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**Department of Biology**

**College of Science**

**Salahaddin University-Erbil**

**Subject: Neuroscience**

**Course Book –Year 3**

**Lecturer's name: Zana Rafiq Majeed, Ph.D.**

**Academic Year: 2022-2023**

**Course Book**

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| **1. Course name** | **Neuroscience** | | |
| **2. Lecturer in charge** | **Dr. Zana Rafiq Majeed** | | |
| **3. Department/ College** | **Biology, College of Science** | | |
| **4. Contact** | **e-mail:** [zana.majeed@su.edu.krd](mailto:zana.majeed@su.edu.krd) | | |
| **5. Time (in hours) per week** | **Didactic and Discussion-based class: 2 hours/week** | | |
| **6. Office hours** | **Dr. Zana Rafiq Majeed: Monday, 9:00 am-12:00 pm**  **Tuesday, 9:00 am- 12:00 pm** | | |
| **7. Course code** | **Neuroscience** | | |
| **8. Teacher's academic profile** | **‌ Dr. Zana Rafiq Majeed**  I obtained my B.Sc. in Biology at Salahaddin University-Erbil in 2003. Then I embarked on studying Master’s degree in Animal Physiology in 2004 and completed the requirements in 2006 at Salahaddin University-Erbil. I travelled to the United States of America to study Ph.D. at the University of Kentucky, Lexington, Kentucky, in 2011. I completed my Ph.D. degree in Physiology/Neurobiology in 2016. I have received many awards at meetings for poster presentation; I attended many professional conferences in the USA: Society for Neuroscience and Skeletal Muscle Biology in Health and Disease to mention few. Besides, I have published 13 papers in prestigious journals, such as Cell Reports (impact factor: 7.87), the Journal of Gerontology, Series A (impact factor of 5.957), the Journal of Physiology (impact factor: 4.739) and the Journal of Applied Physiology (impact factor: 3.0). I have mentored many undergraduate students at Salahaddin University and the University of Kentucky.  **Awards**   * -Awarded the First Place Prize for oral presentation of Graduate Research Competition at the Kentucky Academy of Science meeting (2012) * -Awarded the second Place Prize for oral presentation of Graduate Research Competition at the Kentucky Academy of Science meeting (2013)   **Professional experiences**   1. Lecturer, College of Science, Salahaddin University-Erbil, Erbil, Iraq, October 2010-Present. 2. Assistant Lecturer, College of Science, Salahaddin University-Erbil, Erbil, Iraq, November 2006- 2010. 3. Biology Assistant, College of Science, Salahaddin University-Erbil, Erbil, Iraq, October 2003- November 2004.   **Public services and outreach activities**  A. Science Fair Judge   1. Morton Middle School Science Fair, Lexington, KY, USA (2011) 2. Glendover Elementary School, Lexington, KY, USA (2012)   B. Developed hands-on learning modules for high school and college level courses (2015).  **Professional affiliations**   1. Society for Neuroscience (2011-2016) 2. American Physiological Society (2014-2016) 3. Kentucky Academy of Science (2012-2013) 4. Kurdistan Biology Syndicate (2008-present)   **Scholarship**  PhD Higher Committee for Education Development in Iraq (HCED) (6 years).  **PEER REVIEWED PUBLICATIONS**   1. Miller BF, Hamilton KL, **Majeed ZR**, Abshire S., Confides A, Hayek A, Hunt E, Shipman P, Peelor FF III, Butterfield T, Dupont-Versteegden E (2018) Enhanced skeletal muscle regrowth and remodeling in massaged and contralateral non-massaged hind limb. J Physiol. 2018 Jan 1;596(1):83-103. 2. **Majeed ZR,** Koch, F, Morgan, J, Anderson, H, Wilson, J, and Cooper, RL (2017) A novel educational module to teach neural circuits for college and high school students: NGSS-neurons, genetics, and selective stimulations. F1000Research. F1000Research: Immediate & Transparent Publishing for Life Scientists. F1000 Research Ltd, Middlesex House, 34-42 Cleveland St, London W1T 4LB, UK. 3. Anderson KL, Frazier HN, Maimaiti S, Bakshi VV, **Majeed ZR**, Brewer LD, Porter NM, Lin AL, Thibault O (2017) Impact of Single or Repeated Dose Intranasal Zinc-free Insulin in Young and Aged F344 Rats on Cognition, Signaling, and Brain Metabolism. The journals of gerontology. Series A, Biological sciences and medical sciences 72(2): 189-197. 4. **Majeed ZR,** Abdeljaber E, Soveland R, Cornwell K, Bankemper A, Koch F, Cooper RL (2016) Modulatory Action by the Serotonergic System: Behavior and Neurophysiology in Drosophila melanogaster. Neural Plasticity vol. 2016, 23 pages. http://www.hindawi.com/journals/np/2016/7291438/ 5. Zhu YC, Uradu H, **Majeed ZR,** Cooper RL (2016) Optogenetic stimulation of Drosophila heart rate at different temperatures and Ca2+ concentrations. Physiol Rep. 4(3). pii: e12695. 6. **Majeed ZR,** Ritter K, Robinson J, Blümich SL, Brailoiu E, Cooper RL (2015) New insights into the acute actions from a high dosage of fluoxetine on neuronal and cardiac function: Drosophila, crayfish and rodent models. Comp Biochem Physiol C Toxicol Pharmacol. 176-177:52-61. 7. Titlow JS, Rice J, **Majeed ZR,** Holsopple E, Biecker S, Cooper RL (2014) Anatomical and genotype-specific mechanosensory responses in Drosophila melanogaster larvae. Neurosci Res. 83:54-63. 