

# NS6002: ADVANCED COMPUTATIONAL NEUROSCIENCE

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## Effective Term

Semester A 2025/26

## Part I Course Overview

### Course Title

Advanced Computational Neuroscience

### Subject Code

NS - Neuroscience

### Course Number

6002

### Academic Unit

Neuroscience (NS)

### College/School

College of Biomedicine (BD)

### Course Duration

One Semester

### Credit Units

3

### Level

P5, P6 - Postgraduate Degree

### Medium of Instruction

English

### Medium of Assessment

English

### Prerequisites

Nil

### Precursors

Nil

### Equivalent Courses

Nil

### Exclusive Courses

Nil

## Part II Course Details

### Abstract

Brain computing is vital to understanding various brain functions and phenomena. Thanks to the development of different numerical techniques, computational models, and experimental discoveries, the investigation of computational aspects in Neuroscience has become possible. This course aims to promote the awareness of computational aspects in Neuroscience. Prior experience in computer languages is not necessary in this course. Topics covered in this course include computational models for ion channels, models for synapses, models for neurons, descriptive models, neural coding, information theory, and analysis of neural data. In addition, implementations of computational models and analytic techniques will be exercised.

### Course Intended Learning Outcomes (CILOs)

CILOs		Weighting (if app.)	DEC-A1	DEC-A2	DEC-A3
1	Promote awareness of the computational aspects of Neuroscience	25	x		
2	Gain fundamental knowledge of computational models for neural systems	50	x	x	x
3	Able to apply modern machine learning techniques to analyze neural data	25	x	x	x

#### A1: Attitude

Develop an attitude of discovery/innovation/creativity, as demonstrated by students possessing a strong sense of curiosity, asking questions actively, challenging assumptions or engaging in inquiry together with teachers.

#### A2: Ability

Develop the ability/skill needed to discover/innovate/create, as demonstrated by students possessing critical thinking skills to assess ideas, acquiring research skills, synthesizing knowledge across disciplines or applying academic knowledge to real-life problems.

#### A3: Accomplishments

Demonstrate accomplishment of discovery/innovation/creativity through producing /constructing creative works/new artefacts, effective solutions to real-life problems or new processes.

### Learning and Teaching Activities (LTAs)

LTAs	Brief Description	CILO No.	Hours/week (if applicable)
1	Lecture	The primary form of teaching; Systematic presentation of class content	1, 2, 3
2	Projects	Learning and practicing computing tools for computational models and data analysis; Initiating discussion among students and encouraging explorations in computational studies; Report the results in a journal-article format	1, 2, 3
3	Presentation	Give presentations of the project results; The presentation session will be conference-like	1, 2, 3

4	Hand-in Assignment	Helping the students to check their understanding of class content continuously	2, 3	
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**Assessment Tasks / Activities (ATs)**

	ATs	CILO No.	Weighting (%)	Remarks ("- " for nil entry)	Allow Use of GenAI?
1	Lab Assignments	2, 3	15	Allowed to assist programming mathematical models	Yes
2	Presentation	1, 2, 3	10	-	No
3	Midterm Examination	1, 2, 3	35	-	No
4	Final Project	1, 2, 3	40	Allowed to assist programming mathematical models	Yes

**Continuous Assessment (%)**

100

**Assessment Rubrics (AR)****Assessment Task**

Lab Assignments (for students admitted before Semester A 2022/23 and in Semester A 2024/25 &amp; thereafter)

**Criterion**

Based on the submitted assignment, evaluate whether the students can understand the concepts of the models and skills they learned in lessons.

**Excellent**

(A+, A, A-) The student submits the clearly written lab assignment without errors.

**Good**

(B+, B, B-) The student submits the clearly written lab assignment with minor errors.

**Fair**

(C+, C, C-) The student submits the written lab assignment with some errors.

**Marginal**

(D) The student submits the written lab assignment with significant errors.

**Failure**

(F) The student fails to submit the lab assignment. Or the student submits a partially finished assignment with significant errors.

**Assessment Task**

Presentation (for students admitted before Semester A 2022/23 and in Semester A 2024/25 &amp; thereafter)

**Criterion**

Able to show the origination of the knowledge and concept involved in the computational project.

**Excellent**

(A+, A, A-) The student gives a systematic presentation of the results and responds appropriately to queries from audience classmates.

**Good**

(B+, B, B-) The student gives a moderate presentation of the results and responds acceptably to queries from audience classmates.

