Course Syllabus

MBNS 604 Research Methodology and Techniques in Neuroscience Academic Year 2021

Course ID and Name: MBNS 604 Research Methodology and Techniques in Neuroscience

Course Coordinator: Asst. Prof. Sujira Mukda

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Instructors:

1. Prof. Duncan Richard Smith

- 2. Assoc. Prof. Naiphinich Kotchabhakdi
- 3. Assoc. Prof. Nuanchan Chutabhakdikul
- 4. Assoc. Prof. Vorasith Siripornpanich
- 5. Asst. Prof. Sujira Mukda
- 6. Asst. Prof. Sukonthar Ngampramuan
- 7. Asst. Prof. Kittikun Viwatpinyo
- 8. Asst. Prof. Narisorn Kitiyanant
- 9. Asst. Prof. Alisa Tubsuwan
- 10. Dr. Chutikorn Nopparat
- 11. Dr. Jiraporn Panmanee
- 12. Dr. Narisra Komalawardhana
- 13. Dr. Lalitta Suriya-Arunroj

Supporting Staff:

- 1. Ms. Somsong Phengsukdaeng
- 2. Ms. Sasithorn Prommet
- 3. Ms. Kanda Putthaphongphuek
- 4. Ms. Kornkanok Promthep
- 5. Mr. Umnaj Chanama
- 6. Ms. Chanikarn Boonchuay

Credits: 3 (2-2-5)

Curriculum: Master of Science Program in Neuroscience (required course)

Doctor of Philosophy Program in Neuroscience (required course for students from

B.Sc.)

Semester offering: Second semester

Pre-requisites: None

Course learning outcomes (CLOs):

Upon completion of this course, students are able to:

- 1. Acquire new knowledge in research techniques in Neuroscience (PLO1) I, P
- 2. Integrate and apply comprehensive knowledge in research techniques in Neuroscience to solve scientific research questions (PLO2) P, R
- 3. Analyze and present lab data by using appropriate information and communication technologies (PLO6) P
- 4. Demonstrate scientific integrity, responsibility, and safety practice (PLO1, PLO4) I, P, R
- Demonstrate teamwork, interpersonal skills and responsibilities for the work Assignments (PLO5) P

Alignment of teaching and assessment methods to course learning outcome:

Course learning outcome	Teaching method	Assessment method
1. Acquire new knowledge in	(1) Lecture	(1) Written examination
research techniques in	(2) Class discussion	(2) Reports
Neuroscience		(3) In-class discussion
2. Integrate and apply	(1) Class discussion	(1) Direct observation
comprehensive knowledge	(2) Problem-based learning	(2) Oral presentation
in research techniques in		(3) In-class discussion
Neuroscience to solve		
scientific research		
questions		
3. Analyze and present lab	(1) Experimental data	(1) Reports
data by using appropriate	presentation and discussion	(2) Oral presentation
information and		(3) In-class discussion
communication		
technologies		
4. Demonstrate scientific	(1) Assignment	(1) Assessment of assigned work
integrity, responsibility,	(2) Lab safety guidelines	(2) Direct observation
and safety practice	(3) Hands-on practice	(3) Class attendance
		(4) Lab performance
		(5) MU Labpass certificate

Course learning outcome	Teaching method	Assessment method
5. Demonstrate teamwork,	(1) Group/individual	(1) Direct observation
interpersonal skills and	assignment	(2) Assessment of assigned work
responsibilities for the		(3) Assessment of responsibility
work assignments		for assigned work

Course description:

The principles and methods used in neuroscience research; experimental design, data analysis and interpretation; presentation of the research results; technique to analyse the physiological, anatomical, and chemical changes of the cells, proteins, or genes in the nervous system

Course schedule:

Date: Monday-Friday
Time: 09.00-16.00

Rooms A107⁽¹⁾, B402⁽²⁾, D401-02⁽³⁾, and MB Animal Center ⁽⁴⁾ Institute of Molecular Biosciences

