Advanced Program
in Materials Science and Engineering

Contents

SSH1111 Introduction of the Marxist-Leninist Philosophy

Module designation	Laws and Politics
Module level, if applicable	
Code, if applicable	SSH1111
Subtitle, if applicable	
Courses, if applicable	Introduction of the Marxist-Leninist Philosophy
Semester(s) in which the module is taught	1st semester
Person responsible for the module	PhD. Tran Viet Thang
Lecturer	PhD. Tran Viet Thang Assoc. Prof. Dinh Thanh Xuan PhD. Hoang Thi Hanh PhD. Mai Thi Thanh PhD. Hoang Thu Huong MSc. Le Van Kien MSc. Vu Thi Mai Luong
Language	Vietnamese
Relation to curriculum	The course equips students with the basic and systematic knowledge of Marxism and Leninism philosophy. A materialistic worldview and a materialistic dialectical methodology will be the theoretical foundation for understanding problems and contents of other subjects. Realizing the value, scientific and revolutionary nature of Marxism and Leninism philosophy. Building beliefs, revolutionary ideals for students, ideological - political orientation in both cognitive and practical activities.
Teaching method, contact hours	Target students: Students of all science majors Teaching method: offline, online, B-learning. Contact hours: 45 hours Theoretical teaching: 30 hours Discuss hours: 15 hours Size of class: 50 students
Workload (incl. contact hours, self-study hours)	Workload = 135 class hours Contact hours = 45 class hours Self-study hours = 60 class hours
Credit points	3(2-1-0-6)
ECTS	4.25
Requirements according to the examination regulations	Students with no discussion scores or no test scores will receive a process score of less than 3.0/10.

	If the process score or the final exam score is lower than 3.0/10, students do not complete the course.
Recommended prerequisites	None
Module objectives/intended learning outcomes	Module objectives: **Knowledge:** Understand the basics of dialectical materialism and historical materialism. **Skills**: Train reasoning capability; know how to apply philosophical knowledge, especially methodological principles to assess and interpret things or phenomenon in reality; then influence them effectively in the process of building scientific awareness and reality. **Competences:** Know how to apply the worldview and philosophical methodology in approaching specialized science. Know how to apply the content of philosophical knowledge in establishing an appropriate and scientific worldview and view of life.
Content	**Theoretical teaching (45 contact hours and 90 self-study hours)** **CHAPTER 1.** Theoretical overview of philosophy and philosophy of Marxism and Leninism (10 contact hours and 20 self-study hours) I. PHILOSOPHY AND BASIC PROBLEMS OF PHILOSOPHY 1. Philosophy overview 2. Basic problem of philosophy 3. Dialectic and metaphysical II. MARXISM AND LENINISM PHILOSOPHY AND THE ROLE OF MARXISM AND LENINISM PHILOSOPHY IN PRACTICE 1. Origin and the development process of Marxism and Leninism philosophy 2. Targets and role of Marxism and Leninism philosophy 3. The role of of Marxism and Leninism philosophy in social life and revolution process in Vietnam today **CHAPTER 2.** DIALECTICAL MATERIALISM (20 contact hours and 40 self-study hours) I. MATERIAL AND CONSCIOUSNESS 1. Material and existent forms of materials 2. Origin, nature and structure of consciousness 3. The relationship between material and consciousness II. MATERIALISTIC DIALECTICAL METHODOLOGY 1. Two types of dialectics and materialistic dialectics 2. Content of materialistic dialectics III. THEORY OF CONSCIOUSNESS 1. Principles of dialectical materialist cognitive theory 2. Origin and nature of consciousness 3. Reality and the role of reality to consciousness 4. Basic stages of gaining consciousness 5. The nature of truth

	CHAPTER 3. HISTORICAL MATERIALISM (15 contact hours and 30 self-study hours) I. SOCIAL-ECONOMIC MODEL THEORY 1. Material production is the basis of social existence and development 2. Dialectics between production forces and production relations 3. Dialectics between infrastructure and superstructure of society 4. The development of socio-economic forms is a historical and natural process II. CLASSES AND ETHNIC 1. Class and class struggle 2. Ethnicity 3. Class-Ethnic-Human relations III. THE STATE AND SOCIALIST REVOLUTION 1. The State 2. Socialist revolution IV. SOCIAL AWARENESS 1. The concept of social existence and elements of social existence 2. Concept of social consciousness and structure of social health 3. Dialectical relationship between social existence and social consciousness, relative independence of social consciousness V. PHILOSOPHY OF HUMAN BEING 1. People and their nature 2. Deterioration phenomenon and people liberate 3. Views of Marxism and Leninism philosophy on personal and social relations, on the role of people and leaders in the history 4. People in Vietnam's revolutions
Study and examination requirements and examination forms	Process score (diccusion score, mini test scores, attendance score) accounts for 50% and final exam score (written examination or multiple choice test) accounts for 50%.
Media employed	PPT courseware, multimedia computers, projectors, laser pens, blackboards, etc.
Reading list	**Textbook:** Ministry of Education and Training, Textbook of Marxism-Leninism Philosophy (For students not majoring in political theory), Publisher. National Politics of Truth, Hanoi, 2021. **Reference books :** [1] The Central Council directs the compilation of the national curriculum, Textbook of Marxism-Leninism Philosophy, Publisher. National Politics, Hanoi, 2010. [2] Many authors, Review Guide for the Basic Principles of Marxism-Leninism 1, Publisher. Hanoi Technology 2015.

SSH1121 Introduction of the Marxist-Leninist political economy

Module designation	Laws and Politics
Module level, if applicable	
Code, if applicable	SSH1121
Subtitle, if applicable	
Courses, if applicable	Introduction of the Marxist-Leninist political economy
Semester(s) in which the module is taught	2nd semester
Person responsible for the module	MSc. Ngo Que Lan
Lecturer	Assoc. Prof. Tran Thi Lan Huong MSc. Ngo Que Lan MSc. Trinh Huy Hong MSc. Nguyen Thi Phuong Dung MSc. Phan Yen Trang
Language	Vietnamese
Relation to curriculum	This module provides students with a basic understanding of commodities, currencies, a market economy, and relationships in a market economy. Thereby, students gain knowledge about historical - economic - political - social rules. In addition, this module continues fostering world outlook, methodology and economic thinking, apply economic-political knowledge to the analysis of economic, social and practical issues of the country and of the disciplines which the students are trained in.
Teaching method, contact hours	Target students: Students of all science majors Teaching method: offline, online, B-learning. Contact hours: 30 hours Theoretical teaching: 30 hours Size of class: 50 students
Workload (incl. contact hours, self-study hours)	Workload = 90 hours Contact hours: 30 hours Self-study hours = 60 hours
Credit points	2(2-0-0-4)
ECTS	2.84
Requirements according to the examination regulations	Students with no discussion scores or no test scores will receive a process score of less than 3.0/10. If the process score or the final exam score is lower than 3.0/10, students do not complete the course.
Recommended prerequisites	- Prerequisite Courses: None - Corequisite Courses: Marxist-Leninist philosophy (SSH1111)

Module objectives/intended learning outcomes	Module objectives: **Knowledge:** understand the basic economic categories such as: commodities, money, market rules, market participants, market economy and industrial revolution. **Skills:** apply economic-political knowledge to the analysis of economic, social, and practical issues of the country and of the disciplines which the students are trained in. **Competences:** Based on correct awareness of economic and political issues, learners work in accordance with the motto, guidelines and guidelines of the Communist Party of Vietnam.
Content	**Theoretical teaching (30 contact hours and 60 self-study hours)** **Chapter 1**. Object, research method and function of Marxist-Leninist Political Economy (2 contact hours and 4 self-study hours) - Research Object - Research Method - Function of Marxist-Leninist Political Economy **Chapter 2.** Commodity, market & role of market participants (7 contact hours in class and 14 self-study hours) - Commodity production - Two properties of a commodity and factors affecting the quantity of a commodity's value - Some rules of the market - Market mechanism and role of market participants **Chapter 3.** Production of surplus value in the market economy (7 contact hours in class and 14 self-study hours) - The transformation of money into capital - Theory of the commodity of labor power - Origin of surplus value - Two methods of producing surplus value (with exercises) - Some rules in Capitalism (with exercises) - Manifestations of capital and surplus value in a market economy **Chapter 4.** Competition & monopoly in the market economy (5 contact hours in class and 10 self-study hours) - Overview of competition, monopoly - Five characteristics of monopoly capitalism - State monopoly capitalism **Chapter 5.** Socialist oriented market economy & economic benefits in Vietnam (5 contact hours in class and 10 self-study hours) - Features of the socialist-oriented market economy - The concept and structure of Institutions of the socialist-oriented market economy and the promotion of the Party's leadership role in institutional improvement - The relationship of economic benefits and the role of the State in regulating the relationship of economic benefits

	Chapter 6. Industriality, modernization & international economy integration of Vietnam (4 contact hours in class and 8 self-study hours) - Features of the Modern Scientific and Technological Revolution - Contents of Vietnam's industrialization, adapting to Industry 4.0 - International economic integration of Vietnam
Study and examination requirements and examination forms	Process score (diccusion score, mini test scores, attendance score) accounts for 50% and final exam score (written examination or multiple choice test) accounts for 50%.
Media employed	PPT courseware, multimedia computers, projectors, laser pens, blackboards, microsoft teams, LMS etc.
Reading list	**Textbook:** 1. Vietnam Ministry of Education and Training, Textbook of Marxist-Leninist Political Economy (for students not majoring in political theory), Truth National Political Publ., 2021. 2. Ngo Que Lan, Trinh Huy Hong, Nguyen Thi Phuong Dung & Phan Yen Trang, 99 exercises in the theory of surplus value, HUST Publ., 2022. **Reference books :** 1. Communist Party of Vietnam, Documents of Party Congress XI, XII. 2. Communist Party of Vietnam, Resolution 11-NQ/TW on "Improving the institution of a socialist-oriented market economy" dated June 3, 2017. 3. Communist Party of Vietnam, Report on some issues summarizing theory and practice over thirty years of renovation, Truth National Political Publ., 2016. 4. Robert B. Ekelund and Robert F. Herbert, History of economic theories, Waveland Press, Inc.; 6th edition, 2013. 5. David Begg, Stanley Fisher, Rudiger Dornbusch, Economics, Mcgraw-Hill Publ., 7th edition, 2002. 6. Jeremy Rifkin, The Third Industrial Revolution, St. Martin's Griffin Publ., 2013. 7. Klaus Schwab, The Fourth Industrial Revolution, World Economic Forum, 2016. 8. Manfred B.Steger, Globalization, Oxford University Press, 2003. 9. Tran Thi Lan Huong, Ngo Que Lan et al., Study Guide for Basic Principles of Marxism-Leninism 2, HUST Publ., 2015. (References to chapters 4, 5, 6).

SSH1131 Introduction of the Science socialism

Module designation	Laws and Politics
Module level, if applicable	
Code, if applicable	SSH1131
Subtitle, if applicable	
Courses, if applicable	Introduction of the Science socialism
Semester(s) in which the module is taught	4th semester

Person responsible for the module	PhD. Nguyen Thi Huyen
Lecturer	PhD. Nguyen Thi Huyen Master Luong Minh Hanh Master Nguyen Quang Truong Bachelor of Science Hoang Anh Dong
Language	Vietnamese
Relation to curriculum	The subject Scientific Socialism equips students with socio-political awareness and methodology about the inevitable historical process leading to the formation and development of the communist socio-economic form. Therefore, the classics of Marxism-Leninism were correct in defining scientific socialism that education is the theoretical weapon of society. modern working class and its party to carry out the process of human emancipation, emancipation of themselves. Once the working class and laborers do not have the correct and adequate awareness of socialism, it is impossible to have firm beliefs, ideals and revolutionary bravery in all situations. At every turn of history, there is not enough scientific basis and bravery to apply creatively and properly develop the theory of socialism and the path to socialism in Vietnam as philosophy. Marxism-Leninism and political economy, scientific socialism not only explains the world. , but basically it's about improving the world according to the laws of nature. However, in accordance with progress and civilization. Researching and studying socialism and science contributes to the socio-political orientation for the practical activities of the Socialist Party and State and the people in the socialist revolution, building socialism and protecting socialism. Socialist Fatherland. Researching and studying scientific socialism helps students have grounds to receive scientific knowledge to stay awake, analyze properly, fight against negative perceptions, wrong consciousness, propagate against imperialism. nationalist, reactionary against the Communist Party of Vietnam, the State of the Socialist Republic of Vietnam. socialism, going against the trend and interests of the people, the nation and progressive humanity. Scientific socialism makes an important contribution to the education of scientific belief, educating the people about socialist goals and ideals and the path to capitalist socialism. Scientific beliefs are formed on the basis of scientific awareness and practical activities. On the basis of scientific awareness, through education, activities and practices, beliefs are formed and developed. Scientific belief is the unification between perception, emotion, will and determination to become the spiritual driving force that motivates people to engage in collective activities in an active, self-conscious, creative and revolutionary way.
Teaching method, contact hours	Target students: Students of all science majors Teaching method: offline, online, B-learning

	Contact hours: 30 hours Theoretical teaching: 30 hours Size of class: 50 students
Workload (incl. contact hours, self-study hours)	Workload = 90 hours Contact hours: 30 hours Self-study hours = 60 hours
Credit points	2(2-0-0-4)
ECTS	2.84
Requirements according to the examination regulations	Students with no discussion scores or no test scores will receive a process score of less than 3.0/10. If the process score or the final exam score is lower than 3.0/10, students do not complete the course.
Recommended prerequisites	- None
Module objectives/intended learning outcomes	Module objectives: **Knowledge**: Students grasp the basic and systematic knowledge about the birth, the stages of development; Objects, methods, and meanings of learning, Research objects of scientific socialism. Understand the role and historical. mission of the working class, the transition period to socialism, basic features of socialism, issues of class, ethnicity, religion, family during the transition to socialism. **Skills:** Understand concepts, categories and laws of the process of arising, forming and developing the communist socio-economic form, the first stage being socialism. **Competency:** Being able to apply knowledge of scientific socialism to solve problems for personal development, contributing to the successful construction. of socialism in Vietnam.
Content	**Theoretical teaching (30 contact hours and 60 self-study hours)** **Chapter 1**: Introduction to Scientific Socialism 1. The Birth of Scientific Socialism 1.1. Historical circumstances of the birth of scientific socialism 1.2. The role of Marx and Frederick Engels 2. Basic stages of development of Scientific Socialism 2.1. Marx and Engels developed scientific socialism. 2.2. V.I. Lenin applied and developed scientific socialism in new conditions. 2.3. The creative application and development of scientific socialism since the death of V.I. Lenin up to now. 3. Objects, methods, and significance of the study of Scientific Socialism 3.1. Research Objects of Scientific Socialism 3.2. Research Methods of Scientific Socialism

	3.3. The meaning of studying Scientific Socialism **Chapter 2:** The historical mission of the working class 1. Basic views of Marxism - Leninism on the working class and the world historical mission of the working class 1.1. Concept and characteristics of the working class 1.2. The content and characteristics of the historical mission of the working class 1.3. The conditions that determine the historical mission of the working class 2. The working class and the implementation of the historical mission of the working class today 2.1. Today's working class 2.2. Realizing the historical mission of the working class in the world today 3. Historical mission of the Vietnamese working class 3.1. Characteristics of the Vietnamese working class 3.2. Contents of the historical mission of the Vietnamese working class today 3.3. Directions and some key solutions to build up the Vietnamese working class. today **Chapter 3**: Socialism and the transition to socialism 1. Socialism 1.1. Socialism, the first stage of the communist socio-economic form 1.2. Conditions for the birth of socialism 1.3. The basic features of socialism 2. Transitional period to socialism 2.1. The objective necessity of the transition to socialism 2.2. Characteristics of the transition period to socialism 3. Transition to Socialism in Vietnam 3.1. Transition to socialism bypassing capitalism. 3.2. Features of socialism and the direction of socialist construction society in Vietnam today 3.2.1. Nature features of Vietnamese socialism 3.2.2 The direction of building socialism in Vietnam today **Chapter 4**: Socialist democracy and the socialist state 1. Democracy and socialist democracy 1.1. Democracy and the birth and development of democracy 1.2. Socialist democracy 2. Socialist State 2.1. The birth, nature and functions of the socialist state 2.2. The relationship between socialist democracy and the socialist state 3. Socialist democracy and the socialist rule of law state in Vietnam 3.1. Socialist democracy in Vietnam 3.2. Socialist rule of law in Vietnam 3.3. Promoting socialist democracy, building a socialist rule of law state in

	Vietnam today **Chapter 5**: Social structure - classes and alliances between classes and classes in the transition to socialism 1. Social-class structure in the transition to socialism 1.1. The concept and position of the social-class structure in the social structure 1.2. The regular change of the social-class structure during the transition to socialism 2. Union of classes and classes in the transition to socialism 3. Social structure - class and alliance of classes and classes in the transition to socialism in Vietnam 3.1. Social-class structure during the transition to socialism in Vietnam 3.2. Union of classes and classes during the transition to socialism in Vietnam **Chapter 6**: Nation and religious issues in the transition to socialism 1. The nation in the transition to socialism 1.1. Marxism-Leninism on the nation 1.2. Ethnicity and ethnic relations in Vietnam 2. Religion in the period of transition to socialism 2.1. Marxism - Leninism on religion 2.2. Religion in Vietnam and the current religious policy of our Party and State 3. Ethnic and religious relations in Vietnam 3.1. Characteristics of ethnic and religious relations in Vietnam 3.2. Orientation to solve ethnic and religious relations in Vietnam today. **Chapter 7:** Family problems in the transition to socialism 1. The concept, position, and function of the family 1.1. Family concept 1.2. The position of the family in society 1.3. Basic functions of the family 2. Basis for building a family during the transition to socialism 2.1. Socio-economic foundations 2.2. Socio-political establishment 2.3. Cultural facilities 2.4. Progressive marriage regime 3. Building a Vietnamese family during the transition to socialism 3.1. The transformation of Vietnamese families during the transition to socialism 3.2. Basic direction of building and developing Vietnamese family in the transition to socialism
Study and examination requirements and examination forms	Process score (diccusion score, mini test scores, attendance score) accounts for 50% and final exam score (written examination or multiple choice test) accounts for 50%.
Media employed	Microsoft Teams, LMS, multimedia computers, projectors, laser pens, blackboards, zalo, face book etc.

Reading list	**Textbook:** Textbook of Scientific Socialism, directed by the Ministry of Education and Training, National Political Publishing House, Hanoi 2021 Textbook of Scientific Socialism, directed by the Central Council, compiles the national curriculum of Marxist-Leninist sciences and Ideology of Ho Chi Minh.

SSH1141 Introduction of the Vietnam Communist Party History

Module designation	Laws and Politics
Module level, if applicable	
Code, if applicable	SSH1141
Subtitle, if applicable	
Courses, if applicable	Introduction of the Vietnam Communist Party History
Semester(s) in which the module is taught	4th semester
Person responsible for the module	PhD. Pham Nguyen Phuong
Lecturer	PhD. Pham Nguyen Phuong MSc. Le Thi Lan MSc. Hoang Thi Lan PhD. Le Tien Dung
Language	Vietnamese
Relation to curriculum	Viet Nam Communist Party History provides students with a comprehensive view about the birth of the Communist Party of Vietnam, the path set forth by the Communist Party of Vietnam during the leadership of the Vietnamese revolution from 1930 to present – from the people's democratic national revolution to the socialist revolution. Studying Viet Nam Communist Party History helps students improve their awareness about new era of the nation – Ho Chi Minh era, in order to understand, explain practical problems and apply the Party's point of view to life. In addition, the subject strengthens students' teamwork skills, presentations and serious attitude to study, work and life.
Teaching method, contact hours	Target students: Students of all science majors Teaching method: offline, online, B-learning Contact hours: 30 hours Theoretical teaching: 30 hours Size of class: 50 students
Workload (incl. contact hours, self-study hours)	Workload = 90 hours Contact hours: 30 hours Self-study hours = 60 hours

Credit points	2(2-0-0-4)
ECTS	2.84
Requirements according to the examination regulations	Students with no discussion scores or no test scores will receive a process score of less than 3.0/10. If the process score or the final exam score is lower than 3.0/10, students do not complete the course.
Recommended prerequisites	- None
Module objectives/intended learning outcomes	Module objectives: **Knowledge:** Understand the basic knowledge of Viet Nam Communist Party History, including the Party's founding process, the Party's lines and policies in leading the Vietnamese Revolution. **Skills:** Acquire a theoretical thinking style associated with practice; think creatively, apply knowledge of the Party's leadership to real life. **Competences:** It is expected to cultivate students' interest in Viet Nam Communist Party History so that they can improve the belief in the Party's leadership, the nation's solidity strength, as well as consciously criticizing the wrong perception of the Party's history.
Content	**Theoretical teaching (30 contact hours and 60 self-study hours)** **Chapter 1**. The Communist Party of Vietnam was born and lead the struggle for revolutionary power (1930-1945) (10 contact hours and 20 self-study hours) 1. The Communist Party of Vietnam was born and the Party's first political platform 2. Leading the struggle for power (1930-1945) **Chapter 2.** The Party led two resistance wars, completed national liberation and reunification (1945-1975). (10 contact hours, 20 self-study hours) **2.1.** Lead the construction and defense of the revolutionary government, the resistance war against the French colonialists (1945-1954) **2.2.** The Party led the socialist revolution in the North and the resistance war against the American imperialist aggression, liberated the South, and reunified the country (1954-1975) **Chapter 3.** The Party led the country in the transition to socialism and newly transformed companies (1975-2018) (10 contact hours, 20 self-study hours) 3.1. Leading the country in building socialism and organizing protection (1975-1986) 3.3. Leading the innovation process, promoting industrialization, modernization and international integration (1986-2018)
Study and examination requirements and examination forms	Process score (diccusion score, mini test scores, attendance score) accounts for 50% and final exam score (written examination or multiple choice test) accounts for 50%.
Media employed	Computers, projectors, laser pens, blackboards etc.

Reading list	**Textbook:** Ministry of Education and Training (2021), *Textbook of Viet Nam Communist Party History*, Truth National Political Publishing House, Ha Noi. **Reference books** [1] Truong Huy Quynh, Dinh Xuan Lam, Le Mau Han (2001), *An overview of Vietnamese history, complete volume*, Vietnam Education Publishing House. [2] Communist Party of Vietnam (2002), *Complete Party Document*, National Political Publishing House.

SSH1151 The ideology of Ho Chi Minh

Module designation	Laws and Politics
Module level, if applicable	
Code, if applicable	SSH1050Q
Subtitle, if applicable	
Courses, if applicable	The ideology of Ho Chi Minh
Semester(s) in which the module is taught	4th semester
Person responsible for the module	PhD. Ha Thi Dang Huong
Lecturer	PhD. Ha Thi Dang Huong MSc. Nguyen Quoc Doan MSc. Nguyen Thi Thu Ha MSc. Pham Thi Mai Duyen
Language	Vietnamese
Relation to curriculum	The module equips students with a system of knowledge about the subjects, methods and meanings of the subject Ho Chi Minh's ideology. The course presents the process of the formation and development of Ho Chi Minh ideology, the basic contents of Ho Chi Minh's ideology, morality, culture and style. Helping students understand Ho Chi Minh's system of views on basic issues of the Vietnamese revolution, from the people's democratic revolution to the socialist revolution.
Teaching method, contact hours	Target students: Students of all science majors Teaching method: The courses will be mainly given offline with the assistance of problem explanations online. Contact hours: 30 hours Theoretical teaching: 30 hours Size of class: 60 students
Workload (incl. contact hours, self-study hours)	Workload = 90 hours Contact hours = 30 hours Self-study hours = 60 hours
Credit points	2(2-0-0-4)

ECTS	2.84
Requirements according to the examination regulations	Students with no discussion scores or no test scores will receive a process score of less than 3.0/10. If the process score or the final exam score is lower than 3.0/10, students do not complete the course.
Recommended prerequisites	- Prerequisite Courses: None
Module objectives/intended learning outcomes	Module objectives: **Knowledge:** Understanding of Ho Chi Minh's system of ideological views on national independence, socialist revolution, national and international solidarity, Party and State building, morality, culture, national construction new socialist man. **Skills:** Students understand the application of Ho Chi Minh's theory in leadership to build and defend the country. **Competences:** Can apply the knowledge learned to solve economic, political, socio-cultural issues from the perspective of the Party and State of Vietnam.
Content	**Theoretical teaching (30 contact hours and 60 self-study hours)** **Chapter 1**. Concepts, objects, methods and meanings of studying Ho Chi Minh's ideology - The concept of Ho Chi Minh's ideology - Research subjects - Research Methods - The meaning of studying Ho Chi Minh's ideology subject **Chapter 2.** Foundation, process of formation and development of Ho Chi Minh ideology - Basis of Ho Chi Minh Ideology Formation - The process of formation and development of Ho Chi Minh's ideology - Values of Ho Chi Minh's ideology **Chapter 3.** Ho Chi Minh's ideology on national independence and socialism - Ho Chi Minh Ideology on National Independence - Ho Chi Minh's ideology on socialism and building socialism - Ho Chi Minh Ideology on the relationship between national independence and socialism - Applying Ho Chi Minh's ideology on national independence associated with socialism in the current revolutionary cause of Vietnam **Chapter 4.** Ho Chi Minh's ideology on the Communist Party of Vietnam and the State of the people, by the people, for the people. - Ho Chi Minh Ideology on the Communist Party of Vietnam - Ho Chi Minh's ideology on the State of the people, by the people, for the people - Applying Ho Chi Minh's ideology to the construction of the Party and the State **Chapter 5.** Ho Chi Minh's ideology on great national unity and international solidarity - Ho Chi Minh Ideology on Great National Unity

	- Ho Chi Minh's ideology on international solidarity - Applying Ho Chi Minh Ideology on great national unity and international solidarity in the current period **Chapter 6.** Ho Chi Minh's ideology on culture, morality and human - Ho Chi Minh's ideology on culture - Ho Chi Minh's ideology on morality - Ho Chi Minh's ideology about people - Building the current Vietnamese culture, morality and people according to Ho Chi Minh's ideology
Study and examination requirements and examination forms	Assignments of mid semester accounts for 50% and final exam (written examination or multiple choice test) accounts for 50%.
Media employed	PPT courseware, multimedia computers, projectors, laser pens, blackboards, we chat etc.
Reading list	**Textbook:** Ministry of Education and Training. Textbook of Ho Chi Minh Ideology. National Political Publishing House truth, Ha Noi, 2021 **Reference books** : [1] Ho Chi Minh, Full set. Truth National Political Publishing House (15 volumes), 2011. [2] General Vo Nguyen Giap (editor), Ho Chi Minh Ideology and Vietnam's revolutionary path, National Political Publishing House, 2010. [3] Ho Chi Minh National Academy of Politics, Prof. Dr. Song Thanh (Editor), Ho Chi Minh biography, Political Theory Publishing House, Hanoi, 2006. [4] Nguyen Dinh Loc, Ho Chi Minh Ideology on the state of the people, by the people, for the people, National Political Publishing House, 1998. [5] Song Thanh, Ho Chi Minh, a prominent thinker, Political Theory Publishing House, 2005.

EM1170 General Law

Module designation	Laws and Politics
Module level, if applicable	
Code, if applicable	EM1170
Subtitle, if applicable	
Courses, if applicable	General Law
Semester(s) in which the module is taught	1st semester
Person responsible for the module	Vu Quang, Cao Thuy Duong, Nguyen Thi Thuy Hang, Nguyen Van Lam, Nguyen Thi Yen

Lecturer	Vu Quang, Cao Thuy Duong, Nguyen Thi Thuy Hang, Nguyen Van Lam, Nguyen Thi Yen
Language	Vietnamese
Relation to curriculum	This course helps students to understand the origin of the state and the basic theories of the state, grasp the basics of the law, initially can apply basic knowledge about the state and law to settle disputes and violations of law.
Teaching method, contact hours	Target students: Students of all science majors Teaching method: theoretical teaching Contact hours: 30 hours Theoretical teaching: 30 hours
Workload (incl. contact hours, self-study hours)	Workload = 90 hours Contact hours = 30 hours Self-study hours = 60 hours
Credit points	2(2-0-0-4)
ECTS	2.84
Requirements according to the examination regulations	Students with no discussion scores or no test scores will receive a process score of less than 3.0/10. If the process score or the final exam score is lower than 3.0/10, students do not complete the course.
Recommended prerequisites	- Prerequisite Courses: None
Module objectives/intended learning outcomes	Module objectives: After accomplishing the course, the student will be able to 1. To understand the origins of the state and the basic theories of the state - To identify the concept, nature, role, and function of the State - To understand the form and types of state in history - To master the organizational structure, establishment process and basic functions of agencies in the state apparatus of the Socialist Republic of Vietnam 2. To understand the basics of the law - To understand the concept, nature, attributes, legal functions and types of laws in history - To master the knowledge of legal documents, the system of legal documents, the validity of legal documents, violations of law and legal responsibility - To have a depth of understanding of basic legal aspects in the Vietnamese legal system: Constitution, Administrative, Civil, Criminal, Economic, Labor, Land, International Law 3. To initially apply the basic knowledge on the state and law to resolve disputes, violations of law - To know how to choose a dispute settlement agency, applicable law

	- To understand the process, order and procedures for resolving disputes
Content	Chapter 1. Introduction to Fundamentals of Law - Introduction to General Law, generalization of state relations and laws Chapter 2. Overview of the State in relation to the Law - Overview of the state: its origin, concept, nature, and characteristics - Types, form of State - State apparatus Chapter 3. The government of the Socialist Republic of Vietnam - The State of the Socialist Republic of Vietnam Chapter 4. Basic issues of the Law - The basic issues of law: the concept, role, nature, characteristics, functions of the law - Types of law in history - Form of Law - Legal relations - Implement laws, apply laws, and explain laws - Violating the law and legal responsibility Chapter 5. The main legal systems in the world - The legal system in the world Chapter 6. The legal system of the Socialist Republic of Vietnam - The legal system of the Socialist Republic of Vietnam Chapter 7. The field of intellectual property law and the field of science and technology in Vietnam - Intellectual property law
Study and examination requirements and examination forms	Students are expected to follow the regulations of Hanoi University of Science and Technology and School of Economics and Management For any cheating during the exam or exercise, student must be disciplined by the school and get 0 point for the course. Assignments of mid semester (Writing) accounts for 30% and final exam (written examination) accounts for 70%.
Media employed	PPT courseware, multimedia computers, projectors, laser pens, blackboards, etc.
Reading list	**Textbook** 1. Vũ Quang (2013, Giáo trình pháp luật đại cương, NXB Bách khoa, Hà Nội 2. Phạm Duy Nghĩa (2011), Giáo trình Pháp luật đại cương, NXB CAND, Hà Nội **References** ***In Vietnamese*** 1. Nguyễn Cửu Việt (2004), Giáo trình Nhà nước và Pháp luật đại cương, NXB ĐHQGHN, Hà Nội 2. Lê Minh Toàn, Vũ Quang và những người khác (2002), Giáo trình Pháp luật đại cương, NXB Chính trị Quốc gia, Hà Nội ***In English***

	1. Raymond Wacks (2011), Philosophy of Law (triết học luật pháp), Tri Thuc Publisher, Ha Noi 2. Alexis De Tocqueville (2008), Democracy in America (Nền dân trị Mỹ), Tri Thuc Publisher, Ha Noi 3. Insun Yu (1994). Law and society in seventeenth and eighteenth century Vietnam (Luật và xã hội Việt Nam thế kỷ XVII – XVIII), Social Science Publisher, Ha Noi

MI1112 Calculus I

Module designation	Mathematics and Basic Sciences
Module level, if applicable	
Code, if applicable	MI1112
Subtitle, if applicable	
Courses, if applicable	Calculus I
Semester(s) in which the module is taught	1st semester
Person responsible for the module	
Lecturer	
Language	English
Relation to curriculum	An introduction to the basic ideas and techniques of differential and integral calculus. Topics include differentiation and integration of functions of one variable, differentiation of functions of several variables, partial derivatives, Lagrange's multipliers.
Teaching method, contact hours	Target students: Students of all science majors Teaching method: theoretical and practical teachings Contact hours: 75 hours Theoretical teaching: 45 hours Practical teaching: 30 hours
Workload (incl. contact hours, self-study hours)	Workload = 195 hours Contact hours = 75 hours Self-study hours = 120 hours
Credit points	4(3-2-0-8)
ECTS	6.08
Requirements according to the examination regulations	Students with no discussion scores or no test scores will receive a process score of less than 3.0/10. If the process score or the final exam score is lower than 3.0/10, students do not complete the course.