8. **Majeed ZR,** Stacy A, Cooper RL (2014) Pharmacological and genetic identification of serotonin receptor subtypes on Drosophila larval heart and aorta. J Comp Physiol B. 184(2):205-19. 9. de Castro C, Titlow J, **Majeed ZR,** Cooper RL (2014) Analysis of various physiological salines for heart rate, CNS function, and synaptic transmission at neuromuscular junctions in Drosophila melanogaster larvae. J Comp Physiol A Neuroethol Sens Neural Behav Physiol. 200(1):83-92. doi: 10.1007/s00359-013-0864-0. Epub 2013 Nov 5. 10. Titlow JS, **Majeed ZR,** Hartman HB, Burns E, Cooper RL (2013) Neural circuit recording from an intact cockroach nervous system. J Vis Exp. 81:e50584. 11. Titlow J, **Majeed ZR,** Nicholls JG, Cooper RL (2013) Intracellular recording, sensory field mapping, and culturing identified neurons in the leech, Hirudo medicinalis. J Vis Exp. (81):e50631. 12. **Majeed ZR,** Titlow J, Hartman HB, Cooper RL (2013) Proprioception and tension receptors in crab limbs: student laboratory exercises. J Vis Exp. 80:e51050. doi: 10.3791/51050. 13. **Majeed ZR**, Nichols CD, Cooper RL (2013) 5-HT stimulation of heart rate in Drosophila does not act through cAMP as revealed by pharmacogenetics. J Appl Physiol (1985). 115(11):1656-65. 14. Becnel J, Johnson O, **Majeed ZR,** Tran V, Yu B, Roth BL, Cooper RL, Kerut EK, Nichols CD (2013) DREADDs in Drosophila: a pharmacogenetic approach for controlling behavior, neuronal signaling, and physiology in the fly. Cell Rep. 4(5):1049-59. | | |
| **9. Keywords** | **Neuron, synapse, cortex, behavior** | | |
| **10. Course overview:**  **This course is focusing on the brain at different levels: molecules, cells, circuits, and behavior.**  Neuroscience is a scientific study of the structure and function of the nervous system. It includes the molecular and cellular study, development, physiology, and neurological disorders. Nervous system is divided into central nervous system (CNS) and peripheral nervous system (PNS). CNS consists of the brain and the spinal cord. Brain is one of the most complex organs in the body. There are about 86 billion neurons in human nervous system. Those neurons make around 1015 synapses with each other in neural networks. Understanding the inner workings of the brain gives insight into the functionality of the brain.  In this course, we will talk about the molecular and cellular basis of the nervous system. The information from outside world and inside the body is relayed to the spinal cord and the brain through neurons in a special connection between them called synapse. Synapse is a highly specialized structure that facilitates the information flow from one neuron to another using a chemical neurotransmitter.  We also study the embryonic development of the nervous system to better understand the origin of different parts of the nervous system especially brain. Then we study the sensory and motor systems. In this part, the processing of different sensory modalities, olfaction, vision, hearing and control of voluntary movements will be discussed.  To unravel the mystery of the nervous system one should be familiarized with the neuroanatomy. Neuroanatomy is a very dry subject; however, it really comes to life when you study structure-function relationships of the nervous system. Therefore, the gross anatomy of human nervous system will be our focus in this course.  The ultimate goal of neuroscience is to connect a specific neural circuit to a pertinent behaviour. In this section, the neurobiological basis if various behaviours will be discussed. The quest to answer how organisms store and retrieve memory has energized neuroscientists around the world to work hard to find evidence for learning and memory research. The molecular and cellular mechanisms of memory storage and retrieval will be discussed as well. | | | |
| **11. Course objectives:**  1. In this course, students will learn about structure and function of individual neurons and how they communicate through chemical synaptic transmission.  2. Information flow from one neuron to another is mainly achieved by the chemical synaptic transmission. Students learn how neurons, as an excitable cell, generate and maintain their ionic gradient across the plasma membrane.  3. The direction of information flow inside a neuron is from the dendrites to nerve terminals through action potential generation. Action potentials are generated in the axons due to a rapid change in ionic conduction across the membrane. Students will learn the ionic basis of action potential in the axon of an organism.  4. Students learn how the information from different sensory modalities, vision, audition, olfactory, gustatory and voluntary movement is relayed to and processed in the brain.  5. Students obtain an idea regarding how chemicals control behaviour, such as motivation, sex, emotion, sleep, and higher cognitive functions such as decision making in an organism.  6. This course gives an insight into the wiring diagram of the neural networks of the brain and the molecular mechanism of learning and memory.  7. Students will obtain knowledge about the molecular and cellular basis of neurodegenerative diseases, Alzheimer’s and Parkinson’s diseases, and neuropsychiatric disorders, schizophrenia and depression. | | | |
