September 2016, Vol :IV; No-I

e-mail : sch.tpi@gmail.com

KnowEdge

Department of Science and Humanities
Technique Polytechnic Institute
Panchrokhi, Sugandhya, Hooghly, West Bengal, PIN - 712102

EDITORIAL

We are glad for the timely publication of *'Know-Edge',* Technical magazine of the Department of Science and Humanities. The faculty members are interested in innovative topics gaining momentum in recent era. This magazine will give us a vivid view of these subject matters.

We sincerely thank our Chairman (Governing Body), Executive Director, Principal and Coordinator for their valuable advice that motivates us for this publication.

We convey our heartiest thanks to our colleagues for their cooperation and contribution without which successful publication would remain incomplete. We wish for the best achievements of this magazine in coming days.

CONTENTS

RELATIONSHIPS WITH CO-WORKERS AT WORK PLACE

S. N. Basu

Executive Director, Technique Polytechnic Institute

Culture is the heart of an academic institution and the teachers & students are its life source. When there are bad elements that kill the culture, it negatively affects all the people around them. Culture, Attitude, Aptitude and Personality can be seen as four different attributes and they should not be taken together as one. Building healthy relationships with your co-workers is an important part of having a successful career of the teachers and students. In the department, co-workers spend ample amounts of time together, and sometimes develop personal relationships on top of their professional ones. This can be good for the establishment because it can help the institute create higher performance in the workplace. When it comes to building relationships with your co-workers, be open and honest, and the institute gains when more employees are engaged and supporting each other. Good office etiquette helps build the foundation for a healthy work environment.

Tips to make the most of your interactions with co-workers:

1. Pay attention to all
2. Treat everyone the same
3. Communicate effectively
4. Be positive, polite and respectful
5. Show appreciation and share credit
6. Honour your commitments
7. Practice common courtesy
8. Respect other co-worker's time
9. Stay on the level of understanding
10. Use social media wisely
11. Ask for advise

Another way to improve your relationships at work is to make sure that you and your colleagues are taking breaks and lunches and enjoying time to get to know each other. All employees should understand that work performance is not about competition, it’s about coming together to fulfil a common vision.

Good communication is a must in the workforce. Interact more with co-workers, will help to build stronger cooperation and understanding among them. Miscommunication often plays a large role in problems that arise in the workplace. Compliments on or Praise for Employee's Work Performance from higher authority make employees feel appreciated.

“Attitude, not the aptitude, that determines your altitude”

****

PLANT LAYOUT TOOLS AND TECHNIQUES

Dr. Abhijit Chakraborty

Principal, Technique Polytechnic Institute

Meaning of Plant Layout:

Plant layout is most effective in physical arrangement machine, equipment, material and facilities of plant. Plant layout maintains the co-ordination in between of 4M's (men, material, machine and method). In every plant there are some problems are come to face to solve the problems plant layout techniques are used. To set up a plant layout orderly the techniques are use to help to improve or deal with problems. The plant layout arranges the machine, processing equipment and service department.

Plant Layout Tools and Techniques:

In plant layout various types of techniques are used to arrange the work in co-ordination manner. The techniques arrange the quickest flow of material at lower cost and with lesser handling in processing the product from the acknowledged of the raw material to the shipment of finished product. The technique arrange that which method is done, which material is used to performed in which machine all the process are arranged by the plant layout technique. There are some types of tools and techniques are discussed below.

The following tools are used, in layout planning:

- Operation process charts
- Flow process charts
- Flow diagrams
- String diagram
- Machine data cards
- Templates
- Scale models
- Layout drawings

A. Operation Process Chart:

With the help of operation process chart we can separate and arrange the process of materials moving to which machine and work done under which method all types of operation are arranged by operation process chart.

The operation process chart is mainly used when a new plant is to be laid out. This process chart shows basic activities for producing a product. These carts show the overall visualization with help of elimination, combination, rearrangement or simplification of process and basis for studying possibilities for the improvement operation.

B. Flow Process Chart:

All the production activities occurring on the floor of the plant arerepresenting graphically in flow process chart. The flow process chart real work is to tracing the actual flow of work occurring and the time required for the operation. It works on transportation, storage and delay.

The complete information for the analysis and improvement of plant operation is provided by flow process chart. The result of analysis operation may be eliminated, combined or rearranged. The work station, storage area can be rearranged to reduce traveling distance and labour time. The flow process chart also checks and verify the efficiency of proposed floor plan for a new layout.

C. Flow Diagram:

The flow diagram is used to supplement of the flow process chart. it is graphically representing of work area, machinery, storage area, gang way etc. which path is followed by men or materials is marked on flow diagram. All the symbols and straight lines are joining with each other and make routes to follow by different item are shown in flow diagram.

In flow process chart will trace out the undesirable characteristic of layout which is responsible for delay and increasing transportation by study the process flow diagram and flow process chart.

It is also show nature of back tracking to help on improving the layout and easy to trace and present layout attractive.

D. String Diagram:

The string diagram is one of the simplest techniques. String diagram is a model or scale plan which thread is used to trace and measuring the path of workers, material or equipment.

E. Machine Data Cards:

This is effective tool to provide full information for placement or layout of equipment. The card shows the machine capacity, space and power requirement, handling devices and corresponding dimensions.

F. Templates:

The area taken by a machine is cut to scale from a thick paper is cut to scale from a thick paper to form a template. Not only machine but space covered by furniture, equipment and other components can also form a template these can be shown the well arranged actual plan of layout to be undertaken. The template technique is an important technique because

Unnecessary handling is eliminated, backtracking of materials is minimized, the mechanical handling is possible, and it offers flexibility to meet future changes in the production requirements.

G. Scale Models:

Scale model provide a three-dimensional layout it is better understanding models are used to represent real situation the color cording can be used to define the plant perfectly and easily understand. The scale model is available for large range of machine tools, equipment, bench, storage cupboard etc. the typical type of models are shown in three-dimensional layout. The model is expensive in this model reduce explanation since the other layout.

H. Layout Drawings:

Complete layout are shown in drawing walls, columns, stairways, machines and other equipment, storage areas and office areas. All are shown in respective manner.

Conclusion:

By using proper plant layout tools and techniques, the efficiency of the plant can be increased and more effective utilization of inventory can be done during production time. So, the production manager has to be judgmental in selecting the proper plant layout tools while implementing the same in the concern production unit and gets the maximum value out of it.

****

THE FUTURE OF THE UNIVERSE

Mr. Ayan Ghosh

Lecturer, Department of Science & Humanities

Introduction:

The Big Bang model describes the current universe as expanding. Based on the latest observations, we conclude that the expansion will continue forever. What will happen to Earth, the Solar System, and the rest of the universe as time goes by? The first, the Primordial Era, is the time in the past just after the Big Bang when stars had not yet formed. The second, the Stelliferous Era, includes the present day and all of the stars and galaxies we see. It is the time during which stars form from collapsing clouds of gas. In the subsequent Degenerate Era, the stars will have burnt out, leaving all stellar-mass objects as stellar remnants—white dwarfs, neutron stars, and black holes. In the Black Hole Era, white dwarfs, neutron stars, and other smaller astronomical objects have been destroyed by proton decay, leaving only black holes. Finally, in the Dark Era, even black holes have disappeared, leaving only a dilute gas of photons and leptons.

Let's look first at the evolution of the Solar System (over the next ten or so billion years), and then the evolution of the entire universe.

The Solar System

Our Solar System has been around for about 4.5 billion years. The Sun is a star of relatively low mass, which means that it burns its nuclear fuel relatively slowly. In the core of the Sun, hydrogen atoms are fusing to form helium. The energy released by this reaction pushes the solar material outwards, supporting it against gravity. Eventually, the radiation makes its way to the surface, and then flies into space as (mostly) visible light.

