Postgraduate Certificate
General Relativity and Cosmology

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Postgraduate Certificate
General Relativity and Cosmology

- Modality: **online**
- Duration: **6 weeks**
- Certificate: **TECH Global University**
- Credits: **6 ECTS**
- Schedule: **at your own pace**
- Exams: **online**

Website: **www.techtitute.com/us/engineering/postgraduate-certificate/general-relativity-cosmology**

Index

01

Introduction

In order to understand Cosmology, the formulation and subsequent development of the Theory of Relativity was necessary. Thanks to their understanding, much more accurate results can be obtained from the electromagnetic signals sent from satellites circling the Earth's orbit. These advances undoubtedly require a profound theoretical knowledge on the part of specialists who wish to develop projects. For this reason TECH Global University has created this 100% online program for professionals who will delve into the principles, postulates of this theory and the mathematical studies necessary to enter the primitive universe. All this will be possible thanks to the most advanced content and multimedia resources developed by specialists in this field.

Enroll now in a Diploma that will give you the most relevant knowledge about General Relativity and Cosmology"

The theory of relativity published by Albert Einstein in the early 20th century not only changed physics, but also the way we understand the universe around us, from the orbit of planets to black holes. In addition, it has allowed the development of much more accurate GPS satellites. An essential knowledge to be able to create other disciplines, devices or equipment that must take into account the principles that govern the referential systems.

In this scenario, the engineering professional must have a solid knowledge of General Relativity and Cosmology, in order to contribute from the theoretical and technical point of view in the construction of projects where this theory is applied to high energy or astrophysical phenomena. That is why this academic institution has created this Diploma, where in only 6 weeks you will be able to obtain the most advanced information on this field.

For this purpose, students will be provided with innovative didactic materials that will introduce them to the postulates of special relativity, the equivalence principle, the motion of particles in the gravitational field or curved spacetime. In addition, the case studies provided by the specialized faculty of this degree program will provide a more practical approach to this teaching. Also, with the Relearning system, you will be the graduate to reduce the hours of memorization and of study normally spent in other methodologies.

TECH Global University offers the professional an excellent opportunity to study a university program in a convenient and 100% online format. All you need is an electronic device (computer, tablet or cell phone) with an Internet connection to access, at any time, the syllabus available in the Virtual Campus. This Diploma is therefore an ideal academic option for those who wish to pursue a quality education compatible with the most demanding responsibilities.

This **Postgraduate Certificate in General Relativity and Cosmology** contains the most complete and up-to-date program on the market. The most important features include:

- Practical case studies are presented by experts in Physics
- The graphic, schematic, and practical contents with which they are created, provide scientific and practical information on the disciplines that are essential for professional practice
- Practical exercises where the self-assessment process can be carried out to improve learning
- Its special emphasis on innovative methodologies
- Theoretical lessons, questions to the expert, debate forums on controversial topics, and individual reflection assignments
- Content that is accessible from any fixed or portable device with an Internet connection

You are facing an excellent opportunity to progress with firm steps in your career as an engineer through a 100% online and flexible education”

You will get all the knowledge you need to understand the expansion of the universe through the Friedmann equations"

In 6 weeks you will master the keys to General Relativity and its application in projects in the field of astrophysics.

Thanks to this teaching you will master the key concepts of scalar, vector and tensor fields.

The program's teaching staff includes professionals from the sector who contribute their work experience to this educational program, as well as renowned specialists from leading societies and prestigious universities.

Its multimedia content, developed with the latest educational technology, will provide the professional with situated and contextual learning, i.e., a simulated environment that will provide an immersive education programmed to learn in real situations.

This program is designed around Problem-Based Learning, whereby the professional must try to solve the different professional practice situations that arise throughout the program. For this purpose, the student will be assisted by an innovative interactive video system created by renowned experts.

