

**Course Syllabus**  
**MBNS 604 Research Methodology and Techniques in Neuroscience**  
**Academic Year 2/2025**

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

**Course Coordinator:** Assoc. Prof. Sujira Mukda

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**Instructors:**

1. Prof. Duncan Richard Smith
2. Assoc. Prof. Dr. Vorasith Siripornpanich
3. Assoc. Prof. Dr. Sujira Mukda
4. Asst. Prof. Dr. Sukonthar Ngampramuan
5. Asst. Prof. Dr. Narisorn Kitiyanant
6. Asst. Prof. Dr. Kittikun Viwatpinyo
7. Asst. Prof. Dr. Jiraporn Panmanee
8. Lect. Dr. Narisra Komalawardhana
9. Lect. Dr. Lalitta Suriya-Arunroj
10. Lect. Dr. Siraprapa Boobphahom
11. Lect. Dr. Ekkaphot Khongkla
12. Lect. Dr. Sumeth Klomchitcharoen

**Supporting Staff:**

1. Ms. Somsong Phengsukdaeng
2. Ms. Sasithorn Prommet
3. Ms. Kanda Putthaphongphuek
4. Ms. Kornkanok Promthep
5. Mr. Pannaphan Makarathut
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. Demonstrate an understanding of ethical issues in neuroscience research and apply ethical principles in experimental design. (aligned with PLO1(R))
2. Design a comprehensive research project that integrates neuroscientific theories with practical methodologies. (aligned with PLO3(P))

3. Analyze and interpret quantitative data using appropriate statistical methods. (aligned with PLO5(P))
4. Critically assess existing literature in neuroscience, identifying strengths and weaknesses in study designs. (aligned with PLO2(P))
5. Collaborate effectively within a team to achieve common research goals. (aligned with PLO4(P))

**Alignment of teaching and assessment methods to course learning outcome:**

Course learning outcome	Teaching method	Assessment method
CLO1 Demonstrate an understanding of ethical issues in neuroscience research and apply ethical principles in experimental design.	1. Lecture 2. In-class discussion 3. Hands-on practice	1. Formative assessment using scoring rubric 2. Written examination 3. Assignments/ exercises
CLO2 Design a comprehensive research project that integrates neuroscientific theories with practical methodologies.	1. Lecture 2. In-class discussion 3. Assignments/ Exercises	1. Written examination 2. In-class discussion 3. Assessments/ exercises
CLO3 Analyze and interpret quantitative data using appropriate statistical methods.	1. In-class discussion 2. Assignments/ Exercises	1. Written examination 2. Assessments/ exercises 3. Oral presentation 4. In-class discussion
CLO4 Critically assess existing literature in neuroscience, identifying strengths and weaknesses in study designs	1. In-class discussion 2. Assignments/ Exercises	1. Written examination 2. Assessments/ exercises 3. Oral presentation 4. In-class discussion
CLO5 Collaborate effectively within a team to achieve common research goals.	1. In-class discussion 2. Hands-on practice	1. Formative assessment using scoring rubric 2. In-class discussion 3. Performance in social skills

**Course description:**

The principles and methods used in the research process in neuroscience; fundamental skills required to assess the data generation and collecting; research ethics; research strategy and design; research practice; writing up research proposals; data analyses and interpretation; and presentations of the research results

**Course schedule:**

**Date:** Monday-Friday

**Time:** 09.30-16.00

**Venue:** Lecture: Room A107<sup>(1)</sup> Institute of Molecular Biosciences

Lab: Rooms B402<sup>(2)</sup>, MB Animal Center<sup>(3)</sup>, D401-02<sup>(4)</sup>, and D413<sup>(5)</sup> Institute of Molecular Biosciences

