ICU 60th Year

Introduction to the Natural Science Majors

~ Mathematics, Information Science, Physics, Chemistry, Biology ~

数学・情報科学・物理学・化学・生物学
理学系メジャー履修計画の手引き

Aug. 31st., 2021

2021/Sept. Natural Science Major Guidance

Aug. 31st./2021

Science Foundation Courses at ICU 自然科学系基礎科目

◎: Strongly Recommended ○: Recommended

Major	Course No.	U.	L.	Autumn Term	Winter term	Spring Term	M	IS	P	C	B
数学 [M] *Math.*	MTH102	3	J			Intro. to Mathematics					◎
	MTH102	3	E	Intro. to Mathematics							
	MTH101	3	J		Calculus I		◎	◎	◎	◎	
	MTH103	3	J	Linear Algebra I			◎	◎	◎	◎	◎
	MTH103	3	E		Linear Algebra I						
情報科学 [IS] *Info.Sci.*	ISC103	3	E			Fnd. of Computers	○	◎	○	◎	◎
	ISC104	3	E	Fnd. of Programming				◎			
	ISC106	2	J		Lab. in Info. Science			○			
	ISC101	2	J			Information Ethics		◎			
	ISC102	2	E		Elemt. of Discrete Math.			○			
物理学 [P] *Physics*	PHY106	2	J			Hot topics in Physics	○		◎	◎	◎
	PHY102	2	E	Intro. to Physics							
	PHY102	2	J	Intro. to Physics							
	PHY103	2	E		Fnd. of Physics				◎		
	PHY104	2	E		Intro. to Physics Lab.				◎		
	PHY105	2	J			Fnd. of Physics Lab.					
化学 [C] *Chemistry*	CHM104	2	J	Intro. to Chemistry					○	◎	◎
	CHM101	2	E		Concepts in Chemistry						
	CHM103	2	J			General Chemistry				◎	
	CHM102	2	E			Fnd. of Chem. Lab.				◎	◎
生物学 [B] *Biology*	BIO102	2	J			Intro. to Biology				◎	○
	BIO101	2	J,E		Fnd. of Biology						◎
	BIO103	2	J			Lab. in Fnd. of Biology					◎
	BIO104	2	J	Fnd. of Biochemistry							◎

1) Right 5 columns shows "Recommended courses" of each major. Math[M], Info. Sci. [IS], Pysics [P], Chem. [C], Biol. [B]

◎: Strongly recommended ○: Recommended

2) You should choose more than the number of symbols from courses in a connected column.

3) At least 6 of these must be from students' chosen major; students with a minor or a double major must have at least 6 credits from each major and minor.

General Education Courses for Science Majors 自然科学系一般教育科目

Three GE courses below are strongly recommended courses for Natural Science students.

Major	Course No.	U.	L.	Term	科目名	M	IS	P	C	B
Math., Info. Sci., Physics, Chemistry, Biology	GEN052	2	E	Winter	N2:History of Science 科学史(3rd year)	◎	◎	◎	◎	◎
	GEN053	2	E	Spring	N2:Philosophy of Science 科学哲学(4th year)	◎	◎	◎	◎	◎
	GEN041	3	J	Autumn	N1:Senior Integrating seminar in Natural Sciences 自然科学総合演習(4th year)	◎	◎	◎	◎	◎

Biology

Faculty Members

Prof. Tsuyoshi Mizoguchi
Plant circadian rhythm

Prof. Tatsuo Nunoshiba
Molecular Genetics in Microbes, Genetic Toxicology

Prof. Makito Kobayashi
Reproductive Biology
Fish behavior,
Animal Physiology

Prof. Hiroyuki Kose
Developmental Biology

Assoc. Professor
Takehiko Kamito
Animal Ecology,
Conservation Biology

Biology
Major Advisor

Assoc. Professor
Ryosuke Hayama
Molecular Genetics of Plant Environmental Responses

Assoc. Prof.
Sabine Gouraud S.S.
Cell Biology
Blood pressure regulation

Bio Major
Moodle Page

Biology Model Schedule for 2021 September Students

Aug.31, 2021

Year	Term	JLP	PE	GE	$	Foundation	units	$	Major	units	$	Elective	units	Total
2021	Fr.	A	3～6	1+	#9	(Lin. Alge. I)	3							13+1/3
				1/3	#8	Intro. Calculus (E)	3							
					#4	**Intro. Chem**	2							
					#5	Intro.Physics (E)	2							
		W	3～6	1+	#1	**Fnd of Biology (J&E**	2				#7	Lab. Info. Sci.	2	13+1/3
				1/3	#6	Intro Phys Lab (E)	2				#5	Fnd Phys (E)	2	
					#4	**Concepts Chem (E)**	2							
					#9	Lin. Alge. I (E)	3							
2022		S		1/3	3	#3 **Lab. Fnd Bio**	2	#10	**BC Genetics (E)**	2	#4	General Chem.	2	13+1/3
						Intro. Biol.	2	#10	**BC Cell Biol (E)**	2	#5	Hot Topics Physics	2	
					#6	Fnd. Chem. Lab(E)	2				#6	Fnd Phys Lab	2	
					#8	Calculus I (E)	3							
					#8	Intro. Math	3							
					#7	Info. Ethics	2							
	So.	A		(1/3)	3	#2 **Fnd Biochem (E)**	2	#11	**Lab. in Biology**	2		(Exp. in Chem.)	2	13~15
								#10	**BC Plant Phys**	2				(+1/3)
									Adv.Cell Biol.(E)	2				
									Field Study Biol #Sum	1				
		W		(1/3)	3			#10	**BC Animal Develop.**	2		(Organic Chem. I)	**2**	13~15
														(+1/3)
2023		S		(1/3)	3				**Biostatistics**	2		(Org. Chem.Lab.)	2	13~15
									Animal Dev. Biol.	2		(Organic Chem. II)	2	(+1/3)
									Plant Phys	2				
								#12	**Lab. Ani. Dev.**	2				
								#12	**Lab Mol. Genet. #Spr**	2				
	Jr.	A			3				**Ani. Physiology**	2		(Organic Chem. III)	2	13~15
									Animal Biology	2				
									Microbiology	2				
								#12	**Lab.Animal Cell Biol.(E**	2				
								#12	**Lab. Ani. Physiology**	2				
								#12	**Lab. Biochem. I #Sum**	2				
								#12	**Lab. Plant Physiol. #Su**	2				
									Adv. Sem. II	2				
		W			2				**Ecology**	2				13~15
				(HistorySci)					**Neurobiology**	2				
									Plant Development	2				
									Biochemistry	2				
								#12	**Lab Microb. Genetics.**	3				
									Adv. Sem. III	2				
2024		S			2				**Adv. Sem. I**	2				13~15
				(PhilosSci)										
	Sr.	A			2				**Adv. Std. II**	2				
					SIS				**Sr. Thesis**	3				
		W							**Sr. Thesis**	3				
		S							**Adv. Std. I**	3				
									Sr. Thesis	2				
			(8)	2～4	15～27	MajorFdn 6 + 12			Area Major 30 + Sr. Thesis 9			18～38		136

BOLD Course title: Offered as Biology Major Courses.

#Spr,#Sum,#Aut : Offer during Spring, Summer or Autumn recess.

: Strongly recommended Biology courses

◎Strongly recommended courses for the Biology Major students. (Column $)

A: Foundation Courses

#1. Fnd. of Biology Offered both E and J course

#2. Fnd. of Biochemistry

#3. Lab. Fnd, Biology

#4. At least one of three introductory chemistry lecture course.

(Intro. Chem, Concepts Chem, General Chem.)

(Intro. Chem, and Concepts Chem, are co-listed as the Biology MajorFoundation Course.)

#5. At least one of three introductory physics lecture course.

(Hot Topics Physics, Intro. Physics, Fnd Physics)

#6. At least one Found. Lab. courses from Chem. or Phys.

(Fnd. of Chemistry Lab. , Intro. Physics Lab. , Fnd. of Physics Lab.)

#7. At least one Found. courses from Information Science.(Info. Ethics,Lab. Info. Sci.)

#8. At least one Calculus course. (CalculusI or Intro. Calculus)

#9. Linear Algebra I (Autmn term in Japanese , Winter term in English. Either course uses an English text book.)

B: Area Major Courses

#10. Four "Basic Concepts Biology" courses

#11. Lab. in Biology

#12. At least 3 Biology Laboratory courses

◎Strongly recommended courses for the Biology Minor students. (Column $)

#10. At least three courses out of four "B.C. XXX" Biology courses.

#11. Lab. in Biology

#12. At least one Biology Laboratory courses

◎ Major declaration requirements :

Foundation of Biology or **Introduction to Biology**

◎ Area major requirements :

Foundation

	Sr.thesis Major	(2nd) Major	Minor	Non-major	elective
Single Major	6			12	
Double Major	6	6		6	
Major Minor	6		6	6	

