

Annexe A: New/Revised Course Content in OBTL+ Format

Course Overview

The sections shown on this interface are based on the templates [UG OBTL+](#) or [PG OBTL+](#)

If you are revising/duplicating an existing course and do not see the pre-filled contents you expect in the subsequent sections e.g. Course Aims, Intended Learning Outcomes etc. please refer to [Data Transformation Status](#) for more information.

Expected Implementation in Academic Year	AY2024-2025
Semester/Trimester/Others (specify approx. Start/End date)	Semester 1
Course Author * Faculty proposing/revising the course	Ong Chi Wei
Course Author Email	chiwei.ong@ntu.edu.sg
Course Title	Machine Learning and Optimisation for Bioengineers
Course Code	BG4104
Academic Units	3
Contact Hours	39
Research Experience Components	Not Applicable

Course Requisites (if applicable)

Pre-requisites	CB0494 Introduction to Data Science and Artificial Intelligence
Co-requisites	
Pre-requisite to	
Mutually exclusive to	
Replacement course to	
Remarks (if any)	

Course Aims

The aims of this course are multifaceted and designed to provide students with a deep and practical understanding of AI in healthcare. Firstly, the course aims to offer a comprehensive understanding of AI applications within the healthcare sector, delving into its potential benefits, limitations, and the necessary ethical considerations. Additionally, students will be familiarized with the practical use and integration of AI tools and technologies within various healthcare systems and processes, ensuring they are well-equipped to apply these advancements in real-world scenarios. A significant focus will also be placed on developing critical thinking and problem-solving skills, particularly in the context of AI applications in healthcare, enabling students to tackle complex challenges effectively. Lastly, the course emphasizes instilling a strong sense of ethical responsibility and awareness, ensuring that students recognize and uphold the ethical standards required when implementing AI in healthcare settings.

Course's Intended Learning Outcomes (ILOs)

Upon the successful completion of this course, you (student) would be able to:

ILO 1	Understanding Healthcare Systems: Gain an understanding of healthcare ecosystems, including stakeholders, data sources, and operational challenges.
ILO 2	Fundamentals of AI: Comprehend the basic principles of artificial intelligence, including machine learning, deep learning, and natural language processing, and their relevance in healthcare.
ILO 3	Data Acquisition and Management: Acquire skills in sourcing, preprocessing, and managing healthcare data while adhering to ethical and regulatory standards.
ILO 4	Application of Machine Learning in Healthcare: Apply supervised, unsupervised, and reinforcement learning techniques to healthcare datasets for predictive modeling and outcome prediction.
ILO 5	Deep Learning Applications: Explore the applications of neural networks and deep learning in medical imaging analysis and natural language processing for healthcare data.
ILO 6	AI-Assisted Diagnosis and Treatment: Understand the role of AI in clinical decision support, drug discovery, robotic surgery, and personalized medicine.
ILO 7	Healthcare Operations and AI Integration: Identify opportunities for AI integration in healthcare operations, management, and administration, considering potential challenges and benefits.
ILO 8	Ethical Considerations: Evaluate ethical implications, data privacy, security issues, and regulatory compliance when applying AI in healthcare.
ILO 9	Critical Analysis and Problem-Solving: Develop critical thinking skills to assess the suitability of AI solutions for healthcare problems and propose innovative solutions.
ILO 10	Capstone Project Proficiency: Apply acquired knowledge and skills to design, implement, and present a substantial project addressing a real-world healthcare challenge using AI techniques.

Course Content

Primary Aims of the Course:

Understanding AI in Healthcare: Providing students with a comprehensive understanding of AI applications in healthcare, including its potential, limitations, and ethical considerations.

Integration of AI Tools: Familiarizing students with the practical use and integration of AI tools and technologies within healthcare systems and processes.

Problem-Solving Skills: Developing critical thinking and problem-solving skills specific to AI applications in healthcare contexts.

Ethical Awareness: Instilling a strong sense of ethical responsibility and considerations when using AI in healthcare.

