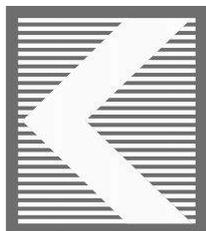


ENVIRONMENTAL

SCIENCE

Subrat Roy



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Subrat Roy

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FOREWORD

Engineering has played a very significant role in the progress and expansion of mankind and society for centuries. Engineering ideas that originated in the Indian subcontinent have had a thoughtful impact on the world.

All India Council for Technical Education (AICTE) had always been at the forefront of assisting Technical students in every possible manner since its inception in 1987. The goal of AICTE has been to promote quality Technical Education and thereby take the industry to a greater heights and ultimately turn our dear motherland India into a Modern Developed Nation. It will not be inept to mention here that Engineers are the backbone of the modern society - better the engineers, better the industry, and better the industry, better the country.

NEP 2020 envisages education in regional languages to all, thereby ensuring that each and every student becomes capable and competent enough and is in a position to contribute towards the national growth and development.

One of the spheres where AICTE had been relentlessly working from last few years was to provide high-quality moderately priced books of International standard prepared in various regional languages to all it's Engineering students. These books are not only prepared keeping in mind it's easy language, real life examples, rich contents and but also the industry needs in this everyday changing world. These books are as per AICTE Model Curriculum of Engineering & Technology – 2018.

Eminent Professors from all over India with great knowledge and experience have written these books for the benefit of academic fraternity. AICTE is confident that these books with their rich contents will help technical students master the subjects with greater ease and quality.

AICTE appreciates the hard work of the original authors, coordinators and the translators for their endeavour in making these Engineering subjects more lucid.

(Anil D. Sahasrabudhe)

Acknowledgement

The author is grateful to AICTE for their meticulous planning and execution to publish the technical book for Diploma students.

I sincerely acknowledge the valuable contributions of the reviewer of the book Prof. S P Mishra, for making it students' friendly and giving a better shape in an artistic manner.

This book is an outcome of various suggestions of AICTE members, experts and authors who shared their opinion and thoughts to further develop the engineering education in our country.

It is also with great honour that I state that this book is aligned to the AICTE Model Curriculum and in line with the guidelines of National Education Policy (NEP)-2020. Towards promoting education in regional languages, this book is being translated in scheduled Indian regional languages.

Acknowledgements are due to the contributors and different workers in this field whose published books, review articles, papers, photographs, footnotes, references and other valuable information enriched us at the time of writing the book.

Finally, I like to express my sincere thanks to the publishing house, M/s. Khanna Book Publishing Company Private Limited, New Delhi, whose entire team was always ready to cooperate on all the aspects of publishing to make it a wonderful experience.

Subrat Roy

Preface

The book titled “Environmental Science” is an outcome of our experience in the area of environmental engineering & science. The very purpose of writing this book is to develop basic concept of environmental science in the diploma students as well as enable them to get insight into the subject. Keeping in mind the purpose of wide coverage as well as to provide essential supplementary information, we have included the topics recommended by AICTE, in a very systematic and orderly manner throughout the book. Efforts have been made to explain the fundamental concepts of the subject in the simplest possible way.

During the process of preparation of the manuscript, I have considered the various standard text books and accordingly, developed sections like subjective and multiple choice questions etc. While preparing the different sections emphasis has also been given on the basic concepts of all the topics. All the topics are supported with relevant photographs to help students understanding the topic in a better way. There are total four units in the book. First unit deals with the ecosystem, second unit is about air and noise pollution, third unit discuss about renewable sources of energy and the fourth topic focuses on solid waste management, ISO 14000 & environmental management. It is important to note that in all the units, we have included the relevant websites and a list of reference books.

The present book on “Environmental Science” is meant to provide a thorough grounding on the topics covered. This part of the environmental science will prepare students to apply the concept of various topics covered in the book to tackle the environmental challenges imposed in 21st century and address the related aroused questions. The subject matters are presented in a constructive manner which will certainly help students to guide society to maintain a pollution free eco-system.

I sincerely hope that the book will inspire the students to learn and discuss the basic concepts of environmental science and will surely contribute to the development of a solid foundation of the subject. I welcome all beneficial comments and suggestions which will contribute to the improvement of the future editions of the book. It gives me immense pleasure to place this book in the hands of the teachers and students. It was indeed an immense pleasure to work on different aspects covered in the book.