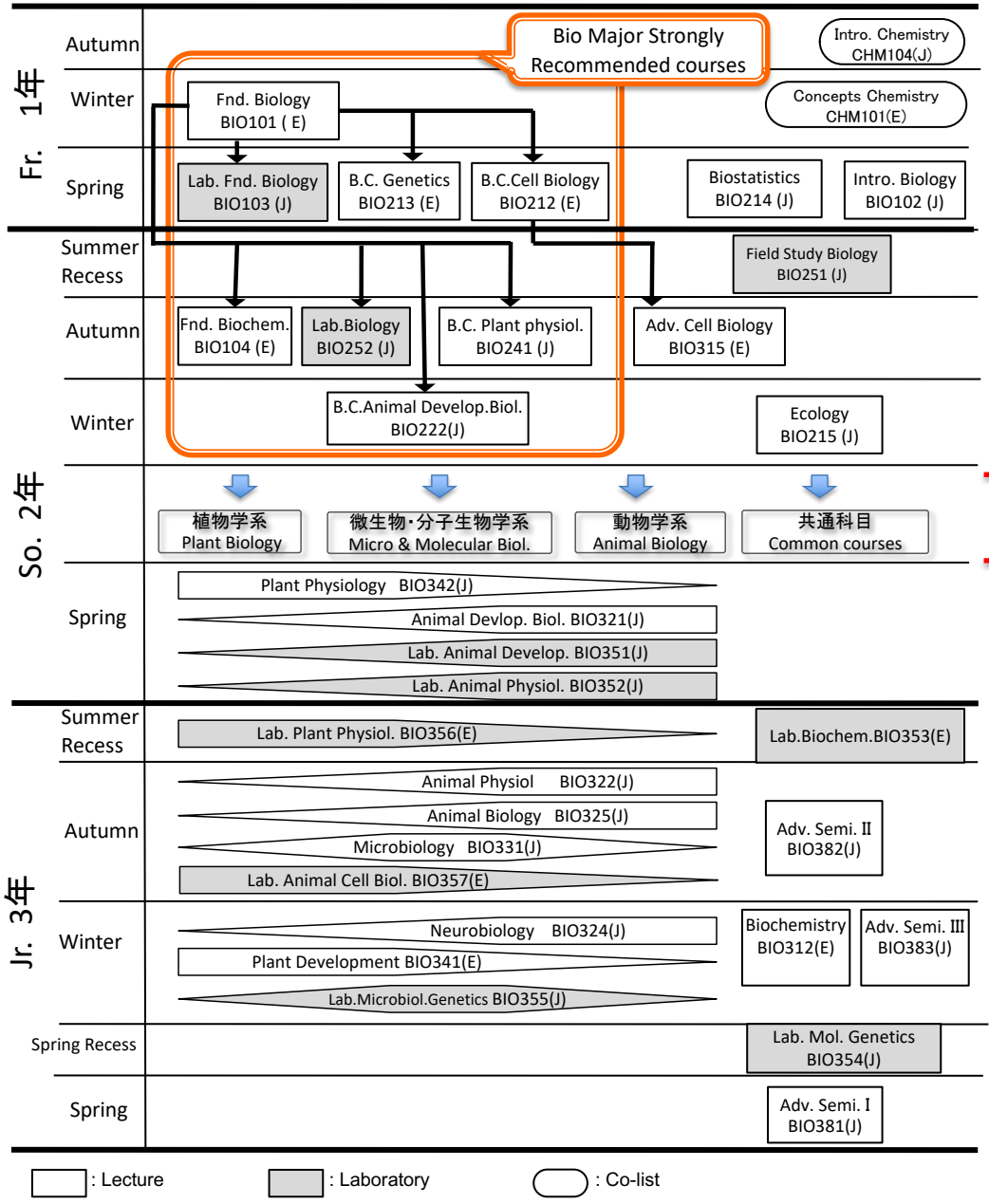
Area Major

	Sr.thesis Major	(2nd) Major	Minor	Non-major	elective
Single Major	21				41
Double Major	21	30			11
Major Minor	21		15		26

AY 2021/9

2021/8/31

Four-year Course flow



Legend

:Biology Major Courses

:Laboratory courses

:Related courses non-Biology major

*****学 BIO***(J)

The bolded part of the diagram is the subject you should take if you want to study the category directly above.

The narrower part of the diagram is for subjects that you can take at your convenience when learning the category directly above.

These categories does **NOT** mean that you must choose any one category.

Biology Courses (2021)

: 生物専修生に履修を強く勧める科目 Strongly Recommended courses for Biology Major students.

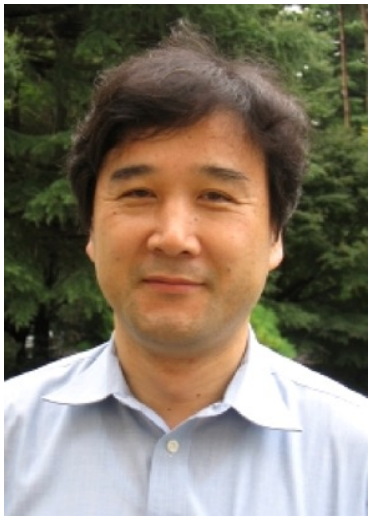
Revised Aug 19/2021

Course Number	Title	Unit	Term	Lang.	Course Description	Remarks
BIO 101	Foundation of Biology 基礎生物学	2	W	J&E	Basic concepts in microbiology, plant biology and animal biology will be introduced as a team-taught course. There will be strong emphasis on text book reading and assignment work. 微生物・植物・動物についての生物学的基本概念を教授する。教科書の精読による内容理解と、課題完成に力点を置いた指導を行う。	The course assumes preliminary knowledge equivalent to high school biology. 高等学校での「生物」履修程度の知識を前提とする。
BIO 102	Introduction to Biology 生物学入門	2	S	J	To learn about the fundamental properties of life. The roll of cell, expression system of genetic information, evolution and biodiversity are presented. The content of lecture is not premised on the completion of high school biology. 生命現象を支える基本的単位としての細胞、遺伝のシステムなどのミクロの領域、および、生物の進化と生物多様性などのマクロの領域について、実例を交えながら学ぶ。入門レベルの内容で、身近な私たちの体や生活、或いは社会との関わりを意識した内容。	The content of lecture is not premised on the completion of high school biology 高校「生物」の既修を前提としない。
BIO 103	Lab. in Foundation of Biol. 基礎生物学実習	2	S	J	Various basic experiments on life phenomenon. Microscopic observation, Field observation and various experiments on plant and animal structure, function or behavior. 顕微鏡を用いた観察、植物、動物の構造や機能、行動に関する実験、野外の動植物の観察等、生物学の基礎的な各種の実験	
BIO 104	Foundation of Biochemistry 基礎生化学	2	A	E J(2021)	To study chemical basis of life. Introduction to the chemical nature and biological properties of low-molecular-weight substances and biopolymers as well as the biochemistry of basic cellular metabolism. 生命の化学的基礎について学ぶ。低分子物質及び生体高分子の化学的性質と生物学特性ならびに基本的細胞代謝の生化学の概論。	**AY2021, Offered in Japanese** 2021年度のみ、日本語開講
BIO 212	Basic Concepts in Cell Biology 細胞生物学概論	2	S	E	The basic components of the cell are presented, including the plasma membrane, mitochondria, chloroplasts, the nucleus and the endomembrane system. There is a strong emphasis on function. 細胞の基本的な構成要素である、細胞膜、ミトコンドリア、葉緑体、核とそれらをつなぐ Endomembrane systemについて学ぶ。特にそれぞれの機能に焦点を当てる。	Recommended to be taken after BIO101 or 102. BIO101 または 102 の既修が望ましい。
BIO 213	Basic Concepts in Genetics 遺伝学概論	2	S	E	Genes are the basic replicating feature of living organisms. Already there is a substantial amount known about genes and complex mechanisms by which genetic information is expressed and regulated. During the development of the field of Molecular Biology, the techniques for examining the fine structure ofgenetic elements (genes) have established. Such techniques are now helping us gaining a clear understanding of life. 生命体共通の特徴であり、同時に、生命体の基本になっている遺伝現象について、基本的な遺伝法則の発見からの流れをたどりながら今日の分子生物学までを、遺伝子の実体、遺伝情報の発現・調節機構、等について、学習・考察する。	Offered in English after AY2022 2022年度より英語開講
BIO 214	Biostatistics 生物統計学	2	S	J	Study of the basic concepts of biostatistics and the fundamental statistical methods used to analyze experimental data. 生物学データの処理と文献理解に必要な統計学の一般理論，実験計画法の基本に関する講義と若干の演習を行なう。	
BIO 215	Ecology 生態学	2	W	J	General and basic concepts (theories) and methods of ecological studies. 生態学の一般的，基礎的な理論と技術等。	
BIO 222	Basic Conc. in Animal Develop. Biol. 動物発生生物学概論	2	W	J	Basic process and mechanism of development including growth, differentiation and morphogenesis in animals. Genetic basis of development in animals is also presented. 動物の発生における成長、分化、形態形成の基本的過程とそのメカニズム。動物の発生を制御する遺伝子の働きについて学ぶ。	Not Offered in 2021 2021年度は開講されない
BIO 241	Basic Conc. in Plant Physiology 植物生理学概論	2	A	J	Basic concepts of plant physiology, especially focusing on photosynthesis and plant growth and development. 光合成，植物の発生・成長など，基本的な植物生理学の概念を理解する.	Recommended to be taken after BIO101 or 102. BIO 101 または 102 の既修が望ましい。
BIO 251	Field Study in Biology 生物学野外実習	2	A	J	Through field observations in the field, classifications, anatomy and ecological relations of plants, insects or mammals are studied. 本学キャンパス、及び東京近郊のフィールドでの野外観察を通して、植物、昆虫、鳥類等の形態、行動、生物間の生態的な関わりを学ぶ	No prior knowledge required 履修の前提となる知識は必要としない
BIO 252	Laboratory in Biology 生物学実習	2	A	J	Fundamental experiments on biological materials using basic techniques for biochemical experiments. タンパク質、核酸等の生体構成成分に関する基礎実験を通して、生体構成成分の性質、取り扱いと、一般的な実験手法を身につける。	Recommended to be taken after BIO 103 BIO103基礎生物学実習の既修が望ましい。
BIO 312	Biochemistry 生化学	2	W	E	Nitrogen cycle in the biosphere, biological nitrogen fixation, biosynthesis and catabolism of amino acids, proteins, nucleic acids, porphyrins, etc. 生物圏における窒素循環，生物による窒素固定，アミノ酸，タンパク質，核酸，ポルフィリン類の生合成と分解。	Recommended to be taken after BIO 104 BIO 104 基礎生化学の既修が望ましい。
BIO 315	Advanced Cell Biology 細胞生物学	2	A	E	This course focuses on the functions of the animal cell integrated into a tissue. This course will cover Cell-to-Cell Junction, Cell-Cell Communication, Cell Signaling Pathways, Cell Division and Cell Death. The regulation of these processes will be discussed. 組織を形成する動物細胞の機能について学習する。特に細胞間接合、細胞間コミュニケーション、細胞シグナル伝達経路、細胞分裂、および細胞死に力点を置く。これらのプロセスの制御機構についてもとりあげる。	This course is recommended to be taken after BIO101 and BIO212. In 2022, the course title will change.（" Cell Dynamics " in 2021.） 基礎生物学実習と細胞生物学概論の既修が望ましい。2022年度から，コース名変更。
BIO 321	Animal Developmental Biology 動物発生生物学	2	S	J	Cellular and molecular mechanisms of morphogenesis and pattern formation in animal development, and evolutionary aspects. 主として動物の発生における形作りやパターン形成のメカニズム、及びそれらの進化的側面を学ぶ。	

