Lectures: M-W-F 12.30-1.20pm, room MC4058
Tutorials: TBD

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Objectives
• To provide the standard concepts of differential geometry and tensor formalism.
• To present the main ideas behind the inception of General Relativity and its main physical predictions (gravitational redshift, bending of light…).
• To explore physical features of key space-times: Minkowski space-time (Special Relativity), Schwarzschild space-time (black-hole), Friedman-Robertson-Walker space-time (cosmology).

Prerequisite Background
AMATH 261/PHYS 263. Fourth year standing is required since the course will require an appropriate level of maturity.

Textbook
No specific textbook, but many can be found on LEARN.

Final grade
For PHYS476 and AMATH475, it will be calculated using the following weighting:
• Assignments: 20%
• Mid-term exam: 30%
• Final exam: 50%.

For AMATH675, it will be calculated using the following weighting:
• Assignments: 20%
• Mini project: 20%
• Mid-term exam: 20%
• Final exam: 40%.
You need to contact me to do the mini-project.

The dates and times of the exams are to be determined.

Assignments
Every two weeks some assignment will be handed out.
Course Outline

Introduction:
Historical recap.

Mathematical framework:
• Tensor formalism.
• Elements of Special Relativity as a first example to practice the use of tensors.
• Differential Geometry:
  o Manifold, metric
  o Connection, curvature

General Relativity:
• Einstein equations.
• Solutions of Einstein equations:
  o Schwarzschild metric
    ▪ Gravitational redshift
    ▪ Perihelion precession
    ▪ Black hole
  o Friedman-Roberts-Walker metric
    ▪ Cosmology
Note for students with disabilities
The Office for Persons with Disabilities (OPD), located in Needles Hall, Room 1132, collaborates with all academic departments to arrange appropriate accommodations for students with disabilities without compromising the academic integrity of the curriculum. If you require academic accommodations to lessen the impact of your disability, please register with the OPD at the beginning of each academic term.

Avoidance of Academic Offenses
Here is the University Policy regarding academic offences, i.e. cheating: In order to maintain a culture of academic integrity, members of the University of Waterloo community are expected to promote honesty, trust, fairness, respect and responsibility. For more information check: www.uwaterloo.ca/academicintegrity/

A student is expected to know what constitutes academic integrity to avoid committing academic offenses and to take responsibility for his/her actions. A student who is unsure whether an action constitutes an offense, or who needs help in learning how to avoid offenses (e.g., plagiarism, cheating) or about rules for group work/collaboration should seek guidance from the course professor, academic advisor, or the undergraduate associate dean. For information on categories of offenses and types of penalties, students should refer to Policy 71.

Student Discipline:
www.adm.uwaterloo.ca/infosec/Policies/policy71.html
For typical penalties check the Guidelines for the Assessment of Penalties:
www.adm.uwaterloo.ca/infosec/guidelines/penaltyguidelines.htm
A decision made or penalty imposed under Policy 71, Student Discipline may be appealed if there are grounds. A student who believes he/she has a ground for an appeal should refer to Policy 72, Student Appeals:
www.adm.uwaterloo.ca/infosec/Policies/policy72.htm