Topic clouds and Mapping of Topic clouds with proposed courses

Area	Topics	Category (Core/ Techniques /Systems)	Course (IE/IS/PC/PE)
Omics	 Cells and organelles Replication Transcription and translation Cell cycle 	Core and Techniques	Concepts & Dynamics: Molecular Cell Biology (PC 4 th) Pre/Co-Req: Biochemistry (PC 3 rd)
	 DNA, RNA, Proteins, metabolites Metabolic pathways Biochemical analysis Enzymes 	Core and Techniques	Biochemistry (PC 3 rd) Pre/Co-Req: None
	 Inheritance Polymerase chain reaction Gene therapy 	Core, Techniques and Systems	Genetics & Gene Manipulation (PC 5 th) Pre/Co-Req: None
 Genomics Transcriptomics Proteomics Metabolomics Mass Spectroscopy 		Core and Techniques	Introductory Omics (PC 6 th) Pre/Co-Req: None
	 Microbial communities Metagenome library Metagenome sequencing 	Core and Techniques	Microbiomes and Metagenomics (PE) Pre/Co-Req: None(PC 3 rd)
	 Biological networks and pathways Data modeling Multi-omics integration 	Systems	Computational methods for multi- omics (PE) Pre/Co-Req: Introductory Omics (PC 6 th)
	 Omics analysis algorithms DNA microarray Data normalization Data visualization 	Core, Techniques and Systems	Microarray data analysis (PE) Pre/Co-Req: None
	 Neural network Deep learning models Deep generative models Representation learning 	Systems	Deep Learning (PC 6 th) (From CS) Pre/Co-Req: Introduction to machine Learning (PC 3 rd)
Biomaterials Engineering	 Biocompatibility and Biodegradability Biomaterial characterization 	Core, Techniques and Systems	Biomaterials Engineering (PC 6 th) Pre/Co-Req: None

	Table 1	Topics	and	Mapping	of	Topic	with	Courses
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	Implants		
	 Cell adhesion on substrate Biofilm formation Surface modification 	Core and Techniques	Cell-material Interactions (PE) Pre/Co-Req: Biomaterials Engineering (PC 6 th)
	 Tissue repair and regeneration Scaffolds Animal cell culture 	Core, Techniques and Systems	Tissue Engineering (PE) Pre/Co-Req: Biomaterials Engineering (PC 6 th)
	 Sustained, on-demand and targeted delivery Drug loading and drug release Pharmacokinetics and pharmacodynamics 	Core, Techniques and Systems	Therapeutic delivery systems (PE) Pre/Co-Req: Biomaterials Engineering (PC 6 th)
	 Human locomotion Tissue mechanics Viscoelasticity 	Core	Principles of Biomechanics (PE) (From ME) Pre/Co-Req: Biomaterials Engineering (PC 6 th)
	 3D printing Field deposition model (FDM) Selective laser sintering Stereolithography 	Techniques and Systems	Additive manufacturing (PE) (From ME) Pre/Co-Req: Biomaterials Engineering (PC 6 th)
	 Bio-transport Hemodynamics Momentum conservation Bio-rheology 	Core and Systems	Bio-transport phenomena (PE) (From BSBE, CHE, ME) Pre/Co-Req: None
Computational & Systems Biology	 Bioinformatics Bio computation Mathematical modelling 	Core and Techniques	Computational and System Biology (PC 5 th) Pre/Co-Req: Concepts & Dynamics: Molecular Cell Biology (PC 4 th)
	 Numerical Methods for PDE Ordinary Differential Equations 	Core and Techniques	Mathematical Biology (PE) (From MA) Pre/Co-Req: Computational Biology (PC 5 th)
	Methods and method development in computational biology	Core, Techniques and Systems	Algorithms in biology (PE) Pre/Co-Req: None
	Biosystems	Core and Techniques	Modelling biological