02

Objectives

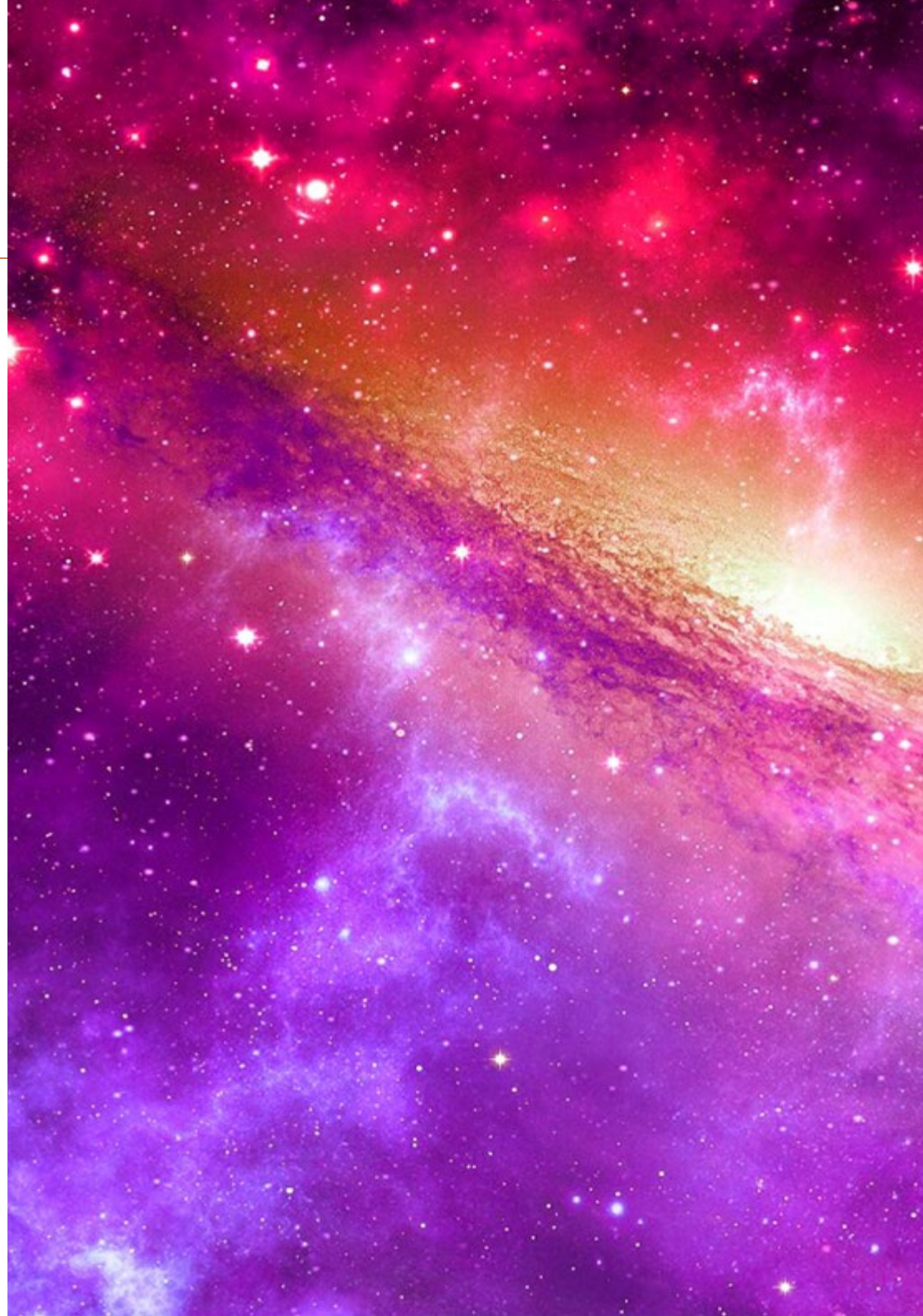
The syllabus of this university degree will allow students to achieve in only 6 weeks, an advanced and intensive knowledge of General Relativity and Cosmology. For this purpose, TECH Global University offers educational tools that will provide, from a theoretical-practical approach, the necessary notions to be able to understand this subject and apply it in their professional field in the engineering sector.