Date/Times	Topic/Dotoils	Number	Class	Locture
Date/Time	Topic/Details	Number	Class	Lecturer
		of Hours	Activity	
21 March 2022				
09.00-11.00	Orientation to IMB Central Instrument	2	Lecture	Sujira
	Facility			Umnaj ⁽¹⁾
13.00-15.00	Lect 1: Neuroimaging techniques	2	Lecture/	Naiphinich/
	- Neuroimaging or Brain Imaging techniques		In-class	Vorasith ⁽¹⁾
	- Structural, Functional and Chemical imaging		discussion	
	techniques			
	- Neuroimaging in Cognitive Neuroscience and			
	Clinical Investigations			
	- From Imaging of microscopic and electron			
	microscopic for various neuronal cells,			
	tissues, to whole brain			
	- Molecular neuroimaging			
	- New advanced techniques, e.g., "Clarity",			
	Optogenetic, Multiphoton Laser Confocal			
	Scanning microscope of living neurons			
	- Neuroimaging for human brain,			
	Computerized Tomography (CT) or			
	Computerized Axial Tomography (CAT),			
	High-speed 3D Fast CT, Magnetic resonance			

Date/Time	Topic/Details	Number	Class	Lecturer
		of Hours	Activity	
	imaging (MRI), nuclear magnetic resonance			
	imaging (NMRI), or magnetic resonance			
	tomography (MRT), Functional MRI,			
	Tractography with Diffusion Tensor Imaging			
	(DTI) for fiber tracts, MRI-Spectroscopy			
	(MRS)			
	- Brain Connectomes, Glass-fly-through			
	techniques,			
	- Experimental neuroimaging designs and			
	their applications			
	- Single Photon Emission Spectroscopy			
	Tomography (SPECT)			
	- Positron Emission Tomography (PET),			
	Functional PET			
	- Development of techniques for investigation			
	of dementia and Alzheimer's Disease			
	- Optical neuroimaging, Functional Near-Infra-			
	Red Spectroscopy (FNIRS)			
	- Neuro-navigators, surgical operating room			
	multimodal neuroimaging			
	- Neuroimaging with EEG, ERP and			
	Topographic Brain Mapping			
22 March 2022				
09.00-11.00	Lect 2: How to design the ERP paradigm	2	Lecture/	Vorasith ⁽¹⁾
	and ERP recording		In-class	
	- Equipments for EEG and ERP recording		discussion	
	- The principle of ERP paradigm			
	- The common ERP paradigms used in			
	cognitive research			
11.00-12.00	Lab: ERP Recording I	1	Lab/	Vorasith ⁽²⁾
	- EEG acquisition		In-class	
	- Using Stim2 program for creating an ERP		discussion	
	paradigm			
	- EEG and ERP recording			
	- Analysis of ERP data			

Date/Time	Topic/Details	Number	Class	Lecturer
		of Hours	Activity	
13.00-16.00	Lab: ERP Recording II	3	Lab/	Vorasith ⁽²⁾
	- EEG acquisition		In-class	
	- Using Stim2 program for creating an ERP		discussion	
	paradigm			
	- EEG and ERP recording			
	- Analysis of ERP data			
23 March 2022				
09.00-11.00	Lect 3: Electrophysiology: extracellular	2	Lecture/	Lalitta ⁽¹⁾
	recording		In-class	
	- Basics of extracellular action potentials		discussion	
	- Potentials, benefits, and limitations			
	- Signal processing (amplifier, analog-to-digital			
	conversion, data synchronization, data			
	storage, etc.)			
	- Single-unit vs. multi-unit activities			
	- Local field potentials (LFP)			
13.00-16.00	Lab: Electrophysiology	3	Lab/	Lalitta ⁽¹⁾
	- Electrophysiology & neural signal collection		In-class	
	- Basics of neural data analyses		discussion	
24 March 2022				
09.00-11.00	Lect 4: Cell culture technique in	2	Lecture/	Chutikorn ⁽¹⁾
	nervous system		In-class	
	- The concept of cell culture		discussion	
	- Describes and classify types of cell culture			
	- Classification the cell culture room			
	- Routine method of cell culture			
	- Apply the cell culture technique in			
	Research			
13.00-15.00	Lect 5: Genetic Modification, Genome	2	Lecture/	Alisa ⁽²⁾
	Editing, and CRISPR		In-class	
	- DNA/Gene/ Genome		discussion	
	- Genome editing			
	- History of genome editing technology			
	- Structure and mechanism of genome editing			
	technologies			