Figure 1: Growing Radious of the Sun

In about 6 billion years, the Sun will have converted almost all the hydrogen in its core into helium. Eventually, the helium in the core will start to fuse together to form carbon. This reaction takes place at much higher pressures and temperatures than hydrogen fusion, and releases much more energy. The extra energy generated in the core will push the outer layers of the Sun far, far beyond their current position. As they are pushed outwards, the outermost layers of the Sun's atmosphere will cool down from the current 5700 degrees Kelvin to perhaps 4000 or 3500 degrees Kelvin. The Sun will swell up and become cooler and redder: a **red giant**.

The radius of the Sun will grow very large during this phase of its evolution. Its outer layers will certainly engulf the planet Mercury, possibly Venus, and maybe even the Earth!

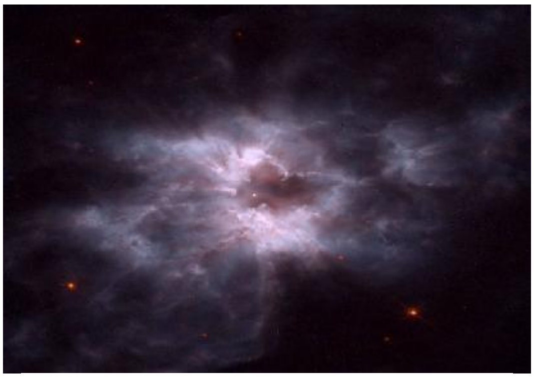


Figure 2: White Dwarf Planet

But, even if the Earth escapes direct contact with the solar atmosphere, it will be doomed nonetheless: the solar luminosity will increase by several thousand as it becomes a red giant, heating the Earth to a temperature of about 2000 Kelvin (about 3000 Fahrenheit). The atmosphere will fly off into space, the oceans will boil away, and a large amount of the continents will melt.

The red giant phase of life is a brief one: after only about 1 billion years, the Sun will deplete all the helium in its core. It does not have sufficient mass to drive pressures and temperatures high enough to fuse carbon into heavier elements. Instead, with no source of energy at its centre, the Sun's luminosity will fall drastically. Its swollen outer layers will be ejected into space, forming a **planetary nebula**, and leaving a small, dense remnant behind: a **white dwarf**.

Although initially very hot (40,000 Kelvin or so), the white dwarf will cool as it radiates away its internally energy. After several billion years, its temperature will have decreased to a few thousand degrees Kelvin and its light will have dimmed to a dull red. The Earth's surface will cool and again solidify, then continue to cool far past our current temperature. Ten billion years from now, what remains of the Earth will be frozen, more than a hundred degrees below zero. Any oxygen or nitrogen gas on the surface (emitted by volcanic activity, perhaps) will be frozen as a frost on the ground.

<u>The Stelliferous Age</u>

Stelliferous means "star-bearing". The current universe is indeed stelliferous: we see new stars being created in galaxies almost everywhere we look. Stars are, in fact, one of the dominant features of the universe right now. Just go outside and look!

When we look at our Milky Way galaxy (or other galaxies) from an overall point of view, we find that much of its light -- perhaps more than half -- comes from a relatively few stars: massive, blue, young stars, less than one billion years old, emit huge amounts of ultraviolet, visible, and infrared radiation. They are often grouped together into star-forming regions, sometimes lighting up gas in their vicinity to form **HII regions.**

Figure 3: The Stelliferous Age

But these massive stars run through their store of nuclear fuel very quickly. The rate at which fusion occurs in a stellar core depends very sensitively on the temperature and pressure. Low-mass stars, with lower temperatures and pressures, consume their nuclear fuel much more slowly than high-mass stars. Even though the low-mass stars start with much less fuel, they continue to burn it for a much longer time.

Initial mass of star	lifetime
10 solar masses	0.02 billion years
5	0.07
2	1
1	10
0.5	100
0.2	1000
0.08	10000

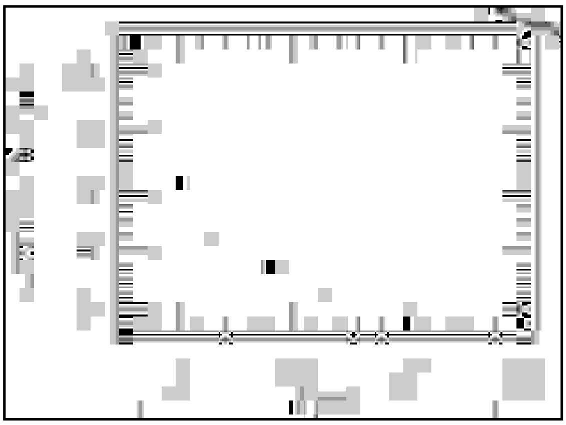


Figure 4: Graph of Lifetime vs. Mass of Different Stars

Objects will masses less than about 0.08 solar do not create high enough temperatures or densities in their cores to permit fusion -- so they do not become stars.

The stars of lowest mass are small, cool, and dim: we call them **red dwarfs**. Their luminosities are so low -- less than one percent of the Sun's -- that only planets with very small orbits could be warm enough to have liquid water. The most frugal of them may continue to burn hydrogen into helium for another 10,000 billion, or 10 trillion, years.

But eventually, even the red dwarfs will run out of fuel. They will cool off and become **black dwarfs**: chunks of helium and heavier elements bound together by gravity, radiating only tiny amounts of energy as they very slowly settle to a final shrunken state. After about 10^{14}, or 100 trillion, years, the stars are dead.

The Degenerate Age

After the Stelliferous age, the universe is very different, for two reasons. First, stars are no longer shining. Second, galaxies which are not gravitationally bound to each other have been carried far away by the expansion of the universe. After several passes between our Milky Way and Andromeda, the two galaxies will merge. After trillions of years, all the galaxies in our Local Group will have coalesced into one big object. But all the other galaxies in the universe will have continued to move farther and farther away: by 10^{14} years in the future, even our nearest unbound neighbors will be more than one million Megaparsecs away from us.

The dominant forms of matter are now mostly dead stars, in several forms:

- brown dwarfs: objects not massive enough to form stars (about the size of Jupiter)
- white dwarfs: the dense, cooling remains of low-mass stars (about the size of the Earth)
- neutron stars: the very dense remains of high-mass stars which ran out of fuel and suffered core-collapse (about the size of New York City)
- black holes: the very very dense remains of high-mass stars whose cores were more than about three solar masses at the time of core collapse (about the size of Rochester)

The atoms in all these objects are unlike those in ordinary matter, due to their high density. Physicists call this sort of material **degenerate,** and that term gives its name to this Age.

Since these objects are not burning any fuel, they do not radiate light. The Degenerate Age is dark.

Over the course of this Age, gravity causes two competing effects.

1. Chance encounters between stellar remnants in our merged "Local Galaxy" cause some of the stars to fly off into intergalactic space, and others to fall deeper into the gravitational well of the "Local Galaxy".

