Exam.	New Back (2066 & Later Batch)		
Level	BE	Full Marks	40
Programme	BCE	Pass Marks	16
Year / Part	II / II	Time	1 ½ hrs.

Subject: - Engineering Geology II (CE553)

✓ Candidates are required to give their answers in their own words as far as practicable.
✓ Attempt **All** questions.
✓ The figures in the margin indicate **Full Marks**.
✓ Assume suitable data if necessary.

1. Write down the parameters of engineering geological system. [3]

2. Mention the major engineering geological problems in the lesser Himalaya with mitigation. [3]

3. Describe the different types of aquifer system of Nepal. [2]

4. a) What is site investigation? Mention the different types of site investigation. [3]

   b) What are the engineering geological factors to be considered for dam site selection? [3]

   c) Describe the various geological problems occur during tunnel construction. [3]

5. a) What is the magnitude of earthquake hazard in Nepal? Differentiate between intensity and magnitude. [5]

   b) Describe the geological hazard in Nepal due to GLOF. [5]

6. a) The altitude of different planes are given below. HS = 110°/40°; B = 130°/20°; J_1 = 100°/40°; J_2 = 200°/50°, ϕ = 32°. Design cut slope inclination to be stable of given discontinuities from different types of failure. [4]
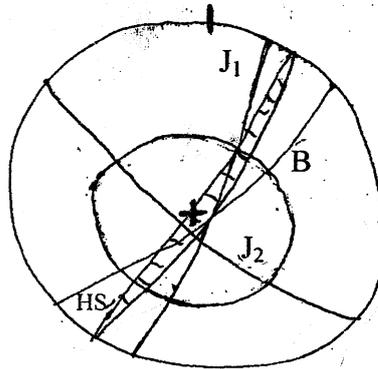
   b) Define stereographic projection and mention the use of stereographic projection in the different field of engineering geology. [3]

   c) Describe the role of RMR system in underground excavation and support design. [3]

7. Mention the different requirements for selecting borrow areas for construction material. [3]

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Subject: - Engineering Geology II *(CE553)*

✓ Candidates are required to give their answers in their own words as far as practicable.
✓ Attempt __All__ questions.
✓ The figures in the margin indicate __Full Marks__.
✓ Assume suitable data if necessary.

1. Write main tasks for EGS in detailed design phase of civil engineering projects.   [3]

2. Describe mitigation measures of geological problems in Himalaya.   [3]

3. Mention geological factors for formation of hydrological conditions.   [2]

4. a) Describe geological criteria for selection of road alignment.   [3]

   b) How do you explain factor of overbreak?   [3]

   c) Describe geophysical exploration.   [3]

5. a) What is factor of safety? Describe strength of earthquake.   [2+2]

   b) How varne classified landslide? Explain.   [3]

   c) Differentiate harzard and risk.   [1.5+1.5]

6. a) What are the meaning of Rock mass classification from RMR-system?   [2]

   b) How do you measured RQD in rock exposure and drilled core samples?   [1+1]

   c) Mention conditions for wedge failure from rock mass.   [2]

   d) Three bore holes were drilled to find out stable place for dam foundation of hydroelectric project. The apparent thickness of quartzite was found as 210 m. The Attitude of Quartzite bed was 220°/36° NE. Calculate true thickness of bedrock.   [4]

7. How do you estimate reserve for construction materials from soil and rock strata?   [3]

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Exam.	Regular / Back		
Level	BE	Full Marks	40
Programme	BCE	Pass Marks	16
Year / Part	II / II	Time	1½ hrs.

Subject: - Engineering Geology II *(CE553)*

✓ Candidates are required to give their answers in their own words as far as practicable.
✓ Attempt **All** questions.
✓ The figures in the margin indicate **Full Marks**.
✓ Assume suitable data if necessary.

1. Describe about the preparation of engineering geological map in the field? [3]
2. What is the engineering significance of major discontinuities system of the Nepal Himalaya? [3]
3. How Darcy's Law describes ground water movement? Describe characteristics of confining beds? (1+1)
4. Describe main purposes of site investigation? How do you make the site investigation below the ground surface? (2+3)
5. Define overbreak. Describe geological parameters for evaluation of bridge site selection ?(1+3)
6. Define intensity and magnitude of the earthquake. Explain the different types of waves generated during earthquake. [2+3]
7. What is mass movement? Explain why Nepal Himalaya is very prone to Landslide. [1+4]
8. What are differences between intact Rock and Rock Mass? Explain about the importance of Rock quality designation (RQD) in Rock Mass classification system based on Rock Mass Rating (RMR) in underground excavation. [2+3]
9. Discuss the stability analysis of the given planes. [5]
   $NS= 320^0/70^0$; $F= 155^0/68^0$; $J1= 240^0/80^0$; $J2=310^0/35^0$; $J3=10^0/85^0$; $\phi=30^0$
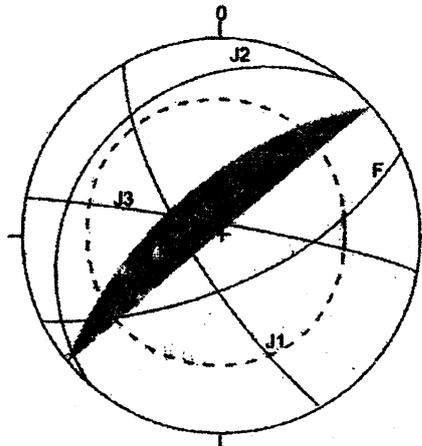
10. How geomorphology, topographical map & engineering geological maps help to searching of construction material? (3)

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Exam.	Regular		
Level	BE	Full Marks	40
Programme	BCE	Pass Marks	16
Year / Part	II / II	Time	1½ hrs.

