrumentation Physics 2

Code / Credits / Pre-req : SCFI603714/ 2 Credits / Instrumentation Physics 1

Objective :

To describe the instrumentation methods and techniques that are widely used in Physics

Subjects :

Introduction of instrumentation systems for equipment test analized. Thermal analysis test tools, spectroscopic (UV-Vis_IR, AAS, GC, HPLC, FTIR), XRD, XRF, SEM, TEM, AFM, NMR, EPR, and mechanical vibration,

Bibliography :

1. Moris, Alan S, *Measurement and Instrumentation Principles, 3rd Ed*, Butterworth – Heinemann, 2001
2. Boyes, Walt, *Instrumentation Reference Book, 3rd Ed,* Butterworth – Heinemann, 2003.
3. Webster, John G., *Measurement Instrumentation and Sensor Handbook,* CRC Press., 1999.
4. Ahuja, S. and Jespersen, N. (Ed), *Modern Instrumental Analysis, Volume 47*, Elsevier, 2006

Course : Internship

Code / Credits / Pre-req : SCFI604742 / 2 Credits / -

Objective :

To apply the principles and practice in the observation, practice skills, train the student community in the work field both in industry, research or engineering technology.

Subjects :

Writing internship proposal for industries, research institutions (research laboratories, engineering and technology) or manufacturing industry, with an appropriate theme with concentration of Instrumentation Physics. Making observations, to the rhythm of work in the workplace practice, to make the analysis of the system, and recommend results in presentation format either in place or in the department work practices.

Bibliography : -

Concentration of Medical Physics & Biophysics

Course : Introduction to Radiology Physics

Code / Credits / Pre-req : SCFI603911/ 2 Credits / Modern Physics

Objective :

To explain the basic principles and concepts of radiation physics and dosimetry.

Subjects :

Classification of radiation, quantities and units of radiation, ionizing radiation directly and indirectly, the interaction of radiation with matter, exponential attenuation, radioactive decay, particle charged and the balance of radiation, radiation dosimetry, cavity theory, ionization chamber, calibration of photons and electrons with ionization chamber, relative dosimetry techniques, and absolute dosimetry techniques

Bibliography :

1. F. H. Attix. *Introduction of Radiological Physics and Radiation Dosimetry*,John Willey and Sons, New York, NY, 1986.
2. H. E. Johns and J. R. Cunningham. *The Physics of Radiology*, 4^{th} ed., Charles C. Thomas, Springfield, IL, 1983.
3. J. F. Knoll. *Radiation Detection and Measurement*. 3^{rd}. ed., John Willey and Sons, New York, NY, 2000.
4. Podgorsak, *Radiation Oncology Physics: Handbook for Teacher and Student*, IAEA, 2005.
5. Metcalfe, *et al*, *The Physics of Radiotherapy X-rays and Electron,* Medical Physics Publishing, 2007.

Course : Anatomy and Physiology

Code / Credits / Pre-req : SCFI603912 / 2 Credits / General Biology

Objective :

To define the medical terminology, identify roughly the anatomical structure, defining most of the organ systems, as well as describe the physiological mechanisms for the improvement, maintenance, and growth.

Subjects :

Nomenclature anatomy, bones, spinal column, thorax, abdomen, respiratory system, digestive system, urinary system, reproductive system, circulatory system, and pathology

Bibliography :

1. R. Putz dan R. Pabst, *Atlas Anatomi Manusia Sobotta,* EGC, 2010.
2. Serwood, *Fisologi Manusia: dari sel ke sistem,* EGC, 2001

Course : Introduction to Radiotherapy Physics

Code / Credits / Pre-req : SCFI604915 / 3 Credits / Introduction to Radiology Physics

Objective :

To explain the application of external and internal radiation beam produced by the therapy.