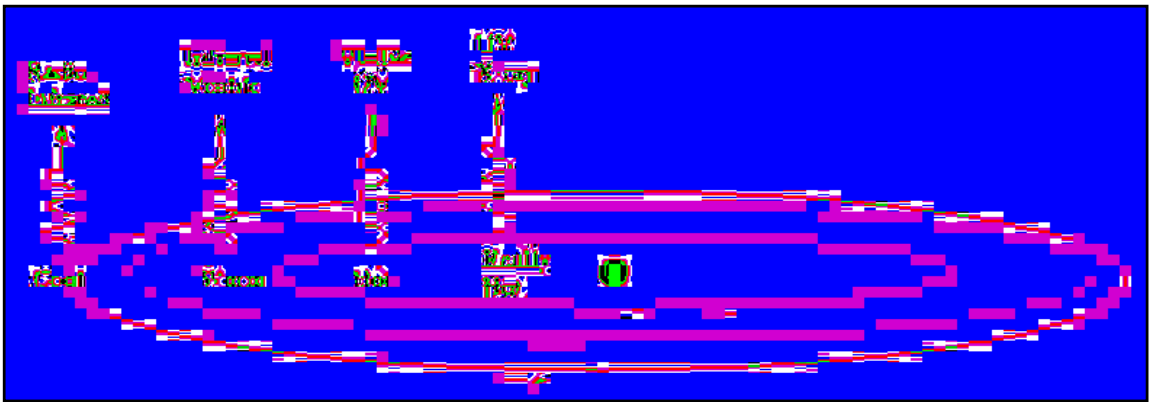


Figure 5: Temperature of various types of Spectrum

If a remnant happens to pass close to a black hole, it may be torn apart. The resulting material may form an accretion disk around the black hole, spiralling inwards and emitting radiation as it goes. The accretion process might last a few years, but will inevitably die away when all the material has fallen into the black hole.

2. Objects in orbit around each other -- binary stars, or planets around a single star -- emit very small amounts of gravitational radiation. Over ordinary timescales, the loss of energy is negligible; but during the Degenerate Era, over periods of quadrillions or quintillions of years, this tiny "leak" causes orbits to shrink. Eventually, all objects in close orbits merge, destroying any planetary systems or double stars.

If two white dwarfs with a combined mass of more than about 1.4 solar masses happen to merge, the resulting object undergoes runaway thermonuclear fusion. The result is a **Type Ia supernova**. Very, very rarely, the darkness of the Degenerate Age is dispelled for a few weeks while a supernova explodes.

At a time of 10^{25} years, the material in the "Local Galaxy" consists of isolated stellar remnants and black holes. Everything is cold and dark.

Some theories of physics predict that protons -- one of the fundamental particles which make up matter -- ought to be unstable over very long timescales. If those theories are correct, then after 10^{30} years or so, the protons in brown dwarfs, white dwarfs, and neutron stars will start to decay. The decaying protons turn into radiation, which flies off into the dark. Eventually, all these remnants disintegrate, leaving behind nothing but electrons, positrons, neutrinos, and radiation.

Only the black holes would be left.

The Black Hole Age

If protons really do decay, then after about 10^{30} years, black holes will be the only collections of matter which remain. Do they last forever, slowly orbiting each other in the isolated, coalesced galaxies?

No!

Black holes, it turns out, do emit a very, very small amount of radiation. Classically, nothing can escape their gravitational pull, not even light; but the rules of quantum mechanics permit a process by which photons or other elementary particles may -- on very rare occasions -- be emitted from the black hole. This is sometimes called "Hawking radiation." Under ordinary circumstances, it is minimal: the radiation emitted by a black hole of one solar mass corresponds to a temperature of 0.0000001 degrees Kelvin.

Nonetheless, during the Black Hole Age, there is plenty of time for this miniscule amount of radiation to carry away a significant portion of a black hole's mass. Moreover, as a black hole loses mass, its temperature and luminosity rise ... so the process speeds up. Eventually, even the most massive black holes must evaporate due to this radiation.

Mass of black hole	Time to evaporate
7×10^{22} kg (Moon)	10^{43} years
6×10^{24} kg (Earth)	10^{49} years
2×10^{30}kg (Sun)	10^{66} years
2×10^{36} kg (million Sun)	10^{84} years
2×10^{42} kg (galaxy)	10^{102} years

As its mass decreases, the amount of radiation emitted by a black hole increases. During the last few seconds of its life, an evaporating black hole emits a burst of light, X-rays, and gamma rays. The cold, dark space of the Black Hole Age will very, very, very occasionally be lit up as a black hole ends its life.

After about 10^{100} years, all the black holes are gone.

The Dark Age

After all the black holes have evaporated, (and after all the ordinary matter made of protons has disintegrated, if protons are unstable), the universe will be nearly empty. Photons, neutrinos, electrons and positrons will fly from place to place, hardly ever encountering each other. It will be cold, and dark, and there is no known process which will ever change things.

Conclusion:

What happens after this is speculative. It is possible that a Big Rip event may occur far off into the future. Also, the universe may enter a second inflationary epoch, or, assuming that the current vacuum state is a false vacuum, the vacuum may decay into a lower-energy state. Presumably, extreme low-energy states imply that localized quantum events become major macroscopic phenomena rather than negligible microscopic events because the smallest perturbations make the biggest difference in this era, so there is no telling what may happen to space or time. It is perceived that the laws of "macro-physics" will break down, and the laws of "quantum-physics" will prevail.

The universe could possibly avoid eternal heat death through random quantum tunnelling and quantum fluctuations, which could produce a new Big Bang in roughly10^{1056} years.

Not a happy ending.

****

BINARY STARS

Mr. Jeet Dutta

Lecturer, Department of Science & Humanities

Abstract: More than four-fifths of the single points of light we observe in the night sky are actually two or more stars orbiting together. The most common of the multiple star systems are binary stars, systems of only two stars together. The orbital periods and distances of binaries vary enormously. Some systems are so close that the surfaces of the stars are practically touching each other and can exchange material. Others may be separated by a few thousand Astronomical Units and have orbital periods of hundreds of years. Astrophysicists find binary systems to be quite useful in determining the mass of the individual stars involved. When two objects orbit one another, their mass can be calculated very precisely by using Newton's calculations for gravity. The data collected from binary stars allows astrophysicists to extrapolate the relative mass of similar single stars.

Introduction: The term binary star is a misnomer because it is actually a star system made up of usually two stars that orbit around one center of mass where the mass is most concentrated. A binary star is not to be confused with two stars that appear close together to the naked eye from Earth, but in reality are very far apart. These systems, especially when more distant, often appear to the unaided eye as a single point of light, and are then revealed as double (or more) by other means. Research over the last two centuries suggests that half or more of visible stars are part of multiple star systems. The term double star is often used synonymously with binary star; however, double star can also mean optical double star. Optical doubles are so called because the two stars appear close together in the sky as seen from the Earth; they are almost on the same line of sight. Nevertheless, their "doubleness" depends only on this optical effect; the stars themselves are distant from one another and share no physical connection. A double star can be revealed as optical by means of differences in their parallax measurements, proper motions, or radial velocities. 85% of the stars in the Milky Way galaxy are not single stars, like the Sun, but multiple star systems, binaries or triplets.

History: The observations of binary stars began with the invention of the telescope, with the first known recordings in the 17 th century. Giovanni Battista Riccioli discovered in 1650 that Mizar was actually a binary.

Christiaan Huygens found that that Theta Orionis was actually three stars in 1656, Robert Hooke made the same observation about Gamma Arietis in 1664, while in 1685 Father Fontenay observed that the star Acrux was really a binary pair.

William Herschel was the first person to coin the term binary star. He defined the term in 1802 as: "***The union of two stars, that are formed together in one system, by the laws of attraction".***

Herschel began his observation of binaries in 1779. The result was a cataloging of over 700 double stars systems as recorded in his book ***Catalogue of 500 new Nebulae ... and Clusters of Stars; with Remarks on the Construction of the Heavens*** in 1802.

By the next year, he concluded that these double stars must be binary systems.

It was not until 1827 though that an actual orbit of a binary star system was calculated. This was completed by Félix Savary of the star Xi Ursae Majoris.

Today over 100,000 binary star systems have been cataloged.

Classification of Binary Stars

Binary stars are classified into Six types according to the way in which they are observed: **1) Optical binaries, 2) Visual binaries, 3) Astrometric binaries, 4) Eclipsing binaries, 5) Spectrum binaries, 6) Spectroscopic binaries**

1) **Optical binaries -** These are simply two stars that happen to lie close to each other on the sky as seen from the Earth, though they do not have any real physical connection.

