Centre Pompidou, Richard Rogers and Renzo Piano

ADVANCED BUILDING SYSTEMS II

INSTRUCTOR
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ISSUE

From Building Performance to Systems

This course examines the critical connection between building performance requirements and the building systems. Through the framework of a structured technical workflow—developed via course syllabus, case studies, and building visits — students will learn to navigate the interdependent relationships among building program, performance requirements, systems selection, design concept, integration strategy, technological approach, and technical compliance.

Emphasis is placed on the spectrum of technological responses available — from passive, vernacular strategies to active, high-performance engineering — in meeting comfort, health, safety and energisation goals. Within this process, compliance is introduced not as a constraint, but as a critical guiding strategy, encompassing codes such as the HK Building Regulations, fire safety, and accessibility standards, alongside broader practice benchmarks.

The core pedagogical aim is to enable the understanding that the choice and integration of systems constitute a fundamental architectural decision. Students will critically analyze how conscious technical responses inform a building's form, materiality, and aesthetic character, transforming performance requirements and regulatory frameworks into drivers of innovative, responsible, and architecturally meaningful design.

DESCRIPTION

Integrated Pedagogical Framework

Instructors Zachary Wong and Nelson Tam have reimagined ARCH 5421/5422 as a year-long exploration of building technologies synchronized with design studios. In term 1, we emphasize on building performances and various ways to achieve them.

Constructing The Technical Workflow
With the Course Syllabus Matrix, case studies, and building visits, we clarify relationships between:

See Appendix 1

Compliance here encompasses codes (e.g., HK Building Regulations & Codes of Practices) in planning, fire safety, and accessibility standards, and practice standards. It is neither the starting point nor end point for the design, but a reference coordinate for us to qualify the standard of quality.

Cultivating Technological Agency
By examining cases like Sydney Opera House retrofit (heritage compliance via adaptive acoustics) and Rogers Stirk Harbour's Leadenhall Building (services integration as aesthetic identity), students will:

1. Demystify compliance as a baseline for innovation, not a creative barrier;
2. Develop critical methodologies for technology selection aligned with design concepts;
3. Master integration strategies where systems coalesce into building integrity—the indivisible unity of performance, form, and experience.

IMPACT AND SUSTAINABILITY

Technology as Social-Ecological Agency
Building technology and its technical compliance are increasingly emphasizing a balanced impact on the planet, people, and prosperity. This course aims to broaden students' understanding of technical approaches, exposing them to a spectrum of strategies ranging from passive to active, vernacular to engineered, and affordable to sophisticated. By exploring these diverse methodologies, students can cultivate a critical perspective on technology and its application in building design and construction.

In terms of technical compliance, the course will cover local building codes as well as global standards (e.g. LEED, BREAM, BEAM Plus, WELL, etc.) to provide students with a comprehensive grasp of current industry practices and potential insights into future trends. This dual focus on technical innovation and sustainability will equip students with the knowledge and skills necessary to address the complex challenges facing the built environment.

COURSE SYLLABUS

Advanced Building Systems Syllabus Matrix for ARCH 5422
Building Performance

See Appendix 2

This course employs a pedagogical matrix to illustrate the interdependencies among building performances, core systems, and technological approaches. The framework operates as follows:

X-Axis: Design Drivers (Topics)
Building Performances (4 Priority Issues):
1. Comfort: Thermal, acoustic, spatial quality
2. Safety: Structural integrity, fire egress, hazard mitigation
3. Health: Indoor air quality, daylighting, biophilic engagement
4. Energisation: Energy autonomy, carbon neutrality, grid resilience

Building systems (4 Core systems):
1. Structural: Load-bearing frameworks & seismic strategies
2. Interior: Space-defining partitions & finish assemblies
3. Envelope: Climate-regulating skins & interfaces
4. Mechanical: Active environmental control systems

Y-Axis: Implementation Spectrum (Cases)
1. Statutory Baseline: Establish code minima
2. Basic Affordable: Low-tech baseline solutions
3. Common Practice: Industry-standard MEP integrations
4. Advanced Engineered: Performance-optimized innovations
5. Cutting-edge Custom: Bespoke technological synthesis

METHODS

During instruction, instructors will introduce each “Building Performance” or “Building System” by initially presenting the relevant “Baseline requirements” in statutory and technical aspects. This step aims to familiarize students with the prevailing industry standards and regulations. Subsequently, cases will be developed to showcase various technological approaches and construction cost scenarios. This sequential approach enables students to grasp the fundamental requirements before delving into diverse strategies and specialized design solutions.
The case studies will encompass a diverse range of building programs to demonstrate how program specifics inform design decisions based on the particular building performance needs related to relevant building systems. Students are supported to recognize the iterative process involved in characterizing a building gradually.

