Clinical Neuroanatomy

2020-2021

ANAT 323-001

Fall: September 2 – December 7, 2020.

Course Director: Abubakr Mossa, MD, PhD
McGill University
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Guest Lecturer: Geoffroy Noel, PhD
Associate Professor
Director of Division of Anatomical Sciences
McGill University
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Schedule Type: **MW**

Credit Value: 3

TA: Brandon Ramchatesingh, BSc, MSc Candidate
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A. Timetable

Lecture and Tutorial: Dr. Mossa or Dr. Noel
Q&A: Dr. Mossa
Tutorial: Brandon Ramchatesingh

Date	Time	Type	Topic of Q&A, clinical vignettes and tutorials
Sept. 2	10:35-11:25	Lecture	Introduction/Overview of CNS (Dr. Noel)
Sept. 7	**Labour Day**		
Sept. 9	9:35-10:25	Tutorial	Flow chart: Introduction to Diagnosis (to apply in clinical vignettes)
Sept. 9	10:35-11:25	Q&A	Video: CNS vs PNS
Sept. 14	10:35-11:25	Lecture	CNS coverings (Dr. Noel)
Sept. 16	9:35-10:25	Tutorial	Medical imaging/Coronal and Horizontal sections
Sept. 16	10:35-11:25	Q&A	Video: Descending tracts
Sept. 21	10:35-11:25	Lecture	Ascending tracts I: posterior columns-medial lemniscus (Dr. Noel)
Sept. 23	9:35-10:25	Tutorial	Clinical vignettes: Descending and Ascending tracts
Sept. 23	10:35-11:25	Q&A	Video: Ascending tracts II: spinothalamic and spinocerebellar tracts
Sept. 28	10:35-11:25	Lecture	Autonomic nervous system I: heart rate, respiratory volume and lacrimation/salivation
Sept.30	9:35-10:25	Tutorial	Clinical vignettes: ANS
Sept. 30	10:35-11:25	Q&A	Video: Autonomic nervous system II: defecation and pupil diameter
Oct. 5	10:35-11:25	Lecture	Autonomic nervous system III: bladder control and sexual response
Oct. 7	24 hrs window		**Midterm 1 (2.5 hrs)**
Oct. 7	10:35-11:25	Q&A	Video: Blood supply of CNS Review Midterm 1
Oct. 12	**Thanksgiving**		
Oct. 14	9:35-10:25	Tutorial	Imaging: T1w T2w FLAIR: pathology
Oct. 14	10:35-11:25	Q&A	Video: Brainstem
Oct. 19	10:35-11:25	Lecture	Cranial nerve II and retina

Oct. 21	9:35-10:25	Tutorial	Imaging: Blood supply (brain)
Oct. 21	10:35-11:25	Q&A	Video: Cranial nerves III, IV and VI
Oct. 26	10:35-11:25	Lecture	Cranial nerves V, VII
Oct. 28	9:35-10:25	Tutorial	Imaging: Blood supply (brainstem)
Oct. 28	10:35-11:25	Q&A	Video: Cranial nerve VIII: hearing
Nov. 2	10:35-11:25	Lecture	Cranial nerves VIII: balance
Nov. 4	24 hrs window		**Midterm 2 (2.5 hrs)**
Nov. 4	10:35-11:25	Q&A	Video: Cranial nerves XI and XII Review Midterm 2
Nov. 9	10:35-11:25	Lecture	Cranial nerves IX, X
Nov. 11	9:35-10:25	Tutorial	Drawing blood supply
Nov. 11	10:35-11:25	Q&A	Video: Thalamus
Nov. 16	10:35-11:25	Lecture	Cerebellum
Nov. 18	9:35-10:25	Tutorial	Clinical vignettes: Stroke and Cerebellum
Nov. 18	10:35-11:25	Q&A	Video: Hypothalamus and cranial nerve I
Nov. 23	10:35-11:25	Lecture	Basal ganglia
Nov. 25	9:35-10:25	Tutorial	Tracts on MRI
Nov. 25	10:35-11:25	Q&A	Video: Limbic system
Nov. 30	10:35-11:25	Lecture	Functional area of cerebral cortex
Dec. 2	24 hrs window		**Midterm 3 (2.5 hrs)**
Dec. 2	10:35-11:25	Q&A	Subcortical fibers Review Midterm 3
Dec. 7-21	TBA	Final	Final Written Exam

B. Overview

ANAT 323 Clinical Neuroanatomy course will focus on the structural and functional relationships of the central nervous system. The human neuroanatomy will be introduced via pathological cases and will be illustrated by use of new medical imaging techniques.

