

**BIOMEDICAL ENGINEERING PROGRAM
(INTERDISCIPLINES)**

Biomedical Engineering (BME) Program was founded in 2006 with the main purpose to educate the graduates who are interested in BME.

BME program involved in application of principle and practice for engineer in order to create the novel knowledge for medicine purposes and to develop the diagnosis and the treatment of diseases. For examples, the applications of sound wave and electromagnetic wave for diagnosis, the applications of nanotechnology for tissue transplantation and artificial organs.

After year 2010, BME was transferred the administration from Graduate School to the Faculty of Engineering. Nowadays, BME program provides Master of Science (M.Sc.), Master of Engineering (M.Eng.), and Doctor of philosophy (Ph.D.) degrees.

HEAD:

Siriporn Damrongsakkul, Ph.D. (London)

PROFESSORS:

Areerat Suputtitada M.D. (Mahidol)
Prabhas Chongstitvatana, Ph.D. (Edinburgh)
Suthiluk Patumraj Ph.D. (New Jersey)

ASSOCIATE PROFESSORS :

Chedsada Chinrungrueng, Ph.D.
Mana Sriyudthsak, D.Eng. (T.I.T.)
(U.C.Berkeley)
Siriporn Damrongsakkul, Ph.D. (London)
Sompol Sanguanrungsirikul M.D., M.Sc. (Chula)
Watcharapong Khovichungij, Ph.D. (UCLA)

ASSISTANT PROFESSORS :

Arporn Teeramongkonrasmee, Ph.D. (Chula)
Charnchai Pluempitiwiryawej, Ph.D.(Carnegie Mellon)
Cherdkul Sopavanit, M.Eng. (Chula)
Sorada Kanokpanont, Ph.D. (Drexel)
Tanom Bunaprasert M.D. (Prince of Songkla)
Tayard Desudchit M.D. (Chula)

INSTRUCTORS :

Apiwat Lek-Uthai Dr.Ing. (Karlsruhe)
Bunchaay Supmonchai, M.Eng. (Chula)
Juthamas Ratanavaraporn Ph.D. (Chula)
Pakpum Somboon Ph.D. (T.I.T.)
Pairat Tangpornprasert D.Eng. (Tokyo)

NAME OF THE DEGREE

: Master of Science
: M.Sc.

ADMISSION

The applicants must hold a Bachelor degree in any fields of Science, Health Science (Medicine, Dentistry, Veterinary Medicine, Pharmacy, Nursing, or Allied Health Sciences), or Engineering and also passed the requirements of the Graduate School or got approval from the program committee for admission.

DEGREE REQUIREMENTS

1. The students have to pass a minimum of 6 credits of required course, 12 credit of elective courses, and 18 credits of thesis, a total of them not less than 36 credits.
2. The students have to pass an oral thesis examination. Some part of thesis has to be published or accepted for publication in a journal or was presented in an academic conference having proceedings.
3. The degree will be awarded for the student who has fulfilled the requirements as followed; G.P.A. not less than 3.00, and period of study not less than 4 semesters and not more than 8 semesters.

STUDY PROGRAM

The First Semester

2100600	Introduction to Biomedical Engineering	3	
2100601	Basic Engineering Knowledge for Biomedical Engineering	3	
XXXXXXX	Free Elective	3	
2100791	Biomedical Engineering Seminar I		(2)* 9

The Second Semester

XXXXXXX	Free Elective	9	
2100792	Biomedical Engineering Seminar II		(2)* 9

Remarks:

* No credit will be granted, evaluation will be only S/U

The Third Semester

2100813	Thesis		9 9
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The Fourth Semester

2100813	Thesis		9 9
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COURSE REQUIREMENTS

- 1) *Required Courses 6 credits*
2100600 Introduction to Biomedical

2100601	Engineering Basic Engineering Knowledge for Biomedical Engineering	3(2-3-7) 3(2-3-7)
2100791	Biomedical Engineering Seminar I	2(2-0-6)
2100792	Biomedical Engineering Seminar II	2(2-0-6)
2) <i>Elective Courses 12credits</i>		
3017767	Human Body for Biomedical Engineering	3(2-3-7)
2100603	Research Methodology and Research Instrumentation	3(3-0-9)
2109556	Biomaterials	3(3-0-9)
3000748	Tissue and Cell Engineering	3(3-0-9)
3000749	Biosystems and Biotransport	3(3-0-9)
3000750	Drug Delivery System	3(3-0-9)
2102611	Medical Instrumentation	3(3-0-9)
2102646	Power Electronics for Biomedical Engineering Applications	3(3-0-9)
2100623	Technology for Seniors and the Disabled	3(3-0-9)
2102631	Mathematical Modeling and Analysis of Physiological Systems	3(3-0-9)
2102523	Biomedical Signal Processing	3(3-0-9)
2102524	Medical Imaging Technology	3(3-0-9)
2110675	Biomedical Information and Communication Systems	3(3-0-9)
3016725	Biomechanics	3(3-0-9)
2100636	Biomedical Analytical Technique	3(3-0-9)
2100696	Special Problems in Biomedical Engineering	3(0-0-12)
2100697	Individual Study	3(0-0-12)
2100796	Advanced Topics in Biomedical Engineering I	3(3-0-9)
2100797	Advanced Topics in Biomedical Engineering II	3(3-0-9)
2102505	Introduction to Optimization Techniques	3(3-0-9)
2102507	Computational Techniques for Engineers	3(3-0-9)
2102531	System Identification	3(3-0-9)
2102635	Control System Theory	3(3-0-9)
2102668	Biosensors	3(3-0-9)
2102546	Analog Integrated Circuits	3(3-0-9)
2102784	Measurement System Design and Simulation	3(3-0-9)
2102785	Advanced Sensor Theory	3(3-0-9)
2102876	Adaptive Signal Processing	3(3-0-9)
2105641	Biodegradable Material Engineering	3(3-0-9)
2111602	Radiation Physics for Medical Science	2(2-0-6)
2100604	Strategic Tissue Engineering and Controlled Release System	3(3-0-9)
2100605	Biomedical Embedded System	3(3-0-9)
3) <i>Thesis</i>		
2100813	Thesis	18 credits

NAME OF THE DEGREE

- : Master of Engineering
- : M.Eng.

ADMISSION

The applicants must hold a Bachelor degree in Engineering and also passed the requirements of the Graduate School or got approval from the program committee for admission.

DEGREE REQUIREMENTS

1. The students have to pass a minimum of 6 credits of required course, 12 credit of elective courses, and 18 credits of thesis, a total of them not less than 36 credits.
2. The students have to pass an oral thesis examination. Some part of thesis has to be published or accepted for publication in a journal or was presented in an academic conference having proceedings.
3. The degree will be awarded for the student who has fulfilled the requirements as followed; G.P.A. not less than 3.00, and period of study not less than 4 semesters and not more than 8 semesters.

STUDY PROGRAM

The First Semester

2100600	Introduction to Biomedical Engineering	3	
3017767	Human Body for Biomedical Engineering		3
XXXXXXX	Free Elective	3	
2100791	Biomedical Engineering Seminar I		(2)* 9

The Second Semester

XXXXXXX	Free Elective	9	
2100792	Biomedical Engineering Seminar II		(2)* 9

Remarks:

* No credit will be granted, evaluation will be only S/U

The Third Semester

2100813	Thesis		9 9
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The Fourth Semester

2100813	Thesis		9 9
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COURSE REQUIREMENTS

1) <i>Required Courses 6 credits</i>			
2100600	Introduction to Biomedical Engineering		3(2-3-7)
3017767	Human Body for Biomedical Engineering		3(2-3-7)
2100791	Biomedical Engineering Seminar I	2(2-0-6)	
2100792	Biomedical Engineering Seminar II	2(2-0-6)	