Subjects :

Introduction of radiation oncology, Radiobiology basic in radiotherapy, descriptions of clinical photon beam; Clinical photon beam: dose calculation; Clinical photon beam: basic clinical dosimetry; The electron beam clinical, basic physics characteristics in brachytherapy and clinical aspects brachytherapy

Bibliography :

1. AAPM Report No. 46. *Comprehensive QA for Radiation Oncology*, American Institute of Physics, New York, 1994
2. AAPM Report No. 47. *AAPM Code of Practice for Radiotherapy Accelerator*, American Institute of Physics, New York, 1994
3. AAPM Report No. 67. *Protocol for Clinical Reference Dosimetry of High Energy Photon and Electron Beams*, American Institute of Physics, New York, 1999.
4. IAEA Report No. 23. *Absorbed Dose Determination in Photon and Electron Beams. An International Code of Practice*, International Atomic Energy Agency, Vienna, Austria, 1987.
5. ICRU Report No. 38. *Dose and Volume Specifications for Reporting Intracavitary Therapy in Ginecology,* International Commission on Radiation Unit and Measurements, Bethesda, MD, 1985.
6. ICRU Report No. 50. *Prescribing, Recording and Reporting Photon Beam Therapy,* International Commission on Radiation Unit and Measurements, Bethesda, MD, 1993.
7. H. E. Johns and J. R. Cunningham. *The Physics of Radiology*, 4th ed., Charles C. Thomas, Springfield, IL, 1983
8. S. C. Klevenhagen, *Physics and Dosimetry of Therapy Electron Beams*, Medical Physics Publishing, Madison, WI, 1993
9. W. J. Meredith and J. B. Massey. *Fundamental Physics of Radiology*. 3rd ed., J. Wright, Bristol, UK, 1977
10. J. Van Dyk (Editor). *The Modern Technology of Radiation Oncology* (Medical Physics Publishing, Philadephia, PA, 1999
11. J. R. Williams dan D. I. Thwaites. *Radiotherapy Physics in Practice*, Oxford University Press, New York, 1994
12. Siamak Shahabi (Editor). *Blackburn's Introduction to Clinical Radiation Therapy Physics*, Medical Physics Publishing Corporation, Madison, Wisconsin, 1989

13. P. M. K. Leung. *The Physical Basis of Radiotherapy*, The Ontario Cancer Institute incorporating The Princess Margaret Hospital, 1990.
14. G. C. Bentel, C. E. Nelson, dan K.T. Noell. *Treatment Planning Dose Calculation in Radiation Oncology*. McGraw Hill, New York, NY, 1989.

Course : Introduction to Biophysics
Code / Credits / Pre-req : SCFI603919 / 2 Credits / General Biology
Objective :

To explain the concept of biophysics especially physics processes in living organisms and the application of the physical sciences in the study of living things.

*Subject*s :

Cells, the physics of the human body, the application of physics methods in the study of living creatures

Bibliography :

1. John R. Cameron. Physics of the Body, Medical Physics Publishing Corp, 1999
2. Roland Glaser, *Biophysics*, Springer, 2001.
3. V. Pattabhi. Biophysics, Springer, 2002

Course : Health Physics and Radiation Protection
Code/ Credits/ Pre-req : SCFI603914/ 2 Credits/ Introduction to Radiotherapy Physics
Objective :

To explain the knowledge about the relationship between microscopic interactions with cell responses, deterministic and stochastic effects, radiation detection equipment and radiation protection.

Subjects :

Introduction, Shielding: properties and design, nuclear counting statistic, radiation monitoring for personnel, internal exposure, environmental dispersion, biological effect, Regulation about radiation protection, garbage disposal of low and high degree, and non-ionizing radiation

Bibliography :

1. ICRP No. 60. 1990 *Recommendations of International Commission on Radiological Protection*, Elsevier Science, 1990.

2. Herman Cember, *Introduction to Health Physics*. 2nd ed., Pergamon Press Inc. New York, NY. 1983.
3. RL. Kathren, *Radiation Protection*, Adam Hilger LTD., Bristol, 1985.
4. D. A. Gollnick. Basic Radiation Protection Technology. 2nd ed., Pacific Radiation Corporation, Altadena, CA, 1993.

Course : Radiobiology

Code / Credits / Pre-req : SCFI603915 / 2 Credits / Anatomy and Physiology

Objective :

To explain the radiation effects on living cells occur in all the medical activities that utilize ionizing radiation, in the areas of diagnostics, radiotherapy and nuclear medicine

Subjects :

Review the interaction of radiation with matter, radiation injuries to DNA, DNA damage repair and repair of chromosome induced by radiation, the theory of the survival curve, cell death: the concept of cell death (apoptosis and reproductive cell death), the healing process of cellular, cell cycle, modifiers responses radiation-sensitizer and protector, RBE, OER, and LET, kinetic cell, tissue radiation injuries, pathology radiasi- acute and late effects, histopathology, tumor Radiobiology, TDF (time, dose, and fractionation), radiation genetics: the effects of radiation on fertility and mutagenesis and molecular mechanisms

Bibliography :

1. G. Gordon Steel (Editor). *Basic Clinical Radiobiology*, Edward Arnold,London, UK, 1993.
2. Eric J. Hall . *Radiobiology for the Radiologist*. 5th ed., Lippincott Williams and Wilkins,Philadelphia, PA, 2000.