Recommended prerequisites	N/A
Module objectives/intended learning outcomes	**Module objectives:** After this course the student will obtain the followings: 1. Master the basic knowledge of calculus 1 and apply in practice to solve related exercises - Master the basic concepts of analysis 1 such as: limit of sequences, limit of functions, continuous functions, higher order derivatives and differentials, extremals of single- variable functions and multi-variable functions; antiderivative and integral of single-variable functions - Be able to apply the knowledge to solve exercises 2. Achieve serious attitude and necessary skills for highly effective work - Be skilled at analyzing and solving problems with strong logical thinking; working independently and staying focused - Identify some practical problems that can be solved by using tools of calculus - Gain serious working attitude, proactive creativity, adaptation to highly competitive working environment
Content	**Chapter 1: Differentiation of functions of single variable** 1.1. Introduction 1.2. Functions: definition, basic notions, composite functions, inverse functions 1.3. Essential functions: inverse trigonometric functions; hyperbolic functions; the concept of elementary functions 1.4. Number sequences: definition, basic notions. Limits law: squeeze theorem; monotone convergence theorem; Cauchy's criterion 1.5. Limit of functions: two equivalent definitions; algebraic limit theorems and properties. Limits of composite functions; one-sided limits; limits at infinity; infinite limits 1.6. Infinites and infinitesimals; comparison of infinites and infinitesimals; theorems 1.7. Continuity; one-sided continuity; uniform continuity and properties. Points of discontinuity: definition and classification. Piecewise continuity 1.8. Derivatives and differentials - Basic concepts - One-sided derivatives, relationship between derivative and one-sided derivatives, relationship between differentiability and continuity - Derivatives of composite functions. Derivatives of inverse functions - Differentials: definition, geometric interpretation, approximation by differentials. Relationship between functions having derivatives and differentiable. Differentials of composite functions and invariance property of first order differentials - Higher order derivatives and differentials 1.9. Mean value theorems and applications - Fermat's, Rolle's, Lagrange's and Cauchy's theorems - Taylor and Maclaurin expansions

	- L'Hospital's rules for eliminating indeterminate forms, application of finite expansion in finding limits - Monotone functions and properties - Convex functions - Local extrema: Local minimum, local maximum - Newton's method 1.10. Curves sketching - Functions y = f (x) - Curves defined by parametric equations - Curves given in polar coordinates **Chapter 2: Integration of functions of single variable** 2.1. Antiderivatives - Basic concepts - Integration of rational functions - Trigonometric integrals; Integration of irrational functions. Simple examples of Euler substitutions 2.2. Definite Integrals - Definition, geometric and mechanical interpretations - Criteria for integrability. Properties of definite integrals - Differentiation with respect to endpoints, Newton-Leibniz formula - Techniques of Integration 2.3. Improper Integrals - Improper integrals of type 1: definitions, geometric interpretation, notions of convergence, divergence, the value of improper integrals - Improper integrals of type 1: improper integrals of nonnegative functions, comparison theorems, absolute convergence, conditional convergence - Improper integrals of type 2: definitions, geometric interpretation, notions of convergence, divergence, the value of improper integrals, improper integrals of nonnegative functions, comparison theorems, absolute convergence, conditional convergence 2.4. Applications of definite integrals - Integration summation diagram and differentiation diagram - Areas of plane regions, solids of revolution; volume of solids, arc length **Chapter 3: Functions of Several Variables** 3.1 Basic concepts - Domain, distance, neighborhood, boundary, closed and open sets, bounded sets - Definition of functions of multivariable, geometric interpretation, domain of definition, range - Pointwise limit of functions of multivariable, algebraic limit theorems - Continuity: definition, operations, properties, uniform continuity 3.2. Partial derivatives and total differentials - Partial derivatives: definition, rules for calculation - Total differential: definition, relationship between functions having partial derivatives and differentiable functions, approximation by differentials

	- Implicit functions: definition, existence theorems and methods for implicit differentiation - Higher partial derivatives and differentials: definition, Schwarz' theorem on equality of mixed partials, non-invariance property of higher differentials - Taylor expansion 3.3. Extrema of functions of multi-variables - Definition - Rules for finding extrema - Constrained extrema - Maxima and minima Summary
Study and examination requirements and examination forms	Students are expected to follow the regulations of Hanoi University of Science and Technology **Progress mark (30%):** Essay Writing, 60 minutes, after the eighth week, content: chapter 1 and 2 to integrals of rational functions **Final mark (70%):** Essay
Media employed	PPT courseware, multimedia computers, projectors, laser pens, blackboards, etc.
Reading list	**Textbooks** [1] Nguyễn Đình Trí, Trần Việt Dũng, Trần Xuân Hiển, Nguyễn Xuân Thảo (2015). Toán học cao cấp tập 2: Giải tích. NXB Giáo dục. [2] Nguyễn Đình Trí, Trần Việt Dũng, Trần Xuân Hiển, Nguyễn Xuân Thảo (2017). Bài tập Toán học cao cấp tập 2: Giải tích. NXB Giáo dục. [3] Nguyễn Đình Trí, Tạ Văn Đĩnh, Nguyễn Hồ Quỳnh (2000). Bài tập Toán học cao cấp tập II. NXB Giáo dục. [4] Nguyễn Đình Trí, Tạ Văn Đĩnh, Nguyễn Hồ Quỳnh (2000). Bài tập Toán học cao cấp tập III. NXB Giáo dục. **References** [1] Trần Bình (1998). Giải tích I: Phép tính vi phân và tích phân của hàm một biến. NXB Khoa học và kỹ thuật, Hà Nội. [2] Trần Bình (2005). Giải tích II và III: Phép tính vi phân và tích phân của hàm nhiều biến. NXB Khoa học và kỹ thuật, Hà Nội. [3] Trần Bình (2001). Hướng dẫn giải bài tập toán học, tập 1. NXB Đại học quốc gia Hà Nội. [4] Trần Bình (2001). Bài tập giải sẵn giải tích II. NXB Khoa học và kỹ thuật, Hà Nội.

MI1121 Calculus II

Module designation	Mathematics and Basic Sciences
Module level, if applicable	
Code, if applicable	MI1121
Subtitle, if applicable	

Courses, if applicable	Calculus II
Semester(s) in which the module is taught	2nd semester
Person responsible for the module	Nguyen Binh Minh, Tran Viet Trung, Nguyen Ba Ngoc, Nguyen Kim Anh, Tran Hai Anh
Lecturer	Nguyen Binh Minh, Tran Viet Trung, Nguyen Ba Ngoc, Nguyen Kim Anh, Tran Hai Anh
Language	English
Relation to curriculum	This course provides some applications of differential calculus in geometry, the basic ideas and techniques of parameter-dependent integrals, double integrals and triple integrals, line integrals of scalar fields and vector fields, surface integrals of scalar fields and vector fields, and vector fields.
Teaching method, contact hours	Target students: Students of all science majors Teaching method: theoretical and practical teachings Contact hours: 60 hours Theoretical teaching: 30 hours Practical teaching: 30 hours
Workload (incl. contact hours, self-study hours)	Workload = 150 hours Contact hours = 60 hours Self-study hours = 90 hours
Credit points	4(3-2-0-8)
ECTS	6.08
Requirements according to the examination regulations	Students with no discussion scores or no test scores will receive a process score of less than 3.0/10. If the process score or the final exam score is lower than 3.0/10, students do not complete the course.
Recommended prerequisites	Prerequisite: MI1111Q Calculus I
Module objectives/intended learning outcomes	**Module objectives:** After this course the student will obtain the followings: 1. Master the basic knowledge of Caculus II and apply in practice to solve related exercises - Master the basic concepts such as: double integrals, triple integrals, line integrals, surface integrals, vector fields as well as applications of differential calculus - Be able to apply the knowledge to solve exercises 2. Achieve serious attitude and necessary skills for highly effective work - Be skilled at analyzing and solving problems with strong logical thinking; working independently and staying focused - Identify some practical problems that can be solved by using tools of calculus.

	- Gain serious working attitude, proactive creativity, adaptation to highly competitive working environment
Content	**Chapter 1: Applications of differential calculus in geometry** 1.1. Applications in plane geometry - Normal vector and equations for tangent lines and normal lines of a curve at a point. - Curvature: mean curvature, curvature at a point, formula of curvature at a point (no proof) and examples. - Envelope of a family of parametric curves: definition, formula, examples. 1.2. Applications in spatial geometry - Vector functions, derivative of vector functions and properties. - Curves: equations of tangent lines and normal planes at a point of curves, curvature at a point of curves (formulas). - Surfaces: equations of tangent planes and normal lines at a point of surfaces (formulas). **Chapter 2. Multiple integrals** 2.1. Double integrals - Definition, geometric meaning, properties. - Calculations of double integrals in the Cartesian coordinate system. - Change of variables in double integrals: general change of variables formula, change of variables in polar coordinate system. - Applications of double integrals: Calculate the volume of an object, the area of a plane domain, the area of a surface (formulas and examples). 2.2. Triple integrals - Definition, geometric meaning, properties. - Calculations of triple integrals in the Cartesian coordinate system. - Change of variables in triple integrals: general change of variables formula, change of variables in cylindrical coordinate system, change of variables in spherical coordinate system. - Applications: Calculate the volume of an object. **Chapter 3. Parameter Dependent Integrals** 3.1. Definite Integrals depending on parameters - Definition - Theorems on continuity - Theorems on differentiation under integral sign, integration under integral sign. 3.2. Improper Integrals depending on parameters - Definition - Uniform convergence, Weierstrass theorem. - Properties: continuity, differentiation under integral sign, integration under integral sign. 3.3. Euler's integrals - Introduce Gamma function and properties: definiteness, continuity, infinite differentiability.

	- Beta function: Introduce Beta function with its two types and properties (no proof): symmetry. **Chapter 4. Line Integrals** 4.1. Line integrals of scalar fields - Definition - Calculation 4.2. Line integrals of vector fields - Definition, physical meaning. - Properties - Relation of line integrals of scalar fields and line integrals of vector fields. - Calculation - Green's Theorem (proof for the case of a simple region). - Path independence of line integrals (no proof). **Chapter 5. Surface integrals** 5.1 Surface integrals of scalar fields - Definition - Calculation 5.2 Surface integrals of vector fields - Definition, properties. - Relation of surface integrals of scalar fields and surface integrals of vector fields. - Calculation - Ostrogradsky's Theorem, Stoke's Theorem (no proof). **Chapter 6. Field Theory** 6.1 Scalar Fields - Notions of scalar fields and level surfaces. - Directional derivative: Definition, Theorem on relation between directional derivative and partial derivative. - Gradient: Definition of vector grad and theorem (no proof) and properties. 6.2 Vector Fields - Notions of vector fields and flow lines, system of differential equations of flow lines. - The flux, dive, incompressible fields: the flux of a vector field across oriented surface S, dive (divergence), properties, incompressible fields, source (point), sink (point). - Circulation and curl vector: the circulation of a vector field around an oriented closed curve, curl vector, curly point. - Conservative vector fields: notions of conservative vector fields **F**, the potential function for **F**, conditions for a vector field to be conservative , conditions for an expression to be the total differential, path independence of spatial line integrals.
Study and examination requirements and examination forms	Students are expected to follow the regulations of Hanoi University of Science and Technology **Progress mark (30%):** Essay Writing, 60 minutes, after the eighth week, content: chapter 1 to section 3.2

	Final mark (70%): Written exam
Media employed	PPT courseware, multimedia computers, projectors, laser pens, blackboards, etc.
Reading list	**Study material** [1] Nguyễn Đình Trí, Trần Việt Dũng, Trần Xuân Hiển, Nguyễn Xuân Thảo (2015). Toán học cao cấp tập 1. NXB Giáo dục. **Reference book** [1] Trần Bình (2005). Giải tích II. NXB Khoa học và Kỹ thuật. [2] Nguyễn Đình Trí, Trần Việt Dũng, Trần Xuân Hiển, Nguyễn Xuân Thảo (2017). Bài tập Toán học cao cấp tập 1. NXB Giáo dục. [3] Nguyễn Đình Trí, Tạ Văn Đĩnh, Nguyễn Hồ Quỳnh (2000). Bài tập Toán học cao cấp tập III. NXB Giáo dục. [4] Lê Ngọc Lăng, Nguyễn Chí Bảo, Trần Xuân Hiển, Nguyễn Phú Trường. Ôn thi học kỳ và thi vào giai đoạn II. NXB Giáo dục. [5] James Stewart (2016). Calculus: Concepts and Contexts, eighth edition. Thomson, Brooks/Cole Publishing Company.

MI1036 Algebra

Module designation	Mathematics and Basic Sciences
Module level, if applicable	
Code, if applicable	MI1036
Subtitle, if applicable	
Courses, if applicable	Algebra
Semester(s) in which the module is taught	3rd semester
Person responsible for the module	School of Applied Mathematics and Informatics
Lecturer	School of Applied Mathematics and Informatics
Language	English
Relation to curriculum	This course aims to provide students with basic knowledge of logics and linear algebra. Topics: Logics, sets, maps, complex numbers, matrices, determinants, systems of linear equations, vector spaces, linear maps, quadratic forms, Euclidean spaces, quadratic lines and surfaces.
Teaching method, contact hours	Target students: Students of all science majors Teaching method: theoretical and practical teachings Contact hours: 75 hours Theoretical teaching: 45 hours Practical teaching: 30 hours
Workload (incl. contact hours, self-study hours)	Workload = 195 hours Contact hours = 75 hours

	Self-study hours = 120 hours
Credit points	4(3-2-0-8)
ECTS	6.08
Requirements according to the examination regulations	Students with no discussion scores or no test scores will receive a process score of less than 3.0/10. If the process score or the final exam score is lower than 3.0/10, students do not complete the course.
Recommended prerequisites	N/A
Module objectives/intended learning outcomes	**Module objectives:** After this course the students are expected to: 1. Have a thorough grasp of basic concepts of logics and linear algebra - Have a thorough grasp of basic concepts of mathematical logics and linear algebra such as: propositional logics, sets, matrices, systems of linear equations, vector spaces, Euclidean spaces, linear maps - Be able to apply learned knowledge to solve related problems 2. Have a positive working attitude and good skills - Be able to analyze and solve problems independently - Have ability to recognize practical problems that can be solved using tools of linear algebra - Have a positive working attitude and able to adapt to a competitive working enviroment
Content	**Chapter 1: Symbolic Logics, Sets, mapping and complex numbers** 1.1. Symbolic Logics - Mathematical propositions and truth values - Logical operations: conjunction, disjunction, negation, implication and equivalence - Propositional functions 1.2. Basic set theory - Sets and elements, subsets, set equality - Operations on sets: Intersection, union, set difference, complement - Cartesian product 1.3. Mappings - Definition and examples - Injective maps, surjective maps, bijective maps, Image, preimage - Composition of maps, inverse of maps 1.4. Complex numbers - Binary operations - Definitions and examples of groups, rings, fields - Construction of the field of complex numbers - Geometrical description and the trigonometric form of a complex number - Operations: addition, subtraction, multiplication, division, exponentiation, root

	- Fundamental theorem of algebra (without proof) **Chapter 2: Matrix, determinant, linear system of equations** 2.1. Matrices - Definitions, some types of matrices: square matrices, zero matrices, upper triangular matrices, lower triangular matrices, diagonal matrices, the identity matrices - Matrix operations: addition, scalar multiplication, matrix multiplication, transpose 2.2. Determinant - First, second, third order determinant, determinant of higher order - Properties of determinant, the determinant of the product of two matrices - Evaluating determinant using elementary operations 2.3. Rank of a matrix, inverse of a matrix - Rank of a matrix, rank of an echelon matrix - Evaluation rank using elementary operations - Inverse of a matrix, properties, conditions of a matrix for being invertible - Find the inverse of a matrix using minors, elementary operations 2.4. System of linear equations - Defintion, solutions, homogeneous and nonhomogeneous systems - Cramer systems, the theorem on the existence and uniqueness of solution, the solution formula - Homogeneous system: n equations, n unknowns - General systems of linear equations, Knonecker - Capelli theorem, Gauss elimination method **Chapter 3: Vector spaces** 3.1. Vector spaces - Definition and examples - Properties 3.2. Subspaces - Definition, criterion, example: solution spaces of homogeneous linear systems - Subspaces generated by vectors 3.3. Dimensions and Coordinates - Linear independence, dependence, generator, basis, dimension of vector spaces - Coordinates - Change of basis and coordinates - Rank of a vector system, finding rank knowning coordinates of vectors, the dimension of subspaces generated by vectors **Chapter 4: Linear maps (mappings, transformations)** 4.1. Linear maps - Definitions and examples - Kernel, image of linear maps, injective, surjective and bijective linear maps 4.2. Matrix of a linear map - Matrix of a linear map

	- Matrices of a linear transformation and change of basis - Matrix similarity 4.3. Eigenvalues and eigenvectors - Eigenvalues and eigenvectors of a matrix - Eigenvalues and eigenvectors of a linear transformation - Matrix diagonalization **Chapter 5: Bilinear forms, quadratic forms, Euclidean spaces, quadratic lines and surfaces** 5.1. Bilinear and quadratic forms - Bilinear and symmetric bilinear forms - Quadratic forms, positive and negative definite quadratic forms, - Matrix of bilinear forms and change of basis - Quadratic forms in canonical form - Lagrange method 5.2. Euclidean spaces - Inner product, length of vectors, orthogonality, angle between vectors, Cauchy Schwarz inequality - Euclidean spaces, orthogonal and orthonormal bases - Orthogonal projections - Gram-Schmidt process - Orthogonal matricé - Orthogonal diagonalization 5.3. Reduction of quadratic forms - Jacobi method - Sylvester criterion - Orthogonal diagonalization method - Sylvester's law of inertia 5.4. Quadratic lines and surfaces - Quadratic lines in planes - Quadratic surfaces in spaces - Quadratic lines and quadratic surfaces classification
Study and examination requirements and examination forms	Students are expected to follow the regulations of Hanoi University of Science and Technology **Progress mark (30%):** Written exam **Final mark (70%):** Written exam
Media employed	PPT courseware, multimedia computers, projectors, laser pens, blackboards, etc.
Reading list	**Textbooks** [1] Nguyễn Đình Trí, Trần Việt Dũng, Trần Xuân Hiển, Nguyễn Xuân Thảo (2015), Toán học cao cấp tập 1: Đại số và hình học giải tích, NXB Giáo dục VN. [2] Nguyễn Đình Trí, Tạ Văn Đĩnh, Nguyễn Hồ Quỳnh (2006), Bài tập Toán học cao cấp tập 1: Đại số và hình học giải tích, NXB Giáo dục VN. **References**

	[1] Dương Quốc Việt, Nguyễn Cảnh Lương (2015), Đại số tuyến tính, NXB Bách Khoa HN. [2] Trần Xuân Hiển, Lê Ngọc Lăng, Tống Đình Quỳ, Nguyễn Cảnh Lương (2007), Phương pháp giai toán cao cấp, Phần đại số, NXB Đại học kinh tế quốc dân, Hà Nội. [3] Nguyễn Tiến Quang, Lê Đình Nam (2016), Cơ sở đại số tuyến tính, NXB Giáo dục, Hà Nội.

ME2016 Technical Drawing I

Module designation	Mathematics and Basic Sciences
Module level, if applicable	
Code, if applicable	ME2016
Subtitle, if applicable	
Courses, if applicable	Technical Drawing I
Semester(s) in which the module is taught	3nd semester
Person responsible for the module	Assoc. Prof. Dr. Hoàng Long
Lecturer	Group of Technical Drawing
Language	English
Relation to curriculum	The subject provides basic knowledge of geometry, methods of representing objects, and the international standard system of drawings. This subject aims to open up the ability to communicate in a language of engineering: visual language (technical drawings). That ability is reflected in 2 areas: 3. Creating technical drawings 4. Interpreting the technical drawings The course also provides students with the necessary knowledge to use graphic software in learning, research, and actual production.
Teaching method, contact hours	Target students: Students of school of mechanical engineering Teaching method: theoretical and practical teachings Contact hours: 45 hours Theoretical teaching: 30 hours Practical teaching: 15 hours
Workload (incl. contact hours, self-study hours)	Workload = 105 hours Contact hours = 45 hours Self-study hours = 60 hours
Credit points	2(1-1-0-4)
ECTS	2.84

Requirements according to the examination regulations	Students with no discussion scores or no test scores will receive a process score of less than 3.0/10. If the process score or the final exam score is lower than 3.0/10, students do not complete the course.
Recommended prerequisites	N/A
Module objectives/intended learning outcomes	**Module objectives:** Upon completion of this course students will be able to: 1. Students shall be able to solve descriptive geometry problems such as the 2D graphical representation of 3D geometric objects, intersections of those objects, finding true shapes, etc. 2. Students shall be able to apply technical drawing standards. 3. Students shall be able to create an engineering drawing 4. Students shall be able to interpret an engineering drawing 5. Students shall be able to use graphic software to create technical drawings
Content	1 Graphical Representation of an object 1.1. Point 1.2. Line 1.3. Plane 1.4. Cone and sphere 2 Replacement of plane of projection 2.1.Principle of the replacement 2..2. Problems: Distance, Angle, True shape… 3. Intersections 3.1. Intersection of a line and a Plane / Cone /Sphere 3.1.2 Intersection of a plane and a Plane / Cone /Sphere 3.1.3 Intersection of two surfaces 4. Basic technical Drawing 4.1. Standards of engineering Drawing 4.2. Multiview Drawing 4.3. Dimensioning 4.3. Section and sectional View 4.5. Isometric Axonometric Projections and interpreting a multiview drawing 5. Solid Work 5.1 2D Sketch 5.1. Create a 3D part file 5.2. Create a 2D Drawing file
Study and examination requirements and examination forms	Students are expected to follow the regulations of Hanoi University of Science and Technology - Attendance: Students must attend all lectures per regulations of HUST - Homework: all must be completed per requirements of the course

	- Labs: all must be completed and defended successfully **Progress mark (30%):** Test/Essay **Final mark (70%):** Test/Essay
Media employed	PPT courseware, multimedia computers, projectors, laser pens, blackboards, etc.
Reading list	**Textbooks** 1. Lương Duyên Bình (Ed.): General physics, Vol. 1: Mechanics - Thermodynamics, Vietnam Education Publishing House, 2010, 267 pp. 2. Lương Duyên Bình, Dư Trí Công, Nguyễn Hữu Hồ, General physics, Vol. 2: Electricity - Oscillations - Waves, Vietnam Education Publishing House, 2009, 343 pp. 3. Lương Duyên Bình (Ed.), Nguyễn Hữu Hồ, Lê Văn Nghĩa, Nguyễn Tụng: Problems on general physics, Vol. 1: Mechanics - Thermodynamics, Vietnam Education Publishing House, 2010, 199 pp. 4. Lương Duyên Bình (Ed.), Problems on general physics, Vol. 2: Electricity - Oscillations - Waves, Vietnam Education Publishing House, 2007, 155 pp. **References** 1. Nguyễn Xuân Chi, Đặng Quang Khang: General physics, Vol. 1: Mechanics - Thermodynamics, Bach Khoa Publishing House, 2000, 467 pp. 2. Trần Ngọc Hợi (Ed.), Phạm Văn Thiều, General physics: Principles and Applications, Vol. 1: Mechanics and Thermodynamics, Vietnam Education Publishing House, 2006, 511 pp.

PH1016 Physics I

Module designation	Mathematics and Basic Sciences
Module level, if applicable	
Code, if applicable	PH1016
Subtitle, if applicable	
Courses, if applicable	Physics I
Semester(s) in which the module is taught	2nd semester
Person responsible for the module	Assoc. Prof. Dr. Phung Van Trinh Assoc. Prof. Dr. Pho Thi Nguyet Hang Dr. Ha Dang Khoa
Lecturer	Assoc. Prof. Dr. Phung Van Trinh Assoc. Prof. Dr. Pho Thi Nguyet Hang Dr. Ha Dang Khoa
Language	English
Relation to curriculum	The course covers the basic knowledge of general physics: Mechanics (the theorems and laws of momentum, angular momentum; kinetic energy, potential energy, conservation of mechanical energy; rotational motion of rigid body, mechanical oscillations and waves) and that of Thermodynamics (the First law,

	Second law, real gases and kinetic-molecular theory of gases) – the foundation of the technical subjects.
Teaching method, contact hours	Target students: Students of all science majors Teaching method: theoretical and practical teachings Contact hours: 60 hours Theoretical teaching: 30 hours Practical teaching: 15 hours Experiments: 15 hours
Workload (incl. contact hours, self-study hours)	Workload = 150 hours Contact hours = 60 hours Experiments = 15 hours Self-study hours = 90 hours
Credit points	4(2-2-1-8)
ECTS	6.08
Requirements according to the examination regulations	Students with no discussion scores or no test scores will receive a process score of less than 3.0/10. If the process score or the final exam score is lower than 3.0/10, students do not complete the course.
Recommended prerequisites	N/A
Module objectives/intended learning outcomes	**Module objectives:** Upon completion of this course students will be able to: 1. Understand and be able to apply the theorems and laws in solving problems in mechanics - Grasp the foundations of mechanics, Galileo's principle of relativity and Newton's laws of motion - Grasp the fundamental physical quantities such as momentum, angular momentum, kinetic energy, potential energy, and the related theorems - Know how to apply the conservation laws (energy, momentum, angular momentum) to solve problems in mechanics - Know the motion in gravitational field, rotational and wave motions 2. Understand and be able to apply the theorems and laws in solving problems in thermodynamics - Understand the random motion of molecules as the basis underlying thermal phenomena - Understand the statistical method (Maxwell– Boltzmann) and thermodynamical method (the First and Second laws) in studying thermal phenomena
Content	**PART 1. MECHANICS (15 T + 9 E)** **CHAPTER 1. INTRODUCTION (2 T + 0 E)** 1.1. The nature of physics 1.2. Physical quantities (units and dimensions) 1.3. Uncertaintties in measurement of physical quantities

	CHAPTER 2. KINETICS OF POINT MASSES (2 T + 1 E) 2.1. Preliminary concepts 2.1.1. Frame of reference and position vector 2.1.2. Equations of motion 2.2. Kinetic characteristics of point masses (formulae, no proof) 2.2.1. Velocity vector of a point mass 2.2.2. Acceleration vector of a point mass (tangential and normal accelerations) 2.3. Basic types of mechanical motion (formulae, no proof) 2.3.1. Motion along a straight line with constant acceleration 2.3.2. circular motion 2.3.3 motion with constant acceleration CHAPTER 3. DYNAMICS OF POINT MASSES (3 T + 2 E) 3.1. Newton's laws of motion 3.2. Galileo's principle of relativity 3.2.1. Space and time in classical mechanics 3.2.2. Galilean transformations 3.2.3. Velocities and accelerations additions 3.2.4. Initial frames of reference and Galileo's principle of relativity 3.3. Forces in mechanics 3.3.1. Centripetal force; centrifugal force 3.3.2. Friction; tension 3.3.3. Inertial force; centrifugal force 3.4. Momentum of a point mass 3.4.1. Theorems for momentum 3.4.2. The meaning of momentum and pulse 3.5. Conservation of momentum of system of point masses 3.6. Angular momentum of a point mass and of a system of point masses 3.6.1. Theorems for angular momentum of a point mass and of a system of point masses 3.6.2. Law of conservation of angular momentum **CHAPTER 4. MECHANICAL ENERGY AND CONSERVATIVE FORCE (4 T + 2 E)** 4.1. Work and power 4.2. Energy and conservation of energy 4.3. Kinetic energy and work-energy theorem 4.4. Potential energy and theorem of potential energy in a uniform gravitational field 4.5. Conservation of mechanical energy 4.6. Radial collisions 4.7. Gravitational fields 4.7.1. Newton's law of universal gravitation. Applications. 4.7.2. Conservation of the gravitational field

	4.7.3. Motion in the gravitational field of the Earth 4.8. The concept of conservative force – The potential energy diagram **CHAPTER 5. ROTATIONAL MOTION OF RIGID BODIES (3 T + 2 E)** 5.1. Center of mass and the equation of motion 5.2. Characteristics of the translational and rotational motions (about a fixed asis) of rigid bodies 5.3. The fundamental equation of rotational motion of a rigid body 5.3.1. Torque 5.3.2. The fundamental equation of rotational motion of a rigid body about an axis 5.3.3. Moment of initia (definition, meaning, and calculation method) 5.6. Angular momentum of rigid bodies. Application of angular momentum conservation. 5.7. Work and kinetic energy of rigid bodies in rotational motion. 5.7.1. Work and power of rigid bodies in rotational motion. 5.7.2. Kinetic energy in rotational motion - rolling without slipping. **CHAPTER 6. MECHANICAL OSCILLATIONS AND WAVES (1 T + 1 E)** 6.1. Mechanical oscillation 6.1.1. Conditions for oscillation (self-study) 6.1.2. Mechanical harmonic oscillation. Physical pendulum. 6.1.3. Damped mechanical oscillation 6.1.4. Forced oscillations. Resonance. 6.1.5. Superposition of oscillations (self-study) 6.1.6. Superposition of two SH motions with the same frequency and direction (self-study) 6.1.7. Superposition of two perpendicular SH momtions with the same frequency (self-study) 6.2. Mechanical waves 6.2.1. Formation of mechanical waves in elastic media. Wave characteristics (self-study). 6.2.2. Wave functions (plane, spherical) 6.2.3. Wave energy and flux. **PART 2. THERMODYNAMICS (15 T + 6 E)** **CHAPTER 7. KINETIC-MOLECULAR THEORY AND DISTRIBUTION LAWS (4 T + 1 E)** 7.1. Characteristics of the gas 7.2. Ideal gas law 7.3. Kinetic-molecular theory 7.3.1. The assumptions 7.3.2. The equation of temperature and pressure (no proof) 7.4. Maxwell-Boltzmann distribution of molecular speeds. 7.5. Degrees of freedom. Internal energy of an ideal gas. 7.6. Barometric formula. Boltzmann distribution of the number of molecules in potential energy.