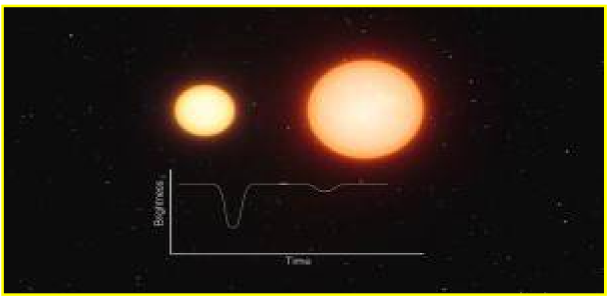


Figure 1: Optical Fibre

Visual binaries - A visual binary consists of two stars, usually of a different brightness. Because of this, the brighter star is called the primary and the fainter one is called the companion. If the primary is too bright, relative to the companion, this can cause a glare making it difficult to resolve the two components. However, it is possible to resolve the system if observations of the brighter star show it to wobble about a centre of mass. A **visual binary** is a gravitationally bound system. In order to work out the masses of the components of a visual binary system, the distance to the system must first be determined, since from these astronomers can estimate the period of revolution and the separation between the two stars. The trigonometric parallax provides a direct method of calculating a stars mass. This won't apply to the visual binary systems, but it does form the basis of an indirect method called the dynamical parallax. The study of visual binaries also reveal other useful stellar characteristics viz, densities, surface temperatures, luminosity, and rotation rates etc.

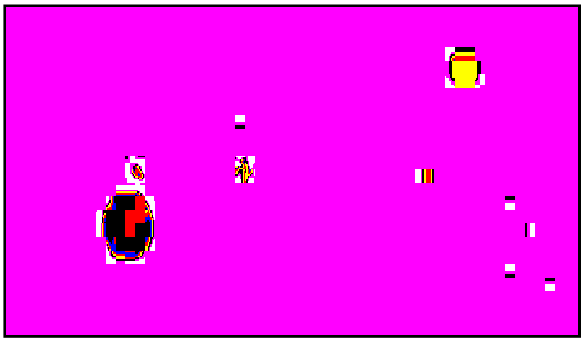


Figure 2: Visual Binary

2) **Astrometric binaries -**In many cases a binary system is too far away, or the stars are too close, or one star is so much brighter than the other that we cannot distinguish the two stars visually. In that case we may still infer that the system is binary by several indirect methods. One such method is to detect the presence of an unseen companion by its gravitational influence on the primary star. A binary discovered in this way is termed an ***astrometric binary***. This process is a slightly modified form of the method for visual binaries. The largest ground telescopes and also the Hubble space telescope are used to try and "see" the fainter component which might turn out to be a brown dwarf or a planet.

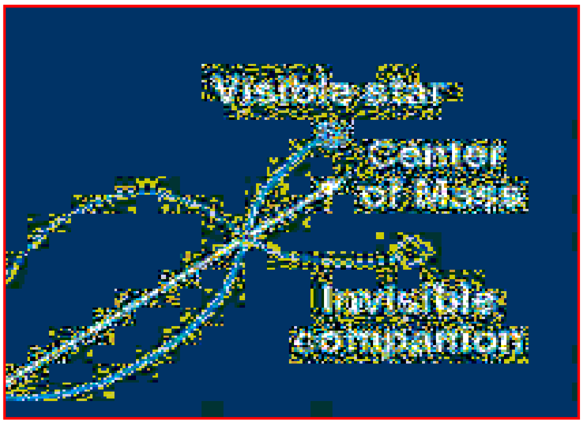


Figure 3: Astrometric Binary

3) **Eclipsing binaries-** An **eclipsing binary star** is a binary star in which the orbit plane of the two stars lies so nearly in the line of sight of the observer that the components undergo mutual eclipses. An eclipsing binary occurs when the orbital plane of the binary system is exactly perpendicular to the plane of the sky. In the case where the binary is also a spectroscopic binary and the parallax of the system is known, the binary is quite valuable for stellar analysis.

Eclipsing binary systems are incredibly important at **Super WASP** (**Wide Angle Search for Planets**) because the effects eclipsing binaries have on light-curves can be similar to that of some planets; as a planet will cause a dip in the brightness of a star when it orbits it like a star would do. Just knowing what kind of eclipsing binary system is present can be difficult enough, without the added challenge of distinguishing planets. Algol is the best-known example of an eclipsing binary.

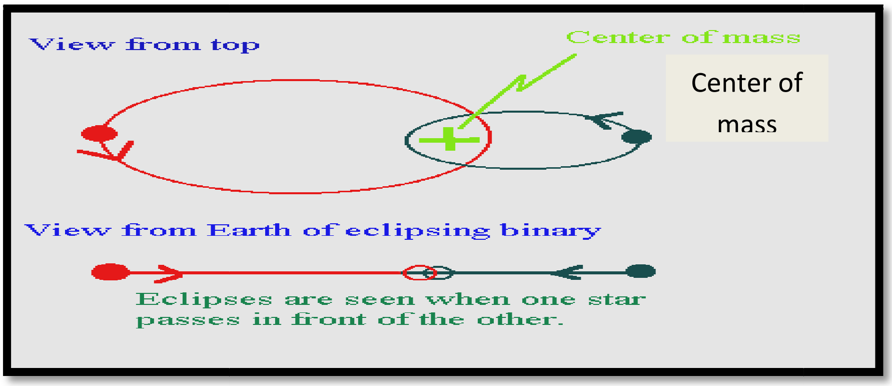


Figure 4: Eclipsing Binary

4) **Spectrum binaries -** These are binaries in which the spectrum consists of the spectra of two different stars. For instance the spectra of the two different stars may be shifted relative to each other because of the Doppler Effect.

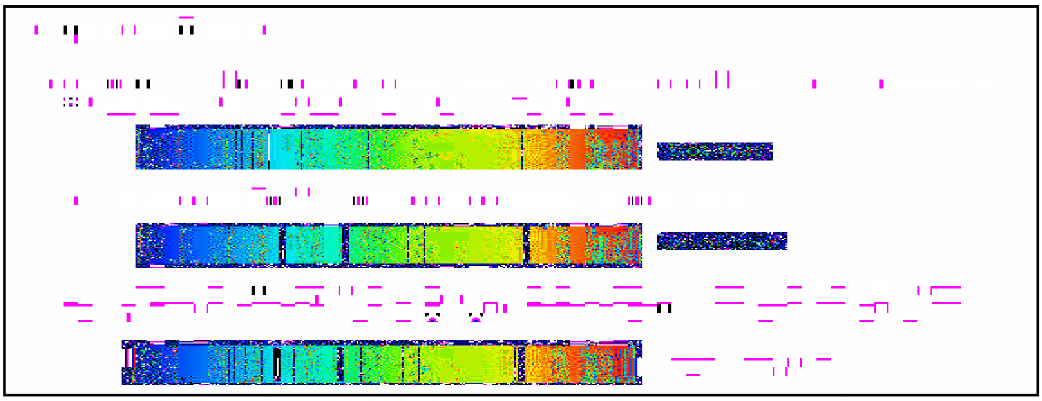


Figure 5: Spectrum Binary

5) **Spectroscopic binaries-** Sometimes, the only evidence of a binary star comes from the Doppler Effect on its emitted light. In these cases, the binary consists of a pair of stars where the spectral lines in the light emitted from each star shifts first toward the blue, then toward the red, as each moves first toward us, and then away from us, during its motion about their common center of mass, with the period of their common orbit. In these systems, the separation between the stars is usually very small, and the orbital velocity very high. Unless the plane of the orbit happens to be perpendicular to the line of sight, the orbital velocities will have components in the line of sight and the observed radial velocity of the system will vary periodically. Since radial velocity can be measured with a spectrometer by observing the Doppler shift of the stars' spectral lines, the binaries detected in this manner are known as **spectroscopic binaries.**