Subject: - Engineering Geology II *(CE553)*

✓ Candidates are required to give their answers in their own words as far as practicable.
✓ Attempt **All** questions.
✓ The figures in the margin indicate **Full Marks**.
✓ Assume suitable data if necessary.

1. Describe the engineering significance of the rock forming minerals. [3]
2. Describe types of aquifer with suitable diagram. What are the different engineering geological problems in the Terai zone of the Nepal Himalaya? [2+3]
3. Define Rock Mass Rating (RMR). Discuss the different type and methods of site investigation for the road in the Nepal Himalaya. [2+4]
4. How mass movements occur? Classify the landslide according to varnes (1978). [2+4]
5. Explain the different effects of earthquake and GLOF in the Nepalese context. [3+2]
6. What is rock mass? Describe the rock mass classification based on Q-system and discuss its implication for the tunnel support design. [2+4]
7. Discuss the different conditions for plane failure in the rock slope. [2]
8. Three boreholes A, B and C were drilled for limestone reserve calculation. Bore hole A lies at 600m distance due N28^{0}E from borehole B. Borehole C lies at 400m distance due S10^{0}W from borehole B. The top and bottom of limestone bed was encountered at the following depth of give boreholes.

| Borehole	Top (m)	Bottom (m)
A	200	260
B	220	280
C	240	3000

Calculate the true thickness of the limestone bed. [4]

9. Discuss the use of topographic map and geological map for the survey of aggregates. [3]

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Exam.	**New Back (2066 & Later Batch)**		
Level	BE	Full Marks	40
Programme	BCE	Pass Marks	16
Year / Part	II / II	Time	1½ hrs.

Subject: - Engineering Geology II *(CE553)*

✓ Candidates are required to give their answers in their own words as far as practicable.
✓ Attempt __All__ questions.
✓ The figures in the margin indicate __Full Marks__.
✓ Assume suitable data if necessary.

1. Define engineering geological map. What are the main parameters for evaluation of engineering geological system? [1+2]

2. Describe the importance of Darcy's law in groundwater movement. Explain the engineering significance of major discontinuities system of the Nepal Himalaya. [2+3]

3. Describe the different types and methods of site investigation and write down the different engineering geological parameters for the bridge site selection. [3+3]

4. Define Mass movement. Differentiate between landslide and debris flow. [2+2]

5. Describe the mechanism of an earthquake. What are the differences between magnitude and intensity of an earthquake? [2+4]

6. Mention the different types of rock mass classification system. How do you measure RQD from given drill core samples? [2+2]

7. Define reserve. Describe the use of engineering geological map for the construction material survey. [1+2]

8. The apparent dip amount of an inclined bed is 1:12 and 1:16 along N30°W and N10°W respectively. Calculate the true dip amount and direction. [4]

9. Discuss the stability analysis based on the following data: [5]

    $HS = 202^0/65^0$, $F = 350^0/2?^0$, $J_1 = 180^0/81^0$, $J_2 = 78^0/69^0$, $J_3 = 21^0/73^0$, $J_4 = 293^0/52^0$
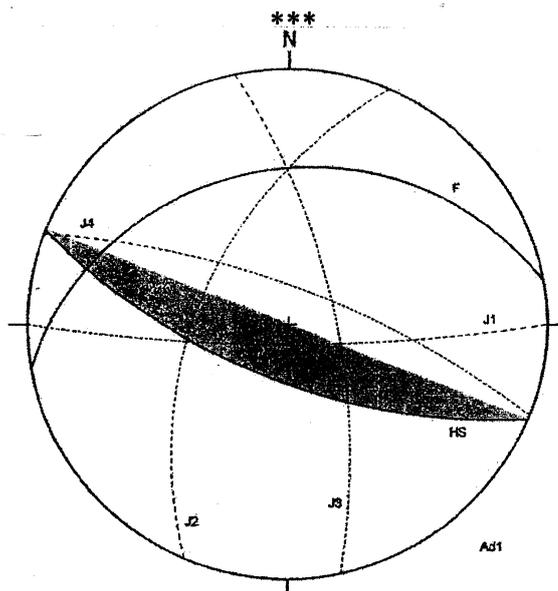
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Subject: - Engineering Geology (CE553)

✓ Candidates are required to give their answers in their own words as far as practicable.
✓ Attempt **All** questions.
✓ The figures in the margin indicate **Full Marks**.
✓ Assume suitable data if necessary.