## Schedule

### MBNS 604 Research Methodology and Techniques in Neuroscience

Lecture: 16 March 2026 – 10 April 2026

Course Coordinator: Assoc. Prof. Sujira Mukda

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	Date	Time	Topic	Lecturer
0	16 Mar 2026	09.30-10.00	<b>L0:</b> Course orientation	Sujira <sup>(1)</sup>
		10.00-12.00	<b>L0:</b> Orientation to IMB Central Instrument Facility <ul style="list-style-type: none"> <li>- Overview of shared research infrastructure and core services</li> <li>- Laboratory safety regulations and access policies</li> <li>- Instrument booking systems and user responsibilities</li> <li>- Introduction to major neuroscience-relevant platforms (imaging, molecular, electrophysiology)</li> </ul>	Pannaphan <sup>(1)</sup>
1		13.30-15.30	<b>L1:</b> Methods for studying human brain functions: from observation to neuroimaging. <ul style="list-style-type: none"> <li>- Historical approaches: lesion studies and behavioral observation</li> <li>- Cognitive and neuropsychological assessments</li> <li>- Structural vs functional neuroimaging principles</li> <li>- Strengths, limitations, and translational relevance of human brain studies</li> </ul>	Vorasith <sup>(1)</sup>
3	17 Mar 2026	10.00-12.00	<b>L2:</b> How do neuroscientists measure the activities of the brain and the mind? <ul style="list-style-type: none"> <li>- Neural correlates of cognition and behavior</li> <li>- Temporal vs spatial resolution in brain measurement</li> <li>- Invasive vs non-invasive recording techniques</li> <li>- Interpretation of neural signals in cognitive neuroscience</li> </ul>	Vorasith <sup>(1)</sup>
		13.30-16.30	<i>Lab:</i> EEG experimental setup <ul style="list-style-type: none"> <li>- EEG system components and electrode placement</li> <li>- Signal acquisition, noise sources, and artifact reduction</li> <li>- Basic EEG paradigms and data visualization</li> </ul>	Vorasith <sup>(2)</sup>
	18 Mar 2026		<b>MB OPEN HOUSE</b>	

	Date	Time	Topic	Lecturer
4	19 Mar 2026	10.00-12.00	<b>L3: Animal research in neuroscience and behavioral studies</b> <ul style="list-style-type: none"> <li>- Principles of animal research and animal models in neuroscience.</li> <li>- Behavioral assessment of cognitive and motor functions in animals.</li> <li>- Interpretation of behavioral data for translational neuroscience research.</li> </ul>	Sukonthar <sup>(1)</sup>
		13.30-16.30	<b>Lab: Animal models</b> <ul style="list-style-type: none"> <li>- Introduction to handling and experimental observation</li> <li>- Behavioral assay demonstrations</li> <li>- Data recording and ethical considerations</li> </ul>	Sukonthar <sup>(3)</sup>
	20 Mar 2026	10.00-12.00	<b>L4: Biosensor technology in neuroscience research</b> <ul style="list-style-type: none"> <li>- Principles of biological sensing</li> <li>- Electrochemical, optical, and molecular biosensors</li> <li>- Applications in neurotransmitter and biomarker detection</li> <li>- Emerging trends and translational potential</li> </ul>	Siraprapa <sup>(1)</sup>
		13.30-15.30	<b>L5: Cell culture technique in nervous system</b> <ul style="list-style-type: none"> <li>- Introduction to cell culture</li> <li>- Cell culture laboratory safety</li> <li>- Guidelines for maintaining cultured cells</li> <li>- Contamination in cell culture</li> <li>- Applications of cell culture in neuroscience research</li> </ul>	Sujira <sup>(1)</sup>
7	23 Mar 2026	10.00-12.00	<b>L6: Nucleic acid isolations &amp; amplification</b> <ul style="list-style-type: none"> <li>- What are nucleic acids?</li> <li>- Central dogma</li> <li>- Biological samples</li> <li>- DNA/RNA isolation</li> <li>- Nucleic acid quantification</li> <li>- Introduction to polymerase chain reaction (PCR) • Reverse Transcription PCR (RT-PCR)</li> <li>- Variations of basic PCR-based techniques</li> <li>- PCR applications</li> </ul>	Jiraporn <sup>(1)</sup>
		13.30-16.30	<b>Lab: RNA isolation &amp; RT-PCR I</b> <ul style="list-style-type: none"> <li>- RNA extraction workflow</li> </ul>	Jiraporn/ Sujira/ Narisorn <sup>(4)</sup>

