Assignment 1:

TRANSLATION TASK (IMPORTANT INSTRUCTION):
Translate the following text from English into Serbian.
Preserve meaning, scientific terminology, and paragraph structure as closely as possible.

EXCERPT FROM BOOK:
General Relativity: Basic and Beyond, p. 63

The current constituents (at least some of these) notably various nuclei and atoms can thus be thought of as being made up during the evolution of the universe. The idea is also attractive from another point of view. If we assume the components of the soup to be in thermal equilibrium, then we can understand how the matter distribution came to be largely homogeneous and isotropic. Can we build a detail picture of this cooking process? Amazingly, the answer turns out to be YES and we obtain a Thermal History of the universe.

We begin by assuming that at some early epoch, the universe consisted of (anti) nucleons, (anti) leptons and photons at some high temperature T. We know that current universe has atoms of various elements and photons. We are assuming that these (at least some of lighter elements) got formed during the expansion of the universe. The question we want to understand is: What determines the products and their abundances during the formation process? For this we must note a few points.

The abundances of various products will be correlated and possibly fixed if the products were in thermal equilibrium at some epoch. To realize and maintain an equilibrium, there must be processes (interactions) among these different species of matter. These have some reaction rates typically proportional to the average speed, the total cross-section and the number densities (just from the definition of a cross-section). These quantities are also functions of the equilibrium temperature and the chemical potentials of the species. However, the universe expands at a certain rate making the temperature fall at some rate making the reaction rates also to fall at some rate. As long as the reaction rate is higher than the expansion rate, thermal contact will be present and equilibrium will be maintained. If however reaction rate falls below the expansion rate, the reaction effectively ceases and thermal contact between the species is broken.

As the universe decelerates, the reaction rates fall faster than the expansion rate thereby switching off some reactions. The number densities (or abundances) of the participants are thus frozen at the values at this cross over time (temperature). Starting with certain number of species with mutual interactions of different types, it is possible that different species will freeze out at different epochs generating different abundances. We thus see a mechanism of generating different products as well as their relative abundances. The task is to determine the details.

Let us note another qualitative feature that can be expected. At sufficiently high temperature, we expect a gas of interacting charged (+ neutral) particles together with photons. Let us momentarily call all particles other than photons as “matter” and imagine an epoch wherein there was an equilibrium between matter and photons.

Assignment 2: THE INTEGERS

We built up most of the basic properties of the natural number system, but we have reached the limits of what one can do with just addition and multiplication. We now introduce a new operation, subtraction, but to do this properly we must move from the natural numbers to a larger system: the integers.

Informally, integers are what you get by subtracting two natural numbers. For example, 3 - 5 and 6 - 2 should be integers.

However, this is not a complete definition because:

(a) It does not explain when two differences are equal (e.g. why 3 - 5 = 2 - 4, but 3 - 5 != 1 - 6).

(b) It does not explain how to perform arithmetic on differences (e.g. how to add 3 - 5 and 6 - 2).

(c) It is circular because subtraction is used before it is defined.

From algebra we know:

a - b = c - d if and only if a + d = c + b.

Also:

(a - b) + (c - d) = (a + c) - (b + d)

(a - b)(c - d) = (ac + bd) - (ad + bc)

We therefore define integers using only addition.

To avoid circularity, we introduce a new notation:

Instead of writing a - b, we treat it as a formal expression a - b where the dash is just a symbol, not real subtraction.

Definition 4.1.1 (Integers)

An integer is an expression a - b where a and b are natural numbers.

Two integers are equal if and only if:

a - b = c - d if and only if a + d = c + b.

Let Z be the set of all integers.

Example:
3 - 5 = 2 - 4 because 3 + 4 = 2 + 5.

But 3 - 5 != 2 - 3.

We must check this is a valid definition of equality (reflexive, symmetric, transitive, substitution).

We define operations:

Definition 4.1.2

Addition:
(a - b) + (c - d) = (a + c) - (b + d)

Multiplication:
(a - b)(c - d) = (ac + bd) - (ad + bc)

We must verify these are well-defined (they do not depend on representatives).

Lemma 4.1.3

Addition and multiplication are well-defined: replacing equal integers does not change results.

The proof uses algebraic manipulation of natural numbers.

We embed natural numbers into integers by:

n = n - 0

So natural numbers are identified with integers of form n - 0.

Negation:

Definition 4.1.4

-(a - b) = (b - a)

So:

- n = 0 - n

Trichotomy:

Every integer x is exactly one of:
(a) 0
(b) a positive natural number
(c) the negative of a positive natural number

Thus integers are either positive, zero, or negative.

Algebra laws:

$x + y = y + x$
$(x + y) + z = x + (y + z)$
$x + 0 = x$
$x + (-x) = 0$
$xy = yx$
$(xy)z = x(yz)$
$x(y + z) = xy + xz$

Subtraction is defined as:

$x - y = x + (-y)$

Cancellation law:

If $ac = bc$ and $c != 0$, then $a = b$.

Order:

$n >= m$ if $n = m + a$ for some natural number a.

Key properties:

- order preserved by addition
- order preserved by multiplication (positive case)
- negation reverses order
- trichotomy: exactly one of $a>b$, $a<b$, $a=b$

Assignment 3. Translate into Serbian the excerpt from the story ‘BLUE CLAY BLUES

By Gwyneth Jones

At the same moment Johnny understood that the truck, which he’d taken to be a mere accidental prop, was here on purpose. A chill and horror of excitement ran through him. He was afraid he was shivering visibly—but in fact he’d have had some excuse because just then the rain arrived. It fell over the whole scene like a roll of silk tossed down, as purple as it had looked on the horizon: scented and cold and shocking.

“What’s your name, boy?”

“Johnny.”

“What d’you do?”

“Uh—I’m an engineer.”

“Looking for work? We could find you some. You need a wife to go with that kid. We got women too.”

This banter didn’t mean anything. Johnny had discovered that everywhere you go in the boondocks, people will invite you to stay. It seemed a point of etiquette to regard any chance comer as a potential addition to the community. It wasn’t something to worry about, no more than the equal number of brief acquaintances who invited you to take them home, see their kids through college, advance the capital for them to set up in business. Banter covered the positioning of the truck, the chaining up of Johnny’s car, all under the hammering of the purple rain. Johnny, expressing decent but not effusive gratitude, got into the back with Bella, who woke as the car was being winched onto the flatbed. She didn’t speak or wail but stared all around her mightily. He could tell she’d been dreaming.

“It’s okay, Bel. The car broke down. These people are giving us a ride into town.”

“Daddy, why are you wet?”

“It’s raining.”

Bella stared with eyes like saucers, and dawning appreciation of this new means of transport, this audience, this adventure. The bikers peered

Task for the student:

Translate the entire passage from English into Serbian, preserving the tone, dialogue, and meaning as closely as possible.