

DO NOT OPEN THIS TEST BOOKLET UNTIL YOU ARE ASKED TO DO SO.

TR/TES/M/CIVIL-II/DEG-GR.I/2026

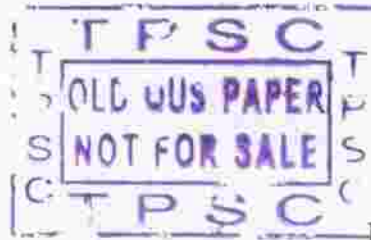
Test Booklet Series

**TEST BOOKLET
CIVIL ENGINEERING
PAPER-II**

C

(Signature of the Candidate)

(Invigilator's Signature)



Time Allowed – 3 hours (Three hours)

Maximum Marks – 200

INSTRUCTIONS

1. IMMEDIATELY BEFORE THE COMMENCEMENT OF THE EXAMINATION, YOU SHOULD CHECK THAT THIS TEST BOOKLET DOES NOT HAVE ANY UNPRINTED OR TORN OR MISSING PAGES OR ITEMS ETC. IF SO, GET IT REPLACED BY TEST BOOKLET OF SAME SERIES.
2. ENCODE CLEARLY THE TEST BOOKLET SERIES IN THE OMR ANSWER SHEET ONLY IN THE APPROPRIATE PLACE IN THE ANSWER SHEET BY BLACK BALL POINT PEN ONLY.
3. This Test Booklet is divided into three SECTIONS i.e., SECTION-A, SECTION-B and SECTION-C.
 - (A) SECTION-A (MCQ Pattern) contains 40 items (questions). Each question, carrying two (2) marks only, has four responses (answers). You will select the response which you want to mark on the OMR Sheet. In case you feel that there is more than one correct response, mark the response which you consider the most appropriate. In any case choose ONLY ONE response for each item.
 - (B) Questions under SECTION-B (Conventional Method) and SECTION-C (Conventional Method) are to be answered in separate Answer Book.
4. You have to mark all your responses of SECTION-A by Black Ball Point pen only on the separate OMR Answer Sheet provided. See directions in the Answer Sheet.
5. Before you proceed to mark in the answer sheet the responses to various items of SECTION-A in the Test Booklet, you have to fill in some particulars in the Answer Sheet.
6. On completion of the Examination, you should handover the OMR Answer Sheet for SECTION-A and Answer Book for SECTION-B and C to the Invigilator only. You are permitted to take the Test Booklet with you.
7. Sheets for rough work are appended on the Test Booklet at the end.
8. Instructions for wrong and multiple answer(s) SECTION-A :
 - (a) There will be four alternatives for the answer to every question. However, there will be no negative marking for wrong answer.
 - (b) If a candidate gives more than one answer, it will be treated as a Wrong Answer even if one of the given answers happens to be correct.

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INSTRUCTIONS

1. There are a total of 60 questions. Q. Nos. 1 to 40 in SECTION-A are Multiple choice questions having 2 marks each.
2. In SECTION-B there are 15 questions. Q. Nos. 41 to 55 of 6 marks each, answers to which is restricted to 40 words each.
3. In SECTION-C there are 5 numerical questions. Q. Nos. 56 to 60 of 6 marks each.
4. All symbols used in the questions carry their usual meanings.

SECTION - A

Example : Poise is the unit of

- (A) Surface tension (B) Buoyant force
 (C) Coefficient of viscosity (D) Gravitational force

Answer : (C) Coefficient of viscosity.

- Choose the correct answer from the following :

2×40=80

1. The Sediment Delivery Ration (SDR) of a watershed is related to watershed area (A), relief (R) and watershed length (L) as

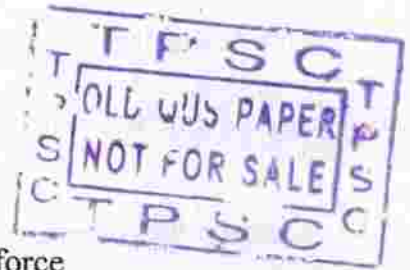
- (A) $SDR = KA^m (R/L)^n$ (B) $SDR = KA^{-m} (R/L)^{-n}$
 (C) $SDR = KA^{-m} (R/L)^n$ (D) $SDR = KA^m (R/L)^{-n}$

Where 'm' and 'n' are constants.

2. The pressure intensity (P_w) in t/m^2 due to waves on the face of a gravity dam is given by

- (A) $P_w = 2.4w (h_w)^2$ (B) $P_w = 2.4w h_w$
 (C) $P_w = 2.4w (h_w)^{1/2}$ (D) $P_w = 2.4w (h_w)^{3/2}$

Where w is the unit weight of water in t/m^3 and h_w is the height of wave from trough to crest, in meters.



