

	MAHATMA GANDHI UNIVERSITY Kottayam, Kerala Undergraduate Programmes (HONOURS) 2025 Admission Onwards
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SYLLABUS			
SIGNATURE COURSE			
Name of the College	Alphonsa College, Pala		
Faculty/ Discipline	Botany		
Programme	BSc (Hons) Botany		
Course Coordinator	Dani Mathew M		
Contributors	Julie J Paramundayil, Dr. Jince Mary Joseph, Biby Annet Baiju		
Course Name	Microscopy and Image analysis		
Type of Course	SEC		
Specialization title	This Signature Course does not have a specialization.		
Course Code	MG6SECBOTA00		
Course Level	300		
Course Summary	This course introduces the principles and applications of light and advanced microscopy, focusing on specimen preparation, image acquisition, and digital image analysis. Students will develop hands-on skills in operating compound, stereo, and digital microscopes and perform basic image processing and quantitative analysis using open-source software. The course aims to bridge theoretical understanding with practical competence relevant to biological research, diagnostics, and biotechnology industries.		
Semester	6	Credits	3
Course Details	Learning Approach		Total Hours
	Credits		45
Pre-requisites, if any	Nil		

Course Outcomes (CO)

Number of COs		4	
CO No.	Expected Course Outcome	Learning Domains *	PO No
1	Explain the principles, components, and working mechanisms of various microscopes used in biological science	U	PO1, PO2, PO3, PO10
2	Demonstrate skills in specimen preparation, focusing, magnification, and digital image capture using different microscopy techniques.	A, S	PO1, PO3, PO10
3	Analyze and interpret microscopic images using image processing tools to quantify biological data.	An	PO1, PO2, PO3, PO10
4	Design and execute a basic microscopy-based mini-project integrating sample preparation, imaging, and analysis.	C, S	PO1, PO2, PO3, PO10

*Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)

CO-PO Articulation Matrix

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10
CO 1	2	2	2	-	-	-	-	-	-	2
CO 2	2	-	2	-	-	-	-	-	-	2
CO 3	2	2	2	-	-	-	-	-	-	2
CO 4	3	3	3	-	-	-	-	-	-	2

'0' is No Correlation, '1' is Slight Correlation (Low level), '2' is Moderate Correlation (Medium level) and '3' is Substantial Correlation (High level).

Course Content

Content for Classroom transaction (Units)

Module	Units	Course Description	Hrs	CO No.
1	Fundamentals of Microscopy			
	1.1	History and evolution of microscopy.	1	["1"]
	1.2	Principles of magnification, resolution, and contrast Optical components and alignment of a compound microscope	3	["1"]
	1.3	Types of light microscopy – bright field, dark field, phase contrast, fluorescence	5	["1"]
	1.4	Care, calibration, and maintenance of microscopes	2	["1"]
	1.5	Hands-on Activities: Calibration of ocular and stage micrometers Observation of plant and animal cells using compound and stereo microscopes Focusing and image optimization techniques	4	["1"]
2	Advanced and Specialized Microscopy			
	2.1	Principles, working and applications of fluorescence microscopy and confocal microscopy, and a comparative overview of electron microscopy (SEM, TEM) as an advanced imaging modality.	8	["2"]
	2.2	Introduction to live-cell imaging and digital microscopy. Digital imaging fundamentals: pixels, resolution, color models, and file formats. Image acquisition parameters: exposure, gain, and dynamic range.	5	["2"]
	2.3	Hands-on Activities Demonstration of fluorescence imaging	2	["2"]

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Module	Units	Course Description	Hrs	CO No.
3		Basics of Image Acquisition and Processing & Quantitative Image Analysis		
	3.1	Ethics in Scientific image processing (avoiding misrepresentation, manipulation, and data integrity in published images). Applications of microscopy in plant science	2	["3"]
	3.2	Introduction to image processing software (ImageJ, Fiji, or similar) Image enhancement, filtering, thresholding, and segmentation	4	["3"]
	3.3	Hands-on Activities Image capture using a digital microscope Performing basic image processing using ImageJ Measurement of cell size, area, and intensity	4	["3"]
	3.4	Quantitative Image Analysis and Reporting. Morphometric and densitometric analyses. Image-based data interpretation and visualization. Preparation of image-based scientific reports Hands-on Activities Mini-project: Capture, process, and analyze an image dataset. Preparation of report and oral presentation of finding	5	["4"]