Reading and References (if applicable)

1. Catania, L. J. (2020). *Foundations of Artificial Intelligence in Healthcare and Bioscience: A User Friendly Guide for IT Professionals, Healthcare Providers, Researchers, and Clinicians*. Academic Press.
2. LIM., C. P., Vaidya, A., Jain, K., Mahorkar, V. U., & Jain, L. C. (2022). *Handbook of artificial intelligence in healthcare*. Springer International Publishing.
3. Esteva, A., Robicquet, A., Ramsundar, B. *et al*. A guide to deep learning in healthcare. *Nat Med* **25**, 24–29 (2019).
4. Topol, E. J. "Machines and empathy in medicine." *Lancet (London, England)* 402, no. 10411 (2023): 1411-1411.
5. Meskó, Bertalan, and Eric J. Topol. "The imperative for regulatory oversight of large language models (or generative AI) in healthcare." *NPJ Digital Medicine* 6, no. 1 (2023).
6. Moor, M., Banerjee, O., Abad, Z.S.H. *et al*. Foundation models for generalist medical artificial intelligence. *Nature* 616, 259–265 (2023).

Planned Schedule

Week or Session	Topics or Themes	ILO	Readings	Delivery Mode	Activities
1	Introduction to Healthcare Systems and AI Fundamentals	1-5	Reading list [1]-[3]	In-person	In-class problem-solving
2	Artificial Intelligence in Healthcare: Challenges and Applications	1-5	Reading list [1]-[3]	In-person	In-class problem-solving
3	Advancements and Challenges in Image Processing	1-10	Reading list [1]-[3]	In-person	
4	Optimization and Deep Learning	1-5	Reading list [1]-[3]	In-person	In-class problem-solving
5	Artificial intelligence and biomechanical modelling	1-5	Reading list [1]-[3]	In-person	In-class problem-solving
6	Hands-on practice I	1-5	Reading list [1]-[3]	In-person	In-class problem-solving
7	Invited talk + report and code submission	1-10	Reading list [4]-[6]	In-person	Hands-on
8	Advancements and Challenges for Deep Learning in Medical Imaging	5-10	Reading list [4]-[6]	In-person	In-class problem-solving
9	AI hands-on practice II	5-10	Reading list [4]-[6]	In-person	Hands-on

Week or Session	Topics or Themes	ILO	Readings	Delivery Mode	Activities
10	Bias and Inequities in AI-Enabled Health Tools	5-10	Reading list [4]-[6]	In-person	In-class problem-solving
11	AI Start-ups & Prompt Engineering Part I	5-10	Reading list [4]-[6]	In-person	In-class problem-solving
12	AI Start-ups & Prompt Engineering Part II	5-10	Reading list [4]-[6]	In-person	
13	Final report and project presentation	1,2,3,4		In-person	Presentation

Learning and Teaching Approach

Approach	How does this approach support you in achieving the learning outcomes?
Immersive Experiential Learning	This course adopts an immersive experiential learning approach, aiming to immerse students in real-world scenarios and practical applications of AI in healthcare. Through various activities and engagements, this approach aims to facilitate deeper learning and skill development among students.
Active Engagement	Interactive sessions, workshops, and discussions during the field trip encourage active participation
Collaborative Learning	Collaborative activities, group projects, and discussions during the trip facilitate teamwork, communication skills, and the ability to work effectively in diverse teams. These skills are vital in the interdisciplinary field of AI in healthcare, where collaboration across specialties is crucial.

Assessment Structure

Assessment Components (includes both continuous and summative assessment)

No.	Component	ILO	Related PLO or Accreditation	Weightage	Team/Individual	Rubrics	Level of Understanding
1	Continuous Assessment (CA): Assignment(Individual assessment)	1-10	a,b,c,d,e,f,g,h,i,j,k	20	Individual	Analytic	Extended Abstract
2	Continuous Assessment (CA): Report/Case study(Team assessment)	1-10	a,b,c,d,e,f,g,h,i,j,k	15	Team	Analytic	Extended Abstract
3	Continuous Assessment (CA): Report/Case study(Peer Review)	1-10	a,b,c,d,e,f,g,h,i,j,k	5	Individual	Analytic	Multistructural
4	Continuous Assessment (CA): Project(Final report)	1-10	a,b,c,d,e,f,g,h,i,j,k	20	Team	Analytic	Extended Abstract
5	Continuous Assessment (CA): Project(Final report Peer review)	1-10	a,b,c,d,e,f,g,h,i,j,k	5	Individual	Analytic	Extended Abstract
6	Continuous Assessment (CA): Project(Presentation)	1-10	a,b,c,d,e,f,g,h,i,j,k	20	Team	Analytic	Extended Abstract
7	Continuous Assessment (CA): Project(Presentation (Peer Review))	1-10	a,b,c,d,e,f,g,h,i,j,k	5	Individual	Analytic	Extended Abstract
8	Continuous Assessment (CA): Test/Quiz(in class quiz)	1-10	a,b,c,d,e,f,g,h,i,j,k	10	Individual	Analytic	Extended Abstract