Format
This course will be delivered through a series of lectures, visits and workshops alongside the design studio, focusing on the core topics and themes specified in the syllabus matrix above. The weekly lectures aim to establish a strong foundational understanding of the subject matter among students. Alongside these lectures, students will undertake visits on which the assignments are based in order to help students to elevate their learning from knowledge-level to knowhow-level. Site visits and guest lectures by industry professionals who offer firsthand perspectives and visits to exemplary buildings provide students with practical exposure and insights.

Except the final assignment which is based on individual studio project. All other three assignments are group work which aims enhance mutual learning and collaborative skills.

DELIVERABLES

Group Work – Case Studies (CUHK Museum & School of Architecture + Future Extension)
1. “Treasure Hunt” – Systems Mapping
2. A full set of drawing (plan, elevation, section) on A2
3. Isometric drawings of systems on A0

Group Work – Conversion - Iso + Plans (Schematic Design / GBP standard)
1. Conversion of CUHK Museum to Music School / School of Architecture to Lab
2. A full set of drawing (plan, elevation, section) on A2
3. Isometric drawings of systems on A0

We take the studio grouping as the default grouping for our course group assignments. There are 14 groups and every group has 6 -7 students. Assignments will carry continuity and progression in ARCH 5421 & 5422 (T1 & T2).

We welcome discussions to tailor deliverables to your specific needs—whether adapting formats, deepening analysis, or exploring entirely new approaches.

LEARNING OUTCOMES

1. Understand the technical workflow and be able to design with reference to it.
2. Understand how human behavior influences building performance requirements and then the building systems design.
3. Recognize the significance of sustainable development and architects' roles in promoting it.
4. Be able to consider barrier-free environments for your studio project.
5. Be able to investigate and select alternative structural, constructional, and material systems relevant to local architectural design practices.
6. Comprehend the physical properties, characteristics, and environmental impact of building materials, components, and systems.
7. Develop a comprehensive understanding of building services systems in the local industry.
8. Gain knowledge of life-safety systems within the local context.
9. Create a schematic building program considering site parameters and regulations.
10. Be able to prepare technical documentation meeting industry standards.
11. Recognize the leadership role of architects within design teams and the construction industry, staying informed about current industry methods and trends.
12. Acknowledge managerial responsibilities in project management, cost control, legal compliance, building code adherence, and contract management.

ASSESSMENT SCHEME

SPECIFIC ASSESSMENT

1. Participation (10%)
2. Group Work- Case Studies (CUHK Museum & SoA + Future Extension) (20%)
3. Group Work- Conversion - Iso + Plans (Schematic Design / GBP standard) (50%)
4. Test 1 (20%)

Total: 100%

COURSE FORMAT

Teaching Days

1. Students must attend for F2F teaching during these teaching hours.
   Teaching Day: Wednesday 2:30 pm – 5:15pm
   Teaching Venue: ARC Zone F

2. Field trips, lectures, and other learning activities may be scheduled outside of teaching days.

Student Study Effort_3 credit course (Total: 120 hrs)

1. Class Contact: 40 hrs (Lecture, Tutorial)
2. Other Student Study Effort: 80 hrs (Self Study / Assignments)

Assistant

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REQUIRED READINGS

Building Systems Intergration

1. Rush, Richard D. The Building Systems Integration Handbook. Boston: Butterworth-Heinemann, 1986. Print.
2. Bachman, Leonard R. Integrated Buildings: The Systems Basis of Architecture. New York: J. Wiley & Sons, 2003. Print.

Construction

1. Deplazes, Andrea. Constructing Architecture: Materials, Processes, Structures, a Handbook. Basel: Birkhäuser, 2005. Print.
2. Advanced building systems: A technical guide for architects and engineers. Daniels, K. (2003). Basel: Birkhäuser.
3. Allen, Edward. and Patrick Rand. Architectural Detailing: Function, Constructibility, Aesthetics. Third edition. Hoboken: Wiley, 2016. Print.
4. Allen, Edward. Fundamentals of Building Construction Materials and Methods, 2nd ed.
5. Watts, A.. Modern construction envelopes (Modern construction series). (2011). Wien: Springer.
6. Ching, Francis. Building Construction Illustrated, Wiley and Sons. 1975.