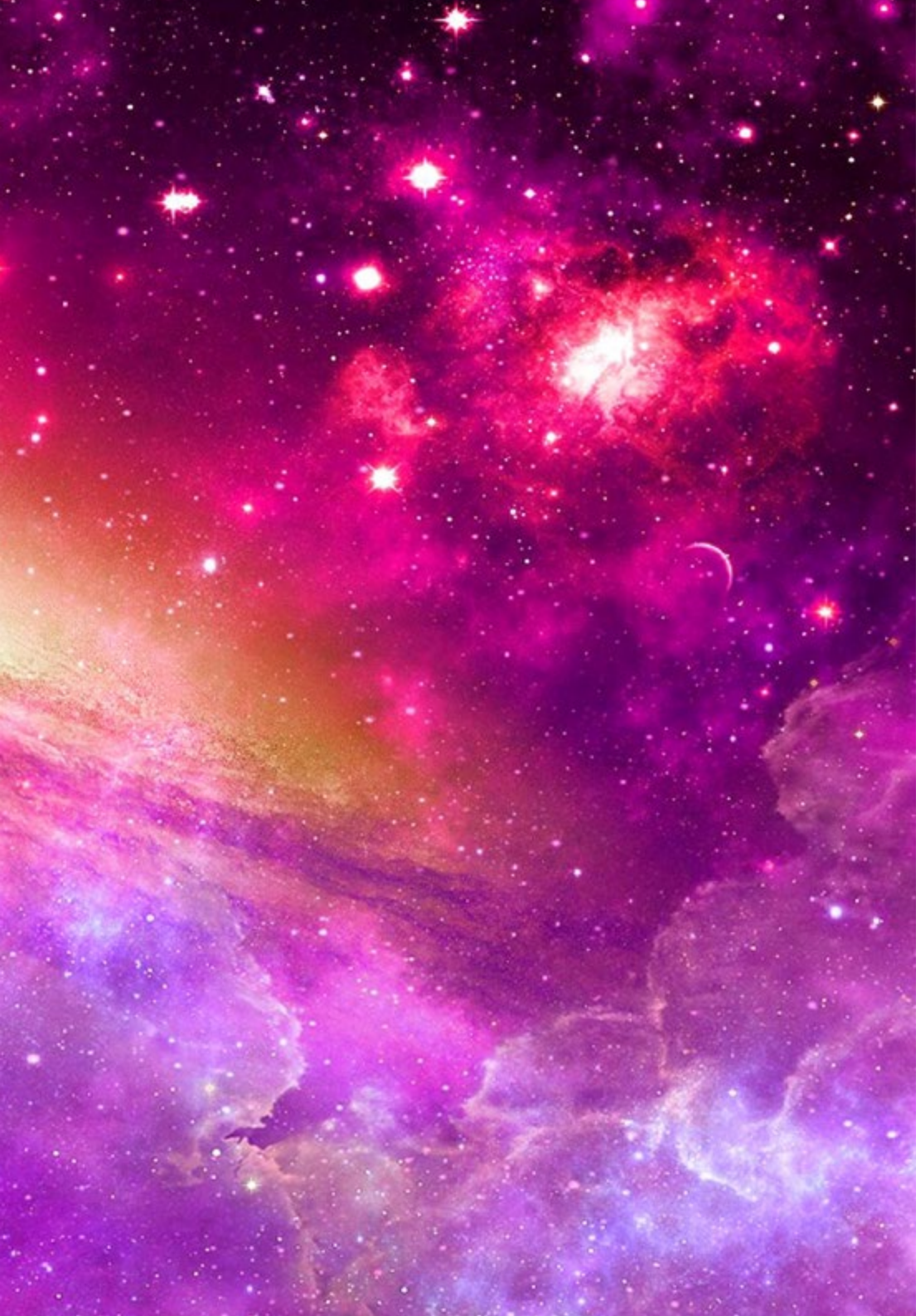
The Relearning method, based on the reiteration of content, will allow you to better assimilate the concepts and reduce the long hours of study"

General Objectives

- Acquire basic notions of general relativity
- Achieve basic knowledge of cosmology and the primitive universe

Do you want to understand particle motion in gravitational fields? This university education will give you the answers. Enroll now"





Specific Objectives

- Know the Einstein's equations in tensor format
- Understand the motion of particles in gravitational fields
- Apply knowledge of calculus and algebra to the study of gravity using the theory of general relativity

03

Course Management

This academic program includes the most specialized teaching staff in the current educational market. They are specialists selected by TECH to develop the whole syllabus. In this way, starting from their own existence and the latest evidence, they have designed the most up-to-date content that provides a guarantee of quality in such a relevant subject.

TECH offers the most specialized teaching staff in the field of study. Enroll now and enjoy the quality you deserve"

International Guest Director

Dr. Philipp Kammerlander is an experienced expert in quantum physics, with high prestige among members of the international academic community. Since joining the Quantum Center in Zurich as Public Program Officer, he has played a crucial role in the creation of collaborative networks between institutions dedicated to quantum science and technology. Based on his proven results, he has assumed the role of Executive Director of that institution.

Specifically from this professional work, this expert has been involved in the coordination of various activities such as workshops and conferences, collaborating with various departments of the Swiss Federal Institute of Technology in Zurich (ETH). He has also been instrumental in fundraising and in the creation of more sustainable internal structures that help the rapid development of the functions of the center he represents.