2) *Elective Courses 12 credits*

2100601	Basic Engineering Knowledge for Biomedical Engineering		3(2-3-7)
2100603	Research Methodology and		

	Research Instrumentation	3(3-0-9)
2109556	Biomaterials	3(3-0-9)
3000748	Tissue and Cell Engineering	3(3-0-9)
3000749	Biosystems and Biotransport	3(3-0-9)
3000750	Drug Delivery System	3(3-0-9)
2102611	Medical Instrumentation	3(3-0-9)
2102646	Power Electronics for Biomedical Engineering Applications	3(3-0-9)
2100623	Technology for Seniors and the Disabled	3(3-0-9)
2102631	Mathematical Modeling and Analysis of Physiological Systems	3(3-0-9)
2102523	Biomedical Signal Processing	3(3-0-9)
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2110675	Biomedical Information and Communication Systems	3(3-0-9)
3016725	Biomechanics	3(3-0-9)
2100636	Biomedical Analytical Technique	3(3-0-9)
2100696	Special Problems in Biomedical Engineering	3(0-0-12)
2100697	Individual Study	3(0-0-12)
2100796	Advanced Topics in Biomedical Engineering I	3(3-0-9)
2100797	Advanced Topics in Biomedical Engineering II	3(3-0-9)
2102505	Introduction to Optimization Techniques	3(3-0-9)
2102507	Computational Techniques for Engineers	3(3-0-9)
2102531	System Identification	3(3-0-9)
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2102546	Analog Integrated Circuits	3(3-0-9)
2102784	Measurement System Design and Simulation	3(3-0-9)
2102785	Advanced Sensor Theory	3(3-0-9)
2102876	Adaptive Signal Processing	3(3-0-9)
2105641	Biodegradable Material Engineering	3(3-0-9)
2111602	Radiation Physics for Medical Science	2(2-0-6)
2100604	Strategic Tissue Engineering and Controlled Release System	3(3-0-9)
2100605	Biomedical Embedded System	3(3-0-9)

excellence level and also passed the requirements of the Graduate School or got approval from the program committee for admission.

3) Thesis

2100813	Thesis	18 credits
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NAME OF THE DEGREE

: Doctor of Philosophy
: Ph.D.

ADMISSION

The applicants have to pass the following basic requirements:

For Pattern 1:

For applicants who held the Master degree in Biomedical Engineering and have got the thesis qualification as the

For Pattern 2:

Pattern 2(1) for applicants who held a Master degree in Biomedical Engineering, Master degree in Engineering or Science and have got the thesis qualification as the good level, and also passed the requirements of the Graduate School or got approval from the program committee for admission.

Pattern 2 (2) for applicants who held a Bachelor degree in Engineering or Science and have got the second honor degree or have G.P.A. not less than 3.25 based on 4 point grading system, and also passed the requirements of the Graduate School or got approval from the program committee for admission.

DEGREE REQUIREMENTS

For Pattern 1:

The students have to get 60 credits, also passed an oral examination and some part of thesis has to be published or accepted for publication in a journal of 2 papers, at least 1 paper has to be published in an international journal.

For Pattern 2(1):

The students have to get 12 credits of elective courses and 48 credits of thesis, total of 60 credits, also passed an oral examination and some part of thesis has to be published or accepted for publication in an international journal.

For Pattern 2(2):

The students have to get 24 credits of elective courses and 48 credits of thesis, total of 72 credits, also passed an oral examination and some part of thesis has to be published or accepted for publication in an international journal.

Remark:

For Pattern 1 may require additional courses or other academic activities (no credit will be granted, evaluation will be only S/U) that will benefit for the thesis, under consent of the advisor and the program committee.

STUDY PROGRAM

Pattern 1

The First Semester

2100791	Biomedical Engineering Seminar I	(2)*
2100829	Dissertation	12 12

The Second Semester

2100792	Biomedical Engineering Seminar II	(2)*
2100829	Dissertation	12 12

The Third Semester

2100793	Biomedical Engineering Seminar III	(2)*
2100829	Dissertation	12 12

The Fourth Semester

2100794	Biomedical Engineering Seminar IV	(2)*
2100829	Dissertation	12 12

The Fifth Semester

2100894	Doctoral Dissertation Seminar	(0)*
2100829	Dissertation	12 12

The Sixth Semester

Remarks:

* No credit will be granted, Evaluation will be only S/U

Pattern 2(1)

The First Semester

2100791	Biomedical Engineering Seminar I	(2)*
XXXXXXX	Free Elective	9 9

The Second Semester

2100792	Biomedical Engineering Seminar II	(2)*
2100828	Dissertation	6
XXXXXXX	Free Elective	3 9

The Third Semester

2100793	Biomedical Engineering Seminar III	(2)*
2100828	Dissertation	9 9

The Fourth Semester

2100794	Biomedical Engineering Seminar IV	(2)*
2100828	Dissertation	9 9

The Fifth Semester

2100894	Doctoral Dissertation Seminar	(0)*
2100828	Dissertation	12 12

The Sixth Semester

2100894	Doctoral Dissertation Seminar	(0)*
2100828	Dissertation	12 12

Pattern 2(2)

