UNIVERSITY OF LIVERPOOL

DEPARTMENT OF BUILDING ENGINEERING

SHORT SYLLABUS OF COURSES

The following syllabuses summarise in shortened form the content of courses leading to the degree of B.Eng. in Building Engineering, as given during 1980/81. (The information is provided for guidance only and the space devoted here to a statement of course content should not be taken to indicate closely the amount of time devoted to treatment of the material concerned.)

YEAR 1

All students take the following courses:

Mathematics: Differentiation with applications. Partial differentiation. Series, exponential and logarithmic functions. Integration, with applications. Linear differential equations. Vector algebra, complex numbers. Non-linear equations.

Theory and design of structures: Equilibrium of forces in trusses, straight and curved beams. Elastic properties of materials. Deflection and stress in beams. Introduction to indeterminate structures. Stability. Laboratory studies.

Environmental Science (a) Heating: Mechanisms of steady state heat transfer in a room. U values. Ambient temperature. Thermal comfort. Design of a simple hot ewater radiator heating system. Steady state moisture transfer in an enclosure, likelihood of condensation.

b) Lighting: Concepts, terminology, units, measurement. The eye, colour. Illumination by daylight and electric lighting. Daylight factor.

c) Acoustics: Concepts and terminology. Human reaction to noise. Noise sources and noise control.

d) Climatology: Weather patterns. The building as a climate filter. Climatological data. Human comfort. Bioclimatic charts. Microclimatology. Solar gain.

e) Energy: Definitions, types. The world energy problem. Methods of reducing consumption. Energy and the built environment.

Mechanical Engineering Basic concepts. Hydrostatics. First and second laws of thermodynamics. Fluid motion. Viscosity. Equations of continuity, momentum and energy. Dimensional analysis. Flow past bluff shapes including buildings. Flow through ducts. Laboratory studies.

Construction Materials: Choice of materials in developed and developing countries. Concrete: mix properties, durability, handling. Steel: production, properties, corrosion, welding. Polymers. Timber: production, strength, durability, preservation, decay, jointing, lamination. Brickwork: bricks and mortar, properties, durability, thermal and moisture effects, appearance. Laboratory studies.

Building Construction: Functional requirements such as strength, stability, durability. Thermal, lighting and sound requirements, fire protection etc. Site assessment. Review of construction details of floors, walls etc. 1 week surveying course.

✓ Graphic communication and design: (Drawing office work). Communication through use of points, lines, colour, lettering, etc., sketching design, the design brief, initial sketches, preparation of working drawings, projections.

Year 2

All students take the courses in Mathematics, Numerical Methods and Statistics, Principles of Building Construction I, Principles of Building Services, and Industrial Engineering I.

Students specialising in Construction Engineering take the courses in Theory and Design of Structures, Structural Concrete and Soil Mechanics.

Students specialising in Services Engineering take the courses in Fluid Mechanics and Heat Transfer in Buildings I.

✓ Mathematics: Linear algebra, vector spaces, matrix multiplication, determinants. Linear differential equations, eigenvalues, superposition, with applications. Partial differentiation, Taylor's theorem. Multiple integration, moments of inertia. Vector calculus. Partial differential equations with applications. Fourier series.

✓ Numerical methods and statistics: Methods of solution of linear equations. Latent roots, vectors. Methods of solution of partial differential equations, finite difference approximations. Concept of probability, probability models, sampling, students t-distribution.

✓ Principles of Building Construction I: Production. Demolition, scaffolding, etc. Site organisation. Safety. Construction. Choice of structural form/shells, frames etc. Precast construction. Condensation risks. Air flow round buildings and wind loading. Fire: behaviour of elements, structural protection, means of escape, legislation. Materials in relation to their function in buildings. Drawing office classes.

✓ Principles of Building Services: Historical introduction: philosophy, hardware and requirements of thermal services. Passive control with minimal services. Control of noise in heating and similar systems. Control of corrosion. Electrical services: terminology, basic electrical principles, distribution systems, grid and emergency supplies, telecommunications, regulations.

✓ Industrial Engineering I: Company formation and growth, use of capital, business ratios, stocks and shares. Structure of building industry, relationships and types of contract between industry and clients. Means of increasing productivity: work study, ergonomics, planning and programming. Cost aspects and finance. Laboratory classes.

✓ Theory & Design of Structures: Elastic analysis of statically indeterminate structures, instability, plastic analysis of structures, energy theorems and applications to determinate and indeterminate structures, etc., influence lines. Laboratory studies.