C. Learning Outcomes

Upon completion of this course, physical and occupational therapy students will be able to:

1. List the major components of the CNS.
2. Describe the structure and function of the meninges and ventricular system.
3. Diagram external features and cross sections of the spinal cord, brain stem, cerebellum, diencephalon, and telencephalon and relate them to functions of the CNS.
4. Describe the course and connections of pathways influencing motor performance.
5. Describe the course and connections of pathways conveying sensory information.
6. Outline the organization and functional significance of the autonomic nervous system.
7. Outline the components, course, functions and clinical testing of the cranial nerves.
8. Discuss the role of the different cranial nerves in the vestibulo-ocular, pupillary light, pupillo-dilator, corneal, jaw-jerk, oculo-cardiac and gag reflexes.

9. Describe the different pathway involved in pain control, eye movement and balance.
10. Identify the relationships between the deep structures of the brain and their role in movement coordination
11. Discuss the role of the different structures involved in the limbic system with an emphasis on memory and olfaction.
12. Carry out problem solving techniques and clinical implications for the PNS and CNS: - given the location of a lesion, predict the most likely clinical consequences, or

    - given a case history, deduce the location and implications of the lesion
13. Discuss the blood supply of the spinal cord, brain stem, and cerebral hemispheres and the functional consequences of selected vascular and traumatic lesions.
14. Discuss cognitive processing and functional localization of the CNS.
15. Identify the gross anatomy of the skull and relate it to the gross anatomy of the CNS.
16. Identify the structural landmarks used to locate nuclei and tracts on MRI and CT scans.
17. From wet specimens and horizontal, sagittal and coronal sections, identify the gross structures of spinal cord, brain stem, cerebellum, diencephalon, basal ganglia, cerebral cortex, their coverings and their respective blood supplies.
18. Demonstrate professional respect and responsible care of human specimens.

D. Instructional Methods

As the format of this course is mixed (synchronous lectures and flipped classroom), there will be lecture and videos. Student will be expected to watch pre-recorded lecture and attend Q&A exercise during half of the lecture hours. Tutorials will be live and consist in resolving clinical vignettes and practicing anatomical recognition on medical imaging.

Lectures: Monday, 10:35-11:25 am EST; Zoom (synchronous) that will be recorded

https://mcgill.zoom.us/j/92766819221

Q&A: Wednesday, 10:35-11:25 am EST; Video Conference (synchronous) that will not be recorded as the pre-recorded lectures are available on Stream

https://mcgill.zoom.us/j/92766819221

Tutorials: Wednesday, 9:35-10:25 am EST; Video Conference (synchronous) that will not be recorded

https://mcgill.zoom.us/j/99447293575

Because some students may not be able to view lectures in fixed time (i.e., synchronously), many instructors will record their lectures over the Fall 2020 term. Recordings will be made available to students from within myCourses. Students registered in the course will have access by logging in with their McGill credentials.

E. Course Materials

The students are responsible for the entire content of the lectures notes and recordings. If maximum benefit is to be obtained from the lecture sessions, they should also acquaint themselves with neuroanatomy textbooks. The following references will support learners in the course work:

Lecture: Clinical Neuroanatomy / Richard S. Snell. Philadelphia : Lippincott Williams & Wilkins, c2006

Lecture materials: MyCourses – ANAT 323: https://mycourses2.mcgill.ca/

Videos: McGill Sharepoint Portal

https://mcgill.sharepoint.com/portals/hub/_layouts/15/PointPublishing.aspx?app=video&p=c&chid=4a1e208e-0b62-44d9-a6c0-6ef27b497d63&s=0&t=pfb

Tutorial Materials: MyCourses – ANAT 323: https://mycourses2.mcgill.ca/

F. Course Content

Neuroanatomy ANAT 323 is designed to assist students to gain further knowledge regarding the anatomy with an emphasis on the nervous system. This course builds on knowledge previously acquired in *Limbs and Back ANAT 315* and *Systemic Anatomy ANAT 316* courses. This course will focus on the structural and functional relationships of the central nervous system. It will start with an overview of the central nervous system and its surface landmarks and it will move to a regional approach of the central nervous system, going from the spinal cord to the cerebral cortex. This sequence will facilitate the transition with ANAT 315 and 316 courses where structures of the peripheral nervous system were introduced. The human neuroanatomy will be introduced via pathological cases and will be illustrated by use of exhibits coordinated with medical imaging.

Lecture 1: Introductory Lecture/Overview of CNS

By the end of this class, students will be able to:

1. Identify the main components of the central nervous system (CNS); spinal cord, brainstem and brain.
2. Describe the organization of grey and white matters in the CNS.
3. Identify the major landmarks on the surface of the cerebrum, cerebellum, brainstem and spinal cord.

