

SCIENCE, TECHNOLOGY AND SUSTAINABLE DEVELOPMENT

COURSE CONTENT

UNIT 1 SCIENCE & TECHNOLOGY (3)

- Overview of S & T in India
- Relevance of S & T to people's well being, and the importance of information in society
- Ethics in S & T in the context of finite resources

UNIT 2 DEVELOPMENT (3)

- The Third World – people & progress, education & health, beneficiaries & victims of development (rural & urban)
- Economic parameters – measuring progress in a globalizing world
- Urbanization – the rural-urban divide, urban chaos & collapse, its causes, effects and future

UNIT 3 ENVIRONMENT & TECHNOLOGY (4)

- Ecology & Culture
- Appropriate technology, NGOs and people's participation
- Pollution – causes, effects, solutions
- Anthropogenic global effects – environmental refugees, environmental conflicts

UNIT 4 AGRICULTURE & WATER (4)

- Water – rivers and engineering
- Biotechnology, bio-diversity and indigenous knowledge systems
- Food technology and contract farming
- Agriculture in a post-hydrocarbon world – sustainable and organic agriculture

UNIT 5 ENERGY (4)

- Energy & the growth of societies
- Electric power generation – supply-side economics or demand-side management?
- Alternative energy sources
- Nuclear energy – policy, costs, benefits, risks, transparency, accountability

UNIT 6 SOCIETY & ECONOMICS (6)

- Indian society, its economics & the WTO
- Ownership of resources & livelihoods – rural-agricultural & urban-industrial
- Primary & secondary education – present status and its effects on the future
- Public health & longevity – QoL & SoL
- Holistic health systems & indigenous medicine

- Transportation – the lifeline of the economy in the context of fuel availability & alternative fuels

UNIT 7 GOVERNANCE (5)

- Planning – “prior informed consent”, transparency & accountability, ethics & practice
- The election process – the system : getting elected on a “minority vote”
- Concept of the corporation – corporate responsibility & the meaning of efficiency
- IFIs and Third World debt
- Protest, militancy and terrorism – causes and solutions : Role of the police and military in a democracy

UNIT 8 INDIA IN A GLOBAL CONTEXT (4)

- The military-industrial complex – corporatizing conflict
- Nuclear states and neo-nuclear states – proliferation
- India in a post-hydrocarbon world
- Regional reactions and repercussions to growing Indo-US ties

SUMMARY

	Lectures (hours)	Panel/group Discussions (hours)
INTRODUCTION	1	
UNIT 1	3	
UNIT 2	3	2
UNIT 3	4	
UNIT 4	4	
UNIT 5	4	2
UNIT 6	6	2
UNIT 7	5	
UNIT 8	4	
TOTAL	34	6
GRAND TOTAL		40 hours

NOTE: The subjects of various lectures have deliberately been chosen to include several topics so that the lecturer only touches on these topics (in 45 minutes) so as to arouse curiosity and elicit questions from the students (in 15 minutes). The inclusion of panel discussions will help in crystallizing thought on the unit subjects.

COURSE III - SCIENCE, TECHNOLOGY AND SUSTAINABLE DEVELOPMENT

REVISED SYLLABUS

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UNIT 1

SCIENCE & TECHNOLOGY

In the contemporary world, S & T is the reason for rapid changes in lifestyles the world over. The most significant changes have been accelerating industrial growth (based first on coal and later on petroleum) and urbanization of populations.

For many, this has meant improvement in the standard of living (SoL), but for very many more the ill effects have lowered their quality of life (QoL). By all accounts this difference is widening and deepening, leading to conflicts of interest and social tensions.

This situation raises ethical and civilizational issues regarding the sharing of finite resources, particularly since most of the benefits of industrialization accrue to those sections that are in power.

But knowledge, they say, is power. Hence knowledge, which is primarily based upon information, can empower the millions who live near the bottom-most rungs of the socio-economic ladder. Today, information technology provides the starting point for a knowledge revolution, but only if primary and secondary education at the lowest socio-economic levels is appropriate to human needs (as opposed to corporate needs) and is imparted universally.