1. Describe the engineering significance of the rock forming minerals. [3]

2. Highlight the major discontinuities system of Nepal Himalaya and their engineering significance. [3]

3. What are different aquifer system in terai, hills and mountains of Nepal? [2]

4. a) What are the engineering geological factors to be assessed for the tunnel site selection? [5]

   b) Write down the documentation process for this task. [4]

5. a) How do you differentiate P-wave and S-wave? Describe strength of earthquake. [2+3]

   b) Define mass movement. Describe causes of landslide. [1+4]

6. a) Bore B in an oil field is 5000 feet due north of bore hole A and bore hole C is 10,000 feet due east of bore hole A. The tops and bottoms of a key sandstone bed are reached at the following altitudes relative to sea leveling the three holes: A, −2500 and −2700 feet; B, −2800 and −3000 feet; and C, −3000 and −3200 feet. What is the attitude of the sandstone and how thick is it? [5]

   b) Suggest the possible mode of failure from following figure. [5]
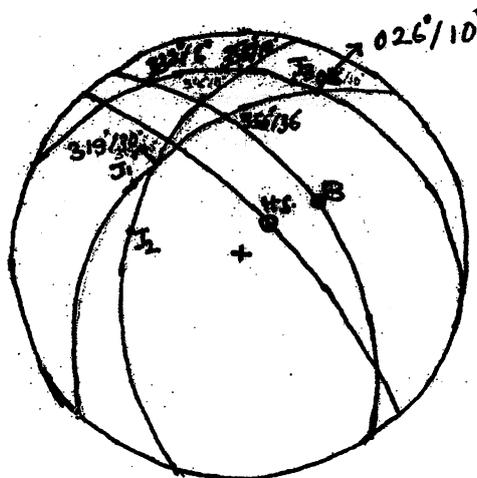
Hill slope: N45°E/70° Bending: N 55°E/45° Joint 1: N47°W/31° Joint 2: N77°E/36° Joint 3: N20°E/10°

7. What are the major steps involved in estimation of the construction materials? [3]

***

Exam.		Regular	
Level	BE	Full Marks	40
Programme	BCE	Pass Marks	16
Year / Part	II / II	Time	1½ hrs.

Subject: - Engineering Geology II

✓ Candidates are required to give their answers in their own words as far as practicable.
✓ Attempt *All* questions.
✓ The figures in the margin indicate *Full Marks.*
✓ Assume suitable data if necessary.

1. Define over break. Describe direct methods of surface investigation with reference to selection of road alignment in rock slopes.   [1+3]

2. Describe river channel morphology. Describe geological factors for formation of aquifer system in mountain.   [1.5+2.5]

3. Write down the mechanisms of mass movement. Discuss the control measures against landslide.   [1+4]

4. Describe condition of toppling failure.   [3]

5. What are main parameters of Engineering Geological System? Describe major geological hazards in the Higher Himalayan Zone.   [1.5+2.5]

6. Bore hole A is 700m due north of bore hole B and bore hole C is 600m due west of bore hole B. The tops and bottoms of a rock layer are reached at the following altitudes relative to the sea level in three holes.   [6]

   Bore hole A : –410m and –430m
   Bore hole B : –380m and –400m
   Bore hole C : –430m and –450m

   Find the attitude and thickness of the rock layer.

7. Define rock mass. Discuss geo-mechanics classification of rock mass.   [1+4]

8. What is engineering geological maps? Describe the importance of engineering geological maps in selection of burrow area.   [2.5+2.5]

9. Write short notes on: [2×2]

   a) Ground water movement
   b) Mechanism of Earthquake

***

INSTITUTE OF ENGINEERING

Examination Control Division

2071 Bhadra

Exam.	Regular / Back		
Level	BE	Full Marks	30
Programme	BCE	Pass Marks	12
Year / Part	II / II	Time	3 hrs.

Subject: - Building Drawing (CE556)

✓ Candidates are required to give their answers in their own words as far as practicable.
✓ Attempt **All** questions.
✓ The figures in the margin indicate **Full Marks**.
✓ **Necessary figures are attached herewith.**
✓ Assume suitable data if necessary.

1. a) List down different building elements in sub-structure and super-structure. [2]

   b) Draw hatching pattern for the following material representation. Use 5 cm × 5 cm area for each symbol. [2]

      i) Glass in elevation
      ii) Wood in section

   c) Explain Floor Area Ratio (FAR). [2]

2. Redraw the given ground floor plan of load bearing structure by showing complete dimensions (3 layers) grid, lettering, hatching etc. (Use 1:50 scale) [12]

3. Make a detailed drawing of staircase as given in the attached drawing. Mention the necessary levels, floor details (ground and upper) and other information. (Use 1:20, 1:10, 1:15 scale) [12]

Description	Door / Windows Schedule	
Wall thickness: 230 (external/internal)	**Symbol**	**Width**
Plinth Height : 450	DW1	2600
Floor Height : 2450	D1	1000
Slab Thickness : 100	D2	900
Plinth Beam : 230 × 230	D3	750
Floor Beam : 230 × 350	W1	2000
Tread Width : 230	W2	1800
Riser Height : 175	W3	900
Stair Width : 1000		
Landing Width : 1000		

Note: All dimensions are in mm.

***

PLAN

VERANDAH

KITCHEN/DINING

LIVING ROOM

BATHROOM

BED ROOM

VERANDAH

A B C

1 2 3 4 5 6

9230
4500 4500
2000
9230
5000
2500
2000
1500
2230
1750
3500
2155
2000
1000
1750
2250
550

