

## PROLOGUE

Views of accomplished people on education at large converge on its need, importance, journey, and impact on society. Words, context and manifestation could be different but, essence remains the same. Despite process of learning, in prevalent parlance of education, is as old as the age of mankind. Changes that it has undergone in the process is, use of tools and emphasis to cater to the needs of society.

This model of **Educational Guidance Centre (EGC)**, which has later evolved into **Interactive Online Mentoring Sessions (IOMS)**, is a result of an introspection of learning experience, state of peers, differential in scope and pace of learning of privileged and unprivileged students vis-a-vis democracy in education, and inherited potential of students. Accordingly, the guiding philosophy of the model is **Excellence Through Education, for Socially, Economically and Geographically Deprived Children**, with a sense of **Personal Social Responsibility (PSR)**. The motto of the model is **स्वार्थ में परमार्थ और परमार्थ में स्वार्थ**. It neither envisages any kind of mercy or kindness towards unprivileged students nor revengeful attitude towards students from privileged or accomplished families. All that it advocates is a platform which is free and open for all to grow through quality education. The model calls upon privileged and accomplished persons to take it upon themselves to create an environment conducive to motivate, facilitate, focus, and needs of hard work for excellence on students in the field of education. It is believed to be a domain of persons who inherits an inborn potential. In this model class conflict is diffused into an environment of coexistence where each collectively complements each other. Thus it develops among the participants a human sensitivity and compassion, essential attributes of a good professional.

Every beginning has to start somewhere, and the author considered it to be most appropriate to concentrate on building excellence in target children of high school, leading them to the level of competence for best of the institute in Engineering and Technology. This choice is neither ad-hock nor by compulsion, but a considered choice to give in the best, where a mentors are at the best. In this pursuit care is taken to overcome all the riddles and riders which are retardant in learning and growth. Accordingly, the model aims at to make learning of mathematics and science, very natural and simple like learning a language. Emphasis is on mentoring the children and not teaching or tutoring. The mentoring of students is done in an interactive environment. Wherever, internet is available simple and affordable technology is used to make the mentoring Online.

Education, unless leads to liberation of students from the bondage of ignorance and dependence, be it on a teacher, it would be short of expectations. This approach requires involvement of mentor at the students' level of understanding, and relating concepts to their real world of students. Though this model makes an intervention at high school level, students are lifted from bottom most level in mathematics, without exception, and a habit of meditating on the subject and its mental revision is inculcated. As a result, it is seen that ability to reason out How? and Why? of every concept that a child learns, and power of imagination, grows out of proportion.

Group learning, also referred to as peer learning stimulated in the model leads to cognitive learning, and problem solving which helps students to know what they do not know, as well as it helps them to know what they ought to know. High school is that level where students' mental faculties have grown biologically, but may not be commensurate with the corresponding academic standards of the target students. This gap can be attributed to various socio-economic and environmental factors. Accordingly, the biological growth is supplemented with proper motivation, facilitation, guidance, envisioning and drill to help students to leap out of lagging phase. In this exercise learning is facilitated in an out-of-box manner such that inquisitiveness of students' is not allowed to dampen in stereotype. It is rather accelerated by fuelling in them the learning desire through necessary concepts which are tailored to the need of students. This whole model got evolved during initiation in June 2012 when children were mentored in the first chapter of science dwelling on properties of matter. It stated - "*separation of matter by centrifugal action.*" Pre-knowledge of mathematics involving vector, trigonometry and calculus, in context of the surroundings, is required to assimilate the concept of centrifugal action. It was a challenge to elaborate the concepts to students of Class 8<sup>th</sup> pass, who were much below the requisite level of understanding. Illustrations were drawn from the surrounding of students. Concept of gradient, first order differentiation, was explained through slope of a flyover along the length at different intervals and thus concept of infinitesimal change was driven home. Likewise, centrifugal separation was related to rotation of a wet towel held at one end, which gets straightened like a beam, while water droplets trapped in the towel sprinkle all around. These examples can be easily experimented by every child to realize

the concept. The journey involves enormous patience, but it was thrilling and satisfying to the mentor as well as students. It ignited desire, both in students and mentor, to continue the model in an uninterrupted manner to cover remaining topics of physics and mathematics in 9<sup>th</sup> and 10<sup>th</sup> class approaching to the level of 11<sup>th</sup> and 12<sup>th</sup> class. In the process, efforts were made to make students to try independently evolve comprehension of problems, solve it, and develop accuracy and speed necessary for a competitive edge.