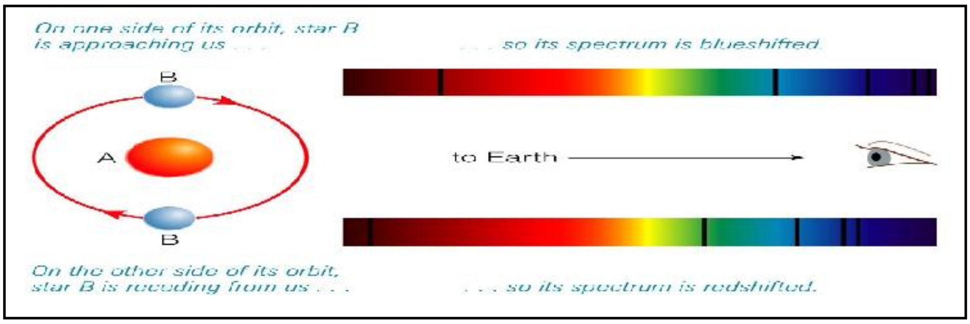


Figure 6: Spectroscopic Binary

Conclusion: There is a direct correlation between the period of revolution of a binary star and the eccentricity of its orbit, with systems of short period having smaller eccentricity. Binary stars may be found with any conceivable separation, from pairs orbiting so closely that they are practically in contact with each other, to pairs so distantly separated that their connection is indicated only by their common proper motion through space. Among gravitationally bound binary star systems, there exists a so called log normal distribution of periods, with the majority of these systems orbiting with a period of about 100 years. This is supporting evidence for the theory that binary systems are formed during star formation. Planets that orbit just one star in a binary pair are said to have "S-type" orbits, whereas those that orbit around both stars have "P-type" or "circum binary" orbits. It is estimated that 50–60% of binary stars are capable of supporting habitable terrestrial planets within stable orbital ranges.

References:

1. Binary and Multiple Star Systems. ***Lawrence Hall of Science at the University of California*****.** Retrieved December 13, 2008.
2. Binary Stars. ***Cornell Astronomy*****.** Retrieved December 13, 2008.
3. Daemgen, S.; Hormuth, F.; Brandner, W.; Bergfors, C.; Janson, M.; Hippler, S.; Henning, T. (2009). "Binarity of transit host stars – Implications for planetary parameters"
4. Kepler Eclipsing Binary Stars. I. Catalog and Principal Characterization of 1879 Eclipsing Binaries in the First Data Release
5. "THE ORIGIN OF BINARY STARS" ------Joel E. Tohline
6. wikipedia.org/wiki/Binary star
7. http://www.universetoday.com/24203/what-is-a-binary-star/

****

THIRD LAW OF THERMODYNAMICS

Mr. Sanjib Mukherjee

Lecturer, Department of Science & Humanities

Introduction

The Third Law of Thermodynamics is concerned with the limiting behavior of systems as the temperature approaches absolute zero. Most thermodynamics calculations use only entropy differences, so the zero point of the entropy scale is often not important. However, we discuss the Third Law for purposes of completeness because it describes the condition of zero entropy.

The Third Law states, “The entropy of a perfect crystal is zero when the temperature of the crystal is equals to absolute zero (0 K).” According to Purdue University, “The crystal must be perfect, or else there will be some inherent disorder. It also must be at 0 K; otherwise there will be thermal motion within the crystal, which leads to disorder.”

The third law of thermodynamics is sometimes stated as follows, regarding the properties of systems in equilibrium at absolute zero temperature: The entropy of a perfect crystal at absolute zero is exactly equal to zero. At absolute zero (zero Kelvin), the system must be in a state with the minimum possible energy, and the above statement of the third law holds true provided that the perfect crystal has only one minimum energy state. Entropy is related to the number of accessible microstates, and for a system consisting of many particles, quantum Mechanics indicates that there is only one unique state (called the ground state) with minimum energy. If the system does not have a well defined order (if its order is glassy, for example), then in practice there will remain some finite entropy as the system is brought to very low temperatures as the system becomes locked into a Configuration with non minimal energy. The constant value is called the residual entropy of the system.

The Nernst–Simon statement of the third law of thermodynamics concerns thermodynamic processes at a fixed, low temperature: The entropy change associated with any condensed system undergoing a 0 K.

Here a condensed system refers to liquids and solids. A classical formulation by Nernst (actually a consequence of the Third Law) is: It is impossible for any process, no matter how idealized, to reduce the entropy of a system to its absolute zero value in a finite number of operations.

Physically, the Nernst–Simon statement implies that it is impossible for any procedure to bring a system to the absolute zero of temperature in a finite number of steps.

History

The Third Law of Thermodynamics was first formulated by German chemist and physicist Walther Nernst. In his book, "A Survey of Thermodynamics" (American Institute of Physics, 1994), Martin Bailyn quotes Nernst's statement of the Third Law as, "It is impossible for any procedure to lead to the isotherm T = 0 in a finite number of steps." This essentially establishes a temperature absolute zero as being unattainable in somewhat the same way as the speed of light c. Theory states and experiments have shown that no matter how fast something is moving, it can always be made to go faster, but it can never reach the speed of light. Similarly, no matter how cold a system is, it can always be made colder, but it can never reach absolute zero. If the entropy of each element in some perfect crystalline state be taken as zero at the absolute zero of temperature, every substance has finite positive entropy. But at the absolute zero of temperature the entropy may become zero, and does so become in the case of perfect crystalline substances. This version states not only S will reach zero at 0 K, but S itself will also reach zero as long as the crystal has a ground state with only one configuration. Some crystals form defects which causes residual entropy. This residual entropy disappears when the kinetic barriers to transitioning to one ground state are overcome. With the development of statistical mechanics, the third law of thermodynamics (like the other laws) changed from a fundamental law (justified by experiments) to a derived law (derived from even more basic laws). The basic law from which it is primarily derived is the statistical-mechanics definition of entropy for a large system:

$$S - S_0 = k_B ln\Omega$$

where S is entropy, k_B is the Boltzmann constant, and Ω is the number of microstates consistent with the macroscopic configuration. The counting of states is from the reference state of absolute zero, which corresponds to the entropy of S_0.

Description

Entropy of a substance at ordinary temperature is found to be a function of (P,T) or (V,T). But when temperature decreases nearly to absolute zero it becomes independent of pressure and volume and depends only on temperature. In 1902 Richard's work on thermodynamic changes in a number of galvanic cell at low temperature showed that with the lowering of temperature G and H approach each other rapidly and at extremely low temperature in the vicinity of absolute zero they become equal. Thus Richard's work did not provide information regarding the rate of change of G and H with temperature near absolute zero

Explanation

In simple terms, the third law states that the entropy of a perfect crystal of a pure substance approaches zero as the temperature approaches zero. The alignment of a perfect crystal leaves no ambiguity as to the location and orientation of each part of the crystal. As the energy of the crystal is reduced, the vibrations of the individual atoms are reduced to nothing and the crystal becomes the same everywhere. The third law provides an absolute reference point for the determination of entropy at any other temperature. The entropy of a system, determined relative to this zero point, is then the absolute entropy of that system. Mathematically, the absolute entropy of any system at zero temperature is the natural log of the number of ground states times Boltzmann's constant k_B=1.38x$10^{-23,}$ JK^{-1}.The entropy of a perfect crystal lattice as defined by Nernst's theorem is zero provided that its ground state is unique, because ln(1) = 0. If the system is composed of one-billion atoms, all alike, and lie within the matrix of a perfect crystal, the number of permutations of one-billion identical things taken one-billion at a time is Ω= 1. Hence:

$$S - S_0 = k_B ln\Omega = k_B ln1 = 0$$

The difference is zero; hence the initial entropy S_0 can be any selected value so long as all other such calculations include that as the initial entropy. As a result the initial entropy value of zero is selected S_0 = 0 is used for convenience.