Building Services & Environmental Technology

1. Grondzik, Walter T. Mechanical and Electrical Equipment for Buildings. 11th ed. Hoboken, N.J: Wiley, 2010. Print.
2. Bradshaw, Vaughn., and Vaughn. Bradshaw. The Building Environment: Active and Passive Control Systems. 3rd ed. Hoboken, N.J: Wiley, 2006. Print.
3. Climate and architecture (1st ed.). Dahl, T. (2010). Milton Park, Abingdon, Oxon; New York, N.Y.: Routledge.

Technical Documentation

1. Lewis, Paul, Marc Tsurumaki, and David J. Lewis. Manual of Section. First edition. New York: Princeton Architectural Press, 2016. Print.
2. Ching, Francis. Building Codes Illustrated. Wiley and Sons. 2003

Building Codes

General

1. Cap. 123F Building (Planning) Regulations
2. Cap. 123I Building (Standards of Sanitary Fitments, Plumbing, Drainage Works and Latrines) Regulations
3. Cap. 123J Building (Ventilating Systems) Regulations
4. Cap. 123M Building (Energy Efficiency) Regulation
5. Cap. 123Q Building (Construction) Regulation
6. Cap. 102 Waterworks Ordinance
7. Cap. 610 Buildings Energy Efficiency Ordinance

Comfort
1. Code of Practice for Overall Thermal Transfer Value in Buildings, Buildings Department https://www.bd.gov.hk/doc/en/resources/codes-and-references/code-and-design-manuals/OTTV1995_e.pdf
2. Code of Practice for Energy Efficiency of Building Services Installation https://www.emsd.gov.hk/beeo/en/pee/BEC_2024_ENG.pdf
3. Code of Practice for Building Energy Audit https://www.emsd.gov.hk/beeo/en/pee/EAC_2024_ENG.pdf

Safety
1. Code of Practice for Fire Safety in Buildings https://www.bd.gov.hk/doc/en/resources/codes-and-references/code-and-design-manuals/fs_code2011.pdf
2. Codes of Practice For Minimum Fire Service Installations and Equipment And Inspection, Testing and Maintenance of Installations and Equipment https://www.hkfsd.gov.hk/eng/source/safety/File2022.pdf
3. Technical Guidance: LPC Rules for Automatic Sprinkler Installations https://www.hkfsd.gov.hk/eng/source/guidance/Technical_Guidance_LPC_Rules_eng_20200911_153808.pdf

Health
1. BEAM Plus New Buildings Version 2.0 https://www.hkgbc.org.hk/eng/beam-plus/file/BEAMPlus_New_Buildings_v2_0.pdf
2. WELL Building Standard https://standard.wellcertified.com/sites/default/files/The%20WELL%20Building%20Standard%20v1%20with%20May%202016%20addenda.pdf
3. Handbook on Plumbing Installation for Buildings https://www.wsd.gov.hk/filemanager/en/content_1369/HBonPIB.pdf
4. Role of healthy drains in the prevention of spread of COVID-19 https://icidportal.ha.org.hk/Home/File?path=/Training%20Calendar/161/Role%20of%20healthy%20drains%20in%20the%20prevention%20of%20spread%20of%20COVID-19.pdf

Energisation
1. CLP Code of Practice 101 for Distribution Substation Design, and Drawings https://www.clp.com.hk/content/dam/clphk/documents/customer-service-site/open-and-close-account-site/cop-101-distribution-substation-design-site/COP%20101%20version%2015%20drawings.pdf
2. HEC Guide to Connection of Supply https://www.hkelectric.com/documents/en/CustomerServices/CI/Documents/GCS_7th_en/GuidetoConnectionofSupply_Full_En.pdf
3. Code of Practice for Building Works for Lifts and Escalator https://www.bd.gov.hk/doc/en/resources/codes-and-references/code-and-design-manuals/BWLE2011e.pdf
4. Guidelnes on Application for Installation of Emergency Generators https://www.epd.gov.hk/epd/sites/default/files/epd/english/environmentinhk/air/guide_ref/files/guidelines_for_e_generator.pdf
5. Task Lighting Design https://www.emsd.gov.hk/filemanager/en/content_764/Task_Lighting_Design.pdf
6. Code of Practice for the Installation and Maintenance of In-building Telecommunications Systems https://www.coms-auth.hk/filemanager/statement/en/upload/104/cop201201e.pdf