Course Number		Title	Unit	Term	Lang.	Course Description	Remarks
BIO	322	Animal Physiology 動物生理学	2	A	J	Animal structure,function, digestive system, respiratory system, osmoregulation, excretory system, endocrine system, and reproduction. 動物の形態と機能、消化吸収、呼吸、浸透圧、排出、内分泌、生殖などについて学ぶ。	In AY 2022, course title will be change 2022年度にコース名変更。
BIO	323	Animal Physiology II 動物生理学 II	2	W	J	Nervous system, sensory system, motor system, and defense system. 神経、感覚、運動および生体防御などについて学ぶ。	In AY 2022, Course will not offer. 2022年度以降、開講されない予定
BIO	324	Neurobiology 神経生物学	2	W	J	Basic cell physiology focusing on the physiological properties of the cell membrane and the physiology of the neuron. 細胞生理学の基礎を、細胞膜の生理学的性質とニューロンの生理学を中心に学ぶ。	
BIO	325	Animal Biology 動物学	2	A	J	Living organisms show diversity from body structure to behavior. To understand the diversity, symbiotic relationship is a key concept. This course deals with diverse animal body structure, metamorphosis or related life history from the viewpoint of symbiotic relationship. 生物は、発生・成長の過程、体の構造、そして行動まで、実に多様な形質を示す。この多様性を解き明かすキーワードとして「共生」の概念を中心に据え、動物の体の構造と変態の機構、及び生態について学ぶ。	Recommended to be taken after BIO101 or 102. BIO101 基礎生物学 または、102 生物学入門の既修が望ましい。
BIO	331	Microbiology 微生物学	2	A	J	Principles of evolution can provide an overarching theme to the course. The DNA replication, transcription, translation, cellular structures, metabolic pathways, regulatory signals, and genetic exchange mechanisms exhibited by microorganisms at present are the products of natural selection. In addition, evolutionary processes can be observed in the microbial world today, in cases such as antibiotic resistance, xenobiotic biodegradation, and the coevolution of hosts and pathogens. 進化の原理は本科目の全体を通した主題である。現在の原核生物に見られるDNA複製、転写、翻訳、細胞構造、代謝経路、制御要因や遺伝子水平伝達機構等は自然選択の結果である。更に、今日の微生物界では薬剤耐性、人工化学物質の生分解、宿主と病原菌の共進化等の現象に現在も進化過程が見られる。	Recommended to be taken after BIO101, 104 and 213. BIO101基礎生物学、104基礎生化学、213遺伝学概論の既修が望ましい。
BIO	341	Plant Development 植物発生学	2	W	E	Development of plant tissue from meristems. 分裂組織からの植物組織の発生過程について学ぶ。	Recommended to be taken after BIO101,212,315 BIO101,212,315の既修が望ましい。
BIO	342	Plant Physiology 植物生理学	2	S	J	Plant growth and development, and their regulation mechanisms controlled by genes, environmental factors and plant hormones. 植物の発生・成長・分化の制御について，遺伝情報，環境因子，ホルモン等による調節機構を学ぶ。	Recommended to be taken after BIO101 or 102 BIO101 または102 の既修が望ましい。
BIO	351	Lab. in Animal Development 動物発生学実習	2	S	J	Preparation and observation of tissue samples of chick embryos. Experiments on regulation of planarian regeneration. ニワトリ胚の標本作製と観察。プラナリアの再生実験。	
BIO	352	Lab. in Animal Physiology 動物生理学実習	2	S	J	Animal dissection and observation of cells. Basic experiments on cell and animal behavior. 動物の解剖、細胞の観察及び基礎的な実験、行動実験を行う	Strongly recommended to be taken simultaneously with or after BIO322. BIO 322 を同時履修、或いは既修が望ましい。
BIO	353	Laboratory in Biochemistry 生化学実習	2	A	E	Experiments on the metabolism of carbohydrates and lipids. Isolation of related enzymes and their reactions. 炭水化物・肪質の合成・代謝及び，酸素的反応速度論に関する実験。	
BIO	354	Lab. in Molecular Genetics 分子遺伝学実習	2	S	J	Understanding of basic and molecular genetics aspect using microorganism and Drosophila melanogaster. 微生物とキイロショウジョウバエなどを用いた分子遺伝学的実験手法により、実態としての遺伝子と基本的遺伝法則の確認を目指す。	Recommend. to be taken after BIO104,212,213, 252. BIO104 、213 、212 、252 の既修が望ましい。
BIO	355	Lab. in Microbial Genetics 微生物遺伝学実習	3	W	J	This lab course focuses on the investigative nature of microbiology to promote understanding of various biological systems in microbes, such as responses to environmental changes and stresses, through experiments using microbial cells, bacteriophages, DNA, and essential techniques such as asepsis. 微生物細胞、バクテリオファージやDNA、そして無菌操作などの手法を用いた実験により、生育環境変化に伴う遺伝子発現の変化やDNAの障害に対する防御の 仕組みなどの生命現象の分子機構について理解を目指す。	Recommended to be taken after BIO 101, 103, 331 and 252. BIO101基礎生物学、103遺伝学概論、331微生物学、252生物学実習の既修が望ましい
BIO	356	Lab. in Plant Physiology 植物生理学実習	2	A	E	Experiments on photosynthesis, water relationships, regulatory mechanisms of plant growth and development. 光合成，水分整理，植物の発生および成長における制御機構等についての実験。	
BIO	357	Lab. in Animal Cell Biology 動物細胞生物学実習	2	A	E	Students learn basic knowledge and techniques used in animal cell biology. 動物細胞生物学の実習を通して知識を学び、基本的な実験手法を身につける。	This course is recommended to be taken after BIO212, 213, 315 and 103. In 2022, the course title will change. BIO212,213,315、および103の既修が望ましい。2022年度からは，コース名変更。
BIO	381, 2, 3	Advanced Seminar in Biology I & II & III 生物学特別演習 I & II & III	2	S,A,W	J or E	Independent study of topics of special interest and value to the student in his/her major field. Permission of the instructor(s) is required. Language of instruction differs by section. 生物学に関する専門的な内容を学ぶ。内容は担当教員により決定される。セクションにより、開講言語が異なる。	担当教員の受講許可を要する。
BIO	384, 5	Advanced Studies in Biology I & II 生命科学特論 I & II	2	S,A	J or E	Students will study how biological research is conducted by reading original research papers. Language of instruction differs by section. 生物学の研究がどのように行われるかについて、研究論文を題材として学ぶ。セクションにより、開講言語が異なる。	This course is mainly for senior thesis students 主に卒業研究の学生を対象にしたコース

Chemistry

化学メジャー
専任教員



Prof. Kenya KUBO
久保 謙哉 教授
(Radiochemistry/ 放射化学)

Prof. Julian R. Koe
ジュリアン コウ 教授
(Inorganic Chemistry/
無機化学)

Prof. Wang-Jae CHUN
田 旺帝 教授
(Physical Chemistry/
物理化学)

Sr. Assoc. Prof.
Junji KOBAYASHI
小林 潤司
上級准教授
(Organic Chemistry/
有機化学)

Sr. Assoc. Prof.
Chika MINEJIMA
峰島 知芳
上級准教授
(Analytical Chemistry/
分析化学)

Major advisor

Model Schedule for Chemistry-Major (September Students)

Year	Term	Lng (LG) (?)	Phys Edu (PE) (4)	Gen Edu (GE) (21)	Foundation (NS)(6+12)	Unit	Area Major I (AM-I)(18) CHM2XX courses	Unit	Area Major II (AM-II)(32) CHM3XX courses	Unit	Electives (EL)	Units	Total
FR 2021	A		1+ 1/3	3	INTRO PHYS**(E)	2					△INTRO CHEM (J)	2	13 + 1/3 or
											INTRO MATH (E)	3	14 + 1/3
											LIN ALG I (J)	3	
											FND PROGRAM (E)	2	
	W		1/3	3	☆CONCEPT CHEM	2					CALCULUS I (J)	3	13 + 1/3 or
					LIN ALG I (E)	2					INTRO PHY LAB*** (E)	2	14 + 1/3
											LAB INFO SCI (J)	2	
											FND BIO* (J&E)	2	
											FND PHYS** (E)	2	
2022	S		1/3	0	☆GEN CHEM	2	MATH FOR NS	2			HOT TOP MATH (J)	2	13 + 1/3 or
					☆FND CHEM LAB	2					INTRO MATH (J)	2	14 + 1/3
					CALCULUS I (E)	3					FND COMP (E)	3	
											HOT TOP PHY** (J)	2	
											INFO ETHICS (J)	2	
											FND PHY LAB (J)	2	
											INTRO BIO* (J)	2	
											LAB FDN BIO*** (J)	2	
SO 2022	A			3-6	FND BIOCHM (E)	2	ANA CHEM I	2					13
							INORG CHEM I	2					
							EXP IN CHEM	2					
	W			3-6			ANA CHEM LAB	2	INORG CHEM II	2	ELM DISC MATH* (E)	2	13
							ORG CHEM I	2	ANA CHEM II	2			
2023	S			3-6			ORG CHEM LAB	2	INORG CHEM III	2			13
							PHYS CHEM I	2	ORG CHEM II	2			
							PHYS CHEM LAB	2					
JR 2023	A								PHYS CHEM II	2			13
									INORG CHEM LAB	2	(LAB IN BIOCHEM:	2	
									SELTOP INOR CHEM $	2	AUTUMN BREAK)		
	W			HISTORY of Science 2					PHYS CHEM III	2	BIOCHEM	2	12
									ADV LAB CHEM I	2			
									ADV LAB CHEM II	2			
2024	S			PHILOSOPHY OF SCIENCE 2					STD CHEM RES I	2			9
									SELTOP ORG CHEM $	2			
SR 2024	A			SIS 3					STD CHEM RES II	2	GERMAN/FRENCH		7
									SENIOR THESIS I	3	ETC.		
									SELTOP ANA CHEM $	2			
	W								SENIOR THESIS II	3			5
									SELTOP PHYS CHEM $	2			
2025	S								SENOR THESIS III	3			3
REQ. UNITS		**?**	**1+1**	**21 (INC. Introduction to Christianity 3UNITS)**	**18 (INC. CHEM FND (☆, 6 UNITS) TO BE COUNTED AS AREA MAJOR UNITS)**		**・SINGLE MAJOR: 30 (Including SENIOR THESIS 9) ・MINOR: 15**		**AREA MAJOR II TO BE COUNTED AS ELECTIVES As many Area Major I and II courses are recommended to be taken**				**136**

☆ : Strongly recommend as Chem major Foundation courses (Total 6 units) $: offered in alternate years

△ : Recommend course to whom did not take al the chemistry courses in high school. Strongly recommend to take this course before doing ☆ courses.

