

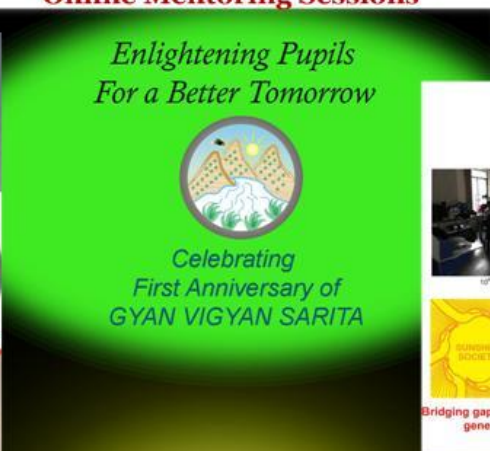
# GYAN-VIGYAN SARITA: शिक्षा



A non-remunerative, non-commercial and non-political initiative to Democratize Education as a Personal Social Responsibility (PSR)

1<sup>st</sup> Annual Issue, 5<sup>th</sup> Quarterly e-Bulletin, dt 2<sup>nd</sup> Oct'17

**We are no more alone !**  
**There are Four More Co-passionate Groups**  
**Collectively Complementing the initiative of**  
**Online Mentoring Sessions**



**Together Each Achieves More**  
**(TEAM)**

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WE COLLECTIVELY COMPLEMENT WITH

- [SARTHAK PRAYASH](#)
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- [RKM School, Guntur and Ek Kadam Aur](#)
- [MORNING STAR SOCIETY](#)

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***e-Bulletin – Eco-friendly: It is a considered decision to make this communiqué an e-Bulletin, and thus save paper. May please like to share it, but please do not print it, unless it is a must.***

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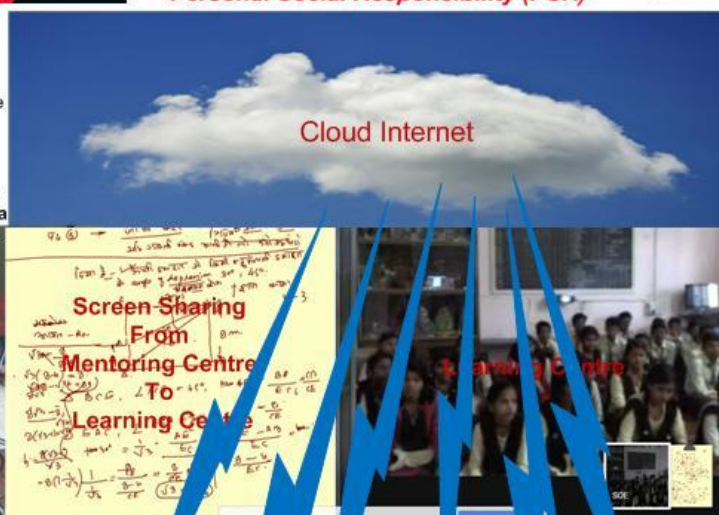


***Aim for the Best, but...***

**Conceptual Representation**  
of  
**Online Mentoring**  
An Initiative To Bridge Gap between  
**Passionate Teachers**  
and  
**Desperate Students**  
**A Selfless Endeavour**  
to  
**Democratize Education**  
with a sense of  
**Personal Social Responsibility (PSR)**



**Equipments at Mentoring Center**  
1.Desk-/Lap-top  
2. WebCam  
3. Headset with Microphone  
4. Digital Pen  
AND  
Broadband-Internet  
Connection: **Min. 20 Mbps**  
and **(1xN) GB** monthly data  
capacity; N= No of Hours  
of Monthly sessions



**Equipments at Learning Center**  
1.Desk-/Lap-top  
2. WebCam  
3. Speakers  
4. USB Microphone  
5. Overhead Projector.  
6. UPS ( For Continuous Power Supply to computer, internet modem and L&F)  
AND  
Broadband-Internet  
Connection: **Min. 20 Mbps**  
and **(1xN) GB** monthly data  
capacity; N= No of Hours  
of Monthly sessions



**Important Links**  
1. Good Internet Connectivity (Wired Broadband Connection)  
2. Subject-wise Coordinator for Each Session to Bridge Learning Gaps between Mentor & Students

**Special Features**  
1. Free and Open to all to adopt. Modify, change, correct  
2. Welcomes participation, promotion and facilitation on Zero-Fund-Zero-Asset (ZFZA) basis  
3. More details on Technological and Operational – please write on <http://www.gyanvigvansarita.in/contact/>



***... start, without loosing time, with whatever is available.***

## SHOWER OF DIVINE BLESSINGS

Visit of Swami Gautamanandaji Maharaj to the Virtual Classroom

R.K.Mohan Rao [rkmoohanrao@gmail.com](mailto:rkmoohanrao@gmail.com)

Mon, Sep 25, 2017 at 1:47

PM

to: Satish Tripathi [satishctripathi2005@yahoo.com](mailto:satishctripathi2005@yahoo.com)

cc: Subhash Joshi <subhashjoshi2107@gmail.com>, Vijayawada Ramakrishna Mission <vijayawada@rkmm.org>

Dear Dr.Tripathiji,

Namaste. We are very happy to inform you that Most Revered Swami Gautamanandaji Maharaj, one of the Vice-presidents of Ramakrishna Order, sanctified our Virtual Classroom and witnessed the session of Dr.Subhash Joshi. Subsequently Swami Gautamanandaji and Swami Sashikantanandaji interacted with Dr.Joshi and it is very touching. Swami Sashikantanandaji Maharaj is the Secretary of Ramkrishna Mission, Vijaywada and Correspondent of Ramkrishna Mission High School, Sitanagaram.



We briefed Swami Gautamanandaji about our association with Ek Kadam Aur and the key role you are playing in promoting the concept of e-learning with e-volunteers. He is quite appreciative of harnessing of technology for achieving excellence in the field of education. He expressed his deep satisfaction over the developments that took place at our school and wished for its replication at all other Ramakrishna Mission Schools throughout the country.

We are attaching herewith the brief biodata of Swami Gautamanandaji Maharaj for your reference.

Today we could resolve the issue of Audio problem and restored the interactive feature of Virtual Classroom.

With regards,  
R.K.Mohan Rao

—00—

### Srimat Swami Gautamanandaji Maharaj



Swami Gautamanandaji joined Ramakrishna Movement in 1951 and received his early spiritual training under Swami Ranganathanandaji and was ordained as a monk in 1966 by Swami Vireshwaranandaji, the tenth President of the Order.

The Swami worked among the tribal people of Arunachal Pradesh (Aalo) and Chhattisgarh (Abujmarh area of Narainpur) for 20 years vigorously promoting value-based education. He served as the General and Executive Member of the Central Board of Secondary Education (CBSE) and the National Council for Educational Research and Training (NCERT), New

Delhi, the two major National educational bodies of Government of India.

The Swami also worked in Ramakrishna Mission centres at Mumbai, Cherrapunjee, Kolkata, Aalo, Raipur and Narainpur. He was appointed as a Trustee of the Ramakrishna Math and was nominated as a member of Governing Council of Ramakrishna Mission in 1990. Since 1995 he is serving as Adhyaksha of Ramakrishna Math at Chennai. Under his stewardship, a glorious Universal Temple of Bhagavan Sri Ramakrishna Paramahansa was built and in due time it has become an eminent Spiritual centre in South India, organising number of spiritual and service activities. In 2017, he became one of the Vice-presidents of the great Ramakrishna Order with its presence not only in India but also in various other countries.

The Swami organised extensive relief operations in India and is an expert in India's cultural heritage. He has lectured extensively both in India and abroad in the East and West to spread the universal message of Sri Ramakrishna in the light of Neo-Vedanta. He is proficient in English, Sanskrit, Hindi, Kannada, Tamil and Bengali. He is highly regarded for his thought-provoking lectures. He has also contributed a number of articles to leading journals.

—00—



## संपादकीय

### नई पहल का एक वर्ष

किसी मंजिल पर पहुंचने के लिये सबसे पहले हमें घर से निकलना पड़ता है। बस हम निकले नहीं कि यात्रा प्रारंभ हो जाती है। मंजिल जो अबतक दूर थी, धीरे धीरे हमारे नजदीक आती जाती है, और एक क्षण ऐसा आता है कि हम मंजिल पर होते हैं। मंजिल पर पहुंचने ही हमें आभास हो जाता है कि यह तो बहुत आसान काम था। बस कठिन काम था, इस यात्रा की शुरुआत करना, चल पड़ना, और चलते रहना। किसी यात्रा की शुरुआत ही उसके खत्म होने की तरफ चल पड़ना होता है। हर शुरुआत में ही उस यात्रा का अंत छिपा होता है। हम इसे ऐसे भी कह सकते हैं कि हर काम की शुरुआत में ही उस काम की पूर्णता छिपी रहती है। किसी भी काम को पूरा करने का एक ही तरीका होता है-उसे करना, करते रहना और अंत तक उसमें लगे रहना।

जब थामस एडिसन बिजली के बल्ब की खोज कर रहे थे, तब उन्हें कई कठिनाइयों का सामना करना पड़ा था। वह लगातार कई बार असफल होते रहे। उनका बल्ब कभी या तो जला ही नहीं अथवा कभी जला, तो चला ही नहीं। पर, उन्होंने हार नहीं मानी। कहा तो यहां तक जाता है कि वह 10 हजार बार असफल हुये। जब किसी ने उनसे इतनी बार की असफलता के बारे में पूछा तो उन्होंने कहा - मैं असफल नहीं हुआ हूं, बल्कि मैंने बस 9999 ऐसे तरीके खोज लिये हैं जो काम नहीं करते हैं। यह होती है, काम पूरा करने की उमंग, उत्साह और लगन।

हमारी सबसे बड़ी कमजोरी है, हार मान लेना। जो हार नहीं मानता है, वह दूसरों से भिन्न हो जाता है, और प्रतिभावान बन जाता है। प्रतिभावान बनना बड़ा आसान होता है। प्रतिभावान वही है जिसने प्रयास किया और पसीना बहाया। हमें याद रखना चाहिये कि कठिन परिश्रम का कोई विकल्प नहीं होता है। हममें क्या है, यह

हमारे काम से लोगों को मालूम पड़ जाता है। अच्छा काम वह होता है जिसे अलग से बताने की जरूरत नहीं पड़ती है।

हमारा प्रयास बुद्धिमत्ता को प्रकाशित करना है। हमारा उद्देश्य उन्हें राह दिखाना है जो किन्हीं कारणों से समाज से उपेक्षित हो गये हैं, और पुनः मुख्य धारा में आने के लिये संघर्ष कर रहे हैं। हां, यह सच है कि ऐसे लोगों को जोड़ते-जोड़ते, अगर मुख्य धारा में पहले से मौजूद लोग भी हमारे प्रयास से लाभ प्राप्त कर लेते हैं, तो यह हमारे लिये अत्यंत गौरव का क्षण होता है, क्योंकि ज्ञान की सुगंध, अथवा ज्ञान का प्रकाश, बिखरते समय किसी से भेदभाव नहीं रखता है।

किसी बागीचे के विकास में उसके माली की सहनशीलता, अनवरत निगरानी और मेहनत जरूरी होती है। कोई भी पौधा इसलिये विकसित नहीं होता है कि पौधे का बढ़ना उसकी नियति है। वह इसलिये बढ़ता है कि माली ने उस पर ध्यान दिया, उसके लिये उपयुक्त वातावरण बनाया और उसे वह सबकुछ दिया जो उसके बढ़ने के लिये हर क्षण जरूरी था। ठीक यही कार्य ज्ञानविज्ञानसारिता परिवार का है। इसका ध्येय है सबका विकास करना और '**हम कर सकते हैं**' इस भाव का संरक्षण करना। ज्ञान, विश्वास, और गुरुकृपा की कोई सीमा नहीं होती है। ज्ञानविज्ञानसारिता परिवार इन्हीं तीनों अद्भुत अपरिमितताओं का मिश्रण है। कारवां बनाने के लिये तो बस एक व्यक्ति को आगे चल पड़ने की जरूरत होती है, पर हमें यहां यह लिखने में तनिक भी संकोच नहीं है कि ज्ञानविज्ञानसारिता परिवार का हर सदस्य स्वयं में एक कारवां है।

वर्ष की शुरुआत में ज्ञानविज्ञानसारिता परिवार के लोग भिन्न-भिन्न थे। एक दूसरे से अपरिचित थे, पर सबमें एक बात समान थी कि उन सबका ध्येय एक था-पढ़ने वाले बच्चों के भविष्य को



तराशना, उनमें छिपी प्रतिभा को निखारना, और उन सपनों को पूरा करना, जिसे उन्होंने हमारे संरक्षण में रहते हुये देखा था।

एकजुट मेहनत रंग लायी। प्रयास सफल हुये, और आज लंबे अंतराल के बाद, जब हम पीछे मुड़कर देखते हैं, और अपने विद्यार्थियों को इंजिनियरिंग की कक्षाओं में पढ़ते हुये पाते हैं, तब हमें आश्चर्यजनक अनुभूति होती है कि हम कहां से कहां आ गये! यह हमारे लगातार काम में लगे रहने और उसे करते जाने, करते जाने का नतीजा रहा। हमारे प्रयास ने प्रकृति के उस नियम को सिद्ध किया कि प्रयास कभी व्यर्थ नहीं जाता है, क्योंकि प्रयास ऊर्जा है, और विज्ञान कहता है कि ऊर्जा कभी विनष्ट नहीं होती है। ऊर्जा नश्वर है।

अक्टूबर का महीना घटनाओं की दृष्टि से बहुत ही महत्वपूर्ण है। 1 अक्टूबर को हम अंतराष्ट्रीय वृद्ध दिवस के रूप में मनाते हैं। 2 अक्टूबर को अंतराष्ट्रीय अहिंसा दिवस के रूप में मनाते हैं। 5 अक्टूबर अंतराष्ट्रीय शिक्षक दिवस के रूप में मनाया जाता है। 9 अक्टूबर विश्व डाक दिवस के रूप में मनाया जाता है। 15 अक्टूबर डा० ए०पी०जे०अब्दुल कलाम का जन्मदिन है। डा० कलाम भारत के ग्यारहवें राष्ट्रपति रहे हैं। उनका मानना था कि इंतजार करने

वालों को सिर्फ उतना ही मिलता है, जितना कोशिश करने वाले छोड़ देते हैं। वे कहते थे कि जीवन में कठिनाइयां हमें बर्बाद करने नहीं आती हैं, बल्कि वे हमारी छुपी हुयी क्षमता और शक्तियों को बाहर निकालने में हमारी मदद करती हैं। हमें कठिनाइयों को यह जान लेने देना चाहिये कि हम उनसे भी ज्यादा कठिन हैं।

यह वार्षिक अंक आपके हाथों में सौंपते हुये, हमें अत्यंत प्रसन्नता हो रही है। आपके पास यह अंक पहुंचते ही, हमें अपने कार्यों पर विश्वास हो चला है, कि अगर काम करते जाओ तो मंजिल जरूर मिलती है। यह कहने में संकोच नहीं है कि ज्ञानविज्ञानसरितापरिवार बच्चों के भविष्य को शिक्षा के माध्यम से निखारने में दीपक बनकर जो प्रयास कर रहा है, वह प्रयास एक दिन सूरज बनकर अपनी किरणों से जरूरतमंदों को उजाला अवश्य देगा। कबीर ने सच कहा है:

जिन दूढ़ा तिन पाईया, गहरे पानी पैठ

जो बउरा डूबन डरा, रहे किनारे बैठ

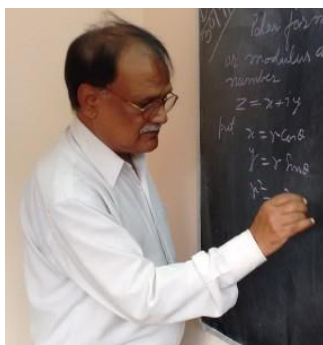
अर्थात् जो गहरे पानी में डूब कर खोजेगा, उसे ही मोती मिलेगा। जो डूबने से डर जायेगा, वह किनारे बैठा रह जायेगा।

—00—

## हमारा पंचवर्षीय प्रवास



Start: June-2012



April-2015



June-2016.....

पारम्परिक शैक्षणिक मार्दर्शन से प्रारम्भ कर आज हम तकनीकी-विकास के सहारे शिक्षा की मूलभूत प्रासंगिकता को आगे बढ़ने में संलग्न हैं

## An Appeal: Gyan Vigyan Sarita

### A non-organizational initiative of a small set of Co-passionate Persons

**Philosophy:** Personal Social Responsibility (PSR)

**Objective:** Groom competence to Compete among unprivileged children from 9<sup>th</sup>-12<sup>th</sup> in Maths and Physics, leading to IIT-JEE.

**Financial Model: Zero-&-Fund-Zero-Asset (ZFZA).** It calls for promoters and facilitators to provide infrastructure for use to the extent they feel it is neither abused nor there is a breach of trust. And, reimbursement of operational expenses to the participators

#### Operation:

- a. **Mode:** Online since July'16, using Google Hangouts, a free we-conferencing S/w, with connectivity upto 15 nodes.
- b. **Participation:** Voluntary and Non-remunerative, Non-Commercial and Non-Political

#### Involvement:

- a. **As Promoter –**
  - i. Initiate a Learning Center,
  - ii. Sponsor a Mentor who is willing to join on certain terms,
  - iii. sponsor cost of operation and up-gradation of infrastructure to voluntary mentors,
  - iv. Sponsor Website.
- b. **As Facilitator –**
  - i. Provide space and infrastructure for **Online Mentoring Sessions (OMS)**, which is generally available, with a marginal add-on,
  - ii. Garner support of elite persons to act as coordinators at a Learning Centre.
- c. **As Participant –**
  - i. As a Mentor,
  - ii. As Coordinator,
  - iii. As Editor and or contributor of thought provoking articles for e-Bulletin, which are relevant to the initiative, and make it more purposeful and reachable to the target audience.
  - iv. As author of Chapters for Mentors' Manual, being uploaded as a Free Web Resource,

- v. Anything else that you feel can add value to the mission and make it more purposeful.
- vi. *Anything else that you consider to make this initiative to become more effective.*

**Background:** The initiative had its offing in May'12, when its coordinator, a power engineer by profession, soon after submission of Ph.D. Thesis in April'12, at IIT Roorkee, at the age of 61 years, decided to mentor unprivileged students.

SARTHAK PRAYASH, a Ghaziabad based NGO, warmly accepted the proposition and created a facility to mentor students from 8+ to prepare in mathematics and physics and prepare them for engineering entrance tests. They warmly reciprocated and created a class room.

Experience in this selfless social work were used to navigate across without losing focus. He was associated with SUBODH FOUNDATION from Sept'15 to Sept'16 during which he published a monthly e-Bulletin **SUBODH-पत्रिका** to create visibility across persons who could make a difference.

In Sept'16, post transition, the mission has been continued as a non-organizational entity **Gyan Vigyan Sarita**, with a set of Four persons, including retired **Prof. SB Dhar**, Alumnus-IIT Kanpur, a middle aged **Shri Shailendra Parolkar**, Alumnus-IIT Kharagpur, settled at Texas, US and **Smt. Kumud Bala**, Retired Principal, Govt. School Haryana. Earlier, they were complementing the OMS. While, the initiative survived transition, a website: <http://gyanvigyansarita.in> has been launched. It contains under its **Menu: Publication>e-Bulletins**, and **>Mentors' Manual**. You may like to read them.

**Actions Requested:** May please like to ponder upon this initiative. **Queries**, if any, are heartily welcome. We would welcome your collective complementing in any of the areas listed at **Involvement**, above, to make the mission more purposeful and reachable to target children.



## Coordinator's View

### Democratic Competition – Education

We did talk of competition while democratizing education and it was responded by social thinkers quite paradoxically. Despite, we put forth our views through this column not as an imposition but to initiate a thought process. Democracy and education is a subject where philosophers, thinkers, statesmen and many others have given valuable thoughts. Among them Geetanjali by Gurudev Ravindranath Tagore is held in high esteem. Founding Father of independent America, Gorge Washington had advised to **“Observe good**

**faith and justice toward all nations. Cultivate peace and harmony with all”**.

Another president of United States, Franklin D. Roosevelt went beyond political and social perspective to say that **“Democracy cannot succeed unless those who express their choice are prepared to**

**choose it wisely. The real safeguard of democracy, therefore, is education”**. The father of nation Mahatma Gandhi had said **“My notion of democracy is that under it the weakest shall have the same opportunities as the strongest... no country in the world today shows any but patronizing regard for the weak... Western democracy, as it functions today, is diluted fascism... true democracy cannot be worked by twenty men sitting at the center. It has to be worked from below, by the people of every village. OR I understand democracy as something that gives the weak the same chance as the strong”**. Swami Vivekananda, initially a science student, who turned into monastery, had said **“They speak of democracy, of the equality of all men, these days. But, how will a man know he is equal with all? He must have a strong brain, a clear mind free of nonsensical ideas; he must pierce through the mass of superstitions encrusting his mind to the pure truth that is in his inmost Self. Then he will know that all perfections, all powers are already within himself that these have not been given to him by others. When he realises**

**this, he becomes free that moment, he achieves equality”**

These inspiring thoughts created many questions to meditate and explore as what are the expectations of **a person in democracy who comes from an unprivileged background** - Does he understand meaning of democracy? Does democracy mean equal rights to unequal? Can unequal compete to make a way? What are the means of bridging inequality? Are they only pacification with promises, or a socio-political mechanism to equalize unequal, or dedicated effort to groom competence among deprived to compete?

An introspection of these questions has been behind genesis of this initiative which sprouted about 8 years ago. Persons coming

from privileged class are bound to advance argument of natural justice in higher opportunities to person with higher competence. Prima facie, it sounds to be perfect and logical. But, in sociological context a question that needs consideration is that - *is a person, in present, enough for comparison?* Answer is obviously NO! Biologically all are born equal, but with unequal opportunities; this is not a fault of the new born. Does it mean that a society, responsible for inequality, can deny right to grow to unprivileged child?

This is where privileged ones need to come forward to embrace to less- or un-privileged ones as their *personal social responsibility* (PSR). This requires a pro-action, just not a lip sympathy. It has to be translated into ground reality; else it would be just hypocrisy. This reality requires grooming of competence among unprivileged to compete with persons who are born in families blessed with opportunities more than their need. This is where, Class Conflict propounded by Karl Marx starts surfacing. And privileged persons start devising ways, means and logics to preserve their belonging right from possession to position.

Winston Churchill a powerful wartime Prime Minister of world's largest empire had opined that - *“The best*

*Where the mind is without fear and the head is held high  
Where knowledge is free  
Where the world has not been broken up into fragments  
By narrow domestic walls  
Where words come out from the depth of truth  
Where tireless striving stretches its arms towards perfection  
Where the clear stream of reason has not lost its way  
Into the dreary desert sand of dead habit  
Where the mind is led forward by thee  
Into ever-widening thought and action  
Into that heaven of freedom, my Father, let my country awake*  
- Rabindranath Tagore



*argument against democracy is a five-minute conversation with the average voter*". Similar thoughts have been expressed by many. But, primary problem revolves around to basic question of meaning of democracy to unprivileged person, who is much below average voter. This is where the importance of education as a social reform comes into play.