3. The discharge (Q) over an Ogee shaped spillway is given by

(A) $Q = C L_e H_e^{3/2}$

(B) $Q = C L_e H_e$

(C) $Q = C L_e H_e^{5/2}$

(D) $Q = C L_e H_e^{3/2}$

Where C is a variable coefficient, L_e is the effective length of the crest, H_e is the total head on the crest.

4. Garret diagram gives the graphical method of designing the channel dimensions based on

(A) Khoshla's Theory

(B) Lacy's Theory

(C) Kennedy's Theory

(D) Inglis's Theory

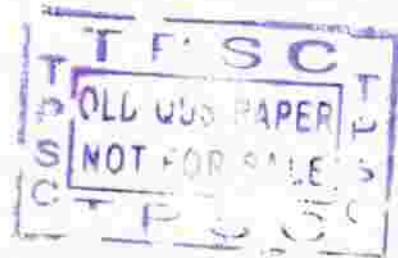
5. Identify the incorrect statement : The possible GVF profiles in

(A) Mild slope channels are M_1 , M_2 and M_3

(B) Adverse slope channels are A_2 and A_3

(C) Horizontal channels are H_1 , and H_3

(D) Critical slope channels are C_1 , and C_3



6. If N is the algebraic difference in grades, S is the minimum sight distance in meters, the length of summit curve (L) in meter is given by the expression

(A) $NS/4.4$ if $S > L$

(B) $NS^2/4.4$ if $S < L$

(C) $(NS)^2/4.4$ if $S > L$

(D) $N^2/4.4$ if $S = L$

7. If the radius of curvature (R) of a hill road is 50m, the % grade compensation should be

(A) $60/R$

(B) $70/R$

(C) $75/R$

(D) $80/R$

8. The area of longitudinal and transverse steel required per meter width or length of cement concrete slab is computed from the formula

(A) $A = Lfw/4S$

(B) $A = Lfw/2S$

(C) $A = Lfw/2S^2$

(D) $A = Lfw/S$

Where A = area of steel required per meter width or length in cm^2 , L = distance between free transverse joints or free longitudinal joints in meter, f = coefficient of friction between pavement and subgrade, usually taken as 1.5, S = allowable working stress in steel, usually taken as $1400/\text{kg/cm}^2$ or 50 to 60 per cent of minimum yield stress, kg/cm^2 , w = weight of unit area of pavement slab, kg/m^2 .

9. If δ is the maximum expansion in a concrete slab of length L_e , with a temperature rise from T_1 to T_2 , then the spacing of expansion joint L_e is given by the equation

(A) $L_e = 2\delta / (100 C (T_2 - T_1))$

(B) $L_e = \delta / (100 C (T_2 - T_1))$

(C) $L_e = 4\delta / (100 C (T_2 - T_1))$

(D) $L_e = \delta / 2(100 C (T_2 - T_1))$

Where C is the co-efficient of expansion of the concrete.

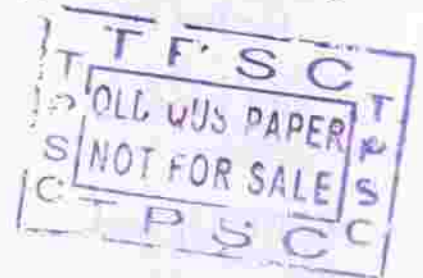
10. Maximum permissible gross weight of transport vehicles of Type 2 (Both axles single tyre) is

(A) 10 Tonne

(B) 12 Tonne

(C) 14 Tonne

(D) 16 Tonne



11. The method of levelling in which the heights of mountains are found by observing the temperature at which water boils, is known as

(A) Barometric levelling

(B) Reciprocal levelling

(C) Longitudinal levelling

(D) Hypsometry levelling

12. An angle made by a survey line with the prolongation of the proceeding line, is known as

(A) Direct angle

(B) Vertical angle

(C) Horizontal angle

(D) Deflection angle

13. To the sum of the first and the last ordinates, add twice the sum of the intermediate ordinates. The total sum thus obtained is multiplied by the common distance between the ordinates. One-half of this product gives the required area. This rule of finding the area is called

- (A) Mid-ordinate rule (B) Trapezoidal rule
(C) Average ordinate rule (D) Simpson's rule

14. The plotting of small areas which can be commanded from a single station is usually done on the plane table by the method of