In addition, he addresses innovative concepts such as the theory of quantum information and its processing. On these topics he has designed curricula and led their development in front of more than 200 students. Thanks to his excellence in these areas, he has received notable distinctions such as the Golden Owl Award and the VMP Assistant Award that highlight his commitment and ability in teaching.

In addition to his work at the Quantum Center and ETH Zurich, this researcher has extensive experience in the technology industry. He has worked as a freelance software engineer, designing and testing business analytics applications based on the ACTUS standard for smart contracts. He has also been a consultant at abaQon AG. His diverse background and significant achievements in academia and industry underscore his versatility and dedication to innovation and education in the field of quantum science.

Dr. Kammerlander, Philipp

- Executive Director of the Quantum Center Zurich, Switzerland
- Professor at the Swiss Federal Institute of Technology Zurich, Switzerland
- Manager of public programs between different Swiss institutions
- Freelance Software Engineer at Ariadne Business Analytics AG
- Consultant at abaQon AG
- Doctorate in Theoretical Physics and Quantum Information Theory at the ETH Zurich
- Master's Degree in Physics at the ETH Zurich

Thanks to TECH, you will be able to learn with the best professionals in the world"

03

Structure and Content

Video summaries, outlines, videos in detail or complementary readings will be key in the learning of students who immerse themselves in this university degree. Thanks to these resources, the graduate will be able to go deeper into spatial relativity and the understanding of Cosmology or the thermodynamics of the early Universe whenever he/she wishes and in a much more agile way. In this way, you will achieve your objectives of career progression through solid knowledge.

A curriculum that will take you comfortably from space relativity to the thermodynamics of the early Universe. Enroll now"

Module 1. General Relativity and Cosmology

1.1. Special Relativity
- 1.1.1. Postulates
- 1.1.2. Lorentz Transformations in Standard Configuration
- 1.1.3. Impulses (Boosts)
- 1.1.4. Tensors
- 1.1.5. Relativistic Kinematics
- 1.1.6. Relativistic Linear Momentum and Energy
- 1.1.7. Lorentz Covariance
- 1.1.8. Energy-Momentum Tensor

1.2. Equivalence Principle
- 1.2.1. Principle of Weak Equivalence
- 1.2.2. Experiments on the Weak Equivalence Principle
- 1.2.3. Locally Inertial Reference Systems
- 1.2.4. Equivalence Principle
- 1.2.5. Consequences on the Equivalence Principle

1.3. Particle Motion in the Gravitational Field
- 1.3.1. Path of Particles under Gravity
- 1.3.2. Newtonian Limit
- 1.3.3. Gravitational Redshift and Tests
- 1.3.4. Temporary Dilatation
- 1.3.5. Geodesic Equation