Unless, growth opportunities are based on competence, incompetence would crepe in, and this is in conformance with the Darwin's Theory of evolution, and a law of nature.

This brings in a paradoxical question - *how to equalize opportunities of building competence among unequal?* This invokes role of state to ensure that its roles does not just end with RTE; it is just a means. Actual role of the state starts with RTE to ensure an environment where unprivileged are able to avail opportunities of education, sustain it and carry it forward to be able pay back to the society, in the form a human resource which is competent to compete. Logic of convenience stipulate that such a voluntary initiative cannot be expected from privileged class. It requires a political will to undertake grooming of competence right upto grassroots level. Initiating such education reforms is a really tough challenge in terms of making available financial resource, human resource, equipment and infrastructure, technology support, communication network and administrative will power. The last of these is mostly engaged in fire-fighting and window dressing. This requires an apolitical administrative force. If it is available, in a sizeable number, from unprivileged class it would be a blessing in disguise. But, a passion and commitment to democratize educational opportunities without discrimination is a pre-requisite. Any element of envy, vengeance and hatred in this role bears a risk of drain of resources to opportunists, without any change in ground reality. This is an extremely difficult task to adjudge and identify the right ones, be it any one.

Education in real sense is just not an end in achieving marks, admissions, placement, package and position. Unless, it invokes wisdom to question, explore answer or solution, translate thoughts and vision into action of sustainable-coexistence, it would be short of its real objective. It is seen that, in social-cum-political debate there are claims and accusations around job creation to pacify political constituency, while social reform through education is seen to be taking rear seats.

Discovering persons passionate to democratize education, in spiritual sense, is the biggest challenge as well as an opportunity for institutions and individuals. The task is quite mammoth; it requires a vision, consistency, commitment and perseverance on a long term basis. This is neither the domain of administrative nor political establishment. It requires statesmen, who can think and act rationally without discrimination to take it upon them to steer the initiatives on education. Government and administration need to identify such initiatives objectively and facilitates them with necessary support with autonomy. It needs a caution that there are cases where such autonomy has been abused to the detriment of an institution or an initiative. Such instances remind the story of डाकू खड़गसिंह और बाबा भारती, highlighting breach of trust, one of the cruellest and the most heinous crime, as also highlighted by honourable courts in recent judgements.

In this mission evolution of Online Mentoring Session (OMS), a means to connect passionate teachers to deprived children is seen as an opportunity to pay demographic dividend, by accomplished persons. It is a potential means to democratize education through discharge of their personal social responsibility (PSR), living within their constraints, yet accessible to anyone who wishes to avail its benefits. It is one of the most economical and pragmatic model that uses available ICT to groom competence to compete unprivileged. It is believed that in Digital India individuals, schools and institutions, corporates and social organizations, administration and government would take a note of it, in fulfilling their spiritual role and responsibilities.

Another, important feature of OMS is to collectively complement efforts of teachers spread across difficult locations. It aims at inclusive transformation of teaching from a profession into a passionate engagement. In the process local teachers would become torch bearer, and seek support, if needed.

It possesses potential of connecting deprived ones, across a couple of locations concurrently, in the process of grooming competence among them. All that is needed to extend them finger holding, without pampering or tempting them, and facilitate them to work hard in the journey of developing a faith in them to be able to compete, a true manifestation of democracy.

## Education in India in the Twenty First Century – A Collage of Images

**Madhubala Nath**

The Right to Education Act passed on 26 August 2009, mandates the right of children to free and compulsory education till completion of elementary education in a neighbourhood school. It also states that 'compulsory education' means obligation of the appropriate government to provide free elementary education and ensure compulsory admission, attendance and completion of elementary education to every child in the six to fourteen age group. 'Free' means that no child shall be liable to pay any kind of fee or charges or expenses which may prevent him or her from pursuing and completing elementary education. It provides for development of curriculum in consonance with the values enshrined in the Constitution, and which would ensure the all-round development of the child, building on the child's knowledge, potentiality and talent and making the child free of fear, trauma and anxiety through a system of child friendly and child centred learning.

Central to this act is the **dignity** of the child and the system of education as a whole is expected to give due respect to the individuality of the child. A child centered system of education is above caste, creed, sex and economic and social background of the child. There is no place for discrimination of any kind in the approaches developed by the centre and the states. The act is in keeping with the fundamental rights enshrined in our constitution. Every child is educable, no matter whatever is his social and economic background. The act clearly states that teaching techniques should be geared to the wellbeing of the child which leads to his cognitive, physical and emotional development.

Furthermore, the spirit of this law is clear. While enforcing rules of discipline, child's dignity and individuality must be respected. The modes of punishment should not violate the basic human values. The evaluation procedures should be continuous and remedial. Child's deficiencies are identified and remedial measures are instituted in progressive manner so that they help children to actualize their potential.

This child-centred approach to education in no way minimizes the importance of the teacher. In a way, the teacher's importance is enhanced and his/her functions become varied and complex. He/she has to

study the child psychologically and has to adopt methods of teaching to suit individual differences. In spite of transmitting knowledge alone, his/her function now is to develop the entire personality of the child

What is very clear from the above is that education today is not pedagogy alone. Unfortunately, even today our teacher's training institutes are largely teaching pedagogy and so the first image in the canvas of education in India is the challenge to recognise whether we as a nation are geared and equipped for this new approach in the transaction of the school curriculum. At this juncture, a collage of posers comes over my mind –

- Are our teachers and administrators in the education system fully conversant and sensitised to issues relating to child rights?
- Are they willing to expand the nucleus of the education system from the teacher to the child?
- Do the teachers stand committed to ensuring that knowledge generates practical wisdom and does not remain bookish knowledge alone?
- Does our school infrastructure create an ethos for easy learning?
- Above all does education nurture positive values in the giver and the receiver of knowledge and learning?

A quick scan of the reality on the ground indicates that the answer to a number of the above posers remains in the negative by and large. There may be a few exceptions to this situation in India which need to be respected, preserved and shared widely as catalysts for the larger change.

### **Are our teachers and administrators in the education system fully conversant and sensitised to issues relating to child rights?**

Article 19 of the Convention on the Rights of the Child, states that state parties must "take all appropriate legislative, administrative, social and educational measures to protect the child from all forms of physical or mental violence" There are ten rights of the child that are listed in the Convention on the Rights of the Child and the core of these ten that relate to the imparting of education include the right to be protected from abuse, the right to express opinions and views the right to appropriate information and

the right to special care and services. We need to ensure that these concepts are included in the training of teachers – in the curriculum be it refresher trainings or induction trainings. This input is fundamental as respect for the rights of the child is a new concept that will take time for teachers to understand and internalise. We have grown up learning that we as students should respect our teachers but teachers have not been taught to respect the rights of students until now. Expanding the sphere of respecting individual rights is a much needed and welcome phenomenon to improve the delivery and outcome of education in India.

**Do the teachers stand committed to ensuring that knowledge generates practical wisdom and does not remain bookish knowledge alone? Does our school infrastructure create an ethos for easy learning?**

areas of our lives: the way we communicate, collaborate, learn, and, of course, teach. Obviously, teaching in the 21-century is an altogether different phenomenon; never before could learning be happening the way it is now. Given a chance, students can produce beautiful and creative blogs, movies, or digital stories that they feel proud of and share with others.

Technology allows collaboration between teachers & students. Creating digital resources, presentations, and projects together with other educators and students which will make classroom activities resemble the real world. Collaboration should go beyond sharing documents via e-mail or creating PowerPoint presentations. The opportunity for teachers and learners today is to connect with like-minded individuals. But we need to engage and train our teachers in new technology. This has not yet happened in a meaningful way and needs to be expedited.

The students today need to have access to authentic resources on the web, experts anywhere in the world, and peer learning. Top down teaching and learning processes with textbooks need to be enhanced. Today's students should develop their own driving questions, conduct their research, contact experts, and create final projects to share using devices. All they need from their teacher is guidance on how to create sharable resources and leave their positive digital footprint on learning. As a natural corollary, therefore, it is

imperative that the government's investment in the education sector is enhanced so that children can have access to computers and other electronic devices as shared resources in schools. There is a need to lobby with the government on this issue.

Spending on education as a share of the government's total budgeted expenditure has been falling for the last three years. In 2013-2014, education got 4.57% of the total expenditure but in 2016-2017, this figure has fallen to 3.65%. In terms of the education spend as a share of the GDP, a similar picture emerges. The spending has dipped from 0.63% of the GDP in 2013-2014 to 0.47% in 2016-2017.

The silver lining in this cloud is that this year in his budget speech, the finance minister stated that India's education sector would follow a reform path in 2017-2018. Overall this year's budget has increased the outlay in the education sector by 9.9% and about 60% of this outlay (Rs. 79,685.95 crores) would be spent on school education. In the words of the finance minister, "Emphasis will be given on science education and flexibility in the curriculum to promote creativity through local innovative content." He also spoke about the innovation fund for the secondary education segment and the need to leverage technology to take quality courses to the mass education base. A digital literacy scheme has been launched and access to SWAYAM education portal on line is a leap forward which will be introduced with 350 on line courses.

Although budget analysts remain sceptical regarding the issue of "walking the talk," my hope is that as long as the intent is in the right direction, we will be able to tread the path to success sooner or later. The seeds of change have been sown and this is a positive development.

**Does education nurture positive values in the learners?**

The Right of Children to Free and Compulsory Education (RTE) Act, 2009 in its Schedule lays down Pupil Teacher Ratio (PTR) for both primary and upper primary schools. At primary level the PTR should be 30:1 and at the upper primary level it should be 35:1. The Rashtriya Madhyamik Shiksha Abhiyan (RMSA) framework stipulates that the PTR at secondary level should be 30:1. Countries that are part of the Organisation of Economic Cooperation and Development (OECD) average about 16 students for



every teacher. The student-teacher ratio ranges from 24 students or more per teacher in Brazil and Mexico, to fewer than 11 in Hungary, Italy, Norway and Poland

The recent District Information System for Education (DISE) report states that 30% of primary and 15% of upper primary schools have PTRs higher than 30:1 and 35:1 though the numbers are not specified. Some private schools in urban areas even have just one teacher for 65-70 students, say academics.. India not only lags far behind international standards — it also falls short by its own. In the 1950s, the PTR in primary schools in India was 20:1.

A study conducted by the Premji Foundation sought to establish a correlation between PTRs and the learning outcomes of children. A survey held at 1,880 government schools in Karnataka revealed that schools with a PTR between 10 and 20 had the best learning levels. Performance dropped sharply as the PTR increased, particularly when the number of children was more than 30.

The DISE report also says that 8.32% of schools in the country have just one teacher, and that out of every 100 teachers, seven are on contractual basis with many of them lacking professional qualifications as well. Moreover, 6,00,000 teaching posts at the primary level are lying vacant in government schools across the country. This state of affairs poses a tremendous challenge to value based education which requires a close and personalised interaction between the teacher and the student. To transform knowledge into wisdom and good behavioural habits, the teacher has to assume the role of a listener, a counsellor, a friend and a guide. With PTRs that are far away from the recommended norms instilling values of truthfulness, nonviolence,

peace, tolerance, integrity, transparency and simplicity may not be easy to inculcate in the students. The recent incidents of child abuse being reported from affluent as well as non-affluent schools are indicating that lust, anger, greed and violence are taking root in the system. The system is obviously in need for a deep cleansing. Time is now of the essence. The RTE Act has opened the gates for millions of Indians to seek education; the infrastructure needs to be geared up to respond adequately to this upsurge in demand. It is therefore a critical imperative that we internalise the above mentioned opportunities and threats and create the path for fulfilling the dreams of our leaders – I quote them below:

**Rabindranath Tagore** - “Where the mind is without fear and the head is held high, where words come out from the depth of truth, where the mind is led forward by Thee into ever widening thought and action, into the Heaven of freedom, my Father, let my country awake.”

**Mahatma Gandhi** – “I regard character building as the proper foundation for education and if the foundation is firmly laid, I am sure that children will learn all the other things themselves or with some assistance of friends.”

**Sri Satya Sai Baba** – Education is for life not merely for a living. The end of education is character, the end of knowledge is wisdom, the end of culture is perfection. In line with this vision, let us reclaim India's reputation of having the most profound learning culture, the earliest systems of intergenerational knowledge transfer, and being perhaps the first spiritual academy ever traced in the history of mankind.



Author is currently Country Representative and Country Director of Engender Health in India. She started her career in early Eighties as a Women Development Officer with the Swedish International Development Authority, (SIDA). Since then she has been associated with various international organization on the cause of women.

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*Education is more about inculcating of values in life with ability to perform*

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## Virtual Classroom – Beginning of A Journey

**R.K. Mohan Rao**

At the outset we express our deep gratitude to Dr. Satish Tripathi, the founding director of 'Ek Kadam Aur' a US based NGO, who has helped us to establish a Virtual Classroom at Ramakrishna Mission High School, Sitanagaram village, Tadepalli Mandal, Guntur District, Andhra Pradesh. Through Virtual Classroom he is also connecting our students to mighty resource persons across the world. This school caters to students from rural background. We are grateful to the Swamis of Ramakrishna Mission Ashrama under whose loving care and meticulous guidance we are working for this Virtual Classroom project. It is like a dream coming true.

In this initiative we were introduced to a Ph.D holder from IITR and a retired engineer from power sector, Dr. Subhash Joshi (+91-9711061199; URL: <http://www.gyanvigyan sarita.in>) on 19<sup>th</sup> August 2017. He started his first session explaining the importance of Physics and Mathematics in daily life. He expressed desire to mentor students outside school working hours, preferably in the morning for one and half hours. The proposal was discussed with school administration, which already has a tight academic schedule. Nevertheless, a group of 26 students from class 9<sup>th</sup> was selected to start with. Parents of these students were persuaded to send their children half-an-hour before school hours and regular on-line classes were scheduled from 8.00 am to 9.30 am from Tuesday to Friday every week.

In the first session itself we could feel the passion, dedication, sincerity and selflessness that were driving the initiative of Ek Kadam Aur and Gyan Vigyan Sarita, for a noble cause. We further understood the value of the opportunity in upbringing our students and the school by way of proactive association with this initiative. Students were motivated to utilise the opportunity coming to them at their door-step and to participate actively in learning and discussions for deriving maximum benefit. Students at Class 9<sup>th</sup> are best suited for this kind of exposure and interaction in virtual classroom. Difference in individual struggle for growth and in a group was emphasized; and accordingly students were motivated to undertake group learning, which, in addition to increasing their confidence in studies, will positively influence their

personality as team players. We divided the children into six groups and each group was named after great scientists of the country. We took the photographs of each group and sent to the mentor. This added self-esteem among students and given them the required identity.

Our Swamiji is very particular that the students consolidate their learning of each session in the form of a note. This was promptly converted into a group activity. Each group prepares its note. Our Teacher-in-charge of virtual classroom took the responsibility of collating these notes from the groups and started producing the session note. We started sharing the note with the mentor for his review, correction and for bridging the understanding gaps. The session note is corrected and retuned promptly by the mentor and it is made available to our children within the next couple of days. This pro-action created a new bondage and confidence between our students, teachers, school administration and the mentor, who is connected to us only on internet. This synergy is also providing comfort to all connected with our school from outside. Our remote school is strengthened with this additional channel of participatory teaching and learning. Recording the session proceedings and listening is also helping us to refine the session documentation as well as reinforcing the conceptual learning of students.

In every session mentor encourages our students to ask him How? and Why? of everything that is elaborated and that children are advised not to allow him to go forward unless understanding is clear. He is asserting that the question may come from one student, but all the others will be benefited by the answer and explanation, and if all students participate this way, learning curve will grow very fast. He is persuasively mentioning them that mother understands the hunger of the baby by its crying and in the same way teacher understands urge of students to learn from their questioning. Ability to think beyond with reason and translate the thoughts into action is the main aim of education. While questioning from front benchers was appreciated, children from middle and back benches are also encouraged and provoked in question-answering activity. With this tenacious persuasion, children not only started feeling free with the mentor,

but they started seeing their real and honest well-wisher in him. He has won their hearts within four or five sessions. One of the directors of 'Ek Kadam Aur' heard the recording of the seventh session and shot us an appreciating e-mail that the interactive sessions are awesome. Very good books in physics and mathematics have been suggested that will help to enhance learning of students and widen their knowledge. He advised us to generate separate e-mails for each group so that students, while working in group, open up to raise doubts and questions to him directly by e-mail. This will reduce process time in communication and accelerate learning. While doing this, respective teacher and coordinator shall remain in the communication loop.

Right from Day 1, mentor is keenly observing the participation of the teachers. Whenever the students are giving good prompting while solving a problem, he reminds the students that it is all because of their good teachers and their good teaching. They must take this GOD blessed opportunity to do their best. In separate on-line meetings with the teachers, the mentor emphatically clarified that his mentoring is only to complement or supplement their teaching and the overall interest is to produce students of excellence. Accordingly, a desire was expressed to include any aspect or any topic which they are unable to cover due to lack of time and other limitations. This shall be in addition to impart extra learning intended in this initiative. This exercise ultimately evolved into a mutual understanding that every Thursday the mentor and teachers would interact to finalise schedule of mentoring for next week. He won the admiration of teachers by virtue of his experience, by his skill of

presenting the concepts and by his ability of developing the subject systematically. He invoked the spirit of collective working for the overall growth and welfare of children, our next generation.

Our Swamis are keenly observing the progress of virtual classroom activity and infusing spirituality into it. After listening the feedback from teachers and students and by their direct observation, they got convinced that the activity is taking firm roots and needs to be nourished very carefully in the interest of the school and students. In addition to the in-charge teacher for virtual classroom, they nominated separate teacher coordinators for Physics and Mathematics. A separate computer with internet facility was arranged for the use of teachers and students exclusively for on-line interactions with the mentors and for preserving the documentation digitally. They are also giving us a free hand wherever and whenever necessary to take it forward.

Without our notice, the mentor, who got connected to us over video-conference as a stranger, has become one amongst us to evolve a structure and a methodology for a comprehensive on-line learning and its sustained operation as a system. We are very grateful to Almighty for providing the blessings through Swamijis, the facility through 'Ek Kadam Aur' and the system approach through 'Gyan Vigyan Sarita'. This is a welfare measure for the benefit of the rural students and absolutely selfless and non-commercial from all sides. This has become a powerful tool to connect the school to persons having expertise in different domains of knowledge and to convert the curriculum based education to wholesome education by seamless crossing of school boundaries.



Author is a former Scientist of Central Scientific Instruments Organisation (CSIO), a constituent laboratory under Council of Scientific and Industrial Research (CSIR). He is associated with Ramakrishna Mission for more than forty years. After his retirement, he is associating with the Swamijis of Ramakrishna Mission and assisting them to execute projects like Value Education, Smart Classrooms, Communicative English, Virtual Classroom etc.  
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***Education is not the learning of facts but the training of mind to think***

***- Albert Einstein***





## EK KADAM AUR FOUNDATION FOR EDUCATION AND HEALTH

Active As on: 17 January 2017 [Update info](#) [Email](#) [Print](#)

### OVERVIEW

EK KADAM AUR FOUNDATION FOR EDUCATION AND HEALTH is an unlisted private company incorporated on 16 January, 2017. Its registered office is at 22 JAHAZ APARTMENT INDER ENCLAVE PASCHIM ENCLAVE, NEW DELHI, West Delhi, Delhi and paid-up capital is INR 1.0 lacs. Details of its last annual general meeting are not available. The



**Collectively Complementing Each Other**

**They alone live who live for others ...**

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### DIRECTORS

NAME	DIN/PAN	DESIGNATION	DATE OF APPOINTMENT	OTHER DIRECTORSHIPS
USHA TIWARI	03334679	Director	16 January 2017	<a href="#">View</a>
SATISH TRIPATHI CHANDRA	07141375	Director	16 January 2017	<a href="#">View</a>



**Democratize Education with  
Personal Social Responsibility**

## A VIEW INTO EDUCATION - SEEING FROM OUTSIDE : A Jig-Saw Puzzle

**Kusum Lata Gupta**

As a daughter of a teacher in college, becoming wife of a teacher in engineering Maulana Azad Regional Engineering College, Bhopal, who soon after became a researcher and a professor at IIT Roorkee and after his retirement seeing him heading JIIT, Sec-128, Noida, I had an opportunity to observe transformation in shades of education from a गुरु-शिष्य परंपरा a legacy of our culture getting lost into a tuition and coaching culture. I have seen teacher at my home and around encouraging students to reach them in case of any difficulty in studies, even after school/college hours. And teachers never saw students coming to them as an interruption in their personal life; rather they were welcome, within their own means, as an integral part of their life. Students, if wanted a private coaching firstly did not find a teacher willing to do that, and if they could find one, it was kept as secret affair being considered a social stigma. The same country, same society has grown a rampant coaching culture.

A person lives in a system as an integral part may have some complaints or grievances about it. I am no exception to it. But, life is much beyond and, with a little sensitivity it is not difficult to believe that we are the blessed ones amongst millions who did not have a small fraction of what we got to be there where we are. With this I can say that I had a proud privilege to be born to a teacher and become wife of Dr. Hari Om Gupta, and be his partner in his journey of life. The only motivation in doing so was that the way education has transformed our life, may it perpetuate to all without discrimination.

My husband growing from a small village Porsa, in Morena District of MP, was the first one to become an engineering graduate against all odds. As he grew, he encouraged and supported all youngsters in family and relations to give priority to education before earning livelihood. He was an instrumental in creating a Porsa Talent Society, in his native place to inspire and promote children from the village, and now it has persons grown into various professions within and outside the country.

I have seen culmination into Gyan Vigyan Sarita, an initiative of a class-mate-cum friend of Dr Gupta, who after superannuation became his student to do Ph.D. from IIT Roorkee. Soon after his research work he took a plunge into mentoring unprivileged children with his full consciousness to his sense of personal social responsibility (PSR), so as to groom competence to

compete among them. It started with Chalk-N-Talk in 2012, and it has now grown into a full-fledged Online Mentoring activity. I have seen my neighbor Mrs Kumud Bala, a retired principal, and a veteran teacher of Chemistry, volunteering in the mission to mentor students online. There are occasions when students learning through online session drop out causing discontinuity in the activity. The discomfort caused to her with such instances is clearly visible, which is attributed to a sense of passion and dedication of her involvement in the mission. I sincerely wish, if I could volunteer to mentor children in English and Geography. But, unfortunately these subjects, as of now, are outside the gamut of the initiative.

Recently returning back to home from US, after 1-1/2 months stay and such visits earlier, I acknowledge that there is nothing better than home, the home land. It has to be admitted that life expectancy in India has gone high, health and economic comfort has grown. In old age, which has to come to everyone, is a stage when children are settled into their profession and families. Sensitized by this, many non-working ladies elderly persons from elite families have started philanthropic activities in and around their condominium or community center where they collectively spend time and money to teach children of poor families and support them with books, stationery, uniform, school admissions etc.

It is seen that there are many drop out, and mostly the target children when reach to the brink of free-education granted under RTE. Does it really help to transform their fortune? These children, with little education, build expectations and in turn become more demanding. It is like a patient, soon after a little relief, discontinues dose of prescribed dose of antibiotic medicines. Thus he gradually develops immunity to the medicine, and in the process the ailment becomes chronic and incurable.