	Boundary conditions		systems (PE) Pre/Co-Req: None
	Experiment designvalidation	Core	Design of experiments (PE)(From MA) Pre/Co-Req: None
Bioimaging	 Optical microscopy Fluorescence microscopy Digital imaging Medical imaging 	Core, Techniques and Systems	Bioimaging (PC 6 th) (From CS/EE) Pre/Co-Req: None
	 Fourier transform theory Filtering Image enhancement 	Techniques and Systems	Digital Image processing (PE) (From CS/EE) Pre/Co-Req: Bioimaging (PC 6 th)
	 Image reconstruction Image restoration Deep learning 2D, 3D registration 	Techniques and Systems	Bio-image computing (PE) (From CS) Pre/Co-Req: Bioimaging (PC 6 th)
	 Electron scattering and diffraction Scanning and transmission Immuno and cryo- electron microscopy 	Techniques and Systems	Electron microscopy for biology (PE) (From CY) Pre/Co-Req: Bioimaging (PC 6 th)
Biosensors	 Impedimetric, voltammetric, amperometric, electrical, optical sensors Selectivity and sensitivity 	Core, Techniques and Systems	Biosensors (PC 5 th) (From EE) Pre/Co-Req: Biochemistry (PC 3 rd)
	 Genetic circuits for biosensors RNA based sensors Reporter genes 	Techniques and Systems	Whole cell based biosensors (PE) Pre/Co-Req: None
	LithographyMicromachiningMEMS	Techniques and Systems	Microsystems Fabrication Technology (PE)(From EE) Pre/Co-Req: None
	 Aptamer sensor Cation-selective sensor Dendrimer based sensor	Techniques and Systems	Chemosensors (PE) (From CY) Pre/Co-Req: Biosensors (PC 5 th)
Microbial systems for sustainable development	 Microbial phylogeny Metabolism Microbial growth Applied microbiology 	Core and Systems	Microbiology (PC 3 rd) Pre/Co-Req: None

	 Wastewater treatment Bio-geo chemical cycling Solid waste management In situ and ex situ bioremediation Probiotic, symbiotic, plant –microbe interaction Fortified food Nutritional supplements 	Systems Systems	Microbial remediation and Environmental Biotechnology (PE) Pre/Co-Req: Microbiology (PC 3 rd) Microbes in food and sustainable agriculture (PE) Pre/Co-Req: Microbiology (PC 3 rd)
	 Solid , liquid, gaseous biofuels Engineering microbes for biofuel production Different generations of biofuels and sustainability analysis 	Systems	Bioenergy (PE) Pre/Co-Req: Microbiology (PC 3 rd) Biochemistry (PC 3 rd)
Drug design and Development	 Protein-protein interaction Protein crystallography Protein folding 	Core and Techniques	Biophysics and Structural Biology (PC 6 th) Pre/Co-Req: Biochemistry (PC 3 rd)
	 Drug targets Computer-aided drug design Virtual screening 	Core, Techniques and Systems	Principles of Drug discovery (PE) Pre/Co-Req: Biophysics and Structural Biology (PC 5 th) Biochemistry (PC 3 rd)
	 Pharmacophore Drug metabolism Chiral drug molecule Antibiotics and antiviral 	Core and Techniques	Medicinal chemistry (PE) (CY) Pre/Co-Req: None
	Virus life cycleViral immunityAntiviral drugs	Core, Techniques and Systems	Viral infection and antiviral drug development (PE) Pre/Co-Req: None
Fundamental courses	 Innate immunity Inflammatory response Cell signaling B- and T-cell lymphocytes Clinical immunology 	Core and Techniques	The Human Immune System: Mechanisms to Detect, Defend and Attack (PC 4 th) Pre/Co-Req: None
	 Membrane transportation Muscle mechanics Membrane potential 	Core	The Human Machine for Engineers: Quantitative Physiology (PC 5 th)

Cardiovascular,	Pre/Co-Req: None
pulmonary, renal	
physiology	