Self-Study Summary Collection

Volume 1

Physics

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Contents

Chapter 1

Study Plan

There are several course topics summarized in this document. They are related in someways but can be regarded as isolated and there for have to correlation to between topics. Each of the courses is summarized in each own chapter and is mostly based on a course from MIT, Yale, or Stanford. MIT in particular has a great selection of open courses in various scientific topics. Each of the chapters starts with a general info of the course it is based on and various relevant links for the course material. The chapters are in chronological order the courses was taken and as no relation to topics [1].

Chapter 2

Fundamental Mathematics

2.1 Terminology

- Axiom: "TODO" [2].

- Definition: "TODO" [2].

- Lemma: "TODO" [2].

- Theorem: "TODO" [2].

- Proposition: "TODO" [2].

- Corollary: "TODO" [2].

- Law: "TODO" [2].

2.2 Geometry

2.2.1 Volumes

Volumes has a unit of cube, e.g., m^3 "meter cube", and a cube has a volume of lenght $\times$ depth $\times$ height $=$ lenght^3 $=$ depth^3 $=$ height^3 $=$ volume since all sides are equal in a cube. For cuboid, however, the sides are different. A cube can express the volume of three-dimensional shapes.

Pyramid

Given a pyramid of height h, length L, and width W, the pyramid's volume can be expressed in terms of cuboids of height h/n where $n \to \infty$. The length of the cuboid layer is $m \times \frac{L}{n}$, where $m \in [1, \ldots, n]$. Likewise, the width is $m \times \frac{W}{n}$, which gives us the sum of all the layer cuboid making up the pyramid is equal

to:

$$\sum_{m=1}^{n} \frac{h}{n} \times m\frac{L}{n} \times m\frac{W}{n}$$

$$= \frac{1}{n^3}hWL\sum_{m=1}^{n} m^2$$

$$= \frac{1}{n^3}hWL\frac{n(n+1)(2n+1)}{6}$$

$$= \frac{1}{n^3}hWL\frac{2n^3 + n^2 + 2n^2 + n}{6}$$

$$= hWL\left(\frac{2n^3}{6n^3} + \frac{3n^2}{6n^3} + \frac{n}{6n^3}\right)$$

$$= hWL\left(\frac{1}{3} + \frac{1}{2n} + \frac{1}{6n^2}\right)$$

Since $n \to \infty$:

$$\lim_{n\to\infty} hWL\left(\frac{1}{3} + \frac{1}{2n} + \frac{1}{6n^2}\right) = \frac{1}{3}hWL$$

2.3   Irrational numbers

2.3.1   Constant e

$$e = \lim_{n\to\infty}\left(1 + \frac{1}{n}\right)^n$$

$$e = 2 + \cfrac{1}{1 + \cfrac{1}{2 + \cfrac{1}{1 + \cfrac{1}{1 + \cfrac{1}{4 + \cfrac{1}{1 + \cfrac{1}{1 + \cfrac{1}{6 + \dots}}}}}}}}$$

2.3.2   Constant π

Chapter 3

Differential Equations

This compendium is based on MIT OpenCourseWare "Learn Differential Equations: Up Close with Gilbert Strang and Cleve Moler" by Professor Gilbert Strang and Dr. Cleve Moler in 2015. I can not guarantee the accuracy of this compendium and that it is a correct interpretation of the material and explanation provided by the lecture notes and lectures. Thus, for accurate information refer to the material that this compendium is based on. If a mistake is in the compendium it is most likely my fault and not the fault of the material in which this compendium is based on.

Chapter 4

Abstract Algebra

This compendium is based on Math E-222 - Abstract Algebra (Fall 2003, Harvard Extension School) by Professor Benedict Gross. I can not guarantee the accuracy of this compendium and that it is a correct interpretation of the material and explanation provided by the lecture notes and lectures. Thus, for accurate information refer to the material that this compendium is based on. If a mistake is in the compendium it is most likely my fault and not the fault of the material in which this compendium is based on.

Chapter 5

Topology

This compendium is based on Topology & Geometry by Dr Tadashi Tokieda held at AIMS South Africa in 2014. I can not guarantee the accuracy of this compendium and that it is a correct interpretation of the material and explanation provided by the lecture notes and lectures. Thus, for accurate information refer to the material that this compendium is based on. If a mistake is in the compendium it is most likely my fault and not the fault of the material in which this compendium is based on.

Bibliography

[1] European Union, *Directive 2014/35/EU of the European Parliament and of the Council of 26 February 2014 on the harmonisation of the laws of the Member States relating to the making available on the market of electrical equipment designed for use within certain voltage limits (recast)*, `https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32014L0035`, Official Journal of the European Union, L 96, 29 March 2014, pp. 357-374, 2014.

[2] *Oxford English Dictionary*, 3rd ed. Oxford University Press, 2024, Accessed online at the Oxford English Dictionary. [Online]. Available: `https://www.oed.com` (visited on 10/27/2024).