Lectures (3)

- Overview of S & T in India
- Relevance of S & T to people's well being, and the importance of information in society
- Ethics in S & T in the context of finite resources

UNIT 2

DEVELOPMENT

The main component of the development paradigm the world over is industrial growth regardless of political ideology or type of government. Research and development (R&D) in the areas of S&T are governed by the economics of the products of R&D in terms of their marketability and the financial profits that they generate.

No doubt a portion of this goes towards the welfare of people (e.g., so-called infrastructure projects), but an increasing share is going towards corporate profit. At national level, economic indicators have been devised to assess sectoral and overall growth, while corporate progress is reflected in the stock market figures.

The welfare and economic progress of most people however do not appear to relate adequately to these economic growth indicators, bringing the validity of the economic indicators into question.

Industrial growth has historically gone hand in hand with urbanization, and concentration of economic power in urban centres has resulted in a rural-urban divide as urban centres expand into the surrounding rural areas. Urban expansion with growing concentration of human and vehicle population is making urban governance increasingly problematic especially in

metros and large cities where the poor section of the population in significant numbers lives in slums. The collapse of governance and urban infrastructure has been typified in New Orleans (Katrina, July 2005) and Mumbai (Floods, July 2005).

Lectures (3)

- The Third World – people & progress, education & health, beneficiaries & victims of development (rural & urban)
- Economic parameters – measuring progress in a globalizing world
- Urbanization – the rural-urban divide, urban chaos & collapse, its causes, effects and future

UNIT 3

ENVIRONMENT & TECHNOLOGY

In times before modern science defined the universe as being composed of elements made up of atoms, collective wisdom held that the universe comprised five elements, namely water, air, earth, energy and space (Jal, Vayu, Pruthvi, Tejas, Aakash, according to Hindus). While in present times nobody denies that matter is composed of elements, it is becoming increasingly clear that the environment that sustains life on Earth consists of the first four of the elements defined by the ancients – Pruthvi (Soil), Jal (Water), Vayu (Air), and Tejas (Energy) - whatever be their form or composition in physical and chemical terms.

Modern technology uses enormous quantities of energy (coal and oil) and apart from the products and services available as a result, produces solid, liquid and gaseous waste products that enter soil, water and air, which we now call the physical environment. Even the “durable” consumer products eventually end their useful life as junk that pollutes the environment. Thus it is obvious that there are many kinds of pollution. Every environment is capable of “carrying” a finite “load” of each type of pollution – beyond this load, the environment “degrades”, as viewed from a biological stand point since life-forms get seriously affected or become extinct.

For the past two decades or so, keen observers and some scientists have noted that earth as a whole has begun to display changes in soil, water and air that have the potential to adversely affect all life-forms in a major, even revolutionary, way. Further, the causes for these changes have been traced to human industrial activity. The finger thus points at modern technology-driven industrial civilization.

We need to think about whether technologies that are more appropriate to peoples basic needs should be introduced and encouraged with wide public participation rather than going on with heavily energy consumptive technology-driven consumerist lifestyles.

Lectures (4)

- Ecology & Culture
- Appropriate technology, NGOs and people’s participation
- Pollution – causes, effects, solutions
- Anthropogenic global effects – environmental refugees, environmental conflicts

UNIT 4

AGRICULTURE AND WATER

In the industrially developed countries and in large portions of industrially developing countries, food and cash crop agriculture is heavily dependent on the use of chemical fertilizers and pesticides. Since these are prepared from oil, oil is a major agricultural input apart from water, thus adding substantially to input costs. Use of oil-based agricultural inputs also causes increased demand for water by the crops, further raising input costs and making farmers

dependent upon intensive irrigation. Thus the profit-orientation of the corporate sector plays an important role in agricultural policy.

As the cost of oil rises, the cost of agricultural inputs also rises and marginal and small farmers in India are getting increasingly driven to destitution for many reasons, among which the use of unsustainable methods is one. Under these circumstances, WTO has facilitated entry of multinational seed corporations that are introducing genetically modified seeds while other multinational corporations are introducing genetically modified agricultural products at lower costs than local produce, thus adding to the woes of farmers.

However, time-tested and proven indigenous knowledge systems in agriculture are seeing a renaissance, and organic farming with use of indigenous seed varieties and water-harvesting conservation systems is beginning to gain popularity due to successful demonstrations of these methods.

