Assignment-4

MM2090

team-1

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Contents

1 Introduction

This is the Assignment-4 submission of Team-1.

2 Aahan Bhargava ME20B001

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2.1 Equations of choice

$$\delta Q = dE + \delta W \tag{1}$$

$$S_2 - S_1 = \int_1^2 \delta Q/T + S_{gen} \tag{2}$$

2.2 Analysis

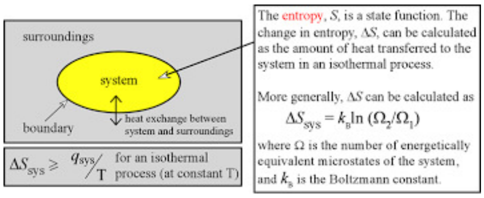

Figure 1: ME20B001

Equation 1 describes the relation of heat(Q) work(W) with the energy of a system in differential form. We have written δQ and δW because heat and work are path functions and energy(E) is a state function. Heat and work exchange are important parameters to predict the change in internal energy of a system. from [12].
Equation 2 describes the relation between entropy(S), heat(Q) and Temperature(T). S_{gen} is the entropy generated because of irreversibilities in the system, eg: friction. Entropy is an important parameter to predict the spontaneity of a process.It is a measure of the randomness of a system. from [9].
In figure 1 we see the relation between entropy(S), heat(Q) and Temperature(T) for any process happening in our world.

3 Alpha P Jose ME20B021

Electric field equation for a point charge :

$$E = \frac{kQ}{r^2} \tag{3}$$

3.1 Analysis

The following paragraph contains a brief explanation of the variables and importance of the equation :

The above given equation 3 has the following terms **E** ,**k** , **Q** and **r**. Here,
E represents electric field strength
k represents the Coulombs Constant
Q represents the point charge producing the field
r represents the distance from point charge

Electric field equation for a point charge an experimental 3 of physics that allows us to calculate intensity of the electric field produced at a known distance 'r' by a point charge . Orginally derived from the Coloumbs force equation where $F = qE$,this law was first discovered in 1762 by English physicist Lorentz .This is the electric field at point due to the point charge Q which is equivalent to the Coulomb force per unit charge that a point charge would experience at a position .This equation derived for electric field of a point charge as it made it possible to discuss the Electric field produced by a point charge in a meaningful way.

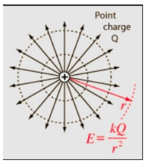

Figure 2: Electric field for a point charge [1]

Webpage Links [2]

4 Arun Palaniappan ME20B036

General Time-delay with single-fractional-pole model (TDSFP) [15] :

$$\mathcal{L}^{-1}\left\{\frac{s^{\alpha-\beta}}{s^{\alpha}+a}\right\} = t^{\beta-1}E_{\alpha,\beta}(-at^{\alpha}) \tag{4}$$

4.1 Analysis

Following contains a brief explanation of the variables and the importance of the equation :

- From equation 4, **'$\mathcal{L}^{-1}$'** is the inverse Laplacian operator, which plays a major role in deducing the solution.
- From equation 4, **'$E_{\alpha,\beta}$'** is the Mittag-Leffler function
- **'α, β'** are the parameters of the Mittag-Leffler function
- From equation 4, **'s'** is the parameter of the TDSFP transfer function
- **'a'** defines the system order during the process
- **'t'** denotes the time from the start of the process