Mentors' Manual is an effort to disseminate experience of mentoring mathematics and science at lowest level. As one proceeds in the manual visibility of the mentoring approach adopted in the model would become clearer.

Good and classical books have been used by the authors in its endeavours to come up with micro detail and illustrations. It is seen that authors of those books assumes pre-knowledge of the reader and builds the illustrations. These authors are constrained to quote in brief knowledge of related fields, while the reader might not have been exposed to it and developed proficiency in its use. In view of this experience, without any intention to pump-in another book, this e-manual has been developed to streamline each topic, seamlessly but not discretely to maintain a logical connectivity in the subject matter, as it grows. It helps to enhance relevance and comprehension of each topic in an integrated manner. This is extremely essential for conceptual understanding of Mathematics and Physics and essentially required for success in IIT-JEE, the toughest examination at that level. Author has no hesitation to confess that he has made use of a bibliography of classic books, rich and original in contents, cited at the end of each chapter, and quoted in the text wherever necessary. Use of these books is inevitable and mentors are advised to use them for practising the concepts through different kind of problems and conditions to develop proficiency in the subjects. These reference books and question banks would expose readers to multitude of facets which cannot be judiciously addressed in this manual.

The choice of students in class 9<sup>th</sup> to 10<sup>th</sup> standard for the IOMS intervention is deliberate and strategic. At this level students are not under pressure of career options and, therefore, can be groomed without pressure of success or failure. At the same time students would be able to explore their hidden talent and choose their place in pyramid of excellence based on their preparedness for self-carving, without envy against those who are above. The model also envisages re-entry of students, who have a desire to grow and to move into higher levels of pyramid.

It is experienced that, every run of mentoring, with same or different set of students, gets articulated differently either in scope or illustrations. This variance is largely attributed to the preparedness of students and sensitivity of the mentor to the reflexes of students. It is highly dynamic and dependent on the circumstances. Thus it may not be possible to lay down a thumb rule but, an effort is being made to present experiences which every mentor may like to explore with his own ingenuity. The ultimate objective should be to ensure that students find learning to be stimulating and is focussed on self-actualization in the field of interest, human values and excellence.

The choice field of Mathematics and Physics is taken by the author based on his own SWOT analysis, It has got widened to Chemistry with support of Mrs Kumud Bala. The core of engineering lies in mathematics and physics which are complementary to each other. These subjects individually and together are so interleaved that their treatment requires hopping across topics and subjects to maintain relevance and continuity. This manual is since focussed on treatment of subjects to build conceptual clarity; practicing of numerical in each chapter from reference books, listed therein, is left to students and if they are unable to evolve solution after minimum two attempts they are welcome to seek guidance of their mentor. Self-actualization of concepts and elevating it to the ability of students to handle them accurately, speedily and mentally, without pen, paper and book, requires rigorous practice of solving problems in a graded manner.

The illustrations and treatment of subjects in this manual is based on actual experience of mentoring students of Class 8<sup>th</sup> to 10<sup>th</sup> and leave them in class 11<sup>th</sup> and 12<sup>th</sup> to enhance their competitive proficiency by practicing solving of problems available anywhere. The task of mentoring and learning practiced at EGC cannot be done within confinement of any textbook or a curriculum; it is only possible by opening thought process of students to assimilate requisite knowledge so as to attain conceptual clarity. It aim at to infuse in mentor a desire to help children in building their concepts, thought provocation and problem solving skill. It is reiterated that, this requires mentor to welcome students to raise questions on how and why, and allowing them to pose unknown problems. In this pursuit mentor does not project himself either as a wizard or a key or encyclopaedia; he becomes a companion of students in problem

solving. It is based on the premise that a problem is that whose solution is to be determined; it is an essence of scientific journey.

Learning and maturing is multi-dimensional. In real world everything is multi-disciplinary and, therefore, unless learning is supplemented with adequate communication and presentation skills, it would remain a matter of one's own pleasure with no dividends to society. Language has a big role to play in presentation and communication skill. Language proficiency cannot be limited to classroom learning, it grows with reading of stories, good books on in subject of interest and last but not the least reading of reference books of mathematics and science along with a history of original contributors. Unfortunately, internet and electronic texts are distancing students from the reading habits. The IOMS model, while emphasizes upon growth of children into the field of engineering and technology, it does not undermine need of proficiency in language, general reading and graphical skills for overall development and presentation skill among target students.