Course : Laboratory Work of Medical Physics and Counter System

Code / Credits / Pre-req : SCFI603927 / 1 Credits / Introduction to Radiology Physics

Objective :

To conduct an experiment of scintillation measurements, nuclear spectroscopy, the use of diode detector, TLD etc.

Subjects :

Design Shielding space plane X-ray characterization of various materials shielding against X-ray energy, calibration of Nuclear Spectroscopy MCA, readings about monitoring individual dose film badge, calibration surveymeter, Nuclear spectroscopy Single Channel

Analyzer (SCA), characterization of detector Geiger Mueller, the determination of the type of radionuclides and dose readings TLD

Bibliography :

1. ICRP No. 60. 1990 *Recommendations of International Commission on Radiological Protection*, Elsevier Science, 1990
2. Herman Cember, *Introduction to Health Physics*. 2nd ed., Pergamon Press Inc. New York, NY. 1983.
3. RL. Kathren, *Radiation Protection*, Adam Hilger LTD., Bristol, 1985.
4. D. A. Gollnick. *Basic Radiation Protection Technology*. 2nd ed., Pacific Radiation Corporation, Altadena, CA, 1993.

Course : Introduction to Medical Imaging and Nuclear Medicine

Code/ Credits/ Pre-req : SCFI604916 / 3 Credits / Introduction to Radiology Physics

Objective :

To explain the basic principles of radiography, mammography, dental radiography, computed tomography, ultrasound, magnetic resonance imaging (MRI) and nuclear medicine.

Subjects :

To make image and contrast, radiography receptor, the film-screen radiography and fluoroscopy, radiography and digital fluoroscopy, mammography, and dental radiology. To make CT image, CT image quality, Imaging Resonance Magnetic Physics. To make MRI image, the principle of Ultrasonography Physics, making ultrasonography image, the principle of Gamma camera, radiopharmacy and pharmacokinetics, Internal dosimetry, SPECT-CT, PET and cyclotron, and QA of nuclear medicine equipment.

Bibliography :

1. J. T. Bushberg, J. A. Seibert, E. M. Leidhodt, Jr., J. M. Boone. *The Essential Physics of Medical Imaging*. 2nd ed., Williams and Wilkins, Baltimore, MD, 2002.
2. P.P Dendy and B. Heaton. *Physics of Diagnostic Radiology*, Institute of Physics Publishing, London, UK, 1999.
3. P. Sprawl. *Physical Principles of Medical Imaging*, Aspen Publishers,. Gaithersburg, Maryland, 1987.
4. Adrienne Finch (Editor). *Assurance of Quality in the Diagnostic Imaging Department*, The British Institute of Radiology, London, 2001

5. G. ter Haar and F. A. Duck (Editor). *The Safe Use of Ultrasound in Medical Diagnostic*, The British Institute of Radiology, London, 2001.
6. AAPM Report No. 39. *Specification and Acceptance Testing of Computed Tomography Scanners*, American Institute of Physics, New York,1993.
7. AAPM Report no. 76. *Quality Control in Diagnostic Radiology*, American Institute of Physics, New York, 2002.

Course : Introduction to Biomaterials
Code / Credits / Pre-req : SCFI604917 / 2 Credits / Introduction to Solid State Physics
Objective :

To explain the concept and the application of biomaterials

Subjects :

Introduction to materials, ceramics, metals, polymers, composition and structure of the mineral components of hard tissue, synthesis material biomimetic, dan microstructure of materials. The effect of simple ion and complex ion in HAP, Material Tri Calcium Phosphate, biocomposites, bioactive glass and ceramic glass, Biocompatibility of materials, the use of clinical calcium phosphate.