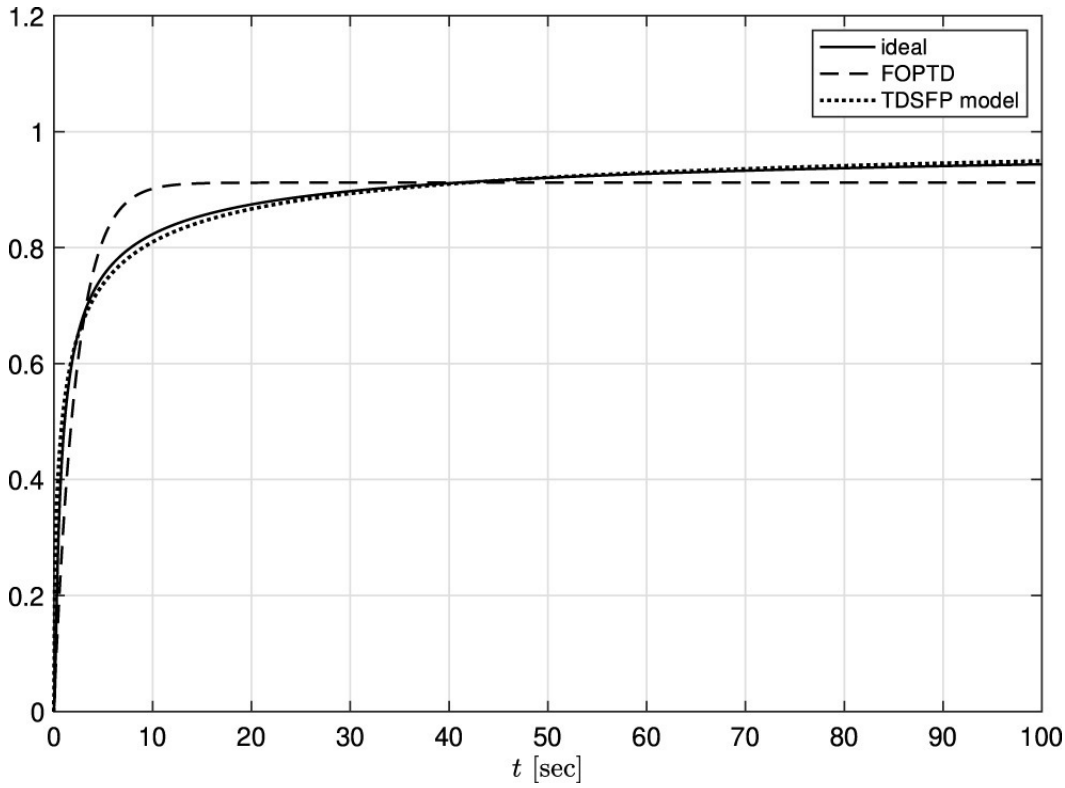

Figure 3: ME20B036

Figure 3 shows the graph plot of the TDSFP model. [15]

4.2 Importance

Modeling of the ideal thermal conduction process is a classical application of TDSFP model. Physically the heat equation describes how temperature evolves over time in a solid medium. It describes the distribution in only one spatial coordinate, and the heat transferred in the direction in which the temperature decreases. [15]

The fact can be seen that TDSFP model in **Figure 3** provides a much more accurate fit of the ideal thermal process compared with traditional FOPTD model. It should be note that the system order equals 0.5 for ideal heat transfer process, and it may has perturbation under external or internal disturbances such as the heat loss in real processes.

5 Bhagat Singh S MM20B011

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5.1 The Time Dilation Equation

5.2 The Equation

$$t' = \frac{t}{\sqrt{1 - \frac{v^2}{c^2}}} \tag{5}$$

Equation 5 has terms **t'** ,**t** , **v** and **c**.
Here,
t' represents the time taken by the moving object
t represents the time taken by light
v represents the speed of the moving object
c represents the speed of light

5.3 Description

This theory is derived from the Special Theory of Relativity devised by Albert Einstein. [10]
In physics and relativity, time dilation [11] is the difference in the elapsed time as measured by two clocks. It is either due to a relative velocity between them or to a difference in gravitational potential between their locations.

