

## **SYLLABUS FOR THE DEGREE OF MASTER OF SCIENCE IN ENGINEERING IN BUILDING SERVICES ENGINEERING MSc(Eng)(BSE)**

[This syllabus is applicable to students admitted to the curriculum in the academic year 2017-18 and thereafter.]

### Definition and Terminology

Discipline course – any course on a list of courses in the discipline of curriculum which a candidate must pass at least a certain number of credits as specified in the Regulations.

Elective course – any course offered by the Departments of the Faculty of Engineering for the fulfilment of the curriculum requirements of the degree of MSc(Eng) in Building Services Engineering that are not classified as discipline courses.

Capstone Experience – a 24-credit dissertation which is a compulsory and integral part of the curriculum.

### Curriculum Structure

Candidates are required to complete 72 credits of courses as set out below, normally over one academic year of full-time study or two academic years of part-time study:

<b>Course Category</b>	<b>No. of Credits</b>
Discipline Courses	Not less than 30
Elective Courses	Not more than 18
Capstone Experience	24
Total	72

The curriculum provides advanced postgraduate education in the fields of design, management and operation of modern building services engineering systems to practising engineers or related professionals who wish to acquire new knowledge and keep abreast of technical developments in the building services industry.

Candidates shall select courses in accordance with the regulations of the degree. Candidates must complete i) 8 courses, including at least 3 courses from List A, and ii) a dissertation. They may select no more than 3 courses offered by other taught postgraduate curricula in the Faculty of Engineering as electives. All course selection will be subject to approval by the Course Coordinators.

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The following is a list of discipline courses offered by the Department of Mechanical Engineering. The list below is not final and some courses may not be offered every year.

All courses are assessed through examination and / or coursework assessment, the weightings of which are subject to approval by the Board of Examiners.

## **List A discipline courses**

### **MEBS6000. Utility services (6 credits)**

Cold and hot water supply: water distribution systems, patterns of usage, estimation of requirements, simultaneous demand, storage capacity, pumping arrangements, calorifiers and water heaters; steam systems: low and high pressure systems, boilers and heat exchangers, steam supply piping and condensate return, insulation, steam trapping; drainage systems and sewage disposal: stormwater and sanitary drainage systems, rainfall intensity, simultaneous sanitary discharge, sizing of drains and sewers, methods of sewage disposal, primary and secondary treatments; security system planning and design; security devices.

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### **MEBS6001. Electrical installations (6 credits)**

This course covers the following topics: Supply rules, standards and codes of practice; types of electrical systems; distribution in buildings; factory built assemblies; protective devices and safety interlocks; overcurrent and fault protection; installation design principles; protective earthing and equipotential bonding arrangements; standby generators; electrical safety; distribution transformers; switchgear and fuses; motor control gears; selection of electrical equipment and conductors; lightning protection.

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### **MEBS6002. Lighting engineering (6 credits)**

Lighting physics; vision and light measurements; human perception; photometry and spectrophotometry; colorimetry; calculations of photometric data; glare control; guidelines for lighting design. Light production; artificial light sources and luminaires; daylighting; daylight factor; split flux formula; optical control; interior lighting; maintained illuminance; uniformity; colour rendering; utilization factors; polar curves; vector/scalar ratio; lighting for safety; lighting for workplaces; floodlighting; illuminance as vector; illuminance in complex situations.

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### **MEBS6003. Project management (6 credits)**

Tendering procedure, contract documents and contract strategy, insurance; project planning, scheduling and control. Management and organization theory and practice; human resources development: motivation; leadership, organization structures, quality management; safety management; environmental issues; communication; disputes; delay analysis.

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### **MEBS7012. Air conditioning and refrigeration (6 credits)**

Advanced psychrometry, thermal comfort, load estimation and energy calculation, air conditioning cycles, air conditioning systems: all-air systems, air-water systems, all-water systems; refrigeration: vapour compression cycle, absorption cycle, heat pump cycle; heat rejection: air-cooling, evaporative cooling, cooling tower; ventilation: fresh air requirement, air contamination, fume and dust removal.

Students who have taken and passed MEBS6006 will not be allowed to take MEBS7012.

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### **MEBS7013. Fire service installations (6 credits)**

Fire detection and alarm systems; water-based fire extinguishing systems: automatic sprinkler systems, fire hydrant and hose reel systems, drencher systems; gas-based fire extinguishing systems: CO<sub>2</sub> and

clean agent systems; special fire extinguishing systems; portable fire extinguishers; means of fire escape; fire resisting construction; statutory regulations governing fire services installations: BS Standards, LPC rules, NFPA codes and local codes of practice; installation, acceptance testing and commissioning.

Students who have taken and passed MEBS6009 or MEBS6021 will not be allowed to take MEBS7013.

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### **List B discipline courses**

#### **MEBS6004. Built environment (6 credits)**

External environment: human factors, climatology; internal design criteria; thermal environment (heat): insulation for energy conservation, heat transmission, e.g. solar contribution; visual environment (light): eye and vision, light production, levels of illumination; aural environment (sound or noise): noise criteria for buildings, sources of noise and vibration, noise and vibration control; functional requirement of buildings.

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#### **MEBS6005. Building automation systems (6 credits)**

Principles of building automation systems: objectives and functions; system configurations; central processor and outstations; transducers, sensors and actuators; distributed processing and intelligence; network architecture; hardware and software. Control fundamentals: Laplace and Z transforms, direct digital PID control; control valve performance Microprocessor and electronics fundamentals: architecture of microprocessor systems; digital-to-analog and analog-to-digital conversions; data sampling. Open systems and interoperability: LonWorks; BACnet; IIOT. Implementation and future development: commissioning; maintenance; integration; building emulator; future development trends.

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#### **MEBS6010. Indoor air quality (6 credits)**

Concept of indoor air quality, health requirements, sick building syndrome, building related illnesses, indoor air quality indicators, types, sources, characterization and health effects of pollutants, concentration, individual and population exposure, dose-response relationships, measurement and monitoring methods, ventilation, filtration, indoor air quality assessment and control, operation and maintenance, legislation and public policy issues, energy and cost implications.

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#### **MEBS6011. Maintenance and management of building facilities (6 credits)**

Areas of facilities management; security of facilities; strategies and philosophies of maintenance; optimum control and operation; fault detection and analysis; building pathology; energy management; safety and environmental maintenance. Operational techniques in maintenance: decision making techniques; spares inventory control; resource management; computerized maintenance; measures of maintenance effectiveness. Plant availability, maintainability and reliability.

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#### **MEBS6013. Testing and commissioning (6 credits)**

The commissioning process: design provisions, specification, documentation, planning and management, contractual responsibilities; setting to work; measurement methods: fundamentals, instrumentation, calibration, methodology, sources of error; commissioning tests on electrical and mechanical plants;

balancing of fluid networks; performance testing; post construction evaluation.

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**MEBS6014. Computer modelling and simulation (6 credits)**

Mathematical modelling: modelling of systems; subsystems and components, deterministic and stochastic modelling, steady-state and dynamic modelling, model format, accuracy and validation, applications to thermofluid systems for design, performance evaluation and economic analysis.

Computer simulation: computer implementation of simulation models, simulation methods by successive substitution and Newton-Raphson approach for univariate and multivariate problems, steady-state simulations for system analysis at off-design conditions, dynamic simulations for transient analysis, techniques for simulation of large systems and use of modular computer simulation packages.

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**MEBS6015. Natural and hybrid ventilation of buildings (6 credits)**

Concepts of natural ventilation and hybrid ventilation, mixed-mode air conditioning, purposes of natural ventilation, driving forces, natural ventilation strategies for simple and complex buildings, design methods and guidelines, wind tunnel and small-scale testing, design processes and life-cycle analyses.

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**MEBS6016. Energy performance of buildings (6 credits)**

Energy terms and concepts; energy use in buildings; energy efficient building design and operation; energy efficient technologies; building energy standards and codes; building energy analysis techniques; energy auditing of buildings; economic and financial analyses.

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**MEBS6017. Building intelligence (6 credits)**

Fundamental concepts of intelligent building systems; whole building intelligence; evaluation of building intelligence; needs of occupants, cost effectiveness, economic benefits; engineering intelligence into buildings; information technology; building energy management and control systems; intelligent building design; intelligent controls; expert systems, artificial neural networks, genetic algorithms, fuzzy logic; potential and direction of future developments.

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**MEBS6018. Clean electrical energy and smart-grids for buildings (6 credits)**

Smart-grid and micro-grid models for communities; clean energy sources for smart-grids, disturbance, noise and pollution in smart-grids; power quality regeneration: power conditioning and uninterruptible power supply; interconnection of smart-grids; smart meter management; power factor correction and tariff consideration; building energy codes; lightning protection.

Students who have taken and passed ELEC6095 will not be allowed to take MEBS6018.

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**MEBS6019. Extra-low-voltage electrical systems in buildings (6 credits)**

This course focuses on extra-low-voltage electrical systems: roles, transmission medium and network, modeling, fixed and movable systems; types. Applications in building services: electrical safety; public address system, communication, cable and satellite television, conference and interpretive system, audio and visual system; service integration and automation; system monitoring. Applications in property

management: fire and life-saving management equipment, electronic patrol, car park management, efficiency management, CCTV, security system, access and security control, electronic receptionist. Disturbance; electromagnetic interference and protective measures.

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**MEBS6020. Sustainable building design (6 credits)**

Sustainable building concepts; energy and environmental design; green building assessment methods; sustainable masterplanning; analysis methods for sustainable building projects; practical examples.

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**MEBS7010. Vertical transportation and drive (6 credits)**

Types of vertical transportation systems: lifts, escalators and passenger conveyors; their construction and features of lifts and lift-wells. Mechanical drives of systems: traction, hydraulic, and single/double-wrap. Electrical drives of systems: alternating current versus direct current. Illumination, power and ventilation requirement. Potential hazards and safety management. Prevention of overload and overspeed. Special systems: fireman lift, service lift, stairlift, fireman lift, observation lift, inclined lift, multi-deck lift, public-service escalator, parabolic escalator, and gondola. Traffic calculation and simulation model. Remote monitoring and protocols. Control and adaptive algorithm. Layout of multiple-lift and multiple-escalator. Energy management. Examination, certification and notification.

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**MEBS7011. Communication technology in building services (6 credits)**

Analogue and digital signal encoding; signal transmission systems in buildings; baseband vs broadband; topologies, LAN/MAN/WAN; OSI model, TCP/IP model; wireline and wireless networks; PSTN; key lines, PABX, VoIP; ISDN, DSL, cable modems, FTTH; ISP, voice/data/video convergence; structured cabling; coordination with architects and structural engineers.

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**MEBS7014. Advanced HVAC applications (6 credits)**

Fans and pumps: types and characteristics, parallel and series operation, system effects; complex fluid network analysis: graphical and iterative methods of solution, application to air and water systems and analysis of building air infiltration; room air diffusion: design strategies, application of computational fluid dynamics; sea water cooling systems: design and operation, water treatment; thermal storage systems: applications, system design and economic analysis; acoustic treatment and vibration isolation: basic principles, need for control, types and methods of control.

Students who have taken and passed MEBS6008 will not be allowed to take MEBS7014.

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**MEBS7015. Fire science and smoke control (6 credits)**

Characteristics and behavior of fire; compartment fire: heat release rate, pre-flashover, flashover, post-flashover phases; fire hazards of materials and buildings; means of fire escape; smoke control: active and passive smoke extraction, staircase pressurization, smoke venting, atrium smoke control; statutory regulations governing smoke control installations: BS Standards, NFPA codes and local codes of practice; installation, acceptance testing and commissioning.

Students who have taken and passed MEBS6009 or MEBS6022 will not be allowed to take MEBS7015.

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## **MECH7012. Principles of engineering management (6 credits)**

The focus of this course is on the basic principles, methods, and functions of engineering management. An overview of systems engineering is provided, with coverage on the design and management of an enterprise as an integrated system. The course objectives are: (1) acquire the essential principles of engineering management and understand how to apply these principles in daily practice in industry; and (2) understand and apply methods for managing the operations of engineering companies in the global business environment.

Topics include: systems engineering; core concepts and tools for the management of operations: operations planning and control functions, ERP systems; contemporary topics and approaches in engineering management: supply chain, green management, ethics, corporate social responsibility and compliance, risk and crisis management.

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## **Capstone Experience course**

### **MEBS6023. Dissertation (24 credits)**

It involves undertaking a practical design or research project which integrates the students' knowledge acquired during the course of studies in the MSc curriculum. The project is closely industrial related to the design or analysis of building services systems and it allows students to conduct in-depth review and appreciation of the system performances through technical and economic analysis, analytical investigation, and evaluation for optimal design solutions. The project is group based but with substantial individual student contribution.

The objectives are to: (1) simulate a realistic working environment for students so that they can integrate what they have learnt into a real life work problem; (2) allow students to apply engineering principles, design skills, engineering economics and project management in the delivery of practical and optimized solutions for realistic project works; (3) train students to work in groups while contributing their abilities independently; (4) demonstrate an ability to have in-depth analytical investigation or evaluation for industrial related or research type problems.

Pre-requisite: Students must have taken and passed TWO of following courses before taking this course: MESB6000, MEBS6001, MEBS6002, MEBS6019, MEBS7012, MEBS7013. A co-requisite arrangement may be allowed for full-time students who enroll in this course in their Year 1 of studies.