Bibliography :

1. Buddy D. Ratner. Biomaterial Science : An Introduction to Material in Medicine , Academic Press, 2012
2. C. Mauli Agrawal. Introduction to Biomaterials: Basic Theory with Engineering Application. Cambridge Press, 2013

Course : Advanced Biophysics
Code / Credits / Pre-req : SCFI604918 / 2 Credits / Introduction to Biophysics
Objective :

To understand the electromagnetics and optics applications in biological and human systems.

Subjects :

Electric-magnetic propagation network, biophysical physiology phenomenon, biophysical of nerve cells and brain, biosensor applications, medical imaging applications, application of biophysical stimulation therapy, biosensors, biosensor applications, OCT

Bibliography :

1. Robert O. Becker. The Body Electric: Elektromagnetism and the foundation of life. Wiliam Morrow, 1995
2. Jaakko malmivuo. Bioelctromagnetism: Principle and Applications of Bioelectric and Biomagnetic Fields.Oxford University Press, 1995
3. Prasad, P.N., "Introduction to Biophotonics", (Wiley-VCH), 2003
4. Wang, LV and Wu HI, Biomedical Optics, Principles and Imaging, (Wiley-VCH), 2007
5. Popp,Tuchin, Chiou, Heinemann (Editors)Handbook of Biophotonics, 3 Volume Set, (Wiley-VCH), 2012
6. Leahy, M.J. editor, Microcirculation Imaging, (Wiley-VCH), 2012.

Course : Introduction to Medical Instrumentation

Code / Credits / Pre-req : SCFI604919 / 2 Credits / Electronics 2

Objective :

To explain the basic of instrumentations and electronics, especially on medical equipments.

Subjects :

The basic of electronic instrumentation and sensors basic with its principles and applications, amplifiers and signal processing, Biopotensial: blood pressure and sound, flow and blood volume measurements, the respiratory system measurement, chemistry biosensor, clinical laboratories instrumentation, prosthetic and physiotherapy equipment, electrical safety, radiation detectors, radiotherapy machine (Co 60 and kV X-ray) and LINAC

Bibliography :

1. J. G. Webster, *Medical Instrumentation: Application and Design*, John Wiley & Sons, New York, 1998.

Course : Laboratory Work of Radiology Physics

Code / Credits / Pre-req : SCFI604921 / 1 Credits / Introduction to Radiology Physics

Objective :

To conduct experiments related to radiological physics and dosimetry measurements

Subjects :

Kerma and X-rays dose measurements, HVL determination of diagnostic radiological planes, Radiochromic Film Calibration, TLD Calibration, Kerma and Co-60 Output Measurements, Output Calibration of Photon and Linac Electrons.

Bibliography :

1. J. T. Bushberg, J. A. Seibert, E. M. Leidhodt, Jr., J. M. Boone. *The Essential Physics of Medical Imaging*. 2nd ed., Williams and Wilkins, Baltimore, MD, 2002.
2. P.P Dendy and B. Heaton. *Physics of Diagnostic Radiology*, Institute of Physics Publishing, London, UK, 1999.
3. P. Sprawl. *Physical Principles of Medical Imaging*, Aspen Publishers,. Gaithersburg, Maryland, 1987.
4. Podgorsak, *Radiation Oncology Physics: Handbook for Teacher and Student*, IAEA, 2005.
5. Metcalfe, *et al*, *The Physics of Radiotherapy X-rays and Electron*, Medical Physics Publishing, 2007.

Course : Internship

Code/ Credits/ Pre-req : SCFI604941 / 2 Credits / Introduction to Radiology Physics, Radiobiology

Objective :

To understand some important facilities in hospitals such as radiotherapy, diagnostic radiology and medical nuclear.

Subjects :

Clinics Orientation, introduction to diagnostic radiology equipment, introduction to radiotherapy equipment, introduction to radiology and radiotherapy dosimetry, quality assurance of diagnostic and therapy radiology equipment, and planning radiotherapy

Bibliography :

1. IAEA Training Course Series No 37, *Clinical Training of Medical Physicist Specializing in Radiation Oncology*, Vienna, 2009
2. IAEA Training Course Series No 47, *Clinical Training of Medical Physicist specializing in Diagnostic Radiology*, Vienna, 2009
3. IAEA Training Course Series No 50, *Clinical Training of Medical Physicist spwcializing in Nuclear Medicine* , Vienna, 2009