Structure

7. Code of Practice for Foundations
   https://www.bd.gov.hk/doc/en/resources/codes-and-references/code-and-design-manuals/FoundationCode2017.pdf
8. Code of Practice for Dead and Imposed Loads
   https://www.bd.gov.hk/doc/en/resources/codes-and-references/code-and-design-manuals/DIL2011e.pdf
9. PNAP ADV-36 Modular Integrated Construction
   https://www.bd.gov.hk/doc/en/resources/codes-and-references/practice-notes-and-circular-letters/pnap/ADV/ADV036.pdf

Drawing Standard

1. CIC BIM Standards - General (Version 2.1 - 2021)
2. Guidelines for using Building Information Modelling in Statutory Submissions

IMPORTANT NOTE TO STUDENTS

Expectations for Professional Conduct
The motto of The Chinese University of Hong Kong (CUHK) is "Through learning and temperance to virtue". This motto places equal emphasis on the intellectual and moral education of students. In addition to pursuing academic excellence, students of CUHK are expected to maintain and uphold the highest standard of integrity and honesty in their academic and personal lives, respect the rights of others and abide by the law. More information on Postgraduate studies can be found in the PG Student Handbook. https://www.gs.cuhk.edu.hk/

Attendance
Class attendance is required in all courses. For an excused absence, the instructor must be notified and presented with documentation of illness or personal matter. Please note: **Three (3)** or more unexcused absences may result in a failing grade for the course.

Academic Honesty
The Chinese University of Hong Kong places very high importance on honesty in academic work submitted by students and adopts a policy of zero tolerance on academic dishonesty

Attention is drawn to University policy and regulations on honesty in academic work, and to the disciplinary guidelines and procedures applicable to breaches of such policy and regulations. Details may be found at: http://www.cuhk.edu.hk/policy/academichonesty/.

With each assignment, students may be required to submit a statement that they are aware of these policies, regulations, guidelines and procedures.

Third-Party Assistance
All intellectual work essential to the design project must be completed by the student and cannot, under any circumstance, be outsourced to a third party (including, but not limited to a company, consultant, alumni, and/or friend).

In the design studio context, students may utilize external resources, such as printing services for presentation materials, and/or laser cutting and 3D printing services for prototyping purposes. Use of such third-party services constitutes non-intellectual work done by others. It is only permitted with prior written consent from the studio tutor and acknowledgment of such work done by the third party.

Assistance from other students or friends for aspects of project production also constitutes non-intellectual work done by others; this is allowed only if declared and acknowledged in a written statement attached to any such work that has received assistance.

Under all circumstances, students must declare all work done by others by completing the school's designated form before assessment. This form must include a detailed explanation of the third party's identity (name and relationship to the student), when and how they were utilized, and the specific tasks they performed in the project. The completed form, signed by the student, must be endorsed by the tutor and presented during the final review. The school will collect and retain this form for record-keeping purposes.

Failure to follow this code of conduct may be considered a case of academic dishonesty, to be reviewed by a disciplinary board, and possible failure of the course.

Artificial Intelligence
Students may use some AI tools in some learning activities and/or assessments on the condition that they make explicit acknowledgement and proper citations of the input from AI tools.

Acknowledging support from AI tools
Students are required to acknowledge all functional uses of an AI tool and cite it when they paraphrase, quote, or incorporate into their own work any content (whether it is text, image, data, or other format) that was created by it.

An example of acknowledgement
'I acknowledge the use of (name of AI tool – e.g. ChatGPT (https://chat.openai.com/) to (specify the support, e.g. plan my essay, generate some ideas for the content, ask for examples of data collection instruments, get the dates of historical events, etc.).

An example of citation
OpenAI. (2023). *ChatGPT* (Mar 20 version). https://chat.openai.com/chat

Students are reminded that due to the rapid developments of AI tools, some citation formats may be updated regularly.