In true sense real transformation will happen only when target children are carried forward to develop a competence to compete. This requires enormous patience, persistence and perseverance. In absence of this such philanthropic measures reduce to a subject of fashionable luxury to the extent one can afford it. The same philanthropy would bear a spiritual meaning when it is driven with a passion and commitment. If it happens it would become a mission which is indomitable in its endeavor to reform the profile of the target children. It



would further transform the vision of the society around it. I have seen it to be happening, but at a very small scale.

Any institution or organization, howsoever accomplished it may be, it has its own limitations to fringe out into welfare activities. Educational initiatives require a long term consistency, continuity and commitment, and which is generally difficult to sustain them. Nevertheless, such selfless educational initiatives of elite, accomplished and senior citizens can be facilitated and promoted by an organization using its CSR provisions in spiritual sense, which are otherwise aimed at brand promotion. Institutions have infrastructure and people who have an opportunity to deploy lean hours to look into this aspect of proaction for a cause which would mend next generation in the spirit of Confucius.

As a senior citizen, most of us experience a vacuum when our children fly off to make our dream and their ambition come true. While we relish this, the aging problems, growing with passage of time, tend to creep in a sense of negativity in life which cannot be remedied with any amount of wealth, comforts and choicest luxuries. The only remedy to this is a selfless engagement, with similar persons, in imparting lifetime learning to those for whom even dreaming is a luxury. The Online Mentoring is now not a proposition, it is a reality. It is an opportunity in a scenario, where longevity is on increase, with physical, financial, emotional and intellectual strength. It requires a meager and affordable resource which most of us are in possession. It requires just a beginning to use the technology interactively right from the place of stay. It needs senior persons come forward to complement. Passionate NGOs, are short of compatible human resource and they would be too happy to support upgradation or maintenance of IT Infrastructure of such respectable volunteers. It involves nominal incremental cost as against invaluable support of the synergy. Moreover, such senior persons get an opportunity to associate and collectively complement each other, generating positivity in life. A little care is required to ensure that there is consistency of commitment, and shed away a generally prevalent psychology of complacence

that “हमने बहुत काम कर लिया अब, हम लोड नहीं लेना चाहते, जब समय मिलेगा तब करेंगे”. It is all about making our old age, a gift of GOD, a little more purposeful.

Benefits of the engagement in such a mission are immense. It is totally selfless, transparent open to add, modify, delete or even take away without any kind of propriety. It believes that quality education with coexistence is propriety of none. It believes that Jig-Saw-Puzzle is just not a childhood game, rather it is a real life proposition that we have been practicing all along to reach where we are. It is definitely not a substitute to Chalk-N-Talk but. But, it provides a real-time connectivity between mentor and students. It is an opportunity to passionate teachers to receive from their senior accomplished persons and to be able to perpetuate. Unlike pre-recorded videos, it integrates mentor with teacher who proactively volunteer to be coordinators. It has a potential of an exponential growth in mentoring centers and learning centers. It would eventually increase beneficiary students in geometric progression. It is with full regard to sovereignty of the persons who volunteer into the mission, but without erosion of the spirit to democratize education with a sense of PSR. It deplores any effort or intention which has extrapolation into packaging of Online Mentoring into a product that would render teachers surplus. It believes that making teachers redundant is like converting a students into robots, an unimaginable damage to our upcoming generation, society and humanity, which would erode generation to follow.

All that it requires is a simple, yet honest, introspection by senior citizens who are at an age and stage of peak of their accomplishment in career, profession and family to explore and proliferate the initiative into a proactive participation in our own way. It would leave a legacy of satisfaction, happiness, peace and coexistence with prosperity to our most beloved descendants to feel proud of. I am sure that these children would reciprocate to support this cause in whatever way they can. Ultimately, we are all sincere to collectively solve the Jig-Saw-Puzzle.



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## VIRTUAL CLASSES OR E-LEARNING: PROMOTING EDUCATION

**D.V.S. Durga Prasad**

Formalised teaching - learning system, with the help of electronic resources is known as E-learning. This is an online class that allows participants to communicate with one another, Teaching in or out of the classrooms, using computers and the Internet as major components of E-learning. Virtual classes can also be termed as a network enabled transfer of skills and knowledge, and the delivery of education is made to a large number of recipients concurrently, at the same or different times irrespective of location. Earlier, it was not accepted wholeheartedly as it was assumed that this system lacked the human interaction required in learning. Still some conservatives object this considering it to be against the ancient Indian education system.

However, the rapid progress in technology and the advancement in learning systems, made the masses to embrace this sophisticated system. Personally, in an affordable manner. But, my inner feeling did not allow me to accept it readily. But, after experiencing and witnessing these effectiveness of virtual classes, I changed my belief, I have started enjoying active interaction in these virtual classes. I am really thankful to the management of Ramakrishna Mission School, Sithanagaram, Guntur district, Andhra Pradesh for providing this opportunity in enhancing my teaching skills and techniques. I had never dreamt of using technology in my teaching Recently, I met with an accident in which my right hand was paralyzed, Though the then Computer faculty in our previous school Sri P.Krishna Reddy repeatedly asked me to learn how to use computers, I did not pay any attention to it. But, now computer and internet has become part and parcel of my life. Now I feel a higher degree of self-esteem in interacting with my colleagues and students who are well versed with computers. I take it to be a God blessed opportunity.



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The introduction of modern communication methods was the basis of this revolution and with the passage of time, as we get hooked to smartphones, tablets, etc. These devices now have an important place in the classrooms for learning. Books are gradually getting replaced by electronic educational materials like optical discs or pen drives. Knowledge can also be shared via the Internet, which is accessible 24X7, anywhere, anytime.

The schools which use E-learning technologies are a step ahead of those which are still practicing the traditional approach towards learning. Teachers of earlier times are requested to update themselves so as to maintain their relevance in contemporary scenario.

No doubt, it is equally important to take forward the concept of non-electronic teaching with the help of books and lectures, but the importance and effectiveness of technology-based learning cannot be taken either lightly or ignored completely. It is believed that the human brain can easily remember the things with audio-visual aids. It has also been found that visuals, apart from holding the attention of the student, are also retained by the brain for longer periods.

E-learning enables to connect the unprivileged children of remote areas to get benefit with the individuals, intellectuals or the group of people who are selflessly struggling to run some organisations such as Ek Kadam Aur , Gnan Vignan Sarita etc. We should be grateful to them for their selfless, passionate and perpetual efforts.

Change in human life is necessary to fly into the range of high sky, without questioning 'why', should one try.

## STATUS OF EDUCATION IN INDIA

**D.V.S. Durga Prasad**

Education is the real important factor in every body's life as it is a fundamental to human progress.

Swami Vivekananda says, ' Education is the manifestation of perfection already in man.'

According to Martin Luther King Jr. "The function of education is to teach one to think intensively and to think critically.

In India it is a fundamental rule that people aged between 6 and 14 should have compulsory free education. This is a legal right of a child. But there is nobody to create awareness among them to make use of this right which was blessed by our constitution.

Intelligence added by character is the goal of true education. Education plays a vital role in overall development of an individual who can build up the society of heaven. Good education today will bring us better tomorrow, as it is said that our future lies in the hands of the present. If we nurture our present education system it will bring us better tomorrow.

As a teacher, I have a strong belief that India has no dearth of knowledge, but this talent needs to be harnessed by giving proper education for our future generation. The present Indian education system is surely in confusion. We have been following the traditional and conventional methods in imparting education among the future citizens of the country. If this is continued, we have to pay an expensive cost for our deeds. Child should be able to think what his future is going to be and what he wants to be. But this condition does not prevail today. The child comes to school for the sake of parents, reads or works for the sake of teachers. Creative thinking is lacking in their tiny minds. In ancient days, grandparents used to create the skills of imagination among them with their fairy tales. On hearing to them they used to think highly. But now this situation is not existed. I am more worried about this. Who can transform this?

Respected teachers, let the child should come out of the bondage of parents as well as teachers.

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## WHO IS THE GREATEST

**PVR Durga Prasad**

Once upon a time a king wanted to honor the greatest wise men in his country in a befitting manner. So he ordered his ministers to search such persons in his kingdom. The ministers selected ten persons. They brought them towards the king to select the most eminent among them.

The first person was great businessman who was born in a very poor family. But he was very industrious and evolved into a very rich person. He also donated his money to the poor people. The second person a great warrior and he defeated the enemies in war field. Third person is a famous doctor who cured the diseases of thousands of people. The fourth person is a great poet and he brought a great fame to his country with his creative writings. In this way the nine persons among them who had achieved a lot in their respective fields were escorted to the king. Then the king was in

confusion. He was in a dilemma as to whom should he honour.

At the end the guards escorted a very old man who was walking with difficulty. The guards helped him to walk. He wore very normal clothes unlike the other nine wise men. But his face is glowing with great knowledge.

The king asked his ministers about this old man. Then they answered "Oh my lord! He is the school teacher of all these nine wise men".

Hearing this immediately the king came down from his throne and greeted the old man with folded. The king said "All these nine wise men are great achievers in their respective fields. They brought laurels to our country. But the person who inspired them is absolutely greater than them. So the teacher is the only the greatest of all".



The court resounded with thumping claps. The sound of the claps of the nine wise men was more clearly audible.

This story is from a book authored by Swami Gnanandanandji Maharaj, published by Ramkrishna

Mission. This story aptly reflects a quote of Swami Vivekananda – ***“The first lamp is the Guru , and the lamp that is lighted from it is the disciple. The second in turn becomes the Guru and so on...”***



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## GROWING WITH CONCEPTS

***Concepts of an expert are not like a static foundation of a huge structure; rather it is like blood flowing in a vibrant mind.***

*During growing into an expert, each one must have used best of the books available on subject and received guidance of best of the teachers. Authors might have had limitations to take every concept thread bare from first principle and so also must be the constraint of teacher while mentoring a class with a diversity of inquisitiveness and focus. As a result, there are instances when on a certain concept a discomfort remains. The only remedy is to live with the conceptual problem and continue to visualize it thread bare till it goes to bottom of heart and that is an **ingenious illustration**.*

*In this column an effort is being made to take one topic on Mathematics, Physics and Chemistry in each e-Bulletin and provide its illustration from First Principle. We invite all experts in these subjects to please mail us their ingenious illustrations and it would be our pleasure to include it in the column.*

*We hope this repository of ingenious illustrations, built over a period of time, would be helpful to ignite minds of children, particularly to aspiring unprivileged students, that we target in this initiative, and in general to all, as a free educational web resource.*

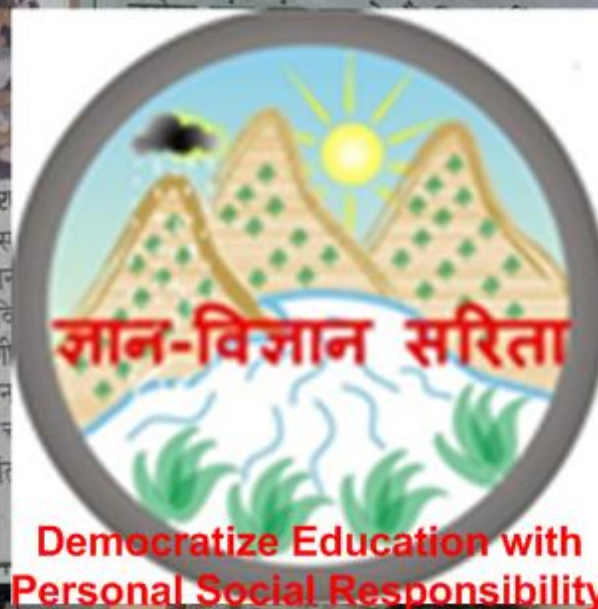
*This e-Bulletin covers – a) [Maths](#), b) [Physics](#), and c) [Chemistry](#). This is just a beginning in this direction. These articles are not replacement of text books and reference books. These books provide a large number of solved examples, problems and objective questions, necessary to make the concepts intuitive, a journey of educational enlightenment.*

*Looking forward, these articles are being integrated into Mentors' Manual. After completion of series of such articles on Physics it is contemplated to come up representative problems from contemporary text books and Question papers from various competitive examinations and a guide to their solutions in a structured manner, as a dynamic exercise to catalyse the conceptual thought process.*

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**Sarthak Prayash**



ज्ञान विज्ञान सरिता के इस पहल का प्रादुर्भाव सार्थक प्रयास के सानिध्य में मई २०१२ को हुआ उनके इस प्रारंभिक सहारे के लिए हम उनले कृतार्थ है

## Online Education and Mentoring – How NGO's Can Make a Difference?

**Vaishali Joshi Mehta**

April 2016, was when the online classes started for Sunshine's sector 50 After School Study Program. A stranger (whom we now know as Dr. Subhash Joshi) dropped in our facility and started discussing with our senior colleague Sh. V.P.Gupta, on his proposition to mentor the students of classes IX, X, XI and XII online.

April 14, 2016 was an exciting day when Dr. Joshi sitting in sector 78 of Noida and our children in sector 50. The projector was set up and connected to laptop and through Dongle Wifi internet connectivity was established and Skype, a video conferencing, platform was set up. The children were most amazed at what the technology had to offer. For us it was ensuring equal opportunity to connect our children to the people who passionately offer to mentor our students.

The one hour+ class was a huge success and now the children knew what to expect. The classes continued daily and children were gaining and understanding Math and Physics better. Things cannot be perfect. A few days into the online schedule, came the teething problems. Sometimes there was no electricity, sometimes the connectivity was bad, sometimes the audio did not work and sometimes the video. The children started getting frustrated with these breaks and trying to fix things that were beyond their control. They started losing interest and started disrupting the classes. We were fighting fires all the time – setting up skype, monthly dongle payment, playing referee in children's fight and figuring out how to ensure the uninterrupted classes. We were convinced that this was the way forward to ensure quality education and equal opportunity to the children.

Strategically we thought appropriate to stop the Online Classes, it was really a tough decision for us, who have taken up After School Study Programme for improving learning quality of the children from the economically weaker section of the society. These children can

neither join expensive school nor coaching or tuitions. This decision was based on our experience that at times when things come easy, people do not realize the value of it. In this case target groups were children, too immature to understand the worth of education coming to them at their door step. It took a few days for children to realize as to what they were missing. Our problem of indiscipline in the class got solved automatically. Next step was to figure out a medium which requires less bandwidth. Dr. Subhash Joshi who continuously was in touch with technology experts to figure a way out of the frequent disconnectivity problem and finally he decided to start the classes with Google hangout. We waited for the requirement to come from the children and sure enough Aanchal and Shilpi of class XI sought guidance for their Physics and Math exam. They had to prepare fourteen chapters, for their final examination, that were not taught in their class! At both ends, we and Dr. Subhash Joshi, were convinced with the potential of ICT to offer Online Mentoring as a solution, to connect students and teacher. They are otherwise inaccessible to each other. Our mutual faith in each other and belief in the power of ICT came to the rescue in the crisis. Online classes were started on a phone call; perhaps both of us were waiting for a ripe occasion to restart Online Sessions. Result was immediate in the form of the children's scores. It is impossible either to convey or measure the satisfaction level in words across all, students, their parents and we as a facilitators at both ends. Our reward is the relief that we could see on the children's faces to have been able to complete their syllabus, who were otherwise deeply distressed. The reward is in seeing the confidence levels of the children to go up by pursuing their education (in many cases the children dropout as they are unable to understand what is being taught in class) The reward is in seeing the steady improvement in the children's scores.



As the children go into the higher classes, they need additional support. If we look around us, majority of our children go for tuitions and as we all are aware, tuitions are quite expensive. Children, whom we target have parents who are unable to pay even their school fee, it is next to impossible that they are able to spend on them for extra tuitions.

This initiative of Dr. Subhash Joshi in the prevalent highly commercial environment in education, made accessible to us, opened doors to equal opportunity to our children. The Online mentoring classes are available for all children without any discrimination absolutely free of cost. We see the benefit of these classes in our children.



Author is the Secretary General and Founding Member of Sunshine Society. She is a post graduate in Anthropology, 1992, from Panjab University, Chandigarh. Her passion is to make a difference in the society and to bring about a change wherever possible.

Sunshine Society is a NGO with Children and Senior Citizens as their focus groups. Sunshine Society is directly sponsoring the education of over 200 children and have four After School Study Programs helping additionally 200 children.

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Sunshine Society (an NGO for children and senior citizens) is happy to bridge the gaps between our target students coming from economically weaker families and a galaxy of accomplished people, carrying a sense of indebtedness towards the society and an urge to give back in the form of grooming equal competence among deprived ones. This spirit is just not limited to senior citizens but across the generations, an inspiring experience to share.

*Please do not hold yourself, come forward be a part of this initiative. Do what you are able to -you may like to teach, provide infrastructure support, get us grants or donate so that we are able to maintain the continuity of the class and reach out to more children from the economically weaker section of the society. We are committed to uphold your trust as ever.*

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***Nature is an excellent example of unity in diversity. At its basic constituent level, atom, it is constituted by particles of different nature. Some of them are of opposite in nature, and experience a strong force of attraction, yet they continue to exist separately and individually; particles of similar nature, having strong force of repulsion continue to exist in vicinity. This has been there since beginning of nature, and shall continue to exist indefinitely. Any unregulated infringement on the other would be a disastrous. The secret of coexistence is respecting others position.***

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4<sup>th</sup> Sept'2017



10<sup>th</sup> April'2016



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much beyond**



**Bridging gaps...connecting  
generations**

**Democratize Education with  
Personal Social Responsibility**



10<sup>th</sup> April'2016

## २१वीं शताब्दी का संचार माध्यम और शिक्षा

२१वीं शताब्दी के इस संसार में संचार एक ऐसा माध्यम है, जिसके द्वारा व्यक्ति एक स्थान से दूसरे स्थान पर आसानी से बातचीत कर सकता है। तकनीक की इस दुनिया में अब कुछ भी असंभव नहीं रहा है। इस के द्वारा व्यक्ति घर बैठे ज्ञान अर्जित भी कर सकता है, और कर भी रहा है। संचार की यह प्रगति विद्यार्थियों के जीवन की उमंगों को ऊँचा उठाने का अथक प्रयास कर रही है। इसके द्वारा ही विद्यार्थियों का जीवन सुलभ होता जा रहा है। वे अपनी पढ़ाई कम्प्यूटर द्वारा आनलाइन करने में सक्षम हो रहे हैं। हमें ऐसे प्रखर विचार सुनने का मौका कई बार मिला और कई बार टी. वी. परिचर्चा भी सुनी। परन्तु एक निम्नस्तर की बालिका, जो हमारा पर्यवेक्षक है, को ऑनलाइन कक्षा तक पहुँच पाना एक दिवा-स्वप्न ही था।

पिछले वर्ष जब हम ११ वीं कक्षा की वार्षिक परीक्षा के लिए हम जब गणित और भौतिक क्षेत्र की परीक्षा की तैयारी से जुड़े रहे थे, तब हमें जानकारी मिली की हमारे क्षेत्र में **सनशाइन सोसाइटी** उसके "आफ्टर द स्कूल स्टडी" कार्यक्रम के तहत पिछड़े वर्ग के लिए, अनुभवी एवं प्रतिष्ठित व्यक्तियों से, शैक्षणिक मार्गदर्शन उपलब्ध कराती है।

जब हमने **सनशाइन सोसाइटी** से संपर्क किया तो वहाँ हमें बड़ी आत्मीयता का अनुभव मिला। हमारी समस्या समझकर उसका तुरंत निदान किया गया। ऑनलाइन कक्षा द्वारा हमें भौतिक शास्त्र और गणित के अध्ययन की व्यवस्था की गयी और तीन दिन में हमारी पढ़ाई आरंभ हो गयी। हमें जानकारी दी गई की **ज्ञान विज्ञान सरिता** द्वारा संचालित ऑनलाइन कक्षा से हमें जोड़ा जायेगा। अब हम १२वीं कक्षा की छात्राएँ हैं, जिन्हें अपनी पढ़ाई में बड़ी कठिनाई महसूस होती है। १२वीं की पढ़ाई इतनी सरल नहीं है कि वह स्वयं से ही कर सके। इसके लिये अनुभवी शिक्षक की आवश्यकता होती है, और वह हमें भी थी। यदि हम इस प्रयोजन से नहीं जुड़ते तब, हमारे सीमित साधनों के चलते, यह एक परिकल्पना ही रह जाती,। ऐसे समय में कुछ लोग ऐसे मिले जो हम छात्राओं का मनोबल बढ़ाने आगे आए जिनमें **सनशाइन सोसाइटी** एवं **ज्ञान विज्ञान सरिता** में संलग्न लोग। इस ऑनलाइन कक्षा में पढ़ाया ही नहीं जाता साथ-ही-साथ हमारी कठिनाइयों, प्रश्नों तथा दुविधाओं का निराकरण भी

किया जाता है। अब हम अपनी शिक्षा सुचारु रूप से जारी रखने में सक्षम हैं और हमारा विश्वास भी बढ़ रहा है।

हम अपने अनुभव से अन्य सहपाठियों, जो देश के विभिन्न भागों में फैले हुए हैं यह कह सकते हैं कि "ऑनलाइन कक्षा एक सुलभ माध्यम है जिसके द्वारा अनेक विद्यार्थियों का भिन्न भिन्न स्थानों में रहते हुए एक साथ पढ़ना मुमकिन है"। यह साधन विद्यार्थियों के लिये अत्यंत लाभकारी है, इसके द्वारा विद्यार्थियों का अधिक समय व्यर्थ नहीं होता है। हमने सबसे पहले Google Hangouts के माध्यम से अपनी कक्षा आरम्भ की। शुरुवात में यह कक्षा अच्छी चली, परन्तु संचार के जहाँ लाभ हैं वहाँ सीमायें भी हैं। अतः कुछ समय बाद इसमें समस्याओं आनी प्रारम्भ हो गई। कभी नेटवर्क समस्या, तो कभी microphone की। अन्ततः, हम WEBEX से जुड़े जहाँ हमें पढ़ते समय अपनी शंकाओं की लिखित रूप से व्यक्त करना संभव है। अब हम भौतिक विज्ञान व गणित की पढ़ाई बिना किसी परेशानियों के आसानी से कर सकते हैं, और कर भी रहे हैं।

जब हमारी पाठशाला में पाठ्यक्रम पूर्ण नहीं हुआ था और हमारी वार्षिक परीक्षा निकट थी, उस समय ऑनलाइन कक्षा ने हमारा बहुत साथ दिया, जिसके फलस्वरूप हम अपनी ११वीं कक्षा अच्छे से उत्तीर्ण कर सके और आज भी हमें शिक्षण और मार्गदर्शन बिना किसी फीस के प्राप्त है। हमें जो भी समस्या होती है, उसे धैर्य पूर्वक स्पष्टता के साथ समझाया जाता है। हम ही नहीं बल्कि हमारे साथ हमारे जैसे और भी कुछ स्थानों से बच्चे ऑनलाइन माध्यम से जुड़े हैं। आज हम सभी भिन्न-भिन्न राज्यों में होते हुये भी प्रतिदिन अपनी कक्षा एक समय पर ऑनलाइन माध्यम से करने में सक्षम हैं, जिसके लिए अनुशासन और समय पाबन्दी अति-महत्वपूर्ण है। हमें जो भी समस्या होती है, उसे धैर्य पूर्वक स्पष्टता के साथ समझाया जाता है।

हम **सनशाइन सोसाइटी** एवं **ज्ञान विज्ञान सरिता**, तथा उसमें कार्यशील स्वयंसेवी व्यक्तियों का हम हृदय से आभार व्यक्त करते हैं कि उन्होंने हमें निःसकोच अपने कार्यक्रम में शामिल कर हमें निराश होने से बचाया, और यह विश्वास जागृत किया की आज भी इंसानियत जिंदा है। सिर्फ आवश्यकता है कि हम किसी भी प्रयोजन में विवेक एवं सतर्कता पूर्ण व्यवहार करें।



**आँचल बैसोया, कक्षा १२ वीं**

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**N.B.:** The article bears editorial changes, without changing contents or essence of the experiences shared by the students.



