

# SYLLABUS

## DOCTOR IN MATERIALS SCIENCE

### A. Compulsory of Doctor by Research & Course Program

#### 1. Course: Philosophy of Science

**Code / Credits / Prerequisites:** SCMS901101 / 2 Credits / -

**Objective:**

Learn about the philosophy of science in general.

**Subjects:**

Philosophical and scientific relations; scientific method; sense and experience; positivism problem of science; the debate between realism and antirealism; postpositivism, critical theory, and constructivism, as well as theoretical and applied ethical discourse.

#### 2. Course: Research Methodology

**Code / Credits / Prerequisites:** SCMS901102 / 2 Credits / -

**Objective:**

Equip students to know in practice the procedures of a research.

**Subjects:**

Basics of research methods; sampling and measurement; design and analysis, reporting procedures.

**Bibliography:**

William M. Trochim, *Knowledge Base Research Methods*, <http://trochim.omni.cornell.edu/kb>, 2006

#### 3. Course: Analytical Method in Materials Characterization

**Code / Credits / Prerequisites:** SCMS901103 / 4 Credits / -

**Objective:**

This course is intended to introduce students to the PS Materials Doctoral Program about the physical principles of measuring instruments and measurement and analysis techniques for the purpose of materials characterization. Activities include face-to-face lectures and lab work. It is expected that the knowledge and experience achieved from the activities can support the research needs of Doctoral students.

**Subjects:**

Overview of Lecture Analytical Methods and Characterization of Materials; Electronic instrumentation measurement system: detector, signal amplification system, S / N ratio, recording system; Statistical analysis and error of measurement data; Sample preparation and error factors; Instrument system and XRD and XRF measurement techniques; Instrument Systems and Electron Microscope measurement techniques; Instrument systems and thermal measurement techniques: Physical principles of DSC, DTA and TGA, measurement techniques, instrument

systems and spectral measurement techniques. Optics, UV VIS, IR and FTIR, AAS; Neutron Diffraction Instrumentation System; Resonant Spin Electron Instrumentation System; Laboratory / research work and research results Seminar

**Bibliography:**

- C. Suryanarayana and M. Grant Norton, X-ray Diffraction a Practical Approach , Plenum Press, 1998
- HH Willard, LI Merrett Jr., JA Dean and FA Settle Jr., Instrumental Methods of Analysis , Wadsworth Publishing Company, Belmont, 1988
- GW Ewing, Instrumental Methods of Chemical Analysis , McGraw-Hill Int.Edition, 1985

**4. Course: Selected Topics**

Code / Credits / Prerequisites: SCMS901104 / 4 Credits / -

**Objective:**

It is a literature review and presentation activity to look for and explore one of the research topics in preparation for making a research proposal. Students are required to search, read and analyze reputable journal scientific publications, then present the results of the literature review and periodically discuss scientific issues.

**Subjects:**

Discussion of specific topics of very specific Materials Science that will be used as a basis for making a dissertation. Face-to-face lectures and writing literature studies related to research topics.

**5. Course: Research Proposal Defence**

Code / Credits / Prerequisites: SCMS901105 / 6 Credits / Credits  $\geq$  12

**Objective:**

Based on the results of the literature review in Periodic Seminars, students can analyze one of the problems to be solved, formulate formulas and limitations of problems, collect hypotheses, analyze facilities and infrastructure to conduct research which is then written in research proposals and present them to the examiners.

**Subjects:**

Contents of Proposal: L back, formulation of the problem, hypothesis, purpose, update, experimental method. Mastery of proposals: S scientific discussion and dexterity discussion. Research readiness .Publication potential

**6. Course: Research Result Defence**

Code / Credits / Prerequisites: SCMS902101 / 10 Credits / SCMS901105

**Objective:**

As a control of the research process carried out, students will present the results of their research, draw conclusions and plan further research.

**Subjects:**

Framework for thinking, methodology and literature review. Results, sharpness of data analysis, stability draw conclusions. Presentation and mastery of materials. Potential for continuation of research

#### **7. Course: Scientific Publication**

**Code / Credits / Prerequisites: SCMS902102 / 8 Credits / SCMS901105**

**Objective:**

Based on the results of his research, with the direction of the supervisor, students are required to make scientific articles that begin with literature search activities, collect materials to be conveyed, frame articles, abstract, process and analyze data by referring to literature, searching for appropriate scientific journals, following the writing format and procedures for submitting to scientific journals.