Plan

Section at A-A

4500

2500

A A

UP
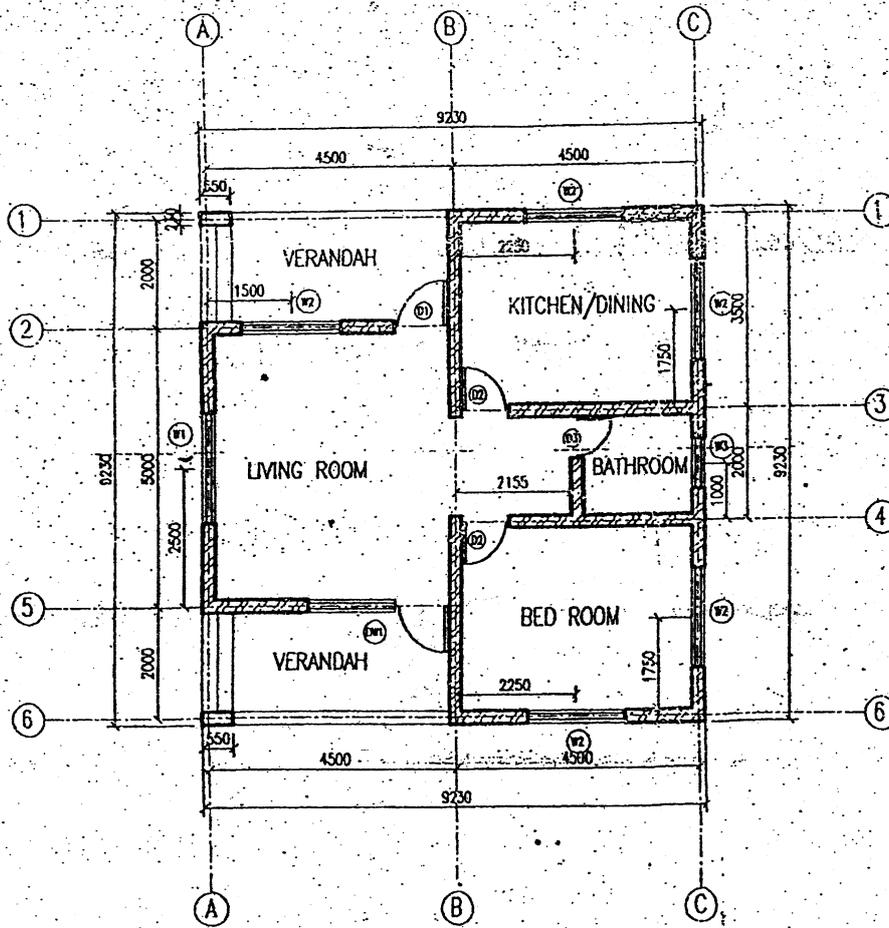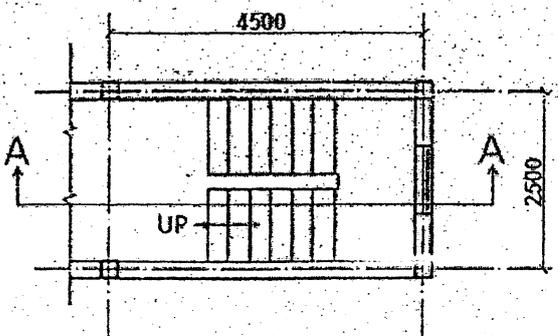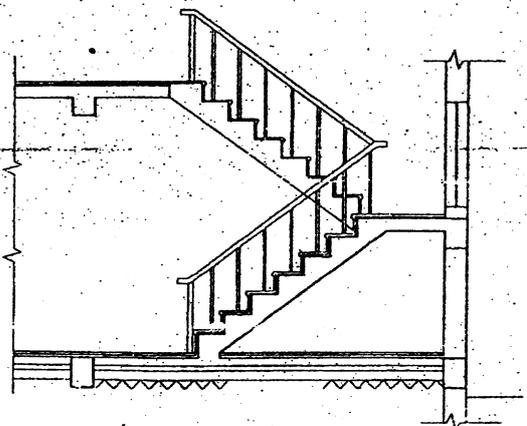
Exam.	New Back (2066 & Later Batch)		
Level	BE	Full Marks	30
Programme	BCE	Pass Marks	12
Year / Part	II / II	Time	3 hrs.

Subject: - Building Drawing *(AR556)*

✓ Candidates are required to give their answers in their own words as far as practicable.
✓ *Attempt __All__ questions.*
✓ *The figures in the margin indicate __Full Marks__.*
✓ *__Necessary figures are attached herewith.__*
✓ *Assume suitable data if necessary.*

1. Calculate the permissible built-up area and number of storey's that can be built with plinth area of 820 sq. ft. The area of plot is 1369 sq. ft. and ground coverage is 60% where FAR is given 1.5 as per building bye-laws.   [2]

2. Make the figure of light plane and ROW (right of way) as per building bye-laws to constrain the height of building.   [2]

3. Write short answers on: (any two)   [2]

   a) Minimum Parapet height of residence building is ....
   b) One ropani is equal to .... sq. ft.
   c) Draw the symbol of MDB and 4 gang of one way switch.
   d) What is soil line connected to before it is connected to the soak pit?

4. Draw Ground Floor Plans of the building as shown in the Figure 1, using appropriate drafting techniques. Refer to the description provided below.   [12]

Drawing unit	: Metric system (All dimensions in mm)
Scale	: 1:50
Column size	: 230 × 230
	c/c spacing - as shown in figure
Wall thickness	: Exterior: 230; Interior: 110
Door D1	: 1000 × 2100
Door D2	: 900 × 2100
Window W1	: 1800 × 1200
Window W2	: 1000 × 1200
Window W3	: 750 × 1200
Ventilation V1	: 400 × 400
Plinth Level	: 450 above ground level
Dimensioning	: - 3 layer dimension for floor plan
	- Floor Levels
Hatching	: as required

   Assume any other dimensions are required.

