SYLLABUS 2012

UNDERGRADUATE PROGRAM IN PHYSICS

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

Course : Basic Physics 1

Code / Credit / Pre-req. : UIST601111 / 3 credits / -

Objectives :

To formulate solution of simple and well-defined mechanical physics problems.

Subjects:

Units, quantities, and vectors, motion in 1-, 2-, 3-dimensions; Newton's Law in motion and its application; work and kinetic energy; potential energy and energy conservation law; momentum impulse and collision; gravitation; rotation of rigid body; rotational motion dynamics; equilibrium and elasticity; periodic motion; static and dynamic fluid mechanics.

Bibliography :

1. Halliday, Resnick, dan Walker, *Principles of Physics 9th Edition*, Wiley, 2011.
2. Serway Jewett,*Physics for Scientists and Engineers 7th Edition*, Thomson Brooks/Cole, 2010.
3. Giancoli, *Physics for Scientists and Engineers 4th Edition*, Pearson, 2008.

Course : Basic Mathematics 1

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

Objectives :

To to explain the fundamental concepts of calculus and competent in solving calculus application problem.

Subjects:

Introduction: The real number system, inequalities and absolute value; one variable function: definition and types, graphs (Cartesian, polar, parameters), operations on functions; Limit: definition and theorem, continuity; The derivative function: definition, geometric meaning, derivatives formulas, the chain rule, high rank derivative, implicit derivative, derivative applications: maximum and minimum, average value theorem; Integral: definition, indefinite and definite integrals, the fundamental theorem of calculus, basic principal of integral, integration techniques, applications; Integral: area and volume of a surface of revolution.

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 : Basic Physics 2

Code / Credit / Pre-req. : SCFI601112 / 3 Credits / -

Objectives :

To formulate solution of simple and well-defined electricity and magnetism physics problem

Subjects:

Electric charge, electric fields, and Coulomb's Law; Gauss' Law; electric potential; capacitance and dielectric; electric current, resistance, and direct current; magnetic field and magnetic force; the source of magnetic field; electromagnetic induction; inductance; alternating current.

Bibliography :

1. Halliday, Resnick, dan Walker, *Principles of Physics 9th Edition*, Wiley, 2011.
2. Serway Jewett,*Physics for Scientists and Engineers 7th Edition*, Thomson Brooks/Cole, 2010.
3. Giancoli, *Physics for Scientists and Engineers 4th Edition*, Pearson, 2008.

Course : Statistical Methods

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

Objectives :

To to explain the fundamental concepts of statistic and its application.

Subjects:

Probability, conditional probability; random variables and probability distribution; Introduction of distribution: the probability distribution of discrete random variable (binomial distribution, Poisson distribution, hypergeometric distribution), the probability distribution of continuous random variables (normal distribution), sampling distribution, the central limit theorem proposition, chi-squared distribution, T-distribution, F-distribution, Statistical Inference: confidence intervals and hypothesis testing for one and two populations; Chi-squared testing; Independence testing, homogeneity testing, compatibility testing; simple linear regression; one-way ANOVA (analysis of variance).

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 Chemistry 1

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

Objectives :

Resolve the question of the matters concept, stoichiometry, chemical reactions, solutions, kinetic gas, chemical bonding, and colligative properties and explanation of the relationship between chemistry and mathematics, biology and physics in daily life.

Subjects:

Chemistry matters and its changes, the components of atoms, ions and molecules, electronic structure of atom, stoichiometry, the main chemical reaction, kinetic theory of gases, solutions and its colligative properties, thermochemical, field integration, integrated science.

Bibliography :

1. Brown, Lemay and Bursten, *Chemistry: The Central Science,* Prentice Hall, NJ,
2. Silberberg, *Chemistry: The Molecular Nature of Matter and Change,* Mc-Graw Hill, 5ed., 2006
3. Brady,J.E., *General Chemistry: Principles & Srtucture*, John Wiley & Sons, 1990

Course : Elementary Linear Algebra

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

Objectives :

To to explain the fundamental concepts of linear algebra with emphasis on computation or calculation.

Subjects:

The system of linear equations; 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 Physics 3

Code / Credit / Pre-req. : SCFI601113/ 4 Credits / Basic Physics 1 and Basic Physics 2

Objectives :

To formulate the solutions of thermodynamics, waves, and simple optics for well defined problems.

Subjects:

Temperature; heat; the first law of thermodynamics; the second law of thermodynamics; heat engine; kinetic theory of gases; entropy; mechanical waves; sound; Maxwell's equations and electromagnetic waves; light polarization; optical geometry; Interference of light wave; light wave diffraction.

Bibliography :

1. Halliday, Resnick, dan Walker, *Principles of Physics 9th Edition*, Wiley, 2011.
2. Serway Jewett,*Physics for Scientists and Engineers 7th Edition*, Thomson Brooks/Cole, 2010.
3. Giancoli, *Physics for Scientists and Engineers 4th Edition*, Pearson, 2008.
4. G. A. Sarojo, Gelombang dan optika, Salemba Teknika, 2011.

Course : Laboratory Work of Basic Physics 1

Code / Credit / Pre-req. : SCFI601121 / 1 Credit / Basic Physics 1, Basic Physics 2, Statistical Method

Objectives :

To produce graph/charts, analysis and conclusions based on the results of fundamental physics experiments, which is include Mechanics and Heat than can to explain the fundamental physics concepts and theories through experiments.

Subjects:

Measurement technique; Mechanics: moment inertia, free fall motion, liquid density, friction coefficient, collisions, swing twist, liquid viscosity, Young's modulus, mathematically swing, surface tension, hardness test ; heat : linear expansion coefficient,

thermal conductivity, calorimeters, Joule's constant, solar collectors, the ideal gases' law, Newton cooling, radiation constant , radiation energy absorbtion.

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 : Basic Mathematics 2

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

Objectives :

To explain the fundamental concepts and be able to solve application in Calculus problems.

Subjects:

Parametric equations, polar coordinate, area in polar coordinates; Vector-valued function, curvature (R2 and R3), derivative of the integral function of transcendent; Application of integral: length of a plane curve and area of a surface of revolution; Indeterminate forms (L'Hospital) and improper integrals; Sequences and infinite series of real numbers; The function of many variables change: limit, continuity, partial derivatives, differentiability, directional derivatives, tangent plane, the maximum and minimum; multiple integration.

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 : General Chemistry 2

Code / Credit / Pre-req. : SCCH601103 / 2 Credits / General Chemistry 1

Objectives :

To explain the question of the kinetics concept, equilibrium, acids and bases, chemical thermodynamics, electrochemistry, the description of the elements and explain the relationship between chemistry and mathematics, biology and physics in daily life.

Subjects:

Chemical kinetics, chemical equilibrium, acid-base, chemical thermodynamics, electrochemistry, chemical and metal processing, non-metallic chemistry, chemistry core, 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., 20
3. J.E. Brady, *General Chemistry: Principles & Stucture*, John Wiley & Sons, 20

Course : General Biology

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

Objectives :

To solve the problems of environment, biodiversity and conservation of Indonesia, in relation to mathematics, physics, and chemistry.

Subjects:

Characteristics of life, cell biology, heredity, evolution, the diversity of living things, the structure and function of the animal, the structure and function of vegetation, the biodiversity of Indonesia, as well as human interaction with other living beings and the environment

Bibliography :

1. Campbell, N.A. & J.B. Reece, *Biology*. 6th ed. Pearson Education Inc., San Fransisco, xxix+1245, 2002.
2. Karp, G. *Cell Biology*. 6th ed. John Wiley & Sons Inc. Singapore. xviii + 765 +I-20, 2010.
3. Russel, P. J. *Genetics: A molecular approach*. 3rd ed. Pearson Benjamin Cummings, 1301 Sansome St., San Fransisco: xix + 828 hlm, 2010
4. Madigan, M.T., J.M. Martinko & J. Parker. *Brock biology of microorganisms*. 9th ed. Englewood Cliff: Prentice Hall International, Inc.; 2001.
5. Corel, R.W. *Impacts of a warming arctic*. Arctic Climate Impact Assessment, Cambridge Press, 2004.

Course : Laboratory Work of Basic Physics 2

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

Objectives :

To produce graph/charts, analysis and conclusions based on the results of fundamental

physics experiments, which is include Electric, Magnetic and Optical than can to explain the fundamental physics concepts and theories throught experiments.

Subjects:

Electricity - Magnet: electrolysis, Wheatstone bridge, Kirchoff's law, Earth's magnetic field, temperature coefficient, AC circuits - RLC, barriers, transformer, ohmic material, RC transient circuit, diode; Optics: polarimeter, optical geometry of the lens, photometry, the refractive index of the prism spectrometer, Newton's rings, a diffraction grating, a 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. : SCFI602111 / 4 Credits / Basic Physics 3, Elementary Mathematic 2

Objectives :

To formulate the problem solving of simple modern physics with good defined, covering relativity, particle-wave duality, quantum physics, atoms and molecules, and radioactivity.