The First Semester

2100791	Biomedical Engineering Seminar I	(2)*
XXXXXXX	Free Elective	9

The Second Semester

2100792	Biomedical Engineering Seminar II	(2)*
XXXXXXX	Free Elective	9

The Third Semester

2100793	Biomedical Engineering Seminar III	(2)*
2100828	Dissertation	3
	Free Elective	6
		9

The Fourth Semester

2100794	Biomedical Engineering Seminar IV	(2)*
2100828	Dissertation	9
		9

The Fifth Semester

2100894	Doctoral Dissertation Seminar	(0)*
2100828	Dissertation	9
		9

The Sixth Semester

2100894	Doctoral Dissertation Seminar	(0)*
2100828	Dissertation	9
		9

The Seventh Semester

2100894	Doctoral Dissertation Seminar	(0)*
2100828	Dissertation	9
		9

The Eighth Semester

2100894	Doctoral Dissertation Seminar	(0)*
2100828	Dissertation	9
		9

COURSE REQUIREMENTS

Elective Courses

Pattern 2.1 = 12 credits and Pattern 2.2 = 12 credits

2100600	Introduction to Biomedical Engineering	3(2-3-7)
2100601	Basic Engineering Knowledge for Biomedical Engineering	3(2-3-7)
2111602	Radiation Physics for Medical Science	2(2-0-6)
2100604	Strategic Tissue Engineering and Controlled Release System	3(3-0-9)
2100605	Biomedical Embedded System	3(3-0-9)
2100791	Biomedical Engineering Seminar I	2(2-0-6)
2100792	Biomedical Engineering Seminar II	2(2-0-6)
3017767	Human Body for Biomedical Engineering	3(2-3-7)
2100603	Research Methodology and Research Instrumentation	3(3-0-9)
2109556	Biomaterials	3(3-0-9)
3000748	Tissue and Cell Engineering	3(3-0-9)
3000749	Biosystems and Biotransport	3(3-0-9)
3000750	Drug Delivery System	3(3-0-9)
2102611	Medical Instrumentation	3(3-0-9)
2102646	Power Electronics for Biomedical Engineering Applications	3(3-0-9)
2100623	Technology for Seniors and the Disabled	3(3-0-9)
2102631	Mathematical Modeling and Analysis of Physiological Systems	3(3-0-9)
2102523	Biomedical Signal Processing	3(3-0-9)
2102524	Medical Imaging Technology	3(3-0-9)
2110675	Biomedical Information and Communication Systems	3(3-0-9)
3016725	Biomechanics	3(3-0-9)
2100636	Biomedical Analytical Technique	3(3-0-9)
2100696	Special Problems in Biomedical Engineering	3(0-0-12)
2100697	Individual Study	3(0-0-12)
2100796	Advanced Topics in Biomedical Engineering I	3(3-0-9)
2100797	Advanced Topics in Biomedical Engineering II	3(3-0-9)
2102505	Introduction to Optimization Techniques	3(3-0-9)
2102507	Computational Techniques for Engineers	3(3-0-9)
2102531	System Identification	3(3-0-9)
2102635	Control System Theory	3(3-0-9)
2102668	Biosensors	3(3-0-9)
2102546	Analog Integrated Circuits	3(3-0-9)
2102784	Measurement System Design and Simulation	3(3-0-9)
2102785	Advanced Sensor Theory	3(3-0-9)
2102876	Adaptive Signal Processing	3(3-0-9)
2105641	Biodegradable Material Engineering	3(3-0-9)

2) Thesis

2100828	Thesis	48 credits
2100829	Thesis	60 credits

on embedded system; advanced, design of embedded system for biomedical applications.

**COURSE DESCRIPTIONS IN BIOMEDICAL ENGINEERING
(M.Eng., M.Sc., Ph.D.)**

2100600 Introduction to Biomedical Engineering 3(2-3-7)

Definition of biomedical engineering and other related fields; role of biomedical engineers; introduction to technology, instruments and basic application programs required for biomedical engineering; ethics in biomedical engineering; case studies : problem and application in biomedical engineering fields; hospital and laboratory visit, and assigned projects to explore the breadth and depth of the biomedical engineering field.

2100601 Basic Engineering Knowledge for Biomedical Engineering 3(2-3-7)

Review of differential equations and transform techniques; signals, circuits and electronics; feedback mechanism, biomaterials; biomedical measurements and instrumentation; technological applications in medical practices; computer applications in biomedical engineering.

2100791 Biomedical Engineering Seminar I 2(2-0-6)
Current topics in biomedical engineering.

2100792 Biomedical Engineering Seminar II 2(2-0-6)
Current topics in biomedical engineering.

3017767 Human Body for Biomedical Engineering 3(2-3-7)

Anatomy, physiology and biochemistry of the human body, including the musculoskeletal, nervous, respiratory, cardiovascular, alimentary, urinary, endocrine and reproductive systems; physiological laboratories of systems related to biomedical engineering.