5. Draw staircase detail (Plan and section at A-A) with detail dimensions, labelling and using appropriate drafting techniques, in scale 1:20, as given in Figure 2. Use the description given below: [12]

   All dimensions are in millimeter. Assume any other dimensions as required.

Floor Height: 2800, Beam size: 230 × 350, Column size: 230 × 230 (c/c spacing - as shown in figure), Wall Thickness: 230, Plinth Level: 750 above Ground Level.

Stair Steps:

16 risers @ 175   Slab Thickness : 100
Tread : 300   Window size : 1500 × 1100
Stair width : 1000   Lintel Beam size : 230 × 100
Waist slab : 125   Sill height : 900

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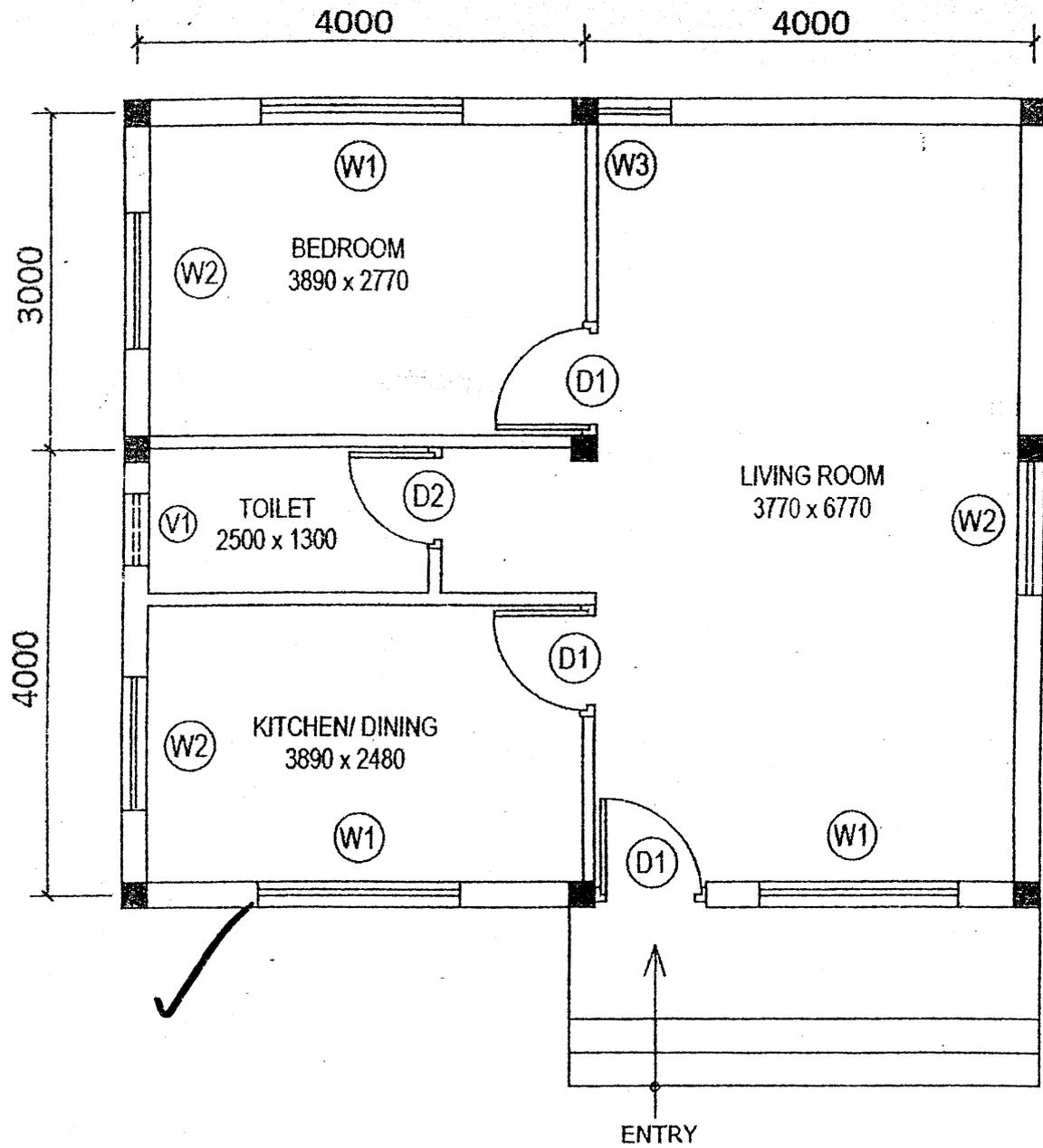
Figure 1: Ground Floor Plan