Subjects:

The theory of special relativity; Dualism Particle of light: like-particle properties, electromagnetic waves and wave-like properties, the material; Quantum mechanics; Atomic physics: a model of the hydrogen atom, hydrogen atom 3-dimensional and many electron atoms; Molecule; Radioactivity and its application.

Bibliography :

1. S. P. Thornton dan 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 Credits / Basic Physics 3, Elementary Mathematic 2

Objectives :

To explain the basic concepts of thermodynamics (the 0 until the 3rd law of thermodynamics) from the empirical review and mathematical formulations expansion, and the application in a variety of thermodynamic systems.

Subjects:

The concept of equilibrium and 0 thermodynamics law, equation of state, the first law of thermodynamics and its consequences, entropy and the 2nd law of thermodynamics, the combination of the 1st and 2nd thermodynamics laws, potentials of thermodynamics and the 3rd law of the thermodynamics, thermodynamic applications on the various of simple systems, kinetic theory, transport phenomena, statistical thermodynamics, applications of statistics on the various systems of gas.

Bibliography :

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

Course : Mathematical Physics 1

Code / Credit / Pre-req. : SCFI602211 / 3 Credits / Elementary Mathematic 2

Objectives :

To apply the mathematical methods as vector analysis, ordinary differential equations, partial differential equations, the coordinate transformation and tensor analysis in the problems of Physics.

Subjects:

Vector analysis, ordinary differential equations, partial differential equations, coordinate transformation and tensor analysis.

Bibliography :

1. M.L. Boas, *Mathematical Methods in The Physical Sciences* 2nd ed, John Wiley & Sons, 1983
2. B.D. Gupta, *Mathematical Physics*, Vikas Publishing, 1993
3. G.B. Arfken and H.J. Weber, *Mathematical Methods for Physicists*, Academic Press, 1995
4. L.A. Pipes and L.R. Harvill, *Applied Mathematics for Engineers and Physicist*, McGraw Hill, 1970.

Course : Mathematical Physics 2

Code / Credit / Pre-req. : SCFI602212 / 2 Credits / Elementary Mathematic 2

Objectives :

To apply the mathematical methods as a Fourier series, integral transformations, calculus of variations, and complex analysis, in Physics' problem.

Subjects:

Fourier series, integral transformations, calculus of variations, and complex analysis.

Bibliography :

1. M.L. Boas, *Mathematical Methods in The Physical Sciences*, 2nd ed, John Wiley & Sons, 1983
2. B.D. Gupta, *Mathematical Physics*, Vikas Publishing, 1993
3. G.B. Arfken and H.J. Weber, *Mathematical Methods for Physicists*, Academic Press, 1995
4. L.A. Pipes and L.R. Harvill, *Applied Mathematics for Engineers and Physicist*, McGraw Hill, 1970.

Course : Electronics I

Code / Credit / Pre-req. : SCFI602311 / 3 Credits / Basic Physics 3

Objectives :

To understand the principles of discrete electronics: power supply, diodes, bipolar transistors, field effect transistors, thyristors and operational amplifiers, and can apply them in the design of electronic systems.

Subjects:

Power Supply, Semiconductor, Diode Theory and Diode circuits, diodes for special purposes, Bipolar-Junction Transistors (BJT), bias transistors, Model AC transistor, voltage amplifier, power amplifier, Junction Field Effect Transistor (JFET), MOSFET, Thyristor. Basic Structure of Operational Amplifier (Op-Amp) and its characteristics, circuit Op-Amp Linear: inverting and noninverting amplifier, Summing Amplifier, DC imperfections, Differential Amplifiers, Instrumentation Amplifiers, Voltage-Controlled Current Sources (VCCS), Operation Op-Amp with a Single Op-Amp circuit Supply Nonlinear: comparators, Integrators, Differentiators, circuit Diode Active, Active Filters. Regulated Power Supplies.

Bibliography :

1. A. P. Malvino, D. J. Bates, *Electronic Principles*, 7th edition, McGraw-Hill Book Co., 2006
2. 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 Credit / Basic Physics 3

Objectives :

To apply the principles of discrete electronics: diode, transistor, Field Effect Transistor (FET) to analyse and design the electronic circuit system.

Subjects:

Using the measuring devices and testing of electronic components, diode characteristics, application of diode and Zener diode, transistor characteristics, transistor circuits, application transistor, characteristics and applications of FET, multivibrator, Schmitt application Triger and simple sensor circuit

Bibliography :

1. A. P. Malvino, *Experiments for Electronic Principles*, 6th ed, McGraw-Hill Co., 1999.
2. A. P. Malvino, D. J. Bates, *Electronic Principles*, 7th ed, McGraw-Hill Book Co., 2006

Course : Laboratory Work of Advanced Physics

Code / Credit / Pre-req. : SCFI602121 / 1 Credit / Modern Physics and Laboratory Work of Electronics I

Objectives :

To conduct experiments of simple modern physics and analysing the results.

Subjects:

Hall effect, photoelectric effect, the Planck constant in black body radiation, Zeemann effects, Franck-Hertz experiment, the charge in the electric and magnetic field, gamma-ray and a Geiger–Muller detector, Michelson interferometer, heat conduction, and Faraday rotation.

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.
9. J.P Holman, *Experimental Method for Engineers*, 7th ed., McGraw-Hill Book,Inc,. 2001
10. Ogawa Seiki, *Instruction Manual: Franck-Hertz demonstration*, OGAWA SEIKI, Tokyo Central PO Box No.1618 Tokyo,Japan, 1987.
11. Ogawa Seiki, *Instruction Manual: e/m Demonstration Apparatus*, OGAWA SEIKI, Tokyo Central PO Box No.1618 Tokyo Japan, 1987
12. Leybold-Heraeus, *Physics Experiment*, vol. 1,2 & 3, Leybold GmBH, 1986.
13. Krane,Kenneth, *Modern Physics*, 2nd ed., Mc Graw Hill, 1996.
14. H.D. Resnick dan J. Walker, *Fundamental of Physics,* 6th ed., John Wiley & Son, Inc, 2001.
15. *Pasco Heat conduction Apparatus*, Instruction Manual 012-09189A, www.pasco.com, 2012.
16. 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 : Classical Mechanics

Code / Credit / Pre-req. : SCFI602113 / 4 Credits / Basic Physics 3, Mathematical Physics 1, Mathematical Physics 2.

Objectives **:**

To apply the concept of classical mechanics to solve problems in dynamics physics.

Subjects:

Newtonian mechanics, dynamics of particle systems, motion in central force field, the motion according to the non-inertial frame, rigid body dynamics, Lagrange mechanics, Hamilton mechanics.

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 Credits / Basic Physics 3, Mathematical Physics 1, Mathematical Physics 2.

Objectives :

To apply the concept of the electromagnetic field time-independent (static and steady state) to solve the problems of electromagnetic physics.

Course Topics:

Electrostatic, the solution of electrostatic problem, the electrostatic field in a dielectric medium, the electrostatic energy, electric current, the magnetic field of steady currents, magnetic properties of matter, energy, magnetic, electromagnetic induction.

Bibliography :

1. J.R. Reitz, F.J. Milford, and R.W. Christy, *Foundations of Electromagnetic Theory*, 4th ed, Addison Wesley, 1993.
2. D.J. Griffiths, *Introduction to Electrodynamics*, 3rd ed, Prentice Hall, 1999.

Course : Vibrations and Waves

Code / Credit / Pre-req. : SCFI602115 / 4 Credits / Basic Physics 3, Mathematical Physics 1, Mathematical Physics 2.

Objectives :

To apply the concepts and principles of vibrations and waves in solving physics problems

of vibrations and waves.

Subjects:

Harmonic vibration, vibration coupled, wave (the wave equation, polarization, superposition of wave / interference, wave packets, dispersion, phase velocity, group velocity, the phenomenon of cut-off, the energy waves), wave at the boundary of two medium (reflectivity, transmission / refraction, diffraction, impedance), the Doppler effect, light (intensity distribution, interference Young / 2-slit, N-slit interference, Fraunhofer diffraction, Fresnel diffraction, the power split, interferometer).

Bibliography **:**

1. H.J. Pain, *The Physics of Vibrations and Waves*, 6th edition, John Wiley and Sons, 2005.
2. A.P.French, *Vibrations and Waves*, The M.I.T. (W.W. Norton and Co.), 1971.

Course : Physics Energy

Code / Credit / Pre-req. : SCFI602116 / 2 Credits / Modern Physics, Mathematical Physics 1, Thermodynamics

Objectives :

To explain all types of energy sources, especially renewable energy.

Subjects:

Utilization of energy sources in general; fission nuclear energy, nuclear fusion 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 energy solar cells; horizontal axis wind energy, vertical axis wind energy; Geothermal energy; synthetic energy; audits energy; 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. Related scientific publication in energy.