$$S - S_0 = S - 0 = 0$$

$$S = 0$$

By way of example, suppose a system consists of 1 cm^3 of matter with a mass of 1 g and 20 g/mol. The system consists of 3x10^{22} identical atoms at 0 K. If one atom should absorb a photon of wavelength of 1 cm that atom is

then unique and the permutations of one unique atom among the 3x10^{22} is N=3x10^{22}. The entropy, energy, and temperature of the system rises and can be calculated. The entropy change is:

$$\Delta S = S - S_0 = k_B ln\Omega$$

From the second law of thermodynamics:

$$\Delta S = S - S_0 = \frac{\delta Q}{T}$$

Hence:

Calculating entropy change: $S - 0 = k_B lnN = 1.38 * 10^{-23} * ln3 * 10^{22} = 70 * 10^{-22} JK^{-1}$

The energy change of the system as a result of absorbing the single photon whose energy is ε:

$$\triangle S = S - S_0 = k_B \ln(\Omega) = \frac{\delta Q}{T}$$

$$\delta Q = \varepsilon = \frac{hc}{\lambda} = \frac{6.62 * 10^{-34} J.s * 3 * 10^8 ms^{-1}}{0.01m} = 2 * 10^{-23} J$$

The temperature of the system rises by:

$$T = \frac{\varepsilon}{\triangle S} = \frac{2 * 10^{-23} J}{70 * 10^{-23} JK^{-1}} = \frac{1}{35} K$$

This can be interpreted as the average temperature of the system over the range from $0 < S < 70x10^{-23}$ J/K. A single atom was assumed to absorb the photon but the temperature and entropy change characterizes the entire system.

An example of a system which does not have a unique ground state is one whose net spin is a half- integer, for which time- reversal symmetry gives two degenerate ground states. For such systems, the entropy at zero temperature is at least k_B*ln(2) (which is negligible on a macroscopic scale). Some crystalline systems exhibit geometrical frustration, where the structure of the crystal lattice prevents the emergence of a unique ground state. Ground- state helium (unless under pressure) remains liquid.

In addition, glasses and solid solutions retain large entropy at 0 K, because they are large collections of nearly degenerate states, in which they become trapped out of equilibrium. Another example of a solid with many nearly- degenerate ground states, trapped out of equilibrium, is ice Ih, which has "proton disorder".

For the entropy at absolute zero to be zero, the magnetic moments of a perfectly ordered crystal must themselves be perfectly ordered, from an entropic perspective, this can be considered to be part of the definition of a "perfect crystal". Only ferromagnetic, ant ferromagnetic and diamagnetic materials can satisfy this condition. However, ferromagnetic materials do not in fact have zero entropy at zero temperature, because the spins of the unpaired electrons are all aligned and this gives a ground- state spin degeneracy. Materials that remain paramagnetic at 0 K, by contrast, may have many nearly- degenerate ground states (for example, in a spin glass), or may retain dynamic disorder (a quantum spin liquid).

Consequences of the third law

Absolute zero: The third law is equivalent to the statement that: "It is impossible by any procedure, no matter how idealized, to reduce the temperature of any system to zero temperature in a finite number of finite operations".

The reason, that T=0 cannot be reached according to the third law, is explained as with the help of a diagram:

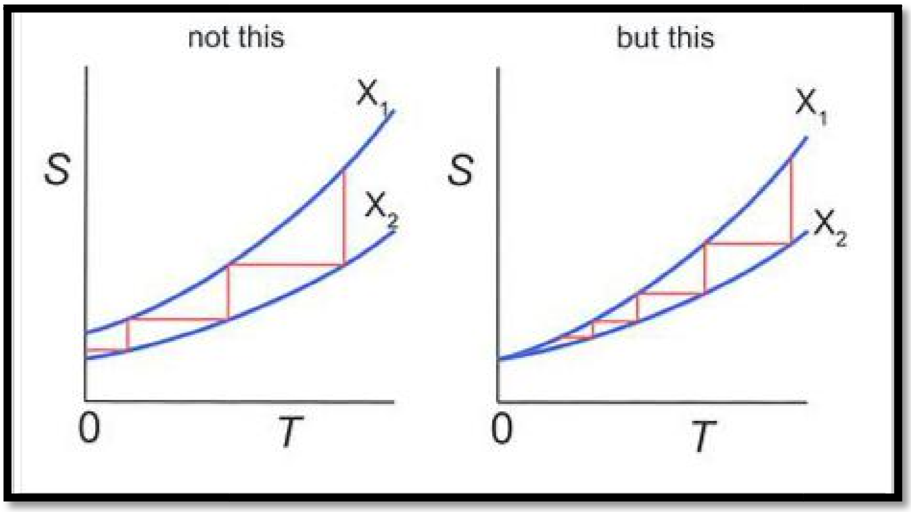


Figure 1: Left side: Absolute zero can be reached in a finite number of steps if $S(0,X_1) \neq S(0, X_2)$.
Right side: An infinite number of steps is needed since $S(0,X_1)= S(0,X_2)$

Suppose that the temperature of a substance can be reduced in an isentropic process by changing the parameter X from X_2 to X_1. One can think of a multistage nuclear demagnetization setup where a magnetic field is switched on and off in a controlled way. If there were an entropy difference at absolute zero, T=0 could be reached in a finite number of steps. However, at T=0 there is no entropy difference so an infinite number of steps would be needed. The process is illustrated in Figure 1.

Conclusion

The third law of thermodynamics states that the entropy of a system approaches a constant value as the temperature approaches absolute zero. Recall the third law of thermodynamics: at zero temperature the system must be in a state with the minimum thermal energy. Mathematically, the absolute entropy of any system at zero temperature is the natural log of the number of ground states times Boltzmann's constant kB. For the entropy at absolute zero to be zero, the magnetic moments of a perfectly ordered crystal must themselves be perfectly ordered.

****

NEXT GENERATION BIO-PLASTICS

Mrs. Pushmita Bhattacharya

Lecturer, Department of Science & Humanities

Bio-plastics obtained from lignin, a new source of organic chemicals significantly reduce costs and increase performances of biophysics.

Lignin is a complex hydrocarbon that provides structural support in plants and trees. It is obtained as a waste product of the pulp and paper industry, hence potentially abundant and cost effective. Next generation bio-plastics can be made from lignin. Scientists has been working to develop several organic chemicals by degradation of lignin using bacteria that has promising properties to be used as an advanced bio-plastics.

Researcher at the Ku Leuven Center for Surface Chemistry and Catalysis has found that the chemicals obtained from lignin can be used in paint, insulation foam and several other products.

Bio-plastics are plastics obtained from renewable biomass sources such as vegetable fats and oils, corn starch. It is also made from used plastics such as fossil fuel plastics(petro based polymers).Biodegradable bio-plastics can break down in either anaerobic or aerobic environments. Products on market produced from natural source are available for a wide range of applications such as cups, bottles, cutlery, plates, bags, bedding, mobile covers, furnishings, carpets, film, textiles and packaging materials. The production and use of bio-plastics is regarded as a more sustainable activity when compared with plastic production from petroleum(petro plastic) because it required less fossil fuels for its production and also introduces fewer green house emissions of its bio-degrades. The use of bio-plastics result in less hazardous waste than oil derived plastics as it remains solid for hundreds of years.

Polylactic acid (PLA) is a transparent plastic produced from corn or dextrose and is widely used in drinking straws, jar made from PLA-blend bio-flex.

****

LIFE SKILLS EDUCATION – A PART OF CURRICULUM

Mrs. Preetha Banerjee

Lecturer, Department of Science & Humanities

Life skills is a set of skills acquired through learning or direct life experience that are used to help individuals, effectively handle problem and questions encountered in their daily life.