	Date	Time	Topic	Lecturer
			- RNA integrity and contamination control	
	24 Mar 2026	10.00-12.00	<b>L7: Bio-statistical analysis for research</b> <ul style="list-style-type: none"> <li>- Statistical methodology</li> <li>- Descriptive statistics <ul style="list-style-type: none"> <li>- The ordered array; The frequency distribution; Measure of central tendency;</li> </ul> </li> <li>- Measure of dispersion</li> <li>- Population and Sample</li> <li>- Inferential statistics</li> <li>- Hypothesis testing; Correlation Analysis; Parametric and Non-parametric tests</li> </ul>	Sumeth <sup>(1)</sup>
		13.30-16.30	<i>Lab: RNA isolation &amp; RT-PCR II</i> <ul style="list-style-type: none"> <li>- Reverse transcription and PCR amplification-</li> <li>- Interpretation of amplification results</li> </ul>	Jiraporn/ Sujira/ Narisorn <sup>(4)</sup>
12	25 Mar 2026	10.00-12.00	<b>L8: Identifying proteins of interest</b> <ul style="list-style-type: none"> <li>- Protein structure and function in neuroscience</li> <li>- Quantitative and qualitative protein analysis</li> <li>- Antibody-based detection principles</li> </ul>	Ekkaphot <sup>(1)</sup>
		13.30-16.30	<i>Lab: Protein extraction and determination</i> <ul style="list-style-type: none"> <li>- Protein isolation methods</li> <li>- Concentration measurement and normalization</li> </ul>	Ekkaphot/ Siraprapa <sup>(5)</sup>
	26 Mar 2026	09.00-12.00	<i>Lab: Western blotting I:</i> Sample preparation and gel electrophoresis	Ekkaphot/ Siraprapa <sup>(5)</sup>
		13.30-16.30	<i>Lab: Western blotting II:</i> Protein transfer and antibody incubation	Ekkaphot/ Siraprapa <sup>(5)</sup>
	27 Mar 2026	09.00-12.00	<i>Lab: Western blotting III: Detection and imaging</i>	Ekkaphot/ Siraprapa <sup>(5)</sup>
		13.30-16.30	<i>Lab: Western blotting IV: Data analysis</i>	Ekkaphot/ Siraprapa <sup>(5)</sup>
2	30 Mar 2026	10.00-12.00	<b>L9: Electrophysiology: extracellular recording</b> <ul style="list-style-type: none"> <li>- Why extracellular recordings: what we can measure (single units, multi-unit, LFP) and what questions it answers (circuit coding, decision signals, sensory/behavior alignment).</li> <li>- Experimental setup overview: electrodes/probes + headstage/amplifier + DAQ.</li> </ul>	Lalitta <sup>(1)</sup>

	Date	Time	Topic	Lecturer
			<ul style="list-style-type: none"> <li>- How a recording session works: targeting strategy, unit search, stabilization, running trials, and the key “in-session QC” checks (noise, SNR, waveform drift, timing sanity).</li> <li>- From raw signals to results: preprocessing, spike sorting basics, unit quality criteria, and examples of readouts (PSTHs, tuning curves, population activity, LFP power/coherence).</li> </ul>	
		13.30-16.30	<i>Lab:</i> Electrophysiology	Lalitta <sup>(1)</sup>
	31 Mar 2026	10.00-12.00	<b>L10:</b> Guidelines on writing a research proposal <ul style="list-style-type: none"> <li>- What is a research proposal - primary and secondary objectives</li> <li>- How do we do a research proposal - sourcing appropriate literature</li> <li>- How to read a scientific paper</li> <li>- A cautionary word: What is, and how to avoid plagiarism</li> <li>- Common research proposal formats</li> <li>- Selecting a title for your proposal               <ul style="list-style-type: none"> <li>- Writing the core sections:                   <ul style="list-style-type: none"> <li>- Introduction and rationale</li> <li>- Objectives and hypotheses</li> <li>- Literature review</li> <li>- Materials and methods (including ethical considerations)</li> </ul> </li> </ul> </li> </ul>	Duncan <sup>(1)</sup>
		13.30-15.30	<b>L11:</b> Basic Histological Technique <ul style="list-style-type: none"> <li>- Tissue fixation and processing</li> <li>- Sectioning and staining principles</li> <li>- Microscopic evaluation of neural tissue</li> <li>- Relevance to structure–function relationships</li> </ul>	Kittikun <sup>(1)</sup>
5	1 Apr 2026	10.00-12.00	<b>L12:</b> Bioinformatics in neuroscience study <ul style="list-style-type: none"> <li>- An introduction to bioinformatics</li> <li>- Type of databases</li> <li>- Primary databases</li> <li>- Secondary databases</li> <li>- Database analysis tools</li> <li>- Neuroinformatics resources</li> </ul>	Jiraporn <sup>(1)</sup>