Date/Time	Topic/Details	Number	Class	Lecturer
		of Hours	Activity	
	- Application of CRISPR/Cas9			
	- CRISPR/Cas9 genome editing workflow			
	(guide RNA design and it functional testing,			
	CRISPR-Cas delivery method, detection and			
	identification of genome editing)			
25 March 2022				
09.00-11.00	Lect 6: Nucleic acid isolations &	2	Lecture/	Jiraporn/
	amplification		In-class	Sujira ⁽¹⁾
	- What are nucleic acids?		discussion	
	- Central dogma			
	- Biological samples			
	- DNA/RNA isolation			
	- Nucleic acid quantification			
	- Introduction to polymerase chain reaction			
	(PCR)			
	- Reverse Transcription PCR (RT-PCR)			
	- Variations of basic PCR-based techniques			
	- PCR applications			
13.00-16.00	Lab: RNA isolation & RT-PCR I	3	Lab/	Jiraporn/
	- RNA isolation using Trizol reagents		In-class	Chutikorn ⁽³⁾
			discussion	
28 March 2022		I	•	1
09.00-11.00	Lab: RNA isolation & RT-PCR II	3	Lab/	Jiraporn/
	- Practicing RT-PCR Gel electrophoresis		In-class	Chutikorn ⁽³⁾
			discussion	
13.00-16.00	Lab: How to design primers for PCR	3	Lab/	Jiraporn/
	- What are primers?		In-class	Chutikorn ⁽³⁾
	- Primer parameters		discussion	
	- Tips for designing primers		3 33.33.31.1	
	- Primer design using NCBI-Primer BLAST			
	- Checking primer quality by PCR primer Stats			
	and PCR in silico UCSC			
29 March 2022		<u> </u>	1	1

Date/Time	Topic/Details	Number	Class	Lecturer
		of Hours	Activity	
09.00-11.00	Lect 7: Identifying proteins of interest	2	Lecture/	Sujira ⁽¹⁾
	- The purpose of protein investigation		In-class	
	- Antibody considerations		discussion	
	- The concepts behind the methods of the			
	protein investigation:			
	- Western blot			
	- Enzyme-linked immunosorbent assay			
	(ELISA)			
	- Immunohistochemistry (IHC)			
13.00-16.00	Lab: Protein extraction and	3	Lab/	Sujira/
	determination		In-class	Kittikun ⁽³⁾
	- Protein extraction		discussion	
	- Determine the concentration of protein			
30 March 2022				
09.00-12.00	Lab: Western blotting I	3	Lab/	Chutikorn/
	- Practice the SDS-PAGE gel setting		In-class	Kittikun/
	- Mix and Load samples in acryamide gel		discussion	Jiraporn ⁽³⁾
13.00-16.00	Lab: Western blotting II	3	Lab/	Chutikorn/
	- Run the SDS-PAGE gel and transfer the		In-class	Kittikun/
	protein samples to PVDF membranes		discussion	Jiraporn ⁽³⁾
	- Blocking the non-specific binding of the			
	protein			
	- Hybridization process			
31 March 2022				
09.00-12.00	Lab: Western blotting III	3	Lab/	Chutikorn/
	- Hybridization process (continue)		In-class	Kittikun/
	- Western blot detection		discussion	Jiraporn ⁽³⁾
13.00-16.00	Lab: Western blotting IV	3	Lab/	Chutikorn/
	- Calculation of the protein band density and		In-class	Kittikun/
	data analysis		discussion	Jiraporn ⁽³⁾
1 April 2022	ı	I	I	1
09.00-11.00	Lect 8: Flow cytometry analysis	2	Lecture/	Narisorn ⁽¹⁾
	- Principles of flow cytometry		In-class	
	- Flow cytometry data analysis and		discussion	
	presentation			
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Date/Time	Topic/Details	Number	Class	Lecturer
		of Hours	Activity	
13.00-15.00	Lect 9: Basic Histological Technique	2	Lab/	Kittikun ⁽²⁾
	- Pros and Cons of histological techniques		In-class	
	- Routine method of tissue processing		discussion	
	- Common errors in tissue processing			
	Advanced methods			
4 April 2022	Examination I (Lecture 1-8) ⁽⁵⁾			
5 April 2022				
09.00-11.00	Lect 10: Animal research in	2	Lecture/	Sukonthar ⁽¹⁾
	neuroscience and behavioral		In-class	
	studies		discussion	
	- Animal for researches			
	- Rodents in neuroscience research			
	- Animal models of neurobehavioral disorders			
	- Cognitive function in animal model			
	- Rodent stereotyped behavior			
	- Motor movement test in animal model			
13.00-16.00	Lab: Animal models	3	Lab/	Sukonthar /
	- Spatial learning memory test (Morris water		In-class	Sujira ⁽⁴⁾
	maze)		discussion	
	- Measurement of rodent stereotyped			
	behavior			
	- Locomotion activity measurement in an			
	open field			
7 April 2022				
09.00-11.00	Lect 11: Bioinformatics in neuroscience	2	Lecture/	Jiraporn/
	study		Computer/	Sujira ⁽¹⁾
	- What is bioinformatics?		In-class	
	- Introduction to primary databases (GenBank,		discussion	
	ArrayExpress and PDB)			
	- Protein analyses using secondary databases			
	(InterPro, Uniprot and Ensembl)			
	- The importance of metadata			
	- Searching homology sequences by BLAST			
	- Identifying protein domains from sequences			
	using protein databases			

