ARCH 1201.01: "Science of the Built Environment 1". (10100)

(Soft copy can be found in BrightSpace, in the contents section under handouts.)

Course Duration:	**Fall Term Sept. 4th, to Dec. 4th., 2024**
Course Location	**Ralph Medjuck Bldg. Room B102**
Lecture Times:	**Wednesdays 2:30 PM (1st Class Sept 4th. Last class Dec 4th)**
Lecturer	**Douglas Pitcairn B.Sc.**
Office: School of Architecture.	**Room HA-31 (Arch Building, faculty area, under the stairs)**
Office Hours	**Prior to class, (roughly 1:00 pm on)**
E-mail (preferred)	**douglas.pitcairn@dal.ca or thepitcairns@ns.sympatico.ca**
Phone: (by prior permission)	**n/a**
Brightspace	**Partially utilized (for quizzes and content distribution only).**

Calendar Description.

ARCH 1201.01: Science of the Built Environment 1

This course introduces a broad range of scientific principles about the relation between modern buildings and their interior environment. Topics include light, heat, sound, electricity, and fire. It uses a "common-sense" approach involving graphic images, practical understanding, and problem-solving. A background in mathematics or science is not required.

CREDIT HOURS: 3

FORMAT: Lecture

Additional Course Description.

Architecture has always been a technologically supported endeavour. Our ability to construct comfortable living spaces that reflect our status and culture continues this trend, as increasingly sophisticated technologies are finding their way into all buildings. Modern houses now include many complex innovations once reserved for only the most advanced buildings. Yet for much of the world, the crushing need for basic shelter continues to be paramount. We will see that technology has the potential for both comfort and simplicity, and perhaps make a case that both are desirable.

This course will examine some common technologies found in the latest buildings and the principles behind these systems. The intention is to instil in students a targeted yet broad science knowledge base, to introduce and explain most of the relevant topics, and encourage further thinking about potential solutions for shelter.

The Class will attempt to use a common sense approach involving graphics, practical understanding and (hopefully) some actual scientific thinking. This course is classroom/lecture based, with study material

provided. There may be suggested readings, but no official textbook. There is, however, a complete set of study notes covering the entire course. These will make up the material for your review for the tests.

COVID NOTE: Aside from the general covid precautions, This course has been recorded and is available for distribution, delivered by Google drive links. This provides us with a complete backup system should the University have to "go online" again. So you will be able to finish the class and receive your grade regardless of covid developments.

A background in science or mathematics is not necessary, indeed, the class assumes you have very little if any science background. Mathematics is used sparingly, and usually in the form of graphs and diagrams. The course is qualitative in both description and assignments required. Class discussions will be encouraged. A sense of humour is useful as always.

Grading will consist of 2 (or 3?) minor assignments together worth %50, and two tests worth 50%. Access to reliable email is important in this class. You must have an active e-mail account. I will use your Banner email address, so be sure to monitor it regularly.

Assignments will be posted in BrightSpace. 'Handin' of assignments and assignment feedback (grades and comments) are done via direct email between the instructor and the student. I would ask that you use a consistent subject line with the course, your name and the reason for the email... like this:

" **Subject:** Arch 1201 Harry Potter a question "

It has always been true that class attendance will give a better result. Your paying good money for these lectures, try to attend them all. I will do my best to give you a memorable and informative lecture, and together we shall investigate this complex field of study.

There is no formal class schedule, the following list of topics is followed closely on a linear basis. Time on each subject can vary with students interest.

Topics List:

Intro Class
Sciences' place in the modern world.

Art and science in Architecture, a synergetic antithesis.
Dependent yet exclusive.
"Shelter most basic" class discussion / exercise

Science's necessity given the population.
The Pandemic response, an obvious example?
The global rise in standard of living attributable to scientific knowledge?
Technology History
Energy Consumption / Pollution
Food Production / Standard of Living
Human Life Expectancy*

The Scientific Principle, A Path to Knowledge.

A process to determine the truth.
    Systematic, repeatable, logical, peer reviewed
Math vs English, Communication of ideas...
Scientific models.
    Solar/Earth interior
    Baby in womb ultrasounds.
    Meteorological models
    Building airflow models, thermal performance models and acoustical models.

Resources and Limitations

The "God Ol' Days... Perceptions of the Past through Rose Coloured Glasses"
Building with less for more. A quick overview
        Embodied energy
        Durability as a resource.
        Energy consumption
Conservation versus resource exploration
        Making do versus buying new
        Samples for Discussion:
            Oil & Gas/Cropland/Helium /Sand
Information technology
        Information overload.
        Technological solution or problem?
        Backups/Data Life span (Keeping what you need, till you need it.)

A Little Physics goes a long way.