Readings: Snell pp 8-14, pp 248-252

Lecture 2 (pre-recorded): *CNS vs PNS*

By the end of this class, students will be able to:

1. Review modalities carried by spinal nerves
2. Explain the concept of spinal reflex.
3. Review blood supply of spinal cord.

4. Explain syndromes related to spinal cord structures

Readings: Snell pp 1-8, pp 70-72, pp 101-104, pp 436-438, pp 481-482

Lecture 3: *CNS coverings*

By the end of this class, students will be able to:

1. Identify the meninges.
2. Describe the different herniations.
3. Explain the ventricular system, its organization and circulation.

Readings: Snell pp 423-432, pp 439-455

Lecture 4 (pre-recorded): *Descending tracts*

By the end of this class, students will be able to:

1. Locate and trace the major descending pathway in the spinal cord; pyramidal and extrapyramidal tracts.
2. Compare decerebrate and decorticate posturing.
3. Define the corticobulbar, vestibulospinal, tectospinal, reticulospinal and lateral lemniscus tracts.

Readings: Snell pp 133-140, pp 152-158

Lecture 5: *Ascending tracts: posterior columns-medial lemniscus*

By the end of this class, students will be able to:

1. Locate and trace one major ascending pathway in the spinal cord; dorsal-column-medial lemniscus.
2. Differentiate between conscious and unconscious propioception.

Readings: Snell pp 159-162, pp 146-151

Lecture 6 (pre-recorded): *Ascending tracts: spinothalamic and spinocerebellar tracts*

By the end of this class, students will be able to:

1. Locate and trace two other major ascending pathways in the spinal cord; spinocerebellar and spinothalamic tracts.
2. Understand the structures involved in pain perception and modulation.

Readings: Snell pp 141-145

Lecture 7: *Autonomic nervous system: heart rate, respiratory volume, salivation/lacrimation*

By the end of this class, students will be able to:

1. Compare the somatic to the autonomic nervous system.
2. Locate the origin of the autonomic efferents
3. Compare the parasympathetic to the sympathetic nervous system.
4. Describe the regulation of heart rate, respiratory volume, salivation/lacrimation.

Readings: Snell pp 391-406

Lecture 8 (pre-recorded): *Autonomic nervous system: defecation and pupil diameter*

By the end of this class, students will be able to:

1. Explain the control of defecation and pupil diameter.

Readings: Snell pp 407-411

Lecture 9: *Autonomic nervous system: bladder control and sexual responses*

By the end of this class, students will be able to:

1. Explain the control of micturation and sexual responses.

Readings: Snell pp 407-411

Lecture 10 (pre-recorded): *Blood supply of CNS*

By the end of this class, students will be able to:

1. Describe the main blood supply of the cranial cavity
2. Describe the blood supply of the brain
3. Describe blood supply of brainstem and spinal cord.

Readings: Snell pp 469-477

Lecture 11 (pre-recorded): *Brainstem*

By the end of this class, students will be able to:

1. Describe the location and function of the reticular formation.
2. Understand rearrangement of tracts and nuclei between spinal cord and brainstem.

Readings: Snell pp 185-205, pp 297-300

Lecture 12: *Cranial nerve II and retina*

By the end of this class, students will be able to:

1. Understand the visual pathway

Readings: Snell pp 325-331

Lecture 13 (pre-recorded): *Cranial nerves III, IV and VI*

By the end of this class, students will be able to:

1. Describe the cranial nerves involved in eye movements
2. Describe and locate the nuclei and tracts involved in eye movements.

3. Understand the processes of saccades and pursuit
4. Explain the pupillary light, the vestibulo-ocular and the pupillodilator reflexes as well as accomodation

Readings: Snell pp 333-335, pp 339

Lecture 14: ***Cranial nerves V and VII***

By the end of this class, students will be able to:

1. Describe the modalities carried by cranial nerves V, VII
2. Discuss the location and function of the different nuclei.
3. Discuss the corneal and jaw-jerk reflexes.

Readings: Snell pp 335-341

Lecture 15 (pre-recorded): ***Cranial nerve VIII; hearing***

By the end of this class, students will be able to:

1. Describe the modalities carried by cranial nerve VIII
2. Discuss the location and function of the different nuclei.
3. Discuss the cochlear system and its role in hearing.