4000

4000

3000

4000

BEDROOM
3890 x 2770

W1

W3

W2

D1

TOILET
2500 x 1300

V1

D2

LIVING ROOM
3770 x 6770

W2

D1

KITCHEN/ DINING
3890 x 2480

W2

W1

D1

W1

D1

ENTRY
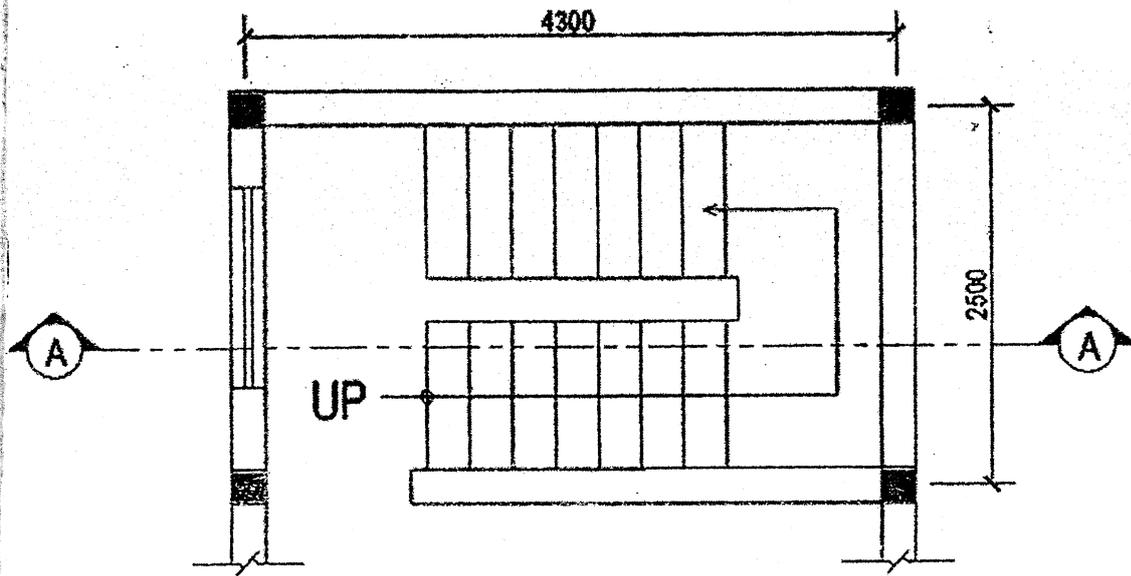
PLAN (GROUND FLOOR)
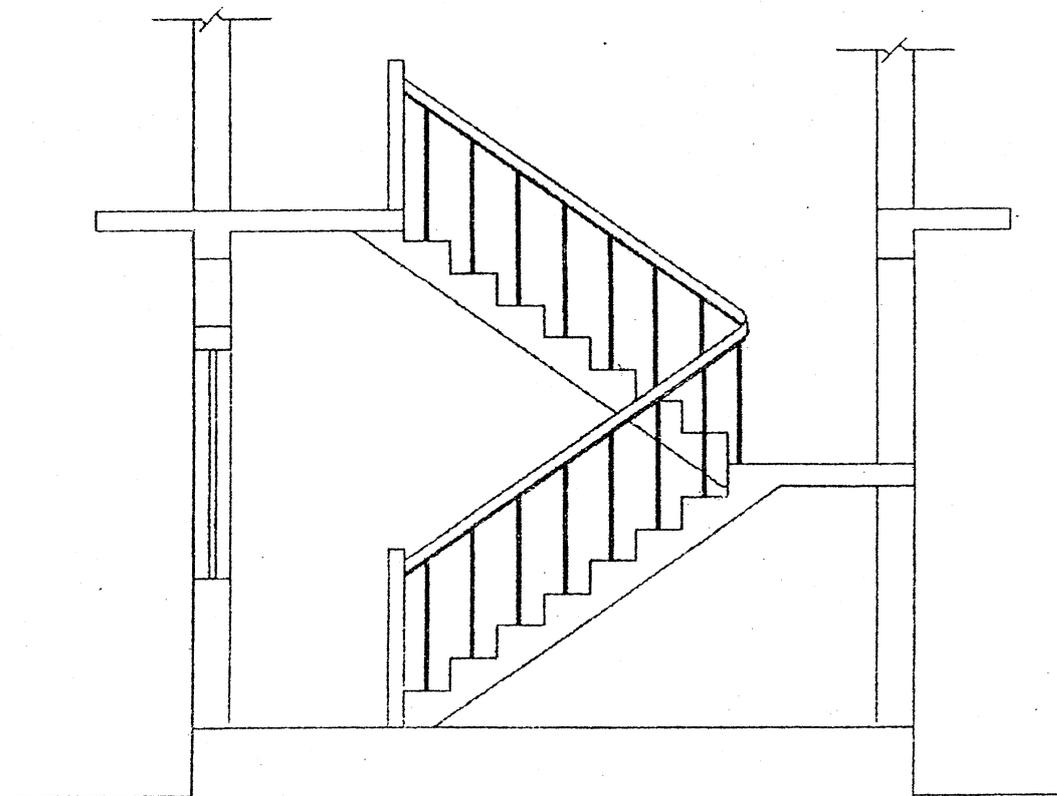
SECTION AT A-A

Staircase detail (Plan & Section)

| Exam.	Regular		
Level	BE	Full Marks	30
Programme	BCE	Pass Marks	12
Year / Part	II / II	Time	3 hrs.

Subject: - Building Drawing *(CE556)*

✓ Candidates are required to give their answers in their own words as far as practicable.
✓ Attempt *All* questions.
✓ The figures in the margin indicate *Full Marks*.
✓ *Necessary figures are attached herewith.*
✓ Assume suitable data if necessary.