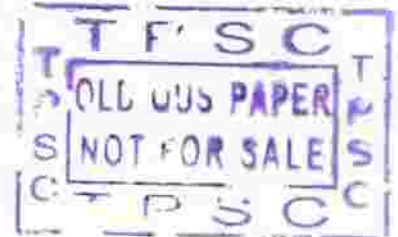
- (A) Radiation (B) Intersection
(C) Traversing (D) Resection

15. A stadia telescope, in a tachometer is fitted with

- (A) two additional vertical hairs (B) two additional horizontal hairs
(C) cross-hairs (D) Both (A) and (B)

16. When the magnetic declination is $5^{\circ} 20'$ east, the magnetic bearing of the sun will be

- (A) $95^{\circ} 20'$ (B) $174^{\circ} 40'$
(C) $185^{\circ} 20'$ (D) $354^{\circ} 40'$



17. The minimum load which will cause failure of a foundation is called — of the soil.

- (A) ultimate tensile strength (B) nominal strength
(C) ultimate compressive strength (D) ultimate bearing power

18. The coefficient of active earth pressure for cohesionless granular soil is given by

(A) $\frac{1 + \sin \phi}{1 - \sin \phi}$

(B) $\frac{1 - \sin \phi}{1 + \sin \phi}$

(C) $\frac{1 + \cos \phi}{1 - \cos \phi}$

(D) $\frac{1 - \cos \phi}{1 + \cos \phi}$

Where ϕ is the angle of internal friction of the soil.

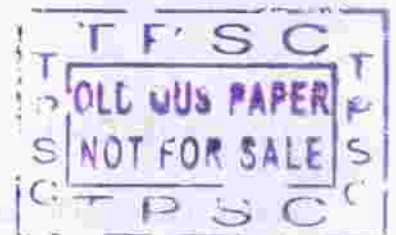
19. The exit gradient of the seepage of water through a soil medium is the

(A) Slope of the flow line

(B) Slope of the equi-potential line

(C) Ratio of the total head to the length of seepage

(D) Ratio of the head loss to the length of seepage



20. For reinforced concrete sewer pipes, the joints commonly provided is

(A) Bell and spigot joint

(B) Collar joint

(C) Simple joints

(D) Open joints

21. The total subsurface soil area required for the soak pit for final purification of the effluent from a septic tank is given by the empirical formula

(A) $Q = 130(t)^{1/2}$

(B) $Q = 130t$

(C) $Q = 130/(t)^{1/2}$

(D) $Q = 130/t$

Where Q = maximum rate of effluent application in litre per day/square meter of leaching surface, and t = standard percolation rate for the soil, in minutes per cm.

22. Factor not affecting bacterial efficiency of chlorine is

- (A) Turbidity (B) Presence of metallic compounds
(C) Ammonia compound (D) Coagulants used

23. For prevention of dental caries in children, the recommended fluoride concentration in water should be in the range of

- (A) 0.2–0.7 (B) 0.7–1.2
(C) 1.2–1.7 (D) 1.7–2.2

24. American Public Health Association formula for aeration time (T) in hours is

- (A) $T = 2La - 1$ (B) $T = (La/20) - 1$
(C) $T = (La/2) - 1$ (D) $T = (La/4) - 1$

Where La = BOD of the aeration tank sewage influent (mg/litre) to be removed.

25. A tank contains oil of specific gravity of 0.9. The depth of the point below free surface where the pressure intensity is 9 kg(f)/cm^2 is

- (A) 1000 m (B) 100 m
(C) 10 m (D) 1 m

26. The loss of head due to frictional resistance due to flow of liquid in a long straight pipe of length L and diameter D is given by

- (A) $\frac{fLV^2}{2gD}$ (B) $\frac{fV^2}{L\sqrt{2gD}}$
(C) $2\frac{fLV^2}{gD}$ (D) $1\frac{fLV}{2gD}$



Where f is the friction factor of the pipe and V is the mean velocity of flow in the pipe.

27. Rouse distance (x) required for establishment of a fully developed turbulent flow in a pipe of diameter D is given by

(A) $\frac{x}{D} = 50$

(B) $x = \frac{50}{D}$

(C) $\frac{x}{D} = (50)^2$

(D) $\frac{x}{D} = \sqrt{50}$

28. The friction factor f , for laminar flow in a pipe is given by

(A) $f = \frac{64}{Re}$

(B) $f = \frac{64}{\sqrt{Re}}$

(C) $f = \frac{8}{Re}$

(D) $f = \frac{8}{\sqrt{Re}}$

Where Re is the Reynolds number of flow in the pipe.