**Subjects:**

Abstracts, article frameworks, research methods, results and discussions, conclusions and suggestions, bibliography.

#### **8. Course: Promotion Defense**

**Code / Credits / Prerequisites: SCMS903001 / 8 Credits / Credits  $\geq$  40**

**Objective:**

The final presentation of research results at the open session of the University of Indonesia's doctoral exam. Doctoral promotion also aims to communicate the results of research in the field of materials science to the general public.

**Subjects:**

Presentation of research results and question and answer in public.

### **Elective courses**

#### **9. Course: Advanced Ceramics**

**Code / Credits / Prerequisites: SCMS901106 / 4 Credits / -**

**Objective:**

Equip students with advanced topics about ceramics

**Subjects:**

Basic Science of Advanced Ceramic, Functional Ceramics (electro-ceramics and optoelectro-ceramics) and ceramics engineering.

**Bibliography:**

- R. M. Spriggs, Handbook of Advanced Ceramics: Materials, Applications, Processing and Properties , Academic Press, 2005
- M. Barsoum, Fundamentals of Ceramics , McGraw-Hill International, 2000
- S. Somiya, F. Aldinger, N. Claussen, RM Spriggs, K. Uchino, K. Koumoto and M. Kaneno, Handbook of Advanced Ceramics Vol I & II, Elsevier Academic Press, 2003

#### **10. Course: Advanced Polymers**

**Code / Credits / Prerequisites: SCMS901107 / 4 Credits / -**

**Objective:**

Equip students with advanced topics about polymers

**Subjects:**

Characterization of polymers, testing for polymer characterization is given specifically regarding failure tests, fault energy, creep failure and crazing of polymeric materials, polymer fatigue, and the thermal and electrical properties of polymeric materials. Use and modification of polymers in industrial fields, polymers and composites, nano-polymers.

**Bibliography:**

- F. Rodriguez, Principles of Polymer Systems , Hemisphere Publishing Corporation, Washington, 1982
- FW Billmeyer, Textbook of Polymer Science , John Wiley & Sons, Inc., New York, 1984

**11. Course: Science and Technology of Metal / Alloy**

**Code / Credits / Prerequisites: SCMS901108 / 4 Credits / -**

**Objective:**

Equip students to recognize methods, processes and applications of metal-based materials and their alloys from the stages of exploration of raw materials to useful products.

**Subjects:**

Characteristics of mineral resources, metal genes, metal exploration, metal exploitation, and phasing exploitation. Process flow from minerals to pig iron, to become semi-finished products or components. Producing minerals to finished materials, metal beneficiation processes, pelletizing, sintering, refining processes in steel such as blast furnace processes (chemical reactions in blast furnaces, blast furnace operations, modern blast furnace techniques), direct reduction processes such as Shaft processes (Midrex, HYL, Purofer), fluidized Bed process FIOR / FINMET, Iron Carbide, Circored), Rotary kiln (Krupp-CODIR, SL / RN, DRC, ACCAR / OSIL), Shaf and Hearth processes (Kinglor-Metor, Fastmet, INMETCO), and the Smelting Reduction process (COREX, DIOS, Hismelt, AISI Direct Steel Making, Romelt, Cyclone Converter Furnace). Smelter and Melter (SEAF, EAF), Vacuum degassing, BOF, AOD. Cast product and wrought product; Continuous casting, ingot casting. Classification of steel, the principle of metallurgical design of steel products. Hot rolling process type, thermo mechanical treatment process, metal reinforcement techniques used, hot rolled coil types and their use, low alloy steel, high strength low alloy steel (HSLA), Manganese steel, stainless steel. Mechanical Testing and microstructure of steel. Type of cold rolling process, annealing and recrystallization process of various types of cold rolled coil products. Texture and shape measurement methods in steel, enamel steel, electrical steel, SPCC, SPCD, SPCEN and Super SPCEN steel and their applications.