	Date	Time	Topic	Lecturer
		13.30-16.30	<i>Lab:</i> How to design primers for PCR - Primer design principles and parameters-Specificity, efficiency, and common errors	Jiraporn/ Sujira/ Narisorn <sup>(4)</sup>
	2 Apr 2026	10.00-12.00	<b>L13:</b> Research ethics - What and why - Six Norms of scientific research - General guidelines for authorship contributions - Case studies	Narisorn <sup>(1)</sup>
6		13.30-15.30	<b>L14:</b> Reference management and Endnote software - Role of reference management in scientific writing and research integrity - Overview of reference management tools (EndNote, Zotero, Mendeley): scope and use cases - Common citation styles in neuroscience (e.g., APA, Vancouver, Nature) - Introduction to EndNote - Building and Organizing an EndNote Library - Using EndNote with Word (Cite While You Write)	Ekkaphot <sup>(1)</sup>
13	3 Apr 2026	10.00-12.00	<b>L15:</b> Research performance analysis and technique - What is research performance, journal quality: quartile, top percentile - How to choose journal for publication - Analysis tool and technique: SciVal - How to analyze research quality: scholarly output, citation, field-weighted citation impact	Narisra <sup>(1)</sup>
14		13.30-15.30	<b>L16:</b> OMICs applications in neuroscience research - Overview of genomics, transcriptomics, proteomics, metabolomics - OMICs experimental workflows - Data integration and systems neuroscience- - Challenges and future directions in OMICs-based neuroscience	Ekkaphot <sup>(1)</sup>
Exam II	7 Apr 2026	09.00-16.00	<b>Exam</b>	Sujira/Somsong
	10 Apr 2026	09.00-12.00	<b>Student Presentation</b>	Lecturers

**Assessment Criteria:**

Assessment Criteria	Assessment Method	Scoring Rubric
Written examination/ Assignments (40%)	1. Written examination 2. Report	1. Comprehension
Laboratory performance (20%)	1. Direct observation 2. Practical examination 3. In-class discussion	1. Ability to follow procedure or to design a procedure for experiment 2. Use of equipment 3. Working area and safety 4. Group work
Problem-based learning presentation (20%)	1. Presentation 2. In-class discussion	1. Ability to apply knowledge to solve research problems 2. Ability to answer questions
Class attendance (10%)	1. Number of classes signed in 1. Direct observation	1. Class attendance
Participation in in-class discussion (10%)	1. In-class discussion	1. Class participation

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	A	Excellent
80-84	B+	Very good
70-79	B	Good
60-69	C+	Fairly good
50-59	C	Fair
45-49	D+	Poor
40-44	D	Very poor
< 40	F	Fall

### Rubric for Evaluating Laboratory Performance

Course: ..... MBNS 604 Research Methodology and Techniques in Neuroscience .....

Student Name: ..... Date of Evaluation: .....

