

# GATE - 2009 - CE

EE1030 : Matrix Theory  
Indian Institute of Technology Hyderabad

Satyanarayana Gajjarapu  
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- 1) Water flows through a 100 mm diameter pipe with a velocity of 0.015 m/sec. If the kinematic viscosity of water is  $1.13 \times 10^{-6} \text{ m}^2/\text{sec}$ , the friction factor of the pipe material is
  - a) 0.0015
  - b) 0.032
  - c) 0.037
  - d) 0.048
- 2) A rectangular open channel of width 4.5 m is carrying a discharge of  $100 \text{ m}^3/\text{sec}$ . The critical depth of the channel is
  - a) 7.09 m
  - b) 3.69 m
  - c) 2.16 m
  - d) 1.31 m
- 3) Water ( $\gamma_w = 9.879 \text{ kN/m}^3$ ) flows with a flow rate of  $0.3 \text{ m}^3/\text{sec}$  through a pipe AB of 10 m length and of uniform cross section. The end 'B' is above end 'A' and the pipe makes an angle of  $30^\circ$  to the horizontal. For a pressure of  $12 \text{ kN/m}^2$  at the end 'B', the corresponding pressure at end 'A' is
  - a)  $12.0 \text{ kN/m}^2$
  - b)  $17.0 \text{ kN/m}^2$
  - c)  $56.4 \text{ kN/m}^2$
  - d)  $61.4 \text{ kN/m}^2$
- 4) An agricultural land of 437 ha is to be irrigated for a particular crop. The base period of the crop is 90 days and the total depth of water required by the crop is 105 cm. If a rainfall of 15 cm occurs during the base period, the duty of irrigation water is
  - a) 437 ha/cumec
  - b) 486 ha/cumec
  - c) 741 ha/cumec

d) 864 ha/cumec

5) The correct match of **Column I** with **Column II** is

<b>Column I</b>	<b>Column II</b>
P. Coriolis effect	1. Rotation of earth
Q. Fumigation	2. Lapse rate and vertical temperature profile
R. Ozone layer	3. Inversion
S. Maximum mixing depth (mixing height)	4. Dobson

- a) P-2, Q-1, R-4, S-3
- b) P-2, Q-1, R-3, S-4
- c) P-1, Q-3, R-2, S-4
- d) P-1, Q-3, R-4, S-2

6) A horizontal flow primary clarifier treats wastewater in which 10%, 60% and 30% of particles have settling velocities of 0.1 mm/s, 0.2 mm/s and 1.0 mm/s respectively. What would be the total percentage of particles removed if clarifier operates at a Surface Overflow Rate (SOR) of  $43.2 \text{ m}^3/\text{m}^2\cdot\text{d}$  ?

- a) 43 %
- b) 56 %
- c) 86 %
- d) 100 %

7) An aerobic reactor receives wastewater at a flow rate of  $500 \text{ m}^3/\text{d}$  having a COD of  $2000 \text{ mg/L}$ . The effluent COD is  $400 \text{ mg/L}$ . Assuming that wastewater contains 80% biodegradable waste, the daily volume of methane produced by the reactor is

- a)  $0.224 \text{ m}^3$
- b)  $0.280 \text{ m}^3$
- c)  $224 \text{ m}^3$
- d)  $280 \text{ m}^3$

8) The correct match of **Column I** with **Column II** is

<b>Column I</b>	<b>Column II</b>
P. Grit chamber	1. Zone settling
Q. Secondary settling tank	2. Stoke's Law
R. Activated sludge process	3. Aerobic
S. Trickling Filter	4. Contact stabilisation

- a) P-1, Q-2, R-3, S-4
- b) P-2, Q-1, R-3, S-4
- c) P-1, Q-2, R-4, S-3

d) P-2, Q-1, R-4, S-3

- 9) Which of the following stress combinations are appropriate in identifying the critical condition for the design of concrete pavements ?

Type of Stress	Location
P. Load	1. Corner
Q. Temperature	2. Edge
	3. Interior

- a) P-2, Q-3  
b) P-1, Q-3  
c) P-3, Q-1  
d) P-2, Q-2

- 10) A crest vertical curve joins two gradients of (+3%) and (−2%) for a design speed of 80 km/h and the corresponding stopping sight distance of 120 m. The height of driver's eye and the object above the road surface are 1.20 m and 0.15 m respectively. The curve length (which is less than stopping sight distance) to be provided is

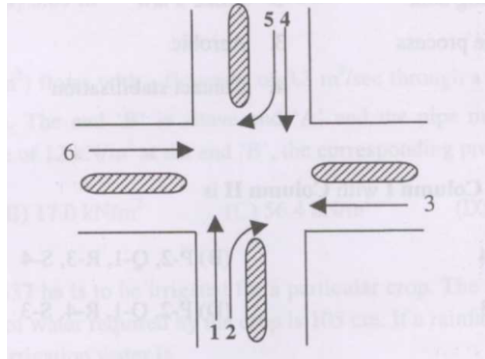
- a) 120 m  
b) 152 m  
c) 163 m  
d) 240 m

- 11) On a specific highway, the speed-density relationship follows the Greenberg's model  $\left[ v = v_f \ln \left( \frac{k_j}{k} \right) \right]$ , where  $v_f$  and  $k_j$  are the free flow speed and jam density respectively. When the highway is operating at a capacity, the density obtained as per this model is

- a)  $e \cdot k_j$   
b)  $k_j$   
c)  $\frac{k_j}{2}$   
d)  $\frac{k_j}{e}$

- 12) A three-phase traffic signal at an intersection is designed for flows shown in the figure below. There are six groups of flows identified by the numbers 1 through 6. Among these 1, 3, 4, and 6 are through flows and, 2 and 5 are right turning. Which phasing scheme is **not feasible** ?

Combination choice	Phase I	Phase II	Phase III
P	1, 4	2, 5	3, 6
Q	1, 2	4, 5	3, 6
R	2, 5	1, 3	4, 6
S	1, 4	2, 6	3, 5



- a) P
- b) Q
- c) R
- d) S