＊ : Recommend to take either one courses which marked with ＊

＊＊ : Recommend to take either one courses which marked with ＊＊

＊＊＊ : Recommend to take either one courses which marked with ＊＊＊

・**Pre-requirement for Chemistry major:**

1) Major, Minor or Double Majors all require one course from Introduction to Chemistry, Concepts in Chemistry, General Chemistry, Foundation of Chemistry Lab.

2) No grade requirement.

・**Courses strongly recommended for Chemistry Major:**

1) Foundation courses (FD): Chemistry FD (Concepts in Chemistry+General Chemistry+Foundation of Chemistry Lab=Total 6 units), Math FD(3+3) and one FD course each from Physics, Computer Science, Biology(2+2+2), as well as one Lab FD course from Physics, Computer Science, Biology (2: lab course will be elective)

2) Area Major courses(AM): Area Major I + as many AM II courses as possible. Special Studies in Chemistry I, II should be included.

・**Courses strongly recommended for Chemistry Minor:**

1) Foundation courses (FD): Concepts in Chemistry+General Chemistry+Foundation of Chemistry Lab = 6 units

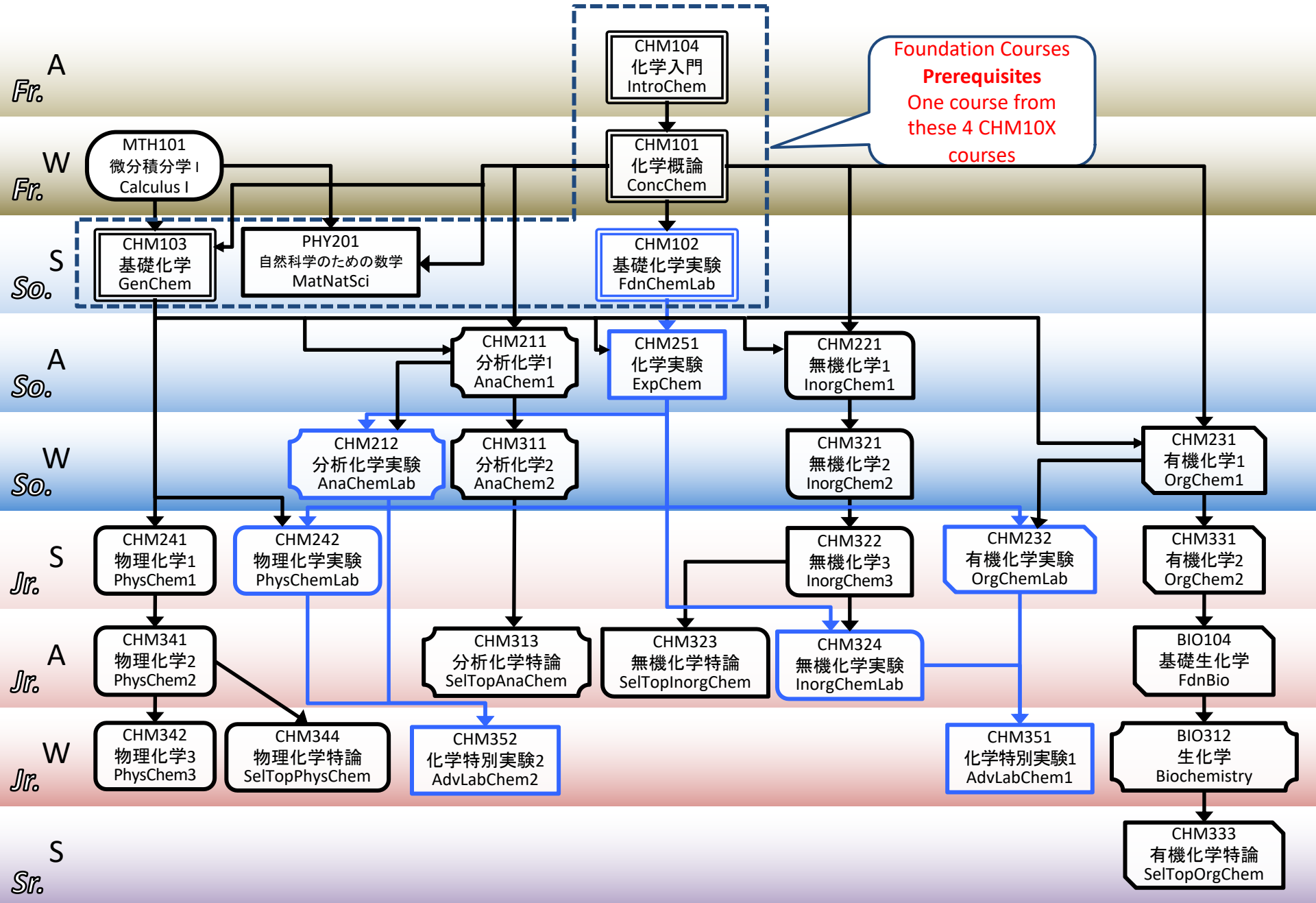
2) Area Major courses(AM): 15 units from Area Major I (18 units)

・Required units（Single major）

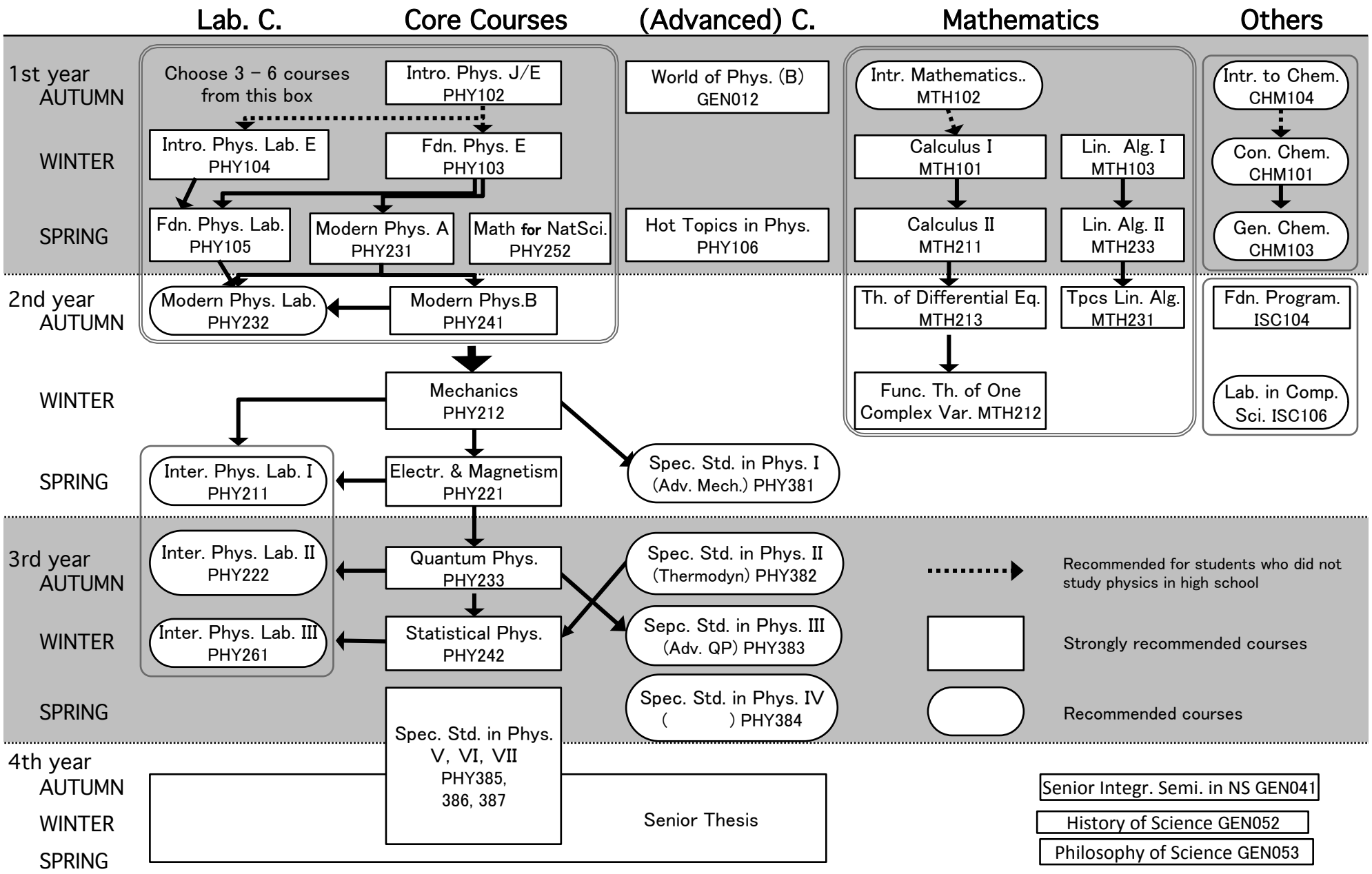
Courses	Units	Comment
LNG	?	
GEN	21	INC. Intro. to Christ 3units
PE	2	
FND	18	INC. CHEM FND (☆, 6 UNITS)
AM	21	
EL	?	Depends on your LNG requirements
Thesis	9	
Total	136	