Date/Time	Topic/Details	Number	Class	Lecturer
		of Hours	Activity	
	- Tools for protein target prediction of			
	bioactive molecules			(1)
13.00-15.00	Lect 12: Bio-statistical analysis for	2	Lecture/	Kittikun ⁽¹⁾
	research		In-class	
	- Experimental designs: observational and		discussion	
	experimental studies			
	- Summarizing data: central tendency and			
	dispersion			
	- Probability distribution and sampling of			
	population			
	- Confidence interval			
	- Hypothesis testings			
	- Statistical errors and significance level			
	- Correlation and regression analysis			
8 April 2022				
09.00-11.00	Lect 13: Research ethics	2	Lecture/	Kittikun ⁽¹⁾
	- Ethical issues and guidelines for human and		In-class	
	animal research		discussion	
	- Ethics in data reporting: falsification and			
	fabrication of data			
	- Plagiarism and copyright infringement			
13.00-15.00	Lect 14: Guidelines on writing a research	2	Lecture/	Duncan ⁽¹⁾
	proposal		In-class	
	- What is a research proposal - primary and		discussion	
	secondary objectives			
	- How do we do a research proposal -			
	sourcing appropriate literature			
	- How to read a scientific paper			
	- A cautionary word: What is, and how to			
	avoid plagiarism			
	- Common research proposal formats			
	- Selecting a title for your proposal			
	- Abstract#1			
	- The introduction: Why and what and			
	structure (and language pointers)			
	- Objectives			

Date/Time	Topic/Details	Number	Class	Lecturer
		of Hours	Activity	
	- Literature review			
	- Materials and methods (including Ethics			
	statements)			
	- Results/preliminary results			
	- Avoiding data presentation problems			
	- Abstract#2			
	- Time lines			
	- Literature citation and referencing			
	- Final words			
11 April 2022				
09.00-11.00	Lect 15: Reference management using	2	Lecture/	Nuanchan ⁽¹⁾
	Endnote software		Computer/	
	- What is EndNote, Workflow of EndNote		In-class	
	- Defining journal term list for new library		discussion	
	- Data inputs: Manual typing, Online search,			
	import filter, Direct export, import pdf			
	- organize references into groups			
	- Maintenance of the library			
	- Cite While You Write (CWYW)			
	- Create separate bibliographies to chapters			
	in a single document			
13.00-15.00	Lect 16: Research performance analysis	2	Lecture/	Narisra ⁽¹⁾
	and technique		Computer/	
	- What is research performance, journal		In-class	
	quality: quartile, top percentile		discussion	
	- How to choose journal for publication			
	- How to analyze research quality: scholarly			
	output, citation, field-weighted citation			
	impact			
	- Analysis tool and technique: JournalFinder,			
	SciVal			
	- How to avoid predatory journals, e-books			
	and publishers			
12 April 2022	Examination II (Lecture 9-16) (5)			
18 April 2022				