Organization of the Mentors' Manual is as under –

Common Section:

**Chapter – G-01:** It contains introduction of the model Democratization of Education – a PSR Driven Initiative, evolved during association with Sarthak Prayash, SUBODH FOUNDATION successively and currently at Gyan Vigyan Sarita, a non-organizational, non-remunerative, non-commercial and non-political initiative of a few compassionate persons.

**Chapter – G-2:** It covers Basic Mathematics. It starts with number theory and ends with basics algebra, geometry and elemental mathematics.

**Chapter – G03:** It is dedicated to Foundation Mathematics required to understand physics upto Class XIIth. It deals with integration of Vectors, Complex Numbers, Coordinate geometry and Trigonometry required for mathematical analysis. It extends coordinate geometry to basic properties of conic sections and concludes with calculus, integral part of learning of physics.

Forward journey into the manual branches into three different streams Mathematics, Physics and Chemistry. Complete scope of Mathematics and Physics, upto Class 12<sup>th</sup> has been completed and Chemistry is in the progressing towards that.

A compilation of problems is being developed supplemented to the manual. These problems are supported with illustrations to the solution of the problems to be used as reference in the event of inability of students to solve the problem. These illustrations are developed so as to add an ease in understanding the concepts involved in the problem. These illustrations would be found useful by those students who are unable to associate in the stream of IOMS and are in self-learning mode.

This effort is totally unaided and unsupported. Therefore, chances of typographical errors or inadvertent inconsistencies are not ruled out. While, all the chapters are being reviewed, observation in respect of errors or inconsistencies would be gratefully welcomed, acknowledged and appropriately incorporated during revision of the documents, a continuous process, to make this selfless initiative more purposeful.

We firmly believes that this model, as a practice, and this manual, as a template, is a gift of society that we have received in our making and that of our families, and therefore we dedicates it to society with no expectations, at all. Accordingly, this manual is made a web enabled **free E-resource** on [www.gyanvigyansarita.in](http://www.gyanvigyansarita.in) for the benefit of mentors, teachers, tutors. It is requested to please collectively complement in enrichment of this manual as we go ahead with individual experiences and realization remembering the famous दोहा

सरस्वती के भंडार की बड़ी अपूरब बात। ज्यों-ज्यों खर्चे बढ़त है बिन खर्चे घट जात ॥

Once concepts are practiced, automatically comprehension and proficiency so developed should be used to solve objective questions available in different question-banks to enhance accuracy and speed, a prerequisite for success in competitive examinations.

At the end author begins with the contention of this manual with a reply of Michael Faraday on being asked about utility of generator, soon after his invention; Faraday politely replied “*it has same utility as that of a new born child*”.

Coordinated and focussed efforts of those who find a ray of hope in this model is envisioned to grow it into an era where children are groomed sociologically, intellectually and professionally with a strong fabric of गुरु-शिष्य परंपरा where teachers do their best in motivating, facilitating and carving of students to the epitome of excellence, without any kind of discrimination, and society takes upon itself to take care of teachers and family needs.

The manual is designed to facilitate the mentor and dissemination of the model. Accordingly, illustrations in the manual are indicative of thought process and would need tailoring by mentor. In the process students may not realize as to when their smooth ride is on an ascending flight, which would be much above the level expected of them, as per academic curricula. However, inquisitive students, if they choose to use it, are advised to do so from beginning and not for selective reading. At times mentor may find the concepts quite intuitive and the illustration in this manual too trivial or more complicated than the need. Despite mentors' patience is requested to appreciate the need of target audience whose understanding is far below the class they study. Many of them might be first generation students, with illiterate parents and surrounding. This makes the initiative much more challenging. The only key to furtherance of model is that mentor has to stimulate among students reasoning of How? and Why? of every concept being mentored without any presumptions or assumptions. This is the underlying thought of intrinsic development of students and ingenuity among them; a must for every teacher and mentor.

Feedback of users, in the spirit of the model, is warmly welcomed and would be appropriately responded and incorporated in updated versions of this manual.

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