**Bibliography:**

- AF Taggart, Handbook of Mineral Dressing , John Wiley & Sons Inc., 1967
- B. A. Wills, Mineral Processing Technology , Caborne School of Mines, Cornwall, UK, 1992
- ML Begeman, Process Manufacturing , John Wiley & Son, 4th Ed, 1981
- S. Business, Manufacturing Processes for Engineering Materials , Addison Wesley, 2 nd Ed, 1980
- EP DeGarmo, Manufacturing and Process in Manufacturing , McMillan Publishing. 7th Ed.1888
- Ginzburg, Steel-Rolling Technology, Teory and Practice , Marcel Dekker, Inc., 1989

- W. L. Robert, Hot Rolling of Steel , Marcel Dekker, Inc., 1983
- W. L. Robert, Cold Rolling of Steel , Marcel Dekker, Inc., 1978

#### 12. Course: Electronic and Magnetic Materials

**Code / Credits / Prerequisites:** SCMS901109 / 4 Credits / -

**Objective:**

Equip students with advanced topics in electronic and magnetic materials

**Subjects:**

Solid state electronics, magnetoelectronics, ferroelectrics, organic electronics, multiferroic, photovoltaics, magnetoresistance, plasmonics, spintronics.

**Bibliography:**

- Pradeep Fulay, Electronic, Magnetic, and Optical Materials (Advanced Materials and Technologies) , CRC Press, 2010

## B. Compulsory of Doctor by Research Program

### 1. Course: Periodic Seminar

**Code / Credits / Prerequisites:** SCMS901201 / 8 Credits / -

**Objective:**

It is a literature review and presentation activity to look for and explore one of the research topics in preparation for making a research proposal. Students are required to search, read and analyze reputable journal scientific publications, then present the results of the literature review and periodically discuss scientific issues.

**Subjects:**

Extent and depth of research topics, mastery of materials, scientific systematic, scientific attitude

### 2. Course: Research Proposal Defense

**Code / Credits / Prerequisites:** SCMS901202 / 4 Credits / SCMS901201

**Objective:**

Based on the results of the literature review in Periodic Seminars, students can analyze one of the problems to be solved, formulate formulas and limitations of problems, collect hypotheses, analyze facilities and infrastructure to conduct research which is then written in research proposals and present them to the examiners.

**Subjects:**

Contents of Proposal: L back, formulation of the problem, hypothesis, purpose, update, experimental method. Mastery of proposals: Scientific discussion and dexterity discussion. Research readiness. potential Publication

### 3. Course: Research Result Defense

**Code / Credits / Prerequisites:** SCMS903201 / 10 Credits / SCMS902201, SCMS902202

**Objective:**

As a control of the research process carried out, students will present the results of their research, draw conclusions and plan further research.

**Subjects:**

Framework for thinking, methodology and literature review. Results, sharpness of data analysis, stability draw conclusions. Presentation and mastery of materials. Potential for continuation of research

**4. Course: Scientific Publication 1**

**Code / Credits / Prerequisites: SCMS902201 / 4 Credits / SCMS901202**

**Objective:**

Based on the results of his research, with the direction of the supervisor, students are required to make scientific publications that begin with literature search activities, collect the materials they wish to convey, frame publications, abstract, process and analyze data by referring to literature, finding appropriate scientific journals, following the writing format and procedures for submitting to reputable national scientific journals.

**Subjects:**

Abstract, Publication framework, research methods, results and discussion, conclusions and suggestions, bibliography.

**5. Course: Scientific Publication 2**

**Code / Credits / Prerequisites: SCMS903202 / 8 Credits / SCMS902201**

**Objective:**

Based on the results of his research, with the direction of the supervisor, students are required to make scientific publications that begin with literature search activities, collect the materials they wish to convey, frame publications, abstract, process and analyze data by referring to literature, finding appropriate scientific journals, following the writing format and the procedure for submitting to reputable international scientific journals.

**Subjects:**

Abstract, Publication framework, research methods, results and discussion, conclusions and suggestions, bibliography.

**6. Course: Scientific Seminar**

**Code / Credits / Prerequisites: SCMS902202 / 6 Credits / SCMS901202**

**Objective:**

To disseminate the results of their research, students are required to present their work in a reputable international scientific seminar.

**Subjects:**

Presentation framework, background, research scope, experimental methods, results and conclusions.

**7. Course: Promotion Defense**

**Code / Credits / Prerequisites: SCMS903001 / 8 Credits / Already  $\geq$  40 credits**

**Objective:**

The final presentation of research results at the open session of the University of Indonesia's doctoral exam. Doctoral promotion also aims to communicate the results of research in the field of materials science to the general public.

**Subjects:**

Presentation of research results and question and answer in public.