Course Syllabus

1. **Subject:** SCBM 375 Microscopy and Bioimaging
2. **Credit:** 2 (1-2-3)
3. **Instructor**

3.1 Course Coordinator:

Asst. Prof. Dr. Worawit Suphamungmee* Asst. Prof. Dr. Monsicha Somrit

Asst. Prof. Dr. Morakot Sroyraya Assoc. Prof. Dr. Rapeepun Vanichviriyakit

Assoc. Prof. Dr. Krai Meemon Dr. Jinchutha Duangdara

*Course coordinator: Department of Anatomy (B118; Phayathai)

Contact: 02-201-5409, Email: worawit.sup@mahidol.edu

3.2 Supporting Staff: Mr. Sukit Meesombat

4. **Semester/Academic Year:** 2/2024
5. **Pre-requisite/Co-requisite:** SCBM 214 Structure of Cell and Tissue
6. **Study Location:** Faculty of Science, Mahidol University
7. **Course Description:**

Microscopy; Optical microscope; Immunohistochemistry; Electron microscope; Biological imaging

8. **Total Hours:**

Lecture (hours)	**Laboratory** (hours)	**Self-study** (hours)
15	**30**	**45**

9. **Objectives:**

9.1 Describe principle and applications of microscopy.

9.2 Explain major components and basic operations of light and electron microscopes.

9.3 Explain routine procedures of specimen preparations in the microscopy techniques.

9.4 Discuss the advantage of biological imaging methods including the quality of the microscopic images.

10. **Course schedule:**

Monday Lecture Room: L03 Laboratory: MDL2, AN1-110, B109/1, B200, P113 [see a full schedule]

Week	Dates	Times	Topics	Lecturers
1	Jan 6	13.00-14.00	**Lecture 1:** Light microscopy (LM): Basic principle of LM and image formation	Worawit
		14.00-15.00	**Lecture 2:** Properties of light and parts of light microscope	Worawit
		15.00-16.00	**Lecture 3:** Dark field microscopy, phase contrast microscopy and differential interference contrast (DIC) microscopy	Morakot

2	**Jan 13**	**13.00–14.00** **14.00–15.00**	**Lecture 4:** Preparation technique for light microscopy: Paraffin technique and frozen tissue preparation **Lecture 5:** Preparation technique for light microscopy: General staining and special staining	Morakot Morakot
3	**Jan 20**	13.00–15.00 15.00–17.00	Lab 1: Paraffin technique 1 – Tissue selection, auto processing, and embedding [B109/1] Lab 2: Paraffin technique 2 – Tissue sectioning and mounting [AN110]	Worawit Rapeepun Morakot Jinchutha
4	**Jan 27**	13.00–15.00 14.00–17.00	Lab 3: H&E staining and digital imaging [MDL2] Lab 4: Masson's trichrome staining and digital imaging [MDL2]	Worawit Rapeepun Morakot Jinchutha
5	**Feb 3**	**13.00–14.00** **14.00–15.00** **15.00–16.00**	**Lecture 6:** Fluorescence microscopy (epifluorescence/inverted fluorescence) **Lecture 7:** Confocal laser microscopy **Lecture 8:** Immunohistochemistry: Immunoperoxidase and immunofluorescence techniques	Monsicha Monsicha Rapeepun
6	**Feb 10**	13.00–15.00 15.00–17.00	Lab 5–6: Immunofluorescence technique: Preparation & staining methods [MDL2] Lab 7–8: Immunoperoxidase technique: Preparation & staining methods [MDL2]	Worawit Rapeepun Monsicha Krai
7	**Feb 24**	13.00–17.00	Lab 9: Digital imaging of the immunofluorescence-stained specimen [B200] and Digital imaging of immunoperoxidase-stained specimen [MDL2] – part I	Worawit Rapeepun Monsicha Krai
8	**Mar 3**	13.00–17.00	Lab 10: Digital imaging of the immunofluorescence-stained specimen [B200] and Digital imaging of immunoperoxidase-stained specimen [MDL2] – part II	Worawit Rapeepun Monsicha Krai
9	**Mar 10**	13.00–14.00 14.00–15.00 15.00–16.00	**Lecture 9:** *In situ* hybridization technique **Lecture 10:** Fluorescent protein tagging: The beauty of design **Lecture 11:** Live cell imaging: An introduction to super resolution imaging	Krai Jinchutha Jinchutha
10	**Mar 17**	13.00–15.00 15.00–17.00	**Lecture 10–11:** Principle and preparation technique of transmission electron microscopy **Lecture 12–13:** Principle and preparation technique of scanning electron microscopy	Worawit Worawit
11	**Mar 24**	13.00–15.00 15.00–17.00	Lab 11: TEM specimen preparation [B200] Lab 12: SEM specimen preparation [B200]	Worawit Wattapong Jirawadee

