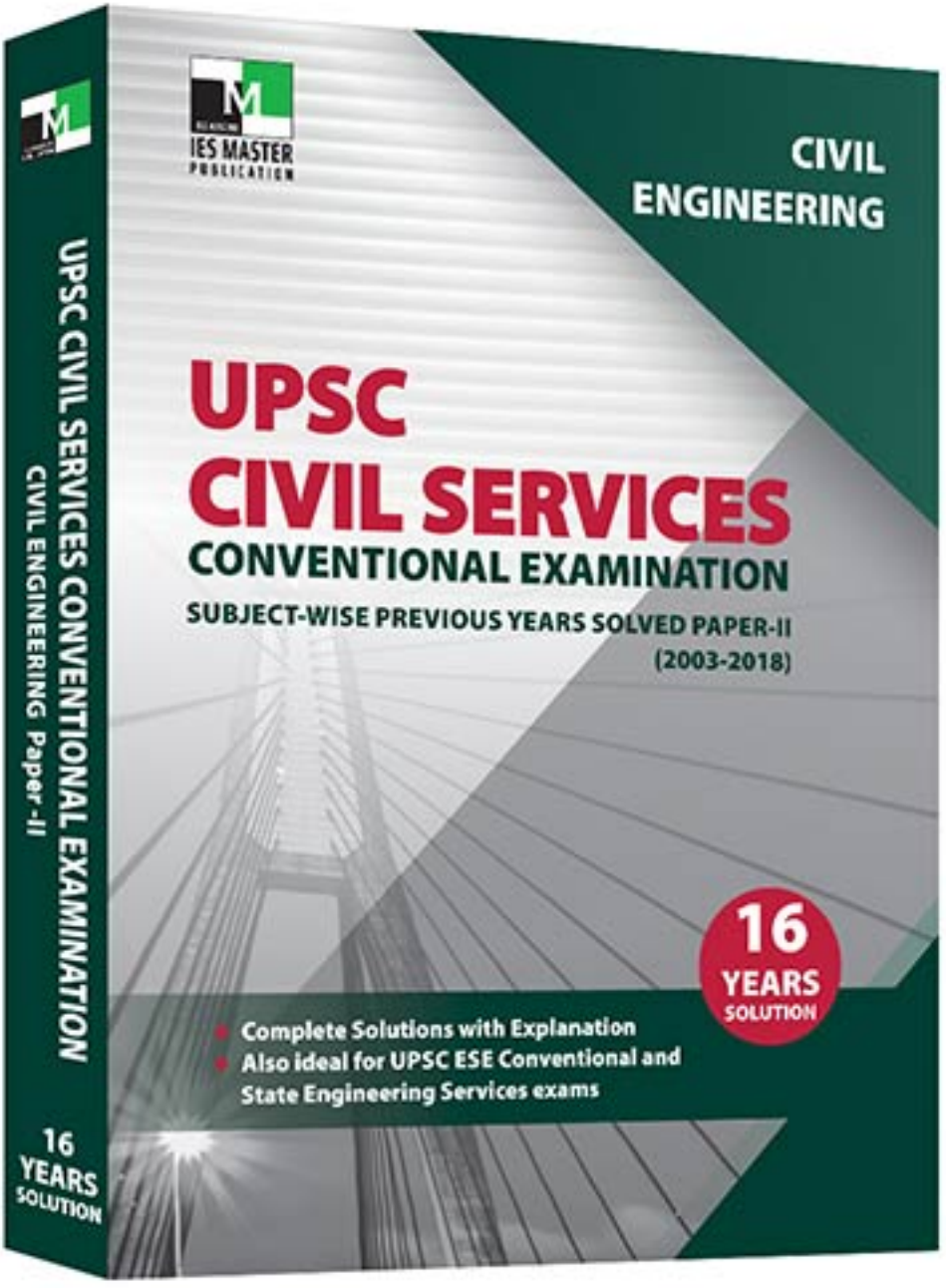
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2003–2018

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E-mail : info.publications@iesmaster.org

Web : iesmasterpublications.com

First Edition : 2019

Typeset at : IES Master Publication, New Delhi-110016

PREFACE

Civil Services Examination (CSE) and Engineering Services Examination (ESE) are two of the most sought after exams in India. The entrance exams for these highly esteemed services are conducted by the Union Public Services Commission (UPSC) every year.