	CHAPTER 8. THE FIRST LAW OF THERMODYNAMICS (3 T + 2 E) 8.1. Internal energy of a thermodynamical system. Work and heat. 8.2. The first law. Corollaries and significance. 8.3. Reversible processes of ideal gas. 8.3.1. Equilibrium states and reversible processes. 8.3.2. Isochoric, isobaric, isothermal, and adiabatic processes. **CHAPTER 9. THE SECOND LAW OF THERMODYNAMICS (4 T + 2 E)** 9.1. Reversible and irreversible processes 9.2. Heat engines. Coefficient of a heat engine. 9.3. The second law: (Clausius) statement of heat transfer and perpetual motion machine of the second kind. 9.4. Carnot cycle and theorem 9.4.1. Carnot cycle 9.4.2. Statement for Carnot theorem 9.5. Mathematical expression for the second law 9.6. Entropy function and principle of increasing entropy 9.6.1. Definition and properties of entropy 9.6.2. Principle of increasing entropy 9.6.3. Entropy change of an ideal gas 9.6.4. The significance of the second law **CHAPTER 10. REAL GASES (2 T + 1 E)** 10.1. Van der WTeaching methodls equation of state 10.1.1. Differences between ideal and real gases 10.1.2. Derivation of the VdW equation. VdW isotherms. 10.2. Experiments on real gases. Critical state. 10.3. Joule-Thomson effect.
Study and examination requirements and examination forms	Students are expected to follow the regulations of Hanoi University of Science and Technology - Attendance: Students must attend all lectures per regulations of HUST - Homework: all must be completed per requirements of the course - Labs: all must be completed and defended successfully **Progress mark (30%):** Test/Essay **Final mark (70%):** Test/Essay
Media employed	PPT courseware, multimedia computers, projectors, laser pens, blackboards, etc.
Reading list	**Textbooks** 1. Lương Duyên Bình (Ed.): General physics, Vol. 1: Mechanics - Thermodynamics, Vietnam Education Publishing House, 2010, 267 pp. 2. Lương Duyên Bình, Dư Trí Công, Nguyễn Hữu Hồ, General physics, Vol. 2: Electricity - Oscillations - Waves, Vietnam Education Publishing House, 2009, 343 pp.

	3. Lương Duyên Bình (Ed.), Nguyễn Hữu Hồ, Lê Văn Nghĩa, Nguyễn Tụng: Problems on general physics, Vol. 1: Mechanics - Thermodynamics, Vietnam Education Publishing House, 2010, 199 pp. 4. Lương Duyên Bình (Ed.), Problems on general physics, Vol. 2: Electricity - Oscillations - Waves, Vietnam Education Publishing House, 2007, 155 pp. **References** 1. Nguyễn Xuân Chi, Đặng Quang Khang: General physics, Vol. 1: Mechanics - Thermodynamics, Bach Khoa Publishing House, 2000, 467 pp. 2. Trần Ngọc Hợi (Ed.), Phạm Văn Thiều, General physics: Principles and Applications, Vol. 1: Mechanics and Thermodynamics, Vietnam Education Publishing House, 2006, 511 pp.

PH1026 Physics II

Module designation	Mathematics and Basic Sciences
Module level, if applicable	
Code, if applicable	PH1026
Subtitle, if applicable	
Courses, if applicable	Physics II
Semester(s) in which the module is taught	3rd semester
Person responsible for the module	Assoc. Prof. Dr. Phung Van Trinh Assoc. Prof. Dr. Pho Thi Nguyet Hang Dr. Ha Dang Khoa
Lecturer	Assoc. Prof. Dr. Phung Van Trinh Assoc. Prof. Dr. Pho Thi Nguyet Hang Dr. Ha Dang Khoa
Language	Vietnamese
Relation to curriculum	This course covers the basic knowledge of general physics: Electromagnetism (electric and magnetic fields), sources of the fields, their properties and characteristics (strengths, potential, flux,...), and the related theorems and laws. Relations between electric and magnetic fields. Magnetic force and applications.
Teaching method, contact hours	Target students: Students of all science majors Teaching method: theoretical and practical teachings Contact hours: 60 hours Theoretical teaching: 30 hours Practical teaching: 15 hours Experiments: 15 hours
Workload (incl. contact hours, self-study hours)	Workload = 150 hours Contact hours = 60 hours Experiments = 15 hours

	Self-study hours = 90 hours
Credit points	4(3-2-1-8)
ECTS	6.50
Requirements according to the examination regulations	Students with no discussion scores or no test scores will receive a process score of less than 3.0/10. If the process score or the final exam score is lower than 3.0/10, students do not complete the course.
Recommended prerequisites	**Preceding courses**: PH1111 Physics I
Module objectives/intended learning outcomes	**Module objectives:** Upon completion of this course students will be able to: 1. Understand and be able to solve problems in electricity - Get hold of the concept of electric field - Understand and be able to solve problems applying the laws for the electric field (Coulomb's law, Ostrogradski-Gauss's theorem) 2. Understand and be able to solve problems in magnetism - Get hold of the concept of magnetic field - Understand and be able to solve problems applying the laws for the magnetic field (the Biot-Savart-Laplace law, Ampere's law) - Understand and be able to solve problems on the relation between the electric and magnetic field (Faraday's law, Maxwell's first and second statements). 3. Know how to utilize the interplay between EM field and media (dielectrics, conductors, ferromagnets) - Understand and be able to solve problems on the influences of EM field on conductors and dielectrics - Get hold of the magnetism of magnetic materials, be able to explain the properties of ferromagnetic materials 4. Know the technical applications: electronics, electricity generation and transmission, EM waves
Content	**PART 3. ELECTROMAGNETISM (30 T + 15 E)** **CHAPTER 1. ELECTROSTATICS (6 T + 4 E)** 1.1. Coulomb's law 1.2. Electric field 1.2.1. Electric field concept 1.2.2. Electric field vector 1.2.3. Superposition principle for electric field 1.2.4. Electric dipole moment 1.2.5. Electric field lines 1.3. Ostrogradski-Gauss's theorem 1.3.1. Electric susceptibility. Electric flux 1.3.2. Ostrogradski-Gauss's theorem and applications 1.4. Electric potential

	1.4.1. Conservative nature of electrostatic fields. Circulation of electric field vector. 1.4.2. Electrostatic potential energy 1.4.3. Electric potential and potential difference 1.4.4. Equipotential surfaces (properties) 1.5. Relation between electric field and potential. **CHAPTER 2. CONDUCTORS (2 T + 1 E)** 2.1. Properties of charged conductors in electrostatic equilibrium. Capacitance of a conductor. 2.2. Electrostatic induction 2.2.1. The phenomenon 2.2.2. Capacitors and capacitance (parallel plate, cylindrical, and spherical capacitors) 2.3. Electric field energy 2.3.1. Electrostatic potential energies of a system of point charges and of charged conductors 2.3.2.Energy stored in a parallel plate capacitor and in an electric field **CHAPTER 3. DIELECTRICS (2 T + 1 E)** 3.1. Polarization 3.1.1. The phenomenon 3.1.2. Electric dipole moment vector 3.1.3. Polarization and surface bound charge density 3.2. Electric field and susceptibility in dielectrics (formulae) 3.3. Special dielectrics 3.3.1.Electrets 3.3.2. Piezoelectric effect **CHAPTER 4. MAGNETIC FIELD (7 T + 4 E + 1 L)** 4.1. Electric current characteristics. 4.1.1. Current density vector and Ohm's law in vector form 4.1.2. Sources and electromotive force. Non-electrostatic fields. 4.2. Magnetic interaction of currents. Ampere's force law. 4.3. Magnetic field 4.3.1. Magnetic field concept 4.3.2. Magnetic induction vector (the Biot-Savart-Laplace law) 4.3.3. Superposition principle of magnetic fields and applications (for a straight current-carrying wire, a circular current loop (definition of magnetic moment of a current loop), a charged particle in motion) 4.3.4. Magnetic field strength vector 4.4. Magnetic flux 4.4.1. Magnetic field lines. Flux. 4.4.2. Ostrogradski-Gauss's theorem for magnetic field 4.5. Ampere's circuital law. Applications. 4.6. Magnetic force 4.6.1. Magnetic force and torque on current-carrying conductors

	4.6.2. Wire loops in magnetic field 4.7. Lorentz force. Motion of charged particles in a uniform magnetic field. 4.8. Work done by magnetic force. **CHAPTER 5. ELECTROMAGNETIC INDUCTION (2 T + 2 E)** 5.1 Laws of electromagnetic induction. Induced emf. 5.2. Self-inductance. Inductance. Self-induced emf. Surface effects (qualitative discussion). 5.3. Energy stored in a solenoid, and an arbitrary magnetic field. **CHAPTER 6. MAGNETIC MATERIALS (3 T + 0 E)** 6.1. Magnetization. Magnetic materials. 6.2. Qualitative explanation of diamagnetism and paramagnetism 6.2.1. Magnetic moment of an atom 6.2.2. Diamagnetism 6.2.3. Explanation of diamagnetism and paramagnetism 6.2.4. Magnetization vector 6.3. Synthetic magnetic fields in magnetic materials 6.4. Ferromagnetism 6.4.1. Properties of ferromagnetic materials (Curie temperature, magnetic hysteresis, ferrimagnetism) 6.4.2. Domain theory. **CHAPTER 7. ELECTROMAGNETIC FIELD (2 T + 1 E)** 7.1. Eddy electric field. Maxwell's first statement. Maxwell-Faraday equation. 7.2. Displacement current. Maxwell's second statement. Maxwell-Ampere equation. 7.3. The concept of electromagnetic field. Maxwell's equations. Energy of electromagnetic field. **CHAPTER 8. ELECTROMAGNETIC OSCILLATION (2 T + 1 E)** 8.1. Free electromagnetic oscillation in RLC circuit (harmonic oscillation, damping, overdamping) 8.2. Forced electromagnetic oscillation (total impedance, resonance) **CHAPTER 9. ELECTROMAGNETIC WAVES (2 T)** 9.1. EM wave formation 9.2. EM wave common properties. 9.3. EM wave equation in a medium (homegeneous, isotropic). Propagation velocity. Refractive index. 9.4. Energy and flux of EM waves. Poynting vector. 9.5. The EM spectrum.
Study and examination requirements and examination forms	Students are expected to follow the regulations of Hanoi University of Science and Technology **Progress mark (30%):** Test/Essay **Final mark (70%):** Test/Essay
Media employed	PPT courseware, multimedia computers, projectors, laser pens, blackboards, etc.

Reading list	**Textbooks** 1. Lương Duyên Bình, Dư Trí Công, Nguyễn Hữu Hồ, General physics, Vol. 2: Electricity - Oscillations - Waves, Vietnam Education Publishing House, 2009, 343 pp. 2. Lương Duyên Bình (Ed.), Problems on general physics, Vol. 2: Electricity - Oscillations - Waves, Vietnam Education Publishing House, 2007, 155 pp. **References** 1. Đặng Quang Khang, General physics, Vol. 2: Electricity, Bach Khoa Publishing House, 2000, 328 pp. 2. Trần Ngọc Hợi (Ed.), Phạm Văn Thiều, General physics: Principles and Applications, Vol. 2: Electricity, magnetism, Oscillations, and Waves, Vietnam Education Publishing House, 2006, 487 pp.

CH1016 General Chemistry

Module designation	Mathematics and Basic Sciences
Module level, if applicable	
Code, if applicable	CH1017
Subtitle, if applicable	
Courses, if applicable	General Chemistry
Semester(s) in which the module is taught	3nd semester
Person responsible for the module	Dr. Tran Thi Thu Huyen
Lecturer	Dr. Tran Thi Thu Huyen
Language	English
Relation to curriculum	This course aims to provide students with the most basic and necessary knowledge of the basis of modern chemical theory; on the basis of which students can study other science-engineering subjects related to chemistry, help the future engineer know how to ask problems and coordinate with chemists to solve practical problems. go out. Students will gain knowledge of substance composition, chemical thermodynamics, electrochemistry and kinetics at a certain level.
Teaching method, contact hours	Target students: Students of school of materials and science and engineering Teaching method: theoretical, lab and practical teachings Contact hours: 60 hours Theoretical teaching: 30 hours Lab: 15 hours Practical teaching: 15 hours
Workload (incl. contact hours, self-study hours)	Workload = 150 hours Contact hours = 60 hours Self-study hours = 90 hours

Credit points	4 (3-2-1-8)
ECTS	6.50
Requirements according to the examination regulations	Students with no discussion scores or no test scores will receive a process score of less than 3.0/10. If the process score or the final exam score is lower than 3.0/10, students do not complete the course.
Recommended prerequisites	N/A
Module objectives/intended learning outcomes	**Module objective:** Acquire the most basic and necessary knowledge of the basis of modern chemistry theory: -Capable of building electron configurations of atoms. Thereby understanding the causes of the law of circulation, the principle of building a system of circulation of the elements that encode them and the connection between the electron configuration of the atom and the properties of the elements. -Understand the two approximate methods of chemical bonding and molecular composition (the bonding electron pairing method and the molecular orbital method). From there, it is possible to explain the nature of chemical bonds, predict the geometric structure of molecules and explain the structure of matter. -Identify the heat of processes, understand the basic principles of thermodynamics, thereby determining the standard of self-evolution and the limits of chemical processes and knowing how to apply this standard to the processes that occur in practice. -Distinguish electrolyte solutions and solutions and understand the properties of these solutions -Identify the important factors that affect the speed of the reaction and know how to influence those factors so that the reaction occurs faster.
Content	**Chapter 1. Atomic composition** 1.1. Protons, electrons and notrons. The development of atomic samples 1.2. Modern view of atomic structure 1.3. The concept of quantum mechanics 1.4. One electron system - Hydrogen atom problem 1.5. The multi-electron atomic problem. Approximate method of an electron 1.6. Electron distribution in atoms 1.7. Configuration of atomic electrons and ions **Chapter 2. The law of circulation and the system of circulation of chemical elements** 2.1. The Law of Circulation 2.2. Characteristics of the circulatory system 2.3. Development of a circulatory system 2.4. Changes in circulation of some properties of elements in the circulatory system 2.5. The relationship between the electron shell structure of atoms of the elements and their location and properties in the circulatory system **Chapter 3. Chemical bonds and molecular structures** 3.1. Summary of the history of the development of chemical bonding theory 3.2. The basic characteristics of chemical bonding 3.3. Classification of links by electrical tonal sound

	3.4. Covalent bonds according to the electron pair theory of bonding 3.5. Hybridization theory 3.6. Pros and cons of bonding electron pair theory 3.7. Molecular orbital theory 3.8. Molecular composition **Chapter 4. Principle I of Thermodynamics - Thermochemistry** 4.1. Some concepts and conventions of thermodynamics 4.2. Principle I of thermodynamics 4.3. Apply principle I of thermodynamics to chemical systems. Chemical heat 4.4. Hess's Law and its consequences; Application of Hess's Law 4.5. The dependence of the heat effect on temperature: Isometric molt heat and isometric molar heat; Kirchoff's Law 4.6. The connection between the heat of the reaction and the energy involved **Chapter 5. Principle II of thermodynamics. Dimensions of chemical processes** 5.1. Entropium and Principle II of thermodynamics 5.2. Principle III of thermodynamics. Absolute entropi 5.3. Entropi variation in chemical reactions 5.4. Thermodynamics and self-evolving standards and limits of the process 5.5. Free enzyme variability of chemical reactions 5.6. Factors that affect free enzymes 5.7. The connection between the structure and dimension of the reaction **Chapter 6. Chemical Balance - Phase Balance** 6.1. Chemical thermodynamics and chemical balance 6.2. Equilibrium of chemical reactions 6.3. Balanced constants, reaction ratios and levels of chemical reactions 6.4. The shift in the chemical balance. Le Chaterlier balance shift 6.5. Definitions of phase balance 6.6. Gibbs Phase Rules 6.7. Phase balance in 1-element system **Chapter 7. Electrolyte solutions and solutions** 7.1. Distributed system 7.2. Solution concentration 7.3. Solubility and solubility 7.4. Properties of solution containing non-volatile soluble substances 7.5. Hemolyticly 7.6. Balance in weak electrolyte solution and electrolyte constant 7.7. Acid theory – base 7.8. Balance in a solution of less soluble electrolytes **Chapter 8. Kinetic chemistry** 8.1. The speed of the chemical reaction. 8.2. Conditions of reaction occurring - Active collision theory 8.3. Factors that affect the speed of chemical reactions **Chapter 9. Idiosyncratic** 9.1. Principles of converting power into electricity - Electric batteries 9.2. Electrodes and electrodes 9.3. The electrodynamic power of the battery and the Nernst formula 9.4. Electrodes and Nernst formulas 9.5. The dimension and equilibrium of the reduction oxidation reaction occurs in the water solution 9.6. Electrolysis

Study and examination requirements and examination forms	Students are expected to follow the regulations of Hanoi University of Science and Technology **Progress mark (30%):** -Presentation 10% -Midterm exam (multiple choice/writing) 20% **Final mark (70%):** -Final exam (multiple choice/writing) 70%
Media employed	PPT courseware, multimedia computers, projectors, laser pens, blackboards, etc.
Reading list	**Textbooks** Nguyễn Đình Chi (2005). *Cơ sở lý thuyết hóa học phần 1: Cấu tạo chất.* NXB Giáo dục. Nguyễn Hạnh (2008).*Cơ sở lý thuyết hóa học phần 2: Nhiệt động hóa học, Động hóa học, Điện hóa học.* NXB Giáo dục. Lê Mậu Quyền (2001). *Cơ sở lý thuyết hóa học phần bài tập.* NXB Khoa học và Kỹ thuật. R. Chang (2006).*General Chemistry.* Mc Graw Hill, 7th edition. **References** James F. Hall (2007). *Experimental Chemistry.* Houghton Mifflin Company, New York. Petrucci, Harwood, Herring (2002). *General Chemistry: Principles and Modern Applications.* 8th Edition Philip Dutton, University of Windsor, Canada, Prentice-Hall. Steven S. Zumdahl (2000).*Chemistry.*Houghton Mifflin Company, New York.

MSE2024E Technical Writing and Presentation

Module designation	Soft skill
Module level, if applicable	
Code, if applicable	MSE2024E
Subtitle, if applicable	
Courses, if applicable	Technical Writing and Presentation
Semester(s) in which the module is taught	4th semester
Person responsible for the module	Assoc. Prof. Le Van Lich Assoc. Prof. Dang Quoc Khanh Dr. Nguyen Cao Son
Lecturer	Prof. Bui Anh Hoa Assoc. Prof. Le Van Lich Assoc. Prof. Dang Quoc Khanh Dr. Nguyen Cao Son

Language	English
Relation to curriculum	The course aims to provide students principles and skills of writing scientific and technical documents and making effective presentations in English, while also enriching their capacity to use English academically and professionally. Students are introduced to the entire writing process including planning, drafting, evaluation, editing and presenting the research results. The problems of analyzing the objectives of the text, organizing information, using graphical support tools are also introduced. As a result, students can write technical reports, theses, abstracts, proposals, CVs, etc. in a correct and professional way. In addition, effective presentation techniques such as using voices, changes of tone, body languages are also introduced in this course.
Teaching method, contact hours	Target students: Students of school of materials and science and engineering Teaching method: theoretical, practical teachings, problem solving, group discussion, critical and reflective thinking, communication, presentation, student work and report, teamwork Contact hours: 60 hours Theoretical teaching: 30 hours Practical teaching: 30 hours
Workload (incl. contact hours, self-study hours)	Workload = 150 hours Contact hours = 60 hours Self-study hours = 90 hours
Credit points	3 (2-2-0-6)
ECTS	4.67
Requirements according to the examination regulations	Students with no discussion scores or no test scores will receive a process score of less than 3.0/10. If the process score or the final exam score is lower than 3.0/10, students do not complete the course.
Recommended prerequisites	N/A
Module objectives/intended learning outcomes	**Module objective:** **Developing speaking and presentation skills in English for students** - Students will acquire basic presentation skills in English and be able to construct individually a presentation - Students will be able to confidently, effectively present technical and academic contexts in English. **Students are expected to understand and be able to write academic and technical reports or articles in English** - Student can read effectively technical reports, research papers and articles for understanding their structures and organizations. - Encouraging students to apply the acquired writing skills for writing technical papers such as scientific reports, research proposals, journals and articles, in which the target is put on how to describe tables, graphs, bar/pie charts, processes, write abstracts, bibliography and use citation to avoid plagiarism.
Content	**Introduction to the course (course structure, expectation, and assessments)**

	Schedule and Assessments; - The aimed output of the course; - Introduction to textbooks and supporting materials for the course; - The policy of the course; - The communication method using in this course – E-mail Learn how to introduce yourself briefly **Part I. Presentation** 1.1. Introduction: why, whom and what presentation. 1.2. Types and structure of presentation - Poster - PowerPoint 1.3. Organize a presentation, using figure, graph, video to describe technical content - Applying multimodalities in presentation - Understanding the bad or good presentation 1.4. Form a poster presentation - Body languages in presentation - Practice presentation 1.5. In class: Group presentation **Part II: Reading** 2.1. Learn how to read a paper: - Strategy for reading a paper - How to search and download a paper - Process of reading an article 2.2. Vocabularies in the major - How to find accurately the meaning of engineering words - Reading skills (Reading the full research articles) - Strategy for writing a paper **Part III: Technical Writing** 3.1. Introduction to technical writing - Classify technical writings - Structure and components of a technical writing - Email and CV 3.2. Research paper structure - Half Truths About Writing - Understanding components of a technical writing: - *Abstract* - *Introduction* - *Main content*

	-Conclusion 3.3. How to write Technical report - 11 Ways to formulate - Better Style - Draft Testing - Organizational Preferences - Recommended Resources 3.4. Writing and Editing - Accuracy - Organization - Select a subject - Preparing references - Forming first paragraph 3.4. Writing and Editing - Clarity - Conciseness - Process - Editing - Proposal - Thesis 3.4. Writing and Editing - Pomodoro - Mind map
Study and examination requirements and examination forms	Students are expected to follow the regulations of Hanoi University of Science and Technology **Progress mark (40%):** -Presentation (Group) 20% -Homework, in-class presentation 20% **Final mark (60%):** -Final exam (multiple choice and writing)
Media employed	PPT courseware, multimedia computers, projectors, laser pens, blackboards, etc.
Reading list	**Textbooks** Lucinda Becker and Joan Van Emden (2004), *Presentation skills for students*, Palgrave. Philip A Laplante (2012), *Technical writing – A practical guide for Engineers and Scientists.* CRC Press. **References** Stephen Bailey (2018), *Academic writing: Academic handbook for international students*, Routledge. Heather Silyn-Roberts (2013), *Writing for Science and Engineering. Papers, Presentations and Reports*, Elsevier. Glasman-Deal and Hilary (2010), *Science research writing for non-native speakers of English*, World Scientific. Straus, Jane, Lester Kaufman, and Tom Stern (2014), *The blue book of grammar and punctuation: An easy-to-use guide with clear rules, real-world examples, and reproducible quizzes*, John Wiley & Sons.

	Kirkman John and Christopher Turk (2015), *Effective Writing. Improving Scientific, Technical and Business Communication*, Taylor & Francis. William Zinsser (2001), *On writing well*, Harper Collins publisher

IT1016 Introduction to Computer Science

Module designation	Mathematics and Basic Sciences
Module level, if applicable	
Code, if applicable	IT1016
Subtitle, if applicable	
Courses, if applicable	Introduction to Computer Science
Semester(s) in which the module is taught	2nd semester
Person responsible for the module	Dr. Ngo Lam Trung
Lecturer	Dr. Pham Dang Hai Dr. Tran Nguyen Ngoc Dr. Nguyen Hong Quang Assoc. Prof. Dr. Tran Quang Duc
Language	English
Relation to curriculum	The course provides students the basic knowledge of computer science and information technology (according to the Circular No. 03/2014/TT-BTTTT on the regulation of IT skills standards) including the knowledge about the representation and processing of information in electronic computers, hardware, operating systems, internet network, utility software, basic office software. It also helps students to represent algorithms using different methods, understand the principle and programming structure of high-level programming languages, and gain the ability to implement algorithms by using the C programming language.
Teaching method, contact hours	Target students: Students with majors related to Computer Science, Computer Engineering, Electrical Engineering, etc. Teaching method: The course will be mainly given offline. Lecturers and teaching assistants may assist students via online learning management system. Contact hours: TBA before each semester
Workload (incl. contact hours, self-study hours)	Total workload = 195 hours Theoretical teaching: 45 hours Exercise: 15 hours Lab: 15 hours Self-study hours = 120 hours
Credit points	3(2-1-2-6)

ECTS	5.08
Requirements according to the examination regulations	Students with no discussion scores or no test scores will receive a process score of less than 3.0/10. If the process score or the final exam score is lower than 3.0/10, students do not complete the course. Students who are absent in all lab classes may receive F score for the course.
Recommended prerequisites	None
Module objectives/intended learning outcomes	**Module objectives:** - Understand the fundamentals of informatics - Obtain basic skills of working with computer, operating system, computer software, internet, and utilities - Obtain basic and advanced skills of building and representing algorithms to solve problems - Understand components and structures of C programs and obtain programming skills to write, compile, and debug C programs to solve problems
Content	**PART 1. FUNDAMENTALS OF INFORMATICS** Chapter 1. Information and Data Representation 1.1. Basic Concepts about Information and Informatics 1.1.1. Information and Information Processing 1.1.2. Computer and Category of Computer 1.1.3. Informatics and Related Fields 1.2. Representation of Data in Computer 1.2.1. Number Systems 1.2.2. Representation of Integer 1.2.3. Representation of Floating-Point Number 1.2.4. Characters Representation Chapter 2. Computer System 2.1. Computer Hardware and Organization 2.1.1. Basic Structure of Computer 2.1.2. Central Processing Unit (CPU) 2.1.3. Memory 2.1.4. IO System 2.1.5. Interconnection Bus 2.2. Computer software 2.2.1. Introduction 2.2.2. Program and program language 2.3. Introduction to Operating System 2.3.1. Basic Concepts 2.3.2. Operating System Command 2.3.3. Microsoft Windows

	2.4. Introduction to Computer Network 2.4.1. Evolution of Computer Network 2.4.2. Categories of Network 2.4.3. Internet and Utilities 2.4.4. Internet 2.5. Applications of Information Technology 2.5.1. Applications in health 2.5.2. Applications in education 2.5.3. Applications in entertainment 2.5.4. Application in business 2.5.5. Applications in science and technology Chapter 3. Algorithm 3.1. Problem solving using computers 3.2. Concept of algorithm 3.3. Algorithm representation 3.4. Some common algorithms **PART II – PROGRAMMING** Chapter 1: Overview of C programming language 1.1. Development history of C programming language 1.2. Basic components of C 1.3. Basic structure of a C program 1.4. Compile C program Chapter 2. Data types and expressions in C 2.1. Standard data types in C 2.2. Expression in C 2.3. Basic operators in C 2.4. Some special operators Chapter 3. Input/ Output in C 3.1. Output data with printf() 3.2. Input data with scanf() Chapter 4. Control structures 4.1. Block command 4.2. Branching command 4.3. Selection command 4.4. Loop commands 4.4.1. while command 4.4.2. do…while command 4.4.3. for command 4.5. Jump commands Chapter 5. Array, pointer, and string 5.1. Array

	5.1.1. Concept of array, declaration, and using 5.1.2. Basic operations on array 5.1.3. Multi-dimensional array 5.2. Pointers 5.2.1. Concept and declaration of pointer 5.2.2. Address and indirection operator 5.2.3. Operators of pointer 5.2.4. Pointer and array 5.3. String 5.3.1. Concept 5.3.2. Declaration and usage 5.3.3. Input/Output string 5.3.4. Character handling functions 5.3.5. String handling functions 5.3.6. Array of strings Chapter 6. Structure 6.1. Concept 6.2. Structure declaration and usage 6.3. Handling structured data Chapter 7. Function 7.1. Concept of function 7.2. Function declaration and usage 7.3. Variable scope 7.4. Parameter passing in function Chapter 8. File 8.1. File concept and categories 8.2. Basic file operators 8.3. Text file 8.4. Binary file
Study and examination requirements and examination forms	Midterm examinations for theorical classes. Lab exercises should be completed by students independently after each lab class. Midterm exam accounts for 25%, lab exam accounts for 25%, and final exam accounts for 50% of the overall score.
Media employed	Class handout (pdf file exported from MS PowerPoint), multimedia computers, projectors, laser pens, blackboards, etc.
Reading list	**Textbooks** 1. Giáo trình Tin học đại cương (Introduction to Information Technology), Khang Dinh Tran et al, Bach khoa Publishing house, Hà Nội **Reference books：** **Vietnamese References** 1. Tin học Căn bản (Fundamentals of Informatics). Quách Tuấn Ngọc. Nhà xuất bản Thống kê. 2001

	2. Mạng máy tính và các hệ thống mở (Computer Network and open systems). Nguyễn Thúc Hải. Nhà xuất bản Giáo dục 3. Ngôn ngữ lập trình C (C programming language). Quách Tuấn Ngọc. Nhà xuất bản Thống kê. 2003 4. Kỹ thuật lập trình C cơ sở và nâng cao (Basic and advanced techniques of C programming languages). Phạm Văn Ất. Nhà xuất bản Khoa học kỹ thuật. 1999 5. Nhập môn Lập trình ngôn ngữ C (Introduction to Programming Language C). Nguyễn Thanh Thủy và các cộng sự. Nhà xuất bản Khoa học kỹ thuật. 2003 6. Bài tập Lập trình ngôn ngữ C (Exercises of Programming Language C). Nguyễn Thanh Thủy, Nguyễn Quang Huy. Nhà xuất bản Khoa học kỹ thuật. 2001 **English References** 1. The C Programming Language, 2nd edition, D.Richie 2. The Architecture of Computer Hardware and Systems Hardware, Chapters 2 and 3. Englander, I. Wiley, [2003].1

MSE3427 Synthesis of Materials

Module designation	Basic Core of Engineering
Module level, if applicable	
Code, if applicable	MSE3427
Subtitle, if applicable	
Courses, if applicable	Synthesis of Materials
Semester(s) in which the module is taught	5th semester
Person responsible for the module	Assoc. Prof. Tran Vu Diem Ngoc Assoc. Prof. Dang Quoc Khanh
Lecturer	Assoc. Prof. Tran Vu Diem Ngoc Assoc. Prof. Dang Quoc Khanh
Language	English
Relation to curriculum	Studies fundamentals of the synthesis of materials. Examines principles of synthesis; processes, approaches, synthetic methodology and probes; methodologies in materials synthesis; polymerization, sol-gel processes, liquid and vapor phase synthesis, materials coupling reactions, and precursor-derived, radiation-induced and asymmetric synthesis.
Teaching method, contact hours	Target students: Students of school of materials science and engineering Teaching method: theoretical teachings, group discussion, teamwork, student report Contact hours: 30 hours Theoretical teaching: 30 hours
Workload (incl. contact hours, self-study hours)	Workload = 90 hours

	Contact hours = 30 hours Self-study hours = 60 hours
Credit points	2(2-0-0-4)
ECTS	2.84
Requirements according to the examination regulations	Students with no discussion scores or no test scores will receive a process score of less than 3.0/10. If the process score or the final exam score is lower than 3.0/10, students do not complete the course.
Recommended prerequisites	MSE 1012 (Introduction to Materials Science and Engineering)
Module objectives/intended learning outcomes	**Module objectives:** 1. To present a systematic approach to the study of "synthesis" in the field of Materials Science and Engineering. 2. To provide students with a broad knowledge of synthetic methodologies along with an understanding of critical needs. 3. To provide students with examples of what's involved in designing and developing a new material through use of case studies. 4. To provide students with a knowledge of the field of high strength/modulus materials including preparation of single crystal ceramics and metals, phase transformation toughened ceramic; composites (both fiber and matrix) with particular emphasis on the syntheses involved. 5. To provide students with an understanding of the field of electronic materials and the role of synthesis in design of microelectronic chips and packaging systems. 6. To provide students with an awareness of the critical needs for new materials in the fields of air and water contaminant removal. 7. To integrate knowledge concerning structure and property relationships and how opportunities can be addressed through innovations in synthesis and processing. 8. To challenge students to think about materials related problems in the world around them and to come up with new materials solutions.
Content	**1** Introduction and background to Materials 1.1. What are Materials 1.2. Classification of Materials 1.3. The importance of Materials 1.4. History of Materials 1.5. Future of Materials, R&D **2** Principles of Synthesis 2.1. Overview and the meaning of synthesis