## THINK CREATIVE

Kamlesh

The creative process is the act of making new connections between old ideas or recognizing relationships between concepts. Creative thinking is not about generating something new from a blank slate, but rather about taking what is already present and combining those bits and pieces in a way that has not been done previously.

While being creative isn't easy, nearly all great ideas follow a similar creative process.

### The Creative Process

1. Gather new material. At first, you learn. During this stage you focus on - **a)** learning specific material directly related to your task, and **b)** learning general material by becoming fascinated with a wide range of concepts.

2. Thoroughly work over the materials in your mind. During this stage, you examine what you have learned by looking at the facts from different angles

and experimenting with fitting various ideas together.

3. Step away from the problem. Next, you put the problem completely out of your mind and go do something else that excites you and energizes you.

4. Let your idea return to you. At some point, but only after you have stopped thinking about it, your idea will come back to you with a flash of insight and renewed energy.

5. Shape and develop your idea based on feedback. For any idea to succeed, you must release it out into the world, submit it to criticism, and adapt it as needed.

**How to Find Your Creative Genius:** Finding your creative genius is easy: do the work, finish something, get feedback, find ways to improve, show up again tomorrow. Repeat for ten years. Or twenty. Or thirty....  
*Inspiration only reveals itself after perspiration.*



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***A Child is genius of tomorrow. All that it needs is to encourage his creativity, have patience and wait!!!***

## Spirituality Brings a Positive Transformation in Child

Aarti Sharma

*Just as a candle cannot burn without fire, man cannot live without spiritual life - Gautam Budhdha*

*Mankind is going through a crisis. Tremendous emphasis on mechanical and scientific life is fast reducing the man to a status of a machine. Moral and religious values are being undermined and the fundamental principles of civilization are being ignored. Conflicts of habits are pervading the atmosphere. Solution to all these social and global evils are through Spiritual education . There is a dire need to awaken the spiritual self within the generation. -Swami Vivekanand*

The above quotes by great saints and philosophers aptly and amply highlight the need for spiritual education in the contemporary curriculum giving the vicissitudes of the modern day world that attach needless importance to materialism and greed leading to restlessness and anxiety ; and consequent imbalance in mind and body that is the cause of many mental ailments and lifestyle diseases .

Spiritual development is a panacea to the above ills as it creates supple pathways in building a poised temperament and sanity of mind in the young generation. Children imbued with spirituality grow into adults with a humane approach to life have a devoted sense of calling towards work and give a worthy regard to relationships. Spirituality, in fact, is inherently inborn in the children. Their brains are impulsively wired to believe in something like God almighty. So many things that children do are unsurprisingly spiritual. It is innately manifest in behavioral characteristics displayed by them such as mindfulness, compassion, charity etc. For instance, they are mesmerized at birds flying in the sky or get glued to the sight of ants carrying food crumbs in a beeline to their anthill for . That's indicative of mindfulness .They feel downcast when they see a homeless person. That's indicative of compassion or mercy. Their charity aspect is demonstrative when they help others and ensure fairness and justice for them.

### **Need to strengthen values of spirituality:**

Children love to forage into transcendent realms as they are propelled by a never ending curiosity to look for such spheres which are hitherto unexplored and not taught in their formal learning matrix . Doing so, uplifts their spirits and deactivates them from several insatiable cravings and desires . Sharing their spiritual outlook with parents and peers also helps them to reduce the incidence of despair and sadness. Kids who are high in transcendence are also high in grit and

determination and likely to be more successful in life. There is thus a need to reinforce their faith in spirituality as it soothes their restless mind and contributes in overall development of mind, body and soul.

When spiritual development is neglected or when a child's individual spiritual curiosity is denied, the child tends fall to wayward and immoral ways and become errant, anarchist and rebellious. In a materialistic world characterized by insatiable desires, mindless competition and hollowness of relationships children need parental and institutional support in their quest for a spiritually grounded life at every age.

**Introducing Spirituality in curriculum:** Spiritual education requires a whole new approach in learning to unfold. All the religious scriptures believe in oneness of good and universal peace. This feeling of universal brotherhood needs to be thoroughly ingrained in the children to ensure future peace and prosperity in the world at large. Besides, lessons of leading life free of vanity and egotism need to be imparted so that children can find a feeling of happiness and wellbeing while doing selfless action for the benefit of the mankind. In this regard its also worth mentioning that while educational institutions run by many religious institutions are able to provide spiritual education based on their religious scriptures , others especially billions of students from majority and allied communities are unfortunately bereft of this significant aspect of education .

For such children that there is a need to formulate a broad universal curriculum incorporating core principle tenets of various religious scriptures that serve the mankind and environment in entirety. In this context, a testament of timeless significance that deserves a distinguished mention is the Bhagwat Geeta. Literally translated as the song of the God , its lessons on leading a life of selfless action , thinking

positive; and controlling anger and restlessness by taming the mind body and speech is of great assistance to students in understanding and coping with the complexities of life and to prepare them to face all the life's challenges with courage and conviction .

**Universal widespread appeal of gospel of Bhagwat Geeta:** Bhagwat Geeta is a scripture that has originated in India but its valuable and eternal teachings are meant not only for the people of India but for all people in the world . The characters of Krishna and Arjuna are not merely persons who might have lived historically long ago. They are, in fact, present perpetually in the features of every human being . Having arisen from a divine source which transcends all the transitions of life , the lessons of Bhagwat Geeta are highly meaningful and relevant for all times under every circumstance, to every person as they have withstood all the uncertainties and fluctuations of life.

For young generation , it is an excellent repertoire of stories citing moral struggles of human life and solutions on how to overcome them as also how to take the right kind of decision . Lord Krishna advised Arjuna about selfless actions ie to do his work without expecting any results for good and noble work done in life would automatically lead to good results . A detailed narrative of the valuable teachings of the Bhgawat Geeta is given in the ensuing chapter.

The yearning to do good deeds also echo down the ages when the Tenth sikh Guru Gobind Singh ji invoked in his prayers to almighty - देह शिवा बर मोहे ईहे, शुभ कर्मन ते कभुं न टरुन डरौं अरि सौं जब जाय लडौं, निश्चय कर अपनी जीत करौं, अरु सिख हों आपने ही मन कौ इह लालच हउ गुन तउ उचरौं ,जब आव की अउध निदान बनै अति ही रन मै तब जूझ मरौं (O power of Akaal , give me this boon May I never shirk from doing good deeds , That I shall not fear when I go into combat And with determination I will be victorious .)

Furthermore, illustrative list of the lessons that can form the core content of the spiritual curriculum are stated below -

**1. Imparting the values of Sewa and Simran - Universal tenets of humanity:** Society , nation and world at large are also imperatively in need of two righteous values - Sewa (selfless service ) and simran (meditation ) in order to bring universal happiness and

peace in the world . Spirituality helps to develop these Virtuous attributes among the young generation .The revered sikh Gurus have highlighted the importance of these facets in the Holy Guru Granth sahib which states that one who perform selfless service(Sewa ) without desire as a duty to the society for reward will certainly attain liberation. Simran (derived from Sanskrit word smaran) refers to meditation or remembrance of god by constant awareness through repetition or recital of his name .Sewa and Simran are like the two wings of a bird . The bird must use both otherwise it will not be able to fly. By imparting knowledge about these values in the program of studies, the educational institutions can imbue the young generation with altruism and an everlasting spirit of service towards humanity and help to curb the negative traits of ego , vanity and arrogance .

**2. The Four Noble Truths:** Buddha ,the enlightened one, born as Siddhartha Gautama in shakhya Royal clan(6<sup>th</sup> century bc) propounded four noble truths and an eightfold path which is a worthy guide to leading a life without suffering . The four noble truths relate to causes and solutions to end suffering . According to the first noble truth , suffering is common to all. This suffering arises from birth , sickness , old age and death. Second noble truth elucidates the cause of suffering. Buddha explained that people live in a sea of suffering because of ignorance and greed. They are ignorant of the law of karma and do things that are harmful to their bodies and peace of mind .To end suffering one must cut off greed and ignorance which is the third noble truth . This can be done by changing one's views and living in a more natural and peaceful way. The fourth noble truth entails an end to suffering by achieving 'Nirvana' which is an everlasting state of great joy and peace. Everyone can be enlightened Nirvana which is possible by the extinction of desire .

The path to end suffering is known as the Noble Eightfold Path. Buddha chose the beautiful symbol of the wheel with its eight spokes to represent the Noble Eightfold Path .Just as every spoke is needed for the wheel to keep turning, we need to follow each step of the path given below-

**1. Right View-** The right way to think about life is to see the world with wisdom and compassion. **2. Right Thought -** Clear and kind thoughts build good, strong characters. **3. Right Speech-** By speaking kind and



helpful words, we are respected and trusted by everyone. **4. Right Conduct-** No matter what we say, others know us from the way we behave. Before we criticize others, we should first see what we do ourselves. **5. Right Livelihood -** Buddha taught not to earn living by harming others. And not to seek happiness by making others unhappy. **6. Right Effort-** A worthwhile life means doing our best at all times and having good will toward others. **7. Right Mindfulness -** This means being aware of our thoughts, words, and deeds. **8. Right Concentration -** One should focus on one thought or object at a time. By doing this, we can be quiet and attain true peace of mind.

### **3. Significance of the three-fold path of right knowledge, right attitude and right conduct:**

Following the three-fold path of right knowledge, right attitude and right conduct as envisaged in Jainism help in achieving feeling of equanimity. Right attitude forms the basis upon which the other two viz., right knowledge and right conduct rest. In Jainism utmost importance is attached to these three jewels as they equip the individual with freedom from delusion and restrain him from doing all censurable movements of mind, speech and body and help him to weaken and destroy all passionate activities. This ultimately leads to non-attachment and purity as also achievement of salvation .

**Conclusion:** Education is not the amount of information that is put into a student's brain and runs

riot there undigested all your life. Education means the process by which a character is formed, strength of mind is increased and intellect is sharpened so that one can stand on one's own feet. Spiritual education which should ideally form the core objective of the education system helps exactly in achieving that by building strength of mind and character through harmonious development of mind, body and soul. Just like a gardener cultivates the garden, spiritual education cultivates the wisdom of the child by treating the mind as a ground and thoughts as the seeds. It helps to plug out faults which is akin to weeding a garden and motivates them to perform noble deeds leading to a harvest of real and lasting happiness.

According to swami Vivekananda, Education is the manifestation of the perfection already in the man. This perfection is the realization of the infinite power that resides in everything and everywhere. Spiritual education enables one to comprehend one's self within as the self everywhere thereby helping to realize essential unity of the entire mankind. Spirituality doesn't essentially mean religion which may consist of dogmas, creeds and set of rituals. To be spiritual means eliminating the ego, false identification and ignorance which fall in the way and leading the life in such a way that one can manifest his /her higher nature, truth, goodness and beauty in thoughts, words and deeds that ultimately helps in the service of humanity.



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***Education is not a mechanical process of production, nor a matter of statistical interest. It is about transfer of spirit by teacher (गुरु ) to his student (शिष्य) through his conduct. Subject is only a carrier of the spirit.***

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## RELATIONSHIP OF A MENTOR AND DISCIPLE

**Sandhya Tanwar**

*“Guru Gobind Dou Khade, Kaake Lage Paun, Balihari Guru Aapne, Gobind Diyo Bataye”.*

I am sure you all have heard of this Kabir's Couplet. It means, Guru and God both are here, whom should I first bow, all glory be unto the Guru, path to God who did bestow.

5<sup>th</sup> September, in last month, was dedicated to all the Teachers to make them feel special that they create lives. No one on this earth can become successful if he don't have a teacher or a guide or a mentor in his life.

We all need mentors in our lives, who can guide us the way to lead life. When we were kids, we were being sent to the school to learn school lessons by the school teachers. After school, we were sent to college to learn college study books, then in a professional institution, to learn the professional courses. And after that, when we join office, we have a leader who leads us the way to a professional life.

This is a universal fact that we need teachers/mentors at every stage of our life. Even when we learn extra-curricular activities like sports, music, dance, swimming, art and craft making etc., we need instructors/coaches, without which it is impossible to learn any activity.

A teacher is one who passes on to his students his skill, knowledge or way of life. The relationship of a teacher and student/ a mentor and a disciple is like needle and thread. The teacher is a needle and the student is a thread. When sewing, the needle leads the way through the cloth, but in the end it is unnecessary and it is the thread that remains and holds everything together. Therefore, teacher-student relationship is of crucial importance.

Since childhood, we have been grown up by learning things from our teachers. Remember, friends, learning never ends and so is the learning taken over from the

teachers. See today also, you know the alphabets A-Z and you are still using this philosophy in your day to day life, as in to start from A and to end at Z. It was taught to you by your teacher when you were just 4-5 years old. A teacher's favour can never be paid off. He teaches us the way to lead a life. A teacher's goal is simple – to help his students reach their goals. Teaching is the greatest act of optimism.

There are millions and trillions of books on every subject available in the market. But to understand a particular area, we need a teacher to make us understand the concept in its entirety.

Life is all about learning at each and every stage. With the help of a mentor/teacher/instructor, it becomes easier to understand the way to deal with difficult situations that we often come across at difficult times, be it sports, academics or any other area.

Let's never disrespect this great profession of a teacher, which has changed many lives and which is going to change many lives in future as well.

On this Teachers' Day, with deep respect and from the depth of my heart, I offer my sincere gratitude to all the people who have come into my life in the form of a teacher, mentor, instructor and a coach to teach me the lessons in different areas and making me exploring the great potential, I have within me. For trusting me, for handling me when I failed and for motivating me to attain the success. Without their help and support, I would have never been able to tap the qualities I have inside me.

Teachers encourage, instruct, mentor, praise, influence, guide and inspire. Let us always remember- One book, one pen, one child and **ONE TEACHER CAN CHANGE THE WORLD.**



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## ONLINE MENTORING - A MENTOR'S PERSPECTIVE

**Shailendra Parolkar**

Online mentoring is a wonderful tool that the current day technology has made possible for us. It can bring the teachers willing to impart knowledge and the students eager to learn on a virtual platform from any corner of the world. The technological advances have also improved the quality of the audio / video interfaces to a great extent and made it economically feasible at the same time. Individuals / organizations aspiring to bring about a positive social change by imparting education to the masses can use this as a powerful tool. Coming from a family of school teacher in English, I found an opportunity to fulfill my urge in this initiative initiated at my homeland. Accordingly, I volunteered and got involved with it to impart free online mentoring to underprivileged children. It is now over a year now and we have realized that it takes a lot more than bringing the mentors and the students together on a sophisticated virtual platform to progress towards the end goal of making a positive long lasting social impact. Living in US, there are constraints of professional engagements and time offset with India. But, no problem is insurmountable if there is a will; finally we decided to have mentoring sessions on weekends from 6-8 pm IST.

There are several challenges at varying levels and difficulty that have to be dealt with in order to scale this initiative up to a level where this can be adopted and replicated across several locations and can be considered for a viable option by parents for their kids. This option has a potential of students learning concurrently at different locations, subject to mentor's preparedness to handle number of such learning centers together,

The easiest part of the problem is finding mentors who are willing to volunteer some time to mentor the kids. We have a group of talented individuals aligned to the

vision of imparting free education to the underprivileged children and I am sure our faculty will grow over the coming years.

The next challenge is finding a facility with adequate online infrastructure and an environment conducive to learning where the parents feel safe to send their kids. These facilities need proper administration and personnel to provide academic support to the children who may need help from time to time. This is extremely important because the mentors are remotely located and can interact with the children during their lectures only. These facilities also need to have an environment where regular supervised testing can be conducted and can provide reliable feedback to the mentors to assess their students.

We also need counselors who can guide and motivate the children and their parents as and when needed. The biggest challenge in the underprivileged part of the society is that the children are expected to start supporting their families financially as they enter adulthood and higher education is thought of as something beyond their reach. Even after getting free support to prepare for higher education, it is looked at as a futile attempt, a waste of time and is often overshadowed by the sight of having an immediate regular income, however small that may be. Parents have to be counseled about how their cooperation to educate their children can bring about a change not only in their children's lives but can propel a gradual yet a huge transformation in the society, because the recipients of this initiative today can be our torch bearers tomorrow and take it to a proportion where there may be some day when such initiatives will be supported by the government and will be available through their schools and colleges.



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## SOME THOUGHTS ON TEACHING

**Prof. S. N. Gupta**

1. A good teacher is a teacher by choice and not by default. For him teaching activity is a pleasure and not an onerous duty.
2. A good teacher must know his subject well and have a good command over it.
3. A good teacher must know his students as much as possible and should not treat them as just names or ID's.
4. A good teacher must have a modern and up to date view of the subject since every subject is a dynamic intellectual enterprise of the human race and its contents are growing exponentially.
5. To keep himself up to date with the latest trends in the teaching of the subject, a good teacher must read reviews of books and expository articles in educational journals on the subject.
6. A good teacher should not aim to cover a course in complete details. He should uncover a part of it and enable the student to uncover the rest of it himself with the help of the text book and other available materials.
7. A subject should be taught, not as a finished product, but as an evolving discipline.
8. Before every lecture, the teacher should plan the motivational aspect and even provocative questions which may make the students think critically in the class-room.
9. Immediately after a lecture, a teacher may write a note as to how he might have made the lecture more interesting and exciting and may consult this note before giving the same lecture next time.
10. The teacher should carefully read the facial expressions and body language of his students and if he finds them inattentive, he should adjust his teaching to make his presentation livelier. He may even occasionally make a deliberate slip and if no student catches it, he should take remedial steps to attract students' attention.
11. A teacher should be able to adjust quickly his speed and teaching patterns to the reactions of his class so that the students do not become just passive listeners
12. The teacher should make judicious use of concept related humor in the class-room.
13. The teacher should encourage questions both inside and outside the class and should not appear annoyed even if a question is not relevant.
14. The teacher should not be over-anxious to help a student who is struggling with a problem and let him muddle around. The muddling process is the core of creative thinking.
15. The teacher should remember that his students may have been reading other subjects before coming to his class. So he should start with a brief review of the previous lecture and touch the new material only after the students have got attuned to the new subject.
16. The teacher should aim at the optimum intellectual development of each student and not direct his efforts at good students only.
17. Special care should be taken of the gifted students. They should be encouraged to read advanced literature and should have opportunity to have discussions with their teachers.
18. Teaching by using the authority of the teacher or teaching by waving of hands or proofs by intimidation have no place in good teaching. The teacher should be intellectually honest with his students.
19. Every teacher should regard himself as a research scholar in education. Every teacher has a rich laboratory in his class-room for experiments in education.
20. In view of the vast explosion of knowledge, teachers have to read continuously throughout their teaching career. They should not take it as a burden but as the price they have to pay for living in exciting times.
21. Student projects are a great help to the learning process. These are longer problems which require

hours and days and even independent reading by students.

22. The activities of students' subject clubs and the teachers' time spent in directing the activities of these clubs should be considered essential components of the teaching process.
23. The society must give the teachers the facilities for learning through refresher courses, seminars, sabbatical leaves and attendance at professional bodies meetings.
24. The society should also agree to reduce the teaching loads of teachers to enable them to study for themselves. This may sometimes imply heavier educational budgets. However, quite often decreased teaching loads may be compensated by increased efficiencies through intensive curricular development programs.
25. The word 'teacher' is misleading. It gives an impression of an active teacher and passive student, while in fact both should be active. Unfortunately no good substitute is available. Some possible substitutes are: learning adviser, learning consultant, learning catalyst, subject adviser, and knowledge stimulator.
26. The word 'lecturer' is also misleading as it gives the impression that the job of the lecturer is just to deliver lecture to his students. In fact lecturing is

only the means to the end. For effective work, pure lecturing is to be minimized.

27. The first principle of true teaching is that nothing can be taught. The teacher is not an instructor or task-master, he is a helper and a guide. He shows his students how to perfect the instrument of knowledge and helps and encourages him in this process.
28. Teaching is more an art than a science, though gradually teaching is becoming more scientific. Today, teaching is a pseudo-science. Each teacher should try to become a good artist; at the same time should make teaching a science.
29. The teacher teaches both directly and indirectly. Students are greatly influenced by their teachers. The teacher therefore has to be extra careful to see that he sets a good example before his students. He should be a role model for the students.
30. If a teacher wishes to be respected by his students, he should respect himself and be at every moment worthy of respect. He should never be arbitrary, despotic, partial or ill-tempered.
31. The teachers should respect themselves and deserve respect from the students. Each teacher must zealously guard the reputation of the profession and must be prepared to condemn those who deviate from the highest standards of the profession.



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***The function of education is to teach one to think intensively and to think critically. Intelligence plus character – that is the goal of true education.***

**- Martin Luther King. Jr.**

## **Higher Education (Engineering) in India : Challenges and Remedies**

**Prof. Neha Sharma**

### **Current Approaches to Teaching Cannot Deliver High Quality Education:**

Education is about learning by students, where learning includes not only knowledge and understanding of a variety of concepts and phenomenon, but also development of higher order skills and capabilities for applying knowledge for problem solving. For those who want to go deeper, learning can be classified using Bloom's taxonomy into ***Remember, Understand, Apply, Analyze, Evaluate, and Create***. I have combined the lower two levels in "***knowledge and understanding***" and higher order four levels—apply, analyze, evaluate, and create into "***skills and capabilities***". Presently, our approach to education, even in many of the top places, is mostly geared towards developing knowledge and understanding with little emphasis on developing skills and capabilities.

Current approach to education in almost all institutions takes a teaching oriented view. For a course, the "syllabus" is defined as a list of topics to be covered, and during the semester, instructors give lectures to cover the topics, in which they explain the topic/concepts and do some examples. Good institutions ensure that the topics are covered, and the not so good institutions do not even ensure this. In the better Institutions, there are labs and assignments, though often the final grades depend largely on exams. This teaching oriented approach to education, at most, delivers mediocre education, and a high quality education is not possible through this way. There are few more reasons why it is so.

First, when a list of topics is the course design, then entire thought processes is about "covering the material", and in the class, at best, the instructor will explain the topic/concepts and may do some examples. It is now well established that students mind is not like a vessel in which information or concepts can be poured through lecturing – learning is a constructive activity and a student learns only by what a student herself does and thinks. In an education style where lecturing is the primary method of teaching, followed by some exams to test the understanding, the focus will mostly be on knowledge and understanding. This approach does not render itself to development of skills and capabilities, for which far more practice (assignments, labs, projects,...) by students under careful supervision and feedback is needed. As exams, by their very nature, can test

mostly concepts and understanding (at worst they may just test for factual knowledge), this cycle of lecturing and exams can lead to learning at the lower levels of Bloom's hierarchy, but does not help develop the higher levels skills and capabilities that are the hallmark of high quality education.

To move towards higher quality education which develops not only deep understanding of acquired knowledge but also development of skills/capabilities of applying the knowledge, it is necessary to move towards learner centric education, as is being done in most developed countries, and as is mandated by the Washington Accord.