With new technologies and improved engineering design, heavy engineering has been employed to construct over 45,000 major dams on rivers in the period from the 1930s to date with construction peaking in the 1970s when 2 to 3 dams were being constructed daily, worldwide. Dams and canals along with “river training” and “flood control” works became easily possible, and since Independence (1947), India has invested heavily in such works. Concomitant with that, about 30-40 million rural and tribal people have suffered involuntary displacement, mostly without adequate or just compensation and many with none at all.

Notwithstanding the human misery inflicted on the weakest and most vulnerable sections of society, the dam-canal projects have rarely if ever, performed according to design parameters, besides suffering time and cost overruns and quality shortfalls. Indeed, to date, there has been no comprehensive, transparent review or study of any dam project from the economic standpoint.

With S&T advances, food technologies have been developed to improve agricultural products and make storage preservation and other properties of various food products more economic. Food technologies have brought in their wake regular markets for processing of agricultural products and, at the input end, entry of corporations into agriculture by way of contract farming.

With heavy dependence of agriculture on oil (for inputs) as at present, and for transportation of agricultural products to markets, a scenario of depleted oil sources or unaffordable oil can have serious effects on the volumes and costs of food production and distribution. In some quarters, this scenario is not being seen so much as a question of whether as of when it might occur and how precisely.

Lectures (4)

- Water – rivers and engineering
- Biotechnology, bio-diversity and indigenous knowledge systems
- Food technology and contract farming
- Agriculture in a post-hydrocarbon world – sustainable and organic agriculture

UNIT 5

ENERGY

From the earliest human settlements to modern times, societies have been dependent upon sources of energy. With time, societies have discovered new sources of energy, developed them and found new uses for them.

The use of steam (produced from boiling water using coal as fuel) for mechanical propulsion and other machines was a revolution in the use of energy that triggered what is today

called the industrial revolution. It caused change from a handicraft economy to one dominated by machine-based industry, triggering technological, socio-economic and cultural changes as mathematics and the physical, biological and earth sciences developed. From coal, industrially advanced countries began to use oil, also a fossil fuel, also finite and irreplaceable like, but far superior to, coal.

In present times, as the finiteness of oil (indeed, fossil fuels in general) is being indirectly emphasized by rising oil prices, there is serious S&T focus on alternative or so-called “non-conventional” sources of energy like solar, wind, ocean-wave, tide and ocean thermal energies, and fuels like hydrogen.

But regardless of the source of energy or the fuel, a vital link in the economic chain of any country is electric power – generated from flowing water or by use of coal, gas or steam from nuclear heat. Economists hold generation of electric power as a sure sign of development, and per capita rate of electric power consumption is the parametric indicator. Hence there is a tendency to resort to supply-side economics in power generation regardless of the productive or unproductive use, misuse, wastage or loss of electric power or the environmental damage caused.

Nuclear-based electric power generation is claimed to be safe, clean and cheap, and at first sight appears to be the ideal solution to the negative effects of most other methods of generation. However, several industrially advanced countries are phasing out nuclear power while some others are going in for or expanding nuclear power generation under draconian laws of secrecy, in spite of demonstrated risks and lifetime audit costs. The dangers of nuclear proliferation only grow.

Lectures (4)

- Energy & the growth of societies
- Electric power generation – supply-side economics or demand-side management?
- Alternative energy sources
- Nuclear energy – policy, costs, benefits, risks, transparency, accountability

UNIT 6

SOCIETY & ECONOMICS

Indian society, from 300 million in 1947 (20% urban, 80% rural) has crossed 1,000 million in 2001 (40% urban, 60% rural) i.e., 60 million urbanites in 1947 have grown to 400 million in half a century. In many metros, slum dwellers are more than 50% of the population e.g., in Mumbai 60% of its population is in slums.

With urban pollution and heavily overloaded civic infrastructure, the quality of life (QoL) of the poor is abysmal, while that of the lower and middle income groups is poor. This, combined with a reasonable standard of living (SoL) for the middle classes and a high consumption lifestyle for the narrow band of the wealthy, has created simmering social tensions that erupt sporadically as sectarian or communal violence. Fall in QoL has resulted in health problems across the social spectrum, with endemic and chronic diseases and lifestyle diseases increasing in incidence.