Description of Assessment Components (if applicable)

In this AI in healthcare module, assessment is structured to gauge the depth of students' understanding and their ability to apply AI concepts and tools to healthcare problems. The assessment components and their corresponding weightage are designed to reflect both individual and team contributions.

Formative Feedback

During Hands on Sessions: As students engage with AI tools such as Google Colab, instructors will provide immediate feedback on their technical skills, problem-solving approaches, and collaborative practices. This real-time guidance helps students to adjust their methods and understanding as they work through healthcare-related AI problems.

Post-assignment Reviews: After submission of assignments like the lab report or project, instructors will offer in-

depth feedback, highlighting strengths and suggesting improvements. This allows students to refine their learning strategies and knowledge application for future tasks.

Peer Evaluations: Students will participate in peer assessments, offering and receiving feedback among themselves. This peer-to-peer interaction encourages reflection on their own work and a deeper understanding of the subject matter through the perspective of their classmates.

Interactive Class Discussions: In-class participation provides an avenue for instant feedback. Through discussions and Q&A sessions, students can gain insights into their comprehension and application of AI in healthcare, fostering a dynamic learning environment.

Regular Check-Ins and Progress Updates: Instructors may also schedule periodic check-ins with students to discuss their progress, providing a more personalized feedback experience.

NTU Graduate Attributes/Competency Mapping

This course intends to develop the following graduate attributes and competencies (maximum 5 most relevant)

Attributes/Competency	Level
Collaboration	Advanced
Communication	Intermediate
Problem Solving	Advanced
Design Thinking	Intermediate
Embrace Challenge	Intermediate

Course Policy

Policy (Academic Integrity)

Good academic work depends on honesty and ethical behaviour. The quality of your work as a student relies on adhering to the principles of academic integrity and to the NTU Honour Code, a set of values shared by the whole university community. Truth, Trust and Justice are at the core of NTU's shared values. As a student, it is important that you recognize your responsibilities in understanding and applying the principles of academic integrity in all the work you do at NTU. Not knowing what is involved in maintaining academic integrity does not excuse academic dishonesty. You need to actively equip yourself with strategies to avoid all forms of academic dishonesty, including plagiarism, academic fraud, collusion and cheating. If you are uncertain of the definitions of any of these terms, you should go to the academic integrity website for more information. On the use of technological tools (such as Generative AI tools), different courses / assignments have different intended learning outcomes. Students should refer to the specific assignment instructions on their use and requirements and/or consult your instructors on how you can use these tools to help your learning. Consult your instructor(s) if you need any clarification about the requirements of academic integrity in the course.

Policy (General)

You are expected to complete all assigned readings, activities, assignments, attend all classes punctually and complete all scheduled assignments by due dates. You are expected to take responsibility to follow up with assignments and course related announcements. You are expected to participate in all project critiques, class discussions and activities.

Policy (Absenteeism)

In-class activities make up a significant portion of your course grade. Absence from class without a valid reason will affect your participation grade. Valid reasons include falling sick supported by a medical certificate and participation in NTU's approved activities supported by an excuse letter from the relevant bodies. There will be no make-up opportunities for in-class activities.

Policy (Others, if applicable)

Last Updated Date: 03-07-2024 15:43:42

Last Updated By: Ong Chi Wei (Dr)

Appendix 1: Assessment Criteria for Assignment (20%)

The lab report will be evaluated on its comprehensive documentation of the problem-solving process using AI within a healthcare context, leveraging Google Colab. Marks will be allocated based on the clarity and depth of the content, which should articulate the healthcare problem addressed, the relevance of AI, and the rationale behind choosing cloud computing for the project.