Course : Mathematical Physics 3

Code / Credit / Pre-req. : SCFI602213 / 3 Credits / Mathematical Physics 1 and Mathematical Physics 2

Objectives :

To solve different types of functions and apply them to Physics problems.

Subjects:

Error function, Beta and Gamma; Bessel functions, Legendre functions, and some special functions (functions Hermite, Laguerre functions and operators Ladder)

Bibliography :

1. M.L. Boas, *Mathematical Methods in The Physical Sciences* 2nd ed, John Wiley & Sons, 1983.
2. B.D. Gupta, *Mathematical Physics*, Vikas Publishing, 1993.
3. G.B. Arfken and H.J. Weber, Mathematical Methods for Physicists, Academic Press, 1995.
4. L.A. Pipes and L.R. Harvill, *Applied Mathematics for Engineers and Physicist*, McGraw Hill, 1970

Course : Electronics 2

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

Objectives :

To explain the principles of digital electronics and can apply them in the design of electronic systems.

Subjects:

Introduction to Digital Electronics, Digital Number Systems, gates-logic basic, circuit logic combination and method of simplification: Algebra Boole, Diagram Karnaugh, method of tabulation Quine McCluskey, concatenation Arithmetic, Design circuit with IC MSI: Decoder, Encoders, Multiplexers and demultiplexers, Magnitude comparators, Family Electronics Digital (DDL, TTL, CMOS, ECL), characteristics and interfacing. Programmable Logic Devices: CPLDs and FPGAs, Digital Electronics circuit design with VHDL. Flip-Flop and Its Application: Shift Registers, Asynchronous (Ripple) Counter, Synchronous (Parallel) Counter, Algorithmic State Machines (ASM) or Finite Sate Machine (FSM), ADC and DAC

Bibliography :

1. J. Bignell, R. Donovan, *Digital Electronics*, 5th edition, Delmar Cengage Leraning, 2006.
2. W. Kleitz, *Digital Electronics, A Practical Approach*, 9th edition, Prentice Hall, 2012.

Course : Laboratory Work of Electronics 2

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

Objectives :

To apply the principles of Operational Amplifier (Op-Amp) and digital electronics to analyse and design electronic circuit systems.

Subjects:

The basic circuit Op-Amp, Op-Amp characteristic, a circuit of addition and subtraction, a circuit of Op-Amp nonlinear, Op-Amp as an active filter, the logic circuit using a diode and a transistor, a circuit of logic gates and legal Boolean, a circuit of Flip-Flop, decoder, multiplexer, demultiplexer and counters, shift registers and arithmetic circuits.

Bibliography :

1. A. P. Malvino, D. J. Bates, *Electronic Principles*, 7th ed, McGraw-Hill Book Co., 2006
2. A. P. Malvino, *Experiments for Electronic Principles*, 6th ed, McGraw-Hill Co., 1999.
3. L. M. Faulkenberry, *An Introduction to Operational Amplifier, with Linear Applications*, 2nd ed, John Wiley & Sons, 1982.
4. J. Bignell, R. Donovan, *Digital Electronics*, 5th ed, Delmar Cengage Leraning, 2006.
5. W. Kleitz, *Digital Electronics, A Practical Approach*, 8th ed, Prentice Hall, 2007.

Course : Introduction to Solid State Physics

Code / Credits / Pre-req. : SCFI603111 / 4 Credits / Modern Physics, Mathematical Physics 3

Objectives :

To explain the basic physical phenomena in solids through a classical, semi-classical and quantum field theory approach.

Subjects:

Crystal structure, X-ray diffraction and lattice, bonds in solids, lattice vibrations, free electrons in the metal theory, the theory of energy bands in solids, semiconductors and

applications, magnetism, the properties of dielectric and superconductivity.

Bibliography :

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

Course : Introduction to Nuclear Physics

Code / Credit / Pre-req. : SCFI603112 / 4 Credits / Modern Physics, Mathematical Physics 3

Objectives :

To describe the structure of nucleon, nuclear processes, and the benefits of nuclear physics.

Subjects:

Rutherford scattering, the structure of nucleon, binding energy, the fraction of the belt, a surface effect, separation energy, core radius, the formula of mass semiempirical, nuclear spin, moment of core electrical, magnetic moment of the nucleon, the instability of the nucleon, radioactivity, models of the nucleon, the nuclear force , particle physics, fundamental interactions, quark model, nuclear astrophysics, accelerator, detectors, nuclear reactors, the benefits 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 : Quantum Mechanics 1

Code / Credit / Pre-req. : SCFI603113 / 3 SKS / Elementary Linear Algebra, Modern Physics, Mathematical 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:

Black body radiation, photoelectric effect, Compton Scattering, Wave-particle duality, Bohr atomic, deBroglie wave, principal of correspondence, wave packets, Heisenberg's uncertainty principle, Schrödinger Equation, wave function, probability interpretations, normalization, expectation value, operators, commutation relation, stationary state, eigen value and eigen function, linear operator, hermitian, expansion theorem, normalization of free wave, parity, degeneration, Dirac notation, representation, potential problems of one-dimensional, simple harmonic oscillator and ladder operator, changes in the expected value of the time, Time dependent operator, Schrödinger and Heisenberg representation, N-particle system, central force, Schrödinger equation in 3 dimension, angular momentum, hydrogen atom

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 : Statistical Physics

Code / Credit / Pre-req. : SCFI603114 / 3 SKS / Thermodynamic, Mathematical 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.

Subjects:

The introduction of statistical method, statistical description of particle system, statistical thermodynamics, macroscopic parameters and the measurement, simple application of macroscopic thermodynamics, fundamental of statistical mechanic method, the equilibrium between phase or chemical species, statistical quantum for ideal gases, interacted particle system, magnetism and low temperature phenomena

Bibliography:

1. F. Reif, *Fundamentals of Statistical and Thermal Physicsthermodynamics, Kinetic Theory, and Statistical Thermodynamics*, McGraw-Hill Book Company, 1985

Course : Measurement Technique

Code / Credit / Pre-req. : SCFI603311 / 2 SKS / Electronics 2

Objective:

To explain the measurement of electrical quantities and several other physical quantities with appropriate instruments.

Subjects:

The basics of measurement systems; type of instrumentation and characterization; analog scale measurements: the time-dependent characteristics; calibration of sensors and measuring instruments; standard measurement units and dimensions; measurement uncertainty; measurement reliability and security system; signal conditioning; digital techniques in mechanization (mechanical) measurement; reading and data processing; example: measurement of some magnitude Physics (distance, temperature and time).

Bibliography :

1. 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, 5^{ed} , 1993.
2. J. G Webster, *The Measurement, Instrumentation and Sensors Handbook*, A CRC Hadnbook Published in Cooperation with IEEE Press, 1999.

Course : Laboratory Work in Measurement Techniques

Code / Credit / Pre-req. : SCFI 603321 / 2 SKS / Laboratory Work of Electronics 2.

Objective :

To calibrate measurement instruments and to measure the electricity quantities and some other physical quantities with the appropriate measurement instrument.

Subjects :

Calibration of sensors and measuring instruments; measuring the analog and the digital quantities with: multimeters, LCR meters, oscilloscopes, frequency meters; single power phase measurement; distant measurement; temperature gauge and timer.

Bibliography :

1. 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, 5^{ed} , 1993.

2. J. G Webster, *The Measurement, Instrumentation and Sensors Handbook*, A CRC Hadnbook Published in Cooperation with IEEE Press, 1999.

Course : Electromagnetic Field 2

Code / Credit/ Pre-req. : SCFI603115 / 3 SKS / Electromagnetic Field 1, Mathematical Physics 3

Objective :

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

Subject :

Maxwell's equations, continuity equation, tensor of energy and momentum, Poynting vector, *gauge* transformation, electromagnetic waves, energy and momentum of electromagnetic waves, reflection and refraction, waveguides, Lienard-Wiechert potential, field due to moving charge, dipole radiation, radiation from an accelerated charge, special relativity and covariant formulation of Maxwell equations.

Bibliography :

1. J.R. Reitz, F.J. Milford, and R.W. Christy, *Foundations of Electromagnetic Theory*, 4th edition, Addison Wesley, 1993.
2. D.J. Griffiths, *Introduction to Electrodynamics*, 3rd edition, Prentice Hall, 1999.

Course : Quantum Mechanics 2

Code / Credit / Pre-req. : 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 problem.

Subject :

The interaction of charged particles and electromagnetic fields, gauge transformation, minimal substitution, mechanics matrix, spin, basis and representation, the sum of the angular momentum, the coefficient of Clebsch-Gordan, spectroscopy notation, parity and angular momentum, orbital, the theory of interference is independent of time: non-degeneration and degeneration, realistic hydrogen atom, helium atom, the structure of atoms, molecules, time-dependent interference theory, scattering theory, matrix density:

the pure state 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 : Computational Physics 1

Code / Credit / Pre-req. : SCFI603021 / 3 SKS / Mathematical Physics 3, Elementary Linear Algebra

Objective :

To apply the basics of macro programming techniques and algorithms using software MatLab or equivalent, to solve the problems of physics in algebra or calculus form.