Now the question comes to the mind of the student why there are classes on life skills in diploma engineering curriculum, "why do we need to study this kind of non departmental subject?" Students are the future of the nation. Democracy needs responsible citizen, responsible in true sense. They are the people who are well able to take responsibilities of themselves, their community or society and contribute to the political process.

Democracy depends upon those citizens who are

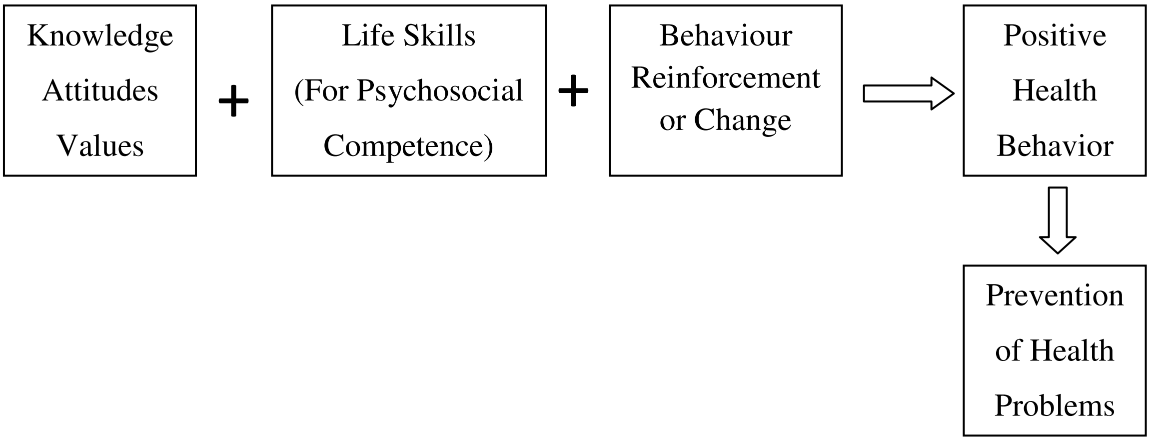
i. Well aware of their rights and responsibilities as the citizen
ii. Informed about social and political issues
iii. Concerned about the welfare of others
iv. Able to clearly articulate their opinions and arguments
v. Capable of having an influence on the world
vi. Active participation in community
vii. Responsible in how they act as citizens.

Certain life skills may be acquired through our everyday experience in home or at work. These are not enough to adequately equip citizens for the active role required in today's complex and diverse society.

Life skills touch upon the issues that are

1. Real: that affects a person's life
2. Topical
3. Sometimes sensitive: that affects a person on a personal level
4. Often controversial: people disagree and hold strong opinions about them.
5. Ultimately moral: they relate what people think is right or wrong, good or bad, important or unimportant in society

Teaching life skills as generic skills in relation to a everyday life could form the foundation of life skills education for the promotion of mental well being and healthy interaction and behavior. Problem specific skills such as assertively dealing with peer pressures to use drugs, to become involved in vandalism, could be built on this foundation. Teaching such skills is a part of broad - based life skills programme is an effective approach for primary prevention education.



The model above shows the model of life skills as a link between motivating factors of knowledge, attitudes and values, and positive health behavior- contributing to the primary prevention of health problems.

Acquisition and application of life skills can influence the way we feel about ourselves and others, and equally will influence the way we perceived by others. Life skills contribute to our perceptions of self- efficacy, self confidence and self esteem. Life skills play an important role in the promotion of well being.

In life skills education, students are actively involved in a dynamic teaching and learning process. The methods used to facilitate this active involvement include working in small groups and pairs, brainstorming, role play, games and debates. A life skill lesson may start with a teacher exploring with the students what their ideas or knowledge is about a particular situation in which life skills can be used.

****

EDUCATED UNEMPLOYMENT IN INDIA: A PROBLEM

Miss. Soumi Das

Lecturer, Department of Science & Humanities

Introduction

The system of Higher Education in India has travelled a long way. Today, we have more than 722 different types of Universities and numerous colleges. Higher education, nowadays, has reached to all corners and concerns of this country. Today one can find progress of Technical higher education also and fruits of its development are also enjoyed by women too. We had ancient Universities like Takshshila, Nalanda & Vallabhi and now every state has University-some of them are controlled by central government and some are controlled by various State governments. We have private Universities also who depend on students' fees. Some institutes of higher learning are also given status of "Universities Deemed to be".

Significance of Higher Education in India

When one looks at importance of Higher Education, one would note that the system of Higher Education enjoys importance at micro, as well as at macro level. It prepares individuals with knowledge and skills which are needed for development of all sectors of economy. Thus, it supplies skilled and trained Human power, demanded by various sectors of our economy. Therefore, matter of quality is a great concern for all of us as effectiveness and efficiency of the system will depend on quality of the system. If a system of Higher Education is having a good quality, nation as a whole would be benefited because purposes of different sectors will be served satisfactorily. One must remember that human resources are of great importance as quality of output will depend on quality of inputs. On the other hand, absence of highly trained and skilled human power will lead to wastage of all resources.

Measures of Quality

One has to remember that the system of Higher Education comprise of undergraduate, post graduate, M.Phil and Ph.D. level courses. Following are some of the indicators for quality with reference to a system of Higher Education:

i. Nature or Character of curriculum
ii. Demand for different types of Human power
iii. Human Resource's character

iv. Allocation of money to Higher Education

Nature or Character of curriculum

We have to remember one thing that supply must be in match with demand. We have to now keep pace with modern technology which has now become inseparable part of our life when we keep in mind all these things; we need to look at our present curriculum. We need to make proper changes with regard to our curriculum as we cannot go a long way with our unchanged curriculum. This is because we cannot respond to market demands and our inputs will simply be wasted and there will be either "Under-employment "or "Unemployment". At micro and macro level, we cannot afford with this situation. Therefore, we must make efforts for bringing relevant changes with regard to our curriculum- both theoretical and sessional aspects. This is true especially for higher professional education. We need not follow blindly whatever takes place in west but at the same time, we cannot close our eyes totally. We should not take unnecessary pride for our age old curriculum under the name of preservation of our old culture. We must change with time and there is no harm if we make proper use of modern educational technology.

Demand for different types of Human power

We should not forget a fact that supply must be accordingly to demand made by different sectors of our economy. If output from various institutions of higher learning is as per demand, we will not find mismatch. This is possible when our human resources are getting latest knowledge and good thinking.

We should not rely on age old things. If our human power is not properly trained for use of modern technology, they would not be of much use for their employers and hence they will not get proper earning. Hence, there will be wastage of Human resources in terms of energy they put in an amount which is spent on them. If they do not update themselves much, they won't find good demand for them from their customers.

Human Resource's character

For ensuring good quality, not only theoretical knowledge but knowledge in terms of sessional aspects will also be of great importance and human resources need to keep pace with latest trends in their own field. They must acquire latest knowledge with needed training. They should develop positive attitude towards changes and they must adopt them, if needed.

Finance to Higher Education

We must feel sorry for one important thing i.e. allocation of money to Higher Education. Though, we all are aware about importance of higher education for a nation but when it comes to allocation from government, we often observe that for government, education was never a priority. But it came only from an end, Secondary Education Commission (1964-66) according to whom, 6% of our Gross National Product (GNP) should be allocated to Education but government has not spend more than 3% of GNP for education.

If we dream for India to be a super power economy in near future, government has to pay due attention and act accordingly. If government leaves everything to private sector, it is not acceptable at all; as many times it is found that private sector is not serving interests of majority but of few only. Further, growth of general streams of higher education was never interest of private sector as money making was possible only in case of professional higher education.

