



**K. K. Wagh Institute of Engineering Education & Research, Nashik**  
(An Autonomous Institute From A.Y. 2022-23)

| WINTER-2025                                  |                        |
|--|------------------------|
| Exam Seat No.:                               |                        |
| Academic Year:2025-2026                      | Semester:VII           |
| Class:FINAL                                  | Program:B.Tech         |
| Branch Code:CIV                              | Pattern:2022           |
| Name of Course:Metro Construction Technology | Course Code:CIV224005B |
| Max. Marks:60                                | Duration:2.30 Hrs.     |

**Instructions:** Candidates should read carefully the instructions printed on the Question Paper and on the cover page of the Answer Book, which is provided for their use.

1. This question paper contains 2 pages.
2. Answer to each new question is to be started on a new page.
3. Assume suitable data wherever required, but justify it.
4. Draw the neat labelled diagrams, wherever necessary.
5. The last columns indicates the Course Outcome of the Question/sub-question.

**Marks CO**

**Question No. 1**

- 1a) Explain the various phases of engineering surveys carried out for metro construction. (6) CO1

**Question No. 2**

- 2a) A metro designer wants a safe operating speed of 80 km/h on a curve. The actual cant provided is  $C_a = 110$  mm and the maximum allowable cant deficiency for design is taken as  $C_d = 100$  mm. Using the New safe-speed formula determine the minimum radius R required to permit safe speed. (6) CO2

**Question No. 3**

- 3a) Explain in detail the various types of tunnels used in metro construction, with reference to their geological conditions. (8) CO3

**OR**

- 3b) Discuss the Tunnel Boring Machine (TBM) method in detail. Explain components of a TBM, its working mechanism in hard rock and soft ground, and advantages over drill & blast. (8) CO3
- 3c) Describe the New Austrian Tunneling Method (NATM) in detail. Explain its principles, step-by-step construction sequence, use of shotcrete, rock bolts, steel ribs, waterproofing layers, and lining concrete. (8) CO3

**OR**

- 3d) Explain the construction of elevated metro viaducts. Discuss pile foundation, pile cap, pier, pier cap, bearings, and types of girders (I-girder, U-girder, Box-girder). (8) CO3

**Question No. 4**

- 4a) Explain in detail the various train resistances that are *independent* and *dependent* on speed. (8) CO4

**OR**

- 4b) Describe the resistances due to tractive effort. (8) CO4
- 4c) A train carries 12 wagons as one AC2Tier, three AC3Tier and rest second sleepers and is driven by a locomotive weighing 120 tons. The train runs at a speed of 110kmph on a gradient of 1 in 150. Determine the train resistances. (8) CO4

**OR**

- 4d) Determine the maximum permissible load that a locomotive with three pairs of driving wheels bearing an axle load of 22 tons each can pull on a straight level track at a speed of 80 kmph. Also calculate the reduction in speed if the train has to run on a rising gradient of 1 in 200. What would be the further reduction in speed if the train has to negotiate a  $4^0$  curve on the rising gradient? Assume coefficient of friction to be 0.2. (8) CO4

**Question No. 5**

- 5a) Explain what is Estimate? State the purpose of Estimating. (8) CO5

**OR**

- 5b) Explain the meaning of the term taking out quantities. (8) CO5  
5c) Describe the role of a Work-Charged Establishment in public works. (8) CO5

**OR**

- 5d) List down typical construction items in a metro construction project with correct units and mode of measurement. (8) CO5

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