NS:6 units, HS: 3 units, SS: 3 units

Chemistry Major Curriculum Flowchart

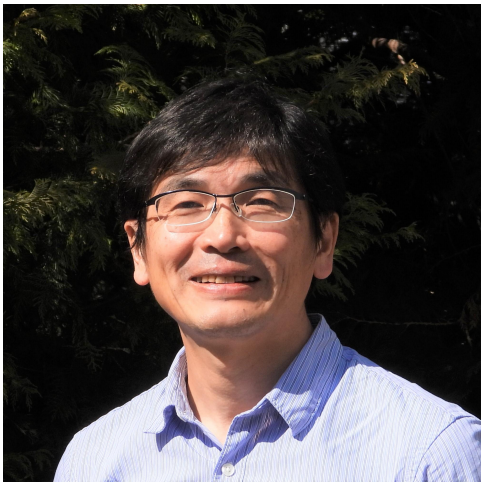


Flow Chart for Physics Major

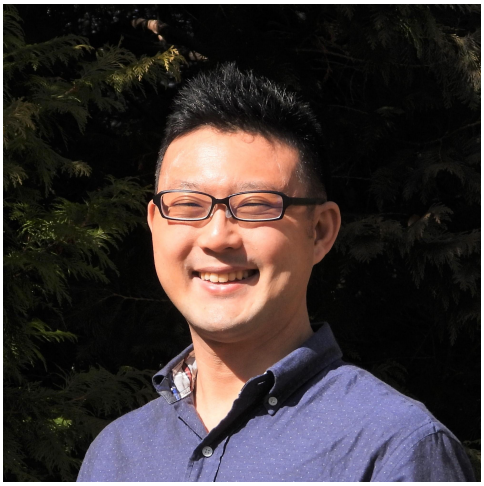


Information Science

Faculty Members



Keisuke Ishibashi
石橋 圭介
Major Advisor



Takashi Kaburagi
鏑木 崇史

Keiji Ohta
太田 啓路

Keiji Osaki
尾崎 敬二

Andrea Matz
マツ, アンドレア
Major Advisor

情報科学メジャーの科目　Information Science Major Courses

全学共通科目（一般教育科目） College-Wide Programs (General Education)

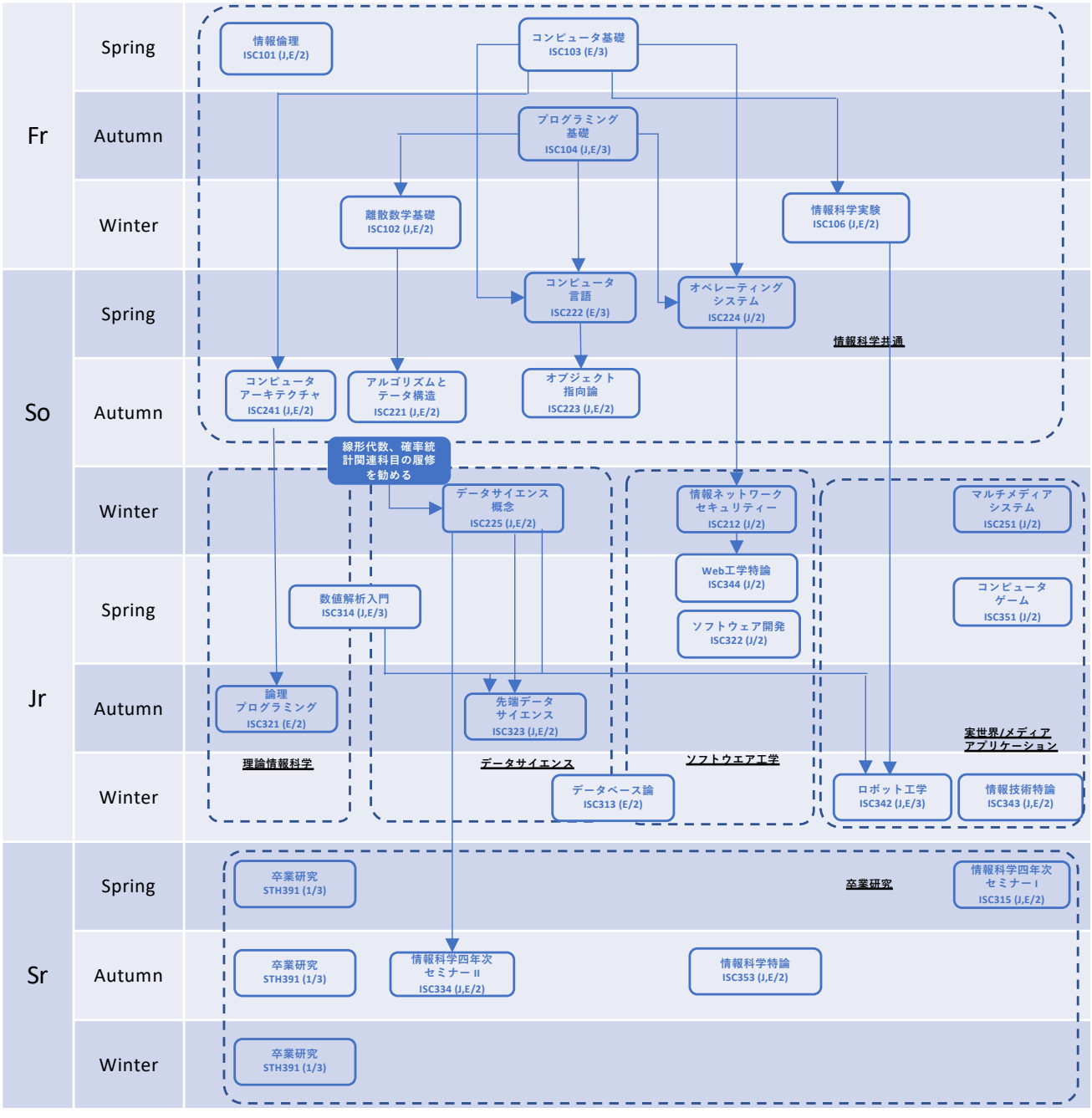
Course No. 科目番号	Course Title	科目名	Unit 単位
GEN000			
GEN021	Computers and Human Interaction	コンピュータと人間	3
GEN023	Introduction to Computer Science	情報科学概論	3
GEN026	Ideas of Data Science	データサイエンスの考え方	2
GEN061	Computer Literacy	コンピュータ・リテラシー	2
GEN062	Digital Network Information Literacy	ネットワーク情報活用	2
GEN063	Multimedia Communication Literacy	理解のためのマルチメディア	2

情報科学メジャー　Information Science Major

Course No. 科目番号	Course Title	科目名	Unit 単位
ISC100			
ISC101	Information Ethics	情報倫理	2
ISC102	Elements of Discrete Mathematics	離散数学基礎	2
ISC103	Foundation of Computers	コンピュータ基礎	3
ISC104	Foundation of Programming	プログラミング基礎	3
ISC106	Laboratory in Information Science	情報科学実験	2
ISC200			
ISC212	Information Network Security	情報ネットワークセキュリティー	2
ISC221	Algorithms and Data Structures	アルゴリズムとデータ構造	2
ISC222	Computer Languages	コンピュータ言語	2
ISC225	Data Science Concepts	データサイエンス概念	2
ISC223	Object-Oriented Method	オブジェクト指向論	2
ISC224	Operating Systems	オペレーティングシステム	2
ISC231	Boolean Functions and Logic Circuit Design	論理関数とその応用	2
ISC241	Computer Architecture	コンピュータアーキテクチャ	2
ISC251	Multimedia Systems	マルチメディアシステム	2
ISC300			
ISC313	Database Systems	データベース論	2
ISC314	Numerical Methods in Science	数値解析入門	3
ISC315	Senior Seminar in Information Science I	情報科学四年次セミナー I	2
ISC321	Logic Programming	論理プログラミング	2
ISC322	Software Development	ソフトウエア開発	2
ISC323	Advanced Data Science	先端データサイエンス	2
ISC333	Seminar in Theory of Computation	計算理論セミナー	2
ISC334	Senior Seminar in Information Science II	情報科学四年次セミナー II	2
ISC342	Robotics	ロボット工学	3
ISC343	Topics in Information Technology	情報技術特論	2
ISC344	Topics in Web Technology	Web工学特論	2
ISC351	Computer Games	コンピュータゲーム	2
ISC353	Topics in Information Science	情報科学特論	2
STH391	Senior Thesis	卒業研究	9

