香港城市大學
City University of Hong Kong

Department of Mechanical Engineering

USER HANDBOOK OF

MECHANICAL ENGINEERING LABORATORIES

Year 2022-23

User handbook of
Mechanical Engineering
Laboratories
City University of Hong Kong

FOREWORD

On behalf of the Department of Mechanical Engineering (MNE), I would like to welcome you to use our facilities. This handbook is intended to provide all the basic information about our facilities and services. The handbook will give you an overview of the organization and operation of the Mechanical Engineering Laboratories (hereafter the LAB). It will also provide the general safety regulations and guidelines, a brief description of each individual laboratory area, and a summary of the services available from the LAB. Through the information provided by this handbook, we hope that you can make the best use of our services. Embracing the spirit of continuous improvement, we welcome any suggestions to improve the quality of our services.

If you are a regular user of the LAB, please kindly take some time to read through the handbook and to fill in those forms that are relevant to you and send it back to the Laboratory Office (Room B1664). Should you have any further queries about the LAB, please feel free to contact the helper or staff in Room B6614-YEUNG or call 3442 8358.

Most of the information covered in this handbook has been uploaded to the LAB website at "https://www.cityu.edu.hk/mne/ " under the "Laboratories" section.

On behalf of all our technical staff, I wish you every success in using our facilities for your research or study.

Dr. LUK Bing Lam
Laboratory Manager,

July 2022

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A. Mission and role of the Lab

Mission

To provide state-of-the-art facilities, world-class technical support and a safe green working environment for university teaching, research, training and industrial consultancy work.

Roles

1. To support MNE Engineering Students' experiments and laboratory exercises,
2. To provide facilities and technical support for MNE Engineering Students to undergo final year projects,
3. To provide a simulated factory environment for MNE Engineering Students to undergo practical engineering trainings,
4. To provide facilities and technical support for research and development work,
5. To support the Departmental and University wide publicity work.

B. Introduction to the Lab

As shown in Appendix II(a-c), many of the Mechanical Engineering (MNE) Laboratories and Biomedical Engineering (BME) Laboratories are split and evolved from its previous (parent) Mechanical and Biomedical Engineering (MBE) Department. As such, many of the major equipment and facilities which hosted in common areas are to be shared by both Departments. The majority of MNE facilities are located on:

- 1st floor, 5th floor and 7th floor of Yeung Kin Man Academic Building (YEUNG),
- 6th floor of Li Dak Sum Yip Yio Chin Academic Building (LI).
- 3rd and 5th floor of Lau Ming Wai Academic Building (LAU)

The total floor area for teaching and research laboratories is over 2,439 sq meters. They are briefly described below:-

Some major Teaching Laboratories:

1. **Computer-Aided Design (CAD) Laboratory (Rm. P7540 YEUNG, 120 sq. m)**
   This laboratory is equipped with about 45 top level PCs that are installed with Computer Aided Design/Computer Aided Manufacturing (CAD/CAM) software systems. The facilities are mainly used to support the teaching and experimental works in CAD/CAM/CAE applications and developments. The laboratory is also used to support Departmental activities such as seminars and conference, Manufacturing Projects, etc. Students not only learn to use commercial CAD/CAM systems, but also learn to implement CAD/CAM algorithms in a proprietary CAD system developed by the laboratory. The software equipped in this laboratory includes the latest version of AutoCAD, SolidWork , SolidCAM, and Pro/E.

2. **Mechanics and Tribology Laboratory (Rm. Y5405/Y5406/Y5407 YEUNG, 81.34 sq.m)**
   This laboratory is mainly designed to support the teaching of basic mechanics and fundamental machine design courses. It is fully equipped with standard apparatus for students to perform experiments on kinetics, kinematics, mechanisms, vibration, stress and

strain analysis etc. This laboratory also supports student centred activities (SCA) which involve the solution of basic mechanical design problems using the practical and theoretical knowledge that they have acquired from this laboratory and from lectures respectively. Furthermore, the laboratory also contains some commercial and self-developed tribological apparatus for the study of lubrication, friction, wear, roller and journal bearings.

3. **Thermal-fluids Laboratory (Rm. Y5101 YEUNG, 26.48 sq. m)**
   This is a newly established laboratory for supporting the teaching of basic and advanced thermal fluids courses.

4. **Basic Training Workshop and Fabrication Laboratory (Rm. B1481 YEUNG, 230 sq. m)**
   The laboratory is equipped with basic workshop machines, tooling and workbenches. The facilities are mainly used to support the teaching of practical training to students, such as Engineering Workshop Practices (MNE2020) for year 2 students. Some work spaces are also created in this workshop to support the fabrication and testing of bulky mechanical devices and systems for various final year project work and applied research work.

5. **Advanced Machining and Materials Processing Laboratory (Rm. B1721/B1722 YEUNG, 164 sq. m)**
   This laboratory is designed to provide experimental facilities in the field of plastic molding, metal forming, heat treatment of materials, casting and surface finishing processes. Several of the machines installed in this laboratory, such as the power press, injection molding machine, rolling mill, etc. are equipped with data logging devices to facilitate the use of these equipment for research purposes. Some rapid prototyping facilities such as spin casting, metal spraying and vacuum casting machines are also available in this laboratory. Besides, a fully instrumented servo-hydraulic testing system and sheet metal testing facility are available for conducting a variety of user-defined or standard tests for research purposes. This laboratory is also equipped with two state-of-the-art universal testers for investigating variety of mechanical properties of engineering materials over a wide range of temperature. Besides, state of the art 5-axis CNC machining Center and CNC EDM wire-cut machines are equipped in this lab. This laboratory is thus therefore capable of supporting research activities related to material science, tribology and precision engineering parts fabrication as well.

6. **Product Safety and Hazard Analysis Laboratory (Rm. Y1421 YEUNG, 59 sq. m)**
   This laboratory is established to support laboratory teaching/final year project works and related researches in regulatory compliance testing of products regarding health, safety and environmental (HSE) standards. The laboratory provides supporting facilities to training and researches on the theoretical principles and practices of safety and environmental testing of toys, electronics and electrical products as stipulated in essential international standards such as Waste Electrical and Electronic Equipment (WEEE), Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment (RoHS), BS EN 71, ASTM F963, etc.. Major equipment of the laboratory include : X-ray fluorescence spectrometer (XRF), Fourier Transform Infrared Spectrometer (FTIR), UV/VIS Spectrophotometer, Atomic Absorption Spectrophotometer System (AAS), and Gas Chromatograph Mass Spectrometer (GCMS).

7. **Metrology Laboratory (Rm. Y1625 YEUNG, 72 sq. m)**
   This laboratory is purposely built on a floating concrete slab. It is designed in accordance with the advice from the National Physical Laboratory (NPL) of UK. All the fixtures in the laboratory are isolated and a separate air-conditioning system is installed to provide a vibration free and adequately clean environment with appropriately stable humidity. Various precision measuring instruments such as the laser interferometer, atomic force microscope (AFM), scanning electron microscope (SEM), nano-grade optical surface profiler, nano-indentor, surface texture tester and roundness testing machines are installed. This laboratory is mainly used for the support of teaching and research in engineering metrology.

8. **Control and Instrumentation Laboratory (Rm. 6502 LI, 81 sq. m)**
   This laboratory is established to facilitate experiments in automatic control and the associated instrumentation applications. It is fully equipped with a wide range of signal processors, oscilloscopes, PID controller, feedback control system, single board computer systems, etc. Various PC-based development software in fuzzy control, neural network control, etc are also available to support the experiments and student projects in advanced control engineering technology.

9. **Service Robotics Laboratory (Rm. 6503 LI, 67 sq. m)**
   With the advances in technology, a wide range of services such as windows cleaning, pipe inspection, automatic vacuum cleaning, surgery, health care and entertainment, can now be carried out by intelligent machinery or robots. The objectives of this laboratory are to demonstrate and promote the use of service robots in manufacturing, processing and services enterprises (including SMEs); to provide training and teaching support in the development and use of service robots; to widen the possible applications for such machinery; and to provide research infrastructures for developing service robots;

10. **Mechatronics and Automation Laboratory (Rm. 6505 LI, 152 sq. m)**
    This laboratory aims to support teaching and research activities in mechatronics and automation. Facilities include multi-axes articulated robots, vision systems, simulation software for automation systems, an array of RFID readers and middle-ware systems and platforms for distributed and real time control. The lab is also equipped with apparatus for structured exercises as well as custom designed workstations for mechatronic final year projects. Current research activities include surface finishing automation, wall climbing robots, robot control, computer vision and motion sensing and control, RFID automation, etc.

11. **Integrated Design and Prototyping Laboratory (Rm. 6506 LI, 68 sq. m)**
    This laboratory is equipped with advanced equipment for integrated design, digital geometry processing, virtual prototyping, reverse engineering and rapid prototyping activities. The basic equipment include one set of Kreon laser scanner, one set of Eden PolyJet 3D printers from Objet Geometries, one set of ThermoJet 3D printer from 3D Systems, and one set of FDM-3000 rapid prototyping machine from Stratasys. Major software include Inus RapidForm and SDRC/Imageware Surfacer software for reverse engineering, Materialise MIMICS software for medical model prototyping, Materialise Magics software and SDRC/Imageware RPM module for rapid prototyping, Sense8 lab license for virtual reality (VR) applications, ACIS and Designbase geometric kernels, Autodesk Maya, Unigraphics, Catia, and other geometric and mathematical libraries. The laboratory provides support to a number of courses and regular final-year projects. It also

provides industrial support on integrated design and prototyping, and support to ongoing research activities on digital geometry processing, virtual prototyping, reverse engineering and rapid prototyping.

12. Nuclear Reactor Simulation Laboratory (Rm. 5201 LAU, 150 sq. m)

The laboratory supports the teaching of the Nuclear and Risk Engineering Major. It is equipped with a state-of-art full scope nuclear reactor simulator based on a commercial 3-loop Pressurized Water Reactor designed by Westinghouse in the USA. It also equipped with 3 sets of virtual panels for human factors research, CATHARE for design-basis accident related studies, and MAAP and MAAP Dose for beyond design-basis accident related research.

13. CLP Power Low Carbon Energy Education Centre (University Level Initiative hosted by MNE, Rm. 3202 LAU, 300 m^2)

The Centre supports undergraduate teaching, especially general education and nuclear engineering related courses. The centre is divided into 5 thematic zones to provide a thought-provoking, interactive experience covering the generation principles, applications, advantages and limitations of different low carbon energy sources (including, solar, natural gas, wind, hydro, and nuclear energy) as well as their future development potential. One of the main teaching equipment is the state-of-the-art 235° 3D Immersive Virtual Reality Display System that can take visitors for a virtual tour of the insides of Daya Bay Nuclear Power Plant.

Some major Research Laboratories:

1. **Advanced Coatings Applied Research Laboratory (ACARL, Rm. Y1531/Y1431 YEUNG, 174 sq. m)**
   The application of diamond and diamond-like carbon (DLC) thin firms has recently attracted a lot of attention in the US, Europe, Japan, South Korea, Taiwan and Singapore. Diamond coatings is a surface coating which can be applied on plastic, glass, ceramic and metal at close at room temperature with its properties rivalling those of nature diamond, but it cost much less. By the supporting of the ISF project, HKSAR Government, ACARL using the existing R&D facility in the laboratory to adapt and improve on the coating techniques and processes for local industrial applications. Besides we intend to produce ready-to-market results of DLC applications by achieving three objectives: to serve as a pilot facility to adapt diamond coatings to various metals, glasses and plastics to improve their hardness, wear and scratch resistance qualities; to provide diamond coating service to specific products from local industries once the coating technique and process for those specific products are finished; and to develop new applications of diamond coatings, and diffuse and promote this technology to local industries.

2. **Bio-Inspired Engineering Laboratory (Rm. Y1522/Y1532, 40 sq. m)**
   Through billions of years of evolution, Nature has orchestrated many elegant principles to accomplish structural and functional integrity. The overarching visions of this laboratory are to advance our understanding of various important interfacial and transport phenomena underlying the multiscale natural system and to mimic these biological principles for healthcare and energy innovation. Some major equipment of the laboratory include DKSH contact angle measurement system, fluorescence microscope, high speed camera (up to 10,000fps).

3. **Advanced Structural Materials Research and Development Laboratory (Rm. B1481A, 55 sq. m)**
   One of the major focus of this laboratory is to prepare and develop advanced metallic materials at temperatures to 2000C in controlled environments. Our programs are required to make existing materials for property evaluations and to develop new materials with superior mechanical and metallurgical properties for engineering use. Currently, we are working on new Fe-, Ti, and Au-based alloys for industrial applications. We are also fabricated special alloys such as bulk metallic glasses and high entropy alloys for use at elevated temperatures. The lab currently houses various casting facilities, including arc – melting furnaces, tube furnaces for heat treating materials in controlled environments at elevated temperatures. We are also in the process of setting up facilities to process rod, wire, and ribbon materials. All furnaces and facilities are capable to prepare various metallic alloys in different sizes, and shapes in controlled environments.

4. **Nanomaterials for Energy Storage & Energetics Laboratory (Rm. Y1414, sq. 30m)**
   This lab is for synthesizing nanomaterials for energy-related applications, especially for energy storage and energetics applications. The lab is capable to synthesize and characterize various 0D nanoparticles, 1D nanowires/rods/tubes, 2D nanowalls/sheets/plates, and complex 3D hierarchical nanostructured materials. This lab has the state-of-the-art facilities for testing the electrochemical properties of the synthesized nanomaterials for energy storage applications such as lithium-ion batteries (LIBs) and supercapacitors. The lab is also capable to test the thermal, combustion, and mechanical

properties of nanoenergetic materials. Nanoenergetic materials have promising applications in airbags, belt tensioners, mining, deconstruction, heat sources for rapid fuses, the joining of materials by means of localized heating, micropropulsion systems, and propellant rate modifiers.

5. **Nanomechanics and Materiomics Laboratory (Rm. Y1504, sq. 32m)**
   The multi-scale in situ mechanical characterization laboratory is established for the holistic study of materials systems, including low-dimensional nanostructures and biological materials, and its applications in advanced materials processing and bio-inspired materials design. Major equipment housed in the laboratory include: in situ SEM tensile tester with 2N, 20N and 200N load cells; MicroManipulatorTM probe station; Electrochemical nanofabrication system; in situ SEM picoindenter (CASM); high resolution in situ micro-imaging system, etc. By synthetically using the experimental and computational approaches, such as in situ electron microscopy (SEM, TEM) techniques, mechanical (as well as electro- and thermal-mechanical) properties and deformation mechanisms of natural and synthetic materials can be systematically investigated in the laboratory, to provide fundamental links between structures and properties at multi-scale, from nano to micro to macro, and under multi-field.

6. **Nano-Materials and Mechanics Research Laboratory (Rm. B1551, sq. 58m)**
   This lab aims to develop the Surface Mechanical Attritions Treatment (SMAT) Technology, which offers an attractive alternative approach to effectively produce nanostructured surface layers on materials. SMAT does not alter the chemical composition of the treated material but can increase its mechanical properties, such as tensile strength and hardness. A high strength and high ductility steel is designed on the basis of a newly developed concept of coherent twin boundaries to meet the demands of safety and lightweight design for the automobile and aeronautic industries. The high density twin structure on the nano/submicron scale not only can induce higher strength, but also provide large ductility by the interaction of dislocation with coherent twin boundaries. The high density twinned steels, with twin thickness on the nano/submicron scale in bulk materials shall be fabricated by surface mechanical attrition treatment (SMAT) with high impact velocity. The mechanism of strain-induced twin by high speed impact is investigated to achieve controllable performance. The relative application of corrosion resistance, welding, and friction and wear properties will also be studied.

7. **CASM Photo-Mechanics Laboratory (Rm. B1555, sq. 56m)**
   The composite laminate in airplanes has been applied in the new airplanes and the proportion is continually increasing. The Surface Mechanical Attrition Treatment (SMAT) and nitriding process greatly improve the corrosion resistance of the fuel rod under multiphysical coupling complex system, i.e. vibration induced fluid structure coupling and irradiation, corrosion and mechanics coupling. The SMAT induced surface compressive prestress also effectively improves service life of the fuel rod under cyclic loading. To achieve those objectives is the experimental measurement of residual stresses in composite laminate parts. Among the different techniques existing for residual stresses characterization, the incremental hole drilling method is developed and coupled with optical instrumentations (ESPI, Moire Interferometry).

8. **Robot Vision Research Laboratory (Rm. Y1412, sq. 35m)**
   The work in this lab is on robot vision in general and is on 3D visual sensing and tracking recently in particular. Some of the recent works conducted include: 3D visual sensing with

structured lighting; Active visual sensing with self-recalibration; Sensor Placement for 3D Measurements and Reconstruction in Uncertain Environments; Omni-Directional 3D Visual Sensing; Tracking with 3D vision; 3D trajectory tracking for activity observation, etc. The relevant applications include advanced product inspection, surveillance, as well as robotics.

9. **Integrated Nano/Bio Systems Laboratory (Rm. Y1513/1515, sq. 72m)**
   This lab focuses on the integration of MEMS, Nanomaterials, DNAs, and Cells for advanced applications in sensing and biomedical engineering. The research team currently emphases on using digitally-controlled and programmable electric fields in microfluidic systems (optically-induced electrokinetics or 'OEK') to manipulate, assemble, pattern, and differentiate cancer and stem cells. OEK is also being applied by the team to rapidly fabricate micro-lens arrays for the development of large-area scanning near-field microscopy (SNOM). Work is also underway in the lab to use micro-nozzles for rapid printing of 3D biological tissues.

10. **Mechanics of Advanced Structural Materials Laboratory (Rm. Y1526, sq. 30m)**
    The Mechanics of Advanced Structural Materials Laboratory is established for the fundamental study of the structure-property relation of advanced structural materials, including deformation, fracture and fatigue. The materials we are concerned with include amorphous alloys, high temperature alloys (such as high entropy and super alloys), bulk nanocrystalline materials, flexible electronics materials, thin films and structural biomaterials. Major testing equipment housed in and related to the laboratory includes: Fullam in-situ microtester and HysitronTM TI 950 nanoindentation system. In addition, the research in this lab deeply involves design and synthesis of advanced structural materials, which links it to the fabrication of advanced structural materials. Besides experiments, this lab is also devoted to micromechanics modeling and numerical simulations, from finite element to molecular dynamics simulations.

11. **Bio-Mechanics Research Laboratory (Rm. Y1516, sq. 30m)**
    This laboratory fabricates and studies mechanical behavior of biomedical materials in multiple size scales in following scopes: (1) bio-inspired design of crack resistant nanoparticle reinforced dental composites; (2) interfacial behavior between particle-particle and particle-polymer pairs; (3) rate and/or temperature dependent properties of biological and biomimetic materials. Major equipment housed in the laboratory include: dynamic mechanical tester, nanocomposite fabrication facilities, imaging system, etc. The laboratory has received financial supports from RGC, ITF, and CityU.

C. The Lab organization

The LAB is managed and operated by a team of 13 experienced technical staff on a daily basis headed by the Laboratory Manager. The entire Laboratory is supervised by the Laboratory Management Committee (LMC) which oversees the long term planning and development of the Laboratories towards achieving the Department mission and vision.

1. Laboratory Management Committee (LMC)

The role of LMC is to contribute to :-

- Planning and development of the Laboratories towards achieving the Departmental mission and vision,
- Planning of laboratory space utilization to support various academic and professional activities of the department,
- Coordinate the planning and use of equipment and consumable budgets
- Oversee the general safety, environmental and hygiene standards in laboratories,
- Oversee the allocation and utilization of resources in the laboratories,
- Oversee the quality level of various services provided by the laboratories.

The composition of LMC consists of a Chairman, who is appointed by the Head of Department, the Laboratory Manager, and 3 members nominated amongst all faculty members.

2. Operation of the LAB

For the effective operation of the entire MNE laboratories, all the technical staff shall work together to provide the timely and necessary services to their users, including academic staff, research staff, undergraduate students and postgraduate students, etc. In general, one technician is assigned to look after the daily operation of at least one individual teaching laboratory area.

The roles of the technical staff are mainly to:-

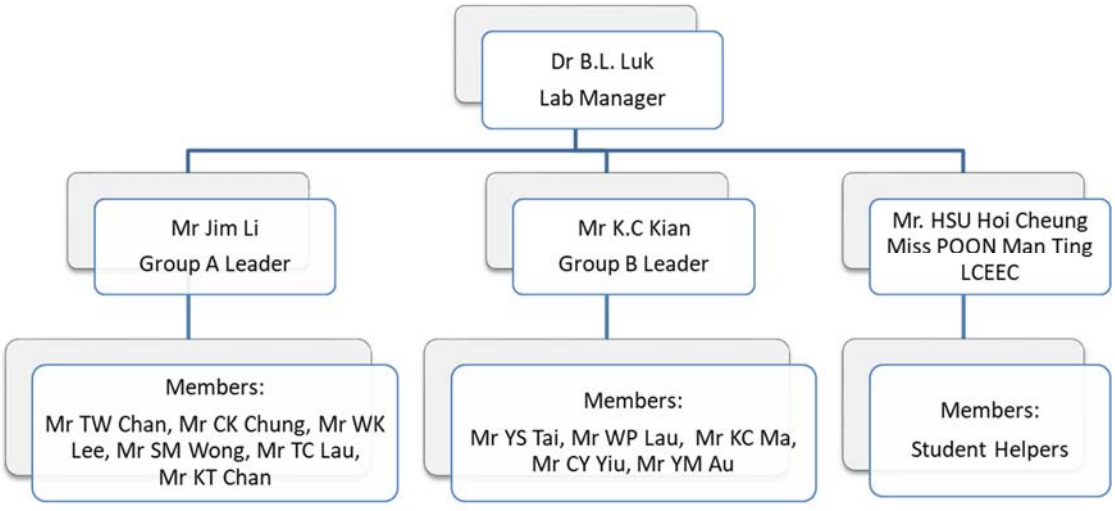
- assist the planning and develop laboratory exercises,
- support the running of laboratory exercises, i.e. :-
  - Prepare necessary equipment and accessories for the running of exercises,
  - Demonstrate the operation of equipment/software systems to students,
  - Ensure the students' safety in operating the equipment, etc.
- support students in working on final year projects , i.e. :-
  - Demonstrate the operation of equipment and use of software systems to students,
  - Provide adequate technical guidance where appropriate,
  - Assist students on the sourcing and purchase of necessary equipment/accessories, etc.
  - Ensure the students' safety when working in the laboratory.
- support Departmental research and industrial services , i.e. :-
  - Conduct risk assessment with RA and PhD students for major teaching equipment,
  - Provide basic operation training of the teaching equipment and its safe operations,
  - Assist the PI to maintain the research lab in good condition and maintenance of some major common research facilities
  - Conduct industrial consultancy work request on a needed basis

- support the Laboratory office to :-
  - Maintain the individual laboratory area clean , tidy and safe,
  - Maintain the equipment and facilities in good condition,
  - Maintain records of various laboratory activities for efficient management,
  - Achieve and fulfill the LAB's mission to its greatest extent.

In general, most of the teaching equipment in the LAB are purchased and setup to support laboratory exercises, student projects, research work and sometime industrial consultancy work. When there are more than one user who want to use a particular equipment at any one time, priority will then be given based on the above order. Final year project students will usually be given a fixed workplace to work with at the start of their project. They are allowed to enter the LAB during daytime and operate the computer or equipment as long as they have informed and agreed by the technical staff and those equipment are not occupied by any laboratory exercises. However, for those potentially dangerous equipment such as industrial robots, machine tools, chemical analysis apparatus and high power equipment, students need to be accompanied by their supervisors(or their delegates) or technical staff.

The overall smooth operation of the LAB and its continuous growth is under the supervision and management of the Laboratory Operational Management Team which is headed by the Laboratory Manager (LM) and assisted by the two senior technical officers. The LM shall oversee the Safety and Security, Fixed Asset Management, Time-tabling and Roster, as well as consumables support for the entire Lab. He is also responsible for the development of supporting infrastructure including the Quality Enhancement Programme, the Safety Enhancement Programme, liaison with the Finance Office for the purchase of teaching equipment, and with the CDO/FMO for the maintenance of basic services in the LAB.

2. Lab Staff Organisation



LCEEC – Low Carbon Energy Education Centre

D. Safety in the Lab

To prevent accidents occurred in the LAB, all users (including students, research assistants, and research students) are required to read carefully and follow exactly the following regulations and safety guidelines when they are working in the laboratories. If found violating these regulations and safety guidelines, they may be asked to leave the laboratories or stopped from entering the laboratories.

****IMPORTANT****

- EXPERIMENTS WITH POTENTIAL FIRE RISKS SHOULD NOT BE LEFT UN-ATTENDED.

- EXPERIMENTS WITHOUT RISK ASSESSMENT AND ADEQUATE SAFETY MEASURES SHOULD NOT BE PERFORMED.

- UNDERGRADUATE STUDENT CAN ONLY WORK IN A SPECIFIC LABORATORY AFTER OBTAINING PERMISSION FROM A QUALIFIED MNE STAFF WHO IS READILY AVAILABLE IN DEPARTMENT'S LABORATORY THROUGHOUT THE TIME OF USE.

a. GENERAL BEHAVIOUR AND ATTITUDE

1. While in the LAB, you are not allowed to smoke, to bring in food to eat and to drink, to cook, to sleep, to gamble or to play games, and you should always dress up appropriately in accordance with the safety regulations. (DO NOT wear shorts, shirt, sandals or slippers in laboratory)

2. Do not use a chair with roller wheels, which you may be sitting on, as a cart and drive it around for fun.

3. You should always be considerate and do not disturb others by rowdy action or by unusual noise.

4. Unless otherwise permitted,
   - 4.1 do not stay in the LAB after office hours;
   - 4.2 do not take anything belongs to the LAB (such as tools, instruments, manuals, equipment, furniture etc) away from the LAB;
   - 4.3 do not dislocate any equipment or furniture;
   - 4.4 do not operate machines or equipment of any kind in the LAB.

5. After you have finished your laboratory experiment or your student centre activity or your project works, clean and tidy up your workplace and return all borrowed equipment and tools to the technicians before you leave.

6. In case of accident or damage to a machine or equipment, you should immediately stop using it and report to the technician-in-charge about the accident or damage.

7. In case of fire, switch off the power supply and leave the LAB orderly through the nearest exit door.

8. If you want to carry on with your research investigation after office hours, you should seek advice from the Laboratory Manager for a proper arrangement to ensure your safety.

9. You should immediately report to the technician-in-charge any malfunction of any equipment or machine. Never attempt to investigate the causes and/or solve the problems on your own.

10. You are fully responsible for your own safety in using the LAB facilities.

b. USE OF CHEMICALS

From 27 July 2020 onward, purchase of controlled chemicals must be made via Chemical Control System (CCS).

The benefits of CCS are:

- Cloud-based chemical order and inventory control system
- To manage the purchase and stock keeping of chemicals on campus in order to meet statutory requirement
- To monitor chemicals stock level
- To minimize effort in compiling chemical inventories
- To provide better bargain and time saving for purchase of commonly used chemicals/solvents utilizing Blanket Order

Principal Investigators:

- appoint the full-time staff/students as Chemical Purchasing Delegate to handle all chemical purchasing issues including obtaining quotations, applying relevant licenses and raising order requests in Chemical Control System (CCS) on behalf of his/her research group;
- undertake the ultimate responsibility for his/her order requests and fulfill relevant statutory requirements;
- take appropriate action against any person who violates statutory requirements;
- be well aware of any hazardous chemicals or controlled substances to be purchased before raising chemical request at CCS;
- settle the payment with FO and FMO.

For further information about CCS, you may visit FMO's website on Safety and Health Information under the Safety, Health and Environment menu:
https://www.cityu.edu.hk/fmo/studentlan/default.aspx?PageID=shi

There are a lot of Chemicals require very special infra-structure before we can use / store it safely, and also some of them may require special approval from Hong Kong Government as well.

1. You must read and understand the operation instructions of the machines and the processes before operation. When in doubt, you should ask the technician-in-charge for help.

2. You must follow all operation instructions closely during the operation.

3. You must wear suitable protective clothing, gloves and face goggles or mask while working in the chemical related laboratories, including the Product Safety & Hazard Analysis Lab.

4. If you are operating a machine or in a process involving chemicals, you must understand the nature of these chemicals, study its MSDS and the necessary precautions to be taken before operation.

5. You must handle all chemical substances with great care. When in doubt, you should ask the technician-in-charge for help.

6. You must keep all chemical containers tightly closed, dry and clean, and in proper position. After using them, you must put them in an appropriate place. Please study carefully and follow the Chemical storage guidelines and Chemical Waste disposal guidelines which can be accessed under the Lab website http://www.cityu.edu.hk/mne/lab-safety.htm

7. You should perform chemical operations in a fume hood whenever it is possible.

8. If you suspect an abnormal gas or chemical leakage, you must report to the technician-in-charge immediately and then leave the area quickly and orderly. DO NOT attempt to tackle the leakage on your own.

9. You should not dispose of chemical wastes to the public drainage system. You should ask the technician-in-charge the proper disposal procedures for chemical wastes. See Appendix III for the Chemical waste disposal guideline for the Department.

c. USE OF ROBOTS

1. You must obtain briefing from the technician-in-charge on the proper operational procedures of a robotic system before you operate it.

2. You have to sign a form and collect the key from the technician-in-charge to operate a robot.

3. When you are testing a new program on a robot, you should always start with the slowest speed to make sure that the whole sequence of motion is complete and no obstruction to the robot movement exists inside its working envelope.

4. Before entering the working envelope of a robot, you must switch off the arm power and wear a safety helmet.

5. When a robot is activated, you should never cross the safety yellow line marked on the floor, and you should never alter any electrical/electronic connections of the robotic system.

6. When a robot is switched on, you should never leave it unattended.

7. Command a robot to its home position then switch off the power and return the key to the technician-in-charge before you leave.

d. USE OF LASERS

1. User must read and fully understand the comprehensive laser safety guidelines issued by Electrical and Mechanical Services Department (EMSD) of Hong Kong Government, which can be accessed from Departmental homepage at www.cityu.edu.hk/mne/lab-safety.htm

2. User must attend and complete the LS-08 Laser Safety on-line training provided by CENG.

3. For use with class 3 laser or above, user must also attend the 3.5 hours training course "Fundamentals of Laser Safety" offered by Occupational Safety & Health Council, or equivalent, as soon as it is available. The LAB will inform the user and do the application and registration of the course for the staff when it is available.

4. Whenever the laser source is turned on, users must not leave it un-attended at any time.

5. Laser equipment is classified into different class from 1 to 4, usually depends on the power of the laser source. It is marked and labelled clearly on the equipment. User must fully aware of the class of its laser source.

6. For laser of class 3 and class 4, they are of high power and shall have potential hazard to the eye if it is exposed to the laser source. For high power class 4 laser, it also possesses potential hazard for skin burn and fire hazard.

7. As such, when operate with such high power laser, user shall always wear laser goggle with suitable wavelength and wear lab cloth to protect possible skin burn.

8. More importantly, for laser of class 3b and class 4, designated controlled area should be used to house, and separate the laser equipment from outside. Warning sign should be used so that other people will not enter the designated area whenever the laser is turned on. User of class 3b and/or 4 laser must seek the approval from Laboratory on the setup of the designated controlled area before it can be used.

9. In CityU, procedure is also established such that regular laser user shall conduct an eye sight test from a registered eye doctor before they operate the laser and prior to their end of their contract with CityU. Please check it with our Laser Safety coordinator ***Mr YIU Kelvin Chi Yan (Tel: 3442 8026)*** and get the eye sight test completed before commencing any laser operation.

10. High power laser source, class 3 or above possess fire hazard when the laser has a chance to emit to the open air. In this case, users should make sure that the environment near the laser source is clean and tidy, does not have any flammable materials such as paper, and paper box. Do use plastic box, (or glass box) to cover and shield the laser source so that it will not emit out. Such box should be painted with black/dark color so as to absorb the laser source as much as possible.

e. USE OF COMPUTERS

1. You should keep all pirated software away from your computer systems as well as from the LAB. Any software without proper license will be removed from your systems immediately without further notice.

2. You can use any PCs that are not being occupied in the LAB provided that you have informed the technical staff in charge. However, priority has to be given to laboratory staff for urgent uses.

3. You should make sure that the data diskettes are free from any virus before using it.

4. Unless otherwise permitted,
   4.1 you are not allowed to install any software of your own in the hard disk drive;
   4.2 you are not allowed to copy any software installed in a PC.

5. You should never delete or modify any file from the hard disk that are not yours, and you should always backup your data and then switch off the PC before you leave.

6. You should not lock the computer screen for more than 15 minutes.

7. In case the PC has to be re-located or re-formatted for other purposes, thus necessitating the deletion of files in the hard disks, you will be given a few days' notice to save your files.

f. USE OF LOCKERS IN LABORATORIES

You are not allowed to carry bags to the laboratories. To provide a temporary storage for your bags and belongings when you enter the laboratories for experiments, project, etc. Lockers (without locks) are provided at the main entrance of the Laboratories. Please follow the below guidelines for the proper use of the lockers.

1. Bring your own personal locks and lock your bags whenever you enter the laboratories.

2. Always clear the lockers and get back your personal locks every day when you leave the laboratories.

3. Never leave your belongings in the locker overnight or else our staff will break the locks and empty the lockers.

4. Never leave your wallet or any expensive belonging in unlocked lockers.

g. MANUAL HANDLING OPERATIONS

1. You should get yourselves aware of the potential danger of manual handling operations.

2. When doubt, you should seek advice from technical staffs.

3. You should not perform any dangerous manual handling operations.

4. You should refer to the Manual Handling Operations Risk Assessment results which can be obtained through Senior Technical Officers before performing the manual handling operations in the LAB.

5. Laboratory staffs will assist you the proper manual handling operations. However, you will be stopped from all improper manual handling operations immediately when it is found.

Regular Risk Assessment for staff

- All the Laboratories and Research Centers should carry out Manual Handling Operations Risk Assessment.

- All Manual Handling Operations Risk Assessment should be reviewed if the working conditions are changed or when new facilities are equipped. Laboratory staffs should inform Senior Technicians to review their assessment when this happen.

- All Manual Handling Operations Risk Assessment results will be centralized in a safety materials cabinet which is located at the Laboratory corridor and is open for public reference.

h. SAFETY TRAININGS AND BRIEFING FOR RESEARCH STAFF

It is a 3-stages process for every academic and research staff who want to conduct their work in the MNE Laboratories.

1. First Stage: FMO Safety Training

After employees join the department and receive an Electronic ID, they need to log in to Canvas (the learning management software system) to conduct the online safety trainings under the FMO Safety Training Course. The Canvas system is easily accessible through the QUICKLINKS menu on the CityU website. Some multiple-choice questions will be asked at the end of the training. Employees need to complete the safety training before they are allowed to go to the 2nd stage of the safety training.

2. Second Stage: MNE Safety orientation and briefing

The staff concerned needs to come down to the Lab office and staff will give them a face to face safety orientation and briefing talk which lasts for about 30 minutes. It will cover some introduction of in-house safety rules and guidelines and some CityU and Departmental safety videos will be given to them. Staff needs to go through all these materials clearly and to sign the declaration form in order to complete this orientation. For ease of administration, this safety orientation will be held regular about once in a week. New staff will be informed and invited to join the orientation.

After these first 2 stages, staff will be allowed to enter to the Laboratory. However, to

conduct work inside individual Lab areas, they need to go through the 3rd stage of risk assessment.

3. Third Stage: Individual Risk Assessment

In order to work inside a particular lab area, staff needs to conduct a risk assessment (the form can be obtained in the Laboratory). The risk assessment should be conducted for each individual workplace. That is to say, if a staff needs to work in 2 different areas, they need to prepare two risk assessment forms. The form will be passed to appropriate technical staff and they will conduct the risk assessment with you and ask you to sign on the form.

Only after all these 3 stages are completed, the staff can then be allowed to work inside the LAB via a proper application (see A*ppendix V* for a sample application form). If you have any further query about this matter, please feel free to contact the Lab Office for details

E. Work in the Lab after normal office hours

(For undergraduate students)

1. Individual laboratories will be opened (usually from 6:30pm – 10:00pm) when there are scheduled laboratory experiment sessions in the evening. Final year project students can work in these laboratories when they are open. Students should stop their work and leave the laboratories when the students there finish their experiments.

2. For laboratories other than those described in condition 1 above, there will be no technicians on duty and the laboratories are closed. Students are not allowed to enter these laboratories.

Remark: -

When students are working independently in a laboratory under condition 1, minimal services and technical advice will be given by the technician on duty since the priority is given to the students doing the scheduled experiments there.

(For MNE research staff)

For safety reasons, it is the general practice that no access will be given to research staff to enter individual teaching laboratory area after **the Lab office hours when the teaching lab is closed**. In order to use a particular piece of teaching equipment in the lab individually, usually the research staff needs to complete a risk assessment application. Once it is done, the research staff is able to access the related teaching lab and to use the equipment until 11:00pm each day by filling the application form (see *Appendix V*) and obtain approval from the Lab Office. To grant access to individual laboratory, the **applicant must**:-

- **Fully fill in the application form and with their supervisor's approval,**
- **Successfully complete the Self Risk Assessment exercise, and with a copy of the assessment form attached,**
- **Fully aware of the Personal Alarm System (PAS), and how to use it when necessary in the lab,**
- **Leave the laboratory and campus before 11:00pm when CityU is officially closed.**

Once approved, the grant will normally be given to 8:00am - 11:00pm every day for MNE staff. For other department's staff, the working hours in individual laboratory will be restricted to the LAB Opening hours stated in *Appendix I.*

If research staff needs to stay at the individual laboratory area after 11:00pm and overnight in some very special occasion, they are required to fill an application form (see *Appendix VI* for the registration form) and send it to Lab Manager for approval. To grant the access, the staff must have completed the risk assessment and is approved to work in this particular lab beforehand. In current practice, each application is ***limited to 4 weeks***. If they need to work overnight for more than 4 weeks, they need to submit a new application.

F. Use of Consumables in the Lab

1. Introduction

To support teaching, student projects and research work, small parts and recurrent items are always required. To differentiate these items with the major equipment purchase, which usually requires tighter and much complicate administrative control procedures, consumable budget account is used. To assist staff and students to better understand the operation of the consumable account, this manual outlines how consumable account and consumable stores are managed in the Department, and the procedures required for such purchase.

2. Definition of Consumable

The consumable account can only be used for consumable purchase. However, there is no precise definition of what is considered as consumable. In general principle, consumable are minor electrical, plastic, chemical and mechanical parts that are re-current in nature and their life time is usually short (less than 1 year) and/or the price for such parts are inexpensive (usually costs less than HK$1,000). Moreover, since City University has a separate budget account for stationery, consumable account cannot be used for stationery purchase, such as papers, photo-copy, stamp, file, books, etc. Users are advised to discuss with the LAB Office, for those items that are not clear whether it is classified as consumable, in advance of their purchase.

3. Purchase of consumables

a. Purchase Requisition (PR)

Each year, the Laboratory receives a lump sum budget from Department for the purchase of consumable to support the teaching and student projects work for the year. Purchase Requisition (PR) needs to be prepared to purchase expensive consumable items (usually when the total purchase per request is more than HK$5000) or those suppliers who do not accept petty cash purchase. Proper account code to be assigned and finally endorsed by the Laboratory Manager. These PRs will be sent to the Finance Office electronically who in turn will issue formal Purchase Order (PO) to the suggested suppliers for us. When the items arrive, it will be delivered to the LAB Receiving Counter at 1/F, Lift No.4 and our student helpers will contact the user to collect it. The central coordinator, Mr. WC Li (x 34429393), is our senior technician to oversee the daily operation of the consumable store in the Department. He is also responsible for the creation and maintenance of computer user accounts that are needed for users to access the Consumable Control system (CCS).

b.) Petty cash purchase

Due to the vast diversity of the type of consumable that we require, it is not viable for our local store to keep an adequate level of all consumables. For urgent requirements, users can go out to local shops to purchase the items first, and then obtain reimbursement later. These petty cash purchase is limited to HK$1000 per single item to be purchased in one day. Users need to access the CCS (Consumable Control System) and print out a claim form and send it to Lab. Manager at the Lab. Office in B1662 for cash reimbursement. Besides, each petty cash claim form is limited to HK$5,000 also.

c.) Blanket order purchase

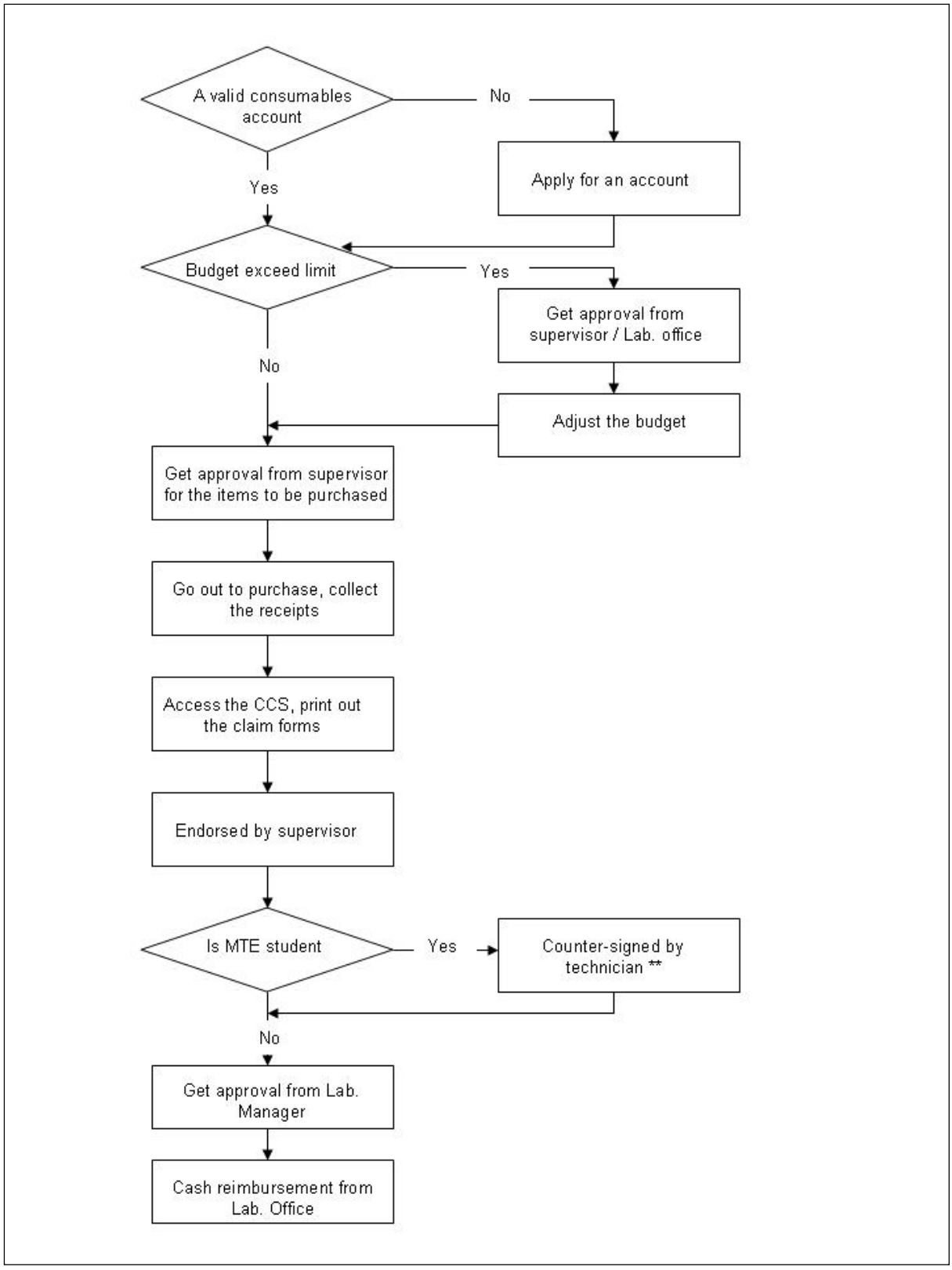
For some urgently required items, there is still another mechanism to speed up the purchase. City University has established purchase agreements with some of the major local consumable suppliers. We can raise a so-called "blanket order" and send it directly to these suppliers. These purchases need not go through the Finance Office for further processing and usually the suppliers are able to deliver the items to us directly within few days. In the current practice, all blanket orders are prepared by technicians on users' requests since they usually have a better understanding and relationship with the suppliers and know the details of each consumable better. For details of all currently available vendors for standing order purchase, students are advised to contact our Senior Technician Mr. WC Li (x 3442 9393) in the Lab office.

4. Consumable computer users account

There is a web-based on-line Consumable Control System (MNE CCS) for users to raise petty cash and blanket order request and it records every purchase transaction including petty cash purchase and reimbursement. The MNE CCS can be accessed by accessing the website www.meem.cityu.edu.hk/webapps/index.asp and click to select CCS application. The operation manual is also available there to assist users to use the MNE CCS. In order to collect items from local store, to obtain reimbursement for petty cash purchase, a computer user account is required for every user to access the MNE CCS. Students and RA/RS should apply for a user account, with some initial budget, at the beginning of each financial year (at around mid-July of each year) (See Appendix VII for a sample application form for user account which can be obtained from Lab. Office B1662 or from INTRAMEL (by accessing the website www.meem.cityu.edu.hk/webapps/index.asp and click to select the IntraMEL application)). The maximum budget for each category of students are confirmed and outlined in Appendix VIII. The consumable account is valid for one year only and will be closed at the end of Sem B each year. Therefore, all users are required to clear all their transactions and claim all petty cash reimbursement well in advance before the end of Sem B. All balances of each account will then be transferred back to Departmental central account automatically and immediately. For academic staff, since it is our intention and ongoing practice that technicians will assist them to take care of all necessary document work, we would not create account for them. Instead, they can simply direct all their requests to the technicians directly.

5. Procedures for purchase and reimbursement

a) Petty cash purchase



b) Purchase by academic staff

For academic staff, we do not have such a complex procedure as for students. In normal practice, when staffs foresee a need for a bulk quantity of consumable to either run a laboratory exercise, they can either talk to the relevant laboratory group leaders and/or Lab. Manager directly. Eventually, technicians will check the existing stock level, and base on the estimated purchase lead-time and the urgency of the items, they will either raise a bulk consumable request or a standing order purchase to the LAB office.

However, it is not recommended for academic staff to purchase items for their project students. Instead, all students should have their own accounts. In this way, we can have a better and more precise record and analysis of the usage of the consumable budget by each category of users.

c) Support for Research work

Due to the limited budget available, and the fact that consumable budget is allocated on the basis of the numbers of student intake, we have to stop the support of consumable for RAs and RSs. Therefore, principle investigators are strongly advised to plan for enough consumable budgets in their research proposals, and they shall purchase and receive their consumable on their own. If the research group wants to make use of the Department consumable control system to purchase and administrate consumable for their work, they can transfer enough funding from their research account to the Department consumable account. In this way, we shall create a consumable account for them so that they can purchase consumables via our system. Appendix IX shows the budget transfer form for this use.

6. Conclusion

This operation manual outlines only the basic management and operation of the consumable budget in our Department. Some detailed mechanisms are skipped for simplicity. In fact, the system itself is quite flexible and there are rooms for us to maneuver. Therefore, users are strongly recommended to discuss with the technicians and/or Lab. Office for any further details.

G. Basic Support for Final Year Project (FYP) Work

For FYP students, please read this note carefully which provides some useful information regarding the FYP work in MNE Laboratory.

- Consumables account and purchase
    - Do check with your project supervisor if you require some budget to purchase consumables for your FYP. If so, you need to submit the application form (Appendix VII) to Lab Office before end of December to create a consumable account for you. After this deadline, no consumable account will be created for you, and you are not allowed to purchase any consumables before an account is created for you and have enough budget to cover the expense.
    - Freight charge for goods purchased oversee or in Mainland China. There is a stringent requirement in CityU that we have to use the least available freight charge for shipment. As such, do check with the Lab Office before confirm the order. You may not be reimbursed the full freight charge if it is found too expensive.
    - **It is important to remind NOT TO RAISE ORDER with the vendor directly and ask MNE to settle the bill. There is a lot of financial practice and procedures to govern this. If you deem need to raise order instead of petty cash purchase, please consult the Lab Office for proper procedures.**

- Chemicals and Biological substances
    - A lot of chemicals are dangerous substances and they are regulated by different laws and internal rules. There are also straight rules in purchasing and bringing chemicals to the Lab. See *appendix IV* for the application form. It is strongly advised that you do not purchase chemicals on your own. Do consult our Lab Chemical coordinator before you do need to purchase.
    - Many Chemicals and Biological substances have potential hazards, you must study carefully the MSDS (Materials Safety Data Sheet) of the substances you are going to use and to consult the technical staff or your project supervisor if adequate safety precautions are in place before you conduct the experiments.

- Dress code and Personal Protective Equipment (PPE)
    - Never wear shorts, skirt, slippers, open toes shoes into the Lab
    - For different operations, you have to wear proper PPE to protect your work. In particular, to deal with chemicals and biological substances, you have to wear lab coats, glove and sometimes glasses to protect yourself during the work. Do ask the technical staff and or research staff who is supervising your work before the operation.

- Supervision and work
    - CityU has a straight regulation that undergraduate students need to be accompanied by a qualified staff whenever they are working in the laboratory.
    - Therefore, you are not allowed and should not work alone in the lab without supervision by a qualified staff.
    - You are either working in a teaching lab or a dedicated research lab. Check the Department home page (under Laboratory section for the list of lab). When you are working in a

teaching lab, there will usually be a technician taking care of your work and you can ask him for technical support related to the equipment in that lab area and other safety matters.

- When you are working in a research lab, usually your project supervisor will assign one of the research assistant or PhD student as a qualified staff to take care of your work. In this case, a registration form will be filed (*see appendix X*) which state clearly who is the qualified staff assigned to look after you. Please check with your supervisor for this form before you work in the research lab.
- Do remember NOT to operate the equipment on your own and /or in doubt of the potential hazard of the operation. Ask the qualified staff to help.

- Online booking of major equipment
  - There may be chance for you to make use of some major equipment which is available for online booking. As FYP students, the equipment charges will deduct from your FYP project account.
  - However, as a regular practice, we do require you to learn how to operate the equipment yourself and to book the equipment in advance using the online booking system. In this case, please use the attached registration form to apply for an account (*see appendix XI*).

- In-house safety rules and regulations
  - To maintain the Lab a safe workplace and to make sure all users work safely in the Laboratory, a numbers of safety rules and guidelines are developed specified for BME. It includes but not limit to Chemicals safety, Chemicals wastes handling, biological substances and wastes handling, Laser safety guidelines, guidelines for animals work, cell culturing safety, etc. As such, you are strongly requested to take a careful read of these rules and guidelines before you commence your FYP work.
  - All these rules and guidelines and the associated forms can be obtained in BME home page at www.cityu.edu.hk/mne/ (under the Laboratories section).

- Useful Contacts
  - Department home page: www.cityu.edu.hk/mne
  - Chemical Control coordinator Mr. WP Lau (3442 7010, email:mebill@cityu.edu.hk)
  - Consumables support: Mr. WC Li (3442 9393, email:mejim.li@cityu.edu.hk)
  - Safety coordinator Mr. KC Kian (3442 8938, email:mekian@cityu.edu.hk)
  - Lab Manager Dr. Luk Bing Lam (3442 8673, email:meblluk@cityu.edu.hk)

H. **Policy on Laboratory Classes**

Laboratory classes are an important part of university engineering education, from which you can learn hands-on experience in specific engineering fields. However, there is more to learn than just engineering knowledge when you attend the hard engineering oriented classes.

Attendance

The knowledge learnt in the lab classes cannot be easily obtained through lectures and private study. Therefore, attending lab classes is critical to achieve a holistic engineering education. The laboratory classes are pre-scheduled and they contribute to the formal assessment of the coursework. Absence without legit support (such as sick leave certificate issued by a Hong Kong registered doctor) implies nil achievement of that part of coursework.

Punctuality

Punctuality is an established professional practice observed in the engineering community. In the real competitive world, professionals often arrive earlier than the official time such that they are better prepared for the work.

As an upcoming engineer, students should arrive no later than 15 minutes from the officially announced or timetabled commencement time of the laboratory session. Attendance register will be closed 15 minutes after the start time of the lab session, and the attendance sheet will be collected by lab tutor for further processing. Students missing the cut-off time are considered as absent from class and make-up lab class WILL NOT be provided. However, late students are encouraged to stay on to participate in the laboratory exercise for the sake of learning.

Safety

As people often say, the world is a dangerous place, and it is even truer inside any laboratories. Most of the time, we are the best person to ensure our own personal safety.

As far as the MNE laboratory is concerned, the Department has imposed the proper dress code for entering and working within the laboratory premises.

1. People SHOULD NOT wear shorts, skirt, sandal and slipper (or any open-toed shoes) when entering and/or working inside MNE Laboratory.
2. All technical staff, sometimes with the assistance of security guards, will check carefully all the people entering the Lab for proper dressing. Anyone violating this rule will be ASKED TO LEAVE THE LABORATORY IMMEDIATELY WITHOUT FURTHER NOTICES.

In addition, eating and drinking are prohibited in MNE laboratories to avoid any contamination by chemicals and dirt. Bags and bulky items should be placed in the nearby lockers to avoid any unnecessary accidents. Each laboratory has its own safety requirements, and students are required to pay attention to laboratory staff's safety briefings, usually at the beginning of the lab session. Anyone violating the laboratory's safety

requirements or staff's safety instructions will be ASKED TO LEAVE THE LABORATORY IMMEDIATELY WITHOUT FURTHER NOTICES. As MNE has many machines in its various laboratories, students are strongly advised not to wear any jewelry or loose items that may be easily caught by the mechanical moving parts of machines during the lab session.

Appendix I

The LAB Opening Hours

During Semester A and B

Mon. - Fri.	9:00am – 12:30pm (closed for lunch 12:30pm - 1:30pm)
	1:30pm – 5:15pm
For scheduled evening work	6:30pm- 10:00pm *

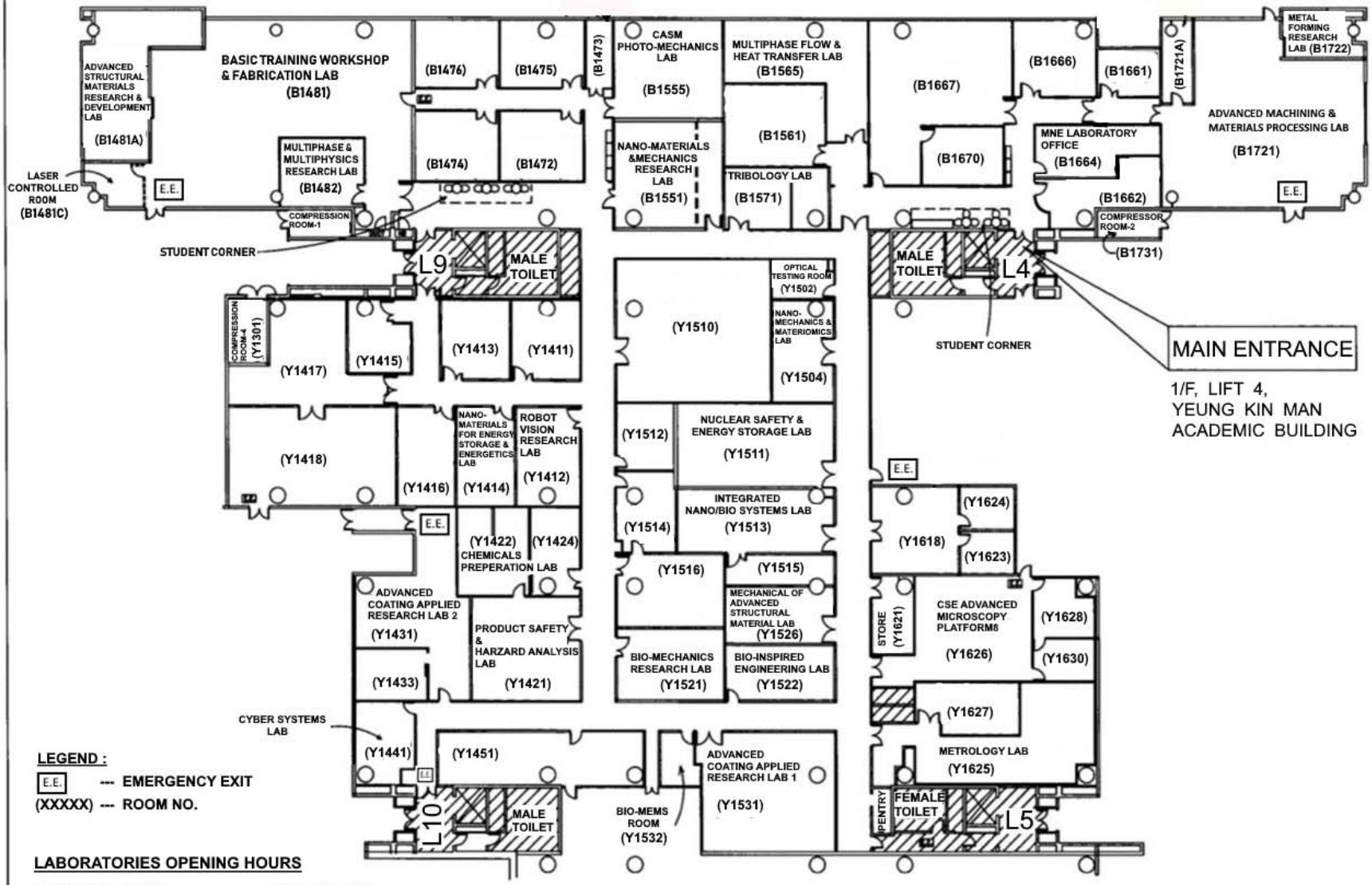
**The LAB will be open in evening only when there are experiments or other scheduled activities.*

Sat.	9:00am - 12:30pm
Sunday and Public holiday	closed

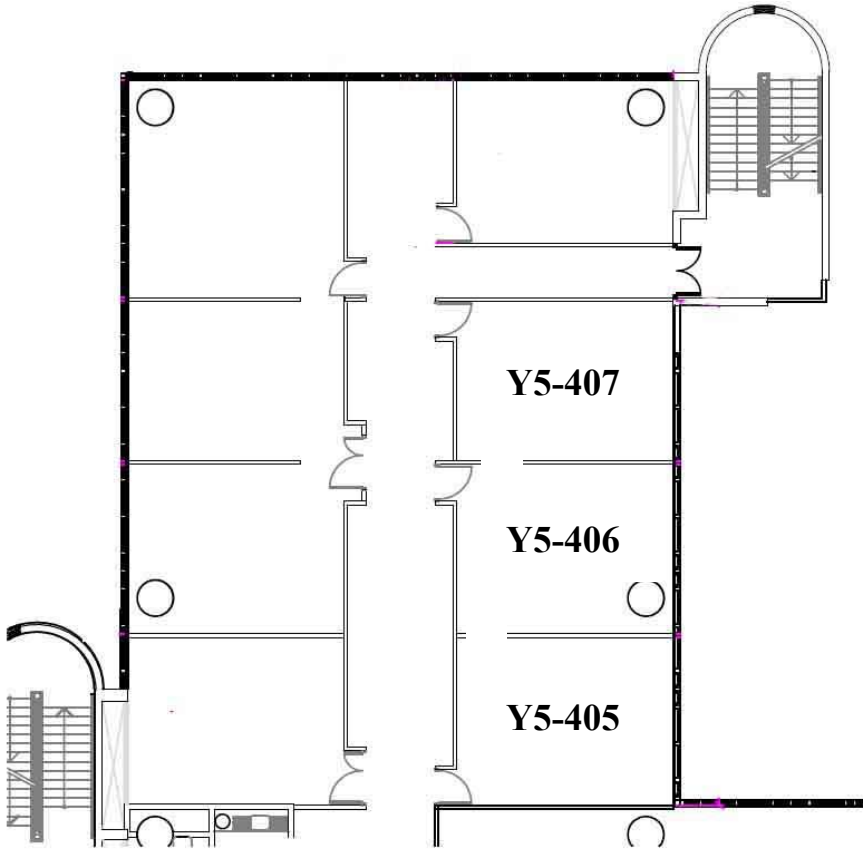
During Semester Break, Summer Term

Mon. - Fri.	9:00am – 12:30pm (closed for lunch 12:30pm - 1:30pm)
	1:30pm – 5:15pm
Sat.	9:00am – 12:30pm
Sunday and Public holiday	closed

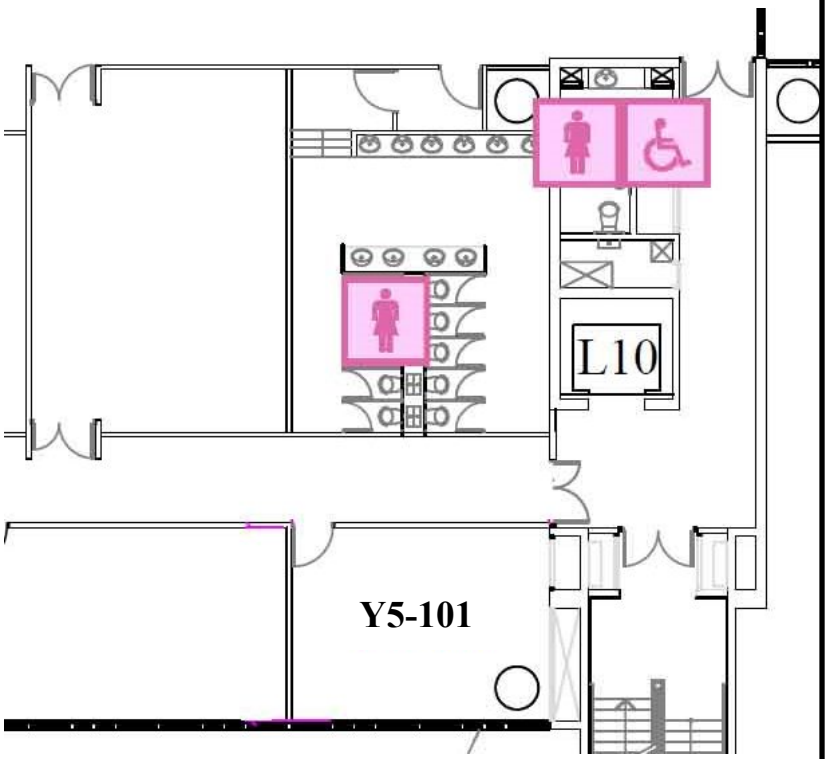
Appendix II-a Mechanical Engineering Laboratories (MNE Labs) on 1/F YEUNG



Appendix II-b **Mechanical Engineering (MNE) Laboratories on 5/F YEUNG**

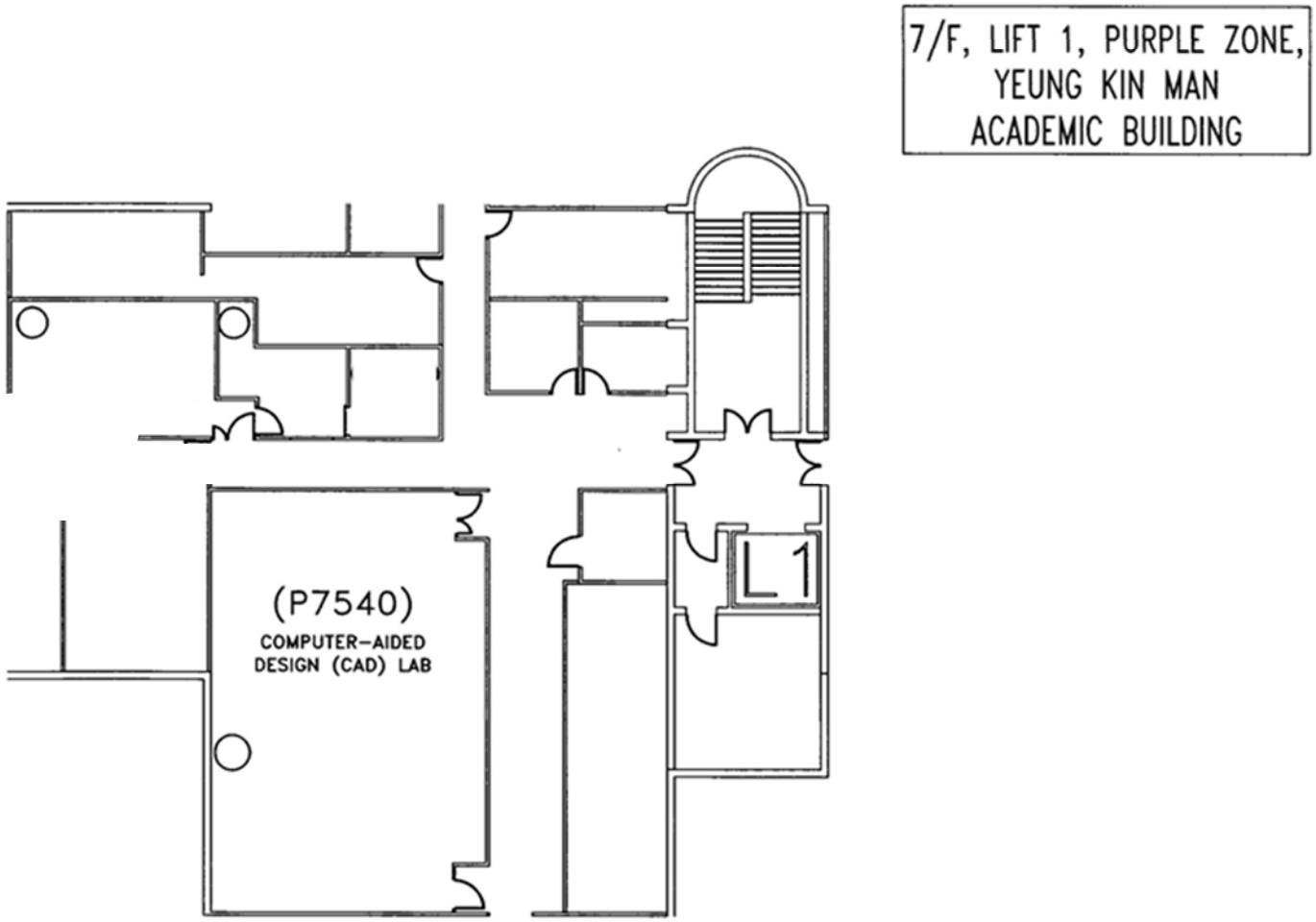


Rm. Y5405/Y5406/Y5407
Mechanics and Tribology Laboratory

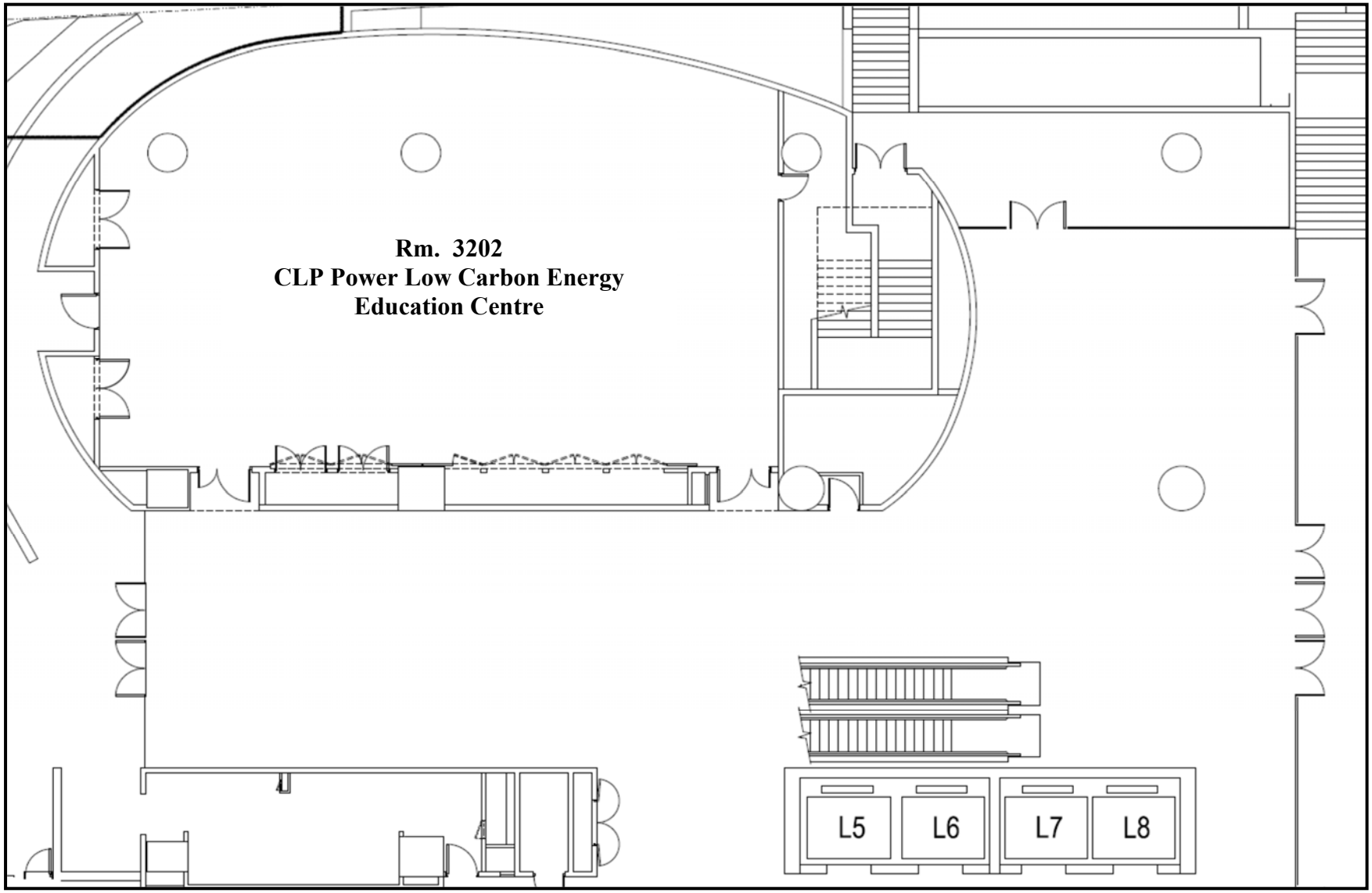


Rm. Y5101
Thermal-fluids Laboratory

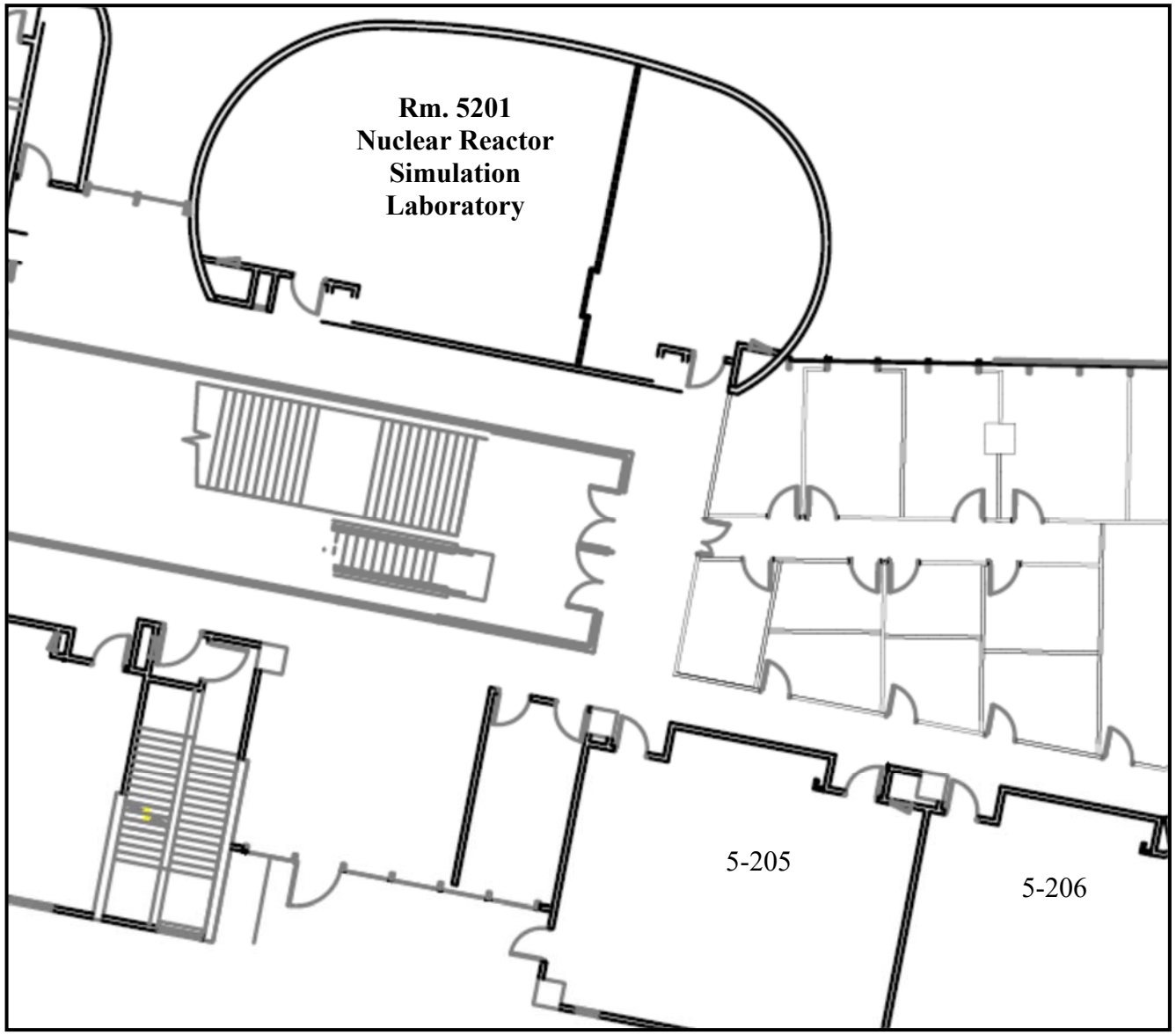
Appendix II-c **Mechanical Engineering (MNE) Laboratories on 7/F YEUNG**



Appendix II-d **Mechanical Engineering (MNE) Laboratories on 3/F LAU**



Appendix II-e **Mechanical Engineering (MNE) Laboratories on 5/F LAU**



Appendix II-f **Mechanical Engineering (MNE) Laboratories on 6/F LI**