An example of including texts generated by an AI tool in their work
"The following text was generated by an AI tool/language model (ChatGPT):"
[Insert the text generated by ChatGPT here.]

An example of including texts generated by an AI tool and the prompts that were used to elicit the text from the AI tool
"[The prompt], as generated by an AI language model (ChatGPT):"
[Insert the text generated by ChatGPT in response to the prompt.]

Students are reminded to learn and use the AI tools responsibly and ethically and be aware of the limitations.

Improper/unauthorized use of AI tools in learning activities and assessments will constitute acts of academic dishonesty which will be handled in accordance with the University's *Procedures for Handling Cases of Academic Dishonesty.*

Students are reminded to clarify with the course teacher and obtain permission if necessary when in doubt.

Students may refer to Approach 2 of the CUHK 'Use of Artificial Intelligence tools in Teaching, Learning and Assessments' – A Guide for Students.

Student Work
Submission of studio documentation must be complete and correctly formatted. Missing or incomplete submission of the documentation folder will result in the grade for the course being withheld. This will prevent registration for the following term or delay graduation. In addition, a grade deduction of *one letter grade* will be made.

External Examination
Of paramount importance to the academic rigour and professional relevance of the architecture programme, the external examination process serves as a critical and impartial review mechanism. An invited panel of distinguished practitioners, academics, and industry experts convenes to rigorously evaluate the school's pedagogical ecosystem. This comprehensive audit scrutinises the fairness and consistency of the internal assessment process, benchmarks the standard and ambition of student work against national and international norms, and provides invaluable feedback on the intellectual and pedagogical direction of the curriculum itself.

As a cornerstone of this process and a mandatory graduating requirement, final-year students from both the Bachelor of Social Sciences (Architecture) and Master of Architecture programmes must present their final project and portfolio work in person. This formal defence before the external panel not only validates the authenticity and depth of their learning but also simulates a professional practice environment, demanding they articulate their design rationale, critical thinking, and technical resolution to an authoritative audience, thereby preparing them for the collaborative and discursive nature of the architectural profession.

SCHEDULE

IMPORTANT DATES

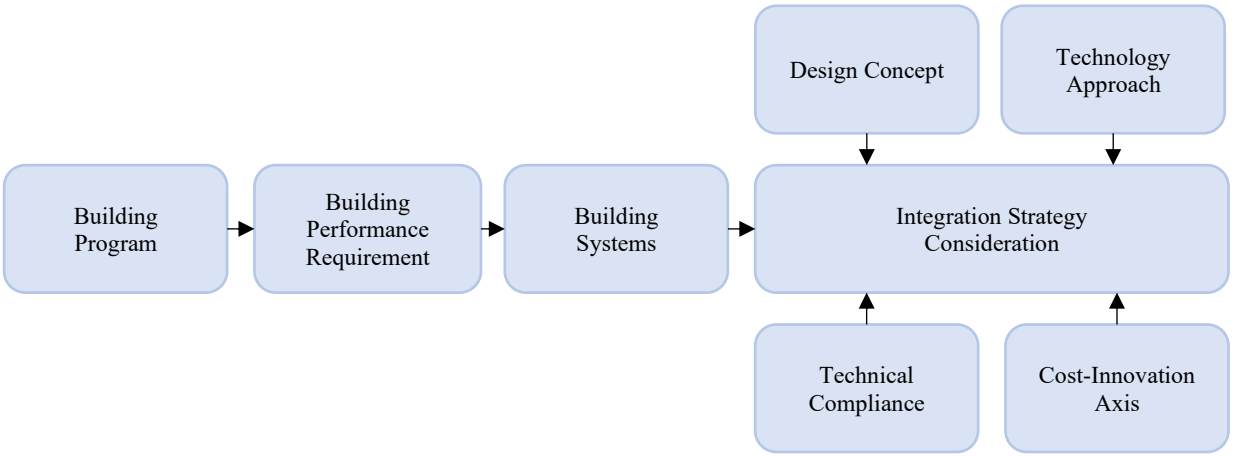
Group Work_Case Studies (CUHK Museum & SoA + Future Extension	OCT
Test 1	NOV
Group Work- Conversion - Iso + Plans (Schematic Design / GBP standard)	DEC

Term 1: 1 September 2025 (Monday) – 29 November 2025 (Saturday)