	2. 2. Historial background 2.3. The role of synthesis in materials research 2.4. Needs for materials synthesis: some examples 2. 5. Opportunities in synthesis 2. 6. The differences between Synthesis and Processing **3** General Synthetic Methodologies 3.1. Preparation of Metals 3.2. Preparation of Ceramics 3.2.1. Solid state reaction 3.2.2. Precipitation synthesis 3.2.3. Sol-gel synthesis 3.2.4. Spray drying synthesis 3.2.5. Hydrothermal synthesis 3.3. Preparation of Polymers 3.4. Preparation of Films 3.4.1. Chemical Vapor Deposition 3.4.2. Pulse laser deposition 3.4.3. Flame spray 3.4.4. Dip coating and spin coating 3.5. Preparation of Fibers **4** Synthesis of Materials with special applications 4.1. Synthesis of High Strength Materials 4.2. Synthesis of Electronic Materials 4.3. Synthesis of Flame Resistant Materials 4.4. Synthesis of Materials for Environmental Control 4.5. Synthesis of Materials with Improved Wear 4.6. Synthesis of Biomaterials 4.7. Synthesis of Microporous and Mesoporous Materials as Catalysts 4.8. Synthesis of Nano Materials
Study and examination requirements and examination forms	Students are expected to follow the regulations of Hanoi University of Science and Technology

	- Students need to strictly follow the rules and regulations of Hanoi University of Science and Technology and the Institute of Economics and Management. - Students need to have a positive attitude, be proactive in learning and well comply with the requirements of the module: read the documents in advance, complete the exercises; submit assignments and essays on time; Deepen your thoughts, read more business, marketing and contact information. - Fraud and plagiarism errors will result in severe discipline. Students who commit cheating or plagiarism will be considered failing the course and receive an F grade. **Progress mark (40%):** -Presentation 20% -Mid-term test (writing) 20% **Final mark (60%):** -Final exam (writing)
Media employed	PPT courseware, multimedia computers, projectors, laser pens, blackboards, etc.
Reading list	**Textbooks** - W. D. Callister, Fundamentals of Materials Science and Engineering, 2001 - Synthesis of Materials, Lecture note, Hanoi University of Science and Technology **References** 1. Materials Science and Engineering for the 1990's: Maintaining Competitiveness in the Age of Materials, Appendix A (Synthesis) & B (Processing), National Academy Press, Washington, D. C., 1989, ISBN: 0-309-03928-2. 2. John Wilford, "Ancient King's Legendary Gold," NY Times, August 15th, 2000 3. Greg Olsen, "Designing a New Material World," Science, Vol. 288, 12 May 2000, pp. 993-998 4. H. Remy, Treatise on Inorganic Chemistry, Vol. II: Subgroups of the periodic table and general topics, Preparation of Metals, Elsevier, 1956. 5. A. M. Buckley and M. Greenblatt, "The Sol-Gel Preparation of Silica Gels," Journal of Chemical Education, Vol. 71 #7, 1994, pp. 599-602 6. J. Livage, and C. Sanchez, "Sol-Gel Chemistry," Journal of Non-crystalline Solids, Vol. 145, 1992, pp. 11-19 7. J. Economy, "Now That's an Interesting Way to Make a Fiber!", Chemtech, Vol. 10, April 1980, pp. 240-247 8. Segal, Chemical Synthesis of Advanced Ceramic Materials, Chapter 6 9. P. Painter and M. Coleman, Fundamentals of Polymer Science: An Introductory Text, Chapters 1 & 2, Technomic, 1997 10. K. Chang, "A Prodigious Molecule and Its Growing Pains," NY Times, Oct. 10, 2000 11. Turner Bowden, Electronic and Photonic Applications of Polymers, Chapter 1, Section 1.1.1.1, pp. 4-11, ACS, 1998 12. B. G. Streetman, Solid State Electronic Devices, Fourth Edition, Chapter 1.3-1.4.4, Prentice Hall, 1995

	13. W. D. Callister, Fundamentals of Materials Science and Engineering, 2001

MSE3417 Material Chemistry

Module designation	Basic Core of Engineering
Module level, if applicable	
Code, if applicable	MSE3417
Subtitle, if applicable	
Courses, if applicable	Material Chemistry
Semester(s) in which the module is taught	4th semester
Person responsible for the module	Dr. Nguyen Cao Son Assoc. Prof. Dr. Duong Ngoc Binh
Lecturer	Assoc. Prof. Dr. Duong Ngoc Binh Dr. Nguyen Cao Son
Language	English
Relation to curriculum	The course provides and introduction to materials chemistry including structural of atom, atomic bonding, crystal structure, chemical reaction and important chemical reaction in metallurgy. Additionally, the subject is focused on materials properties and behavior with respect to application. The course also equips students with the necessary knowledge and understanding to fabricate a material such as metal, alloy, etc. in either traditional or advanced technology.
Teaching method, contact hours	Target students: Students of school of materials science and engineering Teaching method: theoretical teachings, solving problem, group discussion, presentation Contact hours: 30 hours Theoretical teaching: 30 hours
Workload (incl. contact hours, self-study hours)	Workload = 90 hours Contact hours = 30 hours Self-study hours = 60 hours
Credit points	2(2-0-0-4)
ECTS	2.84
Requirements according to the examination regulations	Students with no discussion scores or no test scores will receive a process score of less than 3.0/10. If the process score or the final exam score is lower than 3.0/10, students do not complete the course.
Recommended prerequisites	None

Module objectives/intended learning outcomes	**Understand the structural of atom, crystalline solid** Understanding the structural of atom Understanding the structural of crystalline solid **Understanding the chemical reaction in important metallurgical process** Understanding the chemical reaction in several important metallurgical process **Understanding the fabrication process and properties of Materials** Understanding the fabrication process of the materials Understanding properties and application of the Materials
Content	1. Introduction to materials chemistry 1.1. Structure of atoms 1.2. Bonding 1.3. Crystal structure 1.3.1. Crystal system 1.3.2. Unit cell 1.4. Crystal structure analysis 2. Chemical reactions in metallurgy 2.1. Pyrometallurgy 2.1.1. Roasting & calcination 2.1.2. Reduction 2.2. Hydrometallurgy 2.2.1. Leaching 2.2.2. Cementation 2.3. Electrometallurgy 2.3.1. Electrochemical deposit 2.3.2. Anodizing 3. Metal 3.1. Mining and processing of metal 3.2. Metallic structures and properties 3.3. Metal surface treatments for corrosion resistance 3.4. Magnetism in metals and alloys 4. Alloys, composite and defects 4.1. Overview 4.2. Pure materials and homogeneous solid solutions 4.3. Heterophase Materials 5. Materials in Nanoscience and nanotechnology 5.1. Background and motivation 5.2. Synthesis and fabrication of nanostructures 5.3. Examples of nanostructures 5.4. Major challenges in nanoscience and technology 6. Biomedical Materials 6.1. Special requirements for biomedical materials 6.2. Traditional Biomedical Materials 6.3. Materials for specific Medical Applications 6.4. Fabrication of Biomedical Materials Science
Study and examination requirements and examination forms	Students are expected to follow the regulations of Hanoi University of Science and Technology **Progress mark (30%):** -Mid-term test (Multichoice/Writing)

	Final mark (70%): -Final exam (Multichoice/writing)
Media employed	PPT courseware, multimedia computers, projectors, laser pens, blackboards, etc.
Reading list	**Textbook** - William D. Callister, Jr; *Materials Science and Engineering: An Introduction* - Alain Vignes, Extractive Metallurgy 2 - Metallurgical Reaction Processes, WILEY 2011 - Lecture Notes **References** None

MSE3456 Analysis of Data

Module designation	Basic Core of Engineering
Module level, if applicable	
Code, if applicable	MSE3456
Subtitle, if applicable	
Courses, if applicable	Analysis of Data
Semester(s) in which the module is taught	6th semester
Person responsible for the module	Assoc. Prof. Dr. Dao Hong Bach
Lecturer	Assoc. Prof. Dr. Dao Hong Bach Dr. Nguyen Minh Thuyet Dr. Pham Quang
Language	English
Relation to curriculum	This course provides for graduated students with a basic and in-depth knowledge to carry out experiments effectively, the obtained experimental data has high reliability, understanding the laws of the influence of input variables on the objective function in the research and technology application.
Teaching method, contact hours	Target students: Students of school of materials science and engineering Teaching method: theoretical teachings, critical thinking, group discussion, presentation, student work and report Contact hours: 45 hours Theoretical teaching: 45 hours
Workload (incl. contact hours, self-study hours)	Workload = 135 hours Contact hours = 45 hours Self-study hours = 90 hours

Credit points	3(3-0-0-6)
ECTS	4.25
Requirements according to the examination regulations	Students with no discussion scores or no test scores will receive a process score of less than 3.0/10. If the process score or the final exam score is lower than 3.0/10, students do not complete the course.
Recommended prerequisites	
Module objectives/intended learning outcomes	Upon successfully completing a Data Analytics major, students have gained: -a breadth and depth of mathematics and statistics skills necessary to apply high-level analytical thinking to data analysis problems -an exposure to the basics of computer programming and analytics software use and, thus, the ability to quickly acquire technological know-how demanded on the job. - Students with this minor would be in a position to contribute to data analysis solutions in the workplace, to provide insights that could lead to data-driven decisions, and possibly to attend a graduate program in analytics
Content	Chapter 2: Review of probability -computing probabilities: conditional probabilities and Bayes's rule -Quantiles/percentiles, CDF's, mean, median, variance, standard deviation, covariance, various distributions and what they are used for (particularly Bernoulli, Binomial, Mutinomial, Hypergeometric, Poisson, normal) Chapter 3: Collecting Data -Sampling terminology: convenience sampling, SRS, stratified random sampling, multistage cluster sampling, 1 in K Chapter 4: Summarizing and Exploring Data - Summarizing univariate data: numerically (sample mean, IQR, etc.) and by plotting (pie/bar/pareto chart for categorical data, histogram, box plot, normal plot) -Summarizing bivariate data: Simpson's paradox, scatter plot, sample correlation coefficient - Time series: MA, EWMA, forecast error and MAPE, auto-correlation coefficient Chapter 5: Sampling Distributions of Statistics - Normal approximation to binomial distribution (which relies on the CLT), computing probabilities with chi-square distribution, t-distribution, F-distribution Chapter 6: Basic Concepts of Inference - Bias, MSE, setting up hypotheses, Type I error, Type II error, power -For z-test: z-scores, p-values, confidence intervals Chapter 7: Inferences for Single Samples - Sample size calculation for confidence intervals on z-test, sample calculation for z-test, sample size calculation for power on z-test, t-test, chi-square test for variance Chapter 8: Inferences for Two Samples

	- QQ plots - Comparison of two means for independent samples design (large samples z-test, small sample t-test using either a pooled variance or the Welch-Sattethwaite method) Chapter 9: Inferences for Proportions and Count Data, one way Count Data, Inferences for Two Way Count Data - Comparison to a given proportion using large sample z-test, sample size calculation for confidence intervals -Comparison of two proportions using large sample z-test -Chi-square test (multinomial and goodness of fit) Chapter 10: Similar Linear Regression and Correlation - Computing the least square line, computing r^2, hypothesis testing on beta_1, understanding ANOVA regression tables -Checking model assumptions and transforming data Chapter 11: Multiple Linear Regression - Understanding ANOVA regression tables, t-tests on individual regression coefficients - Multicollinearity - Logical regression
Study and examination requirements and examination forms	Students are expected to follow the regulations of Hanoi University of Science and Technology **Exam(4 exams, 20% each): 80%** **Computer exercises: 20%**
Media employed	PPT courseware, multimedia computers, projectors, laser pens, blackboards, etc.
Reading list	**Textbook**: Tamhane,Ajit C., and Dorothy D. Dunlop.Statistics and Data Analysis:From Elementary to Intermediate. Prentice Hall, 1999. ISBN: 9780137444267. **References** https://ocw.mit.edu/courses/sloan-school-of-management/15-075j-statistical-thinking-and-data-analysis-fall-2011/lecture-notes/

MSE3207 Materials Processing

Module designation	Basic Core of Engineering
Module level, if applicable	
Code, if applicable	MSE3207
Subtitle, if applicable	
Courses, if applicable	Materials Processing
Semester(s) in which the module is taught	4th semester

Person responsible for the module	Prof. Dr. Nguyen Hong Hai Dr. Nguyen Hong Hai Assoc. Prof. Dr. Pham Mai Khanh
Lecturer	Prof. Dr. Nguyen Hong Hai Dr. Nguyen Hong Hai Assoc. Prof. Dr. Pham Mai Khanh
Language	English
Relation to curriculum	Students will be provided with the knowledge on materials manufacturing technologies such as advanced technology in all materials. Besides, the course focuses on several novel technologies such as self-propagation high temperature synthesis, powder metallurgy, nanomaterials manufacturing, 3D printing technology.
Teaching method, contact hours	Target students: Students of school of materials science and engineering Teaching method: theoretical teachings, solving problem, group discussion, teamwork Contact hours: 45 hours Theoretical teaching: 45 hours
Workload (incl. contact hours, self-study hours)	Workload = 135 hours Contact hours = 45 hours Self-study hours = 90 hours
Credit points	3(3-0-0-6)
ECTS	4.25
Requirements according to the examination regulations	Students with no discussion scores or no test scores will receive a process score of less than 3.0/10. If the process score or the final exam score is lower than 3.0/10, students do not complete the course.
Recommended prerequisites	
Module objectives/intended learning outcomes	This course provides an introduction to materials processing science, with an emphasis on heat transfer, chemical diffusion, and fluid flow. We use an engineering approach to analyze industrial-scale processes, with the goal of identifying and understanding physical limitations on scale and speed, and cover materials of all classes, including metals, polymers, electronic materials, and ceramics. Specific processes, such as melt-processing of metals and polymers, deposition technologies (liquid, vapor, and vacuum), colloid and slurry processing, viscous shape forming, and powder consolidation are considered.
Content	What is materials processing? 1 Course overview Heat conduction equation 2 Heat conduction equation review

	3	Comparing heat transfer processes Three important cases
	4	Biot number Newtonian heating / cooling Transient solutions and dimensionless variables
	5	Glass fibers & thermal spray industrial processes Analyzing thermal spray coatings
	6	Hot rolling steel 2D analysis, superposition & friction welding setup
	7	Friction welding Introduction to radiation Black bodies, emissivity & radiation M number
	8	Introduction to solidification Stefan condition, simplifying thermal profile Solidification in a thick mold
	9	Sand casting, lost foam, & cooled molds Interface resistance-limited solidification Single crystal production Introduction to binary solidification
	10	Binary solidification, no diffusion in the solid Solute balance, partition coefficient
	11	Zone refining Solidification with finite diffusion in liquid Unstable solidification fronts Engineering binary alloy microstructures
	12	Fluid mechanics Introduction to fluid flow
	13	Fluid flow Momentum conservation Flow between parallel plates Fluid free surface boundary condition
	14	1D fluid flow with body forces Flow through plates Chart of all math in 3.044 Introduction to glass production

	Pilkington glass process–fluid flow 15 Pilkington glass process–heat transfer Drag force 16 Navier-Stokes equation Reynolds number 17 Class canceled Newtonian flow 18 Introduction to non-Newtonian Solid state shape forming 19 More on Newtonian and non-Newtonian flow Blow molding, compressive forming 20 Introduction to powder processing Sintering, slurry processing 21 Colloid processing Slurry settling / casting Introduction to steel making 22 Steel fluid flow analysis Steel solidification analysis Steel solidification (cont.) 23 Steel factory design A bit about electronics manufacturing
Study and examination requirements and examination forms	Students are expected to follow the regulations of Hanoi University of Science and Technology **Progress mark (40%):** -Mid-term grade 20% -Homework 20% **Final mark (60%):** -Multichoice and writing
Media employed	PPT courseware, multimedia computers, projectors, laser pens, blackboards, etc.
Reading list	**Textbooks** Poirier, D. R., and G. H. Geiger. *Transport Phenomena in Materials Processing*. John Wiley and Sons Ltd, 1998. ISBN: 9780873392723. **References** Kou, Sindo. *Transport Phenomena and Materials Processing*. Wiley-Interscience, 1996. ISBN: 9780471076674. Flemings, Merton C. *Solidification Processing*. McGraw-Hill College, 1974. ISBN: 9780070212831.

MSE1012 Introduction to Engineering

Module designation	Basic Core of Engineering
Module level, if applicable	
Code, if applicable	MSE1012
Subtitle, if applicable	
Courses, if applicable	Introduction to Engineering
Semester(s) in which the module is taught	2th semester
Person responsible for the module	Prof. Dr. Bui Anh Hoa
Lecturer	Prof. Dr. Bui Anh Hoa MSc. Nguyen Van Duc
Language	English
Relation to curriculum	This course presents an overview of materials, basic concepts and core knowledge of materials science and engineering: structure, properties, relationships between structure and properties. Materials technologies, inspection, evaluation and use of materials. The relationship between economic development and materials needs, between materials science and other disciplines, emphasizes the diversity, multidisciplinary of science and technology, importance and meaning of materials in our life.
Teaching method, contact hours	Target students: Students of school of materials science and engineering Teaching method: theoretical, solving problem and practical teachings Contact hours: 45 hours Theoretical teaching: 30 hours Practical teaching: 15 hours
Workload (incl. contact hours, self-study hours)	Workload = 105 hours Contact hours = 45 hours Self-study hours = 60 hours
Credit points	2(2-1-0-4)
ECTS	3.25
Requirements according to the examination regulations	Students with no discussion scores or no test scores will receive a process score of less than 3.0/10. If the process score or the final exam score is lower than 3.0/10, students do not complete the course.
Recommended prerequisites	None
Module objectives/intended learning outcomes	**Module objectives:** 1. Given a type of material, be able to qualitatively describe the bonding scheme and its general physical properties, as well as possible applications.

	2. Given a type of bond, be able to describe its physical origin, as well as strength. 3. Be able to qualitatively derive a material's Young's modulus from a potential energy curve. 4. Given the structure of a metal, be able to describe resultant elastic properties in terms of its 1D and 2D defects. 5. Given a simple set of diffraction data, be able to index the peaks and infer the structure. 6. Be able to describe a polymer's elastic behavior above and below the glass transition. 7. Be able to do simple diffusion problems.
Content	**1. Atomic Structure** (3 hours) 1.1. Materials Science and Engineering 1.1.1. Why Study Materials Science and Engineering 1.1.2. Classification of Materials 1.2. Atomic Structure 1.3. Fundamentals Concepts 1.4. Electrons in Atoms 1.5. The periodic Table **2. Atomic Bonding in Solids** (3 hours) 2.1. Bonding Forces and Energies 2. 2 Primary Interatomic Bonds 2.3 Secondary Bonding or Van der Waals Bonding **3. Crystal structures & crystallography** (1 hours) 3.1. Lattices 3.2. Unit cells 3.3. Crystallographic planes. 3.4. Bragg's Law **4. Introduction to metals** (1 hours) 4.1. fcc, bcc, hcp, atomic packing lattices 4.2. Slip systems, 4.3. Relation to macroscopic phenomena. **5. Introduction to ceramics** (1 hours) 5.1. Crystal structures 5.2. Silicate and carbon ceramics. 5.3. Imperfection in Ceramics. 5.4. Brittle Fracture of Ceramic 5.5. Sress-train behaviour

	5.6. Mechanical of plastic defomation **6. Disorder** (1 hours) 6.1. Vacancies and self- interstitial 6.2. Impurity in solid 6.3. Dislocation- linear Defect 6.4. Microstopic techichal and Grain Size Ditermination **7. Defects** 7.1. Point defects 7.2. Diffusion 7.3. Line defects 7.4. Dislocations 7.5. Dislocation movement **8. Stress and strain** (4 hour) 8.1. Concepts of tress and train 8.2. Elastic Defomation. 8.3. Plastic Defomation 8.4. Prpperty Variability and Design/Safety Factors 9. **Introduction to polymeric materials** (4 hours) 9.1. Hydrocarbon molelcules 9.2. Polymer Molelcules. 9.3. Molelcular Weight 9.4. Molencular shape and structure 9.5. Polymer Crystallinity 9.6. Plastics 9.7. Elastomers, 9.8. Rubber elasticity, **10. Introduction to liquid crystals** (3hours). 10.1. History 10.2. Liquid crystal phases 10.3. Thermotropic liquid crystals 10.4. Lyotropic liquid crystals 10.5. Metallotropic liquid crystals.

	10.6. Biological liquid crystals 10.7. Applications of liquid crystals **11. Introduction to electronic materials** (4 hours) 11.1 Electrical Conduction 11.1.1. Ohm's Law 11.1.2. Electrical Conductivity 11.1.3. Electronic and Ionic Conduction 11.1.4. Energy Band Structures in Solids 11.1.5. Conduction in Terms of Band and Atomic Bonding Model 11.1.6. Electron Mobility 11.1.7. Electrical Resistivity of Metals 11.2. Semiconductivity 11.2.1. Intrinsic Semiconduction 11.2.2. Extrinsic Semiconduction 11.2.3. The Temperature Dependence of Carrier Concentration 11.2.4. Factor that Affect Carrier Mobility 11.2.5. Hall Effect 11.2.6. Semiconductor Devices 11.3 Dielectric Behavior 11.3.1. Capacitance 11.3.2. Field Vector and Polarization 11.3.3. Types of Polarization 11.3.4. Frequency Dependence of the Dielectric Constant
Study and examination requirements and examination forms	Students are expected to follow the regulations of Hanoi University of Science and Technology **Progress mark (60%):** -Mid-term grade 40% -Homework 10% -Attendance 10% **Final mark (40%):** Multichoice and writing
Media employed	PPT courseware, multimedia computers, projectors, laser pens, blackboards, etc.
Reading list	**Textbooks** W.D. Callister, Jr., "Materials Science and Engineering, An Introduction" Wiley -- 7th Edition **References** Rolf E. Hummel. "Understanding Materials Science. History, Properties, Aplications". Springer. 2nd Edition

MSE3436 Microstructure Determination

Module designation	Basic Core of Engineering
Module level, if applicable	
Code, if applicable	MSE3436
Subtitle, if applicable	
Courses, if applicable	Microstructure Determination
Semester(s) in which the module is taught	7th semester
Person responsible for the module	Assoc. Prof. Dr. Nguyen Hoang Viet
Lecturer	Assoc. Prof. Dr. Nguyen Hoang Viet Assoc. Prof. Dr. Pham Mai Khanh Assoc. Prof. Dr. Nguyen Thi Hoang Oanh
Language	English
Relation to curriculum	• Given a powder specimen of a material with a simple crystal structure, be able to collect, analyze and understand powder diffraction data. • Be able to describe the construction of transmission and reflection optical microscope, the factors that control resolution, and contrast mechanisms. • Be able to calculate intensities of a microscope image of a one-dimensional diffraction grating using bright-field, dark field, and phase contrast apertures. • Be able to use Ewald sphere constructions and calculations of structure factors to predict diffraction conditions and intensities from a three-dimensional crystal. • Be able to calculate estimates of x-ray mass absorption coefficients at x-ray energies. • Be able to calculate estimates of electron extinction lengths in transmission electron microscopy.
Teaching method, contact hours	Target students: Students of school of materials science and engineering Teaching method: theoretical, lab, group discussion, presentation, student work and report, and practical teachings Contact hours: 60 hours Theoretical teaching: 30 hours Lab: 15 hours Practical teaching: 15 hours
Workload (incl. contact hours, self-study hours)	Workload = 120 hours Contact hours = 60 hours Self-study hours = 60 hours

Credit points	3(2-1-1-6)
ECTS	4.67
Requirements according to the examination regulations	Students with no discussion scores or no test scores will receive a process score of less than 3.0/10. If the process score or the final exam score is lower than 3.0/10, students do not complete the course.
Recommended prerequisites	MSE1012
Module objectives/intended learning outcomes	**Module objectives:** • To teach students the science of microscopy and diffraction based on the physical optics of scalar waves and elastic scattering of waves from atoms. • To teach students how the design and performance of simple microscopes and diffractometers is based in the fundamentals of geometrical and physical optics. • To teach students diffraction from simple objects and crystals in one-, two-, and three-dimensions. • To extend students knowledge of the mathematics of complex variables. • To give students hands-on experience in the operation of powder diffractometers for studying the structure of materials • To give students hands-on experience in the use of optical bench components for optical metrology. • To teach students the fundamentals of core-level spectroscopy for microanalysis and surface analysis.
Content	**1. Microscopy** 1.1. Geometrical optics 1.2. Resolution in microscopy 1.3. Contrast in microscopy: bright-field, dark-field and phase contrast **2. Diffraction** 2.1. Crystal structures 2.2. Complex notation for wave amplitudes and phase 2.3. Diffraction from one-dimensional objects and crystals 2.4. Diffraction from two- and three-dimensional crystals 2.5. Reciprocal lattices and Ewald sphere constructions for x-ray and electron diffraction 2.6. Atomic scattering factors for photons, electrons, and neutrons

	2.7. Dynamical effects: index of refraction and extinction **3. Spectroscopy** 3.1. Core-level atomic physics and spectroscopic notation 3.2. Cross-sections for core-level impact ionization and photoemission 3.3. Microprobe analysis and x-ray photoelectron spectroscopy
Study and examination requirements and examination forms	Students are expected to follow the regulations of Hanoi University of Science and Technology **Progress mark (30%):** **-Mid-term test** **Final mark (70%):** -Writing exam
Media employed	PPT courseware, multimedia computers, projectors, laser pens, blackboards, etc.
Reading list	1. B. D. Cullity; *Elements of X-ray diffraction*; Addison-Wesley; 1956 2. C. J. Ball; *An introduction to the theory of diffraction*; Pergamon Press; 1971 3. W. T. Welford; *Optics*; Oxford University Press; 1981

MSE3126 Mechanics for Materials

Module designation	Basic Core and Engineering
Module level, if applicable	
Code, if applicable	MSE3126
Subtitle, if applicable	
Courses, if applicable	Mechanics for Materials
Semester(s) in which the module is taught	4th semester
Person responsible for the module	Assoc. Prof. Le Van Lich
Lecturer	Assoc. Prof. Le Van Lich Dr. Do Thanh Dung
Language	English
Relation to curriculum	To provide students with knowledge about static mechanics including decompose and combine forces, analyze structure under loading and establish free-body diagram, calculate the mechanical equilibrium systems. This course also introduces students some analysis and calculation methods for stress sin member subjectd to different types of loading, also introduces concepts of fluid mechanics,

	principles and basic rquation of hydrostatic, hydrodynamic and continuum mechanics, modelling of mechanics.
Teaching method, contact hours	Target students: Students of school of materials science and engineering Teaching method: theoretical teaching, solving problem, group discussion, presentation, student work and report Contact hours: 45 hours Theoretical teaching: 45 hours
Workload (incl. contact hours, self-study hours)	Workload = 135 hours Contact hours = 45 hours Self-study hours = 90 hours
Credit points	3(3-0-0-6)
ECTS	4.25
Requirements according to the examination regulations	Students with no discussion scores or no test scores will receive a process score of less than 3.0/10. If the process score or the final exam score is lower than 3.0/10, students do not complete the course.
Recommended prerequisites	MSE1012 Introduction to engineering
Module objectives/intended learning outcomes	**Module objectives:** The objectives of this part of the course are to provide intermediate-level analysis and problem-solving methods in engineering and to give the students the basis for more advanced course work (e.g. materials processing) required for an in-depth and comprehensive program in materials science and engineering. After learning this subject, students have ability to construct free-body diagrams of mechanically loaded engineering components. They can apply the principles of statics and strength of materials to find force resultants and internal stresses in elementary mechanical structures. And, they can identify types of fluid flow and apply the principles of hydrostatics and fluid dynamics to solve elementary fluid mechanics problems.
Content	**1. Units and Vectors** (1.5-0.5-0-4 hours) 1.1. Fundamental quantities of mechanics 1.1.1. Basic concepts 1.1.2. Newton's Laws 1.2. Units 1.2.1. The US Customary System of Units 1.2.2. The international system of units 1.2.3. Dimensional considerations 1.3. Vector 1.3.1. Scalar and Vectors 1.3.2. Addition of vectors 1.3.3. Unit vectors

	1.3.4. Base vectors and vector components 1.3.5. Rectangular components 1.3.6. A vector connecting two points 1.3.7. The scalar (dot) product and rectangular component 1.3.8.The cross product 1.3.9. The triple product **2. Forces, moments and couples** (3-1-0-8 hours) 2.1. Forces 2.1.1. Force and Characteristics 2.1.2. Rectangular components of a force in two-dimensional force system 2.1.3. Rectangular components of a force in three-dimensional force system 2.1.4. Adding the concurrent forces by using rectangular components 2.2. Moments 2.2.1. The concept of moment 2.2.2. Principle of moments – Verignon' theorem 2.2.3. Moment of a force about a point 2.2.4. The moment of a force about line 2.3. Couples 2.3.1. Couple and characteristics 2.3.2 Equivalent force-couple system **3. Resultants, distributed forces, free-body diagrams, Equilibrium** (3-1-0-8 hours) 3.1. Resultants of force systems 3.1.1. Coplanar force system 3.1.2. Noncoplanar parallel force system 3.2. Distributed forces 3.2.1. Free-body diagram 3.2.2. The concept of free-body diagram 3.2.3. Modeling the action of forces 3.3. Equilibrium forces 3.3.1. Equilibrium in 2-D 3.3. 2. Equilibrium in 3-D **4. Analysis of stress** (3-1-0-8 hours) 4.1. Analysis of stress under axial loading 4.1.1. Axially loaded members – internal forces

	4.1.2. The normal stress under axial loading 4.1.3. Shearing stress in connections 4.1.4. Bearing stress 4.1.5. Units of stress 4.1.6. Stresses on an inclined plane in an axially loaded member 4.2. Torsional shearing stress 4.2.1. Torsional shearing strain 4.2.2. Torsional shearing stress 4.2.3. Stresses on oblique planes 4.3. Combined stress at a general point 4.3. 1. Stress at a general point in an arbitrarily loaded member 4.3.2. Two-dimensional or plane stress 4.3.3. Stress transformation equations for plane stress 4.3.4. Principal stresses and maximum shearing stress - plane stress 4.3.5. Mohr's circle for plane stress **5. Strain and stress-strain relationship** (3-1-0-8 hours) 5.1. Strain and Stress – strain relationships: Axially loading 5.1.1. Displacement, Deformation, and Strain 5.1.2. Stress-strain relationship 5.1.3. Deformation of axially loaded members 5.1.4. Torsional displacements 5.1.5. Statically Indeterminate Axially Loaded 5.2. Strain and strain-stress relationship: General loading 5.2.1. Two dimension or plane strain 5.2.2. The strain transformation equations for plane strain 5.2.3. Principal strains and maximum shearing strain 5.2.4. Mohr's circle for plane strain **6. Centroids, moments** (1.5-0.5-0-4 hours) 6.1. Centroids 6.1.1. Center of gravity and center of mass 6.1.2. Centroid of volumes, areas and lines 6.1.3. Centroid of composite body 6.2. Second moment of area 6.1.1. Second moment of area 6.2.2. Radius of Gyration 6.3.3. Parallel-axis theorem for second moments of area

