



Total No. of Printed Pages – 4

AERTM
CIVIL ENGINEERING
PAPER – II
SUBJECT CODE : 07

Full Marks : 200

Time : 3 Hours

Instructions For Candidates :

Please read each of the following instructions carefully before attempting questions.

- (1) *Answers must be written in **ENGLISH** only.*
- (2) *The question paper contains a total of 8 questions in **TWO** Sections : Section-A and Section-B. (**FOUR** questions in each section)*
- (3) *Question No. 1 of Section 'A' and Question No. 5 of Section 'B' are compulsory.*
- (4) *Candidates have to attempt another **THREE** questions from remaining **SIX** questions choosing atleast **ONE** question from each section.*
- (5) *Assume suitable data if found necessary.*
- (6) *Wherever any assumption be made for answering a question, they must be clearly indicated.*
- (7) *Marks carried by a question / section is indicated against it.*
- (8) *Unless struck off, attempt of question shall be counted even if attempted partly.*
- (9) *Any page or portion of the page left blank in the Answer Booklet must be clearly struck off.*

Marks

SECTION-A

5 × 8 = 40

1. (a) A pipeline carrying water has surface roughness of average height 1.165 mm. If the shear stress developed is 3.6 N/m^2 , what is the nature of the pipe surface ? Find the shear velocity.
- (b) Define Specific speed of a pump. Where is it useful ? A centrifugal pump runs at a speed of 250 rpm for $50 \text{ m}^3/\text{s}$ discharge at a head of 50 m. Find the specific speed.
- (c) Define recurrence interval and return period of a storm.
- (d) Calculate the safe stopping distance for a vehicle travelling at 90 kmph, on an upward gradient of 3 per cent, given total reaction time is 2.5 seconds and the coefficient of friction for the road surface as 0.35.
- (e) What are the assumed conditions of runway length for standard environment which decide the basic runway length ?



2. (a) Design a regime channel for a discharge of $35 \text{ m}^3/\text{s}$ with silt factor of 0.9 by Lacy's theory, taking side slopes as 1H : 2V. 20
- (b) The ordinates of a flood hydrograph, resulting from two successive storms each of 1 cm rainfall excess and 6 hour duration, are tabulated below. Find a 6-hour unit hydrograph. Assume base flow of $10 \text{ m}^3/\text{s}$. 20

Time (hour)	0	6	12	18	24	30	36	42	48	54	60	66	72
Ordinate of 6-hour flood hydrograph (m^3/s)	10	30	90	220	280	220	166	126	92	62	40	20	10

3. (a) While aligning a highway in a built-up area, it was necessary to provide a horizontal circular curve of radius 300 metres. Design the following geometric features :
(Assume design speed 80 kmph, Pavement width 7m)
- Super elevation
 - Extra widening of pavement
 - Length of transition curve
- 20
- (b) A turbine for the following site condition is to be designed. Head is 120 m, power produced = $5 \times 120 \text{ MW}$. Number of turbines 5, Head loss due to friction as 3% the gross head. Length of the penstock 1300 m. each. Overall efficiency 0.87. Number of pairs of poles 18, speed 166.7 rpm, breadth to diameter 0.3. Darcy Weishach $f = 0.02$. Determine the diameter of the penstock, runner and the type of turbine for speed ratio ϕ of 0.75. 20
4. (a) From a BG main line curve of 2° , a 1 : 2 turn out takes off in contrary flexure for a branch line. The speed on the branch line is restricted to 42 km/h. Determine the speed restriction on the main line. Assume permissible deficiency in cant as 75 mm. 20
- (b) At an energy dissipater structure below a low spillway, the discharge is $19 \text{ m}^3/\text{s}$ and the energy loss is 1 m at the hydraulic jump forming therein. Determine the depth of flow at both ends of the jump (Assume rectangular section). 20



SECTION-B

5. (a) A deposit of fine sand has a porosity of 45%. Estimate the critical hydraulic gradient to develop quick sand condition if the specific gravity of grains is 2.70.
- (b) What is coagulation ? Discuss the mechanism of coagulation.
- (c) When an unconfined compression test was conducted on a cylindrical soil sample, it failed under an axial stress of 120 kN/m^2 . The failure plane makes an angle of 50° with the horizontal. Determine the Cohesion and the angle of internal friction of the soil.
- (d) For a BOD test, raw sewage of 3 ml was diluted to 300 ml. The diluted sewage was observed for its dissolved oxygen at the beginning and end of 5 days incubation at 20°C . The respective values were 8.6 mg/L and 4.6 mg/L. Determine the BOD of the raw sewage.
- (e) Explain the terms 'passive remote sensing' and 'active remote sensing'.
6. (a) What are the different zones of pollution in river stream ? Explain the importance of re-oxygenation, de-oxygenation and oxygen deficit in problems of stream sanitation. 20
- (b) A clay soil specimen of 25 mm thick was tested in the laboratory allowing drainage both sides. The specimen showed a decrease of voids ratio from 0.92 to 0.78 when the pressure was increased from 60 kN/m^2 to 120 kN/m^2 . Calculate Coefficient of Compressibility, Coefficient of volume change and Coefficient of Consolidation. If time for 50% consolidation was 5 minutes, determine the soil permeability in cm/s and calculate final thickness of the specimen at the end of the test. 20
7. (a) A rapid sand filter is proposed for water supply treatment plant for a town with a population of 75000. The average rate of water supply is 150 litres/capita/day and the rate of filtration is to be 100 litres/min/sq. m. Design
- (i) Size and number of filter beds.
- (ii) Manifold lateral under drainage system
- (iii) Wash water discharge required, if the rate of washing is 45 cm rise/min. 20



- (b) The following data was obtained from plate load test carried out on a 60 cm square test plate at a depth of 2 m below ground surface on a sandy soil which extends upto a large depth. Determine the settlement of a foundation $3.0 \text{ m} \times 3.0 \text{ m}$ carrying a load of 110 t and located at a depth of 2 m below ground surface. Water table is located at a large depth from the ground surface.

20

Load intensity (t/m^2)	0	5	10	15	20	25	30	35	40
Settlement (mm)	0	2.0	4.0	7.5	11.0	16.3	23.5	34.0	45.0

8. (a) An area of $10 \text{ km} \times 20 \text{ km}$ is to be surveyed using aerial photogrammetry. Average scale of photograph is $1 : 10,000$ at ground elevation of 400 m above the datum. Focal length of camera used is 20 cm and size of photographs are $23 \text{ cm} \times 23 \text{ cm}$. The speed of aircraft is 270 kmph. The forward lap in photographs is 70% and side lap is 30%. Determine the flying height, exposure interval and number of photographs required to complete the survey.

20

- (b) The following readings were noted in a closed traverse :

Line	AB	BC	CD	DE	EA
FB	32°	77°	112°	122°	265°
BB	212°	262°	287°	302°	85°

At which station due you suspect local attraction ? Find correct bearings of line. What will be the true fore-bearings of lines, if the magnetic declination was 12°W ?

10

- (c) A horizontal stratified deposit consists of four layers each uniform in itself. The permeabilities of the layers are $7.5 \times 10^{-4} \text{ cm/s}$, $49 \times 10^{-4} \text{ cm/s}$, $13 \times 10^{-4} \text{ cm/s}$ and $17 \times 10^{-4} \text{ cm/s}$ and their thickness are 5m, 4m, 17 m and 6m respectively. Find the effective average permeability of the deposit in horizontal and vertical directions.

10