Criteria		Unsatisfactory (1-3)	Satisfactory (4-6)	Good (7-9)	Exemplary (10)	Score (1-10)
Assignment	Organisation & Content (35%)	Illogical sequence and irrelevant content, making it difficult for reader to understand content; incomplete summary/abstract; evidence of plagiarism	Content is minimally organized; length requirement is not met; basic summary/abstract; some evidence of plagiarism	Content is adequately organized and comprehensive; length requirement is met with adequate content; adequate summary/abstract	In-depth and well-organized content; meets length requirement with very high-quality content; excellent summary/abstract	
	Topic Focus & Relevance (25%)	Subject matter is irrelevant to the field; there is no focus in the article	Subject matter only slightly relevant to the field; article focus is unclear, without addressing current issues	Subject matter relevant to the field; article focus is appropriate, broadly addressing current issues without particular emphasis on the more pertinent points	Subject matter is highly relevant to the field; article focus is on-point, addressing the most pertinent and current issues; critical arguments are emphasized	
	Significance & Broadness of Readership (25%)	Article offers minimal to zero constructive contribution to the field; appeals to a narrow readership	Article offers satisfactory constructive contribution to the field; provides minimal insight; appeals to a rather narrow readership	Article offers good constructive contribution to the field; provides insight that are thought-provoking; appeals to a broad readership	Article offers excellent constructive contribution to the field; provides insight that can be game-changing; appeals to a broad readership	
	Outlook (15%)	Poor understanding on the progress of the field; unable to provide any future outlook for the subject matter and the field	Satisfactory understanding on the progress of the field; struggling to articulate the future outlook for the subject matter and the field	Good understanding on the progress of the field; able to articulate the future outlook for the subject matter and the field	Excellent understanding on the progress of the field; able to articulate the future outlook for the subject matter and the field confidently	

Appendix 2: Assessment Criteria for Hands-on session assessments (20%)

Lab report (15%)

The lab report will be evaluated on its comprehensive documentation of the problem-solving process using AI within a healthcare context, leveraging Google Colab. Marks will be allocated based on the clarity and depth of the content, which should articulate the healthcare problem addressed, the relevance of AI, and the rationale behind choosing cloud computing for the project.

Criteria	Unsatisfactory (1-3)	Satisfactory (4-6)	Good (7-9)	Exemplary (10)	Score (1-10)
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Lab report	Organisation & Content (35%)	Illogical sequence and irrelevant content, making it difficult for reader to understand content; incomplete summary/abstract; evidence of plagiarism	Content is minimally organized; length requirement is not met; basic summary/abstract; some evidence of plagiarism	Content is adequately organized and comprehensive; length requirement is met with adequate content; adequate summary/abstract	In-depth and well-organized content; meets length requirement with very high-quality content; excellent summary/abstract	
	Topic Focus & Relevance (25%)	Subject matter is irrelevant to the field; there is no focus in the article	Subject matter only slightly relevant to the field; article focus is unclear, without addressing current issues	Subject matter relevant to the field; article focus is appropriate, broadly addressing current issues without particular emphasis on the more pertinent points	Subject matter is highly relevant to the field; article focus is on-point, addressing the most pertinent and current issues; critical arguments are emphasized	
	Significance & Broadness of Readership (25%)	Article offers minimal to zero constructive contribution to the field; appeals to a narrow readership	Article offers satisfactory constructive contribution to the field; provides minimal insight; appeals to a rather narrow readership	Article offers good constructive contribution to the field; provides insight that are thought-provoking; appeals to a broad readership	Article offers excellent constructive contribution to the field; provides insight that can be game-changing; appeals to a broad readership	
	Outlook (15%)	Poor understanding on the progress of the field; unable to provide any future outlook for the subject matter and the field	Satisfactory understanding on the progress of the field; struggling to articulate the future outlook for the subject matter and the field	Good understanding on the progress of the field; able to articulate the future outlook for the subject matter and the field	Excellent understanding on the progress of the field; able to articulate the future outlook for the subject matter and the field confidently	

Peer review (5%)

Criteria (Weights)	Score from 1 to 9* (1: Never; 3: Rarely; 5: Occasionally; 7: Frequently; 9: Always)				
	Member A	Member B	Member C	Member D	Member E
<i>(For 6-members team)</i>					
Member name					
a. Fulfilling one's responsibilities duly (15%)					
Behaved responsibly--such as attend meetings punctually and regularly; participate in discussion; complete assigned tasks/roles punctually.	Score from 1 to 9				
	Qualitative comments/reasons				
b. Fulfilling one's responsibilities effectively (25%)					
Behaved and contributed effectively--such as quality of work produced; creativity of ideas; extensiveness of research and thinking.	Score from 1 to 9				
	Qualitative comments/reasons				
c. Managing interpersonal relationships (30%)					
	Score from 1 to 9				