	6.4.4. Second moment of composites area **7. Beam stresses and Deflection** (6-2-0-16 hours) 7.1. Beam stresses 7.1.1. Flexural strain and stress 7.1.2. Shear forces and bending moments in beam 7.1.3. Load, shear force and bending moment 7.1.4. Shear stress in beams 7.2. Beam deflection 7.2.1. The differential equation of the elastic curve 7.2.2. Deflections by integration 7.2.3. Deflections by integration 7.2.4. Deflections by integration of shear-force or load equations 7.2.5. Statically indeterminate beams: the integration method 7..3. Singularity functions 7..4. Deflections by superposition 7.4.1. Statically determinate beam 7.4.2. Statically indeterminate beams **8. Strain Energy methods** (1.5-0.5-0-4 hours) 8.1. concept of strain energy 8.1.1. Work 8.1.2. Elastic strain energy 8.1.3. Shearing strain energy 8.1.4. The total strain energy 8.2. Applications of the strain energy method 8.2.1. Strain energy in an axial loading 8.2.2. Strain energy in the truss 8.2.3. The strain energy in beam 8.2.3.1. The strain energy due to the flexural stress 8.2.3.2. The strain energy due to the shear stress **9. Introduction to Fluids Mechanics** (1.5-0.5-0-4 hours) 9.1. Fluids 9.2. Newton's Law of Viscosity 9.3. Fluids vs. Solids 9.4. Newtonian / Non-Newtonian Fluids 9.5. Liquids vs. Gasses 9.6. Causes of Viscosity in Fluids

	10. Properties of fluids (1.5-0.5-0-4 hours) 10.1. Density 10.1.1. Mass density 10.1.2 Specific weight 10.1.3 Specific Gravity 10.2. Viscosity 10.2.1 Coefficient of Dynamic Viscosity 10.2.2 Kinematic Viscosity 10.3. Compressibility of Fluids 10.3.1. Bulk Modulus 10.3.2. Compression and Expansion of Gases 10.4. Vapor pressure 10.5. Surface Tension V.1. Surface tension V.2. Effects of capillary **11. Hydrostatic and pressure measurement** (4-2-0-12 hours) 11.1. Fluid static (Hydrostatic) 11.1.1. Pressure at a point 11.1.2. Basic Equation for Pressure Field 11.1.3. Pressure variation in a fluid at rest 11.1.3.1 Incompressible Fluid 11.1.3.2. Compressible fluid 11.1.4. Standard atmosphere 11.2. Measurement of pressure – Manometer 11.2.1. Barometer 11.2.2. Piezometer Tube 11.2.3. U-tube manometer 11.2.4. Inclined-tube manometer 11.3. Forces on Submerged Surfaces in Static Fluids 11.3.1. Hydrostatic force on a plane surface 11.3.2. Pressure Prism 11.3.3. Hydrostatic force on curved surface **12. Conservation equations** (6-2-0-16 hours) 12.1. Reynolds transport theorem 12.1.1 System and control volume 12.1.2. Extensive and intensive

	12.1.3. Derivation of the Reynolds Transport Theorem 12.2. Conservation of mass 12.2.1. Derivation of the continuity equation 12.2.2. Conservation of mass for fixed, non-deforming control volume 12.3. Momentum Equations 12.4. The Energy Equation 12.4.1. Derivation of the Energy Equation 12.4.2. The application of the energy equation 12.4.3. Energy Equation and Bernoulli equation **13. Dimensionless variables** (3-1-0-8 hours) 13.1. Dimensional Analysis 13.2. Buckingham Pi term Theory 13.3. Determination of pi terms 13.4. Manipulation in Pi groups 13.5. The Common Dimensionless Group in Fluid Mechanics 13.6. Correlation of experimental Data 13.6.1. Problems with one Pi terms 13.6.2. The problem with two or more pi terms **14. Laminar and turbulent flows** (3-1-0-8 hours) 14.1. General Characteristics of Pipe Flow 14.1.1. Laminar or Turbulent flow 14.1.2. Entrance Region and Fully Developed Flow 14.1.3. Pressure and shear stress 14.2. Fully Developed Laminar Flow 14.3. Turbulent Flow. 14.3.1. Transition from Laminar to Turbulent Flow 14.3.2. Turbulent Shear Stress 14.3.3. Turbulent velocity profile 14.4. Effects of pipe geometry 14.4.1. Surface roughness effects 14.4.2. Geometry Effects
Study and examination requirements and examination forms	Students are expected to follow the regulations of Hanoi University of Science and Technology **Progress mark (50%):** -Home exercise grading -Mid-term test

	Final mark (50%): -Multichoice and writing
Media employed	PPT courseware, multimedia computers, projectors, laser pens, blackboards, etc.
Reading list	**Textbooks** [1] Mechanics for materials, This is a mechanics literature for students who are attending the Advanced Program of HUT. This literature is writing base on the outline from University of Illinois. [2] Statics and mechanics of Materials, an integrated approach, William F. Riley et al. [3] Fundamentals of Fluid Mechanics 4th Edition - Munson - John Wiley and Sons **References** 1. George E. Mass, Mechanical continuum, Vietnamese translation version. 2. William F. Riley et al, Statics and mechanics of Materials, an integrated approach. 3. Munson et al, Fundamentals of Fluid Mechanics 4th Edition, John Wiley and Sons 4. Kreith, F.; Berger, S.A.; et. al., Fluid Mechanics - Mechanical Engineering Handbook, Boca Raton: CRC Press LLC, 1999 **5.** Many lecture notes.

MSE3447 Electronic, optical and magnetic properties of materials

Module designation	Basic Core of Engineering
Module level, if applicable	
Code, if applicable	MSE3447
Subtitle, if applicable	
Courses, if applicable	Electronic, optical and magnetic properties of materials
Semester(s) in which the module is taught	5th semester
Person responsible for the module	Assoc. Prof. Dr. Nguyen Thi Hoang Oanh Prof. Dr. Nguyen Phuc Duong
Lecturer	Prof. Dr. Nguyen Phuc Duong Assoc. Prof. Dr. Nguyen Thi Hoang Oanh
Language	English

Relation to curriculum	This course offers a description of how the electronic, optical and magnetic properties of materials originate from their electronic and molecular structure and how these properties can be designed for particular applications, for instance in optical fibers, magnetic data storage, solar cells, transistors and other devices. It also offers experimental exploration of the electronic, optical and magnetic properties of materials, including hands-on experimentation using spectroscopy, resistivity, impedance and magnetometry measurements.
Teaching method, contact hours	Target students: Students of school of materials science and engineering Teaching method: theoretical, solving problem, think pair share, presentation, report and practical teachings Contact hours: 60 hours Theoretical teaching: 30 hours Practical teaching: 30 hours
Workload (incl. contact hours, self-study hours)	Workload = 150 hours Contact hours = 60 hours Self-study hours = 90 hours
Credit points	3(2-2-0-6)
ECTS	4.67
Requirements according to the examination regulations	Students with no discussion scores or no test scores will receive a process score of less than 3.0/10. If the process score or the final exam score is lower than 3.0/10, students do not complete the course.
Recommended prerequisites	MSE1012 Introduction to engineering
Module objectives/intended learning outcomes	Understand the formation of electronic structures (energy levels) in atoms, molecules and solids Understand the connection between the electrical, optical, magnetic properties of materials and their electronic structure Applying knowledge to analyze the principles of operation of electronic components
Content	**Chapter 1. Electronic structure of molecules and solids** 1. An overview of the subject 2. Overview of quantum mechanics (approach from experiments) 3. Overview of quantum mechanics (approach from theory) 4. Quantum systems and measurements: physical quantities and operators 5. Schrödinger equation is time-dependent and time-dependent

	6. Experiment of Schrödinger's equation for microparticles to move on circles and on spheres 7. Angular momentum: The quantumization of space 8. Hydrogen atom: Wave function and energy 9. Bonding in hydrogen molecule H_2 10. Links σ, , $\pi\delta$ 11. Orbital hybridization: graphene structure and diamond structure 12. The formation of energy zones in alkali metals 13. The formation of energy zones in silicon: Energy slots 14. Electronic waves in circular fields 15. Free e-gas: State density 16. Energy zone diagrams **Chapter 2. Electrical properties of materials** 17. The Law of Hugging 18. Drude model 19. Mathiessen and Nordheim laws 20. Metal-metal contact: contact position 21. Seebeck effect and thermoelectric pair **Chapter 3. Semiconductors and components** 22. Fermi-Dirac distribution 23. Load particles in separate semiconductors 24. Doped conductivity control 25. The dependence of conductivity on temperature 26. Schottky transition and hugging contact 27. P-n forward 28. Transitors: BJT, JFET, MOSFET 29. Luminescent diodes 30. Solar cells 31. Electronic single transitor: Coulomb barrier effect **Chapter 4. Dielectric Materials** 32. Ion bonding in solids 33.Electrical polarization and relative electroconalysis 34. Dielectric material for capacitors 35. Piezoelectricity 36. Ferroelectricity 37. Pyroelectricity **Chapter 5. Optical properties of the material**

	38. Electromagnetic waves 39. Photon 40. Interaction between light and matter 41. Refractive 42. Reflexes, absorption and transmission 43. Fiber optics 44. Death material and photonic area diagram 45. Fluorescent LED (luminescence, phosphorescence) and LED white light 46. Quantum dots used as photonic crystals **Chapter 6. Magnetic properties of the material** 47. Spin of electrons and private angle momentum: Magneton Bo 48.From the degree of the material: Magnetic dipole torque, atomic magnetic torque, magnetic field, vector from degree, magnetic touch, sheer adjectiveness and magnetic touch 49. Classification of magnetic materials: Inverse words, adjectives, ferromagnetic iron, antimagnetic, pheri words 50. Domen from: Domen cliffs, nanoparticles from single domen 51. Diversion from crystals and late verandas from in iron materials from 52. Hard and soft magnetic materials
Study and examination requirements and examination forms	Students are expected to follow the regulations of Hanoi University of Science and Technology **Progress mark (20%):** - Reports **Final mark (80%):** - Writing exam
Media employed	PPT courseware, multimedia computers, projectors, laser pens, blackboards, etc.
Reading list	**Textbooks** D. G. Pettifor, *Bonding and Structure of Molecules and Solids*. Clarendon Press. 1995 S. O. Kasap, *Principles of Electronic Materials and Devices*. 3rd Edition. McGraw-Hill Education. 2005 Kittel, Charles. *Introduction to Solid State Physics*. 8th ed. Wiley, 2004. ISBN: 9780471415268. O'Handley, Robert C. *Modern Magnetic Materials: Principles and Applications*. Wiley-Interscience, 1999. ISBN: 9780471155669. Saleh, BahTeaching method E. A., and Malvin Carl Teich. *Fundamentals of Photonics*. 2nd ed. Wiley-Interscience, 2007. ISBN: 9780471358329. **References** Ashcroft, Neil W., and N. David Mermin. *Solid State Physics*. Cengage Learning, 1976. ISBN: 9780030839931.

	Griffiths, David J. *Introduction to Quantum Mechanics*. 2nd ed. Pearson Prentice Hall, 2004. ISBN: 9780131118928. Hagelstein, Peter L., Stephen D. Senturia, and Terry P. Orlando. *Introductory Applied Quantum and Statistical Mechanics*. Wiley-Interscience, 2004. ISBN: 9780471202769. B. D. Cullity, C. D. Graham, *Introduction to Magnetic Materials*. 2nd Edition. 2009 Pierret, Robert F. *Semiconductor Fundamentals: Volume I*. 2nd ed. Prentice Hall, 1988. ISBN: 9780201122954.

MSE4405 Materials Design

Module designation	Basic Core of Engineering
Module level, if applicable	
Code, if applicable	MSE4405
Subtitle, if applicable	
Courses, if applicable	Material Design
Semester(s) in which the module is taught	5th semester
Person responsible for the module	Assoc. Prof. Dao Hong Bach Dr. Nguyen Minh Thuyet
Lecturer	Assoc. Prof. Dao Hong Bach Dr. Nguyen Minh Thuyet
Language	English
Relation to curriculum	Students are able to predict the microstructure changes and therefore the fracture and fatigue of parts. Students are also able to know how to select the suitable materials for specific loading condition with best performance.
Teaching method, contact hours	Target students: Students of school of materials science and engineering Teaching method: theoretical teaching, presentation, group discussion, teamwork, student report Contact hours: 30 hours Theoretical teaching: 30 hours
Workload (incl. contact hours, self-study hours)	Workload = 90 hours Contact hours = 30 hours Self-study hours = 60 hours
Credit points	2(2-0-0-4)
ECTS	2.84
Requirements according to the examination regulations	Students with no discussion scores or no test scores will receive a process score of less than 3.0/10.

	If the process score or the final exam score is lower than 3.0/10, students do not complete the course.
Recommended prerequisites	MSE1012 Introduction to engineering
Module objectives/intended learning outcomes	The goals of this of the course is to provide students able to design engineering devices or solve to problems of materials-based solutions wich are originatied from student, faculty, and industrial suggestionsm
Content	Student can choose one of the following topics for their work: 1. Design of various engineering devices 2. Design of various engineering objects 3. Design of various engineering system 4. Materials-based solutions to industrial problems
Study and examination requirements and examination forms	Students are expected to follow the regulations of Hanoi University of Science and Technology **Progress mark (50%):** -Presentation **Final mark (50%):** -Report
Media employed	PPT courseware, multimedia computers, projectors, laser pens, blackboards, etc.
Reading list	**Textbooks** none **References** none

MSE3206 Phase and Phase Relations

Module designation	Basic Core and Engineering
Module level, if applicable	
Code, if applicable	MSE3206
Subtitle, if applicable	
Courses, if applicable	Phase and Phase Relations
Semester(s) in which the module is taught	5th semester
Person responsible for the module	Dr. Nguyen Anh Son Dr. Nguyen Thi Van Thanh
Lecturer	Dr. Nguyen Anh Son

	Dr. Nguyen Thi Van Thanh
Language	English
Relation to curriculum	Introduce to students phase and structure recognition of different materials, time-temperature-transformation diagrams and the role of understanding diagram in engineering materials.
Teaching method, contact hours	Target students: Students of school of materials science and engineering Teaching method: theoretical and practical teachings, solving problem, group discussion, teamwork Contact hours: 60 hours Theoretical teaching: 45 hours Practical teaching: 15 hours
Workload (incl. contact hours, self-study hours)	Workload = 150 hours Contact hours = 60 hours Self-study hours = 90 hours
Credit points	3(3-1-0-6)
ECTS	4.67
Requirements according to the examination regulations	Students with no discussion scores or no test scores will receive a process score of less than 3.0/10. If the process score or the final exam score is lower than 3.0/10, students do not complete the course.
Recommended prerequisites	MSE1012 Introduction to engineering
Module objectives/intended learning outcomes	**Module objectives:** Objectives: 1. The meaning of phases, and the different types of phase transformations. 2. How to interpret a binary phase diagram, especially the compositions and fractions of equilibrium phases according to the lever rule. 3. The crystal structures for common metals, ceramics, and semiconductors, including construction from a lattice plus basis, construction from hard sphere packing, and interstitial positions. 4. Thermodynamic driving forces and kinetic limitations in phase transformations. 5. The meaning and use of time-temperature-transformation diagrams. 6. The microstructures resulting from near-equilibrium vs. far-from-equilibrium thermal treatments. 7. The mechanical properties of metals, ceramics, and polymers as a function of microstructure, as determined by processing. Course Outcomes: 1. Which material properties vary significantly with microstructure? 2. Given a binary phase diagram, what microstructures can be obtained by suitable thermal treatments? Give examples for near-equilibrium and far-from-

	equilibrium processing. 3. What are the crystal structures of the common metals and ceramics? 4. What crystalline structures and transformations are involved in the formation of martensites? Of age-hardened alloys? 5. What are the driving forces and kinetic barriers to phase transformations? 6. What are the governing equations for creep? For brittle fracture? 7. How does the modulus of a polymer vary as a function of temperature, loading rate, and cross-linking? 8. How are the mechanical properties of a composite material related to the properties and arrangement of the component materials?
Content	**1. Phases and phase relations** 1.1. Definition of phase (Phenomen of phase, Compositions of the phases, Gibbs rule) 1.2. Phase diagrams (four kinds of diagrams) 1.3. Relations of phases (eutectic, eutectoid, peritectic, peritectoid, and phase reactions, segregations, eutectic structure, dendrites,...) **2. Crystal structures** 2.1 Main concepts (unit cell, crystall systems, crystallographic directions and planes,..) 2.2 Crystal structures of metal, ceramic and polymer **3. Kinetics of phase transformations** 3.1. The driving force for structural change 3.2. Diffusive transformations 3.3. Nucleation 3.4. Displacive transformations 3.5. Case studies in phase transformations **4. Microstructures** 4.1. Metal structures 4.2. Structure of glasses 4.3. The structure of polymers **5. Metals** 5.1. Carbon steels 5.2. Alloy steels 5.3. The light alloys 5.4. Production, forming and joining of metals 5.5. Case studies in steels

	6. Ceramics and glasses 6.1. Ceramic and glasses 6.2. The mechanical properties of ceramics 6.3. The statistics of brittle fracture and case study 6.4. Production, forming and joining of ceramics 6.5. Cement and concrets **7. Polymers and composites** 7.1. Polymer 7.2. Mechanical behaviour of polymers 7.3. Production, forming and joining of polymers 7.4. Composites: fibrous, particulate and foamed 7.5. Nature's composite: wood **Lab works** Incorporated in MSE3316 and MSE3326
Study and examination requirements and examination forms	Students are expected to follow the regulations of Hanoi University of Science and Technology **Progress mark (40%):** **-Home exercise grading** **-Project** **-Lab work and reports** **-Mid-term test** **Final mark (60%):** -Multichoice and writing
Media employed	PPT courseware, multimedia computers, projectors, laser pens, blackboards, etc.
Reading list	**Textbooks** M. F. Ashby and D. R. H. Jones, Engineering Materials 2: An Introduction to Microstructures, Processing, and Design, Butterworth Heinemann (1998). **References** 1. M. F. Ashby and D. R. H. Jones. Engineering Materials 2: An Introduction to Microstructures, Processing, and Design, Butterworth Heinemann (1998). 2. William F. Smith. Foundations of Materials Science and Engineering, (McGraw-Hill, 1993). 3. R.A. Flinn and P.K. Torjan. Engineering Materials and Their Applications. (Wiley, 1995).

MSE3317 Materials Laboratory I

Module designation	Basic Core of Engineering
Module level, if applicable	
Code, if applicable	MSE3317
Subtitle, if applicable	
Courses, if applicable	Material Laboratory I
Semester(s) in which the module is taught	4th semester
Person responsible for the module	Dr. Nguyen Hong Hai
Lecturer	Dr. Hoang Thi Ngoc Quyen Assoc. Prof. Dr. Pham Quang Assoc. Prof. Dr. Trinh Van Trung Dr. Tran Van Dang Dr. Nguyen Hong Hai
Language	English
Relation to curriculum	This course is all about experiment and training practice skill after learning the basic concept in others course for deeply-understand student's major
Teaching method, contact hours	Target students: Students of school of materials science and engineering Teaching method: Lab works, theoretical teaching, technical practice Contact hours: 60 hours Lab: 60 hours
Workload (incl. contact hours, self-study hours)	Workload = 120 hours Contact hours = 60 hours Self-study hours = 60 hours
Credit points	2(2-0-0-4)
ECTS	2.84
Requirements according to the examination regulations	Students with no discussion scores or no test scores will receive a process score of less than 3.0/10. If the process score or the final exam score is lower than 3.0/10, students do not complete the course.
Recommended prerequisites	Students must has general knowledge of Phisics, Chemistry, Thermal Engineering, Mathematics, Materials Science and Engineering. The Phases and Phase relations, Mechanic for MatSE and Thermodynamics of Materials is must be understood too.
Module objectives/intended learning outcomes	The objectives of this course are help students know about the Materials Science and Engineering more deeply. This is also provide the practice skills at the mechanical and electriccal properties testing for materials, diffusion in solids and

	order-disorder transition with the computer simulation processes, scanning electron microscopy (SEM).
Content	**1. Orientation and Sefety** 1.1. Introduction 1.2. Experiments Procedure 1.2.1. Course Orientation 1.2.2. Sefety 1.2.3. Orientation of Departmental 1.3. Report **2. Introduction to Basic Laboratory Instruments** 2.1. Introduction 2.2. Experimental Procedure 2.2.1. Electrical Measurements 2.2.2. Weight Measurements 2.2.3. Dimensional Measurements 2.3. Report **3. Matallography using Optical Microscopy** 3.1. Introduction 3.2. Experimental Procedure 3.2.1. Sample Preparation 3.2.2. Optical Microscopy and Photography 3.3. Report **4. Data Acquisition and Analysis** 4.1. Introduction 4.2. Experimental Procedure 4.2.1. Equipment and Materials 4.2.2. Measuring Current – Voltage (I – V) Behavior 4.2.3. Thermocouples 4.2.4. Heat Diffusion 4.2.5. Triggering the Computer 4.2.6. Quenching 4.3. Report **5. Scanning Calorimetry and Determination of the Bi – Sn Phase Diagram using Cooling Curve Technique** 5.1. Introduction 5.2. Equipment and Materials 5.2.1. Scanning Calorimetry

	5.2.2. Cooling Curves 5.3. Experimental Procedure 5.3.1. Scanning Calorimetry 5.3.2. Cooling Curves 5.4. Report **6. Thermomechanical Analysis (TMA)** 6.1. Introduction 6.2. Experimental Procedure 6.2.1. Equipment and Materials 6.2.2. Settings 6.2.3. Procedure 6.3. Report **7. Thermogravimetric Analysis (TGA)** 7.1. Introduction 7.2. Equipment and Materials 7.3. Experimental Procedure 7.3.1. Decomposition of Calcium Oxalate Monohydrate ($CaC_2O_4.H_2O$) 7.3.2. Binder Burn – out (ZnO + PEG) 7.4. Report **8. Differential Scanning Calorimetry (DSC)** 8.1. Introduction 8.2. Equipment and Materials 8.3. Experimental Procedure 8.3.1. Sample Preparation 8.3.2. DSC – 7 Operation 8.4. Report **9. Fourier Trasform Infrared Spectroscopy (FTIR)** 9.1. Introduction 9.2. Experimental Procedure 9.2.1. Equipment and Materials 9.2.2. Introduction to FTIR 9.3. Report 9.3.1. Introduction 9.3.2. Experimental Procedure 9.3.3. Results and Discussion

	10. Scanning Electron Microscopy (SEM) 10.1. Introduction 10.2. Experimental Procedure 10.2.1. Equipment and Materials 10.2.2. Sample Preparation 10.2.3. Imaging of Microstructures with SEM 10.3. Lab Reports 10.3.1. Introduction 10.3.2. Experimental Procedure 10.3.3. Results and Discussion
Study and examination requirements and examination forms	Students are expected to follow the regulations of Hanoi University of Science and Technology **Progress mark (80%):** -Home exercise grading -Lab work and reports **Final mark (20%):** -Oral test
Media employed	PPT courseware, multimedia computers, projectors, laser pens, blackboards, etc.
Reading list	**Textbooks** 1. Laboratory Manual, Fall – 2003, Department of Materials Science and Engineering, University of Illinois at Urbana Champaign, Urbana IL 61801 **References** 1. Laboratory Manual, Fall – 2003, Department of Materials Science and Engineering, University of Illinois at Urbana Champaign, Urbana IL 61801

MSE3326 Materials Laboratory II

Module designation	Basic Core and Engineering
Module level, if applicable	
Code, if applicable	MSE3326
Subtitle, if applicable	
Courses, if applicable	Materials Laboratory II
Semester(s) in which the module is taught	7th semester
Person responsible for the module	Dr. Nguyen Anh Son

Lecturer	Assoc. Prof. Dr. Pham Quang Dr. Le Thi Bang Dr. Nguyen Anh Son Dr. Do Thanh Dung Dr. Nguyen Hoai Anh MSc. Nguyen Van Duc Dr. Le Hong Thang Assoc. Prof. Dr. Nguyen Thi Hoang Oanh
Language	English
Relation to curriculum	This course is all about experiment and training practice skill after learning the basic concept in others course for deeply-understand student's major
Teaching method, contact hours	Target students: Students of school of materials science and engineering Teaching method: Lab works, theoretical teaching, teachnical practice Contact hours: 60 hours Lab: 60 hours
Workload (incl. contact hours, self-study hours)	Workload = 120 hours Contact hours = 60 hours Self-study hours = 60 hours
Credit points	2(0-0-4-4)
ECTS	3.67
Requirements according to the examination regulations	Students with no discussion scores or no test scores will receive a process score of less than 3.0/10. If the process score or the final exam score is lower than 3.0/10, students do not complete the course.
Recommended prerequisites	Students must has general knowledge of Phisics, Chemistry, Thermal Engineering, Mathematics, Materials Science and Engineering. The Phases and Phase relations, Mechanic for MatSE, Thermodynamics of Materials, Microstructure Characterization and Kinetec Processes in Materials is must be understood too.
Module objectives/intended learning outcomes	The objectives of this course are help students know about the Materials Science and Engineering more deeply. This is also provided the practice skills at the mechanical and electriccal properties testing for materials, diffusion in solids and order-disorder transition with the computer simulation processes, scanning electron microscopy (SEM).
Content	**1. Tensile Stress – Strain Relations** 1.1. Introduction 1.2. Stress and Strain Relations 1.3. Experiments **2. Impact and Fracture Toughness Testing**

	2.1. Introduction 2.2. Toughness Measurement 2.3. Experiments 2.4. Lab Reports **3. Scanning Electron Microscopy (SEM)** 3.1. Introduction 3.2. Experimental Procedure 3.3. Lab Reports **4. Order – Disoder Transition I: Experiment (Cu_3Au)** 4.1. Introduction 4.2. Measurements 4.3. Experimental 4.4. Laboratory Procedure 4.5. Lab Reports **5. Order – Disoder Transition II: Computer Simulation** 5.1. Introduction 5.2. Probability Exercise 5.3. Chemical Ordering and Disordering **6. Diffusion in Solids I: Decarburization of High Carbon Steel** 6.1. Introduction 6.2. Experimental Procedure 6.3. Analysis of Data 6.4. Lab Reports **7. Diffusion in Solids II: Computer Simulation** 7.1. Introduction 7.2. Diffusion Simulation I: Random Walk 7.3. Diffusion Simulation I: Degassing/Desorption **8. Fourier Trasform Infrared Spectroscopy (FTIR)** **9. Sintering** 9.1. Introduction 9.2. Procedure 9.3. Report **10. Electrical Properties of Materials** 10.1. Matals and Semiconductors 10.2. Insulators

Study and examination requirements and examination forms	Students are expected to follow the regulations of Hanoi University of Science and Technology **Progress mark (80%):** -Home exercise grading -Lab work and reports **Final mark (20%):** -Oral test
Media employed	PPT courseware, multimedia computers, projectors, laser pens, blackboards, etc.
Reading list	**Textbooks** Laboratory Manual, Spring – 2006, Department of Materials Science and Engineering, University of Illinois at Urbana Champaign, Urbana IL 61801 **References** 1. Laboratory Manual, Spring – 2006, Department of Materials Science and Engineering, University of Illinois at Urbana Champaign, Urbana IL 61801

MSE3406 Thermodynamics of Materials

Module designation	Basic Core of Engineering
Module level, if applicable	
Code, if applicable	MSE3406
Subtitle, if applicable	
Courses, if applicable	Thermodynamics of Materials
Semester(s) in which the module is taught	4th semester
Person responsible for the module	Assoc. Prof. Tran Thi Thu Hien
Lecturer	Assoc. Prof. Tran Thi Thu Hien Assoc. Prof. Tran Vu Diem Ngoc
Language	English
Relation to curriculum	The course will introduce to students about the cocncept of thermodynamics, the basic principles of classical thermodynamics and application of basics principles of thermodynamics in chemical production, refining, metal and alloy processing, heat treatment and surface treatment. In the field of materials engineering in general, special engineering metal materials.
Teaching method, contact hours	Target students: Students of school of materials science and engineering Teaching method: theoretical teaching, solving problem, group discussion, teamwork

	Contact hours: 45 hours Theoretical teaching: 45 hours
Workload (incl. contact hours, self-study hours)	Workload = 135 hours Contact hours = 45 hours Self-study hours = 90 hours
Credit points	3(3-0-0-6)
ECTS	4.25
Requirements according to the examination regulations	Students with no discussion scores or no test scores will receive a process score of less than 3.0/10. If the process score or the final exam score is lower than 3.0/10, students do not complete the course.
Recommended prerequisites	Prior courses: CH1026, PH1026, MI1026
Module objectives/intended learning outcomes	**Module objectives:** The purpose of this course is to introduce the application of thermodynamics to a variety of materials problems. You will learn the laws of thermodynamics and fundamental thermodynamic principles and concepts. These principles will be applied to understand phase equilibrium in a broad range of systems, ranging from one-component systems to mixtures, oxidation reactions and electrochemical system. The statistical interpretation of thermodynamics will be discussed at an introductory level. This course aims to provide a basis for a variety of subsequent course in Materials Science and Engineering.
Content	**1. Introduction** 1.1.The Power and Breadth of Thermodynamics 1.2 The Generic Question Addressed by Thermodynamics 1.3. Thermodynamics is Limited to Systems in Equilibrium 1.4. The Thermodynamic Basis for Equilibrium Maps 1.5. Three Levels of the Thermodynamic Apparatus **2. The Structure of Themodynamic** 2.1. A Classification of Thermodynamic Systems. 2.2. Classification of Thermodynamic Variables 2.3. Classification of Relationships 2.4. Criterion for Equilibrium 2.5 Summary of Chapter 2. **3. The Laws of Themodynamics** 3.1. The First Law of Thermodynamics 3.2. The Second Law of Thermodynamics 3.3. Intuitive Meaning of Entropy Production

	3.4. Relation Between Entropy Transfer and Heat 3.5. Combined Statement of the First and Second Laws 3.6. The Third Law of Thermodynamics 3.7. Summary of Chapter 3. **4. Themodynamic Variables and Relations** 4.1. Classification of Thermodynamic Relationships 4.2. General Strategy for Deriving Thermodynamic Relations 4.3. Summary of Chapter 4 **5. Equilibrium In Themodynamics Systems** 5.1. Intuitive Notions of Equilibrium 5.2. Thermodynamic Formulation of a General Criterion for Equilibrium 5.3. Mathematical Formulation of the General Conditions for Equilibrium 5.4. Application of the General Strategy for Finding Thermodynamic Equilibrium: The Unary Two Phase System. 5.5. Alternate Formulations of the Criterion for Equilibrium 5.6. Summary of Chapter 5. **6. Statistical Themodynamics** 6.1. Microstates, Macrostates and Entropy 6.2. Conditions for Equilibrium in Statistical Thermodynamics 6.3. Applications of the Algorithm. 6.4. Alternate Statistical Formulations. 6.5. Summary of Chapter 6. **7. Unary Heterogeneous Systems** 7.1. Structure of Unary Phase Diagrams in (P,T) Space 7.2. The Clausius-Clapeyron Equation 7.3. Integration of the Clausius-Clapeyron Equation 7.4. Triple Points 7.5. Computer Calculations of (P,T) Unary Phase Diagrams 7.6. Alternate Representations of Unary Phase Diagrams 7.7. Summary of Chapter 7 **8. Multicomponent, Homogenneous Non-Reacting Systems: Solution** 8.1. Partial Molal Properties 8.2. Evaluation of Partial Molal Properties 8.3. Relationships Among Partial Molal Properties 8.4. Chemical Potential in Multicomponent Systems 8.5. Fugacities, Activities and Activity Coefficients

	8.6. The Behavior of Dilute Solutions 8.7. Solution Models 8.8. Summary of Chapter 8 **9. Multicomponent, Heterogeneous Systems** . The Description of Multiphase, Multicomponent, Nonreacting Systems 9.2. Conditions for Equilibrium 9.3. The Gibbs Phase Rule 9.4. The Structure of Phase Diagrams 9.5. The Interpretation of Phase Diagrams 9.6. Applications of Phase Diagrams in Materials Science 9.7. Summary of Chapter 9 **10. Themodynamics of Phase Diagrams** 10.1. Free Energy - Composition (G-X) Diagrams. 10.2. Thermodynamic Models for Binary Phase Diagrams 10.3. Thermodynamic Models for Three Component Systems 10.4. Calculation of Phase Diagrams in Potential Space. 10.5. Computer Calculations of Phase Diagrams 10.6. Summary of Chapter 10 **11. Multicomponent, Multiphase Reacting Systems** 11.1. Reactions in the Gas Phase 11.2. Reactions in Multiphase Systems 11.3. Patterns of Behavior in Common Reacting Systems 11.4. Predominance Diagrams and Multivariant Equilibria 11.5. Compounds as Components in Phase Diagrams 11.6. Summary of Chapter 11 **12. Capilarity Effects Themodynamics** 12.1. The Geometry of Surfaces 12.2. Surface Excess Properties 12.3. Conditions for Equilibrium in Systems with Curved Interfaces 12.4. Surface Tension: the Mechanical Analogue of Surface Free Energy 12.5. Capillarity Effects on Phase Diagrams 12.6. The Equilibrium Shape of Crystals: the Gibbs-Wulff Construction 12.7. Equilibrium at Triple Lines.