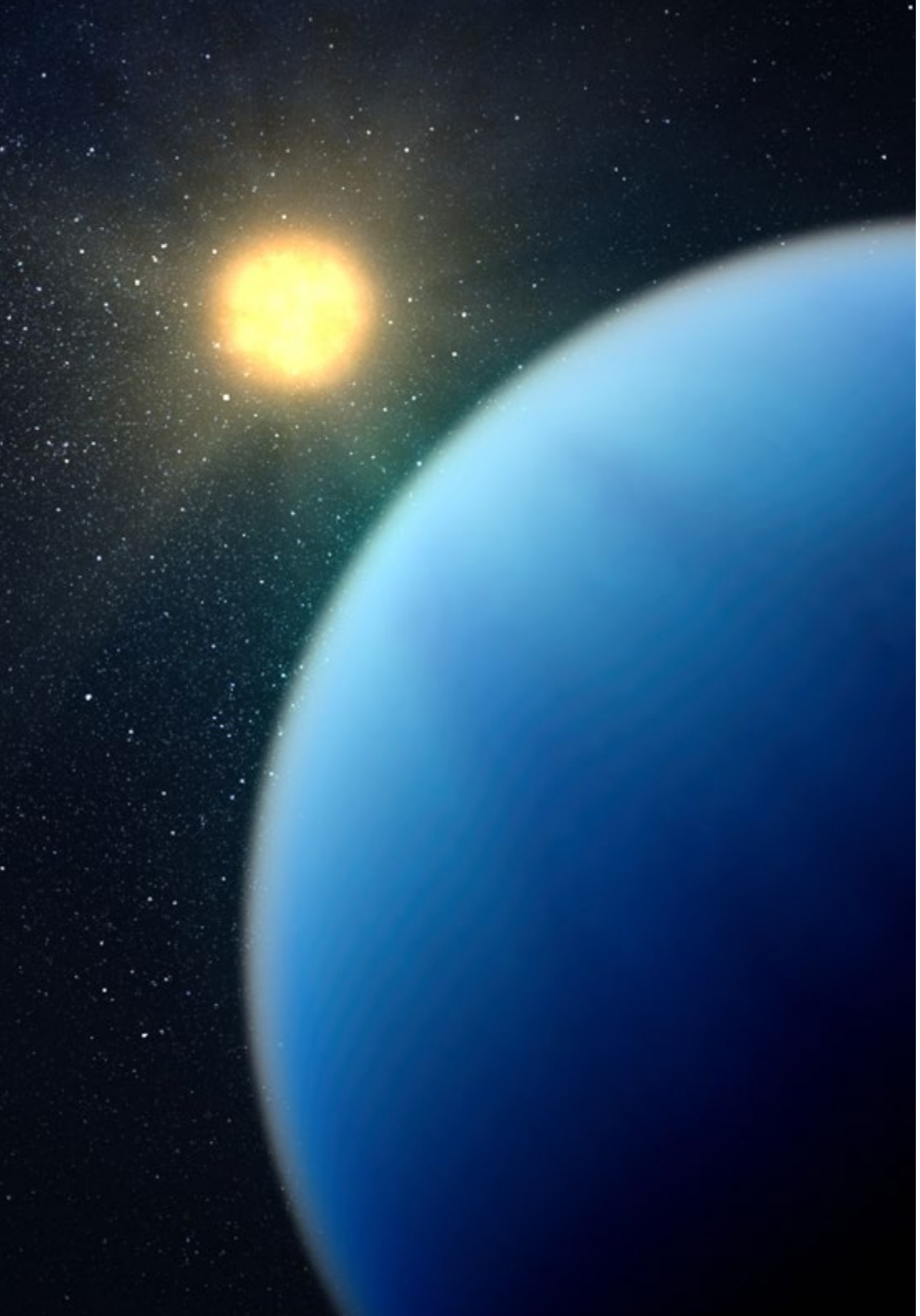
1.4. Geometry: Necessary Concepts
- 1.4.1. Two-Dimensional Spaces
- 1.4.2. Scalar, Vector and Tensor Fields
- 1.4.3. Metric Tensor: Concept and Theory
- 1.4.4. Partial Derivative
- 1.4.5. Covariant Derivative
- 1.4.6. Christoffel Symbols
- 1.4.7. Covariant Derivatives of Tensors
- 1.4.8. Directional Covariant Derivatives
- 1.4.9. Divergence and Lapacian

1.5. Curved Space-Time
- 1.5.1. Covariant Derivative and Parallel Transport: Definition
- 1.5.2. Geodesics from Parallel Transport
- 1.5.3. Riemann Curvature Tensor
- 1.5.4. Riemann Tensor: Definition and Properties
- 1.5.5. Ricci Tensor: Definition and Properties

1.6. Einstein Equations: Derivation
- 1.6.1. Reformulation of the Equivalence Principle
- 1.6.2. Applications of the Equivalence Principle
- 1.6.3. Conservation and Symmetries
- 1.6.4. Derivation of Einstein's Equations from the Equivalence Principle

1.7. Schwarzschild Solution
- 1.7.1. Schwartzschild Metrics
- 1.7.2. Length and Time Elements
- 1.7.3. Conserved Quantities
- 1.7.4. Equation of Motion
- 1.7.5. Light Deflection. Study of Schwartzschild Metrics
- 1.7.6. Schwartzschild Radius
- 1.7.7. Eddington– Finkelstein Coordinates
- 1.7.8. Black Holes

1.8. Linear Gravity Limits Consequences
- 1.8.1. Linear Gravity: Introduction
- 1.8.2. Coordinate Transformation
- 1.8.3. Linearized Einstein Equations
- 1.8.4. General Solution of Linearized Einstein Equations
- 1.8.5. Gravitational Waves
- 1.8.6. Effects of Gravitational Waves on Matter
- 1.8.7. Generation of Gravitational Waves



1.9. Cosmology: Introduction
- 1.9.1. Observation of the Universe: Introduction
- 1.9.2. Cosmological Principle
- 1.9.3. System of Coordinates
- 1.9.4. Cosmological Distances
- 1.9.5. The Hubble's Law
- 1.9.6. Inflation

1.10. Cosmology: Mathematical Study
- 1.10.1. First Equation of Friedmann
- 1.10.2. second Equation of Friedmann
- 1.10.3. Densities and Scale Factor
- 1.10.4. Consequences of Friedmann Equations Curvature of the Universe
- 1.10.5. Primitive Universe Thermodynamics

TECH Global University uses the latest technology applied to university teaching to offer you multimedia pills at the height of today's academic times"

04

Methodology

This academic program offers students a different way of learning. Our methodology uses a cyclical learning approach: **Relearning.**

This teaching system is used, for example, in the most prestigious medical schools in the world, and major publications such as the **New England Journal of Medicine** have considered it to be one of the most effective.