Listened attentively to and sought inputs from others; helped team resolve conflicts and achieved common understanding to function effectively; promoted respect for others and differences; fostered camaraderie.					
	<i>Qualitative comments/reasons</i>				
d. Providing support to others to achieve goals (30%)					
Behaved fairly and ethically—such as sharing responsibilities and giving credits. Exhibited group citizenship behavior--such as helping others to learn and complete their work through guidance and encouragement; standing up for others when needed.	<i>Score from 1 to 9</i>				
	<i>Qualitative comments/reasons</i>				

Appendix 3: Assessment Criteria for Final report (25%)

Final report (20%)

a. Fulfilling one's responsibilities duly (15%)									
	1	2	3	4	5	6	7	8	9
	Never		Rarely		Occasionally		Frequently		Always
Behaved responsibly--such as attend meetings punctually and regularly; participate in discussion; complete assigned tasks/roles punctually.	Did not participate actively in team meetings at all (even though he/she might still be present.) Did not contribute any useful ideas that were relevant for getting the project completed. Did not submit any or usable work on time and never did so without prompting.		Rarely participated actively in team meetings. Rarely contributed useful ideas that were relevant for getting the project completed. Rarely submitted work on time and did so rarely without prompting.		Occasionally participated actively in team meetings. Occasionally contributed useful ideas that were relevant for getting the project completed. Occasionally submitted work on time and did so occasionally without prompting.		Frequently participated actively in team meetings. Often contributed useful ideas that were relevant for getting the project completed. Frequently submitted assigned work on time without prompting.		Always participated actively in team meetings. Always contributed useful ideas that were relevant for getting the project completed. Always submitted assigned work on time without prompting.
b. Fulfilling one's responsibilities effectively (25%)									
	1	2	3	4	5	6	7	8	9
	Never		Rarely		Occasionally		Frequently		Always
Behaved and contributed effectively--such as quality of work produced; creativity of ideas; extensiveness of research and thinking.	Quality could not be evaluated because nothing relevant or usable was submitted.		Quality of work could be improved vastly; required major revisions before submission. Work reflected superficial effort in completing the project.		Quality of work could be improved; required some revisions before submission. Work reflected some effort in completing the project.		Quality of work was of reasonably acceptable standards; required minor revisions before submission. Work reflected reasonable effort in completing the project.		Quality of work was of highly acceptable standards; required no revision before submission. Work reflected extensive effort in completing the project.
c. Managing interpersonal relationships (30%)									
	1	2	3	4	5	6	7	8	9
	Never		Rarely		Occasionally		Frequently		Always

Listened attentively to and sought inputs from others; helped team resolve conflicts and achieved common understanding to function effectively; promoted respect for others and differences; fostered camaraderie.	Never listened to others. Never attempted to help team resolve conflicts. Never attempted to achieve common understanding to function effectively as a team. Never promoted respect for others, with no attempt to foster camaraderie.	Rarely listened to others. Rarely attempted to help team resolve conflicts. Rarely attempted to achieve common understanding to function effectively as a team. Rarely promoted respect for others, with rare attempts to foster camaraderie.	Occasionally listened to others, with occasional attempts to help team resolve conflicts. Occasionally attempted to achieve common understanding to function effectively as a team. Occasionally promoted respect for others, with occasional attempts to foster camaraderie.	Frequently listened to others, with frequent attempts to help team resolve conflicts. Frequently attempted to achieve common understanding to function effectively as a team. Frequently promoted respect for others, with notable attempts to foster camaraderie.	Always listened to others, always attempted to help team resolve conflicts. Always attempted to achieve common understanding to function effectively as a team. Always promoted respect for others and demonstrated consistent attempts to foster camaraderie.
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d. Providing support to others to achieve goals (30%)