2100603 Research Methodology and Research Instrumentation 3(3-0-9)

Experimental and research methods; experimental design; statistics analysis of experimental results; operating principles of biomedical engineering tools and equipment.

2100604 Strategic Tissue Engineering and Controlled Release System 3(3-0-9)

Basic principle, strategies and components of tissue engineering and controlled release system; combination and interaction of biomaterial scaffolds, cells, and biological signaling molecules; requirements and criteria of material design for strategic tissue engineering and controlled release system; functions, applications and limitations of materials in strategic tissue engineering and controlled release system; biological response to biomaterials; mechanism of material-induced tissue regeneration and material-governed controlled release.

2100605 Biomedical Embedded System 3(3-0-9)

Embedded system technology and its biomedical applications; types and selection of embedded system for biomedical applications; basic design of embedded system; hardware and sensor interface; real-time processing based

2109556 Biomaterials 3(3-0-9)

Biological system that interacts with materials, types of materials currently used for biomedical applications; appropriate analytical techniques pertinent to biomaterial research and evaluation; selected important medical fields in which biomaterials play a critical role.

3000748 Tissue and Cell Engineering 3(3-0-9)

Basic concept for engineering of new cells and tissues: components, tissue and organ healing and regeneration processes, ligands and receptors, adhesion and migration of cells; roles of hormones, proteins, stem cells, and immunology on organ transplantation; technology for cell and tissue engineering, scaffolds, nanomaterials, controlled release of metabolites and proteins, surface modification, cell culture in 2- and 3-dimensions; including current clinical applications and future trends.

3000749 Biosystems and Biotransport 3(3-0-9)

Applications of fundamental chemical engineering principles to the study of biological systems with emphasis on current bioengineering research.

3000750 Drug Delivery System 3(3-0-9)

Applications of physical principles and modern methods of analysis to pharmaceutical systems; a conceptual introduction to the way that drugs act and are processed in vivo, including receptor theory, ligand-macromolecule binding, biopharmaceutics, drug metabolism, pharmacokinetics and pharmacodynamics.

2102611 Medical Instrumentation 3(3-0-9)

Basic concepts of amplifiers, signal processing, electrodes, biopotential, sensors, medical devices, therapeutic devices, medical imaging, electrical safety; measurement of blood pressure, blood flow, and biopotential signals; designing and constructing simple medical instruments.

2102646 Power Electronics for Biomedical Engineering Applications 3(3-0-9)

Fundamental theories of power electronics for biomedical equipment; ac-dc and dc to dc converters as well as inverters circuit topologies and operations; converter and inverter control techniques and circuits; switching and control characteristics of semiconductor power devices: diodes, transistors and thyristors; power and control circuit components: inductors, transformers, capacitors, resistors; converter and inverter applications for biomedical equipment: switching power supplies, dc and ac motor drive.

2100623 Technology for Seniors and the Disabled 3(3-0-9)

Limitations of the seniors and the disabled; geriatric ergonomics and ergonomics of the disabled; classification of tools and equipment for seniors and the disabled; design and construction technology of tools and equipment for

daily life, education and work of the seniors and the disabled.

2102631 Mathematical Modeling and Analysis of Physiological Systems 3(3-0-9)

Cellular physiology; biochemical reactions and enzyme kinetics; cellular homeostasis; ion channel; cell excitation; electrical conduction in nerve cells and cardiac muscles; mathematical modeling and analysis of physiological systems.

2102523 Biomedical Signal Processing 3(3-0-9)

Nature of biomedical signals; impulse response; frequency response; noise removal and signal compensation; modeling of continuous-time signals, discrete-time signals and stochastic signals; non-linear models of signals.

2102524 Medical Imaging Technology 3(3-0-9)

Introduction to the formation of various medical imaging modalities: computed tomography (CT), magnetic resonance imaging (MRI), and ultrasonography; image reconstruction, image enhancement, image segmentation, image representation and analysis, image registration, and image visualization.

2110675 Biomedical Information and Communication Systems 3(3-0-9)

Selected topics in information systems: multimedia technology, database system, data security and encryption; selected topics in communication systems: telecommunication, data network technology, Internet; biomedical applications of information and communication systems: telemedicine, medical data communication system in hospitals, role of information and communication technology on health care.

