



CVL-100 Environmental Studies

Minor

Total: 50 Marks

Time: 1 hour

Important Instructions to go through before starting the exam

- Before starting this examination, you need to agree to the below code of ethics:
 - You will not give or receive any form of aid in this examination, which is against the spirit of the examination.
 - You would take part in the examination honestly, abiding by all the rules of the examination.
 - You will do your share and take an active part in seeing to it that others, as well as yourself, uphold the spirit and letter of the Honour Code of IIT Delhi.
 - At the time of admission to IIT Delhi, you signed the Honour Code, and you realize that any violation of that could invite disciplinary action.
- You are free to choose the mode of document(s) used to as answer script. i.e. you can type them in a word document, write them on a paper similar to offline exams etc.. However, these documents should be converted (or scanned and saved) to single PDF and uploaded on moodle. Kindly note that your document is legible before uploading.
- All the calculations should be clearly shown in this document.
- It is an open notes exam, so you are free to refer the material shared/discussed in this course.
- Plagiarism test may be done on all the answer scripts. In addition to considering material available on the internet etc., the answer scripts of other students uploaded may also be considered while estimating similarity.
- Mention the name and entry number in the header of your answer script document. Name the answer script pdf document as CVL100_Minor_//Entry Number// and upload it back on moodle after finishing your exam. For example, if your entry number is 2014CE10080, the answer script document should be named as CVL100_Minor_2014CE10080. Failure to do so may result in penalizing.
- You will not be allowed to upload the answer script after 12:15 PM on 18/3/2021. Submissions on email will not be entertained, unless an exception is given to you by the instructor.
- No queries will be answered during the exam. You can assume any missing data as per your judgement and it may be considered by the instructor based on its merit.



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- 1) What is PM_{2.5}? Discuss its composition. (2)
- 2) Calculate Indian Air Quality Index (AQI) and the most dominant species for:
 - a. A day where the concentrations of PM_{2.5} (24-hr), PM₁₀ (24-hr), SO₂ (24-hr), NO₂ (24-hr), CO (8-hr) and O₃ (8-hr) are 80 µg/m³, 135 µg/m³, 15 µg/m³, 60 µg/m³, 2 mg/m³ and 15 µg/m³, respectively. (2)
 - b. A day where the concentrations of SO₂ (24-hr), NO₂ (24-hr), and CO (8-hr), are 22 µg/m³, 32 µg/m³ and 5 mg/m³, respectively. (2)
- 3) The ambient temperature measured by a meteorologist, in an industrial region, at 2 m and 150 m above the ground surface was 20°C and 16.5°C, respectively. A 60 m tall stack in that region emits 1350 gs⁻¹ of SO₂ at 4.5 m/s and a temperature of 720 K. Estimate the downwind distance at which the maximum surface SO₂ concentration is expected. Assume that the distance from the plume center line is negligible. The ambient wind speed is 2 m/s, and the plume rise is 50 m. (15)
- 4) List five major inferences from your assignments submitted in this course. For your assignments, you used air quality data from CPCB website. What instruments were used by CPCB to collect data in those monitoring stations? (5)
- 5) Briefly discuss about the following: a) London smog b) Confined Animal Feeding Operations c) Global Warming d) Bhopal Gas Tragedy (4)
- 6) PM_{2.5} emissions in Mumbai and Delhi are very similar in November. In 2018, the Supreme Court of India passed an order allowing burning of only green fire crackers. Moreover, as per the honorable court, the crackers should only be burnt from 8 PM to 10 PM. Reports indicate that during Diwali in Delhi and Mumbai approximately 50 Lakh kgs and 75 Lakh kgs of fire crackers were burnt, respectively. However, during that period, Delhi experienced severe unlike moderate PM_{2.5} concentrations in Mumbai. List out the possible reasons. (5)
- 7) A PhD dissertation of a French student concludes that only 1% of water used during shower will have enough contact time for humans, with a skin surface area of 0.5 m², for dermal absorption (coefficient of 0.002 m³ m⁻² h⁻¹). A city water supply has a carcinogenic compound B with a concentration of 5 g m⁻³. An individual who lived in that city for 20 years is a true Indian who follows IS-1172 and uses 5 L day⁻¹ water for drinking. The individual takes a very long shower for about 35 minutes in a very large room, such that both liquid and gas phases will not be in equilibrium during shower. Assuming that the life span of individual is 65 years, estimate the chronic daily intake. Assume that the individual miraculously maintains a body weight of 60 kgs, and takes shower twice a day. (15)



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Relevant data

Table 1 Breakpoints for AQI Scale 0-500 (units: $\mu\text{g}/\text{m}^3$ unless mentioned otherwise)

AQI Category (Range)	PM10 (24-hr)	PM2.5 (24-hr)	NO₂ (24-hr)	O₃ (8-hr)	CO (mg/m^3) (8-hr)	SO₂ (24-hr)
Good (0-50)	0-50	0-30	0-40	0-50	0-1.0	0-40
Satisfactory (51-100)	51-100	31-60	41-80	51-100	1.1-2.0	41-80
Moderate (101-200)	101-250	61-90	81-180	101-168	2.1-10	81-380
Poor (201-300)	251-350	91-120	181-280	169-208	10.1-17	381-800
Very poor (301-400)	351-430	121-250	281-400	209-748	17.1-34	801-1600
Severe (401-500)	430+	250+	400+	748+	34+	1600+

Table 2 Parameters required for plume spread calculations

	a	c	d	f
Unstable	213	440.8	1.941	9.27
Neutral	68	33.2	0.725	-1.7
Stable	34	14.35	0.74	-0.35