Subrat Roy

Outcome Based Education

For the implementation of an outcome based education the first requirement is to develop an outcome based curriculum and incorporate an outcome based assessment in the education system. By going through outcome based assessments, evaluators will be able to evaluate whether the students have achieved the outlined standard, specific and measurable outcomes. With the proper incorporation of outcome based education there will be a definite commitment to achieve a minimum standard for all learners without giving up at any level. At the end of the programme running with the aid of outcome based education, a student will be able to arrive at the following outcomes (as per NBA guidelines):

- PO-1: Basic and Discipline specific knowledge:** Apply knowledge of basic mathematics, science and engineering fundamentals and engineering specialization to solve the engineering problems.
- PO-2: Problem analysis:** Identify and analyse well-defined engineering problems using codified standard methods.
- PO-3: Design/ development of solutions:** Design solutions for well-defined technical problems and assist with the design of systems components or processes to meet specified needs.
- PO-4: Engineering Tools, Experimentation and Testing:** Apply modern engineering tools and appropriate technique to conduct standard tests and measurements.
- PO-5: Engineering practices for society, sustainability and environment:** Apply appropriate technology in context of society, sustainability, environment and ethical practices.
- PO-6: Project Management:** Use engineering management principles individually, as a team member or a leader to manage projects and effectively communicate about well-defined engineering activities.
- PO-7: Life-long learning:** Ability to analyse individual needs and engage in updating in the context of technological changes.

Course Outcomes

After the completion of the course the students will be able to:

CO-1: Analyse real life problems associated with the ecosystem.

CO-2: Explain various types of pollution sources and its effect.

CO-3: Apply various types of pollution control mechanism to curb environmental pollution.

CO-4: Explain various sources of renewable energy and process of harnessing.

CO-5: Explain solid waste management, ISO 14000 & Environmental management.

Course Outcomes	Expected Mapping with Programme Outcomes (1- Weak Correlation; 2- Medium correlation; 3- Strong Correlation)						
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7
CO-1	3	3	-	-	3	-	2
CO-2	3	-	-	1	3	-	2
CO-3	3	1	-	2	3	1	2
CO-4	3	-	-	2	3	1	2
CO-5	3	-	-	-	3	-	2

Abbreviations and Symbols

List of Abbreviations

General Terms			
Abbreviations	Full form	Abbreviations	Full form
Ag	Argentum/Silver	CFC	Chlorofluorocarbon
As	Arsenic	CO	Course Outcome
ATP	Adenosine Triphosphate	DNA	Dioxy-rhibo-nucleic acid
Au	Aurum/Gold	HC	Hydrocarbons
C	Carbon	Hg	Hydragyrum/Mercury
CO	Carbon Monoxide	Mo	Molybdenum
CO ₂	Carbon Dioxide	MSW	Municipal Solid Waste
CH ₄	Methane	Ni	Nickel
Co	Cobalt	Pb	Plumbum/Lead
Cr	Chromium	UV	Ultraviolet
Cu	Cuprum/Copper	VoCs	Volatile Organic Carbon
Units Used			
Abbreviations	Full form	Abbreviations	Full form
cm	Centimetre	mm	Millimetre
μm	Micrometer	dB	Decibels
$\mu\text{N}/\text{m}^2$	Micro Newton/meter square	Hz	Hertz
GW	Gigawatt	KW	Kilowatt
MW	Megawatt	TW	Terawatt

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Guidelines for Teachers

To implement Outcome Based Education (OBE) knowledge level and skill set of the students should be enhanced. Teachers should take a major responsibility for the proper implementation of OBE. Some of the responsibilities (not limited to) for the teachers in OBE system may be as follows:

- Within reasonable constraint, they should manipulate time to the best advantage of all students.
- They should assess the students only upon certain defined criterion without considering any other potential ineligibility to discriminate them.
- They should try to grow the learning abilities of the students to a certain level before they leave the institute.
- They should try to ensure that all the students are equipped with the quality knowledge as well as competence after they finish their education.
- They should always encourage the students to develop their ultimate performance capabilities.
- They should facilitate and encourage group work and team work to consolidate newer approach.
- They should follow Blooms taxonomy in every part of the assessment.

Bloom's Taxonomy

Level	Teacher should Check	Student should be able to	Possible Mode of Assessment
Creating	Students ability to create	Design or Create	Mini project
Evaluating	Students ability to Justify	Argue or Defend	Assignment
Analysing	Students ability to distinguish	Differentiate or Distinguish	Project/Lab Methodology
Applying	Students ability to use information	Operate or Demonstrate	Technical Presentation/ Demonstration
Understanding	Students ability to explain the ideas	Explain or Classify	Presentation/Seminar
Remembering	Students ability to recall (or remember)	Define or Recall	Quiz

Guidelines for Students

Students should take equal responsibility for implementing the OBE. Some of the responsibilities (not limited to) for the students in OBE system are as follows:

- Students should be well aware of each UO before the start of a unit in each and every course.
- Students should be well aware of each CO before the start of the course.
- Students should be well aware of each PO before the start of the programme.
- Students should think critically and reasonably with proper reflection and action.
- Learning of the students should be connected and integrated with practical and real life consequences.
- Students should be well aware of their competency at every level of OBE.

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