3016725 Biomechanics 3(3-0-9)

Review of basic solid and fluid mechanics: statics and dynamics, strength of material and basic of rheology; characteristics of skeletal system, muscular system, blood circulation system: modeling in biomechanics, with applications in various areas: human movement, artificial organs, sports, sports science; applications of biomechanics in human system and prosthetics.

2100636 Biomedical Analytical Technique 3(3-0-9)

Principles of analytical techniques for Biomedical samples related to drug delivery system.

2100696 Special Problems in Biomedical Engineering 3(0-0-12)

Literature review in the field of interest from basic to new innovation, summarizing and presenting reports.

2100697 Individual Study 3(0-0-12)

Literature review, asking research questions, conducting preliminary studies, summarizing and presenting reports.

2100796 Advanced Topics in Biomedical Engineering I 3(3-0-9)

Interesting problems or new development in Biomedical Engineering I

2100797 Advanced Topics in Biomedical Engineering II 3(3-0-9)

Interesting problems or new development in Biomedical Engineering II

2102505 Introduction to Optimization Techniques 3(3-0-9)

Review of linear algebra; solution of nonlinear equations; optimality conditions for unconstrained optimization; numerical methods for unconstrained optimization: steepest descent, Newton's, variable metric, and conjugate gradient methods; optimality conditions for constrained optimization; numerical methods for constrained optimization: penalty and barrier functions, and sequential quadratic programming; solution of linear programming by simplex method.

2102507 Computational Techniques for Engineers 3(3-0-9)

Mathematical preliminaries; computer arithmetic; solution of nonlinear equations; solving systems of linear equations; approximating functions; numerical differentiation and integration; numerical solution of ordinary differential equations.

2102531 System Identification 3(3-0-9)

Models for linear time-invariant and time-varying systems; nonparametric time- and frequency-domain methods; parameter estimation methods; convergence and consistency; asymptotic distribution of parameter estimates computing the estimate; recursive identification methods; experiment design; choice of identification criterion; model structure selection and model validation.

2102635 Control System Theory 3(3-0-9)

Mathematical descriptions of dynamic systems; solutions of linear dynamic equations; stability, controllability and observability; internal stability of interconnected systems; state feedback; optimal regulation; observers and observer-based compensation; introduction to optimal control.

2102668 Biosensors 3(3-0-9)

Necessary concepts relevant to the principle of measuring chemical and biological phenomena with emphasis on integrating these concepts of development to apply and to construct novel instruments for observing, examining and controlling various phenomena in the field of biotechnology, medical sciences and chemical engineering for both fundamental research and process development in industrial production.

2102546 Analog Integrated Circuits 3(3-0-9)

IC Technology; analog circuit modeling; device characterization; analog subcircuits; amplifiers; comparators; operational amplifiers; digital-analog and analog-digital converters; other analog circuits and systems; reference sources; multipliers.

2102784 Measurement System Design and

Simulation 3(3-0-9)

Analysis of measuring system; design of measuring system for sensors; remote sensing and non-invasive measurement; automation system; flow injection analysis; modeling of sensor system; numerical modeling; simulation of the sensor response.

2102785 Advanced Sensor Theory 3(3-0-9)

Principle and theory of physical and chemical sensors; thermodynamics and sensor operation; sensor fabrication technology; micro-machining; sensor fusion; intelligent sensors; data processing and analytical methods.

2102876 Adaptive Signal Processing 3(3-0-9)

Performance analysis of the linear and non-linear adaptive filtering; the linear filtering; method of steepest descent, least-mean square algorithm; non-linear filtering; artificial neural network using the back-propagation algorithm, radial basis function network, and (unsupervised learning based on) k-means clustering.

2105641 Biodegradable Material Engineering 3(3-0-9)

Types of biodegradable materials : synthetic and natural materials, sources and production, properties, biocompatibility, biodegradation mechanism, test methods for biodegradable plastics: polysaccharides, biopolyester, and protein (collagen, gelatin), biodegradable polymers for tissue engineering and controlled release.

2111602 Radiation Physics for Medical Science 2(2-0-6)

Atomic structure and atomic radiation, and particles, radioisotope, radioactivity, interaction of radiation and particles with matters, principles of radiation dosimetry, exposure dose, absorbed dose, radiation protection radiation effects on humans, X-ray equipment, radiation measurement radiation counting statistics phosphorescence and fluorescence screen, factors affecting radiation image quality, calculation of X-ray room shielding.

2100894 Doctoral Dissertation Seminar 0(0-0-0)

2100897 Qualifying Examination 0(0-0-0)