Subject :

Introduction to matrices and matrix operations numerically, the solution of the root functions with halved methods (bisection), numerical integration with the trapezoidal method and Simpson, the solution for system of linear equations by gauss elimination method and LU decomposition and its application for the fitting, interpolation: lagrange, cubic spline, and multidimensional, the solution of differential equations with euler method, Runge-Kutta order 4, and the finite difference approach for one-dimensional problems.

Bibliography :

1. P. L. DeVries, *A First Course in Computational Physics*, John Wiley & Sons, Inc., New York, 1994.
2. R. H. Landau & M. J. Paez, *Computational Physics: Problem Solving with Computers*, John Wiley & Sons, Inc., New York, 1997.
3. S. E. Koonin, *Computational Physics*, Addison-Wesley Publishing Co., Inc., Redwood City, 1986.

Course : Computational Physics 2

Code / Credit / Pre-req. : SCFI604021 / 3 SKS / Physical Computing 1

Objective :

To apply numerical approaches, conducting micro programming algorithms, and translating them into a computer program using the Fortran 90 software or equivalent, to

solve the problems of physics in algebra or calculus form.

Subject :

Solving the root function problem with Newton-Raphson method, numeric integration using Gaussian Quadrature: Gauss-Lagrange, Gauss-Laguerre, the settlement system of linear equations by the iteration method Jacobi and Gauss-Siedel, problem solving eigenvalue by using the power method, the method of the secular equation and the QR method, interpolation with hermite method, solution of ordinary differential equations and partial (elipik, parabolic, and hyperbolic) with the boundary conditions with the approach of finite difference, complex integration, Fourier transform (FT) and Fast Fourier Transform (FFT)

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., Cambridge University 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.
5. R. L. Burden & J.D. Faires, *Numerical Analysis*, 8th Ed.

Course : Seminar

Code / Credit / Pre-req. : SCFI604101 / 2 SKS / > 113 sks

Objective :

To write a research proposal and thesis based on UI regulation and scientific articles as well as to conduction a good presentation.

Subject :

Research proposal writing, thesis writing, writing in the scientific journal and presentation technique

Bibliography :

1. UI Rector Decree No. 628/SK/R/UI/2008 about handbook for thesis writing for Universitas Indonesia Students, 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 / Seminar

Objective:

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

Subject:

The result of 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. The procedure of collecting the final project (Thesis) S1, S2 and S3 (thesis) (Dissertation), Bibliography of the University of Indonesia, December 2012

Concentration of Nuclear Physics and Particle

Course : Nuclear and Particle Physics

Code / Credit / Pre-req. : SCFI603411 / 3 SKS / SCFI602111, SCFI602213

Objective :

To understand about concept and nuclear phenomenon with its application

Subject :

History of nuclear and particle physics, the brief of nuclear reaction application, nuclear reactors, nuclear bomb, de Broglie waves, Schroedinger equation, particle in a potential box, angular momentum, the coefficient of Clebsch-Gordan, classification of particles, leptons, hadrons, quark, super-multiplet of hadrons , fundamental interactions, ionization chambers, proportional counter, Geiger-Mueller counter, semiconductor detectors, scintillation detector, Cerenkov detector, the introduction of radioactivity, decay qualitatively and quantitatively, alpha decay, beta, and gamma, natural radioactive isotopes, common applications of radioactivity, determination fossils through radioactive-carbon-dating, introduction to nuclear force, conservation of energy, linear momentum and angular momentum orbital, spin and total angular momentum, isospin, Pauli principle, Majorana operators, parity, conjugation charge, time reversal, nuclear force independent of charge, theory of pseudoscalar field, phenomenological potential for the two-nucleon, the introduction of nuclear structure, mass and nuclear binding energy, mass formula of semi-empirical Weizsacker, nuclear stability against beta decay, mass distribution and the charge in the nucleus, nuclear form factor, nuclear spin and isospin, hyper nuclear, introduction nuclear model, model of liquid drops, the model of a Fermi gas, shell model: quantum computing and magnetic moment of the nuclear, rotation model, vibration model, Nilsson models, alpha particles model, boson interaction model, introduction to nuclear scattering, Born approaches, elastic scattering, scattering ½ spin and spin 0, nucleons scattering, ortho parahydrogen scattering, effective roaming theory, the introduction of nuclear astrophysics, Big-Bang theory, the evolution of the universe up to t = 250 s, nucleosynthesis in the stars, the evolution of a star.

Bibliography :

1. P.E. Hodgson, E. Gadioli, E. Gadioli Erba, *Introductionary Nuclear Physics*, Oxford, 1997.
2. K. Krane, *Introductory Nuclear Physics*, John-Wiley, 1987.

Course : Classic Field Theory

Code / Credit / Pre-req. : SCFI603414 / 4 SKS / SCFI602113, SCFI602114

Objective :

To understand about theory of classical field as a basic to adapt in lectures such as theory of quantum field as well as to conduct some research in related fields

Subject :

1. The theory of special relativity, Lagrangian and Hamiltonian formulations for continuous systems, conservation theorem for continuous system and the energy-momentum tensor. Lagrangian of the classical relativistic field as a scalar field, Dirac field and the electromagnetic field.
2. The theory of general relativity which is consists of Einstein's equations, exterior Schwarzschild solution, gravitomagnetik effects with a linear approach, the interior Schwarzschild solution, Tolman-Oppenheimer-Volkoff equation also degenerate stars such as neutron stars and white dwarfs. Lagrangain formulation and the law of conservation of general relativity and gravitational waves.

Bibliography :

1. Ryder, L., *Introduction to General Relativity*, Cambridge University Press, 2009.
2. Goldstein, H. S., *Classical Mechanics*, Addison-Wesley, 1980.

Course : Scattering Theory

Code / Credit / Pre-req. : SCFI603412 / 3 SKS / SCFI603113, SCFI603112

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.

Course : Nuclear Model

Code / Credit / Pre-req. : SCFI603413 / 3 SKS / SCFI603113, SCFI603112

Objective :

To understand the models that being used in the field of nuclear physics many objects as the basic for research in the field of nuclear physics.

Subject :

1. Microscopic Model: identical particles, second quantization for Fermion / Boson and the average field approach also Hartree-Fock (HF) approach. Examples of applications at $T = 0$ include not interacting Fermi gas, electron gas against the background of positive rigid ions and the average of field models to describe relativistic nuclear material and finite nuclear. Also on $T \neq 0$ applications include systems Fermi and Boson does not interact and the effects of temperature on the nuclear material within the framework of relativistic average model.
2. Macroscopic Model (collective): the concept of deformation and vibration on the surface of the nuclear material, the model of vibration-rotation on nuclear material and model of interacting bosons (IBM). The relationship between the macroscopic and microscopic models based on the viewpoint of random phase approach (RPA) and time-dependent HF.

Bibliography :

1. Dickhoff, W. H. and Van Neck, D, *Many Body Theory Exposed*, World Scientific, 2005.
2. Greiner, W. and Maruhn, J. A., *Nuclear Models*, Springer-Verlag, 1996.

Course : Relativistic Quantum Mechanics

Code / Credit / Pre-req. : SCFI604411 / 4 SKS / SCFI603116

Objective :

To apply the concepts and equations of relativistic quantum mechanics to the problems of nuclear and particle.

Subject :

Dirac equation, covariance form, and solutions; Foldy-Wouthuysen transformation; hole theory; propagator theory; application on the electromagnetic interaction: Coulomb

scattering, bremsstrahlung, Compton scattering, electron-positron scattering, pair annihilation, vacuum polarization, the Lamb shift; Klein-Gordon equation; application on weak and strong interactions: meson-nucleon scattering, meson decay, neutrino two components

Bibliography :

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

Course : Nucleon Structure

Code / Credit / Pre-req. : SCFI604412 / 3 SKS / SCFI603116, SCFI603112, SCFI603411

Objective :

To understand about proton and neutron structure as well as mechanism to observe that.

Subject :

Kinematics of the reaction from particle process, Mandelstam variable, the energy threshold of the particles reaction, conservation of quantum numbers, elastic scattering and non-elastic electron-proton scattering, form factors Dirac-Pauli electromagnetic and Sachs, the cross section of scattering electron-proton, Rosenbluth separation, the introduction of symmetry SU (3), the properties of quark strange, reactions involving kaon and hyperon, the properties of self-analyzing-power of hiperon Lambda, Feynman diagrams, amplitude, and the cross section of Compton scattering, polarizability of nucleons, pion photoproduct on the order of low, cross-sectional and observable polarization pion photoproduct, theorems low energy (LET), multipoles electric and magnetic, comparison with pion latest experimental data, pion electroproduct, the properties of virtual photons, the cross section as well as observable polarization of pion electroproduct, multipoles electric and magnetic pion electroproduct, a comparison with the latest data experiment about electroproduct pion, photoproduct and electroproduct kaon on the order of low, cross-sectional and observable polarization of kaon photoproduct and electroproduct, multipoles electric and magnetic kaon photoproduct and electroproduct, a comparison with the latest experimental data about kaon photoproduct and electroproduct, the introduction of GDH sum rule, the relationship between GDH sum rule with pion and kaon photoproduct and electroproduct, some versions of GDH sum rule

Bibliography :

1. A.W. Thomas and W. Weise, *The Structure of Nucleon*, Vch Verlagsgeselschaft, 2001.

2. F. Halzen and A.D. Martin, *Quarks and Leptons*, John-Wiley, 1984.
3. I. J. R. Aitchison, *Gauge Theories in Particle Physics*, Adam Hilger, 1989.