Civil Services Mains is a subjective exam, which demands good writing skill as well as core knowledge of the subject. Engineering students need to be familiar with the difficulty level as well as the demand of such an exam. A close and detailed scrutiny of the previous years' question papers of Civil Services Mains Examination by the Research & Development team at IES Master reveals the techniques that need to be deployed in handling the Mains exam of Civil Services.

Civil Engineering as an optional subject can do wonders in CSE. It is one stream that touches upon maximum knowledge area, given the vastness of the syllabus. It is this vastness and wilderness of applied knowledge that gives a decisive edge to the engineers in becoming top administrative officers.

This book captures and decodes technical questions of CSE from 2003 to 2018. It is this depth in time that gives students the ability to gauze the direction, and the construct of an engineer required to be a top bureaucrat.

As you delve into the details of this branch, and confront individual subjects, numerous manifestations pile up block by block. With this final raft foundation, you can build upon absolute command over the required subjects. This book also allows you to practice freely on your own as the detailed solutions guide you step by step, whenever the need arises.

Backed by the trust inspired by the mark of 'IES Master', you can safely rely on this book.

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UNIT-1 ENVIRONMENTAL ENGINEERING

SYLLABUS

Environmental Engineering:

Water supply: *Predicting demand for water, impurities of water and their significance, physical, chemical and bacteriological analysis, waterborne diseases, standards for potable water.*

Intake of water: *Water treatment: principles of coagulation, flocculation and sedimentation; slow-, rapid-, pressure, filters; chlorination, softening, removal of taste, odour and salinity.*

Sewerage systems: *Domestic and industrial wastes, store sewage— separate and combined systems, flow through sewers, design of sewers.*

Sewage characterisation: *BOD, COD, solids, dissolved oxygen, nitrogen and TOC. Standards of disposal in normal water course and on land.*

Sewage treatment: *Working principles, units, chambers, sedimentation tank, trickling filters, oxidation ponds, activated sludge process, septic tank, disposal of sludge, recycling of waste water.*

Solid waste: *Collection and disposal in rural and urban contexts, management of long-term ill-effects.*

Environmental pollution: *Sustainable development. Radioactive wastes and disposal. Environmental impact assessment for thermal power plants, mines, river valley projects. Air pollution. Pollution control acts.*

Q.1: Outline the major legislative measures brought about in India for the management of environment.
[10 Marks CSE–2003]

Sol: The major legislative measures brought about in India for the management of environment are:

(i) During 5th five year plan (1973-77) - "Water (prevention and control of pollution) act, 1974" was passed under which rules were notified for checking and preventing water pollution.

(ii) Central Board for the prevention and control of water pollution was constituted under 1974 act.

(iii) Another act, water (prevention and control of pollution) cess act 1977 was passed to reduce industrial wastes.

(iv) Department of environment was setup in 1981 and air (prevention and control of pollution) act, 1981 was enacted.

(v) In 1986, the environment (protection) act, 1986 was promulgated by parliament under this act various rules like Hazardous wastes (management and handling) rules 1989, The chemical accidents rules 1996 etc. were formed.

(vi) Recent changes in motor vehicles act to promote electric vehicles is initiated to reduce air pollution.

(vii) Constitution of courts under National Green tribunal act 2010 is recent initiative to ensure safe and pollution free environment to citizens.

Q.2: ***Outline the salient functions of the Apex Body in the country related to prevention and control of water pollution.*** ***[10 Marks CSE–2003]***

Sol: The salient functions of the apex body are:

(a) Laying of rules and regulations for various industries and other water polluting entities.

(b) Management of rivers of national importance.

(c) Classification of water bodies and directing controlling authorities to check pollution of these water bodies.

(d) Directing states to form pollution control boards to control water pollution.

(e) Forming rules and laying water quality standards to be maintained for conservation of aquatic life of water bodies.

Q.3: ***Define the term "Optimum Coagulant Dose" and explain its significance in water treatment.*** ***[4 Marks CSE–2003]***

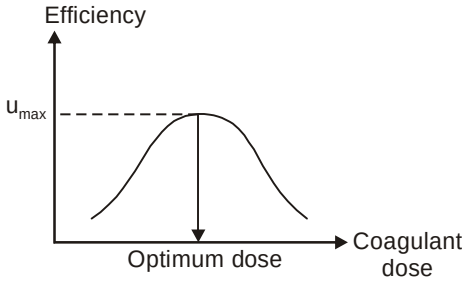
Sol:

- The least amount of coagulant which gives best floc is termed as the optimum coagulant dose. It varies as per the mixing and other factors involved in formation of flocs at site.
- The amount of coagulant added affects the sludge formed. The optimum coagulant dose, gives best sludge with lower moisture content and higher solids thus more clear water available at outlet of sedimentation.