✓ Structural concrete: Composite action of steel and concrete, elastic behaviour of reinforced concrete, limit state design of r.c. beams, columns, slabs, foundations, retaining walls. Precasting. Drawing offices classes.

✓ Soil Mechanics: Relations between basic properties of soils. Fundamental differences between clays, silts and sands. Soil classification. Permeability v. compressibility. Effective stress and pore pressure. Shear strength. Earth pressures. Stability of foundations. Stability of slops. Laboratory classes.

Fluid Mechanics Internal viscous flows: basic relations, laminar and turbulent pipe flow, mixing length, minor losses, emptying of vessels. Compressible flow: compressibility, Mach number, steady I.D. flow, flow through a convengent-divergent nozzle, normal shock wave. Incompressible flow: equations for 2D flow, irrotational and rotational flow, simple fluid flow by superposition. Labcratory studies.

Heat Transfer in Buildings: Steady conouction, conductivity, heat flow along a bar, through slabs and insulated pipes. 2D heat loss from a floor. Convection: the physical processes, stack effect, heat transfer from a slab by dimensional and mechanistic methods, cavities. Radiation: physical processes, Steffan's law, absorptivity, exchange in enclosures. Thermal circuits. Steady state heat loss. Solar radiation, angle of incidence, intensity. Water vapour: physical processes, the saturated vapour pressure curve, moisture content of building materials. Heat exchangers and solar collectors. Laboratory studies. Design project.

Year 3

All students take the courses in Principles of Building Construction II, and Industrial Engineering, and take part in a Group Project.

Students specialising in Construction Engineering take 3 of the 4 following courses: Theory and Design of Structures, Structural Concrete, Soil Mechanics Structural Steelwork.

Students specialising in Services Engineering take the courses in Heat Transfer in Buildings I', Thermal Services Engineering, Lighting Engine ing and Acoustic Engineering.

Students who wish to be considered for an Honours Degree present a dissertation.

✓ Principles of Building Construction II: Communication by drawings, dimensional coordination, tolerances, performances specification. Joints, flat roofs and moisture control. Insulation of roofs, basements. Structural and component failures. Interplay of design and production floor finishes. Industrial building systems. Drawing offices classes.

✓ Industrial Engineering II: Personnel Management. Industry and the law. Working relationships in industry. Factors affecting productivity in building, economics of mechanisation, industrialisation and pre-fabrication. Costing and management of plant. Cost planning and control. Organisation and management of maintenance. Labour. Costs-in-use.

✓ Theory and Design of Structures: Flexibility method of structures analysis: basic concepts, varying section structures. Stiffness method, basic equations and thermal effects. Finite element method: basic concepts, plate bending, applications. Rigid plastic design of frame works: collapse mechanisms, graphical methods.

✓ Structural Concrete: Prestressed concrete: pre- and post- tensioning. analysis and design of simply supported beams, end blocks. Liquid retaining structures. Composite construction in concrete and steel. Limit state design topics. Strength assessment of concrete structures in situ. Laboratory studies.

✓ Soil Mechanics: Seepage through and under dams. Pore pressure evaluation. Stress distribution and settlement. Earth pressures and design of retaining

structures. Piled foundations. A stress strain model for soil. Design work and laboratory studies.

Heat Transfer in Buildings II: The environmental temperature procedure as a design tool. Sinusoidal heat transfer properties of a multilayer construction and an enclosure. The transient heat transfer properties of a slab and an enclosure. The basis of the environmental temperature procedure. Moisture movement. Thermal comfort: heat transfer considerations, Fanger's work, laboratory and field studies.

Thermal Services Engineering: Hydronic circuits. Heating systems: methods and economics. Air conditioning: properties of a water vapour air mix, sensible and latent cooling, design process for various systems. Air distribution in rooms, fan and system considerations. Refrigeration and heat pumps and their application to thermal services. Controls: definitions, systems, applications. Laboratory studies.

Lighting Engineering Decisions in building design. Criteria for electric lighting schemes, future trends. Laboratory studies.

Acoustical Engineering: Sound insulation in buildings, control of traffic and other outdoor noise. Vibration isolation. Control of noise in heating and ventilating systems: criteria, sources, control methods. Laboratory studies.

✓ Dissertation This reports a study of some topic, to be chosen by the student, in the field of building engineering. (The dissertation does not exceed 50 pages in all.)

✓ Group Project: A projec involving the design of constructional and services aspects of a moderately complex building. The project forms the major part of the Course Work in the year. It is intended to emphasise the need for good management in the design process and to show the necessity for co-operation and compromise between the professional disciplines involved.