	12.8. Adsorption at Surfaces 12.9. Summary of Chapter 12 **13. Defects in Crystals** 13.1. Point Defects in Elemental Crystals 13.2. Point Defects in Stoichiometric Compound Crystals 13.3. Nonstoichiometric Compound Crystals 13.4. Impurities in Nonstoichiometric Compounds 13.5. Summary of Chapter 13. **14. Equilibrum In Continuous Systems**: **Themodynamic Effects of External Fields** 14.1. Thermodynamic Densities and the Description of Nonuniform Systems 14.2. Conditions for Equilibrium in the Absence of External Fields 14.3. Conditions for Equilibrium in the Presence of External Fields 14.4. The Gradient Energy in Nonuniform Systems. 14.5. Summary of Chapter 14. **15. Electrochemistry** 15.1. Equilibrium Within an Electrolyte Solution 15.2. Equilibrium In Two Phase Systems Involving an Electrolyte 15.3. Equilibrium in an Electrochemical Cell 15.4. Pourbaix Diagrams 15.5. Summary of Chapter 15.
Study and examination requirements and examination forms	Students are expected to follow the regulations of Hanoi University of Science and Technology **Progress mark (30%):** -Homework 10% -First Mid-term grade 20% **Final mark (70%):** -Writing test
Media employed	PPT courseware, multimedia computers, projectors, laser pens, blackboards, etc.
Reading list	**Textbooks** Thermodynamics in Materials Science by Robert T. DeHoff **References** None

MSE3416 Kinetic Processes in Materials

Module designation	Basic Core and Engineering
Module level, if applicable	
Code, if applicable	MSE3416
Subtitle, if applicable	
Courses, if applicable	Kinetic Processes in Materials
Semester(s) in which the module is taught	7th semester
Person responsible for the module	Prof. Dr. Nguyen Hong Hai
Lecturer	Prof. Dr. Nguyen Hong Hai Assoc. Prof. Dr. Tran Duc Huy
Language	English
Relation to curriculum	Introduction the rules of simple and complex reactions. Kinetic of heterogeneous and heterogeneous reactions.. Kinetics of phases interaction (Solid-solid, solid-gas, solid-liquid, liquid-gas. Diffusion kinetics (diffusion in crystalline, non-crystalline, crystals defects).
Teaching method, contact hours	Target students: Students of school of materials science and engineering Teaching method: theoretical teaching, group discussion, presentation, student work and report Contact hours: 45 hours Theoretical teaching: 45 hours
Workload (incl. contact hours, self-study hours)	Workload = 135 hours Contact hours = 45 hours Self-study hours = 90 hours
Credit points	3(3-0-0-6)
ECTS	4.25
Requirements according to the examination regulations	Students with no discussion scores or no test scores will receive a process score of less than 3.0/10. If the process score or the final exam score is lower than 3.0/10, students do not complete the course.
Recommended prerequisites	Prerequisite(s): MSE3206
Module objectives/intended learning outcomes	• **Objective** 1. To provide a foundation for the principles of kinetic behavior 2. To provide a firm understanding of diffusion in various materials 3. To provide a working knowledge of chemical rate theory

	4. To provide an introduction to thin film growth 5. To provide a firm understanding of phase transformations • **Outcomes** 1. Determine characteristic times for various kinetic processes 2. Formulate and solve rate equations for various reactions 3. Understand and apply basics of alloy processing to fabricate alloys with particularly microstructures 4. Apply basic theory to growth of thin films
Content	**1 Diffusion phenomenology** 1.1. Fick's Laws 1.2. Boundary value problems **2. Atomic theory of diffusion** 2.1. Atomic Mechanisms of diffusion 2.2. Interstitial diffusion 2.2.1. Interstitial diffusion as a random jump process 2.2.2. Effect of tempwrature-thermal activation 2.2.3. Steady-state diffusion 2.2.4. Nonsteady-state diffusion 2.2.5. Solutions to the diffusion equation 2.3. Substitutional diffusion 2.3.1. Self-diffusion 2.3.2. Vacancy diffusion 2.3.3. Diffusion in substitutional alloys 2.3.4. Diffusion in dilute substitutional alloys 2.4. Atomic mobility 2.5. Tracer diffusion in binary alloys 2.6. Diffusion in ternary alloys 2.7. High-diffusivity paths 2.7.1. Diffusion along grain boundaries and free surface 2.7.2. Diffusion along dislocation 2.8. Diffusion in multiphase binary systems **3. Chemical rate theory** 3.1. Rate equations

	3.2. Defect annealing theory 3.3. Vapor condensation **4. Surfaces and Interfaces** 4.1. Interface free energy 4.2. Solid/vapour interface 4.3. Boundaries in single-phase solids 4.3.1. Low-angle and high-angle boundaries 4.3.2. Special high-angle grain boundaries 4.3.3. Equilibrum in polycrystalline materials 4.3.4. Thermally activated migration of grain boundaries 4.3.5. The kinetics of grain growth 4.4. Interphase interfaces in solids 4.4.1. Interface coherence 4.4.2. Second-phase shape: interfacial energy effects 4.4.3. Second-phase shape: misfit strain effects 4.4.5. Coherency loss 4.4.6. Glissile interfaces 4.4.6. Solid/liquid interfaces 4.5. Diffusion-controlled and Interface-controlled growth **5. Phase transformations** 5.1. Homo- and hetero-geneous nucleation 5.1.1. Homogeneous Nucleation 5.1.2. Heterogenous Nucleation 5.2. Alloy Solidification 5.2.1. Solidification of single-phase alloy 5.2.2. Eutectic solidification 5.2.3. Off-eutectic alloys 5.2.4. Peritectic solidification 5.2.5. Case studies 5.3. Diffusional transformations 5.3.1. Precipitate growth 5.3.2. Overall Transformation kinetics – TTT Diagram

	5.3.3. Precipitation in age-hardening alloys 5.3.4. The precipitation of ferrite from austenite 5.3.5. Cellular precipitation 5.3.6. Eutectoid transformation 5.3.7. Massive transformation 5.3.8. Ordering transformation 5.3.9. Case studies 5.4. Martensitic transformations 5.4.1. Martensite Crystallography 5.4.2 Theory of martensite nucleation 5.4.3. Martensite growth
Study and examination requirements and examination forms	Students are expected to follow the regulations of Hanoi University of Science and Technology **Progress mark (30%):** -Homework problems 10% -Midterm exam (writing) 20% **Final mark (70%):** -Final exam (Multichoice and writing)
Media employed	PPT courseware, multimedia computers, projectors, laser pens, blackboards, etc.
Reading list	**Textbooks** Phase Transformations in Metals and Alloys. D.A. Porter and K.E. Easterling, Chapman and Hall, 2nd edition, 1992. **References** 1. Diffusion in Solids, P.G Shewmon, McGraw Hill, New York, 1963 2. Balluffi, R. W., S. M. Allen, and W. C. Carter. *Kinetics of Materials*. New York, NY: John Wiley & Sons, 2005. ISBN: 0471246891 3. Poirier, D. R., and G. H. Geiger. *Transport Phenomena in Materials Processing*. Warrendale, PA: Minerals, Metals & Materials Society, 1994. ISBN: 0873392728 4. Christian, J. W. "Irreversible Thermodynamics." In *Theory of Transformations in Metals and Alloys, Part 1: Equilibrium and General Kinetic Theory*. Kidlington, UK: Pergamon Press, 1975. ISBN: 0080180310. 5. Allen, S. M., and E. L. Thomas. "Point Imperfections in Ionic Crystals." Section 5.1.6 in *The Structure of Materials*. 1999. ISBN: 0471000825.

MSE4407 Smart Materials

Module designation	Basic Core of Engineering
Module level, if applicable	
Code, if applicable	MSE4407
Subtitle, if applicable	
Courses, if applicable	Smart Materials
Semester(s) in which the module is taught	5th semester
Person responsible for the module	Assoc. Prof. Pham Mai Khanh
Lecturer	Assoc. Prof. Pham Mai Khanh Dr. Bui Duc Long Assoc. Prof. Le Van Lich Assoc. Prof. Tran Vu Diem Ngoc
Language	English
Relation to curriculum	Introduction of smart materials based on alloys, polymers, ceramics and composites. Principles, mechanisms, synthesis and properties of shape-memory materials, piezoelectric materials, thermoelectric materials, materials with special thermal, electrical, optical and magnetic properties, smart gels, self-healing materials, MEMs,.. The effect of composition, heat treatment and other factors on structure and properties of smart materials. Applied in biomedical and engineering: dental, orthopedic, surgical, aerospace, automotive, robotic, sensors, energy, etc.
Teaching method, contact hours	Target students: Students of school of materials science and engineering Teaching method: theoretical teaching, group discussion, student report Contact hours: 30 hours Theoretical teaching: 30 hours
Workload (incl. contact hours, self-study hours)	Workload = 120 hours Contact hours = 30 hours Self-study hours = 60 hours
Credit points	2(2-0-0-4)
ECTS	2.84
Requirements according to the examination regulations	Students with no discussion scores or no test scores will receive a process score of less than 3.0/10. If the process score or the final exam score is lower than 3.0/10, students do not complete the course.
Recommended prerequisites	After the course, students will know the properties, structures as well as applications of smart materials. At the same time acquire the basis and foundation to be able to study smart materials later.

Module objectives/intended learning outcomes	**Module objectives:** At the completion of this unit, you should be able to: 1. Design and construct simple functional structures using smart materials 2. Describe and characterise mechanical behaviour of smart materials 3. Characterise interaction between smart materials and simple structures in actuation and sensing 4. Describe and characterise novel functions of smart materials using structure-property relationships 5. Present and demonstrate the functions of smart structures.
Content	1. About Smart Materials 1. General introduction 2. Classification and application of smart materials 3. Some typical types of smart materials 4. Image memory material 2. Piezoelectric Material 1. Introduce 2. Theoretical basis 3. Make 4. Application 3. Electric Iron Material 1. Introduce 2. Theoretical basis 3. Make 4. Electric Iron Material (next) 4. Sensor material 1. Introduce 2. Theoretical basis 3. Make 4. Application 5. Self-healing material 1. General introduction 2. Ceramic System Self-Healing Material 3. Metal System Self-Healing Material 5.3.1. Al system self-healing material 5.3.2. Fe system self-healing material Course summary
Study and examination requirements and examination forms	Students are expected to follow the regulations of Hanoi University of Science and Technology **Progress mark (40%):** -Mid-term exam (writing/multiplechoice) **Final mark (60%):** - Final exam (writing/ multiplechoice)
Media employed	PPT courseware, multimedia computers, projectors, laser pens, blackboards, etc.
Reading list	**Textbooks**

	-Introduction, Classification and Applications of Smart Materials: An Overview, Susmita Kamila, 2013. -Fundamentals of Smart Materials **References** Designing with Active Materials: An Impedance Based Approach", Fairweather, 1998.

MSE3446 Thermal and Mechanical behavior of Material

Module designation	Basic Core of Engineering
Module level, if applicable	
Code, if applicable	MSE3446
Subtitle, if applicable	
Courses, if applicable	Thermal and Mechanical behavior of Material
Semester(s) in which the module is taught	6th semester
Person responsible for the module	Assoc. Prof. Le Thai Hung Dr. Dang Thi Hong Hue
Lecturer	Assoc. Prof. Dinh Van Hai Assoc. Prof. Le Thai Hung Dr. Dang Thi Hong Hue
Language	English
Relation to curriculum	To give the students a fundamental understanding of the thermal behavior and mechanical behavior of materials and to permit processing- stucture- property correlations to be drawn in sbsequent senior year and graduate courses.
Teaching method, contact hours	Target students: Students of school of materials science and engineering Teaching method: theoretical, lab, solving problem, presentation, student work and practical teachings Contact hours: 60 hours Theoretical teaching: 30 hours Lab: 15 hours Practical teaching: 15 hours
Workload (incl. contact hours, self-study hours)	Workload = 150 hours Contact hours = 60 hours Self-study hours = 90 hours
Credit points	3(2-1-1-6)
ECTS	4.67

Requirements according to the examination regulations	Students with no discussion scores or no test scores will receive a process score of less than 3.0/10. If the process score or the final exam score is lower than 3.0/10, students do not complete the course.
Recommended prerequisites	MI1936, MSE3126
Module objectives/intended learning outcomes	To give the students a fundamental understanding of the thermal behavior (e.g., thermal stresses) and mechanical behavior (e.g., stress-strain, fatigue and fracture) of materials, and to permit processing-structure-property correlations to be drawn in subsequent senior year and/or graduate courses. While atomistics of thermal behavior are discussed elsewhere, this course is concerned with the effects on properties and giving a general knowledge of the mechanical properties of materials.
Content	**1. Material Response to Stress** (1h) 1.1. Definition of stress and strain 1.2. Linear elastic behavior 1.3. Non-linear elastic behavior 1.4. Anelastic behavior 1.5. Plastic behavior 1.6. Fracture **2. Linear Elastic Behavior** (6h) 2.1. Simple tensor notation and operations 2.2. Specification of stress and strain at a point 2.3. Elastic stress strain relations 2.4. Elastic constants 2.5. Elastic anisotropy 2.6. Stress concentrations 2.7. Strain energy 2.8. Finite strain elasticity **3. Thermal Behavior** (4h) 3.1. Heat capacity 3.2. Thermal expansion 3.3. Thermal conductivity 3.4. Thermal stresses and shock

	4. Elements of Plasticity (8h) 4.1. Flow curves and constitutive relations 4.2. True stress and strain 4.3. Yield criteria 4.4. Response to multiaxial stresses 4.5. Yield surfaces 4.6. Anistropy to yield behavior 4.7. Stress and strain invariants 4.9. Plastic stress-strain relations 4.10. Slip line field theory 4.11. Anisotropy of plastic response 4.12. Plasticity of crystalline solids 4.13. Plasticity of polymeric solids **5. Viscoelasticity Behavior** (4h) 5.1. Linear viscoelastic models 5.2. Creep and stress relaxation 5.3. Mathematical modelling 5.4. Boltzmann superposition principle 5.5. Maxwell model 5.6. Voight model 5.7. Standard linear solid 5.8. Relaxation time and retardation time spectra 5.9. Dynamical response of solids 5.10. Applications to polymeric behavior 5.11. Application to behavior of crystalline solids 5.12. Nonlinear viscoelasticity **6. Dislocation Theory** (6h) 6.1. Introduction to lattice defects 6.2. Dislocations in crystalline solids 6.3. Slip related to motion of dislocations 6.4. Stress fields and energies of dislocations 6.5. Forces on dislocations

	6.6. Interactions between dislocations 6.7. Interactions with other defects 6.8. Relationships between dislocation behavior, plasticity and anelasticity **7. Strengthening Mechanisms** (4h) 7.1. Single crystal behavior 7.2. Polycrystalline behavior 7.3. Strain hardening 7.4. Grain boundaries 7.5. Yield point behavior 7.6. Solute interactions, solid solution strengthening and softening 7.7. Second phase effects, precipitates dispersions and copolymers 7.8. Phase transformation strengthening 7.9. Recovery and recrystallization **8. Composite Behavior** (2h) 8.1. Classes of composites 8.2. Theory of elastic and plastic response 8.3. Interfaces in composites 8.4. Behavior of polymeric composites 8.5. Behavior of metal-matrix composites 8.6. Behavior of ceramic-matrix composites **9. Fracture** (6h) 9.1. Types of failure 9.2. Theoretical fracture strength 9.3. Griffith theory 9.4. Introduction to fracture mechanics 9.5. Fracture toughness 9.6. Crack tip plasticity 9.7. J. integral (not convered) 9.8. R curve (not convered) 9.9. Fractography of fracture/Failure analysis 9.10. Microstructural aspects of fracture

	9.11. Temperature and strain rate effects 9.12. Crazing and relation to fracture **10. Fatigue Behavior** (2h) 10.1. Phenomenology of fatigue 10.2. Phenomenology of fatigue failures 10.3. Cyclic stress strain behavior 10.4. Crack initiation and propagation 10.5. Fracture mechanics of fatigue **Lab works** Separated manuals
Study and examination requirements and examination forms	- Students are expected to follow the regulations of Hanoi University of Science and Technology **Progress mark (30%):** -Home exercise grading -Lab work and reports -Mid-term test **Final mark (70%):** -Multichoice and writing
Media employed	PPT courseware, multimedia computers, projectors, laser pens, blackboards, etc.
Reading list	**Textbooks** Mech. Behavior of Materials, M.A. Meyers and K.K. Chawla (Prentice-Hall, 1999) **References** 1. Mech. Behavior of Materials, M.A. Meyers and K.K. Chawla (Prentice-Hall, 1999)

MSE4408 Nanostructured materials

Module designation	Basic Core of Engineering
Module level, if applicable	
Code, if applicable	MSE4408
Subtitle, if applicable	
Courses, if applicable	Material Laboratory
Semester(s) in which the module is taught	5th semester

Person responsible for the module	Assoc. Prof. Le Thai Hung
Lecturer	Assoc. Prof. Le Thai Hung Assoc. Prof . Nguyen Thi Hoang Oanh Assoc. Prof. Pham Mai Khanh
Language	English
Relation to curriculum	Provides students the latest scientific developments in the field of mechanics of nanostructured materials based on theoretical, simulation, and experimemental studies. The content of this course includes effect of grain sizes, grain boundaries, and microstructures on mechanical behaviors such as elastic, plastic, and creep properties of nanostructured materials. Mechanism of hardening phenomenon, movement and interaction of dislocation are also discussed. In addition, effect of grain sizes on fracture behavior of nanostructured materials is provided in this course.
Teaching method, contact hours	Target students: Students of school of materials science and engineering Teaching method: theoretical teaching, presentation, group discusion, student work Contact hours: 30 hours Theoretical teaching: 30 hours
Workload (incl. contact hours, self-study hours)	Workload = 90 hours Contact hours = 30 hours Self-study hours = 60 hours
Credit points	2(2-0-0-4)
ECTS	2.84
Requirements according to the examination regulations	Students with no discussion scores or no test scores will receive a process score of less than 3.0/10. If the process score or the final exam score is lower than 3.0/10, students do not complete the course.
Recommended prerequisites	PH1016, PH1026 CH1016 MSE3126
Module objectives/intended learning outcomes	***Course objectives****:* This course introduces students to the field of nanostructured materials. Nanostructured materials have chemical and physical properties that are significantly different from those of bulk materials. The course will cover the structure and properties of a variety of nanoscale materials. In addition, it will cover the synthesis and assemble of nanoscale materials based on top-down and bottom-up approaches. The major potential applications of nanostructured materials will also be discussed. ***Course outcomes:*** • Ability to prepare quality (composition and technical) laboratory reports describing the results of experiments

	• Ability to operate the equipment used for the experiments and interpret the data obtained.
Content	**1. Microscopy** 1.1. Geometrical optics 1.4. Resolution in microscopy 1.5. Contrast in microscopy: bright-field, dark-field and phase contrast **2. Diffraction** 2.4. Crystal structures 2.5. Complex notation for wave amplitudes and phase 2.6. Diffraction from one-dimensional objects and crystals 2.4. Diffraction from two- and three-dimensional crystals 2.8. Reciprocal lattices and Ewald sphere constructions for x-ray and electron diffraction 2.9. Atomic scattering factors for photons, electrons, and neutrons 2.10. Dynamical effects: index of refraction and extinction **3. Spectroscopy** 3.4. Core-level atomic physics and spectroscopic notation 3.5. Cross-sections for core-level impact ionization and photoemission 3.6. Microprobe analysis and x-ray photoelectron spectroscopy
Study and examination requirements and examination forms	(a) Four full, journal type laboratory reports: 10 pages of formal text exclusive of figures. The goal of these reports is to assess the student's composition ability as well as technical understanding. (b) After the first lab report has been graded a one-on-one meeting (1/2 hour) is held with each student to assess the students composition skills (c) Three executive summary reports are prepared on the other laboratory experiments. Each report is typically 5 pages including figures. (d) A final oral presentation, followed by a questioning period, is given by each student about their last laboratory experiment.
Media employed	PPT courseware, multimedia computers, projectors, laser pens, blackboards, etc.
Reading list	**Textbooks** 1. Guozhong Cao, *Nanostructures and Nanomaterials: Synthesis, Properties, And Applications*, Imperial College Press, 2004 **References** 1. K C Patil, M S Hegde, Tanu Rattan, S T Aruna, *Chemistry of nanocrystalline oxide materials combustion synthesis, properties and applications*, World Scientific Publishing, 2008

	2. Dieter Vollath, *Nanomaterials: An Introduction to Synthesis, Properties and Applications*, Second Edition, 2013 3. B. D. Cullity; *Elements of X-ray diffraction*; Addison-Wesley; 1956 4. C. J. Ball; *An introduction to the theory of diffraction*; Pergamon Press; 1971 5. W. T. Welford; *Optics*; Oxford University Press; 1981

MSE4016 Metals Processing

Module designation	Elective Course
Module level, if applicable	
Code, if applicable	MSE4016
Subtitle, if applicable	
Courses, if applicable	Metals Processing
Semester(s) in which the module is taught	7th semester
Person responsible for the module	Dr. Nguyen Hong Hai
Lecturer	Dr. Nguyen Hong Hai Dr. Hoang Van Vuong
Language	English
Relation to curriculum	Introduction to metallurgical engineering & equipment. Technology & equipment for raw materials preparation, pyrometallurgy, hydrometallurgy, metal & alloy refining and powder metallurgy Basic concepts in electrochemical. The types of energy storage and converting devices operate under the electrochemical mechanism. Electrochemical corrosion of metals, alloys and anti-corrosion measures. Application of electrochemical techniques in fabrication & synthesis of materials
Teaching method, contact hours	Target students: Students of school of materials science and engineering Teaching method: theoretical teaching, presentation, teamwork Contact hours: 30 hours Theoretical teaching: 30 hours
Workload (incl. contact hours, self-study hours)	Workload = 90 hours Contact hours = 30 hours Self-study hours = 60 hours
Credit points	2(2-0-0-4)
ECTS	2.84

Requirements according to the examination regulations	Students with no discussion scores or no test scores will receive a process score of less than 3.0/10. If the process score or the final exam score is lower than 3.0/10, students do not complete the course.
Recommended prerequisites	MSE3416, MSE3436
Module objectives/intended learning outcomes	- To provide students with a broad knowledge of metals processing techniques commonly used in industry and in research laboratories, in particular extraction metalurgy, casting, forming, heat treating, powder metalurgy and surface processing. - To demonstrate the correlation between processing conditions, microstructures and properties in common metalic materials - To give the students a direct contact with several processing techniques in their industrial context - To present methods to optimize processing parameters: work and slab methods for the calculation of forming loads, diffusion equations applied to heat treating and surface processing, chemical and electro-chemical equations to determine condition of extraction and refining of metals from their ores or compounds.
Content	**1 Extraction of Metals** 1.1. Pyrometallurgical extraction 1.2 Hydrometallurgy 1.3 Electrometallurgy **2 Casting** 2.1 Sand casting 2.2 Permanent mold casting 2.3 Solidification of metal 2.4 Heat Transfer 2.5 Casting defects **3 Metals Working** 3.1 Classification 3.2 Continium Plastisity 3.3 Work Methods 3.4 Forfing 3.5 Rolling 3.6 Sheet Forming

	3.7 Microstructural Evolution **4 Heat Treating** 4.1 Phase equilibrium of Fe-C Alloy 4.2 Austenitization 4.3 Transformation of Austenite 4.4 Hardening 4.5 Tempering 4.6 Other Annealing processes **5 Powder Metallurgy** 5.1 Powder Production 5.2 Powder Characteristics 5.3 Compaction 5.4 Densification **6 Surface Processing** 6.1 Thermal Surface Processing 6.2 Thermochemical surface Processing 6.3 Coating Processes **Lab works:** in MSE4126
Study and examination requirements and examination forms	• Students are expected to follow the regulations of Hanoi University of Science and Technology **Progress mark (30%):** -Lab work and reports 10% -Mid-term test (writing) 20% **Final mark (70%):** -Final exam (multichoice and writing test)
Media employed	PPT courseware, multimedia computers, projectors, laser pens, blackboards, etc.
Reading list	**Textbooks** 1. Principles of Metal Manufacturing processes, Beddoes and Bibby (Arnold, 1999). 2. Introduction to Materials Science and Processing **References** Metals Handbook, Desk Edition, Q.669.1Am35mabr; Manufacturing with Materials, L. Edwards, M. Endean, 670.42M4181995; Mechanical Metallurgy, G. E. Dieter, 3rd edition, 1986, 669.94 D56M1986 Introduction to Materials Science and Processing

MSE4156 Corrosion of Metals

Module designation	Basic Core of Engineering
Module level, if applicable	
Code, if applicable	MSE4156
Subtitle, if applicable	
Courses, if applicable	Corrosion of Metals
Semester(s) in which the module is taught	6th semester
Person responsible for the module	Dr. Nguyen Ngoc Minh
Lecturer	Dr. Nguyen Ngoc Minh Dr. Nguyen Thi Van Thanh
Language	English
Relation to curriculum	The course provides the theory of corrosion and structural degradation of materials. Insist on the scientific principles of metal corrosion. Introduce to students the basic principles of the interaction of materials with the environment and the degradation of the properties of engineering materials due to environmental exposure. The course provides an understanding of the fundamentals of corrosion processes so that students can identify the various corrosion mechanisms that lead to the deterioration of the structure of a material leading to destruction.
Teaching method, contact hours	Target students: Students of school of materials science and engineering Teaching method: theoretical teaching, solving problem, technical practice, teamwork Contact hours: 45 hours Theoretical teaching: 45 hours
Workload (incl. contact hours, self-study hours)	Workload = 135 hours Contact hours = 45 hours Self-study hours = 90 hours
Credit points	3(2-1-1-6)
ECTS	4.67
Requirements according to the examination regulations	Students with no discussion scores or no test scores will receive a process score of less than 3.0/10. If the process score or the final exam score is lower than 3.0/10, students do not complete the course.
Recommended prerequisites	MSE3416, MSE4116
Module objectives/intended learning outcomes	***Course Objectives:*** 1. Understanding of basic electrochemical reaction thermodynamics and kinetics. 2. Rationalization of corrosion phenomena in terms of mechanism

	3. Introduction to corrosion measurement techniques 4. Use of principles to understand how corrosion can be prevented or ameliorated 5. Demonstration of effects of materials composition and processing in specific systems 6. Survey of experience on the effect of environment on mechanical failure ***Course Outcomes:*** 1. Calculation of cell potential for various electrodes, electrolytes, temperatures and pressures 2. Use of Pourbaix diagrams to understand corrosion and active-passive behavior 3. Use of Tafel plots and Evans diagrams to predict component behavior. 4. Relation between immersion testing, electrochemical measurements and material performance 5. Assessment of alloy selection vs. coatings vs. cathodic protection vs. inhibitors to solve corrosion problems.
Content	**1. Base corrosion of metals** (10h) 1.1. Introduction 1.1.1. Significance of Corrosion 1.1.2. Purposes of the course 1.1.3. Costs of Corrosion 1.1.4. Definitions 1.2. Corrosion Science & Engineering and Electrochemical Reactions 1.2.1. Corrosion Science and Engineering 1.2.2. Electrochemical Reactions 1.3. Electrode potential and polarization 1.3.1. Electrode potential 1.3.2. Polarization 1.3.3. Influence of concentration and temperature on cell potential - Nernst equation 1.3.4. Example problem 1.1 1.4. Corrosion rate 1.4.1. Weight loss 1.4.2. Penetration rates 1.4.3. Prediction of corrosion rates 1.4.4. Corrosion rates from polarization data 1.4.5. Example problem 1.2 1.5. Passivity 1.6. Forms of corrosion 1.6.1. Uniform Corrosion 1.6.2. Galvanic Corrosion 1.6.3. Crevice Corrosion 1.6.4. Intergranular corrosion 1.6.5. Dealloying and dezincification 1.6.6. Erosion–corrosion **2. Corrosion prevention** (10h) 2.1. Designing to prevention corrosion 2.2. Selection of materials resisting to corrosion 2.2.1. Materials for a lightweight factory roof 2.2.2. Automobile exhaust systems 2.2.3. Underground pipes

	2.3. Coatings and inhibitors 2.3.1. Galvanizing 2.3.2. Inhibitors 2.4. Cathodic protection 2.4.1. Sacrificial protection 2.4.2. Protection by imposing a potential **3. Stress corrosion** (5h) 3.1. Characteristics of stress corrosion cracking 3.1.1. Definition and description 3.1.2. Metallurgical effects 3.1.3. Electrochemical effects 3.2. Characteristics of corrosion fatigue cracking 3.2.1. Definition and description 3.2.2. Comparison with stress corrosion cracking 3.3. Characteristics of hydrogen - induced cracking 3.3.1. Definition and description 3.3.2. Comparison with stress corrosion cracking 3.4. Typical cases of stress corrosion cracking 3.5. Methods prevention **4. Corrosion in selected corrosive environments** (10h) 4.1. Water and aqueous solutions 4.1.1. Effects of pH 4.1.2. Dissolved oxygen and other dissolved gases 4.1.3. Harness (hard waters) 4.1.4. Elevated temperature 4.1.5. Sodium Chloride and Seawater 4.1.6. Other Dissolved Salts 4.1.7. Sulfur-Bearing Solutions 4.1.8. Sulfides and Hydrogen Sulfide 4.1.9. Sulfite liquors 4.1.10. Polythionic Acids 4.2. Biologically Influenced Corrosion 4.2.1. Recognition and Prevention 4.2.2. Effects of Anaerobic Bacteria on Iron 4.2.3. Effects of Aerobic Bacteria on Iron 4.2.4. Biological Corrosion of Stainless Steels 4.2.5. Biological Corrosion of other Metals 4.2.6. Macro fouling Organisms 4.3. Corrosion in soil environment 4.3.1. Significance 4.3.2. Soil Corrosivity 4.3.3. Prevention 4.4. Concrete 4.4.1. Corrosive Characteristics 4.4.2. Prevention 4.5. Acid process streams Sulfuric Acid 4.5.1. Nitric Acid 4.5.2. Hydrochloric Acid 4.5.3. Hydrofluoric Acid 4.5.4. Organic Acids 4.6. Alkaline process streams 4.6.1. Caustic Hydroxides