Criteria	PLOs & CLOs Alignment		Poor (1)	Needs Improvement (2)	Satisfactory (3)	Good (4)	Excellent (5)	Level of Achievement*
	CLOs	PLOs						
<b>1. Ethical Conduct and Laboratory Safety</b>	CLO1	PLO1	<input type="checkbox"/> Disregards lab safety and ethical conduct.	<input type="checkbox"/> Frequently fails to follow safety rules or ethical guidelines.	<input type="checkbox"/> Generally follows ethical and safety guidelines but occasionally needs reminders.	<input type="checkbox"/> Follows ethical and safety protocols with minor lapses.	<input type="checkbox"/> Consistently demonstrates ethical behavior and excellent adherence to lab safety protocols without reminders.	<input type="checkbox"/> I <input type="checkbox"/> R <input type="checkbox"/> P <input type="checkbox"/> M
<b>2. Technical Competency in Laboratory Skills</b>	CLO2	PLO3	<input type="checkbox"/> Cannot perform techniques reliably.	<input type="checkbox"/> Struggles to perform basic techniques; needs constant assistance.	<input type="checkbox"/> Can complete techniques with frequent support.	<input type="checkbox"/> Performs techniques correctly with occasional guidance.	<input type="checkbox"/> Performs lab techniques accurately and efficiently with minimal supervision.	<input type="checkbox"/> I <input type="checkbox"/> R <input type="checkbox"/> P <input type="checkbox"/> M
<b>3. Problem Solving and Adaptability</b>	CLO3	PLO5	<input type="checkbox"/> Unable to identify or respond to problems.	<input type="checkbox"/> Rarely identifies issues; depends heavily on supervision.	<input type="checkbox"/> Needs guidance to identify or solve issues.	<input type="checkbox"/> Recognizes problems and takes appropriate corrective actions.	<input type="checkbox"/> Independently identifies and resolves technical issues with innovative solutions.	<input type="checkbox"/> I <input type="checkbox"/> R <input type="checkbox"/> P <input type="checkbox"/> M
<b>4. Data Recording and Interpretation</b>	CLO3	PLO5	<input type="checkbox"/> Records are missing or show no attempt at analysis.	<input type="checkbox"/> Incomplete or unclear records; poor interpretation.	<input type="checkbox"/> Records are complete but lack clarity or critical interpretation.	<input type="checkbox"/> Maintains clear records and makes reasonable interpretations.	<input type="checkbox"/> Maintains accurate, complete lab records and interprets data critically and appropriately.	<input type="checkbox"/> I <input type="checkbox"/> R <input type="checkbox"/> P <input type="checkbox"/> M
<b>5. Engagement with Literature and Protocol Justification</b>	CLO4	PLO2	<input type="checkbox"/> No evidence of literature engagement.	<input type="checkbox"/> Rarely uses literature or struggles to apply it.	<input type="checkbox"/> Refers to literature with limited integration or understanding.	<input type="checkbox"/> Uses literature to support methodology with good understanding.	<input type="checkbox"/> Consistently integrates relevant literature to justify protocol steps and troubleshoot.	<input type="checkbox"/> I <input type="checkbox"/> R <input type="checkbox"/> P <input type="checkbox"/> M
<b>6. Teamwork and Communication (CLOS)</b>	CLO5	PLO4	<input type="checkbox"/> Disrupts teamwork; unwilling to engage with team.	<input type="checkbox"/> Rarely collaborates or communicates effectively.	<input type="checkbox"/> Participates in team activities with occasional issues.	<input type="checkbox"/> Collaborates well and contributes to team goals.	<input type="checkbox"/> Proactively collaborates and communicates effectively within the team; supports others.	<input type="checkbox"/> I <input type="checkbox"/> R <input type="checkbox"/> P <input type="checkbox"/> M
<b>Total Score (30)</b>								

\* **Note:** A score in the "Satisfactory" range indicates that the student has achieved at least a **Practiced (P)** level of competency for this course. Students must achieve at least a **P (Practiced)** level in each of the Course Learning Outcomes (CLOs).

\* **Guideline for Scoring:** 1 = I (Introduced); 2 = R (Reinforced); 3 & 4 = P (Practiced); 5 = M (Mastery)

**Score Interpretation:**

- Outstanding (26 - 30)
- Good (21 - 25)
- Satisfactory (16 - 20)
- Needs Improvement (11 - 15)
- Poor (6 - 10)

**Comments:** .....

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Evaluator: .....

**Rubric for Evaluating Problem-Based Learning (PBL) Presentation**

Course: ..... MBNS 604 Research Methodology and Techniques in Neuroscience .....

Student Name: ..... Date of Evaluation: .....