Course : Quantum Field Theory

Code / Credit / Pre-req. : SCFI604413 / 4 SKS / SCFI603116, SCFI603414

Objective :

To apply the concepts and the equations of quantum field theory to the problems of nuclear and particle.

Subject :

canonical formalism and quantitation fields, conservation laws and symmetry; quantization of the Klein-Gordon field; quantization Dirac field; quantization of the electromagnetic field; interacting field; vacuum expectation value and matrix-S; perturbation theory; dispersion relation; path integral formalism; spontaneous symmetry breaking; renormalization

Bibliography :

1. Bjorken, J.D. and S.D. Drell, *Relativistic Quantum Field*, McGraw-Hill, 1965.
2. L.H. Ryder, *Quantum Field Theory*, Cambridge Univ. Press, 1985.

Concentration of Material Physics

Course : Introduction to Material Science

Code / Credit / Pre-req. : SCFI603511 / 3 SKS / Introduction to Solid State Physics

Objective:

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

Subject :

Overview of materials science, types of materials, relationship of process-properties-structure materials, 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 : Properties of Material

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

Objective :

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

Subject :

Mechanical Properties: the concept of stress - strain, elastic deformation, plastic, dislocation and strengthening mechanism, failure; Electrical properties, Ionic and Magnetic: conductivity, resistivity, semiconductivity, dielectric, magnetism and superconductivity; physical and chemical properties: thermal, optical, 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*, 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.
4. Related scientific publications about materials characteristics

Course : Thermodynamic Material

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

Objective :

To explain the principles of thermodynamics to materials for understand the material response against the effects of thermal treatment.

Subject :

The laws of thermodynamics; property relationships; condition of equilibrium, electrochemistry, solutions and the introduction of a phase diagram, defect in solids, surfaces and interfaces, diffusion and kinetics 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 : Research Methods on Materials

Code / Credit / Pre-req. : SCFI603514 / 2 SKS / Introduction of Material Science

Objective :

To use of various types of equipment for the manufacture of materials and to write reports on important results from material testings.

Subject :

Overview about working in material laboratory, the principles of stoichiometry in the design of the material composition; recognize material various preparation techniques: 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. Related scientific publications about sol-gel process and ultrasonication.

Course : Materials Characterization Method

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

Objective :

To explain physics principle on various material testing instruments and to implement the methods for testing and characterization of raw materials and be able to process data for

the amount of decline in various material properties.

Subject :

Fundamental principal of X-Ray, XRD, XRF, TEM, SEM, EDS, DTA, TGA, DSC, UTM, Impact Test, LPSA, AAS, ESR. Permeameter, VSM. Various of testing standard (include ASTM E 975-65), material phase identification, heat capacity, heat conductivity, APD program, Match program and GSAS program, mechanical properties testing and standardization, application of ultrasonic method, radiography and its application, Eddy Current technique and its application, application of optical diffraction, 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. Related scientific publications about materials characterization methods

Course : Materials Phase Transformation

Code / Credit / Pre-req. : SCFI604511 / 3 SKS / Thermodynamic Material

Objective :

To analyze the research results about problem in the phase transformation in the material.

Subject :

The composition of the material, material preparation, the concept of thermodynamics on the transformation of liquid - solid, equilibrium diagram / phase diagram, diffusion transformation and without diffusion transformation, kinetics of phase transformations, TTT and CCT diagrams, X-ray diffraction techniques and metallography for determining the fraction of phase transformation.

Bibliography :

1. D.A. Porter dan K.E. Easterling, *Phase Transformations in Metals and Alloys*, Van Nostrand Reinhold, New York, 1981.
2. A.K. Jena dan M.C. Chaturvedi, *Phase Transformations in Materials,* Prentice Hall, New Jersey, 1992.
3. David V. Ragone, *Thermodynamics of Materials*,. Vol. II", John Wiley & Sons, Inc., 1995.

4. Related scientific publications about kinetic of phase transformation

Course : Ceramic Physics

Code / Credit / Pre-req. : SCFI604512 / 3 SKS / Material Properties

Objective :

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

Subject :

Physical properties from chemical bonding effect, diffusion and electrical conductivity, formation, structure and properties of glass, solids 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 of Material Science

Objective :

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

Subject :

Introduction about composite materials, various types of composites and its application, various types of matrix and reinforcement, matrix and reinforcement materials selection, interface matrix - reinforcement, mechanical properties of composite isotropic and rule of mixtures(ROM), the introduction of anisotropic model in unbroken fiber amplifier.

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, 6th. Ed., 1992.
3. Related scientific publications about composite materials.

Concentration of Condensed Matter Physics

Course : Solid State Physics I

Code / Credit / Pre-req. : SCFI603611 / 4 SKS / Modern Physics, Thermodynamic, Electromagnetic Field 1

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

Subject :

Crystal structure, X-ray diffraction and reciprocal lattice, bonding crystal and elastic constants, crystals vibration (phonons) and thermal properties, free electron gas model, energy bands, semiconductor, the fermi surface and metal, plasmon, polariton, and polaron, optical and exciton process.

Bibliography:

1. C. Kittle, *Introduction to Solid State Physics* 8th Ed., Wiley, 2005.
2. J. R. Hook and H. E. Hall, *Solid State Physics* 2nd Ed., Wiley, 1991.
3. N. W. Ashcroft and N. D. Mermin, *Solid State Physics*, Saunders College Publishing, 1976
4. H. Ibach and H. Luth, *Solid-State Physics* 4th Ed., Springer, 2009

Course : Solid State Physics 2

Code / Credit / Pre-req. : SCFI603612 / 4 SKS / Introduction of Solid State Physics, Quantum Mechanics 1, Statistical Physics, Solid State Physics 1.

Objective:

To explain the latest phenomena in solids and mechanisms about its background

Subject:

Transport properties in solids, superconductivity, dielectric and ferroelectric, diamagnetism

and paramagnetism, ferromagnetism and antiferromagnetism, magnetic resonance, non-crystalline solids, point defects, the physics of surfaces and interfaces, dislocations, alloy

Bibliography:

1. C. Kittle, *Introduction to Solid State Physics* 8th Ed., Wiley, 2005.
2. J. R. Hook and H. E. Hall, *Solid State Physics* 2nd Ed., Wiley, 1991.
3. N. W. Ashcroft and N. D. Mermin, *Solid State Physics*, Saunders College Publishing, 1976
4. H. Ibach and H. Luth, *Solid-State Physics* 4th Ed., Springer, 2009

Course : Advanced Laboratory

Code/SKS/Pre-req. : SCFI603621/3 SKS/Solid State Physics 1

Objective :

Applying the expertise of theoretical/computational and/or experimental in a small research project in the field of condensed matter

Subject :

The topics of theoretical/computational: the calculation of the energy bands structures 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 techniques of Green's function.

Experimental topics: measurement and analysis of optical spectroscopy, ferromagnetic hysteresis, ferroelectric hysteresis, etc.

Bibliography :

1. Appropriate and required Physics journal/books.

Course : Capita Selecta of Condensed Matter

Code/SKS/Pre-req. : SCFI604612/3 SKS/Introduction of Solid State Physics, Quantum Mechanics 1.

Objective :

Explaining the latest phenomena in condensed matter physics and its application to future technologies, including concepts, analytical and numerical methods for calculating related physical quantities.

Subject :

Strong correlated electron systems, nanoscience, mesoscopic systems, analytical and numerical methods such as Green's functions, linear response theory, average static and dynamic field approach, etc.

Bibliography :

1. Relevant books/journals

Course : Spectroscopy 1

Code/SKS/Pre-req. : SCFI603613/3 SKS/Introduction of Solid State Physics, Quantum Mechanics 1.

Objective :

Explaining the atomic and molecular spectroscopy methods, including rotational, vibrational, and electronical spectroscopy, and analyzing the results of the spectroscopic experiments.

Subject :

The interaction of light with matter and methods of the experiment, atomical spectroscopy, rotational spectroscopy, vibrational spectroscopy, electronical spectroscopy.

Bibliography :

1. J. M. Hollas, *Modern Spectroscopy*, 4th Ed., Wiley, 2004.
2. C.N. Banwell, *Fundamentals of Molecular Spectroscopy*, 4th Ed. Mc Graw Hill 1995.
3. D. W. Ball, *The Basic of Spectroscopy*, SPIE Press, 2001.
4. J. R. Lakowicz, *Principles of Fluorescence Spectroscopy*, 3rd Ed, Springer, 2006.