	1	2	3	4	5	6	7	8	9
	Never		Rarely		Occasionally		Frequently		Always
Behaved fairly and ethically—such as sharing responsibilities, and giving credits. Exhibited group citizenship behavior—such as helping others to learn and complete their work through guidance and encouragement; standing up for others when needed.	Never took on a fair share of responsibilities; never gave appropriate credits to others. Never attempted to help others learn; never provided guidance and encouragement. Never stood up for others when needed.		Rarely took on a fair share of responsibilities; rarely gave appropriate credits to others. Rarely attempted to help others learn; rarely provided guidance and encouragement. Rarely stood up for others when needed.		Occasionally took on a fair share of responsibilities; occasionally gave appropriate credits to others. Occasionally attempted to help others learn; occasionally provided guidance and encouragement. Occasionally stood up for others when needed.		Frequently took on a fair share of responsibilities; frequently gave appropriate credits to others. Frequently attempted to help others learn; frequently provided guidance and encouragement. Frequently stood up for others when needed.		Always took on a fair share of responsibilities; always gave appropriate credits to others. Always attempted to help others learn; always provided guidance and encouragement. Always stood up for others when needed.

Peer review (5%)

Criteria (Weights)	Score from 1 to 9* (1: Never; 3: Rarely; 5: Occasionally; 7: Frequently; 9: Always)				
	Member A	Member B	Member C	Member D	Member E
(For 6-members team)					
Member name					
a. Fulfilling one's responsibilities duly (15%)					
Behaved responsibly--such as attend meetings punctually and regularly; participate in discussion; complete assigned tasks/roles punctually.	Score from 1 to 9				
	Qualitative comments/reasons				
b. Fulfilling one's responsibilities effectively (25%)					
Behaved and contributed effectively--such as quality of work produced; creativity of ideas;	Score from 1 to 9				
	Qualitative comments/reasons				

extensiveness of research and thinking.					
c. Managing interpersonal relationships (30%)					
Listened attentively to and sought inputs from others; helped team resolve conflicts and achieved common understanding to function effectively; promoted respect for others and differences; fostered camaraderie.	<i>Score from 1 to 9</i>				
	<i>Qualitative comments/reasons</i>				
d. Providing support to others to achieve goals (30%)					
Behaved fairly and ethically—such as sharing responsibilities and giving credits. Exhibited group citizenship behavior--such as helping others to learn and complete their work through guidance and encouragement; standing up for others when needed.	<i>Score from 1 to 9</i>				
	<i>Qualitative comments/reasons</i>				

Appendix 4: Assessment Criteria for final presentation (25%)

Presentation (20%)

Once the student completes the term report, they will be required to present their unique solution to address clinical needs in the class. The presentation will showcase the start-up's innovative utilization of advanced AI technology in biomedical engineering, aiming to assist doctors in diagnosing and treating medical conditions more effectively. Through this presentation, the student will demonstrate their ability to effectively communicate their proposed AI solution and its potential as a promising investment in the healthcare industry.

Criteria	Unsatisfactory (1-3)	Satisfactory (4-6)	Good (7-9)	Exemplary (10)	Score (1-10)
Content & Organization (50%)	<ul style="list-style-type: none"> Does not have grasp of information and cannot answer questions about subject Does not clearly define subject and purpose; provides weak or no support of subject; gives insufficient support for ideas or conclusions 	<ul style="list-style-type: none"> Is uncomfortable with information and is able to answer only rudimentary questions Attempts to define purpose and subject; provides weak examples, facts, and/or statistics, which do not adequately support the subject; includes very thin data or evidence 	<ul style="list-style-type: none"> Is at ease with expected answers to all questions, without elaboration Has somewhat clear purpose and subject; some examples, facts, and/or statistics that support the subject; includes some data or evidence that supports conclusion 	<ul style="list-style-type: none"> Demonstrates full knowledge by answering all class questions with explanations and elaboration Provides clear purpose and subject; pertinent examples, facts, and/or statistics; supports conclusions/ideas with evidence 	
Delivery (25%)	<ul style="list-style-type: none"> Holds no eye contact with audience, as entire report is read from notes 	<ul style="list-style-type: none"> Displays minimal eye contact with audience, while reading mostly from the notes 	<ul style="list-style-type: none"> Consistent use of direct eye contact with audience, but still returns to notes 	<ul style="list-style-type: none"> Holds attention of entire audience with the use of direct eye contact, seldom looking at notes Speaks with fluctuation in 	