12	**Mar 31**	13.00–15.00 15.00–17.00	Lab 13: Basic operation of TEM [P113] Lab 14: Basic operation of SEM [B200]	Worawit Wattapong Jirawadee
13	**Apr 21**	13.00–15.00	Lab 15: Conference: Discussion on techniques & applications [L03]	Worawit Rapeepun Morakot Krai
14	**Apr 28**	13.00–15.00	Examination	
15	**Apr 30**	12.00	Submission Due for Lab Report	

Teaching Materials: available in Google Classroom

Google Classroom: https://classroom.google.com/c/NzMyODYwNTIyNTE4 Passcode: igujeec

11. Evaluation:

Summative examination	50%
Individual lab report	25%
Lab presentation (conference)	20%
Class attendance (15 activities)	5%

Final grades are set as follows (total of 100 collective points):

A (80–100); B+ (75–79), B (70–74); C+ (65–69), C (60–64); D+ (55–59), D (50–54); F (0–49)

12. Class Attendance:

Attendance and active participation at each classroom and laboratory session is an essential part of the coursework and part of the final grade. Since laboratory sessions are vital to learning the practical aspects of the techniques presented during the classroom lectures, they are an integral part of this course. One cannot expect to finish the course successfully without attending them all. Unexcused absences are not acceptable. (“Excused absences” are for participation of the university activities, medical and other life-altering events)

13. Laboratory Reports:

Each student is responsible for writing a short laboratory report summarizing each laboratory session and turning it in by the end of the coursework. The report of each practical session should be written in between 1-2 pages long. It should summarize in the student’s own words what she/he has learned and worked on during the laboratory. Main writing should cover brief principle and objectives, method & setup, results & discussion, figures, special note & references. It should also include the advantages and disadvantages of each microscopy technique covered and discuss what types of samples are appropriate and why. If there are any images, pictures, drawings etc. they should be titled as “Figure #: <description>”, referenced in the main text, and

appended on additional pages. Each page should have 1-inch margins all around, and the font size should be appropriately readable (titles could be larger).

12. References:

Textbooks:

Bozzola JJ. Russell LD. (1998). Electron Microscopy. 2nd ed. Jones & Bartlett Learning. ISBN-10: 0763701920.

Chandler DE, Robertson RW. (2008). Bioimaging: Current Concepts in Light and Electron Microscopy. 1st ed. Jones & Bartlett Learning. ISBN-10: 0763738743.

Mertz, J. (2019). Introduction to Optical Microscopy. 2nd ed. Cambridge: Cambridge University Press. doi:10.1017/9781108552660

Murphy DB, Davidson MW. (2013). Fundamentals of Light Microscopy and Electronic Imaging. 2nd ed. Wiley-Blackwell. ISBN-10: 047169214X.

Williams DB, Carter CB. (2009). Transmission Electron Microscopy: A Textbook for Materials Science, Vol. 4 set. 2nd eds. Springer. ISBN: 0387765026.

Sanderson J. (2019). Understanding Light Microscopy. 1st ed. Wiley. ISBN-10: 0470973757.

External resources:

https://micro.magnet.fsu.edu/primer/anatomy/anatomy.html

https://www.microscopyu.com/

https://www.olympus-lifescience.com/en/microscope-resource/primer/anatomy/introduction/

https://www.open.edu/openlearn/science-maths-technology/biology/introduction-microscopy/content-section-0?intro=1