	4.6.2. Hypochlorites 4.7. Atmospheric corrosion 4.7.1. Atmospheric parameters affecting corrosion 4.7.2. Weathering steels 4.7.3. Electrochemical mechanism 4.7.4. Prevention **5. Corrosion at high temperatures** (10h) 5.1. Oxidation at elevated temperature 5.1.1. The Driving Force for Oxidation of Metals in Oxygen or Air 5.1.2. Thermodynamics of Oxidation of Metals in Gaseous Environments 5.1.3. Effect of Temperature on the Standard Free Energy 5.1.4. Oxide structure and sensor 5.1.5. Oxidation and non –Stoichiometric oxides 5.1.6. Representation of atoms, ions and defects in an ionic crystal 5.1.7. Oxidation reactions 5.1.8. Scale types 5.1.9. Kinetics of oxidation 5.1.10. Mechanism of Oxide Film Formation on Nickel in Oxygen 5.1.11. Mechanism of Oxide Film Formation on iron in Oxygen 5.2. Oxidation resistance
Study and examination requirements and examination forms	Students are expected to follow the regulations of Hanoi University of Science and Technology **Progress mark (40%):** -Home exercise grading 10% -Project 10% -Mid-term test (writing) 20% **Final mark (60%):** -Final exam (Multichoice and writing)
Media employed	PPT courseware, multimedia computers, projectors, laser pens, blackboards, etc.
Reading list	**Textbooks** Denny A. Jones, Principles and Prevention of Corrosion, 2nd edition, McGraw-Hill, 1996 **References** 1) ASM Handbook, Vol. 13, Corrosion, 1987 2) Uhlig's Corrosion Handbook, Wiley and Sons, 2000, Selection and Application of Batteries, 2nd edition, 1998 3) E. Verink, Construction of Pourbaix Diagrams, J. Ed. Modules, Vol 1, No. 3, 1979 4) Galerie, NGUYEN Van Tu, Ăn mòn và bảo vệ vật liệu, 2nd edition, nxb KHKT, 2008

MSE4175 Solidification Processing

Module designation	Basic Core of Engineering
Module level, if applicable	
Code, if applicable	MSE4175
Subtitle, if applicable	
Courses, if applicable	Solidification Processing
Semester(s) in which the module is taught	5th semester
Person responsible for the module	Prof. Dr. Nguyen Hong Hai Assoc. Prof. Pham Mai Khanh
Lecturer	Prof. Dr. Nguyen Hong Hai Assoc. Prof. Pham Mai Khanh
Language	English
Relation to curriculum	Fundamentals of crystallization and solidification processes. Defects formed during solidification process and their preventing. Some theoretical aspects on Al-alloys microstructure refining. Theoretical basics of semi-solid casting processes. Solidification and cooling processes of Fe-based alloys
Teaching method, contact hours	Target students: Students of school of materials science and engineering Teaching method: theoretical teaching, group discussion, presentation, student work Contact hours: 30 hours Theoretical teaching: 30 hours
Workload (incl. contact hours, self-study hours)	Workload = 90 hours Contact hours = 30 hours Self-study hours = 60 hours
Credit points	2(2-0-0-4)
ECTS	2.84
Requirements according to the examination regulations	Students with no discussion scores or no test scores will receive a process score of less than 3.0/10. If the process score or the final exam score is lower than 3.0/10, students do not complete the course.
Recommended prerequisites	MSE3416, MSE4116
Module objectives/intended learning outcomes	
Content	**1. Introduction** 1.1. The importance of solidification

	1.2. Solidification microstructures **2. Thermodynamics of solidification** 2.1. Introduction 2.2. Pure materials 2.3. Binary alloys: stable-phase equilibrum 2.4. The partition ratio 2.5. Effect of curvature 2.6. Effect of presure 2.7. Binary alloys: Metastable-phase equilibrum 2.8. Composition at the liquid-solid interface 2.9. The equilibrum shapes of phases 2.10. Anisotropy of liquid-solid surface energy **3. Nucleation of crystals from metallic melts** 3.1. Introduction 3.2. Homogeneuos nucleation 3.3. Heterogeneous nucleation 3.4. Rate of nucleus formation **4. Dendritic solidification** 4.1. Introduction 4.2. Morphological interface instability 4.3. Dendritic Morphology 4.4. Steady-state dendritic growth models 4.5. Primary spacing of constrained dendrites 4.6. Secondary spacing of dendrites **5. Eutectic solidification** 5.1. Introduction 5.2. Eutectic morphologies 5.3. Elementary phenomena occurring during eutectic growth 5.4. Energy balance and mean eutectic undercooling 5.5. Energetic and kinetic constributions of eutectic undercooling 5.6. Operating point and operating range of eutectics

	6. Microsegration 6.1. Introduction 6.2. Transisients 6.3. Mass balance equations 6.4. Microsegration 6.5. Homogenisation 6.6. Solidification path of multicomponent alloys 6.7. Microsegregations in multicomponent alloys **7. Macrosegregation and mesosegregation** 7.1. Introduction 7.2. Rimming steel cast in ingots 7.3. Killed steel castings and non-ferrous alloys 7.4. Continuous cast steel 7.5. Basic phenomena capable of inducing macro- or mesosegregations 7.6. Interpretation of the macrosegregation observed during monodirectional solidification **8. Microporosity** 8.1. Introduction 8.1. Mechanisms of porosity formation 8.2. Precipitation of gases in metal melts 8.3. Precipitation of inclusions in metal melts 8.4. Aluminium and aluminium alloys 8.5. Copper and copper alloys 8.6. Steel and iron alloys 8.7. Cast iron 8.8. Nickel and nickel-base alloys **9. Hot tearing and stress-related defects** 9.1. Introduction 9.1. Stress-related phenomena in the mushy zone 9.2. Development of stress and strains 9.3. Residual stress and deformation 9.5. Hot tearing observations

	10. Controlled solidification processes 10.1. Introduction 10.2. Czochralski growth (crystal pulling) 10.3. Bridgman-type solidification 10.4. Zone melting 10.5. Rapid solidification: microstructures and processes 10.6. Rheo- and thixocastings
Study and examination requirements and examination forms	- Students are expected to follow the regulations of Hanoi University of Science and Technology **Progress mark (30%):** - Home exercise grading 10% - Mid-term test (writing) 20% **Final mark (70%):** - Final exam (multichoice)
Media employed	PPT courseware, multimedia computers, projectors, laser pens, blackboards, etc.
Reading list	**Textbooks** W. Kurz, D.J. Fisher. Fundamental of solidification. Trans. Tech. Publication 1989. **References** 1. Merton C. Flemings. Solidification processing. McGraw Hill. ISBN 0-07-021283-x 2. H . Combeau et al. Solidification Course 1998. Savanah, Georgia, USA 3. Minkoff. Solidification and cast structure. John Wiley & Sons Ltd. ISBN 0 471 90798 7

MSE4118 Composite Materials

Module designation	Elective Course
Module level, if applicable	
Code, if applicable	MSE4426
Subtitle, if applicable	
Courses, if applicable	Composite Materials
Semester(s) in which the module is taught	Elective

Person responsible for the module	Assoc. Prof. Le Thai Hung Assoc. Prof. Dang Quoc Khanh
Lecturer	Assoc. Prof. Le Thai Hung Assoc. Prof. Dang Quoc Khanh
Language	English
Relation to curriculum	Provide to students some basic knowledge of composite materials, which have concepts of non-traditional material synthesis processes.
Teaching method, contact hours	Target students: Students of school of materials science and engineering Teaching method: theoretical teaching, group discussion, presentation, student work and report Contact hours: 30 hours Theoretical teaching: 30 hours
Workload (incl. contact hours, self-study hours)	Workload = 90 hours Contact hours = 30 hours Self-study hours = 60 hours
Credit points	2(2-0-0-4)
ECTS	2.84
Requirements according to the examination regulations	Students with no discussion scores or no test scores will receive a process score of less than 3.0/10. If the process score or the final exam score is lower than 3.0/10, students do not complete the course.
Recommended prerequisites	MSE4436, MSE3446
Module objectives/intended learning outcomes	*Objectives:* - To describe synthesis, processing and properties of fibers for composite reinforcements. - To examine bonding and properties of composite interfaces. - To provide guidelines for selection of the matrix materials. - To describe key processing techniques for producing metal, ceramic and polymer-matrix composites. - To demonstrate the relationship among synthesis, processing and properties in composite materials. - To analyze the mechanics of the composite materials - To provide theoretical treatment of the composite properties. *Course Outcomes*: - Able to explain how common fibers are produced and how the properties of the fibers are related to the internal structure. - Able to explain how interfacial bonding may be archived between two materials.

	- Able to suggest and analyze the methods for determining mechanical properties of interfaces. - Able to select matrices for composite materials in different applications. - Able to describe key processing methods for fabricating composites. - Able to explain how key processing parameters affect composite materials. - Able to analyze the mechanics of the composite materials. - Able to explain the anisotropy in the elastic properties and strengths of the composite.
Content	**1. Introduction** 1.1. Definitions and classification 1.2. Natural composites 1.3. More about the matrix and reinforcement 1.4. Factors which determine properties 1.5. The benefits of composites 1.6. Summary **2. Reinforcements** 2.1. Fibers 2.1.1. Natural fibers 2.1.2. Introduction to synthetic fibers 2.1.3. Synthetic organic fibers 2.1.4. Synthetic inorganic fibres 2.1.5.Particular and whisker reinforcements 2.1.6. Reinforcement-matrix interface 2.1.7. Summary 2.2. Strengths of fibers **3. Composite Interfaces** 3.1. Bonding Mechanisms 3.2. Bond Strength 3.3. Interfacial Toughness **4. Polymer Matrix Composites** 4.1. Polymer Matrices 4.1.1. Thermosetting reins 4.1.2. Thermoplastic reins 4.2. Processing Techniques

	4.2.1. Compression moulding 4.2.2. Injection moulding 4.2.3. Resin transfer moulding 4.3. Glass Reinforced Plastics 4.4. Carbon Fiber Composites **5. Metal Matrix Composites** 5.1. Metal Matrices 5.2. Processing Techniques 5.3. Interfacial Controls 5.4. Discontinuously Reinforced Composites 5.5. Fiber Composites **6. Ceramic Matrix Composites** 6.1. Ceramic matrices 6.2. Processing Techniques 6.3. Alumina Matrix Composites 6.4. Glass Matrix Composites **7. Composite Properties** 7.1. Elastic Properties 7.2. Composite Stregths **Lab works** Separated manuals.
Study and examination requirements and examination forms	- Students are expected to follow the regulations of Hanoi University of Science and Technology 1. Weekly homework problems (10%) 2. Two mid-term examinations (30%) 3. A comprehensive final examination (60%)
Media employed	PPT courseware, multimedia computers, projectors, laser pens, blackboards, etc.
Reading list	**Textbooks** Composite Materials: Engineering and Science, F. L. Matthews and R. D. Rawlings, Chapman & Hall 1994. **References** Composite Materials: Engineering and Science, F. L. Matthews and R. D. Rawlings, Chapman & Hall 1994.

MSE4651E Amorphous Materials

Module designation	Elective Course
Module level, if applicable	
Code, if applicable	MSE4651E
Subtitle, if applicable	
Courses, if applicable	Amorphous Materials
Semester(s) in which the module is taught	Elective
Person responsible for the module	Assoc. Prof. Dr. Nguyen Hoang Viet
Lecturer	Assoc. Prof. Dr. Nguyen Hoang Viet Assoc. Prof. Dr. Pham Mai Khanh Assoc. Prof. Nguyen Thi Hoang Oanh
Language	English
Relation to curriculum	Introduce the basics of materials science to amorphous materials. The structure of the material is amorphous and kinetically fundamental to form these forms of structure. Assess the effect of structural forms on the mechanical, electrical, dielectric, magnetic, thermal and optical properties of the amorphous material families. The characteristic methods and applications of techniques of amorphous materials.
Teaching method, contact hours	Target students: Students of school of materials science and engineering Teaching method: theoretical teaching, solving problem, presentation, student report, practical teaching Contact hours: 30 hours Theoretical teaching: 30 hours
Workload (incl. contact hours, self-study hours)	Workload = 90 hours Contact hours = 30 hours Self-study hours = 60 hours
Credit points	2(2-1-0-4)
ECTS	3.25
Requirements according to the examination regulations	Students with no discussion scores or no test scores will receive a process score of less than 3.0/10. If the process score or the final exam score is lower than 3.0/10, students do not complete the course.
Recommended prerequisites	MSE3436, MSE1021
Module objectives/intended learning outcomes	**Master knowledge of amorphous structures** Understand the concept of amorphous structure. Classification of amorphous materials.

	Glass phase and amorphous phase theory Technologies for making amorphous materials **Properties and applications of amorphous materials** Grasp the basic properties: viscosity, viscous elasticity and recovery properties Understand and explain the durable mechanism of the alloy. **Know how to analyze the characteristics of amorphous materials** Applying learned knowledge explains the relationship between the measurement method and the structure and properties of the material
Content	**1. Introduction** 1.1. Structural characteristics of amorphous materials 1.2. Thermodynamic characteristics 1.3. Related basic terms **2. Classification of amorphous materials** 2.1. Glass, denatured and intermediate networking agents 2.2. Forms of Glass Oxide B and Silicate 2.3. Metal Glass 2.4. Other forms of glass **3. Manufacturing and manufacturing of amorphous materials** 3.1. Coating method 3.2. Quick cooling method 3.3. Method of creating non-shaped powder 3.4. The method of converging **4. Theory of glass phase creation** 4.1. Structural theory of glass phase creation 4.2. Dynamic theory of glass phase creation 4.3. Inoue's aimless phase creation rule **5. Characteristics of glass/amorphous materials** 5.1. Viscosity 5.1.1. Viscosity Reference Point 5.1.2. Effects of temperature and patterns 5.1.3. Viscosity measurement 5.2. Shaped deformation 5.2.1. Shaping and manufacturing glass products 5.2.2. Glass 3D printing 5.2.3. BMG Block Metal Glass Shaping 5.3. Viscous elasticity and recovery

	5.3.1. Viscous elastic material and model 5.3.2. Structural and model restoration 5.3.3. Glass Phase Transfer **6. Muscular properties** **6.1. Theoretical and practical durability** 6.2. Mechanism of destruction 6.3. Stress fatigue and corrosion 6.4. Determining impact toughness 6.5. Demolition statistics: Weibull graph **7. Glass Chemistry** 7.1. Durable chemical techniques 7.2. Structural design increases durability 7.3. Flexible glass **8. Transport phenomena and electrical properties** 8.1. Electronic transport and ion conductivity 8.2. Electronic structure of amorphous semiconductors **9. Si root amorphous electronic material** 9.1. Properties of Si and Si:H amorphous 9.2. TFT positive matrix display 9.3. Si amorphous photovoltaic cells. **10. Optical properties** 10.1. Optical characteristics: refraction, decline and color 10.2. Optical fibers and optical conductivity **11. Amorphous state characteristics** 11.1. Generalization of characteristics and measurement techniques 11.2. Diffraction method 1 1.2.1. Debye diffraction equation 1 1.2.2. Decoding the spectrum from X-ray diffraction experiment results: standardizing and correcting errors 1 1.2.3. X-ray diffraction, electrons and neutrons. 11.3. Raman spectroscopy method 1 1.3.1. Raman spectral expansion: the scattering of phonon energy. 11.4. Thermal analysis 1 1.4.1. Thermal effect 1 1.4.2. Explain DSC and DTA metrics 1 1.4.3. Glass Phase Transfer

Study and examination requirements and examination forms	- Students are expected to follow the regulations of Hanoi University of Science and Technology **Progress mark (30%):** -Presentation 15% -Mid-term test 15% **Final mark (70%):** -Writing exam
Media employed	PPT courseware, multimedia computers, projectors, laser pens, blackboards, etc.
Reading list	**Textbooks** - Musgraves, J. David, Hu, Juejun, Calvez, Laurent (Eds.). *Springer Handbook of Glass*. Springer International Publishing, 2019 - Arun K. Varshneya and John C. Mauro. *Fundamentals of Inorganic Glasses*. Elsevier Inc., 3rd Edition 2019 **References** None

MSE4117 Design of Engineering Alloys

Module designation	Elective Course
Module level, if applicable	
Code, if applicable	MSE4117
Subtitle, if applicable	
Courses, if applicable	Design of Engineering Alloys
Semester(s) in which the module is taught	Elective
Person responsible for the module	Assoc. Prof. Dao Hong Bach Dr. Nguyen Minh Thuyet
Lecturer	Assoc. Prof. Dao Hong Bach Dr. Nguyen Minh Thuyet
Language	English
Relation to curriculum	The subject provides students with knowledges in detail abouts a given topic relates to metallurgical processes for different metals
Teaching method, contact hours	Target students: Students of school of materials science and engineering Teaching method: theoretical teaching, presentation, teamworks, student report Contact hours: 30 hours Theoretical teaching: 30 hours

Workload (incl. contact hours, self-study hours)	Workload = 90 hours Contact hours = 30 hours Self-study hours = 60 hours
Credit points	2(2-0-0-4)
ECTS	2.84
Requirements according to the examination regulations	Students with no discussion scores or no test scores will receive a process score of less than 3.0/10. If the process score or the final exam score is lower than 3.0/10, students do not complete the course.
Recommended prerequisites	
Module objectives/intended learning outcomes	**Module objectives:** On successful completion of this unit, you should be able to: 1. Develop a thorough understanding of the combinations of mechanical properties exhibited by engineering alloys and how these compare with other materials classes 2. Develop an understanding of the methodology used in objectively selecting a material and processing procedure for a given engineering application 3. Develop in depth understanding of the microstructures and their development for the most common classes of engineering alloys 4. Develop an understanding of the principles of microstructural design for mechanical applications.
Content	1. Iron-carbon alloy system (Chaps 1 & 2) 2. Carbon and alloy steels (Chaps. 3 & 4) 3. Stainless steels (Chap. 7) 4. Copper alloys (Chap. 6) 5. Nickel alloys (Chap. 11) 6. Intermetallics and superalloys (class notes, Chap. 11) 7. Aluminum alloys (Chap. 5) 8. Titanium alloys (Chap. 10) 9. Refractory metal alloys (Chap. 13)
Study and examination requirements and examination forms	Students are expected to follow the regulations of Hanoi University of Science and Technology **Progress mark (40%):** -Presentation 20% -Mid-term exam 20% **Final mark (60%):** -Final exam (writing / multiplechoice)
Media employed	PPT courseware, multimedia computers, projectors, laser pens, blackboards, etc.

Reading list	**Textbooks** ASM Handbook, Desk Edition and vols. 1-20, Q.669.1Am35mabr (online at https://dl-asminternational-org.proxy2.library.illinois.edu/handbooks) **References** Steels, R.W.K. Honeycombe & H.K.D.H. Bhadeshia, 669.96142h757s1996 (online at https://www.sciencedirect.com/book/9780081002704/steels-microstructure-and-properties). Materials Selection in Mechanical Design, M. Ashby, 1992, 620.11AS34M (online at https://www.sciencedirect.com/book/9781856176637/materials-selection-in-mechanical-design) Physical metallurgy handbook, A. K. Sinha, 669.9 Si64p (reference).

MSE4119 Clean Energy Materials

Module designation	Elective Course
Module level, if applicable	
Code, if applicable	MSE4119
Subtitle, if applicable	
Courses, if applicable	Clean Energy Materials
Semester(s) in which the module is taught	Elective
Person responsible for the module	Dr. Bui Duc Long Assoc. Prof. Tran Vu Diem Ngoc Assoc. Prof. Duong Ngoc Binh
Lecturer	Dr. Bui Duc Long Assoc. Prof. Tran Vu Diem Ngoc
Language	English
Relation to curriculum	Introducing the application of materials in clean energy. The principles, challenges and potentials of clean energy include areas such as thermal-electric, photovoltaic, piezoelectricity and energy storage, etc. The relationship between physical and chemical properties to the material's ability to metabolize energy. Groups of clean energy materials, fabrication methods and applicability
Teaching method, contact hours	Target students: Students of school of materials science and engineering Teaching method: theoretical teaching, presentation, teamwork, student report Contact hours: 30 hours Theoretical teaching: 30 hours
Workload (incl. contact hours, self-study hours)	Workload = 90 hours Contact hours = 30 hours Self-study hours = 60 hours

Credit points	2(2-0-0-4)
ECTS	2.84
Requirements according to the examination regulations	Students with no discussion scores or no test scores will receive a process score of less than 3.0/10. If the process score or the final exam score is lower than 3.0/10, students do not complete the course.
Recommended prerequisites	None
Module objectives/intended learning outcomes	**Module objectives:** Know about energy and environmental issues. 1. Energy sources and the environment 2. Trends in the development of materials technology for clean energy 3. The potential and challenges of clean energy materials Understand the mechanisms of energy conversion and storage 1. Principles of thermal-electrical conversion, photovoltaic 2. Principle of electromechanical transformation 3. Principle of storing electrical energy Understanding and applying knowledge about clean energy materials 1. Research and manufacture clean energy materials. - The ability to apply metabolic devices and store energy.
Content	1. Intro 1.1. Energy and environmental issues. 1.2. The role and application of clean energy materials today 1.3 Groups of Clean Energy Materials 2. Thermal-electrical material 2.1. Introduction to thermal-electrical materials 2.2. Mechanism and efficiency of thermalpower conversion 2.3 Thermal-Electrical Properties 2.4 Thermal-Electrical Equipment 2.5 The potential and challenges of thermal-electrical materials. 2.6 Methods to improve thermal-electrical conversion efficiency 2.7 Groups of materials-thermoelectricity 2.8 Material fabrication methods 2.9 Applications of thermal power 3. Photovoltaic Material 3.1 About Photovoltaics 3.2 Solar Energy 3.3 Principles of photovoltaic conversion 3.4 The potential and challenges of photovoltaic equipment 3.5 Groups of photovoltaic materials 3.6 Methods of making photovoltaic materials. 3.7 Photovoltaic Application

	4. Piezoelectric material 4.1. Definition and classification 4.2. Voltage mechanism 4.2.1. Piezoelectric Effect 4.2.2 Polarization Process 4.2.3. Mechanical-electrical bonding coefficient 4.3. Technology for manufacturing piezoelectric materials 4.3.1. Piezoelectric Ceramics 4.3.2 Voltage Polymer 4.4 Application of piezoelectric material 4.5 The potential and challenges of piezoelectric materials 5. Materials for energy storage 5.1 Electrical Energy Storage Equipment 5.1.1 Battery and battery application 5.1.2 Potential and Challenges 5.2 Battery Working Principles 5.3 Acidic, alkaline battery 5.3.1 Introduction 5.3.2 Battery Fabrication Material 5.4 Pin Li-ion 5.4.1 Principles 5.4.2 Anot Material 5.4.3 Catot Material 5.4.4 Electrolyte Solution
Study and examination requirements and examination forms	Students are expected to follow the regulations of Hanoi University of Science and Technology **Progress mark (30%):** -Mid-term exam (wirting) **Final mark (70%):** -Final exam (writing)
Media employed	PPT courseware, multimedia computers, projectors, laser pens, blackboards, etc.
Reading list	**Textbooks** Q. Xu, T. Kobayashi, Advanced materials for clean energy, CRC press, Taylor & Francis Group 2015 **References** 1. C A Vincent, B Scrosati, MODERN BATTERIES - An Introduction to Electrochemical Power Sources, Linacre House, Massachusetts, USA 2. Masaki Yoshio, Ralph J. Brodd, Akiya Kozawa, (Editors), Lithium-Ion Batteries - Science and Technologies, Springer Science+Business Media, LLC 2009

MSE4652 Functional Materials

Module designation	Elective Course
Module level, if applicable	
Code, if applicable	MSE4652
Subtitle, if applicable	
Courses, if applicable	Functional Materials
Semester(s) in which the module is taught	Elective
Person responsible for the module	Dr. Nguyen Ngoc Minh
Lecturer	Dr. Nguyen Ngoc Minh Dr. Nguyen Minh Thuyet
Language	English
Relation to curriculum	Students are able to understand the advanced materials with special function such as materials with low, zero or negative thermal expansion, materials based on thermoelectric effect, piezoelectric or materials with special optical and magnetical properties are also mentioned in this course.
Teaching method, contact hours	Target students: Students of school of materials science and engineering Teaching method: theoretical teachings, solving problem, presentation, student report Contact hours: 30 hours Theoretical teaching: 30 hours
Workload (incl. contact hours, self-study hours)	Workload = 90 hours Contact hours = 30 hours Self-study hours = 60 hours
Credit points	2(2-0-0-4)
ECTS	2.84
Requirements according to the examination regulations	Students with no discussion scores or no test scores will receive a process score of less than 3.0/10. If the process score or the final exam score is lower than 3.0/10, students do not complete the course.
Recommended prerequisites	
Module objectives/intended learning outcomes	**Module objectives:** After completion of the course the student should be able to: - Give a qualitative description of the simples and most common crystal structures of inorganic materials and have basic knowledge of symmetry operations in order to be able to describe the different point groups and space groups.

	- Classify and charactrise different phase transitions - Relate phase transitions, crystal structure and crystal symmetry to the different functional properties covered. - Describe microscopic mechanisms for electronic conductivity in metals, semiconductors, and insulators. In addition, the student should be able to name specific examples of materials that exhibit these properties. - Name several different ionic conducting materials and describe microscopic mechanisms for ionic and mixed conductivity in addition to writing down defect equilibrium equations. - Describe microscopic mechanisms for ferroelectricity, ferromagnetism, in addition to related dielectric and magnetic properties. The student should be able to describe specific materials exhibiting dielectric and magnetic properties. - Relate crystal structure and electronic structure to optical and thermal properties. - Predict electronic, dielectric, magnetic, optical and thermal properties based on the acquired knowledge. - Name several different applications for different functional materials. - Identify which functional properties would be required for different technological applications and be able to propose specific materials suitable for the application in question.
Content	Functional materials are materials that have one or more properties that can be significantly changed in a controlled fashion by external stimuli (temperature, electric/magnetic field, etc.) and are therefore applied in a broad range of technological devices as for example in memories, displays and telecommunication. Subjects: Relation between properties, structure and crystal symmetry – Size and interface effects on properties - Electronic bands structures - Charge transport – Semiconductor devices – Optical active materials: theory, examples of materials and applications Dielectrics, piezo- and ferroelectrics: theory, examples of materials and applications – Magnetism: theory, examples of materials and applications
Study and examination requirements and examination forms	Students are expected to follow the regulations of Hanoi University of Science and Technology **Progress mark (30%):** -Mid-term exam (writing/ multiplechoice) **Final mark (70%):** -Final exam (writing/ multiplechoice)

Media employed	PPT courseware, multimedia computers, projectors, laser pens, blackboards, etc.
Reading list	**Textbooks** Functional Materials – 1st Edition – Elsevier **References** none

MSE4653 Atomic Scale Simulation

Module designation	Elective Course
Module level, if applicable	
Code, if applicable	MSE4653
Subtitle, if applicable	
Courses, if applicable	Atomic Scale Simulation
Semester(s) in which the module is taught	Elective
Person responsible for the module	Prof. Nguyen Trong Giang Assoc. Prof. Dr. Dao Hong Bach Assoc. Prof. Dinh Van Hai Assoc. Prof. Le Van Lich
Lecturer	Assoc. Prof. Dr. Dao Hong Bach Assoc. Prof. Dr. Dinh Van Hai Assoc. Prof. Le Van Lich Dr. Dang Thi Hong Hue
Language	English
Relation to curriculum	Introduce to numerical simulation of materials. Using the computer or supercomputer, numerical mathematics and specialized software to simulate the characteristics of materials.
Teaching method, contact hours	Target students: Students of school of materials science and engineering Teaching method: theoretical teachings, group discussion, critical thinking, student work and report Contact hours: 30 hours Theoretical teaching: 30 hours
Workload (incl. contact hours, self-study hours)	Workload = 90 hours Contact hours = 30 hours Self-study hours = 60 hours

Credit points	2(2-0-0-4)
ECTS	2.84
Requirements according to the examination regulations	Students with no discussion scores or no test scores will receive a process score of less than 3.0/10. If the process score or the final exam score is lower than 3.0/10, students do not complete the course.
Recommended prerequisites	PH1016, PH1026 MSE3447, MSE1012, MSE3406
Module objectives/intended learning outcomes	**Module objectives:** At the end of the course, students are complemented by the traditional theoretical and experimental approach based on the application of digital methods to solve complex physical, chemical and mechanical equations describing the properties and attributes of materials. the process as well as the use of software to simulate numbers and experimental methods for the process of modeling and simulation.
Content	GENERAL INTRODUCTION 1. The basic knowledge for digital modeling and simulation 2. Diffusion at the granular level 3. Transition from random movement to continuous diffusion CHAPTER 1. CONTINUOUS ENVIRONMENTAL METHODS 1. 1.1.Continuous environmental theory 1.1.1. Laws of Conservation 1.1.2. Property relationship 1.1.3. The concept of discrete and continuous 2. 1.2.Digital methods 1.2.1.Finite differential method 1.2.2.The method of finite elements of gravity residue 1.2.3.The method of finite element diversion 3. 1.3.Application problems 1.3.4.Heat transfer problem 1.3.6. Flow problem 1.3.7.Material shaping problem 1.3.8. Issues related to continuous environmental mechanics 4. 1.4.Review of continuous environmental methods 5. 1.5.Digital simulation exercises on application software (ANSYS and DEFORM) 6. 1.6. Check CHAPTER 2. MOLECULAR METHODS 2.1.Monte Carlo Method I: Osmosis

	2.2. Monte Carlo II Method: Fractal Model 2.3.Monte Carlo III method: Randomly folded 2.4. Basic Monte Carlo method 2.5.Monte Carlo modeling for physical systems 2.6.Optimized by Monte Carlo programming and Genetics 2.7.Basic molecular dynamics 2.8.Introduction to interatomic voltage 2.9.Metal modeling 2.10. Electrical resistance 2.11. Simulation of atomic dynamics for liquids 2.12. Review of molecular methods 2.13. Exercises on digital modeling and simulation using the MD method 2.14. Check CHAPTER 3. QUANTUM METHODS 3.1 Quantum computation in numerical modeling and simulation 3.2. Introduction to Hartree-Fock and density function theory method
Study and examination requirements and examination forms	Students are expected to follow the regulations of Hanoi University of Science and Technology **Progress mark (40%):** -Mid-term exam **Final mark (60%):** -writing exam
Media employed	PPT courseware, multimedia computers, projectors, laser pens, blackboards, etc.
Reading list	**Textbooks** 1. Zoe Barber, *Introduction to Materials modelling*, Materials Science and Metallurgy Department of Cambridge University. 2. Đào Huy Bình, *Cơ học môi trường liên tục*, Đại học xây dựng. **References** 1. Allen M. P., and D. J. Tildesley. *Computer Simulation of Liquids*, New York, NY: Oxford University Press, 1989. ISBN: 9780198556459. 2. Rapaport D. C., *The Art of Molecular Dynamics Simulation*, 2nd ed. New York, NY: Cambridge University Press, 2004. ISBN: 9780521825689. 3. Frenkel D., and B. Smit, *Understanding Molecular Simulation*, 2nd ed. Burlington, MA: Academic Press, 2001. ISBN: 9780122673511. 4. Cleri F., S. Yip D. Wolf, and S. R. Phillpot, *Atomic-Scale Mechanics of Crack-Tip Plasticity: Dislocation Nucleation and Crack-Tip Shielding*, Physical Review Letters 79, No. 7 (August 18, 1997): 1309-1312. 5. E. R. Champion, *Finite Element Analysis in Manufacturing Engineering* - McGraw - Hill, New York, USA 1992.