Course : Spectroscopy 2

Code/SKS/Pre-req. : SCFI604611/3 SKS/Introduction of Solid State Physics, Quantum Mechanics 1

Objective :

Explaining the method of magnetic spectroscopy, electron spin and nuclear resonance, as well as Mossbauer spectroscopy, thermal analysis, and electron microscope, and analyzing the results of the spectroscopy experiment.

Subject :

Magnetic Spectroscopy, Electron Spin Resonance Spectroscopy (ESR), Nuclear Magnetic Resonance Spectroscopy (NMR), Mossbauer Spectroscopy, thermal analysis, and electron

microscope.

Bibliography :

1. J. M. Hollas, *Modern Spectroscopy*, 4th Ed., Wiley, 2004.
2. D.R. Vij, *Handbook of Applied Solid State Spectroscopy*, Springer, 2006.
3. T. Hatakeyama, Z. Liu (Eds), *Handbook of Thermal Analysis*, John Wiley and Son, 1998.
4. G. Gaulitz and T. Vo-Dinh, *Handbook of Spectroscopy*, Wiley-VCH Verlag GmbH & Co, 2003.

Concentration of Instrumentation Physics

Course : Sensor and Actuator 1

Code/SKS/Pre-req. : SCFI603711/ 2 SKS/ Electronics 2

Objective :

To explain sensors and actuators technology, selecting and choosing the right sensors and actuators for specific purposes, and applying it to monitoring and measurement of physical quantities.

Subject :

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

Bibliography :

3. Webster, John G., *The Measurement, Instrumentation and Sensors Handbook*, CRC Press, 1999.
4. Fraden, J. , *GAIP Handbook of Modern Sensors, Physics, Designs and Applications*, J American Institute of Physics, 2004.
5. Beckwith, T. G. , Marangoni, R. D. and 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/SKS/Pre-req. : SCFI603712/ 2 SKS/ Electronics 2

Objective :

To explain the basic principles of system instrumentation.

Subject :

Types of instrumentation. Instrumentation systems modeling. Static and dynamic characteristics of instrumentation. Systematic and random errors in the measurement process. The principle of calibration. Noise measurement and signal processing. Indicators and instrumentation for testing of electrical signals. Electrical quantities conversion method, including delta-sigma. Transmission of electrical signals, pneumatic, optical fiber, and radio. Digital signal transmission protocol. Digital computing and smart devices. Display, recording and presentation of the results of the measurement data. Reliability and safety of the instrumentation systems.

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.

Course : Sensor and Actuator 2

Code/SKS/Pre-req. : SCFI603713/ 2SKS/ Sensor and Actuator 1

Objective :

Explaining the Sensor and Actuator technology, select and choose Sensor and Actuator appropriately for a particular purpose, and applying it to monitoring and measurement of physical and chemistry quantities.

Subject :

Optical Sensor (Infra red & Piroelectric, UV, Visible, Image Sensor), Magnetic Sensor (Magnetogalvanic Sensors, Magnetoresistive Sensors , Inductive Sensor and Eddy Current), Biology Sensor (Biosensor), Pneumatic Actuator, 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. and J. H. Lienhard V, *Mechanical Measurements (I. Fundamentals of Mechanical Measurement, II. Applied Mechanical Measurements)*, Addison-Wesley Publishing Company, 6ed , 2006.

Course : Laboratory Work of Sensor and Actuator

Code/SKS/Pre-req. : SCFI603723/ 1 SKS/ Sensor and Actuator 1

Objective :

To design electrical circuits for Sensor and Actuator applications and used for monitoring and measurement of physical quantities, performing calculations, charts, analysis and conclusions based on experimental results and to explain the physics concepts through experimentation and theory.

Subject :

The design of electronic circuits and measured using temperature sensor, pressure sensor, flow sensor, level sensor, distance sensor, load sensor, light sensor, magnetis sensor, chemical sensor, electrical actuator, hydraulic actuator and pneumatic actuator.

Bibliography :

1. Departement of Physics FMIPA UI, Buku Panduan Praktikum Sensor and Actuator Practice Guide Books
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. and J. H. Lienhard V, *Mechanical Measurements (I. Fundamentals of Mechanical Measurement, II. Applied Mechanical Measurements)*, Addison-Wesley Publishing Company, 6ed , 2006.

Course : Instrumentation Physics 2

Code/SKS/Pre-req. : SCFI603714/ 2 SKS/ Instrumentation Physics 1

Objective :

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

Subject :

Introduction of instrumentation system analytic test equipment, Lock-In Amplifier, Impedance meters, thermal analysis test tools, Spectroscopy, XRD, NMR, EPR, and 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 : Control Systems

Code/SKS/Pre-req. : SCFI603715/3 SKS/Electronics 2

Objective :

To analyze and design control systems for continuous linear systems.

Subject :

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

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 Systems

Code/SKS/Pre-req. : SCFI603725/1 SKS/Electronics 2

Objective :

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

Subject :

Introduction of control system and programming using Matlab and LabVIEW language, the representation of good system using transfer function, *state variables* including linearization technique system, the responds of the system to a variety of standard signals, and its control techniques, determination of PID parameters using following methods 1. *Trial and error*, 2. *Direct synthesis*, 3. *Nichols Zieler* reaction curve. Its application to the DC motor control system, *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 : Digital Signal Processing

Code/SKS/Pre-req. : SCFI604711/ 3 SKS/Modern Physics, Mathematical Physics 2, Electronics 2

Objective :

Explaining the digital processing system and able to perform signal processing in a discrete time domain and discrete frequencies, as well as applying for a digital filter applications on board DSK (*digital starter kit*).

Subject :

Introduction of signal-system, the conversion of analog signals to digital signals and vice versa, discrete-time signal, Z Transformation and its application to linear time invariant (LTI) system, the analysis of continuous time signal frequency, the analysis of discrete-time signal frequency, Fourier transform for discrete-time signal, filter concept, FIR digital filter, IIR, implementation of digital filter on DSK (*digital starter kit*)

Bibliography :

1. Kehtarnavas, N., *Digital Signal Processing System Design: LabVIEW-Based Hybrid Programming*, Academic Press, 2008.
2. Chassaing, R., *Digital Signal Processing and Application with the C6713 and C6416 DSK,* Wiley & Sons, 2005.
3. Proakis, J.G., and Manolakis, D.G., *Digital Signal Processing: Principle, Algorihtms, and Application*, McMillan,1993.
4. Oppenheim, A.V. and Schafer, R.W., *Discrete-Time Signal Processing (3rd Ed),* Prentice Hall, 2009.

Course : Computer-based Acquisition

Code/SKS/Pre-req. : SCFI604712/ 2 SKS/Electronics 2

Objective :

To explain the various basic techniques for data acquisition using a computer using LabVIEW software or programming language.

Subject :

The introduction of computer-based data acquisition system, the introduction of graphical programming using LabVIEW, Input - Output on the computer system, the techniques of signal conditioning, Analog to Digital conversion (ADC) system and Digital to Analog

(DAC) system, the serial and parallel data communication system, simple examples of the computer-based acquisition techniques design.

Bibliography :

1. Cotfas, P.A., Cotfas, D.T., Ursutiu, D. and Samoila, C., *NI ELVIS Computer-Based Instrumentation*, NTS, 2012
2. Derenzo, S.E., *Practical Interfacing in the Laboratory: Using a PC for Instrumentation, Data Analysis, and Contro*l, Cambridge University Press, 2003.
3. Sumathi, S. and Surekha, P., *LabVIEW based Advanced Instrumentation Systems*, Springer, 2007.
4. Blasinger, F., and Schleider, M., *Digital Interfaces and Bus Systems for Communication: Practical Fundamental*, M.K. Juchheim GmbH&Co., 2001.

Course : Embedded System

Code/SKS/Pre-req. : SCFI604713/3 SKS/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.

Subject :

Introduction to Embedded Systems: Embedded System definition, examples of embedded systems, microprocessors and microcontrollers; microcontroller architecture; memory organization; microcontroller-based minimum system; 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 : Laboratory Work of Embedded System

Code/SKS/Pre-req. : SCFI604723/1 SKS/Electronics 2

Objective :

Applying the principles of embedded system design, operating systems and its programming to analyze and design embedded systems applications.

Subject :

Introduction of microcontroller minimum system 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 : Internship

Code/SKS/Pre-req. : SCFI604741/2 SKS/-

Objective :

To apply the principles given in lectures and practice in the observation, practice skills, train the student to socializing in the world of work in industry, research or engineering technology.

Subject :

Internship proposal on enterprises, research institutions (research laboratories, engineering technology) or manufacturing industry, with an appropriate theme with Systems and Instrumentation specialization. Make observations, to the rhythm of work in the workplace, make the analysis of the system, and recommend the results in presentation format either in the place of internships or in the department of university.