Readings: Snell pp 343

Lecture 16: ***Cranial nerve VIII; balance***

By the end of this class, students will be able to:

1. Discuss the vestibular system and its role in balance.

Readings: Snell pp 341-342, pp 344

Lecture 17 (pre-recorded): *Cranial nerves IX and X*

By the end of this class, students will be able to:

1. Describe the modalities carried by cranial nerves IX, X
2. Discuss the location and function of the different nuclei.
3. Discuss the gag reflexes.

Readings: Snell pp 345-348

Lecture 18: *Cranial nerves XI and XII*

By the end of this class, students will be able to:

1. Describe the modalities carried by cranial nerves XI and XII
2. Discuss the location and function of the different nuclei.

Readings: Snell pp 349-351

Lecture 19 (pre-recorded): *Thalamus*

By the end of this class, students will be able to:

1. Describe the nuclei of thalamus.

Readings: Snell pp 365-370

Lecture 20: *Cerebellum*

By the end of this class, students will be able to:

1. Describe the contents of the cerebellar peduncles.

2. Describe the cerebellar afferents; spinocerebellar, cuneocerebellar, pontocerebellar, olivocerebellar and vestibulocerebellar tracts.
3. Describe the cerebellar efferents; dentato-, interposito- and gastigio-thalamic fibers.
4. Explain the three different functional areas of the cerebellum.

Readings: Snell pp 219-232

Lecture 21 (pre-recorded): *Hypothalamus and cranial nerve I*

By the end of this class, students will be able to:

1. Describe the anatomy of hypothalamus.
2. Describe the functional anatomy of the olfactory system.

Readings: Snell pp 377-386

Lecture 22: *Basal ganglia*

By the end of this class, students will be able to:

1. Describe the basal ganglia and their relationship with the ventricles.
2. Describe the blood supply of the basal ganglia and its related lesions.

Readings: Snell pp 309-315

Lecture 23 (pre-recorded): *Limbic system*

By the end of this class, students will be able to:

1. Describe the anatomy of limbic system and its role in memory.
2. Locate the amygdala, hippocampus and cingulate gyrus.
3. Explain the Papez circuit with the mammillary bodies and fornix.

Readings: Snell pp 300-305

Lecture 24: ***Functional areas of cerebral cortex***

By the end of this class, students will be able to:

1. Localize the functional areas of the cerebral cortex.
2. Compare the sensory and motor homunculi.
3. Explain the function of Broca's and Wernicke' areas.
4. Differentiate between right and left hemisphere lesions.

Readings: Snell pp 275-288

Lecture 25: ***Subcortical fibers***

By the end of this class, students will be able to:

1. Describe the major subcortical fibre bundles.
2. Describe the tracts of the internal capsule and their relation to the thalamus.

Readings: Snell pp 254-260

G. Methods of Evaluation

Final exams will occur in the official exam period. Students will NOT be allowed to write exams prior to the scheduled date. The final exams will be cumulative. The final practical exam will include both lecture and lab material. Students are required to attend all classes and labs.

Student Assessments include the following components:

Professionalism	2%
Midterm 1 (Oct. 7th, 2020, 9:05-9:55, MCQ on clinical vignettes)	15%
Midterm 2 (Nov. 4th, 2020, 9:05-9:55, MCQ on clinical vignettes)	15%
Midterm 3 (Dec. 2nd, 2020, 9:05-9:55, MCQ on clinical vignettes)	10%
Final Written Examination (MCQ on clinical vignettes, official exam period)	58%
Total Grade	**100%**

The passing grade in the Faculty of Medicine is 55%.

H. McGill Policy Statements

- ***McGill University values academic integrity. Therefore, all students must understand the meaning and consequences of cheating, plagiarism and other academic offences under the Code of Student Conduct and Disciplinary Procedures (see www.mcgill.ca/students/srr/honest/ for more information).****(approved by Senate on 29 January 2003)*

- © Instructor generated course materials (e.g., handouts, notes, slides, video recordings, summaries, exam questions, etc.) are protected by law and may not be copied or distributed in any form or in any medium without explicit permission of the instructor. Note that infringements of copyright can be subject to follow up by the University under the Code of Student Conduct and Disciplinary Procedures.