**Fair**

(C+, C, C-) The student gives a basic presentation of the results and responds partly to queries from audience classmates.

**Marginal**

(D) The student gives a basic presentation of the results and fails to respond to queries from audience classmates.

**Failure**

(F) The student fails to give a presentation of the results and fails to respond to queries from audience classmates.

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**Assessment Task**

Midterm Examination (for students admitted before Semester A 2022/23 and in Semester A 2024/25 & thereafter)

**Criterion**

Able to show an understanding of concepts and applications of numerical methods and models.

**Excellent**

(A+, A, A-) Students achieve a 86% or greater on the examination.

**Good**

(B+, B, B-) Students achieve a 65% or greater on the examination.

**Fair**

(C+, C, C-) Students achieve a 50% or greater on the examination.

**Marginal**

(D) Students achieve a 40% or greater on the examination.

**Failure**

(F) Students achieve less than 40% on the examination.

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**Assessment Task**

Final Project (for students admitted before Semester A 2022/23 and in Semester A 2024/25 & thereafter)

**Criterion**

Able to show an understanding of concepts and applications of numerical methods and models to solve given problems

**Excellent**

(A+, A, A-) The students solved the problems properly and submitted a well-written report without errors.

**Good**

(B+, B, B-) The students solved the problems properly and submitted a well-written report with minor errors.

- Fair**  
(C+, C, C-) The students solved the problems in the correct direction and submitted a well-written report with some errors.
- Marginal**  
(D) The students partially solved the problems and submitted a basic report with some errors.
- Failure**  
(F) The students failed to solve the problems or submit a report.
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**Assessment Task**

Lab Assignments (for students admitted from Semester A 2022/23 to Summer Term 2024)

**Criterion**

Based on the submitted assignment, evaluate whether the students can understand the concepts of the models and skills they learned in lessons.

**Excellent**

(A+, A, A-) The student submits the clearly written lab assignment without errors.

**Good**

(B+, B) The student submits the clearly written lab assignment with minor errors.

**Marginal**

(B-, C+, C) The student submits the written lab assignment with some errors.

**Failure**

(F) The student fails to submit the lab assignment. Or the student submits a partially finished assignment with significant errors.

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**Assessment Task**

Presentation (for students admitted from Semester A 2022/23 to Summer Term 2024)

**Criterion**

Able to show the origination of the knowledge and concept involved in the computational project.

**Excellent**

(A+, A, A-) The student gives a systematic presentation of the results and responds appropriately to queries from audience classmates.

**Good**

(B+, B) The student gives a moderate presentation of the results and responds acceptably to queries from audience classmates.

**Marginal**

(B-, C+, C) The student gives a basic presentation of the results and responds partly to queries from audience classmates.

**Failure**

(F) The student fails to give a presentation of the results and fails to respond to queries from audience classmates.

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**Assessment Task**

Midterm Examination (for students admitted from Semester A 2022/23 to Summer Term 2024)

**Criterion**

Able to show an understanding of concepts and applications of numerical methods and models.

**Excellent**

(A+, A, A-) Students achieve a 86% or greater on the examination.

**Good**

(B+, B) Students achieve a 65% or greater on the examination.

**Marginal**

(B-, C+, C) Students achieve a 50% or greater on the examination.

**Failure**

(F) Students achieve less than 40% on the examination.

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**Assessment Task**

Final Project (for students admitted from Semester A 2022/23 to Summer Term 2024)

**Criterion**

Able to show an understanding of concepts and applications of numerical methods and models to solve given problems

**Excellent**

(A+, A, A-) The students solved the problems properly and submitted a well-written report without errors.

**Good**

(B+, B) The students solved the problems properly and submitted a well-written report with minor errors.

**Marginal**

(B-, C+, C) The students solved the problems in the correct direction and submitted a well-written report with some errors.

**Failure**

(F) The students failed to solve the problems or submit a report.

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## Part III Other Information

**Keyword Syllabus**

Neuronal Models, Synaptic Models, Neuronal Network, Neural Coding, Information Theory, Analysis of Neural Data.

**Reading List**

**Compulsory Readings**

Title	
1	Nil. All necessary materials will be provided.

**Additional Readings**

<b>Title</b>	
1	Dayan, P., & Abbott, L. (2014). Theoretical neuroscience: Computational and mathematical modeling of neural systems. MIT Press.
2	James V Stone. (2018). Principles of Neural Information Theory. Sebtel Press.