The model of development adopted since Independence has favored the urban-industrial over the rural-agricultural, and since 1991 when India’s New Economic Policy was formulated, this differential has been accentuated. Further, India joined WTO in 1995 and the difference has become stark over the past decade. In the rural areas and in tribal areas, a lively debate has commenced regarding community ownership of natural resources. The link between community

control over and ownership of water-forest-land (jal-jangal-zameen) with the constitutional right to livelihood has been understood at rural level, and forms the basis for grass-roots movements.

The economy runs on the basis of agricultural and industrial products of all kinds being transported to markets for consumers besides providing input materials for both sectors. Urban centers, big and small, receive supplies of food and fuel from distant places due to the transport sector, while physical movement of people is also dependent upon it. In short, transportation is not merely necessary for economic growth, but in the contemporary context is a vital need for survival, a lifeline for the nation. The cost of living rises with the cost of fuel, but beyond a certain point the volume of transportation (and goods transported) is bound to decline, leading to shutting down of sectors of the economy. Any interruption in oil supplies due to any reason can precipitate an economic crisis primarily due to collapse of the transportation system - this is true for any country. The search for alternative fuels is on, but there are no moves to re-design the economy itself, which is so highly and dangerously dependent on depleting fossil fuels.

Lectures (6)

- Indian society, its economics & the WTO
- Ownership of resources & livelihoods – rural-agricultural & urban-industrial
- Primary & secondary education – present status and its effects on the future
- Public health & longevity – QoL & SoL
- Holistic health systems & indigenous medicine
- Transportation – the lifeline of the economy in the context of fuel availability & alternative fuels

UNIT 7

GOVERNANCE

The function of government is to deliver basic civic services and security to people. In a democracy, since government is meant for people, it is also elected by the people. However, the election system and its process sends elected representatives who are in fact not truly representative of the people's needs, wishes and aspirations because they represent a minority of the population. (The "first-past-the-post" system has this disadvantage). To make matters worse, corruption in government, need for huge finance to stand for elections, the sources of finance having their own agenda, and the need to "recover the investment" while in office, together go to make governance ineffective because mostly only the wealthy and influential benefit from governments' development plans while the poor and unempowered receive little or no benefits, and even become the victims of the projects of development in various ways.

Government is increasingly being influenced by corporate power in elections as well as in governance by setting agendas and proposing programs and projects that primarily benefit themselves. Governments often offer benefits of projects as promises to gain political mileage, when the benefits can materialize years (even decades) in the future, when there is no guarantee that the same government will be in power at that time. Hence there is little or no accountability, and performance of projects is not reviewed transparently to learn from past mistakes. In-house performance reports are only for the purpose of justifying further investment in similar projects. Naturally, since politicians usually do not remain in power beyond a maximum of 5 years, the central role of the bureaucracy in this is obvious.

This is not to say that large or mega-projects have not brought benefits, but only to emphasize that the benefits are routinely exaggerated so as to obtain sanction. As for the costs of projects, it is not possible to quantify the social costs of rehabilitation of populations displaced due to the project. (Since 1947, it is estimated that 30-40 million people, mostly rural or tribal

people have suffered displacement). The Benefit:Cost ratio calculated for sanctioning the project is thus inherently inaccurate, even if it is not manipulated by engineers.

Planning is a central activity of government, but input data is often out-dated and in any case the prior, informed consent of people who will be adversely affected (and have to pay in terms of displacement and/or loss of livelihood) is never sought. This results in protests, representations and unnecessary litigation. (This is one of the reasons why, of the million plus pending cases in the courts of law in India, government is one of the parties in a large majority of the cases).

Protest in a democracy is only to be expected when people who are adversely affected by government decisions get no relief when they state their problems through the “proper” official channels. Protesters are people who suffer from real or perceived injustice. Protests are usually peaceful at the outset, but if government ignores them or refuses to engage in discussion, public frustrations can build up to the point of militancy, which may still not be physically violent, though this is not often the case. These are political problems that need solution by political means. However, much too often, governments use police or military force to quell protest.