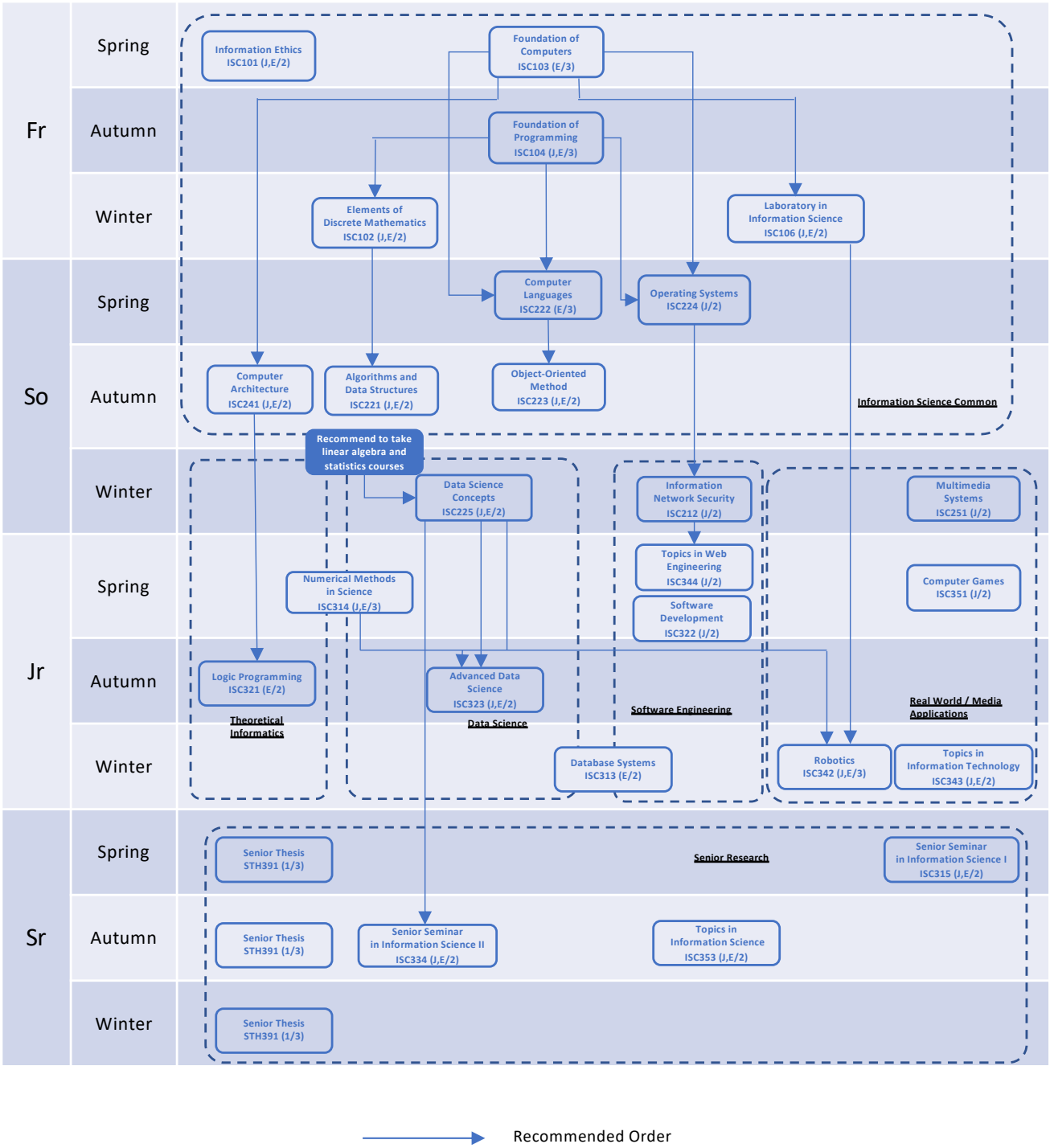
カリキュラムツリー

- ISC103コンピュータ基礎、ISC104プログラミング基礎 or ISC106情報科学実験、ISC221アルゴリズムとデータ構造, ISC224 オペレーティングシステムは、情報科学メジャーのコア科目であり、メジャー選択前の履修を強く勧める。
  - 特にプログラミング未経験者は、200番台の講義履修前にプログラミング基礎もしくは情報科学実験でプログラミングを学ぶこと。
- 情報倫理は他の科目とは独立であり、いつ履修しても問題ない。
- データサイエンス系科目の履修にあたっては、事前に確率統計の基礎、線形代数の基礎を学ぶことを勧める。



Curriculum Tree

- "ISC103 Foundation of Computers", "ISC104 Foundation of Programming" or "ISC106 Laboratory in Information Science", and "ISC 221 Algorithm and Data Structures", "ISC224 Operating Systems" are the core courses of Information Science (ISC) major and strongly recommended before ISC major declaration.
  - Specifically, students who do not have any programming experience must learn programing at ISC104 or ISC106 before taking 200-series courses.
- "ISC101 Information Ethics" is an independent course and can be taken at any time.
- Before taking Data Science related courses, it is recommended to learn the foundation of statistics, probability and linear algebra.



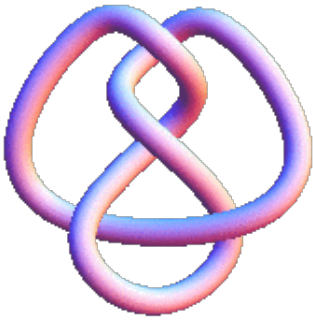
Mathematics major

数学メジャー 専任教員

Yuji Shimizu
Algebraic Geometry
清水勇二　教授
代数幾何学

Mitsuru Yamazaki
Theory of Nonlinear Partial Differential Equations
山崎満 教授
非線形偏微分方程式論
Major advisor

Tomoo Matsumura
Algebraic Topology and Combinatorics
松村朝雄 准教授
代数的トポロジーと組み合わせ論



2021 Model Schedule for September Students

	Y	T	L	PE	GE	Foundation	Area Major	Elective
2021		A				Introduction to Mathematics (E) 3 (Linear Algebra I) 3		
	Fr.	W				Calculus I 3 Linear Algebra I (E) 3		
		S				Hot Topics in Mathematical Sciences 2	Linear Algebra II 2 Basic Concepts in Math I (Sets and Algebraic Structure) 2 Calculus II (Vector Analysis) 2	
2022							Topics in Linear Algebra 2	
	So.	A					Basic Concepts Math II (Introduction to Analysis) 2 Theory of Differential Equations 2	Introduction to Probability and Statistics 2 Teaching Method in Math I 2
		W					Basic Concepts in Math III (General Topology) 2 Function Theory of One Complex Variable 2	Probability and Statistics 2 Teaching Method in Math II 2
		S					Algebra I 2 Analysis I 2 Geometry I 2	Advanced Seminar in Math I 2
2023	Jr.	A					Algebra II 2 Analysis II 2 Geometry II 2	Advanced Seminar in Math II 2 Teaching Method in Math III 2
		W			History of Science 2			Topics in Math III, IV 2,2 (Topics in Math I, II) 2,2 Advanced Seminar in Math III 2 Teaching Method in Math IV 2
		S			Philosophy of Science 2			Senior Seminar in Math I 2
2024	Sr.	A			SIS 3		卒論 Senior Thesis 3	Senior Seminar in Math II 2
		W					卒論 Senior Thesis 3	
		S					卒論 Senior Thesis 3	
			x	2	21	≧18	≧21+9	