The learner centric approach has three key aspects. First, for a course learning outcomes have to be defined, not in terms of list of topics, but in terms of knowledge and skills that the student should have at the completion of the course. Second, the course syllabus and design should be such that it can deliver the learning objectives – the lectures on topics should be supported by suitable exercises and projects with proper and critical feedback to allow practice which can help develop skills, as they cannot be developed in a lecture theatre. Finally, the grade given to a student must be based on an assessment of how well the student fulfilled the learning outcomes. So, if a learning outcome says that at the end of the course the student will have "the ability to solve problems using x,y, z", then this must be assessed directly.

Of course, designing the course in this manner in itself does not lead to better learning. This course design has to be delivered by competent faculty – a challenge for many universities and colleges who simply don't have competent faculty. Those institutions who have good faculty, however, can transform their education from teaching oriented approach to learner centric approach, which can lead to huge improvement in quality of education. It may be added, that this type of approach is what accreditation looks for.

This "list of topics" approach has worked reasonably well in the past in some of the top institutions. This was so as these top institutes had students and faculties ratio very small, and moreover they had a very good faculty which empowered them to develop some skills and capabilities through personal mentoring and oversight. This approach cannot work now as the skills and capabilities needed are far more complex, and the scale of education is significantly larger



now. These require a systematic approach as the earlier mentorship based approach cannot scale up.

#### *Introducing Engineering Design in First Year of a BTech Program:*

The traditional model of engineering education for decades has been that in the first year physics, chemistry, and maths are taught as foundation courses. Then courses on different foundational areas of the discipline and engineering are taught. Only after that a student can try to practice engineering. The overall model has been to teach the foundations in the initial years, and only in final year the students may do full engineering projects in which they may build some systems. It has been found that in most cases; unfortunately even in final years decent engineering projects are not done.

This model has been under challenge for some time, as it does not allow students to experience the excitement of engineering, which comes from building useful systems that work, till very late. To address this, many institutions across the world have introduced project-based courses early to provide students some experience of building systems.

For example, very early the institutes can introduce two courses in the first year whose focus is on “hands on experience”. In the first semester, students can do a course called “System Management” in which they work with laptops and mobile phones and their components, and learn what they can do with these machines, how they can manage them well, explore internals by opening them and seeing inside, etc.

In the second semester (by when they have learned programming as well as electronics in their first semester) we can introduce an Intro to Engineering Design (IED) course, whose basic goal is to design a working physical system that included hardware and software (so software only projects are not permitted) to solve some problem. In IED the focus should be on project – the lectures should support the projects. So, the lectures provide an overview of the basic components that are widely used in such projects – a cheap but versatile platform like RasPI or Arduino, common sensors for vision, motion, proximity, etc, and some actuators like stepper motors, etc. They should also learn a bit about workshop and tools.

Students should form teams and start thinking about the project from the start of the semester. Each project team should be given a budget to buy the components for their project – this exposes them to the process of buying components and markets, as well as about the basic engineering principle of cost control and delivering the project within budget. The completed projects should be

discussed amongst all in an open house at the end of the semester.

These type of courses emphasize the fact that engineering is about solving problems of people by building systems and solutions using science, mathematics, and theories related to them. Engineering is clearly not about theoretical understanding only in which problems are solved on paper and tested in exams, or in labs with defined experiments that are repeated by students year after year.

Unfortunately, this is what engineering education in the country has degenerated to. Most of the engineering institutions teach concepts, and that too not too well, with almost no exposure to actual engineering. The reason behind it is that the faculty does not have the necessary skills to guide such projects. As a result, the engineering graduates don't acquire any real engineering or problem solving skills and are found not employable. Due to the unemployment, a large number of engineering graduates proceed for MBA where engineering skills are not important, but only conceptual knowledge is needed to do the problems in entrance tests.

This lacuna in engineering education is also contributing to the immature innovation-led ecosystem in our country to generate businesses offering new products and solutions. It has also led to an underdeveloped engineering industry. Thankfully, one is now seeing some examples of innovation resulting from deep understanding of the problem and technology and delivering solutions that can work to solve problems and scale – these are often led by teams that excel in engineering capabilities. Thankfully also, some leading engineering institutions including some IITs (e.g. IIT Delhi) are introducing project based courses early in their curriculum. These bode well for the future for engineering in the country.

This excellent learner-centric approach, however, faces some challenges. First of all, it requires competent and committed faculty for successful adoption. The main problem in teaching is the teaching efficiency of a faculty. Even though the faculty teaching a subject from top university, if he doesn't know how to inject the subject in a lucid way to the students, his qualification doesn't help. Lots of students especially bunking classes of well qualified faculty classes is their inefficient teaching style. Also, due to YouTube and nptel, now a days the faculty are becoming content passers rather content creators.

The course should be designed and taught such that, at the end of the course, the students should not think like “We just have to complete that \*\*\*\*\* project to pass that \*\*\*\*\*

course.” Of course, system of lab assignments and projects is better and more beneficial than exams. Students may end forming a wrong attitude about this system too. And the result is..you know what it is. Even guys from top IITs struggles in practical skills. When a person is not interested in a subject, his or her attitude becomes like “I just have to complete that \*\*\*\*\* project/exam/class(any other thing) to pass that \*\*\*\*\* course”. And every teacher is not Walter Lewin or Feynman. Developing interest /passion/curiosity(long term) is a very very very hard thing. Once a person develops curiosity and passion for a topic, then he or she started “exploring” it on his owns. It’s then when he starts studying NOT for exams, but for he wants to know more. And that’s where the real learning takes place.

The second issue that needs attention is how to best bridge differences in current knowledge between students at the

outset of a course — i.e., ensuring students meet certain “pre-conditions”. Bridging such a knowledge-gap would be especially required for students just starting out on their Bachelor’s, having come from vastly differing educational backgrounds. I think that, an investment in grass-roots education is the correct, long term cure. A stop gap solution can be implemented in a principled / standardized manner by Indian institutes that are beneficial in the short term. Some measures that alleviate this problem could be taken for the same.

Last but not the least, the courses should be designed such that the students, at the completion of their course, acquire the knowledge, skills, values & mindsets that make them successful in their careers, keep them happy with their lives, and ultimately, transform them into good citizens.



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**OUR MENTORING PHILOSOPHY:** Mentoring is not teaching, neither tuition nor coaching. It is an activity driven by passion, and commerce has no place in it. In this effort is to caution students that -

- This place is not where they will be taught how to score marks and get higher ranks, but to conceptualize and visualize subject matter in their real life so that it becomes intuitive.
- This place is not to aim at solutions but inculcate competence to analyze a problem and evolve solution.
- This place does not extend selective and personalized attention, rather an opportunity to become a part of which is focused on learning and problem solving ability collectively.
- This place provides an opportunity to find students above and below one’s own level of learning. Thus students develop not in isolation but learn from better ones and associate in problem solving to those who need help. This group dynamics while create a team spirit, an essential attribute of personality, while one learns more by teaching others.
- This place has strategically chosen Online Mentoring, so that those who are unprivileged can gather at one point and those who can facilitate learning of such students by creating, necessary IT setup. Aseperate [Mentor’s Manual](#) is being developed to support the cause.

We are implementing this philosophy through [Online Mentoring](#)

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## GROWING WITH CONCEPTS - Mathematics

## TRIGONOMETRY

Prof. SB DHAR

## Measurement of Angles

There are three systems of measuring angles:

## (i) English System

It is called **Sexagesimal** system. In this system

$$1 \text{ Right Angle} = 90^0 \text{ (degrees),}$$

$$1^0 = 60' \text{ (minutes)}$$

$$1' = 60'' \text{ (seconds)}$$

## (ii) French System

It is called **Centesimal** System.

$$1 \text{ Right Angle} = 100^g \text{ (grades),}$$

$$1^g = 100' \text{ (minutes),}$$

$$1' = 100'' \text{ (seconds)}$$

## (iii) Circular System

$$1 \text{ Right Angle} = \left(\frac{\pi}{2}\right)^c \text{ (radians),}$$

## Relation between measuring systems

$$1 \text{ Right Angle} = 90^0 = 100^g = \left(\frac{\pi}{2}\right)^c$$

## Relation between arc, radius and angle at the centre of a circle

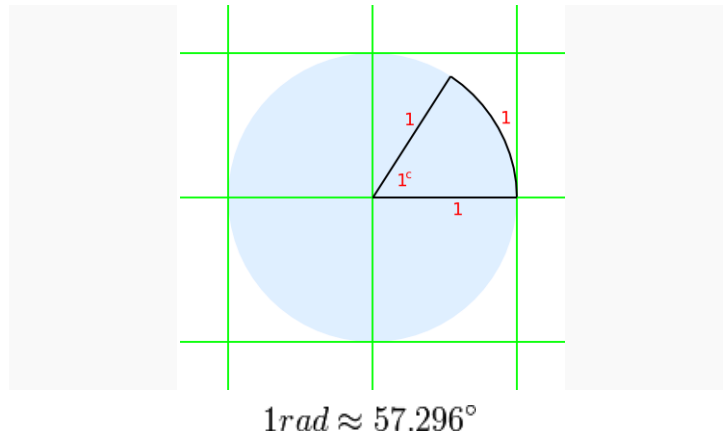
Angle subtended at center of a circle by an arc :

$$\theta(\text{in..radians}) = \frac{\text{arc}}{\text{radius}} ; \text{radian is always constant i.e,}$$

it has no unit.

## Definition of One radian Angle

A single radian is defined as the angle formed in the minor sector of a circle, where the minor arc length is the same as the radius of the circle.



## Notable facts

- (i) **Hiparchus**, a Greek Astronomer is considered the Father of Trigonometry.
- (ii) Angle moved by hour hand in one hour=30 degrees.
- (iii) Angle moved by hour hand in one minute= (1/2) degrees.
- (iv) Angle moved by minute hand in one minute= 6 degrees.

## Important Facts

$$1. \sin(-x) = -\sin x$$

$$2. \cos(-x) = \cos x$$

$$3. \tan(-x) = -\tan x$$

$$4. \text{Trigonometric identity: } \sin^2 \theta + \cos^2 \theta = 1$$

5. Two angles are said to be **allied** when their sum or difference is either 0 or multiple of 90 degrees.

6. Algebraic sum of two or more angles are called **compound** angles and the angles are called the constituent angles.

7. The **maximum** and **minimum** values of  $a \cos x + b \sin x + c$  are  $c + \sqrt{a^2 + b^2}$ ,  $c - \sqrt{a^2 + b^2}$

## Range of Trigonometric Functions

$$8. |\sin x| \leq 1 \Rightarrow -1 \leq \sin x \leq 1$$

$$9. |\cos x| \leq 1 \Rightarrow -1 \leq \cos x \leq 1$$



$$10. |\sec x| \geq 1 \Rightarrow \sec^2 x \geq 1, \\ \forall x \in \mathbb{R} \text{ where } \tan x \text{ is defined}$$

$$11. |\operatorname{cosec} x| \geq 1 \Rightarrow \operatorname{cosec}^2 x \geq 1, \\ \forall x \in \mathbb{R} \text{ where } \cot x \text{ is defined}$$

$$-\infty < \tan x < \infty; \\ -\infty < \cot x < \infty$$

$$6. \tan^2 x = \tan^2 \alpha \\ \Rightarrow \text{general value of } x = n\pi \pm \alpha \\ \text{Where } n \in \mathbb{I}$$

**12.  $\tan x$ ,  $\sec x$ , and  $\operatorname{cosec} x$  are unbounded, positive or negative.**

**13.  $\tan x$  and  $\cot x$  can take any value,**

**14.  $\sec x$  and  $\operatorname{cosec} x$  can never lie between -1 and 1.**

$$15. \sin^2 \alpha + \operatorname{cosec}^2 \alpha \geq 2$$

$$16. \cos^2 \alpha + \sec^2 \alpha \geq 2$$

$$17. \tan^2 \alpha + \cot^2 \alpha \geq 2$$

$$18. \sec^2 \alpha + \operatorname{cosec}^2 \alpha \geq 4$$

**In a triangle ABC, where  $A+B+C=180^\circ$**

$$1. \cos A + \cos B + \cos C \leq 3/2$$

$$2. \sin A + \sin B + \sin C \leq (3\sqrt{3}/8)$$

$$3. \tan A + \tan B + \tan C \geq 3\sqrt{3}$$

$$4. \tan A \tan B \tan C \geq 3\sqrt{3}$$

$$5. \tan^2 A/2 + \tan^2 B/2 + \tan^2 C/2 \geq 1$$

If in a triangle ABC, **a** is the length of side opposite to angle A, **b** is length of side opposite to B, and **c** is the length of side opposite to angle C,  $s=(a+b+c)/2$ , then

$$1. (s-a)(s-b)(s-c) \leq abc/8$$

$$2. \frac{1}{b+c-a} + \frac{1}{c+a-b} + \frac{1}{a+b-c} \geq \frac{1}{a} + \frac{1}{b} + \frac{1}{c}$$

$$3. \Delta \leq (s^2/3\sqrt{3}) \text{ where, } \Delta = \sqrt{s(s-a)(s-b)(s-c)}$$

**Sign of equality holds in case of equilateral triangles.**

### Trigonometric Equations

$$1. \sin x = \sin \alpha$$

$$\Rightarrow \text{general value of } x = n\pi + (-1)^n \alpha$$

$$2. \cos x = \cos \alpha$$

$$\Rightarrow \text{general value of } x = 2n\pi \pm \alpha$$

$$3. \tan x = \tan \alpha$$

$$\Rightarrow \text{general value of } x = n\pi + \alpha$$

$$4. \sin^2 x = \sin^2 \alpha$$

$$\Rightarrow \text{general value of } x = n\pi \pm \alpha$$

$$5. \cos^2 x = \cos^2 \alpha$$

$$\Rightarrow \text{general value of } x = n\pi \pm \alpha$$

### Note For Solving Trigonometric Equations

- Squaring should be avoided as far as possible. If at all squaring is done check for extraneous roots.
- Never cancel the terms which are in product on both sides. (if you cancel your solution contains loss of roots).
- The solution should never contains such values of the variable which makes any of the given terms undefined.
- When  $\tan \theta$  or  $\sec \theta$  are involved in the equation then  $\theta$  is not equal to odd multiples of  $\pi$ .
- When  $\operatorname{cosec} \theta$  or  $\cot \theta$  are involved then  $\theta$  is not equal to integral multiples of  $\pi$ .
- Domains of the given equation should not change. If at all change necessary corrections must be made.
- If the given equation contains  $\sin \theta \pm \cos \theta$  and  $\sin \theta \cdot \cos \theta$  then put  $\sin \theta \pm \cos \theta = t$  and proceed
- Whenever the terms are in  $\sin$ ,  $\cos$ , in powers 1, all terms connected with plus sign and number in R.H.S [ with (+) or (-) sign ] then each term must have its extremum value.
- In such problems each term will be (+1) when the number in R.H.S is (+)ve and each term will be (-1) when the number in R.H.S is (-1)ve.
- Whenever the equation is of the form  $a \cos \theta + b \sin \theta = c$ , the first of all check that whether real solution exists or not. The condition for this is  $|c| \leq \sqrt{a^2 + b^2}$ . If this condition satisfies then proceed the problem by dividing with  $\sqrt{a^2 + b^2}$  on both sides.
- The solutions of a trigonometric equation for which  $0 \leq x < 2\pi$  are called principal solutions.

12.  $\sqrt{f(x)}$  is always positive for example :  
 $\sqrt{\cos^2 x} = |\cos x|$  and not  $\pm \cos x$ .

### Properties of Triangles

1. A triangle is an equilateral if

(a)  $\cot A + \cot B + \cot C = \sqrt{3}$

(b)  $\sin^2 A + \sin^2 B + \sin^2 C = 2$

(c)  $\cos A + \cos B + \cos C = 3/2$

(d)  $\frac{a}{\cos A} = \frac{b}{\cos B} = \frac{c}{\cos C}$

(e)  $\begin{vmatrix} a & b & c \\ b & c & a \\ c & a & b \end{vmatrix} = 0$

2. A triangle is a right angled triangle if

(a)  $8R^2 = a^2 + b^2 + c^2$ , where R is the radius of circum-circle

(b) If cosines of two angles are inversely proportional to the sides opposite to the angles i.e.  $a \cos A = b \cos B$

(c)  $\frac{a^2 - b^2}{a^2 + b^2} = \frac{\sin(A - B)}{\sin(A + B)}$

(d)  $2\Delta^2 = \frac{a^2 b^2 c^2}{a^2 + b^2 + c^2}$

3. A triangle is an isosceles if

$a^2 \sin(B - C) + b^2 \sin(C - A) + c^2 \sin(A - B) = 0$

4.  $\frac{\sin A}{a} = \frac{\sin B}{b} = \frac{\sin C}{c} = \frac{1}{2R}$

5.  $\cos A = \frac{b^2 + c^2 - a^2}{2bc}$

6.  $a = b \cos C + c \cos B$

7.  $\tan \frac{B - C}{2} = \frac{b - c}{b + c} \cot \frac{A}{2}$

8.  $\sin \frac{A}{2} = \sqrt{\frac{(s - b)(s - c)}{bc}}$

9.  $\cos \frac{A}{2} = \sqrt{\frac{s(s - a)}{bc}}$

10.  $\sin A = \frac{2}{bc} \Delta$

11.  $r = \frac{\Delta}{s}$

$= (s - a) \tan \frac{A}{2} = (s - b) \tan \frac{B}{2} = (s - c) \tan \frac{C}{2}$

$= 4R \sin \frac{A}{2} \sin \frac{B}{2} \sin \frac{C}{2}$

12.  $r_1 = \frac{\Delta}{(s - a)} = s \tan \frac{A}{2}$

$= 4R \sin \frac{A}{2} \cos \frac{B}{2} \cos \frac{C}{2}$

13.  $r_2 = \frac{\Delta}{(s - b)} = s \tan \frac{B}{2}$

$= 4R \cos \frac{A}{2} \sin \frac{B}{2} \cos \frac{C}{2}$

14.  $r_3 = \frac{\Delta}{(s - c)} = s \tan \frac{C}{2}$

$= 4R \cos \frac{A}{2} \cos \frac{B}{2} \sin \frac{C}{2}$

15.  $\frac{1}{r_1} + \frac{1}{r_2} + \frac{1}{r_3} = \frac{1}{r}$

16.  $\frac{1}{r} + \frac{1}{r_1} + \frac{1}{r_2} + \frac{1}{r_3} = \frac{a^2 + b^2 + c^2}{\Delta^2}$

17.  $2r \leq R$

18.  $r_1 + r_2 + r_3 = 4R + r$

19.  $r_1 r_2 + r_2 r_3 + r_3 r_1 = s^2 = \frac{r_1 r_2 r_3}{r}$

20.  $\frac{1}{bc} + \frac{1}{ca} + \frac{1}{ab} = \frac{1}{2rR}$

21.  $\Delta = 2R^2 \sin A \sin B \sin C$
22. The lengths of medians of  $\Delta ABC$  whose sides are  $AB=c$ ,  $BC=a$ ,  $CA=b$ , and D,E and F are the mid-points of BC, CA, AB respectively, are given by
- $$AD = \frac{1}{2} \sqrt{2b^2 + 2c^2 - a^2} \text{ or } \frac{1}{2} \sqrt{b^2 + c^2 + 2bc \cos A}$$
- $$BE = \frac{1}{2} \sqrt{2c^2 + 2a^2 - b^2} \text{ or } \frac{1}{2} \sqrt{c^2 + a^2 + 2ca \cos B}$$
- $$CF = \frac{1}{2} \sqrt{2a^2 + 2b^2 - c^2} \text{ or } \frac{1}{2} \sqrt{a^2 + b^2 + 2ab \cos C}$$
23. **In centre** is represented by I ; **Orthocentre** by O' or H ; **Circumcentre** by O ; **Centroid** by G ; **Ex-centres** by  $I_1, I_2, I_3$  ; **In-radius** by r ; **Ex-radii** by  $r_1, r_2, r_3$  and **Circum-radius** by R.
24. **Pedal triangle** is the triangle formed by joining the feet of the altitudes from the vertices to the sides.
25. The Radius of the circle circumscribing the Pedal triangle is  $R/2$  where R= Radius of the Circum-circle circumscribing the original circle. The circle circumscribing the Pedal triangle bisects the line joining the orthocentre to the circum-centre of the original circle.
26. Distance between the Orthocentre and side  $BC=2R \cos B \cos C$ , between  $CA=2R \cos C \cos A$ , and between  $AB=2R \cos A \cos B$ .
27. **Nine – point Circle** is a circle that passes through (three middle points of the sides, three feet of altitudes from the vertices to the opposite sides and three mid-points of the line joining orthocentre to the vertices).
28.  $R = \frac{abc}{4\Delta}$
29. The distance of the ortho-center from the vertices of the triangle are:  $2R \cos A$ ,  $2R \cos B$ ,  $2R \cos C$ .
30. If  $\sin A$ ,  $\sin B$ ,  $\sin C$  are in AP then the altitudes are in HP.
31. The ratio of the distances of the ortho-center of an acute angled triangle ABC from the sides BC, CA, and AB are  $\sec A : \sec B : \sec C$ .
32. If I is the incentre, then ratio of  $IA:IB:IC = \operatorname{cosec} A/2 : \operatorname{cosec} B/2 : \operatorname{cosec} C/2$
33. The distance between the circumcentre(O) and the orthocentre(H) of a triangle ABC is  $OH = R\sqrt{1 - 8\cos A \cos B \cos C}$
34. Distance between the circumcentre(O) and the centroid(G) is given by  $OG = (1/3)OH$
35. Distance between orthocentre and centroid  $HG = (2/3)OH$ .
36. Distance between circumcentre and the incentre  $OI = R\sqrt{1 - 8\sin \frac{A}{2} \sin \frac{B}{2} \sin \frac{C}{2}}$ .
37. Distance between circumcentre and the escribed centre  $I_1$  touching externally side a  $OI_1 = R\sqrt{1 + 8\sin \frac{A}{2} \cos \frac{B}{2} \cos \frac{C}{2}}$ .
38. Distance between circum-centre and the escribed centre  $I_2$  touching externally side b  $OI_2 = R\sqrt{1 + 8\cos \frac{A}{2} \sin \frac{B}{2} \cos \frac{C}{2}}$ .
39. Distance between circumcentre and the escribed centre  $I_3$  touching externally side c  $OI_3 = R\sqrt{1 + 8\cos \frac{A}{2} \cos \frac{B}{2} \sin \frac{C}{2}}$ .
40. Radius of the circumcentre of triangle  $I_1 I_2 I_3 = 2R$ .
41. The distance between the circumcentre and the incentre of the triangle ABC is  $\sqrt{R^2 - 2Rr}$
42. The line joining the in centre to the circumcentre of a triangle ABC is inclined to the side BC at  $\tan \theta = \left( \frac{\cos B + \cos C - 1}{\sin C - \sin B} \right)$
43. Sum of the opposite angles of a cyclic quadrilateral is always 180 degrees.
44. Sum of the products of the opposite sides is equal to the product of the diagonals. (**Ptolemy's law**)
45. If sum of opposite sides of a quadrilateral is equal, then and only then a circle can be inscribed in the quadrilateral.
46. Area of a cyclic quadrilateral whose sides are  $AB=a, BC=b, CD=c, DA=d$ , is  $\sqrt{(s-a)(s-b)(s-c)(s-d)}$  where  $2s = a+b+c+d$ .
47. In cyclic quadrilateral,



$$\cos B = \frac{a^2 + b^2 + c^2 + d^2}{2(ab + cd)}$$

48. Circum-radius (R) of Cyclic quadrilateral ABCD is

$$\text{given by } R = \frac{1}{4} \sqrt{\frac{(ab + cd)(ad + bc)(ac + bd)}{(s - a)(s - b)(s - c)(s - d)}}$$

49. A regular polygon is a polygon that has all its **sides** as well as its **interior** and **exterior** angles equal.

If the polygon has n sides then the sum of its internal angles is 2(n-2) right angles and each

$$\text{angle is } \frac{(n-2)\pi}{n}$$

50. Sum of the exterior angles of a polygon taken in one direction remains constant and is equal to 360 degrees.

51. In the regular polygon the centroid, the circumcenter and the incentre are same.

52. The radii of the inscribed and the circumscribed circles for a regular polygon if n sides with each side

$$a \text{ is } \frac{a}{2} \cot \frac{\pi}{n}, \frac{a}{2} \operatorname{cosec} \frac{\pi}{n}$$

53. The area of regular polygon =

$$\frac{1}{4} na^2 \cot\left(\frac{\pi}{n}\right) = nr^2 \tan\left(\frac{\pi}{n}\right) = \frac{1}{2} nR^2 \sin\left(\frac{2\pi}{n}\right)$$

54.  $(\cos A + \cos B)(\cos 2A + \cos 2B)(\cos 2^2 A + \cos 2^2 B) \dots (\cos 2^{n-1} A + \cos 2^{n-1} B)$

$$= \frac{\cos 2^{n+1} A - \cos 2^{n+1} B}{2^n (\cos A - \cos B)}$$

55.  $\tan A + 2\tan 2A + 2^2 \tan 2^2 A + 2^3 \tan 2^3 A + \dots + 2^n \tan 2^n A + 2^{n+1} \cot 2^{n+1} A = \cot A$  for all n when it is natural number.