Date/Time	Topic/Details	Number	Class	Lecturer
		of Hours	Activity	
09.00-11.00	Student Presentation	3	Problem-	RCN Staff ⁽²⁾
			based	
			learning/	
			In-class	
			discussion	

Assessment Criteria:

Assessment Criteria	Assessment Method	Scoring Rubric
Assignments/ Examination	(1) Report	(1) Comprehension
(50%)	(2) Written examination	
Laboratory performance	(1) Direct observation	(1) Ability to follow
(20%)	(2) Practical examination	procedure or to design a
	(3) In-class discussion	procedure for experiment
		(2) Use of equipment
		(3) Working area and safety
		(4) Group work
Problem-based learning	(1) Presentation	(1) Ability to apply knowledge
presentation (20%)		to solve research
		problems
		(2) Ability to answer
		questions
Class attendant (10%)	(1) Number of classes signed in	(1) Class participation
	(2) Direct observation	

Student's achievement will be graded using symbols: A, B+, B, C+, C, D+, D and F based on the criteria as follows:

Percentage	Grade	Description	
85-100	А	Excellent	
80-84	B+	Very good	
70-79	В	Good	
60-69	C+	Fairly good	
50-59	С	Fair	

Percentage	Grade	Description	
45-49	D+	Poor	
40-44	D	Very poor	
< 40	F	Fall	

Lab Performance Evaluation Rubric					
Criteria	Exemplary	Proficient	Basic	Inadequate	
	(score = 4)	(score = 3)	(score = 2)	(score = 1)	
Active participation	participation Student		Student is	Student shows	
	enthusiastically	involves in	present in class	no interest in	
	involves in	participation in	and shows	participation or	
	participation and	class with	moderate	fails to present in	
	discussion with	friends and	interest during	class.	
	friends and	teachers.	study.		
	teachers, and				
	shows evident				
	leadership skills.				
Group		Student	Student	Student fails to	
communication		communicates	moderately	communicate	
		well with other	communicates	with others and	
		students and	or discusses	tends to leave	
		teachers, both	with other	discussion.	
		verbally and	students, or		
		non-verbally.	when being		
			asked.		
Theory knowledge		Student shows	Students has	Student has very	
		profound	some degree of	little or no	
		background	knowledge of	knowledge about	
		knowledge on	topics being	topics being	
		topics being	studied, but	studied and not	
		discussed and	could be	prepared for this	
		evaluated.	improved in	session.	
			certain points.		

Criteria Excellent (score = 5) Very good (score = 3) Adequate (score = 3) Limited (score = 2) Poor (score = 1) Information quality and organization of quality and organization of quality and organization of quality and organization of topic presented (including impressive detail and organization. Information is directly linked to the topic of presentation. Main points are mot clear and lack and have no detail. detail. detail. detail. detail. detail. detail. detail. Information is some more detail information is organization. Information is directly linked to the topic given. Information information is organized and information is organized and information organized and information organized and information organized and information organized information. Information is organized and information organized and information organized and information organized information organized information organized and information organized information. Information is organized organized and information organized organized organized organized and information organized organized organized organized and information organized organized organized and information organized organized organized organized organized and information organized organized organized organized and information organized organized organized organized organized organized and information organized or		Problem-based learning Presentation Rubric				
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Problem-based learning Presentation Rubric					
Criteria	Excellent	Very good	Adequate	Limited	Poor
	(score = 5)	(score = 4)	(score = 3)	(score = 2)	(score = 1)
	gestures are		not very		gesture is
	presented to		effective.		presented.
	support the				
	presentation.				
Visual tools	Visual aids	Visual aids	Visual aids	Limited visual	No visual aids
	are very	are typically	are good in	aids are used	are used, and
	creative, easy	clear and	terms of	or difficult to	presentation is
	to read and	easy to	quality, but	help	not interested
	greatly	follow.	some points	audiences	by audiences.
	enhance		can be	follow the	
	presentation.		improved.	topic.	

Date revised: 2 June 2021