1. Draw the hatching symbols in the box of 40×40 mm   [2]
   a) Brick in section
   b) Concrete in section
   c) Wood in section
   d) Stone in section

2. Draw the figure of light plane as per building bye-laws. Mention the right of way (ROW) to constrain the height of building.   [2]

3. Redraw the following ground floor plan as shown in figure. Make complete dimension (3 layers) by showing all information as required in scale-1:50   [12]

4. Redraw the given wall section through ground level to parapet level. Mention the necessary levels, floor details (ground and upper) and other missing information. Use scale 1:20.   [14]

Descriptions:

Column (RCC)	: 230 x 300	Riser	: 175
Wall (Brick)	: 230 / 110 (External/Internal)	Tread	: 250
Slab thickness	: 100 (RCC)	Stair Width	: 1000
Slab projection	: 750	Landing Width: 1000	
Floor Beam	: 230 x 350	**Door/Window Schedule**	
Plinth Beam	: 230 x 230	DW1: 2300 x 2100	
Floor Height	: 2800	W2 : 2000 x 1350	
Sill Height	: 750	W3 : 1800 x 1350	
Sill Band	: 230 x 50	W4 : 900 x 1350	
Lintel Height	: 2100	W5 : 1000 x 1350	
Lintel Band	: 230 x 150	D2 : 900 x 2100	
Parapet Height	: 900	D3 : 750 x 2100	

***

Top dimension chain:

1	2	3	4	5
10163				
3500	2003	2343	2035	
600	2000	600	900	1000	1735

W2   W4   W5

A

150

LIVING ROOM

BATH

VERANDAH

STAIRS: TREAD=250 RISER=175

T=300 R=150

UP

DW1

1135
W2 2000
1135

4500

03

02

02

1200 230 1180

02

B

1235

1500

2770

250

4500

10230

4500

KITCHEN/DINING

STORE

03

110

BED ROOM

K

W2 2000

W3

W3

1800

770

W4

C

K

1800   900   1040   2000   1040

3500   2000   4380

10180

1 2 3 4

4500   1800   1235   250   1000

10230

GROUND FLOOR PLAN

WALL SECTION AT K-K

EARTH COMPACTION
150 SAND FILLING
ONE LAYER FLAT BK SOLING
75 THK RCC(1:3:6)
20 MM SCREED
NEAT CEM FL FINISH

GROUND LEVEL

± 000 PLINTH LEVEL

230 X 230 RCC TIE BEAM

100 HIGH SKIRTING

100 THK RCC SLAB

12 CEM PLASTER

230 X 350 RCC BEAM

DRIP

750

30°

100 HIGH SKIRTING

20 SCREED

NEAT CEM FL FINISH

100 THK RCC SLAB

12 CEM PLASTER

230 X 350 RCC BEAM

750

100 THK RCC SLAB

12 CEM PLASTER

30°

800
750
230
1350
150
550
433
317
1350
150
550
433
230
75

Exam.		Regular	
Level	BE	Full Marks	30
Programme	BCE	Pass Marks	12
Year / Part	II / II	Time	3 hrs.

Subject: - Building Drawing *(CE556)*

✓ Candidates are required to give their answers in their own words as far as practicable.
✓ Attempt __All__ questions.
✓ The figures in the margin indicate __Full Marks__.
✓ __Necessary figures are attached herewith.__
✓ Assume suitable data if necessary.

1. Draw the hatching symbols in the box of 40×40 mm   [2]
   a) Brick in section
   b) Concrete in section
   c) Wood in section
   d) Stone in section

2. Draw the figure of light plane as per building bye-laws. Mention the right of way (ROW) to constrain the height of building.   [2]

3. Redraw the following ground floor plan as shown in figure. Make complete dimension (3 layers) by showing all information as required in scale-1:50   [12]

4. Redraw the given wall section through ground level to parapet level. Mention the necessary levels, floor details (ground and upper) and other missing information. Use scale 1:20.   [14]

Descriptions:

Column (RCC)	: 230 x 300	Riser	: 175
Wall (Brick)	: 230 / 110 (External/Internal)	Tread	: 250
Slab thickness	: 100 (RCC)	Stair Width	: 1000
Slab projection	: 750	Landing Width: 1000	
Floor Beam	: 230 x 350	**Door/Window Schedule**	
Plinth Beam	: 230 x 230	DW1: 2300 x 2100	
Floor Height	: 2800	W2 : 2000 x 1350	
Sill Height	: 750	W3 : 1800 x 1350	
Sill Band	: 230 x 50	W4 : 900 x 1350	
Lintel Height	: 2100	W5 : 1000 x 1350	
Lintel Band	: 230 x 150	D2 : 900 x 2100	
Parapet Height	: 900	D3 : 750 x 2100	

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INSTITUTE OF ENGINEERING

Examination Control Division

2069 Poush

Exam.	New Back (2066 & Later Batch)		
Level	BE	Full Marks	30
Programme	BCE	Pass Marks	12
Year / Part	II / II	Time	3 hrs.

Subject: - Building Drawing *(CE556)*

✓ Candidates are required to give their answers in their own words as far as practicable.
✓ Attempt *All* questions.
✓ The figures in the margin indicate *Full Marks*.
✓ *Necessary figures are attached herewith.*
✓ Assume suitable data if necessary.