56.  $(2\cos A - 1)(2\cos 2A - 1)(2\cos 2^2 A - 1) \dots (2\cos 2^n A - 1)$

$$= \frac{2\cos 2^{n+1} A - 1}{2\cos A - 1} \text{ for all n when it is natural number.}$$

57.  $\tan A + \cot A = 2 \operatorname{cosec} 2A$

58.  $\cot A - \tan A = 2 \cot 2A$

59.  $\sin(A+B) = \sin A \cos B + \cos A \sin B$

60.  $\sin(A-B) = \sin A \cos B - \cos A \sin B$

61.  $\cos(A+B) = \cos A \cos B - \sin A \sin B$

62.  $\cos(A-B) = \cos A \cos B + \sin A \sin B$

63.  $2\sin A \cos B = \sin(A+B) + \sin(A-B)$

64.  $2\cos A \cos B = \cos(A-B) + \cos(A+B)$

65.  $2\sin A \sin B = \cos(A-B) - \cos(A+B)$

66.  $\sin C + \sin D = 2 \sin \frac{(C+D)}{2} \cos \frac{(C-D)}{2}$

67.  $\sin C - \sin D = 2 \cos \frac{(C+D)}{2} \sin \frac{(C-D)}{2}$

68.  $\cos C + \cos D = 2 \cos \frac{(C+D)}{2} \cos \frac{(C-D)}{2}$

69.  $\cos C - \cos D = 2 \sin \frac{(C+D)}{2} \sin \frac{(D-C)}{2}$

70.  $\sin 2A = 2 \sin A \cos A = 2 \tan A / (1 + \tan^2 A)$

71.  $\cos 2A = \cos^2 A - \sin^2 A = 2\cos^2 A - 1 = 1 - 2\sin^2 A = (1 - \tan^2 A) / (1 + \tan^2 A)$

72.  $\tan 2A = (2 \tan A) / (1 - \tan^2 A)$

73.  $\sin 3A = 3 \sin A - 4 \sin^3 A$

74.  $\cos 3A = 4 \cos^3 A - 3 \cos A$

75.  $\tan 3A = (3 \tan A - \tan^3 A) / (1 - 3 \tan^2 A)$

$$76. \tan nA = \frac{{}^nC_1 \tan A - {}^nC_3 \tan^3 A + {}^nC_5 \tan^5 A - \dots}{1 - {}^nC_2 \tan^2 A + {}^nC_4 \tan^4 A - {}^nC_6 \tan^6 A + \dots}$$

$$77. \sin \alpha + \sin(\alpha + \beta) + \sin(\alpha + 2\beta) + \dots + \sin\{\alpha + (n-1)\beta\} \\ = \frac{\sin\left(\alpha + \frac{n-1}{2}\beta\right) \sin \frac{n\beta}{2}}{\sin \frac{\beta}{2}}$$

$$78. \{\cos \alpha + \cos(\alpha + \beta) + \cos(\alpha + 2\beta) + \dots + \cos\{\alpha + (n-1)\beta\}\} \\ = \frac{\cos\left(\alpha + \frac{n-1}{2}\beta\right) \sin \frac{n\beta}{2}}{\sin \frac{\beta}{2}}$$

$$79. \cos \alpha \cdot \cos 2\alpha \cdot \cos 2^2 \alpha \dots \cos 2^{n-1} \alpha = \frac{\sin 2^n \alpha}{2^n \sin \alpha}$$

$$80. \text{Interior angle of a regular polygon of n sides} = \frac{(2n-4)}{n} \cdot 90^\circ$$

### Perimeter, Area, and Volume

$$1. \text{ Area of an equilateral triangle} = \frac{\sqrt{3}}{4} a^2 \text{ where } a \text{ is}$$

the side of the triangle.

$$2. \text{ Area of a right angled triangle} \\ = (1/2) (\text{base}) \times (\text{height}).$$

$$3. \text{ Area of a parallelogram} = \text{base} \times \text{height}$$

$$4. \text{ Area of Rhombus} \\ = (1/2) (\text{product of diagonals})$$

$$5. \text{ Area of trapezium} \\ = (1/2) (\text{sum of parallel sides}) \times \text{Height}.$$

$$6. \text{ Area of an ellipse} = \pi ab \\ \text{where } 2a = \text{length of the major axis and} \\ 2b = \text{length of the minor axis}$$

$$7. \text{ Perimeter or circumference of an ellipse} \\ = \pi \sqrt{2(a^2 + b^2)} \text{ approx.}$$

$$8. \text{ Volume of cube} = a^3 \\ \text{where } a = \text{length of an edge}$$

$$9. \text{ Total surface area of the cube} = 6a^2$$

$$10. \text{ Diagonal of a cube} = \sqrt{3} a.$$

$$11. \text{ Volume of a cuboid} = l \times b \times h$$

$$12. \text{ Area of curved surface of a cylinder} = 2 \pi r h$$

$$13. \text{ Volume of a cylinder} = \pi r^2 h$$

$$14. \text{ Volume of a cone} = (1/3) \pi r^2 h$$

$$15. \text{ Curved surface area of a cone} \\ = \pi r l \text{ where } l = \text{slant height}$$

$$16. \text{ Volume of a sphere} = (4/3) \pi r^3$$

$$17. \text{ Surface area of a sphere} = 4 \pi r^2.$$

$$18. \text{ Volume of a Prism} = \frac{\sqrt{3}}{4} a^2 h \text{ where } a = \text{side of the} \\ \text{base and } h = \text{height of the prism.}$$

$$19. \text{ Total surface area of the prism} = \text{lateral surface area} \\ + \text{sum of the areas of two ends} = 3ah + \frac{\sqrt{3}}{4} a^2.$$

$$20. \text{ Volume of a Pyramid} \\ = (1/3) \text{ height} \times \text{Area of base.}$$

$$21. \text{ Lateral surface area of pyramid} \\ = (1/2) (\text{perimeter}) \times (\text{slant height})$$

### Complementary and Supplementary angles

$$1. \sin(90^\circ - A) = \cos A$$

$$2. \cos(90^\circ - A) = \sin A$$

$$3. \sin(90^\circ + A) = \cos A$$

$$4. \cos(90^\circ + A) = -\sin A$$

$$5. \sin(180^\circ - A) = \sin A$$

$$6. \cos(180^\circ - A) = -\cos A$$

$$7. \sin(180^\circ + A) = -\sin A$$

$$8. \cos(180^\circ + A) = -\cos A$$

$$9. \sin(360^\circ \pm A) = \pm \sin A$$

$$10. \cos(360^\circ \pm A) = \cos A$$

$$11. \sin 18^\circ = \frac{\sqrt{5} - 1}{4}$$

$$12. \cos 36^\circ = \frac{\sqrt{5} + 1}{4}$$

### Inverse Trigonometric Functions Map Real Number To Angles

- The branch of  $\sin^{-1}$  function with range is the principal branch. So  $\sin^{-1} : [-1, 1] \rightarrow \left[-\frac{\pi}{2}, \frac{\pi}{2}\right]$
- Inverse of sine function denoted by  $\sin^{-1}x$  or arc ( $\sin x$ ) is defined on  $[-1, 1]$  and range may be any of the intervals:  $\left[-\frac{3\pi}{2}, -\frac{\pi}{2}\right], \left[-\frac{\pi}{2}, \frac{\pi}{2}\right], \left[\frac{\pi}{2}, \frac{3\pi}{2}\right], \dots$
- The value of an inverse trigonometric function which lies in its **principal value branch** is called the **principal value** of that inverse trigonometric function.
- The graph of  $\sin^{-1}$  is obtained from the graph of  $\sin x$  by interchanging the  $x$  and  $y$  axes.
- Graph of the inverse function is the mirror image (i.e. reflection) of the original function along the line  $y = x$ .

$$6. \cos^{-1} x + \cos^{-1} y =$$

$$\cos^{-1}[xy - \sqrt{1-x^2}\sqrt{1-y^2}], x, y \in [-1, 1]; LHS \in [0, \pi]$$

$$7. \sin^{-1} x + \sin^{-1} y =$$

$$\sin^{-1}[x\sqrt{1-y^2} + y\sqrt{1-x^2}], x, y \in [-1, 1]; \\ LHS \in [-\pi/2, \pi/2]$$

$$8. \sin^{-1} \frac{2x}{1+x^2} = 2 \tan^{-1} x, |x| \leq 1$$

$$9. \sin^{-1} \frac{2x}{1+x^2} = 2 \cot^{-1} x, |x| \geq 1$$

$$10. \cos^{-1} \frac{1-x^2}{1+x^2} = 2 \tan^{-1} x, |x| \geq 0$$

$$11. \tan^{-1} \frac{2x}{1-x^2} = 2 \tan^{-1} x, |x| < 1$$

$$12. \tan^{-1} \frac{1+x}{1-x} = \frac{\pi}{4} + \tan^{-1} x, x < 1$$

$$13. \tan^{-1} \frac{1-x}{1+x} = \frac{\pi}{4} - \tan^{-1} x, x > -1$$

$$14. \sin^{-1} x + \cos^{-1} x = \frac{\pi}{2}, |x| \leq 1$$

$$15. \operatorname{cosec}^{-1} x + \sec^{-1} x = \frac{\pi}{2}, |x| \geq 1$$

$$16. \tan^{-1} x + \cot^{-1} x = \frac{\pi}{2}, x \in R$$

$$17. \sin^{-1} x : |x| \leq 1, [-\pi/2, \pi/2]$$

$$18. \cos^{-1} x : |x| \leq 1, [0, \pi]$$

$$19. \tan^{-1} x : x \in R, (-\pi/2, \pi/2)$$

$$20. \operatorname{cosec}^{-1} x : |x| \geq 1, [-\pi/2, 0) \cup (0, \pi/2]$$

$$21. \sec^{-1} x : |x| \geq 1, [0, \pi/2) \cup (\pi/2, \pi]$$

$$22. \cot^{-1} x : x \in R, (0, \pi)$$

$$23. \sin(\cos^{-1} x) = \cos(\sin^{-1} x) = \sqrt{1-x^2}, |x| \leq 1$$

$$24. \sec(\operatorname{cosec}^{-1} x) = \operatorname{cosec}(\sec^{-1} x) = \frac{|x|}{\sqrt{x^2-1}}, |x| > 1$$

### Notes:

$\sin^{-1}(\sin x) = x \dots \text{domain} = R; \dots \& \dots \text{range} = \left[-\frac{\pi}{2}, \frac{\pi}{2}\right]$ ; this is periodic with  $2\pi$ .

$\sin(\sin^{-1} x) = x \dots \text{domain} = \left[-\frac{\pi}{2}, \frac{\pi}{2}\right], \dots \text{range} = [-1, 1]$  and this is not periodic.

$$\sin^{-1} x + \sin^{-1} y = \pi \quad \text{iff } x=y=1$$

$$\sin^{-1} x + \sin^{-1} y = -\pi \quad \text{iff } x=y=-1$$

$$\cos^{-1} x + \cos^{-1} y = 0 \quad \text{iff } x=y=1$$

$$\cos^{-1} x + \cos^{-1} y = 2\pi \quad \text{if } x=y=-1$$

25. While calculating the period of the periodic functions, one must remember that trigonometric functions may have period but algebraic functions do not have except the fractional part function  $\{x\}$  that has period 1.

26. While calculating period of the mixed functions like trigonometric and others, one must remember that LCM or HCF is calculated only for all the rationales or all the irrationals. The LCM or HCF of 2 and  $\pi$  is not possible because one is rational and the other is irrational number.

27. Trigonometric functions are not one-one and onto over their natural domains and ranges and hence their Inverse do not exist.

28. Inverse exists for the functions that are one-one and onto.

29. If we restrict sine to have domain only  $\left[-\frac{\pi}{2}, \frac{\pi}{2}\right]$  instead of  $R$  then sine becomes one-one and onto with range  $[-1, 1]$ .

30. This restriction is also for intervals  $\left[-\frac{3\pi}{2}, -\frac{\pi}{2}\right]$ ,  $\left[-\frac{\pi}{2}, \frac{\pi}{2}\right]$ ,  $\left[\frac{\pi}{2}, \frac{3\pi}{2}\right]$  etc. with the same range  $[-1, 1]$  but  $\left[-\frac{\pi}{2}, \frac{\pi}{2}\right]$  is called the principal value and

$\sin^{-1} x : [-1, 1] \rightarrow \left[-\frac{\pi}{2}, \frac{\pi}{2}\right]$  and the graph that lies in this range is called the Principal value branch.

31. It is obvious:  $\sin(\sin^{-1} x) = x$  if  $-1 \leq x \leq 1$  and  $\sin^{-1}(\sin x) = x$  if  $-\frac{\pi}{2} \leq x \leq \frac{\pi}{2}$ .

$$32. \sin^{-1}(-x) = -\sin^{-1} x$$

$$33. \operatorname{cosec}^{-1}(-x) = -\operatorname{cosec}^{-1} x$$

$$34. \tan^{-1}(-x) = -\tan^{-1} x$$

$$35. \cos^{-1}(-x) = \pi - \cos^{-1} x$$



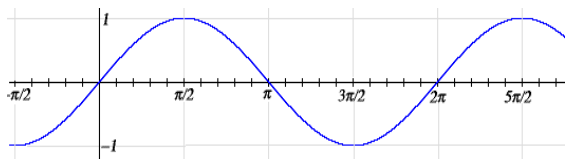
$$36. \cot^{-1}(-x) = \pi - \cot^{-1}x$$

$$37. \sec^{-1}(-x) = \pi - \sec^{-1}x$$

38. While converting radians into degrees and degrees into radians, the value of  $\pi$  should be taken  $22/7$  (approx) and not 180 etc.

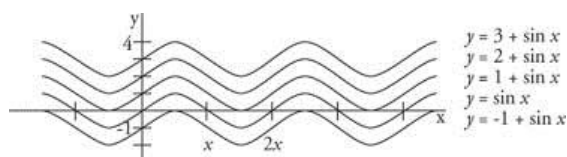
### Sine function

A good way to understand a function is to look at its graph. Let's start with the graph of  $\sin t$ . Take the horizontal axis to be the  $t$ -axis (rather than the  $x$ -axis as usual), take the vertical axis to be the  $y$ -axis, and graph the equation  $y = \sin t$ . It looks like this.



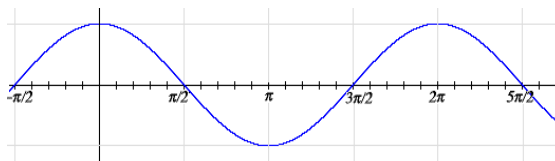
#### Note:

- It is periodic of period  $2\pi$ . Geometrically, it means that if one takes the curve and slides it  $2\pi$  either left or right, then the curve falls back on itself.
- The graph is within one unit of the  $x$ -axis. Not much else is obvious, except where it increases and decreases. For instance,  $\sin x$  grows from 0 to  $\pi/2$  since the  $y$ -coordinate increases as the angle increases from 0 to  $\pi/2$ .
- The graph of  $y = \sin x$  changes if the additional term  $A$  is introduced to  $y = A + \sin x$ . The graph shifts vertically upward or downward depending on the value of  $A$  (positive or negative) as shown below:



### Cosine function

Look at the graph of cosine. Again, take the horizontal axis to be the  $t$ -axis, but now take the vertical axis to be the  $x$ -axis, and graph the equation  $x = \cos t$ .

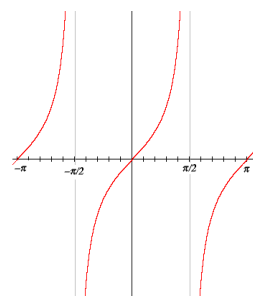


#### Note

It looks just like the graph of  $\sin t$  except it's translated to the left by  $\pi/2$ . That's because of the identity  $\cos t = \sin(\pi/2 + t)$ .

### Tangent function

The graph of the tangent function has a vertical asymptote at  $x = \pi/2$ . This is because the tangent approaches infinity as  $t$  approaches  $\pi/2$ . (Actually, it approaches minus infinity as  $t$  approaches  $\pi/2$  from the right as it is obvious on the graph.)

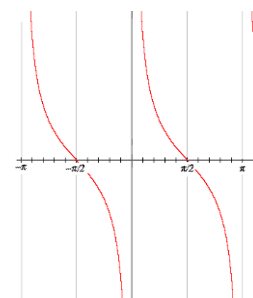


#### Note:

- Tangent has period  $\pi$
- There are vertical asymptotes every  $\pi$  units to the left and right.
- Algebraically, this periodicity is expressed by  $\tan(t + \pi) = \tan t$ .

### Cotangent function

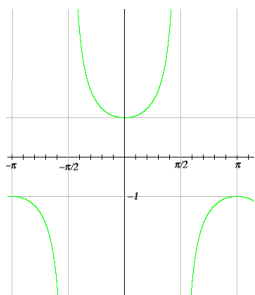
The graph for cotangent is very similar.



This similarity is simply because the cotangent of  $t$  is the tangent of the complementary angle  $\pi - t$ .

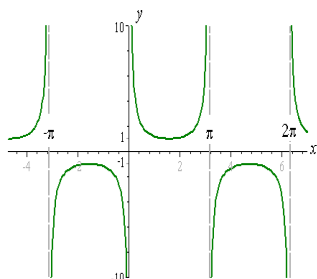
### Secant function

- (a) The secant is the reciprocal of the cosine, and as the cosine only takes values between  $-1$  and  $1$ , therefore the secant only takes values above  $1$  or below  $-1$ , as shown in the graph.
- (b) Secant has a period of  $2\pi$ .



### Cosecant function

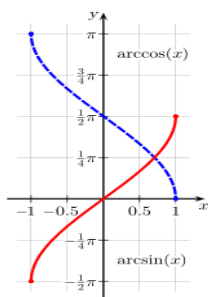
The graph of the cosecant looks much like the graph of the secant as below:



### Graphs of Inverse functions:

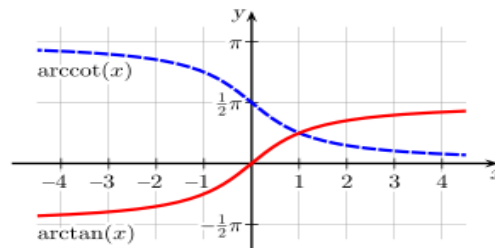
The notations  $\sin^{-1}$ ,  $\cos^{-1}$ , etc. are often used for arcsin, arccos, etc., but this convention logically conflicts with the common semantics for expressions like  $\sin^2(x)$ , which do not refer to function composition but rather multiplication, and therefore may result in confusion between multiplicative inverse and compositional inverse.

#### (a) $\sin^{-1} x$ and $\cos^{-1} x$



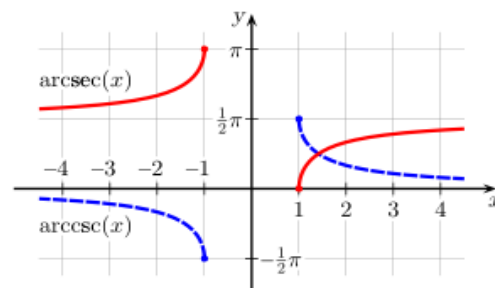
The usual principal values of the  $f(x) = \arcsin(x)$  and  $f(x) = \arccos(x)$  functions graphed on the cartesian plane.

#### (b) $\tan^{-1} x$ and $\cot^{-1} x$



The usual principal values of the  $f(x) = \arctan(x)$  and  $f(x) = \text{arccot}(x)$  functions graphed on the cartesian plane.

#### (c) $\sec^{-1} x$ and $\text{cosec}^{-1} x$



Principal values of the  $f(x) = \text{arcsec}(x)$  and  $f(x) = \text{arccsc}(x)$  functions graphed on the cartesian plane.

### Some Illustrations

1. If  $\sin x + \sin^2 x = 1$ , then evaluate  $\cos^8 x + 2\cos^6 x + \cos^4 x$ .

**Hint:**

Write  $\sin x = 1 - \sin^2 x = \cos^2 x$

Or  $\sin^2 x = \cos^4 x$

$1 - \cos^2 x = \cos^4 x$ , Or  $\cos^2 x + \cos^4 x = 1$

Square both sides to get the required result.

2. If  $x = y \cos 2\pi/3 = z \cos 4\pi/3$  then evaluate  $xy + yz + zx$

**Hint:**

Note  $x = -y/2 = -z/2$

Hence  $x = m$ ,  $y = -2m$ ,  $z = -2m$

Put these values in  $xy + yz + zx$  to get value  $= 0$

3. If  $\sin\alpha + \sin\beta = 0$  and  $\cos\alpha + \cos\beta = 0$ , then find the value of  $\cos 2\alpha + \cos 2\beta$ .

**Hint:**

Square and subtract (i) from (ii) to get the required result =  $-2 \cos(\alpha - \beta)$

4. If  $\cot(A/2) = (b+c)/a$ , then show that the triangle is a right angled triangle.

**Hint:**

Use sine formulae:

$$(\sin A)/a = (\sin B)/b = (\sin C)/c = \lambda$$

Replace a, b and c and write

$$\sin B + \sin C = 2 \left\{ \sin(B+C)/2 \right\} \left\{ \cos(B-C)/2 \right\}$$

and simplify writing

$$\sin(B+C)/2 = \sin(180^\circ - A)/2 = \cos A/2.$$

5. If  $\tan(\pi \cos \theta) = \cot(\pi \sin \theta)$ , then find the value of  $\cos \{ \theta - (\pi/4) \}$ .

**Hint:**

Write the expression as

$$\tan(\pi \cos \theta) = \cot(\pi \sin \theta) = \tan\{\pi/2 - (\pi \sin \theta)\}$$

$$\text{ie } \pi \cos \theta = \pi/2 - (\pi \sin \theta)$$

simplify to find the result.