Reasons for low quality of Higher Education:

i. Irrelevant out dated curriculum syllabus
ii. Lack of good quality training of human resources
iii. Lack of sufficient allocation of money to higher education system
iv. Large scale unemployment
v. Lack of due interest of private initiatives
vi. Lack of adequate infrastructure facilities in institutions of higher learning
vii. Lack of suitable mechanism for improvement of quality of higher education

Therefore, due measures need to be taken to overcome these causes which are responsible for low quality of a system of higher education.

Causes for low rate of Employment

It is well known fact that in India, person is deprived from his earnings for the job. Here he/she is either underemployed or unemployed. Unemployment is a situation when one is jobless. We need to understand various causes for this situation.

1. ***Outdated curriculum:*** It is a sad state of affair that curriculum at all levels, especially in higher education, is outdated. We are still following that age old curriculum. In other words, we fail to keep pace with the changing world. We must regularly update our curriculum since failure in this regard will lead to a situation where we cannot provide employment to those who would pass out from institutions of higher learning. Therefore, we

need to include all those inputs in curriculum, so they will keep pace with changes of modern times. Transaction of revised curriculum in our classrooms will make it easier for our products to get proper employment.

2. ***Lack of proper skill development to those who study in institutions of higher education:*** We provide such education which is not only age old but we provide theoretical education – to a great extent and we fail to equip our outputs with such skills which would help them in job markets. The situation is truer in case of general education. We must make our education more practice based since such education would prepare our products to earn or to get reward from whatever they put in. They do invest time, money and physical as well as mental labor and if they do not get proper return out of their investment, it is not a desirable situation. They have to get proper, return from their investment otherwise that is not an investment.

3. ***Lack of enterprising attitude among young people:*** Those who pass out from institutions of higher learning – be from any discipline, they would look for a job where they would be employed by others. But they lack an enterprising attitude which would make them self employed. There are many professions and occupations where they can earn for themselves. They can be their own employers. There are many virgin fields which needs exploration. Of course, that will demand more time but they need to be patient for earning. When they earn by their own efforts, they would get lot of freedom/autonomy to work. They can evolve their own set of rules than following someone's rules. Even if their reward is not very high in the beginning, they need to wait for some time to get higher earnings.

4. ***Absence of good enthusiasm for vocational education***: This is in match with what Ghandiji said centuries ago. Such education would help them in two ways. One, they would be able to earn and secondly, they would develop dignity of labor. They should not consider any work of inferior status. They should drive out such notions from their mind. They should give equal value to all jobs. This is because that job would help them to earn something (Beneficial at micro level) and society, at large, would also be benefited (Beneficial at macro level). Therefore, we would be able to solve problem of unemployment which at present is prevailing on larger scale. Educated persons would not be trapped by concept of so called "social status" attached to some jobs only.

5. ***Mismatch between supply and demand:*** When one keeps in mind two elementary

concepts of economics, one would notice that in India, supply of highly educated human power is more torn then their demands in job markets. In our mad race to increase rate of higher education, we did promote private efforts and we did produce greater number of output from our institutions of higher learning. Thus, not only colleges and universities increased in number but we also produced very large number of products. At the same time, various sections of economy fail to employ them in sufficient number and hence there was way a situation of unemployment.

Conclusion

One cannot deny importance of higher education at micro and macro level. Our ultimate goal should be improvement of quality because more quantitative expansions cannot ensure long term development in a real sense. If we want to transform our dream of being a "Super Power Economy" in reality, we must make hard efforts to bring quantitative improvement in a positive direction. At the same time we have to make sincere efforts to increase employment among our educated youth because if they remain unemployed for a longer time, our dream of development will not be achieved in a real sense.

Reference

[1] Government of India (1998) Unorganized Manufacturing Sector in India: Its Size, Employment and Some Key Estimates, July 1994–June, 1995, NSS Report No. 433. New Delhi: National Sample Service Organization.

[2] Dev, S. Mahendrav and M. Venkatanarayana (2011) Youth Employment and Unemployment in India, Indira Gandhi Institute of Development Research, Mumbai

[3] Visaria, P. (1998) Unemployment among Youth in India: Level, Nature and Policy Implications. Employment and Training Paper 36, Employment and Training Department. Geneva: International Labor Organization.

[4] World Bank (2010) India's Employment Challenge – Creating Jobs, Helping Workers. New Delhi: Oxford University

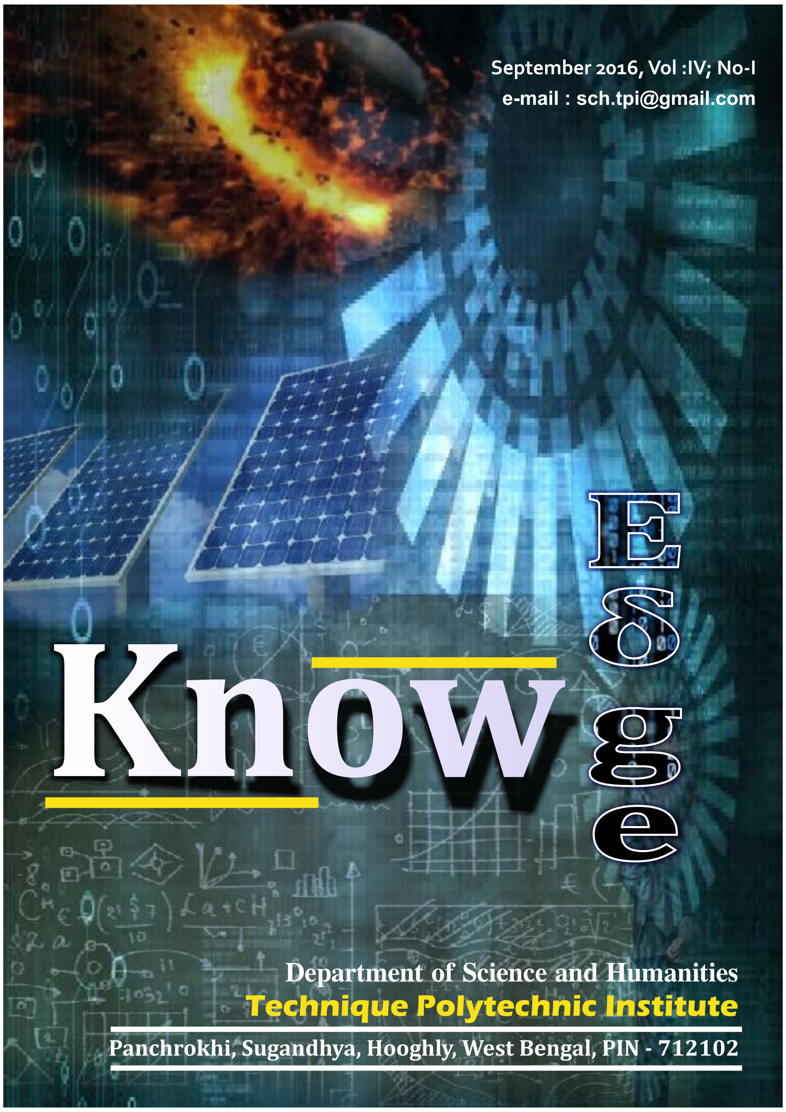
[5] http://www.importantindia.com/10338/short-essay-on-unemployment-in-india/

[6] http://www.importantindia.com/2405/unemployment-is-a-major-problem-in-india/

[7] http://www.futureofeducation.com/profiles/blogs/problems-and-solutions-to-unemployment-in-india

[8] http://nptel.ac.in/courses/109103022/11

****


September 2016, Vol :IV; No-I
e-mail : sch.tpi@gmail.com
Know
Edge
Department of Science and Humanities
Technique Polytechnic Institute
Panchrokhi, Sugandhya, Hooghly, West Bengal, PIN - 712102