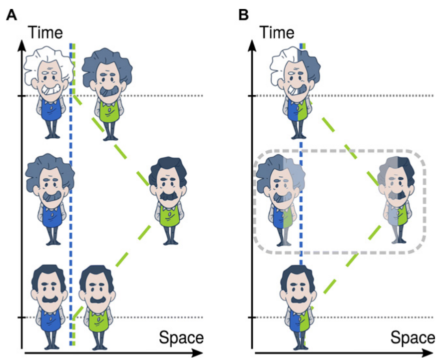

Figure 4: Twin Paradox

A closely related phenomenon predicted by special relativity is the so-called twin paradox [13]. Suppose one of two twins carrying a clock departs on a rocket ship from the other twin, an inertial observer, at a certain time, and they rejoin at a later time. In accordance with the time-dilation effect, the elapsed time on the clock of the twin on the rocket ship will be smaller than that of the inertial observer twin—i.e., the non-inertial twin will have aged less than the inertial observer twin when they rejoin.(see Figure 4)
The time-dilation effect [14] predicted by special relativity has been accurately confirmed by observations of the increased lifetime of unstable elementary particles traveling at nearly the speed of light.

6 Rithwin K Ashraf ME20B150

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6.1 The Gravitational Force Equation

6.2 The Equation

$$F = \frac{Gm1m2}{r^2} \tag{6}$$

The above given equation 6 has terms **F** ,**G** , **m1**,**m2** and **r**.
Here,
F represents the force exerted by m1 on m2 or vice versa
G represents the Gravitational Constant
m1 represents the mass of object1
m2 represents the mass of object2
r represents the distance between object 1 and object2

6.3 Description

This is a general physical law derived from empirical observations by what Isaac Newton called inductive reasoning.
Newtons laws of universal gravitation(see equation 6) is usually stated as that every particle attracts every other particle in the universe with a force that is directly proportional to the product of their masses and inversely proportional to the square of the distance between their centers.

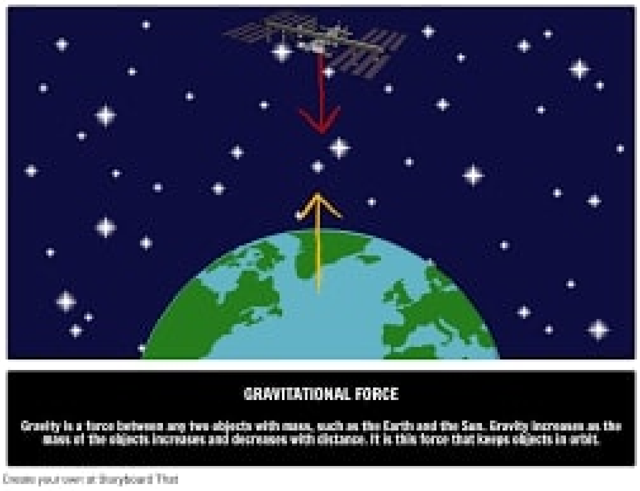

Figure 5: Gravity[3]

This is a general physical law derived from empirical observations by what Isaac Newton called inductive reasoning.[4] It is a part of classical mechanics and was formulated in Newton's work Philosophiæ Natural is Principia Mathematica ("the Principia"), first published on 5 July 1687. When Newton presented Book 1 of the unpublished text in April 1686 to the Royal Society, Robert Hooke made a claim that Newton had obtained the inverse square law from him.
Newton's law of gravitation resembles Coulomb's law of electrical forces, which is used to calculate the magnitude of the electrical force arising between two charged bodies. Both are inverse-square laws,

where force is inversely proportional to the square of the distance between the bodies. Coulomb's law has the product of two charges in place of the product of the masses, and the Coulomb constant in place of the gravitational constant.
Webpage links[4]

7 Roshan Biju MM20B052

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7.1 MASS-ENERGY EQUIVALENCE EQUATION

7.2 EQUATION

$$E = M(C^2) \tag{7}$$

Equation 7 has terms **E** ,**M** ,**C**.
In this equation,
E -Energy of the system
M -Mass of the system
C -Speed of light

7.3 DESCRIPTION

This equation is the last part of the derivation of Albert Einstien's Special Theory of Relativity.
In physics, mass–energy equivalence is the relationship between mass and energy in a system's rest frame, where the two values mass and energy differ only by a constant and the units of measurement.