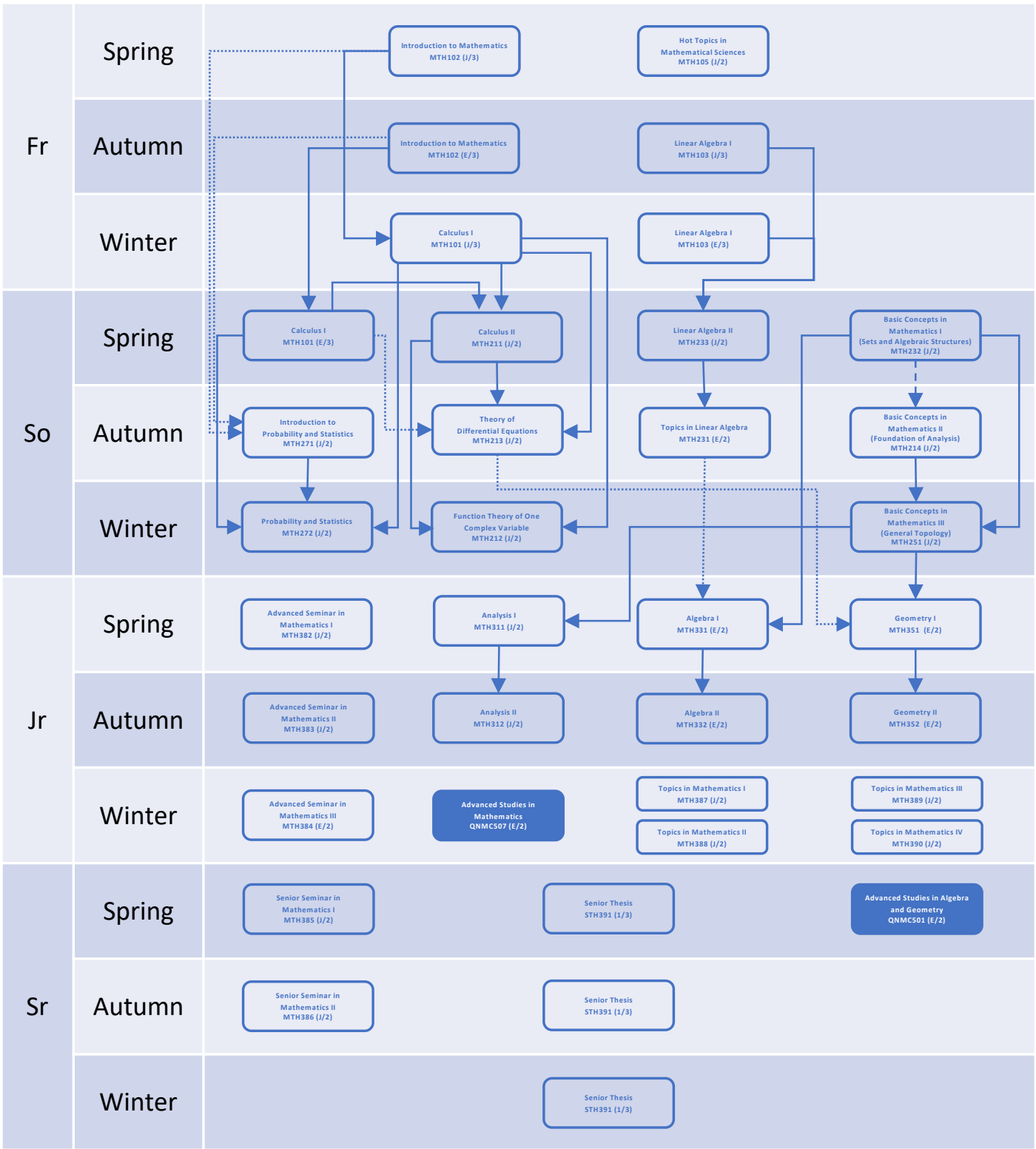
Language units x + Elective unit ≧ 65

Math Course

	Course Number	Title	Units	Term	Course Description : [Key Words]	Remark
Fdn	MTH102 J,E	Introduction to Mathematics	3	S + A	Covers the basic concepts necessary for college-level mathematics, mainly foundation of calculus of one-variable functions.. [limits, continuity, elementary functions, differentiation, indefinite/definite integrals, integration by substitution, integration by parts, applications of definite integrals]	The completion of high school calculus (Mathematics III) is not premised.
	MTH101 J	Calculus I	3	W + S	Calculus of one-variable and many-variable functions in continuation to Introduction to Mathematics. [differentiation and integration of functions of one variable, the concept of continuity, partial derivatives, extrema problem, multiple integrals]	Prerequisite: high school calculus (Mathematics III) or Introduction to Mathematics.
	MTH103 J,E	Linear Algebra I	3	A + W	Introductory courses on linear algebra basic to further study in mathematics. [vectors, matrices, rank of a matrix, determinants, solutions of systems of linear equations, eigenvalues, eigenvectors and matrix expression of linear transformations]	
	MTH105 J	Hot Topics in Mathematical Sciences	2	S	This course presents hot topics in mathematical sciences from a wide perspective and discusses breadth and depth of mathematics.	Prerequisite: high school mathematics
AM	MTH233 J	Linear Algebra II	2	S	General theory of vector spaces in continuation to Linear Algebra I. [general vector spaces (including a complex vector space), linear independence, linear transformations, their matrix representations, vector spaces with metric]	Prerequisite: Linear Algebra I.
	MTH231 J	Topics in Linear Algebra	2	A	Further study of selected topics of Linear Algebra in continuation of Linear Algebra II. [eigenvalues, eigenvectors, diagonalization, standard form of a matrix, quadratic forms]	Prerequisite: Linear Algebra II.
	MTH211 J	Calculus II (Vector Calculus)	2	S	Vector calculus, including necessary topics in calculus of many-variable functions.. [derivation of vector-valued functions, line and surface integrals, theorem of Stokes, theorem of Gauss and potential fields.]	Prerequisite: Calculus I.
	MTH212 J	Function Theory of One Complex Variable	2	W	Calculus of complex functions. [derivatives and integrals of functions of a complex variable, power series, calculus of residues, analytic continuation].	Prerequisite: Calculus II.
	MTH213 J	Theory of Differential Equations	2	A	Introduction to the theory of differential equations. [linear ordinary differential equations, existence theorem of solutions, eigenvalue problems]	Prerequisite: Calculus II.
	MTH232 J	Basic Concepts in Mathematics I (Sets and Algebraic Structures)	2	S	Foundation of sets and algebraic structures basic to modern mathematics. [sets and mappings, equivalence relations and equivalence classes, cardinal, and algebraic structures]	
	MTH214 J	Basic Concepts in Mathematics II (Introduction to Analysis)	2	A	Critical review of basic concepts in calculus. [continuity, structure of real numbers, limits, continuous functions, Riemannian integrals, convergence of series]	Recommended to be taken after Basic Concepts in Mathematics I.
	MTH251 J	Basic Concepts in Mathematics III (General Topology)	2	W	Introduction to topological structures basic to modern mathematics. [metric spaces, topological spaces, connectedness, compactness, separation axioms].	Recommended to be taken after Basic Concepts in Mathematics I, II.
	MTH271 J	Introduction to Probability and Statistics	2	A	Foundations of probability and mathematical statistics. [random variables, probability distribution, expectation, variance, covariance, Bernoulli distribution, binomial distribution, geometric distribution, probability density, distribution function]	Prerequisite : Introduction to Calculus or high school calculus (Mathematics III)
	MTH272 J	Probability and Statistics	2	W	Further study of probability and statistics. [theory of probability, descriptive statistics, inductive stochastics, central limit theorem, law of large numbers]	Prerequisite : Calculus I, Introduction to Probability and Statistics.
	MTH311,312 J	Analysis I, II	2, 2	S, A	Introduction to modern analysis. [theory of measure, Lebesgue and Stieltjes integrals, Hilbert spaces, Banach spaces, Fourier analysis, distributions]	Prerequisite: Calculus I. Recommended to be taken after Basic Concepts in Mathematics II, III.
	MTH331, 332 J/E	Algebra I, II	2, 2	S, A	Introduction to modern algebra. [group theory, ring theory]	Prerequisite: Linear Algebra II. Recommended to be taken after Basic Concepts in Mathematics I.
	MTH351, 352 J	Geometry I, II	2, 2	S, A	Introduction to modern geometry. [differentiable manifolds, tangent vectors, tangent spaces, metrics, differential forms]	Prerequisite: Calculus II, Linear Algebra II. Recommended to be taken after Basic Concepts in Mathematics III.
	MTH382, 383, 384 J	Advanced Seminar in Mathematics I,II,III	2	W	Seminar on an advanced theme of mathematics.	
	MTH385, 386 J	Senior Seminar in Mathematics I, II	2, 2	S, A	Seminar for senior students of mathematics major, where he/she studies advanced subjects in a specific field of mathematics.	
	MTH387,388, 389,390 J	Topics in Mathematics I, II, III, IV	2, 2	W, W	Aims to provide advanced knowledge of modern mathematics. The topics are selected by the instructor among various fields of analysis, algebra, geometry, etc. Two periods of lecture weekly.	
	STH391	Senior Thesis	3,3,3	S, A, W	Senior students, under the guidance of an advisor, will select a subject related to their major and prepares a senior thesis. The final product should represent the efforts of one year of sustained and rigorous thinking, research, and writing. Required of all students in their senior year.	

Curriculum Tree: Mathematics

Last Update 2020/3/10

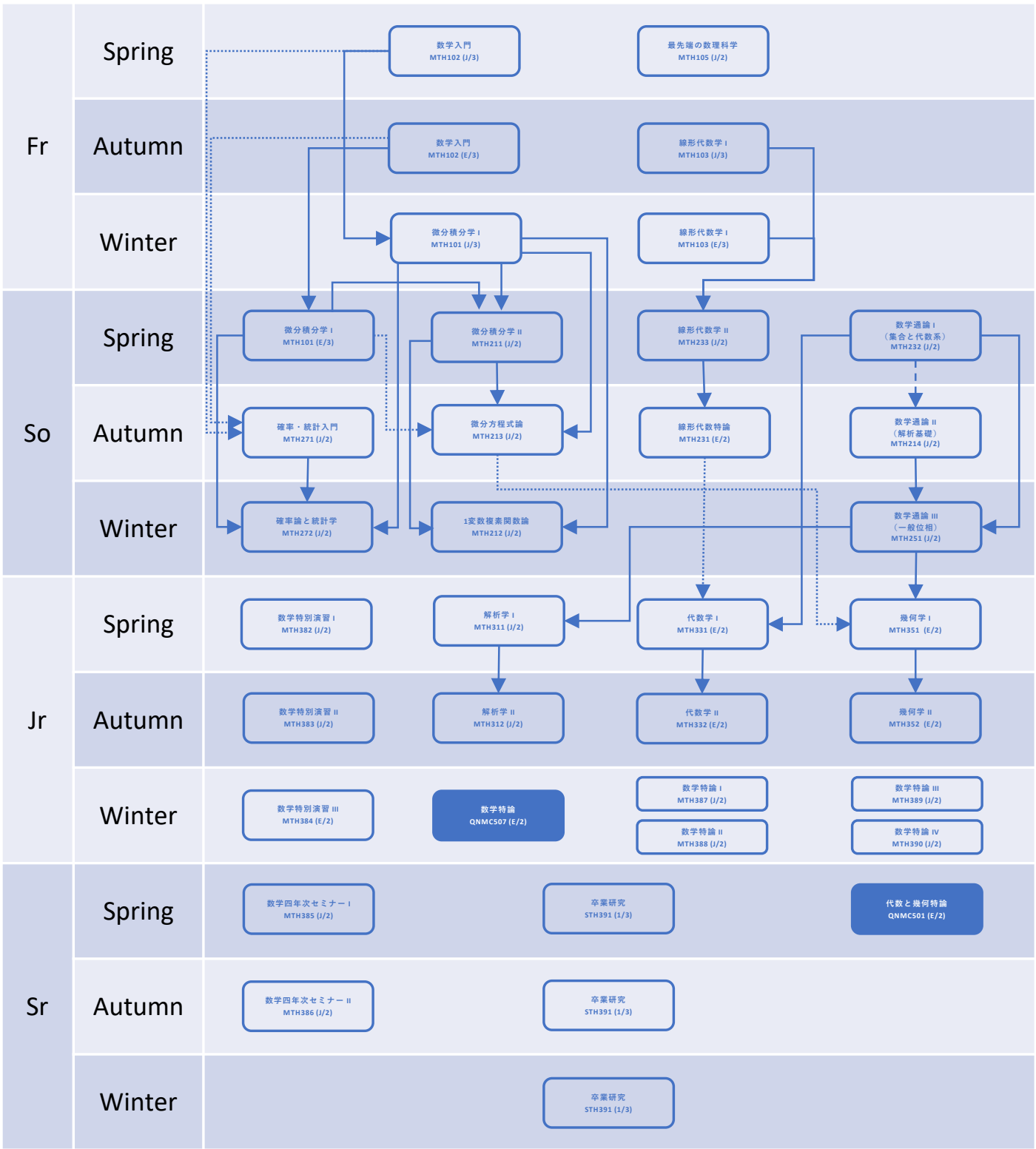


Highly recommended order

Recommended order

Curriculum Tree: 数学

Last Update 2020/3/10



この順序での履修を強く勧める

この順序での履修を勧める

Physics Faculty Members

Prof. Hideki OKAMURA
(Laser Physics)
Major advisor

Prof. Dai HIRASHIMA
(Condensed-matter Physics)

Prof. Ken OKANO
(Solid State Physics)

Assoc. Prof.
Rekishu YAMAZAKI
(Quantum Information)

Senior Assoc. Prof.
Eckhard HITZER
(Mathematical Physics)

Physics Major Model Schedule for AY2021 September Students

Y	T	JLP	PE	GE	Foundation (Major) Fdn-P (PHY1**)	Foundation (Others) Fdn-O (XXX1**)	Area Major I AM-I (PHY2**)	Area Major II AM-II (PHY3**)	Electives EL
Fr.	A		1/3	3	◇ Intro. **Phys.** 2	◇ Intro. Math 3			
	W		1/3	3	**Fdn. Phys.** 2 **Intro. Phys. Lab.** 2	○ Linear Alg. I 3 ○ Calculus I 3			
	S		1/3	3	Hot Topics in Phys 2 **Fdn. Phys. Lab.** 2	Fdn. Computers 3 Infrom.Ethics 2	**Modern Phys. A** 2 **Math. For Nat. Sci.** 2 ◎ Calculus II 2		○ Lin. Alg. II 2 B. C. in Math. I 2
So.	A		1/3	3		○ Fdn. of Programming 3 ◇ Intro. Chem. 2	**Modern Phys. B** 2 Modern Phys. Lab. 2 ◎ Th. of Differ. Eq. 2		○ Topics Lin. Alg 2 B. C. in Math. II 2
	W		1/3	3		Concepts Chem. 2	**Mechanics** 3 ◎ Compl. Func. of One Var. 2		B. C. in Math. III 2
	S		1/3	3		Gen. Chem. 2 Fdn. Chem. Lab. 2	**Electr. & Magnet.** 3 Inter. Phys. Lab. I 2	Spec. Std. in Phys. I 2	Analysis I 2
Jr.	A			3			**Quantum Phys.** 3 Inter. Phys. Lab. II 2	Spec. Std. in Phys. II 2	Analysis II 2
	W			2 HS			**Statistical Phys.** 3 Inter. Phys. Lab. III 2	Spec. Std. in Phys. III 2	
	S			2 PS.				(Spec. Std.in Phys. IV) 2	
Sr.	A			2 SIS				Spec. Std. in Phys. VI 2 Sr. Thesis II 3	
	W							Spec. Std. in Phys. VII 2 Sr. Thesis III 3	
	S							Spec. Std. in Phys. V 2 Sr. Thesis I 3	
Units		max 45	2	15 + (max. 21)	Fdn-P = 6 + Fdn = Fdn-P + Fdn-O = 18 +		As Major, Major1 : AM-P = AM-I + AM-II = 21 + As Major2: AM-P = AM-I + AM-II = 30 + (whereas AM-II = 3 +) AM-O = 21 + from Major 1 AM As Minor: AM-P = AM-I + AM-II = 15 + AM-O = 21 + from Major AM AM = AM-P (+ AM-O) + Sr. Thesis 9		EL + (GE − 15) + (Fdn −18) + (AM − 21) = 36 + (DB 6+; MM 21+)