Frequently, a project proposed can be executed only when adequate external funding is available. When prior, informed consent of the affected public is not obtained, but financial agreements and work contracts have been finalized, government, under pressure from corporations, is unable to tolerate dissent or protest. Finance is obtained from international financial institutions (IFIs) like WB, ADB or JBIC, and the imperatives of debt-servicing force governments to push ahead with the work by brushing aside protest and agitations using the means at their disposal, namely, propaganda that highlights the benefits to get the support of the (usually better-off) beneficiaries to ridicule, denigrate or browbeat the protestors, and the police to break up demonstrations and meetings held by project-affected people. To be fair, this situation is not peculiar to India, and exists where corporate power equals or exceeds real political power.

Lectures (5)

- Planning – “prior informed consent”, transparency & accountability, ethics & practice
- The election process – the system : getting elected on a “minority vote”
- Concept of the corporation – corporate responsibility & the meaning of efficiency
- IFIs and Third World debt
- Protest, militancy and terrorism – causes and solutions : Role of the police and military in a democracy

UNIT 8

INDIA IN A GLOBAL CONTEXT

India has been hailed as an emerging economic and military force in the world and particularly in Asia, next to its powerful neighbor China. With a 1.5 million-strong Defence force, ex-servicemen are a ready source of trained manpower for security, policing, quasi-defence and even defence employment in the private sector, especially as many soldiers retire at the age of around 35 years when they are still physically fit and active and are in need of employment. In the context of USA employing mercenaries in Iraq (about 10% of troop strength), India is a good source for recruiting mercenaries though government has restrained Indian corporations from sending Indian ex-servicemen on sub-contract to US firms such as Halliburton-subsi-dary Kellogg, Brown & Root in Iraq. At any rate, in today’s globalizing world, corporate interest in armed conflict has been established at the human-resource level, and India is a source for such human-resource.

It is no secret that the military-industrial complex (MIC) in USA is among the most powerful lobbies that influence government. Tie-ups between India and USA in the defense section is sure to give a boost to MIC in USA and also in India, where out-sourcing to industry for production of items of military hardware is increasing. There is considerable disquiet that this situation will lead India into the “US Camp”, involve India in conflicts started by USA, and make India and Indians a target for the fundamentalist forces that are reactively targeting USA.

India has made its “informal” entry into the club of nuclear states by dint of dedicated work over decades without external help, by its own pool of scientists and technologists. With the US-India understanding on nuclear power following US President Bush’s visit in 2006, there are voices within USA that accuse their own president of legitimizing violation of the NPT by admitting India into the select club of nuclear nations without itself being a signatory to the NPT. The fear of nuclear proliferation - with Iran, a signatory of NPT, insisting on continuing with its uranium enrichment for nuclear power reactor fuel - is leading USA into a possible attack on Iran, even as its present engagement in Iraq shows no easy exit. Such an attack may well destabilize the entire region, with India getting drawn into armed conflict because of its growing diplomatic proximity to and military cooperation with USA.

In the context of conflict in the Middle East that is the center of gravity of oil reserves, India’s supplies of oil may be severely reduced or become unaffordable, with consequent effect on Indian’s economy. This however, is in the short term (say one or two years) within which the Middle East may erupt. But even if this does not occur, the longer-term effect of oil depletion (peak oil production world-wide is said to have already occurred or is about to occur) is sure to have serious effects not only on India and other industrially developing countries, but especially on USA and the EU.

Lectures (4)

- The military-industrial complex – corporatizing conflict
- Nuclear states and neo-nuclear states – proliferation
- India in a post-hydrocarbon world
- Regional reactions and repercussions to growing Indo-US ties

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SUMMARY OF LECTURES

	<u>Lectures</u>	<u>Panel/Group</u>
	(hours)	<u>Discussions</u>
		(hours)
INTRODUCTION	1	
UNIT 1	3	
UNIT 2	3	2 (Unit 1 & 2)
UNIT 3	4	
UNIT 4	4	
UNIT 5	4	2 (Unit 4 & 5)
UNIT 6	6	2 (Unit 6)
UNIT 7	5	
UNIT 8	4	

TOTAL	34	6
GRAND TOTAL		40 hours

NOTE: The subjects of the various 1-hour lectures have deliberately been chosen to include several topics so that the lecturer only touches on these topics (in 45 minutes) so as to arouse curiosity and elicit questions from the students (in 15 minutes). The inclusion of three panel discussions of 2 hours each will help in crystallizing thought on the unit subjects.