Discover Relearning, a system that abandons conventional linear learning, to take you through cyclical teaching systems: a way of learning that has proven to be extremely effective, especially in subjects that require memorization"

Case Study to contextualize all content

Our program offers a revolutionary approach to developing skills and knowledge. Our goal is to strengthen skills in a changing, competitive, and highly demanding environment.

At TECH, you will experience a learning methodology that is shaking the foundations of traditional universities around the world"

You will have access to a learning system based on repetition, with natural and progressive teaching throughout the entire syllabus.

The student will learn to solve complex situations in real business environments through collaborative activities and real cases.

A learning method that is different and innovative

This TECH program is an intensive educational program, created from scratch, which presents the most demanding challenges and decisions in this field, both nationally and internationally. This methodology promotes personal and professional growth, representing a significant step towards success. The case method, a technique that lays the foundation for this content, ensures that the most current economic, social and professional reality is taken into account.

> *Our program prepares you to face new challenges in uncertain environments and achieve success in your career"*

The case method is the most widely used learning system in the best faculties in the world. The case method was developed in 1912 so that law students would not only learn the law based on theoretical content. It consisted of presenting students with real-life, complex situations for them to make informed decisions and value judgments on how to resolve them. In 1924, Harvard adopted it as a standard teaching method.

What should a professional do in a given situation? This is the question that you are presented with in the case method, an action-oriented learning method. Throughout the program, the studies will be presented with multiple real cases. They will have to combine all their knowledge and research, and argue and defend their ideas and decisions.

Relearning Methodology

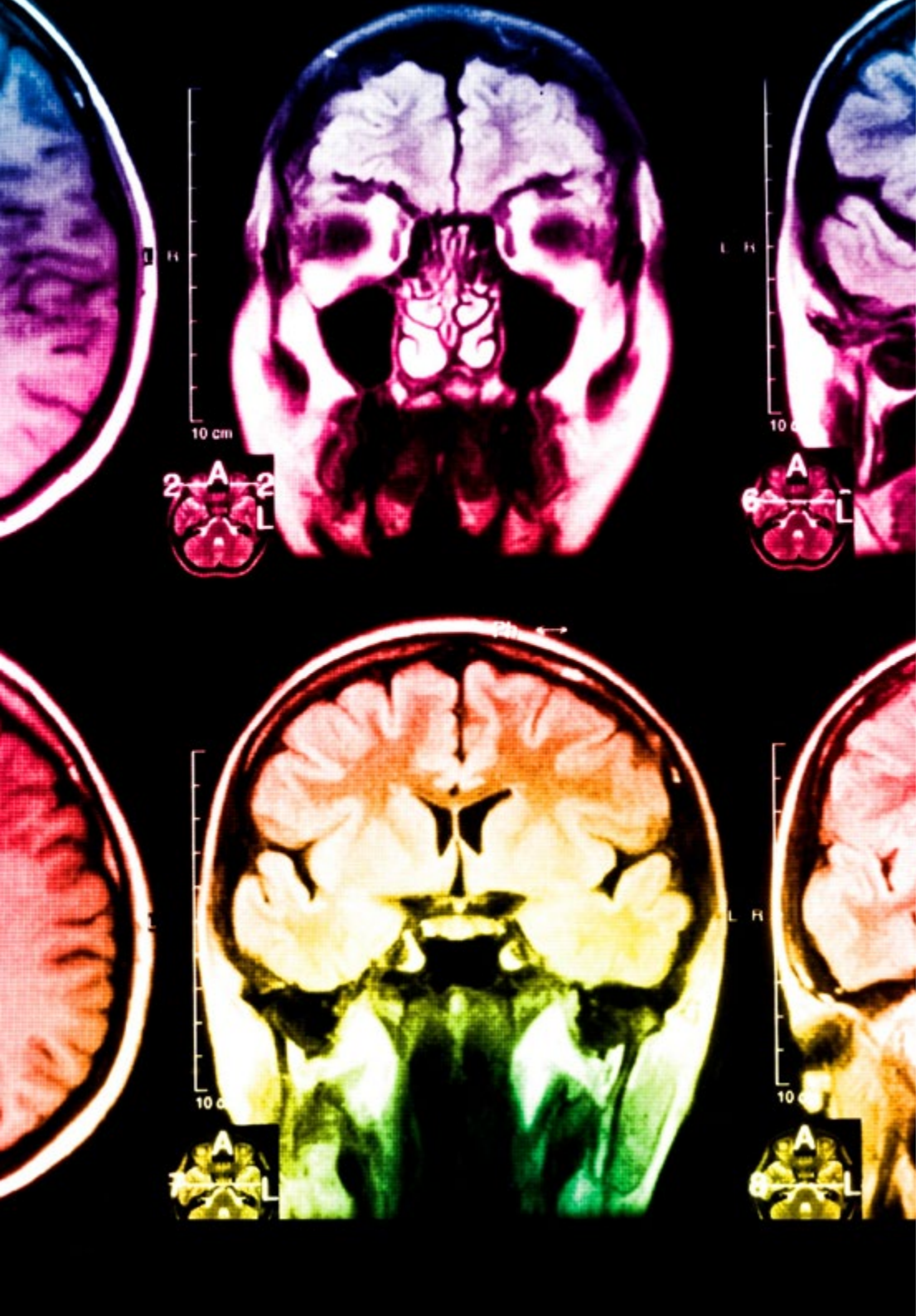
TECH effectively combines the Case Study methodology with a 100% online learning system based on repetition, which combines 8 different teaching elements in each lesson.