29. For steady laminar flow in circular pipes, the shear velocity is given by the expression

(A) $V = \sqrt{\frac{f}{8}}$

(B) $\sqrt{\frac{Vf}{8}}$

(C) $\frac{f}{8}$

(D) $\frac{1}{8} \frac{V}{\sqrt{f}}$

Where V is the mean velocity of flow and f is the friction factor of the pipe.

30. For laminar flow between parallel plates – both plates being at rest, the relation between mean velocity of flow (V) and the maximum velocity of flow ($V_{\max}$) is

(A) $V = \frac{2}{3} v_{\max}$

(B) $V = \frac{3}{2} v_{\max}$

(C) $V = \frac{1}{3} v_{\max}$

(D) $V = \frac{4}{3} v_{\max}$

31. For turbulent flow in pipes with mean velocity of flow (V) and the maximum velocity of flow ($V_{\max}$), v being the local velocity at any point, velocity defect is defined as

(A) $V - v_{\max}$

(B) $v - v_{\max}$

(C) $v_{\max} - v$

(D) $V - v$

32. For a given Venturi Meter, the cross-sectional area of the inlet section and the throat be a_1 and a_2 and the Venturi Head be h , the theoretical discharge is given by

(A) $Q_{th} = \frac{a_1 a_2 \sqrt{2gh}}{\sqrt{a_1^2 - a_2^2}}$

(B) $Q_{th} = \frac{\sqrt{2gh} a_1 a_2}{\sqrt{a_1^2 - a_2^2}}$

(C) $Q_{th} = \frac{2a_1 a_2 \sqrt{2gh}}{\sqrt{a_1^2 - a_2^2}}$

(D) $Q_{th} = \frac{a_1 a_2 \sqrt{2gh}}{a_1^2 - a_2^2}$

33. Euler Number is

(A) Inertia-Pressure Force Ratio

(B) Inertia-Gravity Force Ratio

(C) Inertia-Surface Tension Force Ratio

(D) Inertia-Elasticity Force Ratio



34. For complete similarity to exist between the model and its prototype, there should be

(A) only geometric similarity

(B) only kinematic similarity

(C) only dynamic similarity

(D) geometric, kinematic and dynamic similarity

35. Theoretical power required to drive a Single acting Reciprocating Pump is

$$(A) P = \frac{\omega(ALN)(H_s + H_d)}{60}$$

$$(B) P = \frac{\omega(ALN)(H_s - H_d)}{60}$$

$$(C) P = \frac{\omega(ALN)\sqrt{(H_s + H_d)^2}}{60}$$

$$(D) P = \frac{\omega(ALN)\sqrt{(H_s - H_d)^2}}{60}$$

ω is the specific weight of the liquid. A is the cross-sectional area of piston or the plunger. L is the length of the stroke, N is delivery stroke per minute, H_s is the static head, H_d is the delivery head

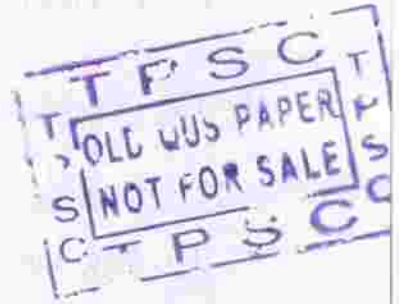
36. Mean diameter or the pitch diameter 'D' of the Pelton Wheel which rotates at N revolution per minute is given by

$$(A) D = \frac{60\sqrt{2k_u gh}}{\pi N}$$

$$(B) D = \frac{(\sqrt{2k_u gh})}{\pi N}$$

$$(C) D = \frac{60(2k_u \sqrt{2gh})}{\pi N}$$

$$(D) D = 60 k_u \sqrt{\frac{2gh}{\pi N}}$$



Where K_u is the speed of rotation and h is the net head.

37. The overall efficiency of Francis Turbine is given by

$$(A) \lambda_0 = \frac{P}{(WH)}$$

$$(B) \lambda_0 = \frac{(WH)}{P}$$

$$(C) \lambda_0 = \frac{(2WH)}{P}$$

$$(D) \lambda_0 = \frac{2P}{(WH)}$$

Where W is the weight of water per second which strikes the runner, P is the power available at the runner shaft, H is the net head at the runner shaft.

38. If a gauging section is having shifting control due to backwater effects, then

- (A) a loop rating curve results
- (B) the section is useless for stream gauging purposes
- (C) the discharge is determined by the area velocity methods
- (D) a secondary gauge downstream of the section is needed

39. The flow duration curve is a plot of

- (A) accumulated flow against time
- (B) discharge against time in chronological order
- (C) the base flow against the percentage of times the flow is exceeded
- (D) the stream discharge against the percentage of times the flow is equaled or exceeded



40. The unit of intrinsic permeability is

- (A) cm/day
- (B) m/day
- (C) darcy/day
- (D) cm^2 .