The formula defines the energy E of a particle in its rest frame as the product of mass (m) with the speed of light squared (c^2). Because the speed of light is a large number in everyday units ($approximately\ 3x10^8\ meterspersecond$), the formula implies that a small amount of rest mass corresponds to an enormous amount of energy, which is independent of the composition of the matter
In physical theories prior to that of special relativity, mass and energy were viewed as distinct entities. Furthermore, the energy of a body at rest could be assigned an arbitrary value. In special relativity, however, the energy of a body at rest is determined to be mc^2. Thus, each body of rest mass m possesses mc^2 of "rest energy," which potentially is available for conversion to other forms of energy.

This is particularly true in the case of nuclear fusion($fig - 2$) reactions that transform hydrogen to helium, in which 0.7 percent of the original rest energy of the hydrogen is converted to other forms of energy. Stars like the Sun shine from the energy released from the rest energy of hydrogen atoms that are fused to form helium.

This equation greatly helped in knowing and quantifying the energy released during all nuclear processes such as fission fusion and radioactive decay,which then led to the discovery of atomic bombs.

$linkswebsites$ [7] [8]

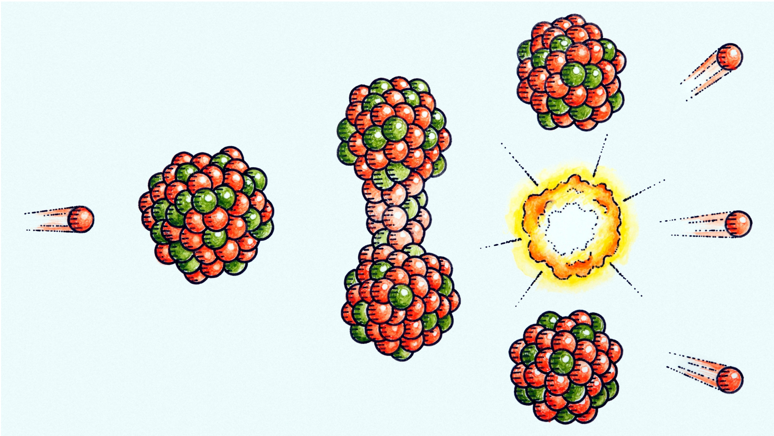

Figure 6: Atomic fission[5]

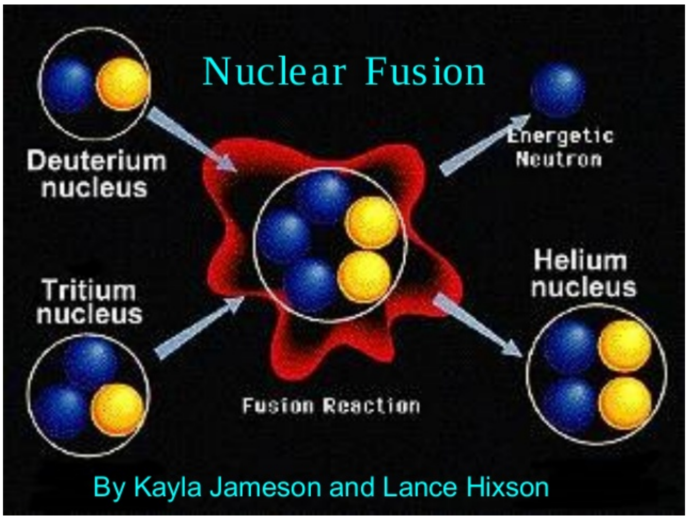

Figure 7: Atomic fusion[6]

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[5] https://www.google.com/url?sa=iurl=httpsFebruary.

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