- *As the instructor of this course I endeavor to provide an inclusive learning environment. However, if you experience barriers to learning in this course, do not hesitate to discuss them with me and the Office for Students with Disabilities, 514-398-6009.*

- *End-of-course evaluations are one of the ways that McGill works towards maintaining and improving the quality of courses and the student's learning experience. You will be notified by e-mail when the evaluations are available on Mercury, the online course evaluation system. Please note that a minimum number of responses must be received for results to be available to students.*

- *"In the event of extraordinary circumstances beyond the University's control, the content and/or evaluation scheme in this course is subject to change.*

- *Additional policies governing academic issues which affect students can be found in the McGill Charter of Students' Rights" (The Handbook on Student Rights and Reponsibilities is available here).*

- *In the case of a **justified absence** due to serious illness or significant extenuating circumstances AND when valid documentation[1] is received by the Course Coordinator within FIVE working days of the original midterm exam, students may be offered the following accommodation: add the weight of the midterm exam assessment to the final exam or another course component*

- *Per McGill's Code of Student Conduct and Disciplinary Procedures, "[t]he integrity of University academic life and of the degrees the University confers is dependent upon the honesty, integrity and soundness of the teacher-student learning relationship and, as well, that of the assessment process." Note that student obligation measures under the heading "C. Academic Offences" in the Code of Student Conduct and Disciplinary Procedures (i.e., avoiding plagiarism or cheating) and associated disciplinary measures apply as much during online exams or other remotely-conducted evaluations as exams and other evaluations on McGill premises.*

- *Do not share your login or password information. Keeping this information confidential minimizes the risk of harassment and intrusion into your classes by unauthorized and ill-intended users, and ensures that you remain compliant with the requirements of the Policy on the Responsible Use of McGill's Information Technology Resources.*

- *You must consent to being recorded if you are attending a lecture or participating in a component of a course that is being recorded. You will be notified through a "pop-up" box in Zoom if a lecture or portion of a class is being recorded. If you are not comfortable being in a class that is recorded, you may decide to not take part by*

logging off Zoom. Students who log off will be able to later watch the video recording in myCourses. In addition to the recording of your image and voice, your name (or preferred name) may be displayed on screen, and your instructor may call your name during the lecture. As such, this personal information will be disclosed to classmates, whether during the lecture or in viewing the recording. By remaining in classes that are being recorded, you accept that personal information of this kind may be disclosed to others, whether during the lecture or in viewing the recording.

- *The University recognizes the importance of maintaining teaching spaces that are respectful and inclusive for all involved. To this end, offensive, violent, or harmful language arising in contexts such as the following may be cause for disciplinary action:*
    - *Username (use only your legal or preferred name)*
    - *Visual backgrounds*
    - *"Chat" boxes*

- *To maintain a clear and uninterrupted learning space for all, you should keep your microphone muted throughout your class, unless invited by the instructor to speak.*

GRADING

- *The Department of Anatomy & Cell Biology will **NOT** revise/upgrade marks except on sound academic grounds. Once computed, the marks in this course will **NOT** be altered/increased arbitrarily. Decimal points will be "rounded off" as follows: if the final aggregate mark is computed to be 79.5%, the mark will be reported as 80% (an A-); a final aggregate mark of 79.4% will be reported as 79% (a B+). These marks are **FINAL and Non-negotiable.***

REASSESSMENTS AND REREADS: FACULTIES OF ARTS AND SCIENCE (INCLUDING B.A. & SC.)

http://www.mcgill.ca/study/2016-2017/university_regulations_and_resources/undergraduate/gi_final_examinations

There are two recognized types of impartial reviews, i.e., reassessments or rereads:

- reassessment of coursework (term papers, mid-terms, assignments, quizzes, etc.)
- reread of a final exam

In both cases, rather than recorrect the work and then grade it as they would have done themselves, reviewers assess the **appropriateness** of the original grade based, for example, on the application of the grading key to the student's work. If a grade is deemed unfair, it is changed, whether the new grade is higher or lower than the original, i.e., the reviewer's grade takes precedence over the original grade.

Reassessment of Coursework

These reassessments are administered and conducted solely by the units involved according to procedures specified by the units and made available to staff and students. Requests for such reassessments must be made within 10 working days after the graded material(s) has been made available for students to view. Reassessments should normally be completed within 20 working days of the request.

Rereads of Final Examinations

Deadlines to request final exam rereads:

- **March 31** for courses in the Fall term
- **September 30** for courses in the Winter and Summer terms

Exam reread fees apply; refer to the Student Accounts website for fee amounts and information.
For students pursuing a *Bachelor of Arts*, *Bachelor of Science*, or the *Bachelor of Arts & Science*:

- Requests for a final exam reread must be made via the Service Point webform;
- It is strongly recommended, but not required, that you consult with the instructor of the course before requesting a reread of a final exam.

Students from outside the Faculties of Arts or Science who are taking a course administered by the Faculty of Arts or Science must submit final exam reread requests directly to the Student Affairs Office of their Faculty for approval.
Reassessments and rereads in courses not in the Faculties of Arts and Science are subject to the deadlines, rules, and regulations of their relevant faculties.

Programs, Courses and University Regulations—2016-2017 (last updated Jan. 14, 2016) (disclaimer)