WEEK 1		
03.09	**LECTURE**	Introduction to Advanced Building Systems
WEEK 2		
10.09	**LECTURE + WORKSHOP**	Topic: Comfort
WEEK 3		
17.09	**LECTURE +VISIT**	Guest Lecture on CUHK Museum, AR. Chloe Lun (TBC)
WEEK 4		
24.09	**LECTURE +VISIT**	Guest Lecture on SoA Extension, AR. Cai@MATTER (TBC)
WEEK 5		
01.10	**NATIONAL DAY**	No Class
WEEK 6		
08.10	**LECTURE + WORKSHOP**	Topic: Safety
WEEK 7		
15.10	**ASSIGNMENT 1 REVIEW**	
WEEK 8		
22.10	**ASSIGNMENT 1 REVIEW**	
WEEK 9		
29.10	**CHUNG YEUNG FESTIVAL**	No Class
WEEK 10		
05.11	**LECTURE + WORKSHOP**	Topic: Health
WEEK 11		
12.11	**LECTURE + WORKSHOP**	Topic: Energisation
WEEK 12		
19.11	**TEST + WORKSHOP**	
WEEK 13		
26.11	**STUDIO PREP.**	
WEEK 14		
03.12	**STUDIO REVIEW**	No Class
WEEK 15		
10.12	**ASSIGNMENT 2 REVIEW**	
WEEK 16		
17.12	**ASSIGNMENT 2 REVIEW**	

APPENDIX 1

Constructing The Technical Workflow
With the Course Syllabus Matrix, case studies, and building visits, we clarify relationships between:



APPENDIX 2

Course Syllabus
Building Performance

Advanced Building Systems Syllabus Matrix						
		Building Performances				
	Issues/ Systems	Comfort	Safety	Health	Energisation	
	Topics	Thermal/ Ventilation	Fire Services	Lighting/ Plumbing / Drainage/ Ventilation	Electrical / Automation	
Technology Approach	Governing Factors (Statutory / Technical)	Standards and Certifications: ASHARE, OTTV, RTTV, LEED, BREAM, BEAM Plus	Local building ordinance and regulations, Codes of practice	Local building ordinance and regulations (Lighting, Ventilation) ASHARE	Standards and Certifications: CIBSE, BEEO, OTTV, RTTV, LEED, BREAM, BEAM Plus, CLP101, HKE Guide	Cost
Passive Design	Baseline	Natural ventilation	Means of escape, means of access, fire resisting construction	Water Retention / Ventilation	Natural lighting	Basic/ Affordable
Active / Integrated Design	Common Practice	HVAC: Individual/ Central type	Fire services installation	Basic plumbing and drainage system	Power / Lighting / Mobility / Vertical circulation	
	Advanced / Special Practice	Resilient Design	Safety & Security	Advanced plumbing and drainage system/ Mechanical Ventilation	IT / Data / WiFi / 5G / Office Automation	
Pioneering / Experimental Engineering	MIC, DfMA, robotics, 3D printing, new materials, etc.	Advanced Buildability and Regional Planning	Fire engineering	Healthy Architecture	Renewable power / IOT / AI / Smarts System / Drone, etc.	Advanced: articulated, engineered & customised

Grade	Descriptor	Criteria	Points
A	Excellent	Comprehensively excellent performance on all aspects of the design intention, development, technical resolution and presentation. Achieving all learning outcomes with distinction.	4
A-	Very Good	Generally outstanding performance on the design intention, development, technical resolution and presentation. Achieving all learning outcomes with merit.	3.7
B+	Good	Substantial performance on the design intention, development, technical resolution and presentation. Achieving all learning outcomes satisfactorily.	3.3
B			3
B-			2.7
C+	Fair	Fair performance on the design intention, development, technical resolution and presentation. Achieving all learning outcomes at a passing standard.	2.3
C			2
C-			1.7
D+	Pass	Barely satisfactory performance on the design intention, development, technical resolution and presentation. Achieving all learning outcomes at a barely satisfactory standard.	1.3
D			1
F	Failure	Unsatisfactory performance on the design intention, development, technical resolution and presentation. Not achieving all learning outcomes.	0

Written Feedback to Students

Term: _____ **Grade:** _____

Course Code: _____

Review: _____

Tutor: _____

Student Name: _____

Student ID: _____

Feedback from Tutor:

Achievements:

Challenges: