

# Civil Engineering

## Paper-II

Time Allowed: Three Hours

Maximum Marks: 300

*Note: Candidate should answer questions No. 1 and 5 which are compulsory and any **three** of the remaining questions, selecting at least **one** from each section.*

### SECTION – A

1. The gradings of fine and two coarse aggregates available at a project site are listed in columns b, c, and d respectively in the following Table. Determine the proportions of these aggregates, so as to achieve the grading of column e of the Table. Also determine the percentage passing of combined grading on each sieve. 60

IS Sieve	Percentage passing of Fine Aggregate	Percentage passing of Coarse Aggregate-I	Percentage passing of Coarse Aggregate-II	Percentage passing of Specified grading
(a)	(b)	(c)	(d)	(e)
20 mm	100	100	95	100
10 mm	100	94	18	45
4.75 mm	100	12	2	30
2.36 mm	84	2	0	23
1.18 mm	75	0	0	16
600 $\mu\text{m}$	51	0	0	9
300 $\mu\text{m}$	11	0	0	2
150 $\mu\text{m}$	2	0	0	0

2. Following data is given about durations and costs of various activities of a project: 60

Activity	Normal duration (weeks)	Normal cost (Rs.)	Crash duration (weeks)	Crash cost (Rs.)
1-2	4	4000	2	12000
2-3	5	3000	2	7500
2-4	7	3600	5	6000
3-4	4	5000	2	10000

The project overhead costs are Rs. 2000 per week. Find out the optimum duration of the project and cost associated with it. Also, draw the least cost network.

3. Two straights AB and BC intersect at chainage (412+15), the deflection angle being  $40^\circ$ . It is proposed to insert a circular curve of 300 m radius with a transition curve of 90 m length at each end. Make all calculations necessary for setting out the curve by the method of deflection angles using peg interval as 15 m on transition curve and 30 m on the circular curve. 60
4. The speeds of overtaking and overtaken vehicles are 70 kmph and 40 kmph respectively on a two way traffic road. If the acceleration of overtaking vehicle is  $0.99 \text{ m/sec}^2$ , (a) calculate safe overtaking sight distance, (b) mention the minimum length of overtaking zone and (c) draw a neat sketch of the overtaking zone and also show the position of sign posts. 60

## SECTION – B

5. The ordinates of a 6-hour unit hydrograph (UH) of a catchment are given below: 60

Time (h)	0	3	6	9	12	15	18	24
Ordinate of 6-h UH	0	25	50	85	125	160	185	160
Time (h)	30	36	42	48	54	60	69	
Ordinate of 6-h UH	110	60	36	25	16	8	0	

Derive the flood hydrograph for the catchment due to the storm given below:

Time from start of storm (h)	0	6	12	18
Accumulated rainfall (cm)	0	3.5	11.0	16.5

The storm loss rate ( $\Phi$  - index) for the catchment is estimated as 0.25 cm/h. The base flow may be taken 15 m<sup>3</sup>/s at the beginning and increasing by 2.0 m<sup>3</sup>/s for every 12 hours till the end of direct runoff hydrograph.

6. Design a channel section by Kennedy's theory for the following given data: 60

Discharge,  $Q = 28$  cumecs,

Kutter's,  $N = 0.0225$ ,

Critical velocity ratio,  $m = 1$ ,

Side slope =  $\frac{1}{2} : 1$  and

(Base width / Depth) = 7.6.

Find also bed slope of the channel.

7. A proposed reservoir has a capacity of 500 ha-m. The catchment area is 125 km<sup>2</sup> and the annual stream flow averages 12 cm of runoff. If the annual sediment production is 0.03 ha-m/km<sup>2</sup>, what is the probable life of the reservoir before its capacity is reduced by 10% of its initial capacity by sedimentation? The relationship between trap efficiency  $\eta$  (%) and capacity inflow ratio (C/I) is as under: 60

C/I	0.01	0.02	0.04	0.06	0.08	0.1	0.2	0.3	0.5	0.7
$\eta$ (%)	43	60	74	80	84	87	93	95	96	97

8. Determine the size of a high rate trickling filter for the following data:

12×5

- (i) Sewage flow = 4.5 Mld,
- (ii) Recirculation ratio = 1.5,
- (iii) BOD of raw sewage = 250 mg/l,
- (iv) BOD removal in primary tank = 30% and
- (v) Final effluent BOD desired = 30 mg/l.