Criteria	PLOs & CLOs Alignment		Poor (1)	Needs Improvement (2)	Satisfactory (3)	Good (4)	Excellent (5)	Level of Achievement*
	CLOs	PLOs						
<b>1. Ethical Considerations</b>	CLO1	PLO1	<input type="checkbox"/> Missing.	<input type="checkbox"/> Vague or poorly applied.	<input type="checkbox"/> Basic mention.	<input type="checkbox"/> Appropriate and clear.	<input type="checkbox"/> Insightful and thorough application.	<input type="checkbox"/> I <input type="checkbox"/> R <input type="checkbox"/> P <input type="checkbox"/> M
<b>2. Research Question and Rationale</b>	CLO2	PLO3	<input type="checkbox"/> Missing or irrelevant.	<input type="checkbox"/> Poorly justified or unclear.	<input type="checkbox"/> Basic question with some rationale.	<input type="checkbox"/> Clear, reasonably justified.	<input type="checkbox"/> Highly original, clear, strong theoretical integration.	<input type="checkbox"/> I <input type="checkbox"/> R <input type="checkbox"/> P <input type="checkbox"/> M
<b>3. Methodology Selection and Appropriateness</b>	CLO2 CLO3	PLO3 PLO5	<input type="checkbox"/> Missing or unjustified.	<input type="checkbox"/> Inappropriate or unclear.	<input type="checkbox"/> Basic, limited justification.	<input type="checkbox"/> Appropriate methodology, good justification.	<input type="checkbox"/> Highly appropriate methodology, deeply justified.	<input type="checkbox"/> I <input type="checkbox"/> R <input type="checkbox"/> P <input type="checkbox"/> M
<b>4. Data Analysis Plan</b>	CLO3	PLO5	<input type="checkbox"/> No clear plan.	<input type="checkbox"/> Unclear, inappropriate.	<input type="checkbox"/> Basic, some inaccuracies.	<input type="checkbox"/> Clear, correct, minor flaws.	<input type="checkbox"/> Advanced, correct, and well-explained.	<input type="checkbox"/> I <input type="checkbox"/> R <input type="checkbox"/> P <input type="checkbox"/> M
<b>5. Critical Analysis of Literature</b>	CLO4	PLO2	<input type="checkbox"/> Missing or irrelevant review.	<input type="checkbox"/> Mostly descriptive, little critique.	<input type="checkbox"/> Basic critique, limited depth.	<input type="checkbox"/> Good critique, identifies some gaps.	<input type="checkbox"/> Deep critique, multiple perspectives, well-argued.	<input type="checkbox"/> I <input type="checkbox"/> R <input type="checkbox"/> P <input type="checkbox"/> M
<b>6. Q&amp;A Response and Critical Thinking</b>	CLO4	PLO3	<input type="checkbox"/> Inability to answer questions effectively.	<input type="checkbox"/> Struggles to answer or defend logically.	<input type="checkbox"/> Answers basic questions, limited critical defense.	<input type="checkbox"/> Mostly clear answers, minor gaps in defense.	<input type="checkbox"/> Accurate, thoughtful, critically defends research choices.	<input type="checkbox"/> I <input type="checkbox"/> R <input type="checkbox"/> P <input type="checkbox"/> M
<b>7. Presentation Skills (Overall Communication)</b>		PLO5	<input type="checkbox"/> Disorganized, unclear.	<input type="checkbox"/> Confusing, weak delivery.	<input type="checkbox"/> Understandable, some disorganization.	<input type="checkbox"/> Clear, organized, minor lapses.	<input type="checkbox"/> Highly professional, engaging, excellent structure.	<input type="checkbox"/> I <input type="checkbox"/> R <input type="checkbox"/> P <input type="checkbox"/> M
<b>Total Score (35)</b>								

\* **Note:** A score in the "Satisfactory" range indicates that the student has achieved at least a **Practiced (P)** level of competency for this course. Students must achieve at least a **P (Practiced)** level in each of the Course Learning Outcomes (CLOs).

\* **Guideline for Scoring:** 1 = I (Introduced); 2 = R (Reinforced); 3 & 4 = P (Practiced); 5 = M (Mastery)

**Score Interpretation (Overall):**

- Excellent (32 - 35)
- Good (28 - 31)
- Satisfactory (24 - 27)
- Needs Improvement (20-23)
- Poor (≤19)

**Comments:** .....

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**Evaluator:** .....

Date revised: 12 February 2026