Atomic structure Tiny bits on which it all depends...
    Molecules, Atoms, Protons to Quarks,
    Atomic structure
    Four Forces of Nature (The 4 fundamental forces which explain everything.)
        Electromagnetism
        The Nuclear Brothers
        Newton & Motion & Gravity
        Einstein
    Electromagnetic Theory+
        Nature of Light
        Waves vs Particles
        Light and Colour
        White light & why
        Absorption/emission?
    The Other Bands+
        Infrared
        Ultra Violet
        Radio
        X Rays
        Gamma
    Danger/Temp/Energy/ Wavelength
    Blackbody radiation in general.
    Blackbody radiation in Architecture:
    Spectral Lines
        Emission and Absorption

Colour

Rainbows and Fly's Wings Our Colored World.
    Colour Theory from Newton to Martha Stewart.
        Physics of colour.

- Human Vision and colour.
- Reflected versus transmitted (Usually both)
- Colour in the natural world
  - Blue Sky, Red Sun
  - Rainbows
  - Furys Wings and others
  - Stability of colour
- Colour in emission, colour in absorption.

Colour in Architecture.

Lighting

Lighting in the Built Environment.

- Artificial Lighting.
  - A bit of History
    - Fires of various origins.
    - Window panes.
    - Gas Lighting
    - Electric the light fantastic.
  - Types of Lamps
    - Incandescent
    - Fluorescent
    - Arc Discharge Lighting
    - Neon, LED other.
  - Lighting costing.
    - Switches, lamps and watts.
    - Lumens. Lux and Candelas CRI
    - Fixture efficiency.
    - Reflectance (thus colour) as a cost item.
  - Colour perceptions and Psychology of light.

  - Artificial vs natural
    - Daylight and sunlight.
    - Helidon
    - Lighting Levels
    - Lighting aesthetic.
      - Texture
      - Geometry
        - Position
        - Glare

Materials for Building

Wheels and Levers, Bricks and Sticks...

- Energy and Power , Some Thermodynamics, (but just a bit).
- Energy converted and conserved
  - Pendulum
  - Power generation path.
  - Perpetual motion
  - Levers, Gears, Clocks
- Motion Heat and Friction.
- Efficacies and losses. Waste Heat

Construction, Some Design Issues for the Built Environment.

- Material Characteristics
  - Suitability
  - Cost
  - Availability
  - Sustainability

Durability
Embodied energy
Recyclability
Combustibility
Toxicity

Strength of Materials.
Compression and Tension
Load Transfer as a concept. Static and Dynamic
Aesthetics
Roofing by way of example
WaterProof
UV troubles.

Some Building Materials.
Natural vs Man Made A Brief History
Fabric
Mud n Clay
Rock
Thatch n Brush
Ice
Wood
Concrete
Metal
Glass
Plastics
Foams
Composites

Vibrations, Physics of sound.

Simple Harmonic Motion
Restoring force
Frequency and Wavelength,
Amplitude and Decibels
Spectrum concept.
Resonance
General /Tidal / Tuning Forks / Speakers / Rooms
Human Perceptions
One mans music, another's noise.
Noise as a comfort... a resource?
Physiology
Psychology

Noise Control

Exterior Sources
Buildings, Berms and Trees
NC ratings / Volume over Time
Keeping out the Sound
STC ratings
Mass / Isolation / Integrity
Infiltration
Muffling/Vibration isolation
Active and passive masking

Enclosed Space Acoustics

Good acoustics defined
The behavior of Sound in an enclosed space.
Reflections from a plane / curves / corners.
Dispersion

- Shadows / diffusion
- Sound Reinforcement
  - Room shape, reflectors, electronics
- Sound Dispersion
  - Discrete Echo avoidance.
- Sound Absorption.
  - In the Air / Surfaces / Furnishings / Audience
- Measurement of absorption.
- Reverberation
  - Loudness / absorbency / volume
- Sabine Standard.
- Calculating Reverb time.

Electricity

- Electrons in motion.
  - A bit of Physics.
  - Some Definitions
    - Voltage
    - Current
    - Resistance/ water model
    - Conductors / Insulators
  - AC/DC back and forth
  - A bit of History
  - Power supplies by way of example
  - Power Grids and Transmission Lines
  - Distribution Grids.
  - Power Distribution in Buildings
    - Domestic / Commercial
    - Panels
    - Master Switches
    - Fuses/breakers
    - Wires

Fire and Buildings

- Combustion
  - Basic Chemistry
  - Oxygen, fuel and ignition
  - History of Fire
  - Building materials
    - Surface combustibility
    - Fuel volume
    - Volatility
  - Behavior of Fire in structures.
    - Radiant ignition
    - Flashback
    - Stack Pressure
  - Alarms and Detectors
  - Extinguishers+
    - Types 1 to 4
  - Fire Code (NFC of Canada 1995 addendum 2005)
    - Exit strategies
    - Material restrictions
    - Structural protection
    - Alarms and Sprinklers

Accommodation

Students may request accommodation as a result of barriers related to disability, religious obligation, or any characteristic under the Nova Scotia Human Rights Act. Students who require academic accommodation for either classroom

participation or the writing of tests and exams should make their request to the Advising and Access Services Centre (AASC) prior to or at the outset of the regular academic year. Please visit www.dal.ca/access for more information and to obtain the Request for Accommodation - Form A