6. If in a triangle ABC, angles A, B, C are in AP,

then find the value of  $\frac{a+c}{\sqrt{a^2 - ac + c^2}}$

**Hint:**

$$\text{Given } 2B = A + C$$

$$B = 60^\circ$$

$$\cos B = \cos 60^\circ = \frac{c^2 + a^2 - b^2}{2ca}$$

simplify and get the result.

7. If  $A+B+C=270^\circ$ , then find the value of  $\cos 2A + \cos 2B + \cos 2C + 4 \sin A \sin B \sin C$

**Hint:**

$$\text{Use: } \cos C + \cos D = 2 \cos(C+D)/2 \cos(C-D)/2.$$

Write the given expression

$$= 2 \cos(A+B) \cos(A-B) + 1 - 2 \sin^2 C + 4 \sin A \sin B \sin C$$

$$= 2 \cos(270^\circ - C) \cos(A-B) + 1 - 2 \sin^2 C + 4 \sin A \sin B \sin C$$

Simplify and find the value = 1

8. Find the value of  $\cos x \cdot \cos 2x \cdot \cos 3x \dots \cos 999x$  if  $x = 2\pi/1999$ .

**Hint:**

$$\text{Assume, } P = \cos x \cdot \cos 2x \cdot \cos 3x \dots \cos 999x$$

$$\text{And, } Q = \sin x \cdot \sin 2x \cdot \sin 3x \dots \sin 999x$$

$$PQ = 2 \sin x \cos x (2 \sin 2x \cos 2x) \dots (2 \sin 999x \cos 999x)$$

$$= \sin 2x \cdot \sin 4x \cdot \sin 6x \dots \sin 1998x$$

$$= \sin 2x \cdot \sin 4x \cdot \sin 6x \dots \sin 999x \cdot \{-\sin(2\pi - 1000x)\} \cdot \{-\sin(2\pi - 1002x)\} \dots \{-\sin(2\pi - 1998x)\}$$

$$= \sin 2x \cdot \sin 4x \cdot \sin 6x \dots \sin 998x \cdot \sin 999x \cdot \sin 997x \dots \sin x \text{ as } 2\pi = 1999x$$

$$= Q$$

Hence

$$P = (1/2^{999}) \text{ is the required result.}$$

9. Find the set of solutions of  $[\tan^{-1} x] + [\cot^{-1} x] = 2$  where  $[.]$  denotes greatest integer function.

**Hint:**

Assume

**Case I**

$$[\tan^{-1} x] = 1 \text{ and } [\cot^{-1} x] = 1$$

$$\Rightarrow 1 \leq \tan^{-1} x < 2 \text{ and } 1 \leq \cot^{-1} x < 2$$

$$\Rightarrow x \in [\tan 1, \infty) \text{ and } x \in (\cot 2, \cot 1]$$

$$\text{But } \cot 1 < \tan 1$$

Hence no such x possible that satisfy the both.

**Case II**

$$\text{Assume } [\cot^{-1} x] = 2 \text{ and } [\tan^{-1} x] = 0$$

$$\Rightarrow x \in (\cot 3, \cot 2] \text{ and } x \in [0, \tan 1)$$

Again no such x exists as  $\cos 2 < 0$ .

**Case III**

$$\text{Assume } [\cot^{-1} x] = 3 \text{ and } [\tan^{-1} x] = -1$$

$$\Rightarrow x \in (-\infty, \cot 3] \text{ and } x \in [-\tan 1, 0)$$



Again no such  $x$  exists as  $\cot 3 < -\tan 1$

Hence no  $x$  exists for which the equation is 2.

**10. Find the Minimum value of  $\cos(\cos x)$ .**

**Hint:**

Note,  $-1 \leq \cos x \leq 1$  for all real values of  $x$

Hence if  $\cos x$  is replaced by  $\cos(\cos x)$  then the inequality becomes

$$-1 \leq \cos(\cos x) \leq 1$$

Hence the minimum value is -1

**11. If  $A = \cos^2 x + \sin^4 x$  then for all values of  $x$ , find the maximum and minimum values of  $A$ .**

**Hint:**

Rewrite

$$A = 1 - \cos^2 x + \cos^4 x$$

$$\Rightarrow 1 - A = \cos^2 x - \cos^4 x$$

$$= \cos^2 x \sin^2 x = (1/4)(\sin 2x)^2$$

$$\Rightarrow 0 \leq (1-A) \leq (1/4) \text{ as } 0 \leq (\sin 2x)^2 \leq 1.$$

$$\Rightarrow (3/4) \leq A \leq 1$$

**12. Find the minimum value of  $\sin(\cos x)$ .**

**Hint:**

Note  $\cos x \in [-1, 1]$  and  $\sin x$  is an increasing function on  $[-\pi/2, \pi/2]$

Hence maximum value of  $\sin(\cos x)$  is

$$\sin(\text{maximum of } \cos x) = \sin 1$$

**13. If  $[x]$  denotes the greatest integer less than or equal to  $x$  and  $f(x) = \sin x + \cos x$ . Then find the most general solution of**

$$f(x) = \left[ f\left(\frac{\pi}{10}\right) \right].$$

**Hint:**

$$\text{Obviously, } f(\pi/10) = \sin 18^\circ + \cos 18^\circ = \sqrt{2} \sin 63^\circ.$$

$$\text{Since, } \sin 63^\circ > \sin 45^\circ = \frac{1}{\sqrt{2}} \text{ and } \sin 63^\circ < 1$$

$$\Rightarrow 1 < f\left(\frac{\pi}{10}\right) < 2 \Rightarrow \left[ f\left(\frac{\pi}{10}\right) \right] = 1 \Rightarrow \sin x + \cos x = 1$$

And hence the required solution can be evaluated.

**14. Find the number of solutions of the equation  $x^3 + x^2 + 4x + 2 \sin x = 0$  in  $0 \leq x \leq 2\pi$ .**

**Hint:**

Rewrite the given expression as

$$x^3 + (x+2)^2 + 2 \sin x = 4$$

obviously  $x=0$  is a solution.

Hence if  $0 < x \leq \pi$  then

$$x^3 + (x+2)^2 + 2 \sin x > 4$$

And if  $\pi < x \leq 2\pi$  then

$$x^3 + (x+2)^2 + 2 \sin x > 4$$

Hence,  $x=0$  is the only solution.

**15. Find the number of real solutions of  $\sin e^x \cdot \cos e^x = 2^{x+2} + 2^{-x-2}$ .**

**Hint:**

Rewrite the given expression

$$\frac{1}{2}(\sin 2e^x) = 2^{x+2} + 2^{-x-2}.$$

Apply AM – GM inequality

$$\frac{2^{x+2} + 2^{-x-2}}{2} \geq \sqrt[2]{2^0} \Rightarrow 2^{x+2} + 2^{-x-2} > 2 \Rightarrow \sin(2e^x) > 4$$

Hence no solution.

**16. Find the value(s) of  $a$  for which the equation  $2\sin^2 x - (a+3)\sin x + 2a-2 = 0$  has a real solution.**

**Hint:**

$$\text{Find } \sin x = \frac{(a+3) \pm \sqrt{(a+3)^2 - 8(2a-2)}}{4} = 2, \frac{a-1}{2}$$

For real solutions

$$-1 \leq \sin x \leq 1 \Rightarrow -1 \leq \frac{a-1}{2} \leq 1 \Rightarrow a \in [-1, 3]$$

**17. Find the general solution of the equation  $\sin^{100} x - \cos^{100} x = 1$ .**

**Hint:**

Rewrite the given expression as below:

$$\sin^{100}x = 1 + \cos^{100}x$$

LHS  $\leq 1$  but RHS  $\geq 1$  except when  $\cos x = 0$

Hence general solution is

$$x = n\pi + (-1)^n (\pi/2)$$

**18. Solve the equation:  $\sin x = [1 + \sin x][1 - \cos x]$  where  $[.]$  is a greater integer function.**

**Hint:**

**Case I:**  $x = -\pi/2$  or  $3\pi/2 \Rightarrow -1 = +1$  i.e. an absurd result.

**Case II:**  $x = 0 \Rightarrow 0 = 1$  i.e. an absurd result.

**Case III:**  $x = \pi/2 \Rightarrow \sin x = 3$ , an absurd result.

**Case IV:**  $x = \pi \Rightarrow \sin x = 3$ , an absurd result.

**Case V:**  $x \in (-\pi/2, 0)$  gives absurd result

**Case VI:**  $x \in (0, \pi/2)$  gives absurd result

**Case VII:**  $x \in (\pi/2, \pi)$  gives absurd result

**Case VIII:**  $x \in (\pi, 3\pi/2)$  gives absurd result. Hence, no solution.

**19. Find the condition for  $k$  if  $k \cos x - 3 \sin x = k+1$  is solvable.**

**Hint:**

Simplify as below

$$\cos(x + \theta) = \frac{k+1}{\sqrt{k^2+9}}$$

And for a solution,

$$-1 \leq \cos(x + \theta) \leq 1 \Rightarrow -1 \leq \frac{k+1}{\sqrt{k^2+9}} \leq 1 \Rightarrow k \leq 4 \Rightarrow x \in (-\infty, 4]$$

**20. Find the number of solutions of  $\cos x = 1/\sqrt{1 + \sin x}$  on the interval  $[0, 3\pi]$**

**Hint:**

Obviously  $1 + \sin x \geq 0$  hence  $\cos x - \sin x = 1$  if the solution holds.

$$\text{Rewrite as } \cos(x + \pi/4) = 1/\sqrt{2}$$

$$\Rightarrow x = 0, 3\pi/2, 2\pi \Rightarrow 3 \text{ solutions.}$$

**21. Find the number of solutions of  $2^{\cos x} = 1/\sin x$  on the interval  $[-2\pi, 2\pi]$ .**

**Hint:**

The equation is true for only  $x = \pi/2$  hence  $\sin x = \pm 1$  and hence 4 solutions.

**22. Find the number of solutions of  $\sin \{x\} = \cos \{x\}$  on  $[0, 2\pi]$ , where  $\{.\}$  denotes the fractional part.**

**Hint:**

Use graphs of  $\sin \{x\}$  and  $\cos \{x\}$  to find the solution

Obviously the intersection points are in number = 6 in given interval.

**23. Solve:  $\cos x \cos y = 1$ .**

**Hint:**

$$-1 \leq \cos x \leq 1 \text{ and}$$

$$-1 \leq \cos y \leq 1$$

$$\Rightarrow \cos x \cos y = 1$$

$$\Rightarrow \cos x = 1 \text{ and } \cos y = 1$$

$$\Rightarrow x = 2n\pi, n \in \mathbb{I} \text{ and } y = 2m\pi, m \in \mathbb{I}$$

Also

$$\cos x = -1 \text{ and } \cos y = -1$$

$$\Rightarrow x = (2n+1)\pi \text{ and } y = (2m+1)\pi$$

**24. Solve :  $x+y = 2\pi/3$  and  $\cos x + \cos y = 3/2$ .**

**Hint:**

Rewrite  $\cos x + \cos y = 3/2$  as below:

$$2\cos\{(x+y)/2\} \cdot \cos\{(x-y)/2\} = 3/2$$

$$\Rightarrow \cos\{(x-y)/2\} = 3/2 \text{ that is absurd.}$$

$$\Rightarrow \text{no solution.}$$

**25. Find the number of solutions of  $e^{\sin x} - e^{-\sin x} - 7 = 0$ .**

**Hint:**

$$\text{Note } -1 \leq \sin x \leq 1$$

$$\Rightarrow e^{-1} \leq e^{\sin x} \leq e^1$$

But the original equation gives

$$e^{\sin x} = 7 + (1/e^{\sin x})$$

For no value of  $x$  the two sides LHS and RHS can be equal and hence no solution exists.

26. **Evaluate:**  $\sum_{k=1}^{\infty} 3^{k-1} \sin^3 \frac{a}{3^k}$

**Hint:**

Use the formula:  $\sin 3x = 3 \sin x - 4 \sin^3 x$ .

And rewrite the given expression

$$= \sum_{k=1}^{\infty} \frac{1}{4} \left( 3^k \sin \frac{a}{3^k} - 3^{k-1} \sin \frac{a}{3^{k-1}} \right)$$

$$= \lim_{k \rightarrow \infty} \frac{1}{4} \left( 3^k \sin \frac{a}{3^k} - \sin a \right)$$

as all other terms cancel out if we put  $k=1,2,3,\dots$ , and this can be evaluated by changing to the form (0/0) and using the standard limit of

$$\lim_{k \rightarrow \infty} \frac{\sin \frac{a}{3^k}}{\frac{a}{3^k}} = \lim_{k \rightarrow \infty} \frac{\sin 0}{0} = 1.$$

27. **If  $x \neq (n\pi/2)$  then solve the equation**

$$(\cos x)^{\sin^2 x - 3 \sin x + 2} = 1.$$

**Hint:**

Obviously,  $\cos x \neq 0, 1, -1$  as  $x \neq (n\pi/2)$ .

$$\Rightarrow \sin^2 x - \sin x + 2 = 0$$

$$\Rightarrow (\sin x - 2)(\sin x - 1) = 0$$

$$\Rightarrow \sin x = 1 \text{ as } \sin x \text{ cannot be } 2.$$

$\Rightarrow \cos x = 0$  but  $\cos x$  cannot be zero as  $0^\circ \neq 1$  hence no solution is possible.

28. **If the arcs of the same lengths in two circles subtend angles  $65^\circ$  and  $110^\circ$  at the centre, then find the ratio of their radii.**

**Hint:**

Let  $r_1, r_2$  be the radii of the two circles. Then

$$\theta_1 = 65^\circ = \frac{\pi}{180} \times 65 = \frac{13\pi}{36} \text{ radians}$$

$$\theta_2 = 110^\circ = \frac{\pi}{180} \times 110 = \frac{22\pi}{36} \text{ radians}$$

We know that if  $l$  be the length of equal arcs then

$$l = r_1 \theta_1$$

$$l = r_2 \theta_2$$

$$\text{Then the required ratio is } \frac{r_1}{r_2} = \frac{\theta_2}{\theta_1} = \frac{22}{13}$$

29. **If  $\cos x = -\frac{3}{5}$ ,  $x$  lies in the third quadrant, find the values of other five trigonometric functions.**

**Hint:**

From  $\sin^2 x + \cos^2 x = 1$ ,

$$\sin^2 x = \frac{16}{25} \Rightarrow \sin x = \pm \frac{4}{5}$$

Since  $x$  lies in third quadrant, hence  $\sin x$  will be negative. Therefore,  $\sin x = -\frac{4}{5}$ .

Similarly, other ratios keeping their existence with sign may be calculated.

30. **Find the principal solution of the**

$$\text{equation } \sin x = \frac{\sqrt{3}}{2}.$$

**Hint:**

$$\text{We know that } \sin \frac{\pi}{3} = \frac{\sqrt{3}}{2} \text{ and } \sin \left( \pi - \frac{\pi}{3} \right) = \frac{\sqrt{3}}{2}.$$

Hence  $\frac{\pi}{3}$  and  $\frac{2\pi}{3}$  are the principal solutions

because principal solutions are the solutions that lie in the interval  $[0, 2\pi)$

31. **If  $\sin x = \frac{3}{5}$  and  $\cos y = -\frac{12}{13}$ , where  $x$  and  $y$  both lie in the second quadrant, find the value of  $\sin(x+y)$ .**

**Hint:**

We know that  $\sin(x+y) = \sin x \cos y + \cos x \sin y$



$\sin x$  is given hence from the identity  
 $\sin^2 x + \cos^2 x = 1$ ,

$\cos^2 x = \pm \frac{4}{5}$  but  $x$  lies in second quadrant, hence  
 $\cos x$  should be negative.

$$\text{So, } \cos x = -\frac{4}{5}$$

Similarly,  $\sin y = \pm \frac{5}{13}$ . Here  $\sin y$  will be positive as  
 $y$  lies in second quadrant.

$$\text{So, } \sin y = \frac{5}{13}$$

Now, on putting the essential values,  $\sin(x+y)$  can  
be evaluated as  $-\frac{56}{65}$

**32. Find the principal value of  $\sin^{-1}\left(\frac{1}{\sqrt{2}}\right)$ .**

**Hint:**

Let us assume

$$\sin^{-1}\left(\frac{1}{\sqrt{2}}\right) = x$$

$$\Rightarrow \sin x = \left(\frac{1}{\sqrt{2}}\right) \text{ or}$$

$$x = \left(\frac{\pi}{4}\right) \text{ or } \left(\pi - \frac{\pi}{4}\right).$$

But the principal value branch of  $\sin^{-1}$  is  $\left(-\frac{\pi}{2}, \frac{\pi}{2}\right)$ .

Since  $\left(\frac{\pi}{4}\right)$  lies in this interval, hence this is the  
principal value.



Dr S.B. Dhar, is **Editor of this Quarterly e-Bulletin**. He is an eminent mentor, analyst and connoisseur of Mathematics from IIT for preparing aspirants of Competitive Examinations for Services & Admissions to different streams of study at Undergraduate and Graduate levels using formal methods of teaching shared with technological aids to keep learning at par with escalating standards of scholars and learners. He has authored numerous books – Handbook of Mathematics for IIT JEE, A Textbook on Engineering Mathematics, Reasoning Ability, Lateral Wisdom, Progress in Mathematics (series for Beginner to Class VIII), Target PSA (series for class VI to class XII) and many more.

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*Education is just not training;*

*It is about ability to think;*

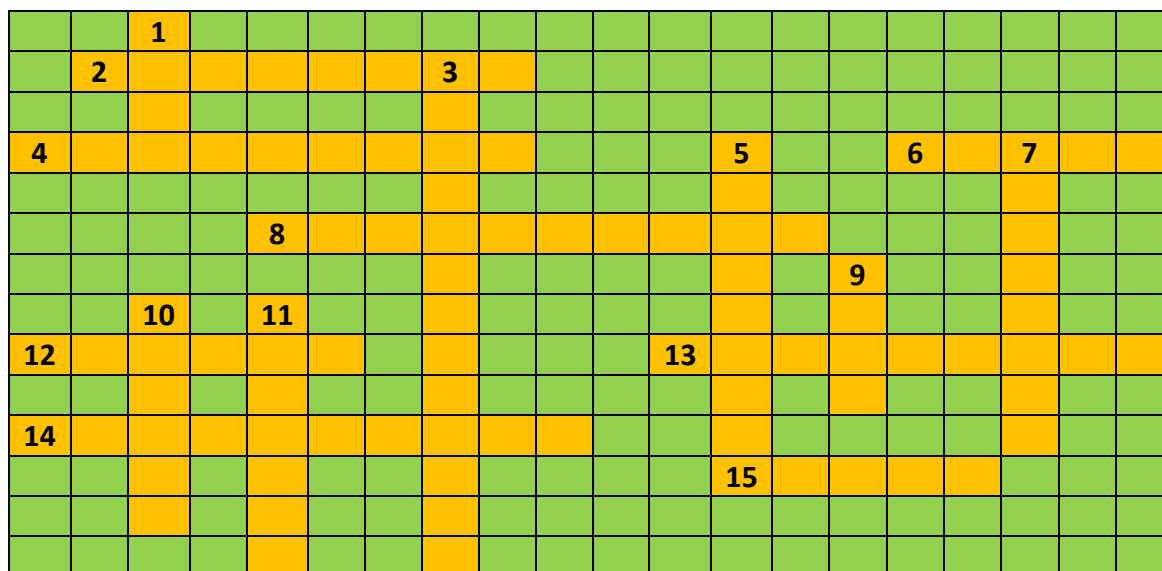
*It is about ability to reason;*

*It is about ability to choose;*

*It is to develop a faith in self,*

*And, a passion to apply.*

—00—

**CROSS WORD PUZZLE Oct'17: World Days****S.B. Dhar****ACROSS**

- 2: *October 9*
- 4: *October 12*
- 6: *October 15*
- 8: *October 1*
- 12: *October 4*
- 13: *October 31*
- 14: *October 20*
- 15: *2<sup>nd</sup> Thursday of October*

**DOWN**

- 1: *October 9*
- 3: *October 24*
- 5: *October 14*
- 7: *October 5*
- 9: *October 23*
- 10: *October 19*
- 11: *First Monday of Octobe*

**SOLUTION : CROSSWORD PUZZLE Sept'17: EDUCATION****Prof. S.B. Dhar**

									1P										
					2L				O										
					3E	X	P	U	L	S	4I	O	N						
5R	U	B	R	I	C				Y		N								
					T				M		T								
					U		6A	C	A	D	E	M	I	A					
					R				T		L								
		7M			E			8C	H	I	L	D							
		E									I								9W
		M				10A	N	D	R	A	G	O	G	Y			11D		I
		O									E						U		S
	12B	R	A	I	N	W	A	S	H	I	N	G					N		D
		Y									C						C		O
										13S	E	L	F	E	S	T	E	E	M

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**INVITATION FOR CONTRIBUTION OF ARTICLES**

Your contribution in the form of an article, story poem or a narration of real life experience is of immense value to our students, the target audience, and elite readers of this Quarterly monthly e-Bulletin **Gyan-Vigyan Sarita: शिक्षा**, and thus create a visibility of the concerns of this initiative. It gives them a feel that you care for them, and they are anxiously awaiting to read your contributions. We request you to please feel free to send your creation, by **20<sup>th</sup> of this month** to enable us to incorporate your contribution in next bulletin, [subhashjoshi2107@gmail.com](mailto:subhashjoshi2107@gmail.com).