We enhance the Case Study with the best 100% online teaching method: Relearning.

In 2019, we obtained the best learning results of all online universities in the world.

At TECH, you will learn using a cutting-edge methodology designed to train the executives of the future. This method, at the forefront of international teaching, is called Relearning.

Our university is the only one in the world authorized to employ this successful method. In 2019, we managed to improve our students' overall satisfaction levels (teaching quality, quality of materials, course structure, objectives...) based on the best online university indicators.



In our program, learning is not a linear process, but rather a spiral (learn, unlearn, forget, and re-learn). Therefore, we combine each of these elements concentrically. This methodology has trained more than 650,000 university graduates with unprecedented success in fields as diverse as biochemistry, genetics, surgery, international law, management skills, sports science, philosophy, law, engineering, journalism, history, and financial markets and instruments. All this in a highly demanding environment, where the students have a strong socio-economic profile and an average age of 43.5 years.

Relearning will allow you to learn with less effort and better performance, involving you more in your training, developing a critical mindset, defending arguments, and contrasting opinions: a direct equation for success.

From the latest scientific evidence in the field of neuroscience, not only do we know how to organize information, ideas, images and memories, but we know that the place and context where we have learned something is fundamental for us to be able to remember it and store it in the hippocampus, to retain it in our long-term memory.

In this way, and in what is called neurocognitive context-dependent e-learning, the different elements in our program are connected to the context where the individual carries out their professional activity.

This program offers the best educational material, prepared with professionals in mind:

Study Material

All teaching material is produced by the specialists who teach the course, specifically for the course, so that the teaching content is highly specific and precise.

These contents are then applied to the audiovisual format, to create the TECH online working method. All this, with the latest techniques that offer high quality pieces in each and every one of the materials that are made available to the student.

Classes

There is scientific evidence suggesting that observing third-party experts can be useful.