MSE4654 Solid State Electronic Devices

Module designation	Elective Course
Module level, if applicable	
Code, if applicable	MSE4654
Subtitle, if applicable	
Courses, if applicable	Solid State Electronic Devices
Semester(s) in which the module is taught	Elective
Person responsible for the module	Prof. Nguyen Phuc Duong Dr. Nguyen Ngoc Minh
Lecturer	Prof. Nguyen Phuc Duong Dr. Nguyen Ngoc Minh
Language	English
Relation to curriculum	The course introduces the latest basics of solid-state electronic. The knowledge concepts of solid-state sintering: process, process parameters, development of sintering theory (geometrical, thermodynamic and kinetic basis; structure evolution of sintering sample) and also an introduce about semiconductor.
Teaching method, contact hours	Target students: Students of school of materials science and engineering Teaching method: theoretical teachings, group discussion, student work Contact hours: 30 hours Theoretical teaching: 30 hours
Workload (incl. contact hours, self-study hours)	Workload = 90 hours Contact hours = 30 hours Self-study hours = 60 hours
Credit points	2(2-0-0-4)
ECTS	2.84
Requirements according to the examination regulations	Students with no discussion scores or no test scores will receive a process score of less than 3.0/10. If the process score or the final exam score is lower than 3.0/10, students do not complete the course.
Recommended prerequisites	
Module objectives/intended learning outcomes	**Module objectives:** -An ability to identify, formulate, and solve engineering problems by applying principles of engineering, science, and mathematics. - An ability to apply both analysis and synthesis in the engineering design process, resulting in designs that meet desired needs.

	- An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions. - An ability to communicate effectively with a range of audiences. - An ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts. - An ability to recognize the ongoing need for additional knowledge and locate, evaluate, integrate, and apply this knowledge appropriately. - An ability to function effectively on teams that establish goals, plan tasks, meet deadlines, and analyze risk and uncertainty
Content	Chapter 1: Introduction to semiconductor materials Chapter 2: Atomic structure and the periodic table Chapter 3: Energy bands and charge carriers in semiconductors Chapter 4: Excess carriers in semiconductors (the continuity equation) Chapter 5: p-n junctions Chapter 6: Metal-oxide-semiconductor field effect transistor (mosfet) Chapter 7: Bipolar junction transistor (bjt)
Study and examination requirements and examination forms	Students are expected to follow the regulations of Hanoi University of Science and Technology **Progress mark (40%):** -Presentation -Midterm exam (writing / multiplechoice) **Final mark (60%):** -Final exam (writing / multiplechoice)
Media employed	PPT courseware, multimedia computers, projectors, laser pens, blackboards, etc.
Reading list	**Textbooks** Solid State Electronic Devices - Ben G. Streetman **References** Advanced Semiconductor Fundamentals (QM, SM, Transport) Semiconductor Device Fundamentals (Diode, Bipolar, MOSFET)

MSE3161E Materials for extreme condition

Module designation	Elective Course
Module level, if applicable	
Code, if applicable	MSE3161E
Subtitle, if applicable	
Courses, if applicable	Materials for extreme condition

Semester(s) in which the module is taught	Elective
Person responsible for the module	Assoc. Prof. Dr. Bui Anh Hoa Assoc. Prof. Tran Vu Diem Ngoc
Lecturer	Assoc. Prof. Dr. Bui Anh Hoa Assoc. Prof. Dr. Pham Mai Khanh Assoc. Prof. Tran Vu Diem Ngoc Dr. Nguyen Ngoc Minh
Language	English
Relation to curriculum	The course will begin with a broad overview of materials for extreme condition, followed by detailed consideration of starting materials, manufacturing processes, tooling, analysis methods, non-destructive inspection, and process selection strategy. An ability to apply fundamental knowledge about powder metallurgy for materials selection and performance. The knowledge of topics in design and materials selection that enable the comparison of similarities and differences among methods. Understanding the impact of engineering solutions in a global, economic, environmental, and societal context. Design considerations in the use of materials, quality control, selecting materials to optimize multiple properties, materials failure, long-term materials properties, materials behavior under extreme conditions.
Teaching method, contact hours	Target students: Students of school of materials science and engineering Teaching method: theoretical teaching, group discussion, presentation, student work and report Contact hours: 30 hours Theoretical teaching: 30 hours
Workload (incl. contact hours, self-study hours)	Workload = 90 hours Contact hours = 30 hours Self-study hours = 60 hours
Credit points	2(2-0-0-4)
ECTS	2.84
Requirements according to the examination regulations	Students with no discussion scores or no test scores will receive a process score of less than 3.0/10. If the process score or the final exam score is lower than 3.0/10, students do not complete the course.
Recommended prerequisites	None
Module objectives/intended learning outcomes	**Module objectives:** **Understand and describe the changes that occur on the surface of the material under the influence of different special working environments** Be aware of special work environments. Understand the interaction of special environments with materials during work

	Understanding and recognizing organizational changes and properties of materials under the influence of factors from a particular environment Be aware of the changes of the material organization when working in special environments Analysis assesses the impact of the work environment on structural changes **Know how to choose the right materials and technologies to work in harsh environments** Know how to evaluate the selection of materials with properties suitable for working environments Be aware of the appropriate process for the fabrication and handling of working materials under a number of special conditions.
Content	**1. Introduction** 1.1. Introduction to the subject. 1.2. Overview of nuclear power plants, aerospace and chemical plants. 1.3. Requirements on material features in the above-mentioned areas. **2. Materials working under high pressure** 2.1. Phase transition mechanism at high pressure 2.2. Amorphous transformation due to pressure 2.3. Re-crystallization of the amorphous phase 2.4. Illustrations **3. Materials in a strong corrosive environment** 3.1. Corrosion of materials in alkaline and acid solution 3.2. Corrosion of steam-induced materials of nuclear plants 3.3. Corrosion of materials in seawater 3.4. Application of materials in strong corrosive environments (nanocompozite polymers, super alloys, ceramics,...) **4. Vacuum and high temperature materials** 4.1. The mechanics and properties of materials under high temperatures 4.2. Microscopic organizational transformation of vacuum and high temperature materials 4.3. Sealing material at high temperature 4.4. Intermetal, silicate and application alloy phases at high temperatures 4.5. High Entropy Alloy 4.6. High temperature ceramics

	4.7. Bonding and phase transfer in ceramic materials due to the impact of high temperatures 4.8. Testing methods to evaluate and forecast the working life of materials under high temperatures **5. Abrasion-resistant coating material in extreme conditions** 5.1. Material abrasion mechanism in extreme conditions 5.2. Features and applications of coating materials (nitrites, borites and cacbits,...) **6. Materials under radiation conditions** 6.1. Principles of operation of nuclear reactors 6.2. Damage to radioactive material 6.3. Ion interaction – solid 6.4. Phase transitions in radioactive conditions 6.5. Life expectancy of materials in nuclear power plants and assessment methods 6.6. Methods of treatment of nuclear waste and requirements of materials **7. Materials in electric fields and high magnetic fields** 7.1. High magnetic field formation 7.2. Feedback of materials in high magnetic fields 7.3. Superconducting material in high magnetic field 7.4. Magnetic materials in current technology 7.5. Material interaction with electric and magnetic fields 7.6. Insulation material for ultra-high voltage circuits 7.7. Insulation materials in special environments **8. Simulation and design of materials for special environments** 8.1. Simulation of the mechanics and organization of materials under conditions of high temperature and pressure 8.2. Calculation and design of working materials at high temperature and pressure conditions
Study and examination requirements and examination forms	Students are expected to follow the regulations of Hanoi University of Science and Technology **Progress mark (30%):** - Presentation (group-work) 10% - Mid-term exam (writing) 20% **Final mark (70%):** - Final exam (writing)

Media employed	PPT courseware, multimedia computers, projectors, laser pens, blackboards, etc.
Reading list	**Textbooks** Materials under extreme condition: recent trend and future prospects, edited by A.K Tyagi and S.Bannerjee **References** **None**

MSE4655 Advanced Ceramics

Module designation	Elective Course
Module level, if applicable	
Code, if applicable	MSE4655
Subtitle, if applicable	
Courses, if applicable	Advanced Ceramics
Semester(s) in which the module is taught	Elective
Person responsible for the module	Assoc. Prof. Tran Vu Diem Ngoc Assoc. Prof. Dang Quoc Khanh
Lecturer	Assoc. Prof. Tran Vu Diem Ngoc Assoc. Prof. Dang Quoc Khanh
Language	English
Relation to curriculum	The key to the development and the improvement of novel ceramic materials with ultimate properties is a detailed understanding of their physical and chemical working principles, their synthesis and preparation, and their characterization. The class will focus on the design and the construction of advanced ceramics for next-generation device technologies as well as emerging and potential engineering applications. The content shows the processing, the analysis of the material structure, and knowledge of the way of the fabrication of advanced ceramic materials with designed properties such as optical, electric, magnetic, thermal, biomimetic, energy, or environmentally. After that, understanding materials research and the development in an academia and an industry, with the aptitude to grasp the economic and environmental effects of new materials.
Teaching method, contact hours	Target students: Students of school of materials science and engineering Teaching method: theoretical teaching, group discussion, presentation, think pair share Contact hours: 30 hours Theoretical teaching: 30 hours
Workload (incl. contact hours, self-study hours)	Workload = 90 hours Contact hours = 30 hours Self-study hours = 60 hours

Credit points	2(2-0-0-4)
ECTS	2.84
Requirements according to the examination regulations	Students with no discussion scores or no test scores will receive a process score of less than 3.0/10. If the process score or the final exam score is lower than 3.0/10, students do not complete the course.
Recommended prerequisites	MSE1012, MSE3427
Module objectives/intended learning outcomes	**Module objectives:** 1. Understand advanced processes of working in clay from start to finish 2. Demonstrate the use of clay terms 3. Complete self-directed projects according to specific requirements 4. Research clay artists in order to participate in the contemporary clay world 5. Follow studio rules 6. Participate in a classroom community
Content	Chapter 1: Introduction to Ceramics and Composites Chapter 2: Crystal Structure & Symmetry: Symmetry Operators, Introduction to Point group and Space group Chapter 3: Point Defects in Ceramics Chapter 4: Defect Chemistry of Metal Oxides Chapter 5: Demonstration & Interactive Session: Pyro/Piezo/Ferro-electric measurement Chapter 6: Demonstration & Interactive Session: Grain Size Estimation Analysis Chapter 7: Ceramic Powder Processing Chapter 8: Ceramic Sintering Chapter 9: Advanced Sintering Techniques (Flash sintering, Spark Plasma Sintering, etc.) Chapter 10: Ceramic Coating & Composites Chapter 11: Demonstration & Interactive Session: Ceramic Processing (Flash Sintering, Spark Plasma)
Study and examination requirements and examination forms	Students are expected to follow the regulations of Hanoi University of Science and Technology **Progress mark (30%):** -Mid-term exam 20% -Presentation 10% **Final mark (70%):** -Final exam (writing)

Media employed	PPT courseware, multimedia computers, projectors, laser pens, blackboards, etc.
Reading list	**Textbooks** Handbook of Advanced Ceramics - 2nd Edition - Elsevier **References** Advanced Ceramic Materials - Ashutosh Tiwari, Rosario A. Gerhardt, Magdalena Szutkowska

MSE4656 Surface and thin film technology

Module designation	Elective Course
Module level, if applicable	
Code, if applicable	MSE4656
Subtitle, if applicable	
Courses, if applicable	Surface and thin film technollogy
Semester(s) in which the module is taught	Elective
Person responsible for the module	Assoc. Prof. Dr. Trinh Van Trung
Lecturer	Assoc. Prof. Dr. Trinh Van Trung Dr. Hoang Van Vuong
Language	English
Relation to curriculum	The topics of this lecture are the basic physical principles of thin film deposition and thin film formation. The physical principles of vacuum technology, the emission of atoms from the solid phase by thermal or mechanical processes and the elementary steps of film condensation from the vapor phase are discussed. Additionally, the reasons why the mechanical, electronical and optical properties of thin films differ from the theree dimensional bulk are elucidated. The lecture aims at master students and therefore requires knowledge about certain advanced mathematical and physical methods and concepts as e. g. distribution functions, transport theory and thermodynamics.
Teaching method, contact hours	Target students: Students of school of materials science and engineering Teaching method: theoretical teaching, presentation, student work and report Contact hours: 30 hours Theoretical teaching: 30 hours
Workload (incl. contact hours, self-study hours)	Workload = 90 hours Contact hours = 30 hours Self-study hours = 60 hours
Credit points	2(2-0-0-4)
ECTS	2.84

Requirements according to the examination regulations	Students with no discussion scores or no test scores will receive a process score of less than 3.0/10. If the process score or the final exam score is lower than 3.0/10, students do not complete the course.
Recommended prerequisites	None
Module objectives/intended learning outcomes	**Module objectives:** Upon completion of this section the student has the ability to: 1. Presented: Principles of thin film technologies, scope of application of each type 2. Description: The basis of surface layer formation 3. Application: Making a project to put thin film technology into production and implementation 4. Assessment: Quality of surface layer after treatment, evaluation of technology efficiency
Content	1. The basis of thin film technologies 2. Germ birth 3. 2D single-class development (layers over layers) 4. 2D multilayer development (epitaxy technology) 5. Graphene and CNTs.
Study and examination requirements and examination forms	Students are expected to follow the regulations of Hanoi University of Science and Technology **Progress mark (30%):** -Mid-term test **Final mark (70%):** -Final exam (oral test)
Media employed	PPT courseware, multimedia computers, projectors, laser pens, blackboards, etc.
Reading list	**Textbooks** [1] Nguyễn Văn Tư, Xử lý bề mặt, ĐHBK Hà nội, 1998 [2] Thin film Technology, internet **References** [3] Burakowski, Tadeusz, Surface engineering of metals ; principles, equipment, technologies / Tadeusz Burakowski, Tadeusz Wierzchon, CRC Press, 1999 [4] Professor Hongjie Dai; Department of Chemistry, Stanford University, nanotubes lesson, 2003

MSE4657 Nanobiomaterials Technology

Module designation	Elective Course
Module level, if applicable	
Code, if applicable	MSE4657
Subtitle, if applicable	
Courses, if applicable	Nanobiomaterial Technology
Semester(s) in which the module is taught	Elective
Person responsible for the module	Assoc. Prof. Dr. Tran Duc Huy Dr. Le Thi Bang
Lecturer	Assoc. Prof. Dr. Tran Duc Huy Dr. Le Thi Bang
Language	English
Relation to curriculum	This course introduce to nanobiomaterial for a better scientific understanding on the preparation & characterization of Materials in Nanoscales towards enhanced Utilization & Applications especially in biology.
Teaching method, contact hours	Target students: Students of school of materials science and engineering Teaching method: theoretical teaching, group discussion, presentation Contact hours: 30 hours Theoretical teaching: 30 hours
Workload (incl. contact hours, self-study hours)	Workload = 90 hours Contact hours = 30 hours Self-study hours = 60 hours
Credit points	2(2-0-0-4)
ECTS	2.84
Requirements according to the examination regulations	Students with no discussion scores or no test scores will receive a process score of less than 3.0/10. If the process score or the final exam score is lower than 3.0/10, students do not complete the course.
Recommended prerequisites	MSE3446, MSE 4106, MSE3447, MSE3207
Module objectives/intended learning outcomes	**Module objectives:** By the end of this course, the student should be able to: 1. Describe the fundamental properties of synthetic and natural nanostructured biomaterials, list new and different classes of nanostructured materials used in biomedical applications, and explain the various factors (materials properties, biologic response, etc.) that define the utility and applications of these materials.

	2. Recognize properties of cells, nucleic acids, proteins, and immunology as these topics relate to nanostructured biomaterials· 3. Apply knowledge of mathematics, science, and engineering to topics such as processing, characterization, and end use of nanostructured biomaterials. 4. Analyze and interpret data related to characterization of nanostructured biomaterials· 5. Design a medical device or a prosthesis using nanostructured biomaterials in order to meet desired clinical needs 6. Identify contemporary issues in nanostructured biomaterials engineering from current events and discuss the practice of ethical responsibility related to development and use of nanostructured biomaterials in clinical applications.
Content	Chapter 1: - Introduction to nanobiomaterials - Development of nanobiomaterials (current applications, nanostructured materials used in pharmaceutical/biomedical applications - Micro-, meso- and macroporous structures - Nanostructured surfaces - Examples of polymeric, metallic, inorganic, hybrid and composite nanobiomaterials preparation Chapter 2: - Functionalization/bioconjugation of nanobiomaterials - Smart and stimuli-responsive nanobiomaterials;examples of specific applications (pharmaceutical/diagnostic/theranostic applications, and implantable materials/devices - biodegradable/non-biodegradable) Chapter 3: - Nanometrology and nanotoxicity - Regulation and translation to the clinic - Regulatory frameworks - FDA/EMA
Study and examination requirements and examination forms	Students are expected to follow the regulations of Hanoi University of Science and Technology **Progress mark (40%):** -Mid-term exam 20% -Presentation 20% **Final mark (60%):** -Final exam (writing/multiplechoice)
Media employed	PPT courseware, multimedia computers, projectors, laser pens, blackboards, etc.
Reading list	**Textbooks** *Biomaterials Science: An Introduction to Materials in Medicine* – Buddy D. Ratner, Allan S. Hoffman, Frederick J. Schoen, Jack E. Lemons **References** None

MSE4658 Nanosensor and devices

Module designation	Elective Course
Module level, if applicable	
Code, if applicable	MSE4658
Subtitle, if applicable	
Courses, if applicable	Nanosensor and devices
Semester(s) in which the module is taught	Elective
Person responsible for the module	Prof. Dr. Nguyen Duc Hoa Dr. Bui Duc Long
Lecturer	Prof. Dr. Nguyen Duc Hoa Dr. Bui Duc Long
Language	English
Relation to curriculum	Introduction to the field of nano-devices, characterizations and their applications in civil and environmental engineering.
Teaching method, contact hours	Target students: Students of school of materials science and engineering Teaching method: theoretical teaching, group discussion, presentation, teamwork Contact hours: 30 hours Theoretical teaching: 30 hours
Workload (incl. contact hours, self-study hours)	Workload = 90 hours Contact hours = 30 hours Self-study hours = 60 hours
Credit points	2(2-0-0-4)
ECTS	2.84
Requirements according to the examination regulations	Students with no discussion scores or no test scores will receive a process score of less than 3.0/10. If the process score or the final exam score is lower than 3.0/10, students do not complete the course.
Recommended prerequisites	
Module objectives/intended learning outcomes	**Module objectives:** The goal of this class is to discuss theprinciples and operation of nanosensors and nanobiosensors, based on differentnanomaterials, detection modes and recognition events.We will also cover the fabrication of nanosensors and the large-scaleintegration of nanosensor arrays, related surface chemistry, along with practical (biomedical, environmental, security) applications.

Content	Chapter 1: Sensor and nanosensor Chapter 2: The design and use of: -Sensors that are made via nanofabrication -Instruments to characterize phenomena at the nanoscale -The use of data from sensors for manufacturing and decision making The use of data from instruments for accelerated learning and modeling
Study and examination requirements and examination forms	Students are expected to follow the regulations of Hanoi University of Science and Technology **Progress mark (30%):** -Presentation 10% -Mid-term exam 20% **Final mark (70%):** -Final exam
Media employed	PPT courseware, multimedia computers, projectors, laser pens, blackboards, etc.
Reading list	**Textbooks** Physical, Chemical, and Biological (Series in Sensors) 1st Edition **References** None

MSE4659 Carbon nanotechnology

Module designation	Elective Course
Module level, if applicable	
Code, if applicable	MSE4659
Subtitle, if applicable	
Courses, if applicable	Carbon nanotechnology
Semester(s) in which the module is taught	Elective
Person responsible for the module	Assoc. Prof. Dr. Nguyen Van Quy Assoc. Prof. Dr. Dang Quoc Khanh
Lecturer	Assoc. Prof. Dr. Nguyen Van Quy Assoc. Prof. Dr. Dang Quoc Khanh
Language	English
Relation to curriculum	Introduction to the field of nanotechnology with a special emphasis on nanomaterials synthesis, characterizations and their applications in civil and environmental engineering.

Teaching method, contact hours	Target students: Students of school of materials science and engineering Teaching method: theoretical teaching, group discussion, teamwork, student report Contact hours: 30 hours Theoretical teaching: 30 hours
Workload (incl. contact hours, self-study hours)	Workload = 90 hours Contact hours = 30 hours Self-study hours = 60 hours
Credit points	2(2-0-0-4)
ECTS	2.84
Requirements according to the examination regulations	Students with no discussion scores or no test scores will receive a process score of less than 3.0/10. If the process score or the final exam score is lower than 3.0/10, students do not complete the course.
Recommended prerequisites	
Module objectives/intended learning outcomes	**Module objectives:** This course will introduce students to the field of nanotechnology with a special emphasis on nanomaterials synthesis, characterizations and their applications in civil and environmental engineering. The specific applications will include, but not limited to, tailoring mechanical property, durability, self-cleaning, self-sealing, self-sensing, energy harvesting and other multi-functionality. It integrates the fields of materials science, civil engineering and electrical engineering. The basic concepts will be discussed including nano-scale effect, process-structure-property relationship, nano- and micro-structure property characterizations, multi-functional materials, nano-device fabrication and their applications for energy harvesting, water infiltrations and environmental sensing. lab will be provided to students enrolled in the course to learn nano and micro-structure characterizations skills.
Content	**Chapter 1** - Nanotechnology Overview - Nanotechnology Applications - Nanostructures **Chapter 2** - Crystal Structure of Solids - Bravais Lattice & Unit Cell - Crystal Plane & Miller Indices - Crystal Defects - Crystal Structure on Mechanical Property - Electron Transport in Crystals

	Chapter 3 - Gas Phase Deposition - Electrospinning - Solid Phase Synthesis: Ball Milling - Lithography **Chapter 4** - Scanning Electron Microscopy (SEM) - Transmission Electron Microscopy - Atomic Force Microscope - X-ray Diffraction (XRD) **Chapter 5** - Electrical Property Characterizations - Thermal Property Measurement - Thermal Characterization: TGA and DSC - Nanoindentation
Study and examination requirements and examination forms	Students are expected to follow the regulations of Hanoi University of Science and Technology **Progress mark (30%):** -Mid-term exam (writing) **Final mark (70%):** -Final exam (writing/multiple choice)
Media employed	PPT courseware, multimedia computers, projectors, laser pens, blackboards, etc.
Reading list	**Textbooks** **References** Callister, W. D., & Rethwisch, D. G. (2013). *Materials science and engineering: An introduction*. Wiley. Dai, L. (2006). *Carbon nanotechnology: Recent developments in chemistry, physics, materials science and device applications*. Elsevier.

MSE3151E Advanced Materials Processing

Module designation	Elective Course
Module level, if applicable	
Code, if applicable	MSE3151E
Subtitle, if applicable	
Courses, if applicable	Advanced Materials Processing

Semester(s) in which the module is taught	Elective
Person responsible for the module	Assoc. Prof. Dr. Pham Mai Khanh Assoc. Prof. Dr. Duong Ngoc Binh
Lecturer	Assoc. Prof. Dr. Pham Mai Khanh Assoc. Prof. Dr. Duong Ngoc Binh Assoc. Prof. Dr. Nguyen Thi Hoang Oanh
Language	English
Relation to curriculum	Introduction some groups signature advanced materials: Supper alloys, High entropy alloys, metalic materials, electronic materials, nano materials, together with their properties, applications and advanced fabrication process.
Teaching method, contact hours	Target students: Students of school of materials science and engineering Teaching method: theoretical teaching, group discussion, presentation Contact hours: 30 hours Theoretical teaching: 30 hours
Workload (incl. contact hours, self-study hours)	Workload = 90 hours Contact hours = 30 hours Self-study hours = 60 hours
Credit points	2(2-0-0-4)
ECTS	2.84
Requirements according to the examination regulations	Students with no discussion scores or no test scores will receive a process score of less than 3.0/10. If the process score or the final exam score is lower than 3.0/10, students do not complete the course.
Recommended prerequisites	MSE1012
Module objectives/intended learning outcomes	**Module objectives:** **Understand and describe advanced materials** Recognizing the types of advanced materials, characteristics of advanced materials **Understanding and recognizing advanced materials manufacturing technologies** Be aware of advanced materials manufacturing technologies Analysis assesses the technology of manufacturing specific details from advanced materials **Understand and recognize the applications of advanced materials technology**

	Be aware of the applications of advanced materials technology. Analyzing, evaluating and selecting advanced materials technologies applied for specific details
Content	**1. Introducing the subject** **2. Super alloy** - Overview of super-alloys - Microstructure and properties of super-alloys - Fabrication of turbine engine wings with super-alloy single crystallines - Fabrication of turbine motor discs from super alloys - Super-alloy surface technology **3. High Entropy Alloy (HEA)** - About High Entropy Alloys - The characteristics of high Entropy alloys - High Entropy Alloy Fabrication Technology - Advanced analytical methods **4. Titanium Alloy** - About titanium and titanium alloys - Microstructure and properties - Titanium Alloy Technology **5. Magnesium Alloy** - Overview of magnesium and magnesium alloys - Microstructure and properties - Magnesium Alloy Technology **6. Porous Metal** - Overview of porous metals - Structure and properties of porous metals - Porous Metal Technology **7. Semiconductor Materials Technology** - About semiconductor materials, components and electronic microchips - Semiconductor Materials Technology • Singlecrystalline fabrication • Thin film technology • Oxidation technology • Photo-engraving technology • Corrosive technology • Pairing technology
Study and examination requirements and examination forms	Students are expected to follow the regulations of Hanoi University of Science and Technology **Progress mark (30%):** -Presentation 10% -Mid-term exam (writing) 20% **Final mark (70%):** -Final exam (writing)
Media employed	PPT courseware, multimedia computers, projectors, laser pens, blackboards, etc.

Reading list	**Textbook** Roger C. Reed, ***The Superalloys Fundamentals and Applications***, Cambridge University Press K. Otsuka and C.M. Wayman, ***Shape Memory Materials***, Cambridge University Press Carolin Koerner, ***Integral Foam Molding of Light Metals,*** Springer Serope Kalpakjian and Steven R. Schmid, ***Manufacturing Engineering and Technology***, Prentice Hall **References** Hans-Peter Degischer, ***Handbook of Cellular Metals*** – Wiley

MSE4095E Bachelor Practicum

Module designation	Bachelor Practicum and Thesis
Module level, if applicable	
Code, if applicable	MSE4095E
Subtitle, if applicable	
Courses, if applicable	Bachelor Practicum
Semester(s) in which the module is taught	8th Semester
Person responsible for the module	Prof. Bui Anh Hoa Assoc. Prof. Dang Quoc Khanh
Lecturer	Staffs in the School of Materials Science and Engineering
Language	English
Relation to curriculum	Upon completion of this course, student will be able to: - Understand the practical knowledge of structure, principles of details and systems; - Applying theoretical knowledge into evaluation and solving some practical problems in model rooms, and companies. - Able to participate in designing and manufacturing of new products in the field of materials engineering.
Teaching method, contact hours	Target students: Students of school of materials science and engineering Teaching method: experiments, teamwork, think pair share, communication with the teachers for scientific research Contact hours: 120 hours Theoretical teaching: 00 hours Practical teaching: 00 hours Experiment: 120 hours

Workload (incl. contact hours, self-study hours)	Workload = 180 hours Contact hours = 120 hours Self-study hours = 60 hours
Credit points	2(0-0-4-4)
ECTS	3.67
Requirements according to the examination regulations	Students with no discussion scores or no test scores will receive a process score of less than 3.0/10. If the process score or the final exam score is lower than 3.0/10, students do not complete the course.
Recommended prerequisites	
Module objectives/intended learning outcomes	Module objectives: This module aims to help students synthesize and apply gained knowledge and practice at internship enterprises according to management aspects, identify problems of enterprises/manufacturing/factory/industry, factors affecting business results and effectiveness, and create firm basic to carry out graduation thesis. After completing this module, students will be able to: - Know the key contents need to collect data and analyze in their internship fields at enterprise; - Know how to plan and conduct the actual data collection on production and business as required by the subject; - Know how to assess the level of business performance and the functional aspects of business management based on evaluation criteria (sales and marketing, human resources, materials and fixed assets management, cost management, and financial performance); - Identify key issues facing the business; determine the topic for graduation thesis.
Content	Provide students with practical knowledge about the orientation of intensive mechatronics technology. Students are allowed to practice the technical work, operate or monitor the management of a process, a stage, or a product, to participate in technical design, technological design ... of intensive materials orientation. With the help of instructors and engineers at the production facility. Through this module, students are initially acquainted with the duties of a technician, with a deeper understanding of their career when graduated.
Study and examination requirements and examination forms	Students are expected to follow the regulations of Hanoi University of Science and Technology **Progress mark (30%):** -Presentation **Final mark (70%):** -Final exam: Report, presentation and inteview
Media employed	PPT courseware, multimedia computers, projectors, laser pens, blackboards, etc.
Reading list	

MSE4999E Bachelor Thesis

Module designation	Bachelor Practicum and Thesis
Module level, if applicable	
Code, if applicable	MSE4999E
Subtitle, if applicable	
Courses, if applicable	Bachelor Thesis
Semester(s) in which the module is taught	8th Semester
Person responsible for the module	Prof. Bui Anh Hoa Assoc. Prof. Dang Quoc Khanh
Lecturer	Lecturers in the School of Materials Science and Engineering
Language	English
Relation to curriculum	The Bachelor thesis is a student's initial research on a practical or theoretical problem with the purpose of supplementing, completing, enriching the knowledge and skills that have been provided in the first step is to solve practical problems with the creativity of the students under the guidance of the instructor. A basis for the university to allow the thesis defense, assessment, recognition, and award of graduation degrees for students.
Teaching method, contact hours	Target students: Students of school of materials science and engineering Teaching method: theoretical, experiments, teamwork, and communication with the teachers for scientific research and graduation thesis Contact hours: 240 hours Theoretical teaching: 00 hours Practical teaching: 00 hours Experiment: 240 hours
Workload (incl. contact hours, self-study hours)	Workload = 480 hours Contact hours = 240 hours Self-study hours = 240 hours
Credit points	6(0-0-12-12)
ECTS	11
Requirements according to the examination regulations	Students with no discussion scores or no test scores will receive a process score of less than 3.0/10. If the process score or the final exam score is lower than 3.0/10, students do not complete the course.
Recommended prerequisites	

Module objectives/intended learning outcomes	Module objectives: Upon completion of this course, student will be able to: - Apply the knowledge learned to solve the tasks of mechanical engineering industry such as: Design of materials, Design of technological process of manufacturing a materials product according to the concentration of the Materials Science and Engineering Program. - Propose a technical solution and participate in designing and manufacturing of new products in the field of materials engineering. - Working in interdisciplinary team to solve complex interdisciplinary problems of the industries. - Working in groups and using mechanical software to solve related issues, report, presentations and discussions. - Synthesize, systematize all the knowledge and skills that they use to solve a specific task in the field of industrial metallurgy, materials science, and engineering in organizations/businesses and/or manufacturing/factories. - Practice thinking, analytical skills, problem solving and problem-solving skills, writing and presentation skills. - Training skills independently and promote capacity as well as creative ability. A basis for the university to allow the thesis defense, assessment, recognition, and award of graduation degrees for students.
Content	Students apply the knowledge gained from the courses to solve specific tasks of the graduation project under the guidance of instructors; write thesis and complete the technical drawings related to the project; present of graduation projects for thesis defense
Study and examination requirements and examination forms	Students are expected to follow the regulations of Hanoi University of Science and Technology **Progress mark (50%):** writing thesis **Final mark (50%):** writing thesis, presentation and interview
Media employed	PPT courseware, multimedia computers, projectors, laser pens, blackboards, etc.
Reading list	