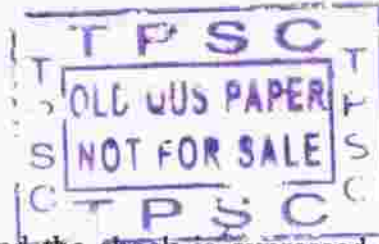
SECTION – B

Answer *all* the following questions :

6×15=90

41. Prove that the maximum efficiency of Pelton wheel occurs when the ratio of bucket velocity 'u' to the jet velocity, 'V' is given by the expression

$$\rho = \frac{u}{v} = \frac{1 - \cos\theta + k_1}{2(1 - \cos\theta) + k_1 + k_2}$$

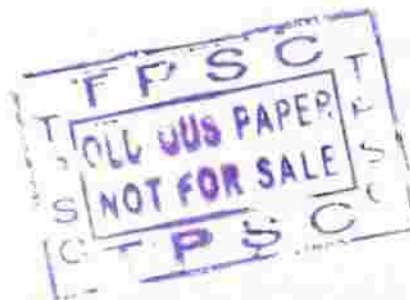


Where the loss due to bucket friction and the shock is expressed as $\frac{k_1(V-u)^2}{2g}$ and

that due to bearing friction and windage losses as $\left[k_2 \frac{u^2}{2g} \right]$ k_1 and k_2 are constants and θ being the bucket angle at outlet. Neglect volumetric losses.

42. What are the assumptions made in Unit Hydrograph Theory ?
43. Define partially submerged orifice and derive the equation for total discharge through the orifice.
44. Obtain the condition for maximum efficiency for transmission of power through a pipeline transporting any liquid.
45. What do you understand by hydrodynamically smooth and rough pipes ?
46. What is most economical or most efficient section of an open channel. Prove that a rectangular channel section will be the most economical when either the depth of flow is equal to half the width of the bottom or hydraulic radius is equal to half the depth of flow.
47. What are the functions of irrigation water ?
48. Draw the curve for optimum moisture percentage versus the rate of growth of the plant.

49. What do you understand by seepage pressure and quick sand condition in soil ?
50. In the context of applying irrigation water, explain kor depth and kor period, outlet factor, time factor, capacity factor, cumec day, and paleo.
51. What is "Incremental Increase Method" of population forecast for supplying domestic water ? Derive an equation for the population at the end of 'n' number of decades for present population as 'P', average increase per decade as 'I' and average incremental increase as 'r'.
52. Describe mass curve method for determination of capacity of a distribution reservoir.
53. What is Stopping Sight Distance (SSD) for a highway ? Mention the factors on which the stopping sight distance depends.
54. What is Passenger Car Units (PCU) and what are the factors affecting PCU values ?
55. What are the differences between "Primary Consolidation" and "Secondary Consolidation"?



SECTION – C

Answer *all* the following questions. Q. No. 56 to 60 are of 6 marks each :

6×5=30

56. An open oil tank of 5 meter in length contains 2 meter depth of oil (Specific gravity of 0.8). If the tank accelerates up a 30° incline plane at 3.6 m/sec^2 , what is the angle, the oil surface makes with the horizontal? Also find the pressure intensities at the bottom of the vessel at the front and the rear ends.
57. Design a Francis Turbine runner with the following data : Net head $H = 68$ meter, speed $N=750$ r.p.m; output power $P = 330$ kW, Hydraulic Efficiency (η_h) = 94%, overall efficiency (η_o) = 85%, flow ratio (ψ) = 0.15, breadth ratio, $n = 0.1$, inner diameter of runner is one-half of outer diameter. Also assume 6% of circumferential area of the runner to be occupied by the thickness of the vanes. Velocity of flow remains constant throughout and flow is radial at exit.
58. A catchment area has six rain gauge stations. In a year the annual rainfall recorded by the gauge are as follows :

Station	A	B	C	D	E	F
Rainfall (cm)	82.6	102.9	180.3	110.3	98.8	136.7

For a 10% error in the estimation of the mean rainfall, calculate the minimum number of additional stations required to be established in the catchment.

59. The slope of a channel is $S=1/5000$; Lacey's silt factor=0.9, channel side slope is $\frac{1}{2} : 1$. Find the channel section and the maximum discharge which can be allowed to flow in it.
60. An ascending gradient of 1 in 100 meets a descending gradient of 1 in 120. A summit curve of what length is to be designed for a speed of 80 kmph so as to have an overtaking sight distance of 470 m?