| **12. Student's obligation**   * Attendance will be taken at the beginning of each class. Students are expected to be in the lecture hall on time. * Put your phone on silent mode before you come to the lecture hall. * Students are highly encouraged to use English language in the classroom. * Students should turn in their homework assignments at the end of each class * Class disruption by any means is not tolerated. | | | |
| **13. Forms of teaching**  - Encouraging class group discussion.  - Using educational videos from various sources.  - Using Blackboard during class activity.  - Using Moodle site to create an interactive environment. | | | |
| **14. Assessment scheme**  - 3 exams each on 100% (will be converted to final 40%). This is subject to changes. | | | |
| **15. Student learning outcome:**  This course will focus on the principles of inner workings of the nervous system which is important to those who are new in neuroscience field. At the end of this course, students will have a better understanding of the functions of different parts of the brain and other nervous system structures. By taking this course, students will have an opportunity to find their interest and passion in a specific topic in this fast-growing field. Students can use the knowledge they obtain from this course to further advance in their future carrier especially in medical related jobs. In this course, students learn how various drugs affect on the nervous system and how toxins target specific protein in neurons. Students can apply this knowledge in pharmaceutical companies to find a therapy for a specific neurological disorder, which can be done through research. | | | |
| **16. Course Reading List and References‌:**  Bear M.F., Connors B.W., Paradiso M.A. (2016). Neuroscience: Exploring the Brain. Wolters Kluwer; 4th edition.  There is a free electronic textbook for the neuroscience. You can use the animations inside the site to better understand the important concepts in neuroscience. You can access to the site through the link below:  <https://nba.uth.tmc.edu/neuroscience/toc.htm> | | | |
| **17. The Topics:** | | **Weeks** |
| **Lecture 01:** Neuron Structure and Function | | Week 1 |
| **Lecture 02:** Glial Cell Structure and Function | | Week 2 |
| **Lecture 03:** Synaptic Transmission | | Week 3 |
| **Lecture 04:** Synaptic Integration and Neurotransmitter Systems | | Week 4 |
| **Lecture 05:** The organization of the cerebral cortex | | Week 5 |
| **Lecture 06:** Neural Circuit Development | | Week 6 |
| **Lecture 07:** Human Neuroanatomy | | Week 7 |
| **Exam 01** | | Week 8 |
| **Lecture 08:** Neurodevelopmental disorders | | Week 9 |
| **Lecture 09:** Learning and Memory | | Week 10 |
| **Lecture 10:** Regeneration in the Nervous System | | Week 11 |
| **Lecture 11:** Adult Neurogenesis | | Week 12 |
| **Lecture 12:** Neural Development | | Week 13 |
| **Lecture 13:** Brain Imaging Techniques | | Week 14 |
| **Exam 02** | | Week 15 |
| **18. Practical Topics (If there is any)** | | | |
| In this section the lecturer shall write titles of all practical topics he/she is going to give during the term. This also includes a brief description of the objectives of each topic, date and time of the lecture. | | | |
| **19. Examinations:**  **Types of Exam questions:**   1. **Short essay questions** 2. A region of the cerebrum is now called Broca’s area. What function do you think this region performs, and why? 3. What are three physical characteristics that distinguish axons from dendrites? 4. Knowledge of genes uniquely expressed in a particular category of neurons can be used to understand how those neurons function. Give one example of how you could use genetic information to study a category of neuron. 5. When the brain is deprived of oxygen, the mitochondria within neurons cease producing ATP. What effect would this have on the membrane potential? Why? 6. **Identify different parts of a structure in a picture or figure**   Image result for synapse structure  Image result for synapse structure   1. **Multiple choice questions** 2. The main excitatory neurotransmitter in the brain is 3. GABA b. Glutamate c. Acetylcholine d. serotonin 4. Puffer fish produces tetrodotoxin, its toxic action is exerted through blocking of 5. K+ channels b. voltage-gated Na+ channels c. chloride channels d. Ca+2 channels | | | |
| **20. Extra notes:**  Here the lecturer shall write any note or comment that is not covered in this template and he/she wishes to enrich the course book with his/her valuable remarks. | | | |
| **21. Peer review**  This course book has to be reviewed and signed by a peer. The peer approves the contents of your course book by writing few sentences in this section.  *(A peer is person who has enough knowledge about the subject you are teaching, he/she has to be a professor, assistant professor, a lecturer or an expert in the field of your subject).* | | | |

**Peer reviewed by:**

**Mr Mohammed Ali Saleem**

**Head of Department of Biology**