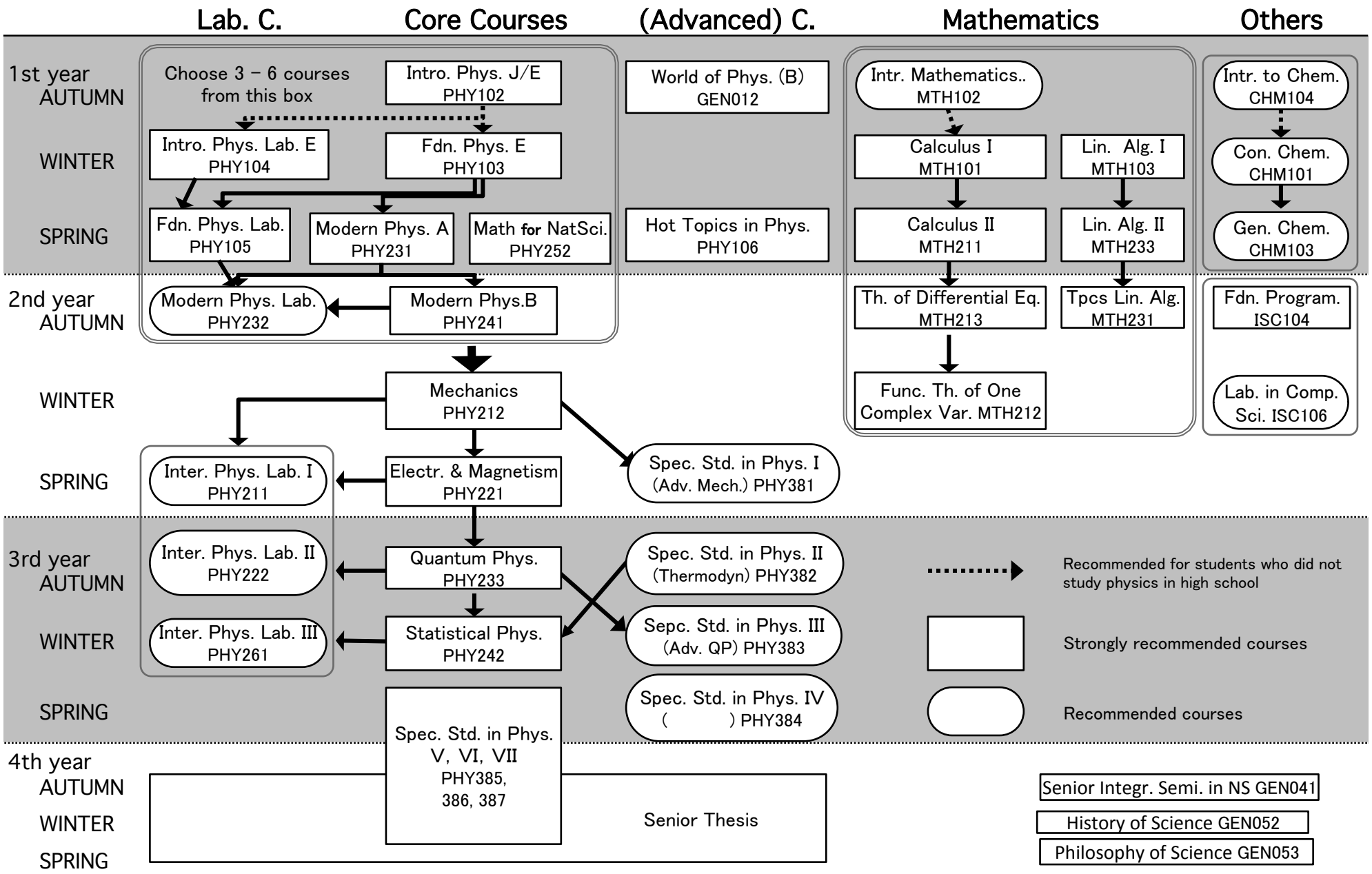
Bold: Core course of Physics Major

◇ Strongly recommended course for students who did not take those subjects in high school

○ Strongly recommended course besides physics

◎ Co-listed course as area major of physics

Flow Chart for Physics Major



AY2021

Environmental Studies

About the Major

Human is a part of nature. We all receive influences from the natural environment, human environment, and social environment. Same time, we affect them through our daily lives because all of our activities relate to the environment directly or indirectly. In other words, the critical point is what kind of balance human is making with nature through their activities.

However, do we understand we live as part of an ecosystem that supports or destroys life forms? Do we understand the underlying mechanism of ecosystems or earth? Also, do we intend to construct balanced, sustainable relationships with our surrounding environments?

Environmental issues are related to any lifestyle and job and are unavoidable problems for all humans. Therefore, today is the day we should reevaluate our lifestyle, social activities, and industrial activities in terms of sustainability and start acting as mature global citizens.

Environmental Studies Major aims to guide the students to have strong fundamental knowledge, high critical thinking skills, expansive views across the subject areas, and self-motivation to deal with environmental issues from community level to global scale.

Major Faculty

Chun, Wang Jae
Fujinuma, Ryosuke
Kamito, Takehiko
Kanazawa, Yuichiro
Kobayashi, Makito
Kubo, Kenya
Langager, Mark W.
Minejima, Chika
Mizoguchi, Tsuyoshi
Nunoshiba, Tatsuo
Okamura, Hideki
Okano, Ken
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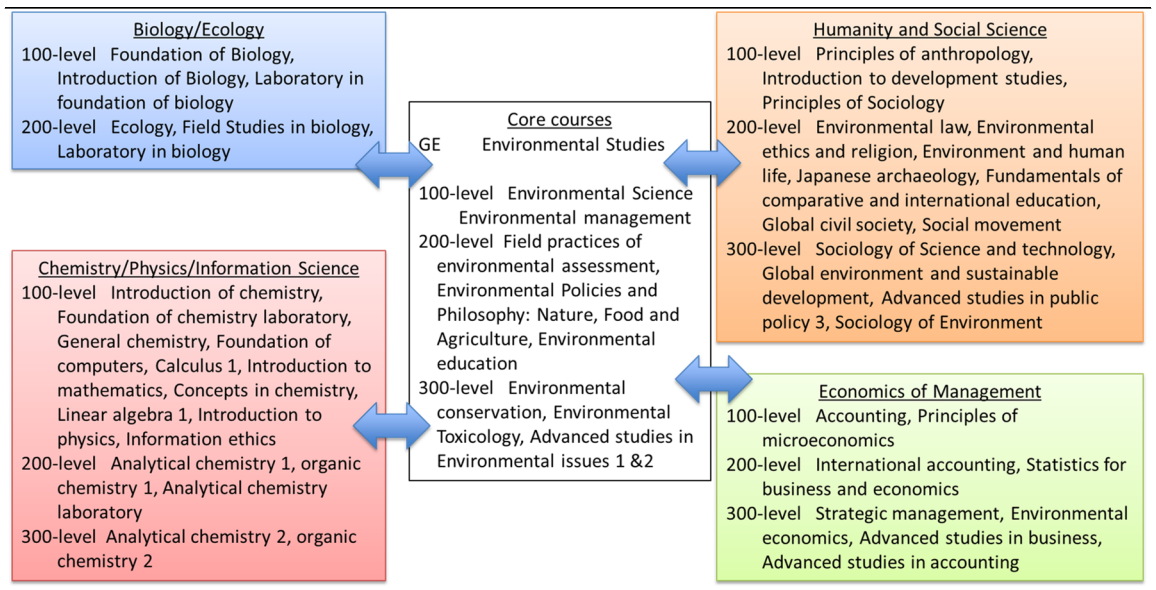
The curriculum



Environmental Studies major is a field to seek the sustainable balances between humans and the environment. Hence, the major is **an interdisciplinary major**, including natural sciences, social sciences, economics and business, and information technologies. We recommend students to take the core introduction courses (GE: Environmental Studies, 100 level: Environmental Management, Environmental Science) first with a vision of mastering their viewpoint regarding "Environment". Outside of that, students can take courses from Environmental Studies (ENV codes, such as Field practice of environmental assessment; Environmental policies and philosophy: nature, food and agriculture; Environmental education, Environmental conservation, Environmental toxicology, Advanced studies in Environmental studies 1 & 2) and other co-listed courses from Sociology, Education, Law, Humanity, Economics, Chemistry, Biology, Information Science, and Philosophy and Religion (see curriculum tree). Deepening the knowledge of Environmental Studies requires experiences outside of the classrooms, so we strongly recommend registering for laboratory and practical courses.

What can you learn?

Area related to "Environment" Roughly categorized into 4 areas

1. **Global environment**
2. **Natural environment**
3. **Social-regional environment**
4. **Human environment**

Taking multidisciplinary courses let you learn both direct effects and indirect effects

Bottom-line concepts

- **Less impacts on the environment**
- **Environmental conservation**
- **Balanced human well-being**

Possible topics for the thesis

- Plant response on environmental stresses
- Energy crisis and renewal energy
- Electricity and energy consumption
- Radi-isotope analyses of environmental samples
- Atmospheric pollution
- Environmental education
- Ethical consumption
- Environmental accounting/economics
- Animal ecology on campus
- Plant ecology on campus
- Environmental ethics in the Old Testament
- Environmental Law
- Sustainable development/intensification of systems
- Sustainable soil management