	<ul style="list-style-type: none"> Speaks in low volume and/ or monotonous tone, which causes audience to disengage 	<ul style="list-style-type: none"> Speaks in uneven volume with little or no inflection 	<ul style="list-style-type: none"> Speaks with satisfactory variation of volume and inflection 	<ul style="list-style-type: none"> volume and inflection to maintain audience interest and emphasize key points 	
Delivery (25%)	<ul style="list-style-type: none"> Shows no interest in topic presented Fails to increase audience understanding of knowledge of topic 	<ul style="list-style-type: none"> Shows little or mixed feelings about the topic being presented Raises audience understanding and knowledge of some points 	<ul style="list-style-type: none"> Shows some enthusiastic feelings about topic Raises audience understanding and awareness of most points 	<ul style="list-style-type: none"> Demonstrates strong enthusiasm about topic during entire presentation Significantly increases audience understanding and knowledge of topic; convinces an audience to recognize the validity and importance of the subject 	

Peer review (5%)

Criteria (Weights)	Score from 1 to 9* (1: Never; 3: Rarely; 5: Occasionally; 7: Frequently; 9: Always)				
	Member A	Member B	Member C	Member D	Member E
(For 6-members team)					
Member name					
a. Fulfilling one's responsibilities duly (15%)					
Behaved responsibly--such as attend meetings punctually and regularly; participate in discussion; complete assigned tasks/roles punctually.	Score from 1 to 9				
	Qualitative comments/reasons				
b. Fulfilling one's responsibilities effectively (25%)					
Behaved and contributed effectively--such as quality of work produced; creativity of ideas; extensiveness of research and thinking.	Score from 1 to 9				
	Qualitative comments/reasons				
c. Managing interpersonal relationships (30%)					
Listened attentively to and sought inputs from others; helped team resolve conflicts and achieved common understanding to function effectively; promoted respect for others and differences; fostered camaraderie.	Score from 1 to 9				
	Qualitative comments/reasons				
d. Providing support to others to achieve goals (30%)					
Behaved fairly and ethically—such as sharing responsibilities and giving credits. Exhibited group citizenship behavior--such as helping others to learn and complete their work through guidance and encouragement; standing up for others when needed.	Score from 1 to 9				
	Qualitative comments/reasons				

Appendix 5: Assessment Criteria for In-Class Quiz (10%)

In-class quiz is integral to the learning process and will be assessed using the following criteria. Firstly, regular class participation is expected to demonstrate commitment and engagement. Active participation involves contributing to discussions, asking questions, and sharing insights, showcasing understanding. The quality of contributions will be assessed based on critical thinking, analysis, and evidence-based reasoning. Additionally, engagement in group activities and collaborative projects will be evaluated, including effective communication and teamwork. Respectful and professional behavior towards the instructor and classmates is expected. Assessment will be based on continuous observation, class notes, and instructor evaluations. Active participation in in-class quiz and discussion is crucial for a comprehensive learning experience and knowledge acquisition.

Mapping of Course ILOs to EAB Graduate Attributes

Course Code & Title	BG4104 Machine Learning and Optimisation for Bioengineers
Course Type	Core module

Overview											
(a)	●	(b)	●	(c)	●	(d)	●	(e)	●	(f)	●
(g)	●	(h)	●	(i)	●	(j)	●	(k)	●		
Legend: ● Fully consistent (contributes to more than 75% of Student Learning Outcome) ○ Partially consistent (contributes to about 50% of Student Learning Outcome) ○ Weakly consistent (contributes to about 25% of Student Learning Outcome) Blank Not related to Student Learning Outcome											

Course ILOs		EAB Graduate Attributes
1)	Understanding Healthcare Systems: Gain an understanding of healthcare ecosystems, including stakeholders, data sources, and operational challenges.	a,b,c,d,e,f,g,h,i,j,k
2)	Fundamentals of AI: Comprehend the basic principles of artificial intelligence, including machine learning, deep learning, and natural language processing, and their relevance in healthcare.	a,b,c,d,e,f,g,h,i,j,k
3)	Data Acquisition and Management: Acquire skills in sourcing, preprocessing, and managing healthcare data while adhering to ethical and regulatory standards.	a,b,c,d,e,f,g,h,i,j,k
4)	Application of Machine Learning in Healthcare: Apply supervised, unsupervised, and reinforcement learning techniques to healthcare datasets for predictive modeling and outcome prediction.	a,b,c,d,e,f,g,h,i,j,k
5)	Deep Learning Applications: Explore the applications of neural networks and deep learning in medical imaging analysis and natural language processing for healthcare data.	a,b,c,d,e,f,g,h,i,j,k
6)	AI-Assisted Diagnosis and Treatment: Understand the role of AI in clinical decision support, drug discovery, robotic surgery, and personalized medicine.	a,b,c,d,e,f,g,h,i,j,k
7)	Healthcare Operations and AI Integration: Identify opportunities for AI integration in healthcare operations, management, and administration,	a,b,c,d,e,f,g,h,i,j,k