Teaching and Learning Approach	Classroom Procedure (Mode of transaction) Lecture-Discussion Instructor-led demonstrations of microscopy techniques and digital imaging methods. Hands-on Training ICT-Enabled Learning-Use of videos, virtual microscopy, and image analysis tutorials using open-source software (ImageJ/Fiji). Group-based mini-projects Seminar and Report Presentation
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Assessment Types	MODE OF ASSESSMENT Mode of Assessment: Theory
	A. Continuous Comprehensive Assessment (CCA) • Theory - 25 Marks Group-based mini-projects, Report Presentation Seminar Assignment Demonstration of microscopic skills Group discussion
	B. End Semester Evaluation (ESE) • Theory - 50 Marks Assessment Methods – End Semester examination Duration of Examination – 1.30 Hrs Pattern of examination for Theory – Non-MCQ Different parts of written examination – Part - A , B , C Answer Type: ◦ PART - A ◦ One Sentence - (10 out of 12) – 10 × 1 = 10 ◦ PART - B ◦ Short Essays - (6 out of 8) – 6 × 5 = 30 ◦ PART - C ◦ Essays - (1 out of 2) – 1 × 10 = 10

References

- Murphy, D. B., & Davidson, M. W. (2012). Fundamentals of light microscopy and electronic imaging (2nd ed.). Wiley-Blackwell. DOI:10.1002/9781118382905
- Sluder, G., & Wolf, D. E. (Eds.). (2013). Digital microscopy (4th ed.). Academic Press.
- Russ, J. C and Neal, F. B(2018). The image processing handbook (7th ed.). CRC Press. <https://doi.org/10.1201/b18983>
- Rost, F. W. D. (1991). Quantitative fluorescence microscopy. Cambridge University Press.

- Rasband, W.S. (1997). ImageJ. National Institutes of Health, Bethesda, Maryland, USA. <http://imagej.nih.gov/ij>
- Schindelin, J., Arganda-Carreras, I., Frise, E., Kaynig, V., Longair, M., Pietzsch, T., Preibisch, S., Rueden, C., Saalfeld, S., Schmid, B., Tinevez, J. Y., White, D. J., Hartenstein, V., Eliceiri, K., Tomancak, P., & Cardona, A. (2012). Fiji: an open-source platform for biological-image analysis. *Nature methods*, 9(7), 676–682. <https://doi.org/10.1038/nmeth.2019>

Suggested Readings

- Morris, K. (2009). *An Introduction to Microscopy*. An Introduction to Microscopy. <https://doi.org/10.1201/B15738>
- Rochow, T.G & Rochow, E.G. (2012). *Introduction to microscopy by means of light, electrons, X-rays, or ultrasound* (5th ed.). Springer New York, NY. <https://doi.org/10.1007/978-1-4684-2454-6>
- North, A. J. (2006). Seeing is believing? A beginners' guide to practical pitfalls in image acquisition. *Journal of Cell Biology*, 172(1), 9–18. <https://doi.org/10.1083/jcb.200507103>
- Collins, T. J. (2007). ImageJ for microscopy. *BioTechniques*, 43(1), 25–30. <https://doi.org/10.2144/000112517>
- Pawley, J. B. (Ed.). (2006). *Handbook of biological confocal microscopy* (3rd ed.). Springer.

Affidavit

- We, Alphonsa College, Pala and Dani Mathew M, agree to permit the use of our proposed course syllabus by other faculty members within the same discipline for course delivery at their respective institutions.
- We, Alphonsa College, Pala, agree to appoint a new course coordinator for the proposed Microscopy and Image analysis in the event of the unavailability of the currently nominated coordinator. This appointment will ensure the continued coordination of course delivery, assessments, and all related academic responsibilities necessary for the successful implementation of the signature course, for as long as the college offers this programme.
- We, Alphonsa College, Pala and Dani Mathew M, declare that no part of this signature course submitted here for approval has been taken from the course content developed by, or from any of the course titles prepared by, the BoS/expert committee in the same discipline under our University.



MGU-UGP (HONOURS)

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