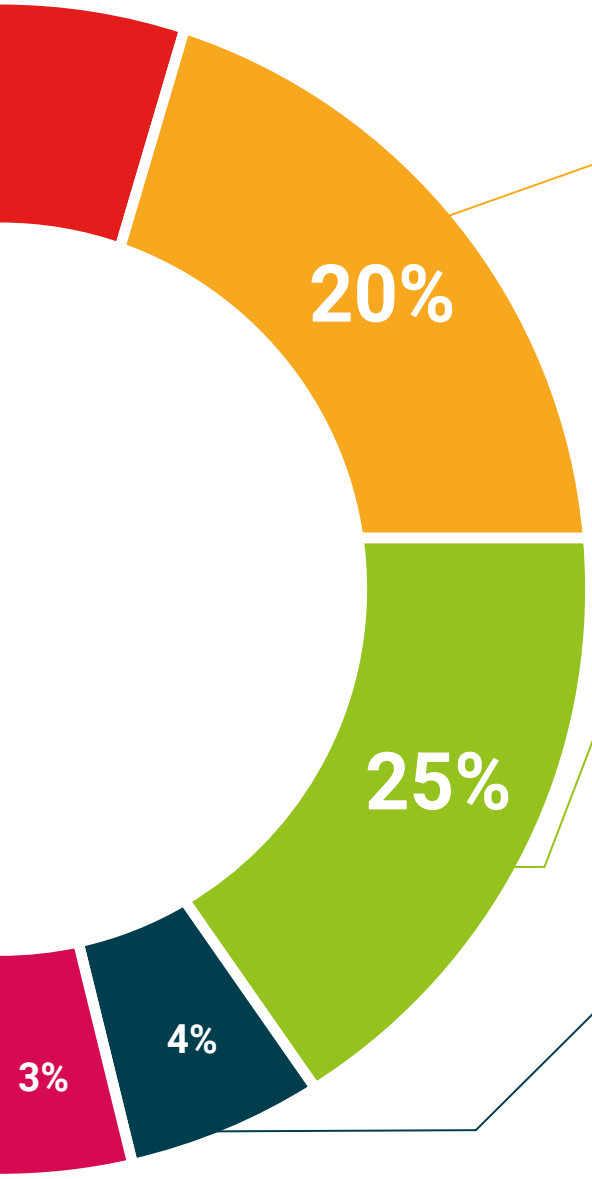
Learning from an Expert strengthens knowledge and memory, and generates confidence in future difficult decisions.

Practising Skills and Abilities

They will carry out activities to develop specific skills and abilities in each subject area. Exercises and activities to acquire and develop the skills and abilities that a specialist needs to develop in the context of the globalization that we are experiencing.

Additional Reading

Recent articles, consensus documents and international guidelines, among others. In TECH's virtual library, students will have access to everything they need to complete their course.



Case Studies

Students will complete a selection of the best case studies chosen specifically for this program. Cases that are presented, analyzed, and supervised by the best specialists in the world.

Interactive Summaries

The TECH team presents the contents attractively and dynamically in multimedia lessons that include audio, videos, images, diagrams, and concept maps in order to reinforce knowledge.

This exclusive educational system for presenting multimedia content was awarded by Microsoft as a "European Success Story".

Testing & Retesting

We periodically evaluate and re-evaluate students' knowledge throughout the program, through assessment and self-assessment activities and exercises, so that they can see how they are achieving their goals.

05

Certificate

The Postgraduate Certificate in General Relativity and Cosmology guarantees students, in addition to the most rigorous and up-to-date education, access to a Postgraduate Certificate issued by TECH Global University.

Successfully complete this program and receive your university qualification without having to travel or fill out laborious paperwork”

This program will allow you to obtain your **Postgraduate Certificate General Relativity and Cosmology** endorsed by **TECH Global University**, the world's largest online university.

TECH Global University is an official European University publicly recognized by the Government of Andorra (***official bulletin***). Andorra is part of the European Higher Education Area (EHEA) since 2003. The EHEA is an initiative promoted by the European Union that aims to organize the international training framework and harmonize the higher education systems of the member countries of this space. The project promotes common values, the implementation of collaborative tools and strengthening its quality assurance mechanisms to enhance collaboration and mobility among students, researchers and academics.

This **TECH Global University** title is a European program of continuing education and professional updating that guarantees the acquisition of competencies in its area of knowledge, providing a high curricular value to the student who completes the program.

Title: **Postgraduate Certificate General Relativity and Cosmology**

Modality: **online**

Duration: **6 weeks**

Accreditation: **6 ECTS**


tech global university

Mr./Ms. _____, with identification document _____
has successfully passed and obtained the title of:

Postgraduate Certificate General Relativity and Cosmology

This is a program of 180 hours of duration equivalent to 6 ECTS, with a start date of dd/mm/yyyy and an end date of dd/mm/yyyy.

TECH Global University is a university officially recognized by the Government of Andorra on the 31st of January of 2024, which belongs to the European Higher Education Area (EHEA).

In Andorra la Vella, on the 28th of February of 2024

Dr. Pedro Navarro Illana
Rector

This qualification must always be accompanied by the university degree issued by the competent authority to practice professionally in each country. Unique TECH Code: AFWORD23S techtitute.com/certificates

*Apostille Convention. In the event that the student wishes to have their paper diploma issued with an apostille, TECH Global University will make the necessary arrangements to obtain it, at an additional cost.

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