	considering potential challenges and benefits.	
8)	Ethical Considerations: Evaluate ethical implications, data privacy, security issues, and regulatory compliance when applying AI in healthcare.	f,g,h,i,j
9)	Critical Analysis and Problem-Solving: Develop critical thinking skills to assess the suitability of AI solutions for healthcare problems and propose innovative solutions.	a,b,c,d,e,f,g,h,i,j,k
10)	Capstone Project Proficiency: Apply acquired knowledge and skills to design, implement, and present a substantial project addressing a real-world healthcare challenge using AI techniques.	a,b,c,d,e,f,g,h,i,j,k

EAB Graduate Attributes

- a) **Engineering Knowledge:** Apply the knowledge of mathematics, natural science, computing and engineering fundamentals, and an engineering specialisation as specified in WK1 to WK4 respectively to the solution of complex engineering problems.
- b) **Problem Analysis:** Identify, formulate, research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences with holistic considerations for sustainable development. (WK1 to WK4)
- c) **Design / Development of Solutions:** Design creative solutions for complex engineering problems and design systems, components or processes that meet identified needs with appropriate consideration for public health and safety, whole-life cost, net zero carbon as well as resource, cultural, societal, and environmental considerations as required. (WK5)
- d) **Investigation:** Conduct investigations of complex problems using research-based knowledge (WK8) and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
- e) **Modern Tool Usage:** Create, select and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering problems, with an understanding of the limitations. (WK2 and WK6)
- f) **The Engineer and the World:** When solving complex engineering problems, analyse and evaluate sustainable development impacts to: society, the economy, sustainability, health and safety, legal frameworks and the environment (WK1, WK5, and WK7).
- g) **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of engineering practice and adhere to relevant national and international laws. Demonstrate an understanding of the need for diversity and inclusion (WK9).
- h) **Individual and Collaborative Team Work:** Function effectively as an individual, and as a member or leader in diverse and inclusive teams and in multidisciplinary, face-to-face, remote and distributed settings (WK9).
- i) **Communication:** Communicate effectively and inclusively on complex engineering activities with the engineering community and with society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions, taking into account cultural, language, and learning differences.
- j) **Project Management and Finance:** Demonstrate knowledge and understanding of engineering management principles and economic decision-making, and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
- k) **Life-long Learning:** Recognise the need for, and have the preparation and ability to (i) engage in independent and life-long learning, and (ii) adapt to new and emerging technologies, and (iii) think critically, in the broadest context of technological change (WK8).

No	Knowledge Profile
WK1	A systematic, theory-based understanding of the natural sciences applicable to the discipline and awareness of relevant social sciences
WK2	Conceptually-based mathematics, numerical analysis, data analysis, statistics and formal aspects of computer and information science to support detailed analysis and modelling applicable to the discipline
WK3	A systematic, theory-based formulation of engineering fundamentals required in the engineering discipline
WK4	Engineering specialist knowledge that provides theoretical frameworks and bodies of knowledge for the accepted practice areas in the engineering discipline; much is at the forefront of the discipline
WK5	Knowledge including efficient resource use, environmental impacts, whole-life cost, re-use of resources, net zero carbon, and similar concepts that supports engineering design and operations in a practice area
WK6	Knowledge of engineering practice (technology) in the practice areas in the engineering discipline
WK7	Knowledge of the role of engineering in society and identified issues in engineering practice in the discipline such as the professional responsibility of an engineer to public safety and sustainable development.
WK8	Engagement with selected knowledge in the current research literature of the discipline, awareness of the power of critical thinking and creative approaches to evaluate emerging issues
WK9	Knowledge of professional ethics, responsibilities, and norms of engineering practice. Awareness of the need for diversity by reason of ethnicity, gender, age, physical ability etc with mutual understanding and respect, and of inclusive attitudes

Reference: [EAB Accreditation Manual](#)