Q.4: ***Explain how the information on "Optimum Coagulant Dose" is utilized to administer actual dose in the plant. Highlight also the consequences if proper dosing was not carried out.*** ***[8 Marks CSE–2003]***

Sol: **Amount of coagulant depends on turbidity and colours of raw water.**

- The use of optimum amount of coagulant to form a gelatinous precipitate (floc) is determined in the laboratory by jar test.
- In this test, the coagulant is added in a sample of water and after rapid mixing the turbidity of the sample is used to know the optimum coagulant dose.
- Higher turbidity shows less effective coagulation and coagulant dose is again varied.
- The dose at which minimum turbidity is observed is the optimum coagulant dose.



- If the coagulant added is more than optimum dose then the coagulant itself will act as turbidity and efficiency will reduce
- The study of relationship among pH, colloidal concentration of water and optimum coagulant dose is necessary for satisfactory operation of a coagulation process. There might be following four cases:

  (i) **High Turbidity, low alkalinity of water:** In this case, more nuclei are available, so less amount of coagulant is sufficient.

  (ii) **High Turbidity, High alkalinity of water:** This type of water is unaffected by the addition of coagulants. Higher coagulant dosage should be used to ensure sweep coagulation.

  (iii) **Low Turbidity, High Alkalinity of water:** Due to low colloidal concentration, the low dose of coagulants is less effective. Hence, high coagulant dosages will enmesh the colloidal particles and form "sweep floc". Addition of coagulant aid (i.e., Bentonite clay) will help to reduce the high coagulant dosage.

  (iv) **Low Turbidity, Low Alkalinity water:** Because of low colloidal concentration, coagulation is the most difficult and low alkalinity does not permit the effective formation of $Al(OH)_3$ floc. It may be useful to add both turbidity and alkalinity.

Thus, in treatment plants, it is significant to determine the optimum dosage to minimize the dosing cost and sludge formation and also to obtain the optimum performance in treatment.

Q.5: ***Filter sand is to be prepared for a rapid sand filter from the stock sand for which the details of sieve analysis are given below:***

Sieve Size (mm)	***Weight Retained (g)***	***Sieve Size (mm)***	***Weight Retained (g)***
2.0	***0***	***0.50***	***168***
1.5	***100***	***0.40***	***159***
1.2	***125***	***0.30***	***165***
1.0	***150***	***0.20***	***95***
0.9	***210***	***0.10***	***120***
0.8	***115***	***0.08***	***51***
0.75	***100***	***0.06***	***33***
0.70	***170***	***Finer***	***04***
0.60	***235***		

The required effective size and the uniformity coefficient of the filter media is 0.3 mm and 2.5, respectively.

Determine amount of usable sand and percentage and size above and below which the sand is too coarse or too fine.

[20 Marks CSE–2003]

Sol: D_{10} filter media = 0.3 mm

C_u filter media = 2.5; $C_u = \dfrac{D_{60}}{D_{10}}$

$$\Rightarrow \quad \frac{D_{60}}{D_{10}} = 2.5 \Rightarrow D_{60} = 0.3\times 2.5 = 0.75 \text{ mm}$$

(1)	(2)	(3)	(4)	(5) = 100 – (4)
Size (mm)	Mass retained (gm)	% Mass retained $\frac{(2)}{2000}\times 100 = \frac{(2)}{20}$	Cumulative % mass retained	Cumulative % age finer (P_{st})
2	0	0	0	100
1.5	100	5	5	95
1.2	125	6.25	11.25	88.75
1.0	150	7.50	18.75	81.25
0.9	210	10.50	29.25	70.75
0.8	115	5.75	35.00	65.00
0.75	100	5.00	40.00	60.00
0.70	170	8.50	48.50	51.50
0.60	235	11.75	60.25	39.750
0.50	168	8.40	68.65	31.35
0.40	159	7.95	76.60	23.40
0.30	165	8.25	84.85	15.150
0.20	95	4.75	89.60	10.40
0.10	120	6.00	95.60	4.40
0.08	51	2.55	98.15	1.85
0.06	33	1.65	99.80	0.20
finer	04	0.20	100.00	0
Σ	2000	100		

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₹ 550.00

ISBN 978-93-88380-51-6