Bibliography : -

Concentration of Geophysics

Course : Introductory Geophysics

Code/SKS/Pre-req. : SCFI603811 /2 SKS/Mathematical Physics 3, Electromagnetic Field 1, Vibrations and Waves

Objective :

To explain basic concepts, scope and applications of geophysics as well as multi-disciplinary what it takes to be a geophysicist

Subject :

The structure of the earth and geodynamic, global tectonic, magnetism of the earth and rocks, preliminary geophysical methods, seismology, seismic methods, gravity method, magnetic methods, electrical and electromagnetic methods, *well logging*, the selection of geophysical methods, exploration of hydrocarbons, exploration of ore, exploration of geothermal, environmental and engineering geophysics

Bibliography :

1. M.B. Dobrin, and C.H. Savit, *Introduction to Geophysical Prospecting*. McGraw-Hill.Singapore, 1988.
2. A.E. Mussett and A. Khan, *Looking Into the Earth, An Introduction to Geological Geophysics*. Cambridge University Press. United Kingdom, 2000.
3. J. M., Reynolds, *An Introduction to Applied and Environmental Geophysics*. John Wiley and Sons, England, 1997.

Course : Fundamental Geology

Code/SKS/Pre-req. : SCFI603812 /2 SKS/Mathematical Physics 3, Electromagnetic Field 1, Vibrations And Waves

Objective :

To explain the basics of geological sciences

Subject :

Introduction of geological sciences, parts of the earth, the theory of tectonics plate, the geologic time scale, the material characteristics, classification of rocks (igneous, sedimentary, metamorphic), volcanic formations, geological and topographical maps, structural geology, history of geological natural disasters.

Bibliography :

1. J. A. Katili & Marks, Geologi kilat madju, 1963
2. *The Story of the Earth*, London Geological Museum, 1981
3. S. Judson & M.E. Kauffman, *Physical Geology* Prentice Hall Inc. , 1990
4. M.D. Ragan, *Structural Geology*, John Wiley & Sons1978
5. Frank Press & Raymond Siever, *Earth*, Freeman & Company, 1985

Course : Structure and Tectonics Geology

Code/SKS/Pre-req. : SCFI603813/2 SKS/Fundamental Geology

Objective :

To explain the basics science of structure and earth evolution geology.

Subject :

The introduction of structural geology, tectonics of the earth and its processes, the process of earth deformation, kinetics and dynamics of the earth, folds and faults, regional structural model and tectonic model, the theory of earth evolution.

Bibliography :

1. G.H. Davis, *Structural Geology of Rocks and Regions*, John Wiley, 1984
2. D.M. Ragan, *Structural Geology, Introduction to Geometrical Techniques*, John Wiley, 1979
3. B.E. Hobbs, W.D. Means and P.P. William, *An Outline of Structural. Geology*, Prentice-Hall.
4. J. Suppe, *Principles of Structural Geology*, Prentice-Hall, 1985.
5. Seiya Uyeda, *The New View of the Earth*, Freeman, 1978.

Course : Geoelectrical and Electromagnetical Methods

Code/SKS/Pre-req. : SCFI603814/3 SKS/Introduction to Geophysics and Fundamental Geology

Objective :

To explain the basic concepts of geoelectric and electromagnetic methods, data collection techniques, data processing and data interpretation as well as application of geoelectric and electromagnetic methods in geoscience exploration

Subject :

Introduction, basic principles of resistivity method: the electrical properties of rocks, the flow of electric current in the earth, the electrode configuration and geometry factors, in field measurements methods, analysis and interpretation of data, the basic concept of Self-Potential (SP) method, measurement techniques, processing and interpretation of SP data, the basic concept Induced Polarization (IP) method, measurement techniques, processing and interpretation of the IP data, fundamental concepts of electromagnetic (EM), measurement techniques, processing and interpretation of EM data, applications and case studies.

Bibliography :

1. M.B. Dobrin and C.H. Savit, *Introduction to Geophysical Prospecting*. McGraw-Hill.Singapore, 1988.
2. A. E. Mussett and A. Khan. *Looking Into the Earth, An Introduction to Geological Geophysics*. Cambridge University Press. United Kingdom, 2000.
3. J.M. Reynolds *An Introduction to Applied and Environmental Geophysics*. John Wiley and Sons. England, 1997.

Course : Gravity and Magnetic Methods

Code/SKS/Pre-req. : SCFI603815/3 SKS/Introduction to Geophysics and Fundamental Geology

Objective :

To explain the basic concepts of gravity and magnetic methods, data collection techniques, data processing and data interpretation as well as application of the gravity and magnetic method in geoscience exploration

Subject :

Introduction, basic concepts of gravity, gravity meter equipment, gravity measurements, reduction of gravity data, the separation of regional residual gravity, interpretation of gravity data, the basic concepts of magnetic, magnetic properties of rocks, earth magnetic

field, magnetic equipment, magnetic measurements, corrections magnetic data, interpretation gravity data, applications and case studies

Bibliography :

1. M.B. Dobrin and C.H. Savit, *Introduction to Geophysical Prospecting*. McGraw-Hill.Singapore, 1988.
2. A.E. Mussett and A. Khan *Looking Into the Earth, An Introduction to Geological Geophysics*. Cambridge University Press. United Kingdom, 2000.
3. J.M. Reynolds *An Introduction to Applied and Environmental Geophysics*. John Wiley and Sons. Englan, 1997.

Course : Seismic Methods

Code/SKS/Pre-req. : SCFI603816/3 SKS/Introduction to Geophysics and Fundamental Geology

Objective :

To explain the Fundamentals of seismic methods and their application in oil and gas, coal mining, mineral and geothermal exploration

Subject :

The introduction of seismic methods, seismic wave propagation principles, fundamentals of seismology, reflection and refraction of seismic waves, seismic data acquisition, seismic data processing, seismic data interpretation, seismic method applications in oil and gas, coal mining, mineral and geothermal exploration

Bibliography :

1. Stuart W Fagin, *Seismic Modeling of Geologic Structures*, Society of Exploration Geophysicists, Tulsa, 1991.
2. Robert E Sheriff, *Encyclopedic Dictionary of Exploration Geophysics*, 3rd Ed, Society of Exploration Geophysicists, Tulsa, 1991
3. Robert E. Sheriff and Lloyd P. Geldart, *Exploration Seismology*, Cambridge University Press, Cambridge, 1995
4. Ozdogan Yilmaz, *Seismic Data Analysis*, Vol. 1 & 2, Society of Exploration Geophysicists, Tulsa, 2000.

Course : Geophysical Data Analysis

Code/SKS/Pre-req. : SCFI604811/2 SKS/Geoelectrical and Electromagnetical Methods, Gravity and Magnetical Methods, Seismic Methods

Objective :

To explain the geophysical data analysis techniques in seismic and geopotential data for Objective exploration of natural resources.

Subject :

Range of seismic waves, seismic data display, speed analysis, seismic waves geometry, seismic wave propagation, migration techniques, seismic inversion, linear and non-linear inversion, *first and second derivative, continuation, upward* and *downward*, polynomial, *power spectrum*.

Bibliography :

1. Gray F. Margrave, *Numerical Methods of Exploration Seismology*, Department of Geology and Geophysics, the University of Calgary, . 2001.
2. M. B. Dobrin *Introduction to Geophysical Prospecting*, Mc. Graw-Hill Book Company, Sidney.
3. R. E. Sheriff and L. P. Geldart, *Exploration Seismology*, Vol. 1, 1982, Cambridge University Press, Cambridge.
4. Edwin S. Robinson, *Basic Exploration Geophysics*. John Willey & Sons, 1988.
5. Ozdogan Yilmaz, *Seismic Data Analysis*, Vol. 1 & 2, Society of Exploration Geophysicists, Tulsa, 2000

Course : Petroleum Exploration

Code/SKS/Pre-req. : SCFI604812/2 SKS/Geoelectrical and Electromagnetical Methods, Gravity and Magnetical Methods, Structural Geology and Tectonics Methods

Objective :

To describe geothermal system and application of integrated geoscience methods in geothermal exploration, particularly in geophysical applications

Subject :

Tectonics plate and the Ring of Fire, geothermal and surface manifestations system concept, deployment and potential of geothermal in the world and in Indonesia, technology, exploration and utilization of geothermal energy and its stage, application of the geology method in geothermal exploration, application of the geochemistry methods

in geothermal exploration, application of geophysical methods in geothermal exploration, integrated geoscience methods in geothermal exploration, geothermal exploration case study

Bibliography :

1. M.P. Hochstein and S. Soengkono *Geothermal Exploration for Earth Scientists*. Geothermal Institute Lecture Notes. Auckland, New Zealand, 1995.
2. R. DiPippo, Geothermal Power Plants. 2nd Ed, McGraw-Hill, 2007

Course : Petroleum Exploration

Code/SKS/Pre-req. : SCFI604813/2 SKS/Seismic, Structural Geology and Tectonics Methods

Objective :

To explain the formation process of petroleum and its accumulation in an oil deposits as a knowledge base to introduce the techniques of petroleum exploration.