**We will be pleased have your association in taking forward path our plans as under-**

- **With the start of Second year of operation, 1<sup>st</sup> Supplement to 1<sup>st</sup> Quarterly e-Bulletin Gyan-Vigyan Sarita: शिक्षा shall be brought out 1<sup>st</sup> November'17.**
- **And this cycle monthly supplement to Quarterly e-Bulletin Gyan-Vigyan Sarita: शिक्षा aimed to continue endlessly**

**We believe that this monthly supplements to quarterly periodicity of e-Bulletins shall make it possible for our esteemed contributors to make contribution rich in content, diversity and based on their ground level work.**

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*Growing With Concepts : Physics***AN APOLOGY****Dr Subhash Kumar Joshi**

*It has been an endeavor to maintain continuity of a monthly article covering concepts involved in Physics, which was started nearly Two years ago. With the journey continuing scope of articles has been enlarged to encompass Mathematics and Physics, with passionate and dedicated teacher Prof. SB Dhar and Mrs. Kumud Bala. These articles have been complied in Mentors' Manual. While articles on mathematics and Chemistry continue to be in this annual e-Bulletin, article on Physics has been skipped.*

*In the process of evolving this annual issue, happily Two new Learning Centres came up at Ram Krishna Mission School, Guntur with 30-40 students and Academy Home Lucknow, having Seven students from 9<sup>th</sup> to 11<sup>th</sup> standard. Intensive participation of students at these Learning Centers to Online Mentoring Sessions, which we have been striving since last Five Years, was obvious to receive our considered attention.*

*At this juncture there are conflicting priorities of writing article on Physics at one end, and upkeeping expectations of fascilitators and more particularly requirement of support to the students, at the other end. These target students who have come forward in the mid of their academic session. It was. Therefore, considered decision was taken to support students with the guidance that they were looking for.*

*The set of articles on Physics have reached a stage where additional Two-Three articles would complete conceptual part of Physics upto 12<sup>th</sup> standard. This we shall pursue to include problems of variety and support the practice in application of the concepts.*

*Nevertheless, an unconditional apology is extended to the readers for my personal inability to maintain the stream of articles on Physics in this e-Bulletin. It is assured that this gap shall be filled up soon.*

*Author is Coordinator of this initiative Gyan-Vigyan Sarita. e-Mail ID: [subhashjoshi2107@gmail.com](mailto:subhashjoshi2107@gmail.com)*



## GROWING WITH CONCEPTS - Chemistry

## SPONTANEITY IN TERMS OF FREE ENERGY CHANGE

Kumud Bala

**(a) Deriving the criteria from entropy consideration:** It has already been explained that the total entropy change for a system which is not isolated from the surroundings is given by-

$$\Delta S_{\text{total}} = \Delta S_{\text{system}} + \Delta S_{\text{surroundings}} \dots\dots (i)$$

Consider a process (or a reaction) being carried out at constant temperature and pressure. Suppose the heat is lost by the surroundings and gained by the system. If the heat lost by the surroundings is represented by  $q_p$  ( $p$  indicating that the process is being carried out at constant pressure) then by definition of entropy change

$$\Delta S_{\text{surroundings}} = -q_p/T \dots\dots\dots (ii)$$

(minus sign before  $q_p$  indicates that the heat is lost by the surroundings). Further, we know that at constant pressure

$$q_p = \Delta H \dots\dots\dots (iii)$$

Substituting this value in equation (ii), we get

$$\Delta S_{\text{total}} = \Delta S_{\text{system}} - \frac{\Delta H}{T} \dots\dots\dots (iv)$$

Using the symbol  $\Delta S$  in place of  $\Delta S_{\text{system}}$ , we can write equation (iv) as

$$\Delta S_{\text{total}} = \Delta S - \frac{\Delta H}{T} \dots\dots\dots (v)$$

Multiplying throughout by  $T$ , we get

$$T\Delta S_{\text{total}} = T\Delta S - \Delta H \dots\dots\dots (vi)$$

But, for a change taking place at constant temperature and pressure,

$$\Delta G = \Delta H - T\Delta S \dots\dots\dots (vii)$$

Substituting this value in equation (vi), we get

$$T\Delta S_{\text{total}} = -\Delta G \text{ or } \Delta G = -T\Delta S_{\text{total}} \dots\dots\dots (viii)$$

But in terms of total entropy change, it has already been explained that if  $\Delta S_{\text{total}}$  is positive, the process is spontaneous. If  $\Delta S_{\text{total}}$  is zero, the process is in equilibrium, and if  $\Delta S_{\text{total}}$  is negative, the direct

process is non-spontaneous; the reverse process may be spontaneous.

Putting these results in equation (viii), it can be concluded that the criteria in terms of free energy change for the spontaneity of the process will be as follows:

- (i) If  $\Delta G$  is negative, the process will be spontaneous.
- (ii) If  $\Delta G$  is zero, the process is in equilibrium.
- (iii) If  $\Delta G$  is positive, the direct process is non-spontaneous; the reverse process may be spontaneous.

An important advantage of free energy criteria over the entropy criteria lies in the fact that the former requires free energy change of the system only whereas the latter requires the total entropy change for the system and the surroundings.

**(b) Deriving the criteria from Gibbs energy equation**

The Gibbs energy equation is given by  $\Delta G = \Delta H - T\Delta S$ . This equation combines in itself both the factors which decide the spontaneity of a process, namely, (i) the energy factor,  $\Delta H$  (ii) the entropy factor,  $T\Delta S$ . Thus,  $\Delta G$  is the resultant of the energy factor (i.e., tendency for minimum energy) and the entropy factor (i.e., the tendency for maximum randomness). Depending upon the signs of  $\Delta H$  and  $T\Delta S$  and their relative magnitudes, the following different possibilities arise:

1. When both  $\Delta H$  and  $T\Delta S$  are negative, i.e., energy factor favours the process but randomness factor opposes it, then (i) If  $\Delta H > T\Delta S$  the process is spontaneous and  $\Delta G$  is negative. (ii) If  $\Delta H < T\Delta S$ , the process is non-spontaneous and  $\Delta G$  is positive. (iii) If  $\Delta H = T\Delta S$ , the process is in equilibrium and  $\Delta G$  is zero.
2. When both  $\Delta H$  and  $T\Delta S$  are positive, i.e., energy factor opposes the process but randomness factor favours it. Then (i) If  $\Delta H > T\Delta S$ , the process is non-spontaneous and  $\Delta G$  is positive. (ii) If  $\Delta H < T\Delta S$ , the process is spontaneous and  $\Delta G$  is

negative. (iii) If  $\Delta H = T\Delta S$ , the process is in equilibrium and  $\Delta G$  is zero.

3. When  $\Delta H$  is negative but  $T\Delta S$  is positive, i.e., energy factor as well as the randomness factor favour the process. The process will be highly spontaneous and  $\Delta G$  will be highly negative.
  4. When  $\Delta H$  is positive but  $T\Delta S$  is negative, i.e., energy factor as well as the randomness factor oppose the process. The process will be highly non-spontaneous and  $\Delta G$  will be highly positive.
- To sum up, the criteria for spontaneity of a process in terms of  $\Delta G$  is as follows:
- (i) If  $\Delta G$  is negative, the process is spontaneous.
  - (ii) If  $\Delta G$  is zero, the process does not occur or the system is in equilibrium.
  - (iii) If  $\Delta G$  is positive, the process does not occur in forward direction. It may occur in the backward direction.

#### Effect of temperature on the spontaneity of a process:

The spontaneity of a process depends upon (i) the energy factor ( $\Delta H$ ), and (ii) the randomness/ entropy factor ( $T\Delta S$ ). The magnitude of the first factor does not change much with temperature but the second factor changes appreciably with change of temperature. Hence, the resultant  $\Delta G = \Delta H - T\Delta S$  would change with temperature and so would the spontaneity of the process, e.g.,

- (a) For endothermic reaction:  $\Delta H$  is always positive, i.e., this factor opposes the process. If  $T\Delta S$  is negative, this factor will also oppose the process and process will be non-spontaneous. However, if  $T\Delta S$  is positive (so that it favours the process), then the process can if magnitude of the factor  $T\Delta S$  is greater than the magnitude of  $\Delta H$ . The reaction is then said to be entropy driven. The magnitude of the factor,  $T\Delta S$  is affected by temperature as follows:
- (b) If the temperature is very low such that  $T\Delta S < \Delta H$  slightly in magnitude,  $\Delta G$  will be positive and hence the process will be non-spontaneous.
  - (i) If the temperature is moderate such that  $T\Delta S > \Delta H$  slightly in magnitude,  $\Delta G$  will be slightly negative. Hence, the process will be spontaneous but slow.
  - (ii) If the temperature is high,  $T\Delta S$  will be much greater than  $\Delta H$  in magnitude so that  $\Delta G$  is highly negative. Hence, the process will not only be spontaneous but fast. Thus, an

endothermic reaction which may be non-spontaneous at low temperature may become spontaneous at high temperature. This is the reason why endothermic reactions are carried out at high temperature.

- (c) For exothermic reactions:  $\Delta H$  is always negative, i.e., this factor always favours the process. Thus, if  $T\Delta S$  is positive, this factor will also favour the process and the process will always be spontaneous. However, if  $T\Delta S$  is negative (so that it opposes the process), then the process can occur only if the magnitude of  $\Delta H$  is very large so that  $\Delta G$  is negative. The reaction is then said to be enthalpy driven. Alternatively, the spontaneity of the reaction is affected by temperature as follows:
  - (i) If the temperature is so high that  $T\Delta S > \Delta H$  in magnitude,  $\Delta G$  will be positive and the process will be spontaneous.
  - (ii) If the temperature is made so low that  $T\Delta S < \Delta H$  in magnitude,  $\Delta G$  will be the process will be negative and the process will be spontaneous. Thus, an exothermic reaction which may be non-spontaneous at high temperature may become spontaneous at low temperature.

Depending upon the signs of  $\Delta H$  and  $\Delta S$  and the value of temperature, the various possible results may be summed up as follows:

SIGN OF $\Delta H$	SIGN OF $\Delta S$	VALUE OF TEMPERATURE (T)	SPONTANEITY
-	+	Any	Spontaneous
+	-	Any	Non-spontaneous
-	-	Low	Spontaneous
-	-	High	Non-spontaneous
+	+	Low	Non-spontaneous
+	+	High	Spontaneous

**EXAMPLE:** Enthalpy and entropy changes of a reaction are  $40.63 \text{ kJ mol}^{-1}$  and  $108.8 \text{ J K}^{-1} \text{ mol}^{-1}$  respectively. Predict the feasibility of the reaction at  $27^\circ\text{C}$ .

**Solution:** Here, we are given

$$\Delta H = 40.63 \text{ kJ mol}^{-1} = 40630 \text{ J mol}^{-1}$$

$$\Delta S = 108.8 \text{ J K}^{-1} \text{ mol}^{-1}$$

$$T = 27^\circ\text{C} = 27 + 273 = 300 \text{ K}$$

$$\therefore \Delta G = \Delta H - T\Delta S$$

$$= 40630 \text{ J mol}^{-1} - 300 \text{ K} \times 108.8 \text{ J K}^{-1} \text{ mol}^{-1}$$

$$= 7990 \text{ J mol}^{-1}$$

Since  $\Delta G$  comes out to be positive (i.e.,  $\Delta G > 0$ ) the reaction is not feasible in the forward direction.

### Standard free energy change of a reaction ( $\Delta_r G^\circ$ ) and standard free energy of formation ( $\Delta_f G^\circ$ ):

Standard free energy change of a reaction is defined as the change in free energy which takes place when the reactants in the standard state (1 atm., 298K) are converted into the products in their standard state.

Just as the enthalpy of a reaction can be calculated from the standard enthalpies of formation ( $\Delta_f H^\circ$ ), taking the standard enthalpies of formation of the elements as zero, the free energy change during a process (or a reaction) can be calculated in a similar way from the standard free energy of formation ( $\Delta_f G^\circ$ ) of the different reactants and products involved, taking standard free energy of formation of the elements as zero i.e.,

for any process or reaction,

$\Delta_r G^\circ = [\text{Sum of the standard free energy of formation of products}] - [\text{Sum of standard free energy of formation of reactants}]$

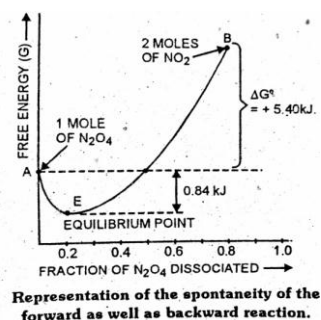
$$= \sum \Delta_f G^\circ(\text{Products}) - \sum \Delta_f G^\circ(\text{Reactants})$$

Standard free energy of formation of a compound is defined as the energy change which takes place when one mole of the compound is formed from its elements taken in their standard states. Similar to standard enthalpy of formation ( $\Delta_f H^\circ$ ), the standard free energy of formation ( $\Delta_f G^\circ$ ) of elementary substances is taken as zero.

**Free energy change and chemical equilibrium:** We know that a reaction is spontaneous if  $\Delta G$  is negative. Now, in a reversible reaction, the forward as well as backward reaction takes place. This means that  $\Delta G$  is negative for the forward as well as for backward reaction. Let us now see how it happens.

To understand free energy changes taking in reversible reactions, let us consider the following reaction:  $\text{N}_2\text{O}_4(\text{g}) \leftrightarrow 2\text{NO}_2(\text{g})$ . The standard free energy change ( $\Delta_r G^\circ$ ) for this reaction is  $+5.40 \text{ kJ mol}^{-1}$ . Since  $\Delta_r G^\circ$  is positive, one might predict that  $\text{N}_2\text{O}_4$  in its standard state (at 298 K and 1 bar pressure) would not dissociate into  $\text{NO}_2$  at all and that the reverse reaction (i.e., formation of  $\text{N}_2\text{O}_4$  from  $\text{NO}_2$ ) would go to completion. However, both these predictions are incorrect. The reaction is reversible and we know that the reversible reactions tend to go to

equilibrium and not to completion. Moreover, the forward as well as the backward reaction should be spontaneous.



The free energy of the system in which the above reaction occurs at 298 K and 1 atmosphere is plotted against the fraction of  $\text{N}_2\text{O}_4$  dissociated. In the figure, point A represents the standard free energy of one mole of  $\text{N}_2\text{O}_4$ , point B represents the standard free energy of two moles of  $\text{NO}_2$  and the other points between A and B on the curve represents the free energies of mixtures of  $\text{N}_2\text{O}_4$  and  $\text{NO}_2$ .

The free energy curve exhibits a minimum at the equilibrium point E, where 16.6% of the  $\text{N}_2\text{O}_4$  is dissociated. The difference between the standard free energy of two moles of  $\text{NO}_2$  (point B) and the standard free energy of the one mole of  $\text{N}_2\text{O}_4$  (point A),  $\Delta_r G^\circ$  for the reaction is  $+5.40 \text{ kJ}$ . However, as shown in figure, the free energy of the reaction mixture at the equilibrium point (E) is less than either of the pure reactant (A) or the product (B). In the present example, the point E is lower by  $0.84 \text{ kJ}$  than the point A. This means that when 1 mole of  $\text{N}_2\text{O}_4$  changes into the equilibrium mixture, the value of  $\Delta_r G^\circ = -0.84 \text{ kJ}$ . Similarly, when 2 moles of  $\text{NO}_2$  change into the equilibrium mixture, the values of  $\Delta_r G^\circ = -5.40 + (-0.84) = -6.24 \text{ kJ}$ . Thus, in both the cases, the values of  $\Delta_r G^\circ$  are negative and hence both the processes (i.e., forward reaction as well as backward reaction) are spontaneous.

**Relationship between standard free energy and equilibrium constant:** The free energy change of the reaction in any state  $\Delta G$ , (when equilibrium has not been attained) is related to the standard free energy change of the reaction,  $\Delta_r G^\circ$  (which is equal to the difference in free energies of formation of the products and reactants both in their standard states) and is given by the equation,

$$\Delta_r G = \Delta_r G^\circ + RT \ln Q \dots\dots\dots (i)$$

where Q is the reaction quotient, it is equal to  $Q_p$  if the reactants and products are gaseous and equal to  $Q_c$  if they are in the solution.

When equilibrium is attained, there is no further free energy change, i.e.,  $\Delta G = 0$  and Q become equal to K (equilibrium constant). Hence, the above equation becomes

$$0 = \Delta_r G^\circ + RT \ln K \text{ or } \Delta_r G^\circ = -RT \ln K \dots (ii)$$

$$\text{Or } \Delta_r G^\circ = -2.303 RT \log K \dots (iii)$$

**Example:** Calculate the standard free energy change for the reaction  $4\text{NH}_3(\text{g}) + 5\text{O}_2 \rightarrow 4\text{NO}(\text{g}) + 6\text{H}_2\text{O}(\text{l})$ . Given that the standard free energies of formation ( $\Delta_f G^\circ$ ) for  $\text{NH}_3(\text{g})$ ,  $\text{NO}(\text{g})$  and  $\text{H}_2\text{O}(\text{l})$  are  $-16.8$ ,  $+86.7$  and  $-237.2 \text{ kJ mol}^{-1}$  respectively. Predict the feasibility of the above reaction at the standard state.

**Solution:** Here, we are given

$$\Delta_f G^\circ (\text{NH}_3) = -16.8 \text{ kJ mol}^{-1}$$

$$\Delta_f G^\circ (\text{NO}) = +86.7 \text{ kJ mol}^{-1}$$

$$\Delta_f G^\circ (\text{H}_2\text{O}) = -237.2 \text{ kJ mol}^{-1}$$

$$\begin{aligned} \therefore \Delta_r G^\circ &= \sum \Delta_f G^\circ (\text{products}) - \sum \Delta_f G^\circ (\text{reactants}) \\ &= [4 \times \Delta_f G^\circ (\text{NO}) + 6 \times \Delta_f G^\circ (\text{H}_2\text{O})] - [4 \times \Delta_f G^\circ (\text{NH}_3) + 5 \times \Delta_f G^\circ (\text{O}_2)] \\ &= [4 \times (86.7) + 6 \times (-237.2)] - [4 \times (-16.8) + 5 \times 0] \\ &= -1009.2 \text{ kJ} \end{aligned}$$

Since  $\Delta_r G^\circ$  is negative, the process is feasible.

**Example:** Calculate  $\Delta_r G^\circ$  for conversion of oxygen to ozone  $3/2 \text{ O}_2(\text{g}) \rightarrow \text{O}_3(\text{g})$  at 298 K, if  $K_p$  for this conversion is  $2.47 \times 10^{-29}$

$$\text{Solution: } \Delta_r G^\circ = -2.303 RT \log K_p$$

$$= - (2.303) (8.314 \text{ J K}^{-1} \text{ mol}^{-1}) (298 \text{ K}) \log (2.47 \times 10^{-29})$$

$$= 163229 \text{ J mol}^{-1} = 163.2 \text{ kJ mol}^{-1} \text{ [For standard condition, T}$$

$$= 298 \text{ K, and } \log(2.47 \times 10^{-29})$$

$$= -29 + 0.3927 = -28.6073]$$



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### Answers to Science Quiz in Sept'17

**Kumud Bala**

#### ANSWERS :

- 1.(C) 2. (C) 3. (B) 4. (B) 5. (C) 6. (B) 7. (C) 8. (A) 9. (A) 10. (D) 11. (D) 12. (C)  
13. (A) 14. (D) 15. (C) 16. (C) 17. (B) 18. (C) 19. (B) 20. (C)

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**SCIENCE QUIZ : Oct'17****Kumud Bala**

- The law of octaves was given by:  
(A) Luther Meyer (B) Newlands  
(C) Dobereiner (D) Lavoisier
- Mendeleev periodic table was based on:  
(A) Atomic number (B) Atomic mass  
(C) Atomic volume (D) Atomic configuration
- All the elements belonging to second period are :  
(A) Normal elements (B) Transition elements  
(C) Stable elements (D) Halogens
- The maximum number of elements in third period is :  
(A) 8 (B) 18  
(C) 32 (D) Between 8 and 18
- The elements on the right hand side of the periodic table are:  
(A) Metals (B) Non-metals  
(C) metalloids (D) Ferromagnetic.
- The number of periods in the long form of the periodic table is:  
(A) Seven (B) Nine  
(C) Eighteen (D) As many as groups
- Element of atomic number 24 belongs to:  
(A) s- block (B) p- block  
(C) d- block (D) Both s- and d- block
- On moving from left to right across a period in the periodic table, the size of the atom generally:  
(A) Decreases  
(B) Increases  
(C) Remains constant  
(D) Decreases up to IV A group and then increases.
- Which one of the following is smallest in size?  
(A)  $N^{3-}$  (B)  $O^{2-}$  (C)  $F^-$  (D)  $Na^+$
- The minimum ionization energy from the isoelectronic species  $Ca^{2+}$ ,  $K^+$ , Ar,  $Cl^-$  is of:  
(A)  $Cl^-$  (B) Ar (C)  $Ca^{2+}$  (D)  $K^+$
- Out of K, Na, Be and Kr, the highest ionization energy is of :  
(A) Kr (B) Be (C) Na (D) K
- In the periodic table, the highest ionization energies are for:  
(A) Halogen (B) Noble gases  
(C) Alkali metals (D) Chalcogens.
- Which of the following has the maximum value of electron affinity?  
(A) F (B) Cl (C) Br (D) I
- Which of the following has the least electro negativity value?  
(A) C (B) Al (C) Si (D) P
- Cerium ( $Z = 58$ ) belongs to :  
(A) s- block (B) p- block  
(C) d- block (D) f – block
- Alkali metals are powerful reducing agents because:  
(A) These are metals  
(B) Their ionic radii are large  
(C) These are mono valent  
(D) Their ionization potentials are low.
- In a group of the periodic table, the elements possess:  
(A) Same number of electrons  
(B) Same number of protons  
(C) Same number of neutrons  
(D) Same number of electrons in the outermost shell.
- Property of alkaline earth metals that increases with their atomic number is:  
(A) Ionization energy  
(B) Solubility of their hydroxides  
(C) Solubility of their sulphates  
(D) Electronegativity.
- Among the following: NaOH,  $Ca(OH)_2$ , KOH, and  $Zn(OH)_2$ , the weakest base is:  
(A) NaOH (B)  $Ca(OH)_2$   
(C) KOH (D)  $Zn(OH)_2$
- Which of the following oxides is amphoteric in character?  
(A) CaO (B)  $CO_2$   
(C)  $SiO_2$  (D)  $SnO_2$

**(Answers to this Science Quiz – Nov'17 shall be provided in Quarterly e-Bulletin**

**dt 1<sup>st</sup> November'17)**

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## Theme Song :

**PREMISE:** *We are pleased to adopt a song “ इतनी शक्ति हमें देना दाता.....” from a old Hindi Movie Do Aankhen Barah Haath दो आँखें बारह हाथ of year 1957, directed by The Late V. Shantaram. The lyrics are by Shri Bharat Vyas, singer Melody Queen Sushri Lata Mangeshkar, and Music Direction by Vasant Desai. It has become a widely accepted inspirational song and/or prayer in many educational institutions and socially inspired initiatives engaged in mentoring of unprivileged children. This newly formed non-organizational initiative, being selflessly operated by a small set of compassionate persons, finds its philosophy in tune with the song and conveys its gratitude to all the eminent persons who brought out the song in a manner that it has attained an epitome of popularity. While working its mission and passion, the group invites one and all to collectively complement in grooming competence to compete among unprivileged children. The song/prayer goes as under -*

इतनी शक्ति हमें देना दाता, मन का विश्वास कमजोर हो ना

हम चले नेक रस्ते पे हमसे, भूलकर भी कोई भूल हो ना ॥

दूर अज्ञान के हो अंधेरे, तू हमें ज्ञान की रोशनी दे

हर बुराई से बचते रहें हम, जितनी भी दे भली ज़िन्दगी दे

बैर हो ना किसी का किसी से, भावना मन में बदले की हो ना ॥

इतनी शक्ति हमें देना दाता, मन का विश्वास कमजोर हो ना

हम चले नेक रस्ते पे हमसे, भूलकर भी कोई भूल हो ना ॥

हम ना सोचें हमें क्या मिला है, हम ये सोचे किया क्या है अर्पण

फूल खुशियों के बाँटे सभी को, सब का जीवन ही बन जाए मधुबन

अपनी करुणा का जल तू बहा के, कर दे पावन हर एक मन का कोना ॥

इतनी शक्ति हमें देना दाता, मन का विश्वास कमजोर हो ना

हम चले नेक रस्ते पे हमसे, भूलकर भी कोई भूल हो ना ॥



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*Every end, so also end of this e-Bulletin, is a pause for a review, before re-continuing of a journey far beyond ...*