Subject :

The introduction of petroleum exploration, petroleum systems, physical and chemical properties of petroleum, depositional environment, sedimentary basins and sedimentary rocks, process of petroleum formation, migration, reservoir, trap and the covering (impermeable).

Bibliography :

1. Ivanhoe, *Get Ready for Another Oil Shock*, 1997.
2. *Sedimentary Environments, Earth Systems History*, Colson Library.
3. Franc Press & Siever Raymond, *Earth*, W.H. Freeman Company, NY., 1985
4. Franc Press & Siever Raymond, *Understanding Earth*, W.H. Freeman Company, NY., 1985

Course : Field trip Geophysics

Code/SKS/Pre-req. : SCFI604821/2 SKS/Geoelectrical and Electromagnetical Methods, Gravity and Magnetical Methods, Seismic Methods

Objective :

To apply geophysics knowledge comprehensively in the field, ranging from the design of the measurement, data collection, data processing, data interpretation, up to reports preparation technique and presentations, and build ability of student to get work in a team professionally

Subject :

Geological and geophysical measurements design, geological measurements in the field, geophysical measurements in the field, geological and geophysical data processing in the laboratory, geological and geophysical data interpretation in the laboratory, analysis and interpretation of integrated geological and geophysical data, preparation of reports and presentations

Bibliography :

http://geophysics.mines.edu/splash_fieldcamp.html

Concentration of Medical Physics and Biophysics

Course : Introduction to Radiological Physics

Code / Credit / Pre-req. : SCFI603911 / 2 SKS / Modern Physics

Objective:

To describe the basic principle and concept of radiation and dosimetry.

Subjects:

Classification of radiation, quantities and units of radiation, direct and indirect ionizing radiation, interaction of radiation and matters, exponential attenuation, radioactive decay, charged particles and radiation equilibrium, radiation dosimetry, cavity theorem, ionization chamber, photon and electron calibration with ionization chamber, relative dosimetry technique, and absolute dosimetry technique.

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*, 4th ed., Charles C. Thomas, Springfield, IL, 1983.
3. J. F. Knoll. *Radiation Detection and Measurement*. 3rd. 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 / Credit / Pre-req. : SCFI603912 / 2 SKS / General Biology

Objective:

To describe the medical terminology, identify in general the anatomy structure, identify the organ system, and describe the mechanism of physiology of reconstruction, treatment, and growth.

Subjects:

Anatomical Nomenclature, bones, spinal column, thorax, abdomen, respiration system, digestion system, urinary system, reproduction system, circulation 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 : Imaging Theory

Code / Credit / Pre-req. : SCFI603913 / 2 SKS / Introduction to Radiological Physics

Objective:

To explain the concept of medical imaging techniques, quality of image, and image reconstruction.

Subjects:

Introduction to computational physics, 2D image reconstruction techniques, 3D image reconstruction techniques, image formation and contrast, radiography receptor, film-screen radiography and fluoroscopy, digital radiography and fluoroscopy, mammography, and dental radiology

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 dan 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 : Health physics and radiation protection

Code / Credit / Pre-req. : SCFI603914 / 2 SKS / Introduction to Radiological Physics

Objective:

To explain about the correlation between microscopic interaction and cell reaction, deterministic and stochastic effect, radiation detector and protection equipment.

Subjects:

Introduction to Shielding: character and design, statistic of nuclear decay count, personnel radiation monitoring, internal exposure, environment dispersion, biology effect, regulation about radiation protection, low and high degree waste disposal, 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 / Credit / Pre-req. : SCFI603915 / 2 SKS / Anatomy and Physiology

Objective:

To explain about the effect of radiation on living cell in every medical activity which using ionizing radiation, diagnostic activity, radiotherapy, and nuclear medic.

Subjects:

Review about interaction between radiation and matters, radiation wound on DNA,

damaged DNA reconstruction, radiation induction damaged chromosome and the repair, survival curve theory, the death of cell: concept of death of cell (apoptosis and reproduction of dead cell), cellular healing process, cell cycles, radiation-sensitizer response modifier and protector, RBE, OER, and LET, cell kinetics, radiation wound on tissues, radiation pathology, continuous and critical effect, histopathology, radiobiology tumor, TDF (time, dose, and fractionation), radiation genetics: radiation effect on fertility and mutagenesis, and molecular mechanism.

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 : Basic Principle of Medical Instrumentation

Code / Credit / Pre-req. : SCFI603916 / 2 SKS / Electronica 2

Objective:

To describe the basic instrumentations and electronica specific on medical instrumentation.

Subjects:

Basic electronic instrumentation, basic sensors, the principles and applications, amplifiers and signal processing, Biopotential: blood pressure and sound, flow and volume measurements of blood, respiration system measurement, chemistry biosensors, instrumentation of clinic laboratory, prosthetic and physiotherapy equipment, electrical safety, radiation detector, radiotherapy device (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 : Practical Health Physics and Counting System

Code / Credit / Pre-req. : SCFI603917 / 1 SKS / Introduction to Radiological Physics

Objective:

To conduct experiments of scintillation measurements, nuclear spectroscopy, using diode

detector, TLD etc.

Subjects:

Designing Shielding chamber of X-ray device, characteristic of shielding materials against X-ray energy, nuclear spectroscopy calibration MCA, personal film badge dose monitoring, survey meter calibration, nuclear spectroscopy Single Channel Analyzer (SCA), Geiger Mueller work characteristic, determining radionuclides and reading TLD dose.

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 : Laboratory Work of Radiology Diagnostic

Code / Credit / Pre-req. : SCFI603918 / 1 SKS / Introduction to Radiological Physics

Objective:

Do the experiment related to Radiology diagnostic physics in hospital, quality control process, and dosimetry measurements.

Subjects:

Radiodiagnostic film characteristic towards kV, mA and time, Kerma measurements and dependence to kV, mA and time, determining HVL, radiology diagnostic device, Focal Spot and Beam Alignment measurements, and accuracy of kV and X-ray device timer.

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.

Course : Laboratory Work of Radiotherapy

Code / Credit / Pre-req. : SCFI604914 / 1 SKS / Introduction to Radiological Physics

Objective:

To conduct experiments related to Radiotherapy physics in hospital, quality control process, and dosimetry measurements.

Subjects:

Environment and measurements and Shutter movements correction (Transit time of Co-60 device), Co-60 device output calibration, depth dose percentage (DDP) of Co-60 Teletherapy device, Wedge factor of Co-60 Teletherapy device, Tissue Phantom Ratio (TPR) of Co-60 Teletherapy device, determination of Back Scatter Factor of Teletherapy, and Photon and Electron output calibration of LINAC Device

Bibliography:

1. Podgorsak, *Radiation Oncology Physics: Handbook for Teacher and Student*, IAEA, 2005.
2. Metcalfe, *et al*, *The Physics of Radiotherapy X-rays and Electron*, Medical Physics Publishing, 2007.

Course : Biophysics

Code / Credit / Pre-req. : SCFI604911 / 2 SKS / General Biology

Objective:

To explain the concept of biophysics especially the physical processes on living organism and physics application in researches on living organism.

Subjects:

Cell, Physics in human body, application of Physics methods in research on living organism, biomaterial and fabrication processes.

Bibliography:

1. Roland Glaser, *Biophysics*, Springer, 2001.

Course : Introduction to Medical Imaging and Nuclear Medic

Code / Credit / Pre-req. : SCFI604912 / 2 SKS / Imaging Theory

Objective:

To explain the basic principle of Computed Tomography, ultrasound, magnetic resonance

imaging (MRI) and nuclear medic.

Subjects:

CT image formation, CT image quality, Physical principles of Magnetic Resonance Imaging, MRI image formation, physical principles of Ultrasonography, Ultrasonography image formation, working principle of gamma camera, radiopharmaceuticals and pharmacokinetic, internal dosimetry, SPECT-CT, PET and cyclotron, and QA nuclear medic 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 Radiotherapy

Code / Credit / Pre-req. : SCFI604913 / 2 SKS / Introduction to Radiological Physics

Objective:

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

Subjects:

Introduction to Radiation oncology, basic of radiobiology in radiotherapy, description of clinical photon beam: calculation of dot dose, clinical photon beam, basic clinical dosimetry, clinical electron beam, basic physical properties in brakhitherapy and clinical

brakhitherapy aspects.

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.
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Course : Internship

Code / Credit / Pre-req. : SCFI604941 / 2 SKS / Introduction to Radiological Physics, Radiobiology

Objective:

To understand important facilities in the hospital such as, radiotherapy, radiology diagnostic and nuclear medic.

Subjects:

Clinical orientation, introduction to radiology diagnostic, introduction to radiotherapy equipment, introduction to radiology dosimetry and radiotherapy, quality assessment of radiology diagnostic and radiotherapy equipment, and radiotherapy planning

Bibliography:

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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