1. Write down the name of the different parts of a building as shown in the figure-1 below.   [1]

Figure -1
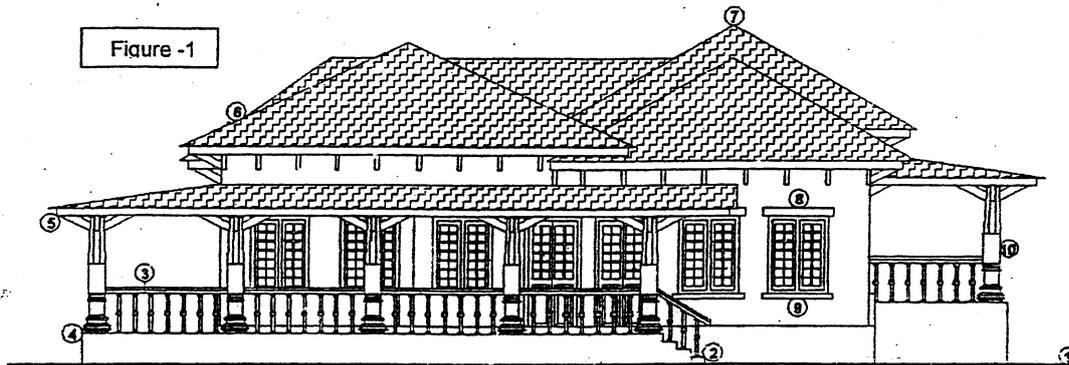
2. Draw the architecture symbol of rubble stone masonry and brick masonry in the box size 5cmx5cm. [0.5x2]

3. What is the angle of light plane? If road width is 12' for any plot calculate the permissible maximum height of the building.

   [1]

4. Redraw the following ground floor plan with complete dimensions (3 layers) by showing all information as required in scale 1:50

   [12]

Description

Column (RCC)	: 230 x 300
Wall(Brick)	: 230 (External/Internal)
Slab thickness	: 100(RCC)
Slab projection	: 600
Parapet Height	: 750
Beam	: 230 x 350
Plinth	: 450
Floor Height	: 2800
Riser	: 175
Tread	: 250
Sill Height	: 900
Lintel Height	: 2100
Plinth Beam	: 230x230

Doors and Windows Schedule

TYPE	WIDTH	HEIGHT
D1	1000	2100
D2	900	2100
W1	1800	1200
W2	900	1200
W3	1500	1200
D3	750	2100

STAIRCASE

i) Stair width : 1000
ii) waist slab : 150
iii)Landing Width : 1000

iv) hand rail : 65 x 100
v) height : 900
vi) Baluster : 40 dia.

Ground Floor Plan
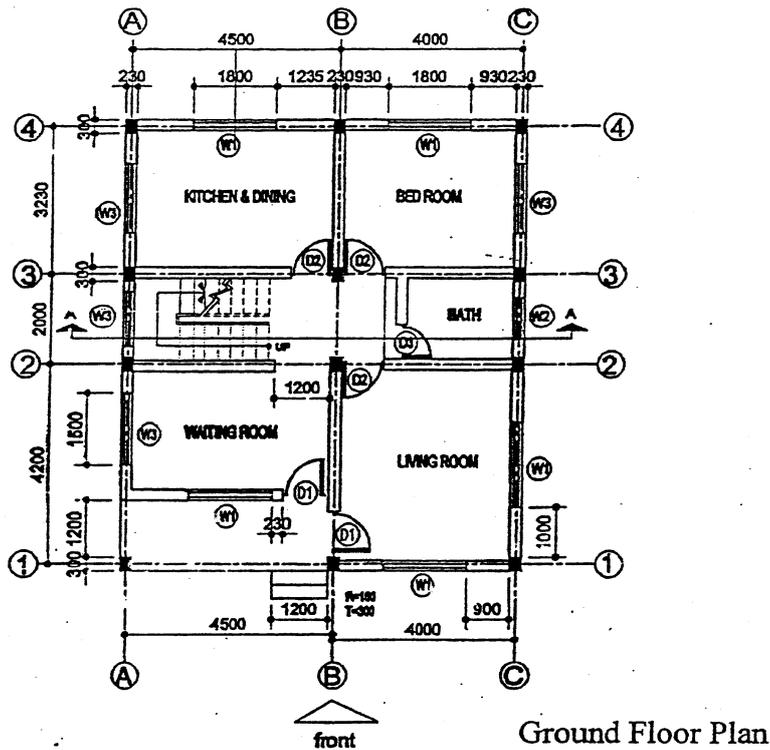
5. Draw elevation and vertical and horizontal detail section of a typical wood frame-glazed/glass window. The size of window is 7'x4'6". Three panel window having central panel fix and two side panels are openable. There is no ventilator on window.

i) Elevation: (scale 1" = 2'0")

ii) Vertical and horizontal detail sections (scale 1" = 1'0") [5]

6. Draw the staircase detail of given above ground floor plan [3+3]

(i) Plan (scale: 1:25) (ii) section (scale 1:25)

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INSTITUTE OF ENGINEERING
Examination Control Division
2069 Bhadra

Exam.	Regular (2066 & Later Batch)		
Level	BE	Full Marks	30
Programme	BCE	Pass Marks	12
Year / Part	II / II	Time	3 hrs.

Subject: - Building Drawing *(CE556)*

✓ Candidates are required to give their answers in their own words as far as practicable.
✓ Attempt *All* questions.
✓ The figures in the margin indicate *Full Marks*.
✓ *Necessary figures are attached herewith.*
✓ Assume suitable data if necessary.

1. Explain the types of drawings, what are the minimum drawings for a municipality pass drawing sheet? [2]

2. Draw hatching for the following material representation. Use 5cm×5cm area for each hatching a) Brick elevation (b) Concrete elevation (c) Liquid elevation (d) Gravel elevation. [2]

3. If ground coverage is 80%, calculate the permissible ground coverage area of given plan figure 1. [1]

4. Fill in the gap with appropriate words (use drawing sheet as answer paper) [0.5×4]

   a) Scale for Kathmandu valley's map is ....(1:20,000, 1:10 or 1:100)
   b) Draw the symbol of dome light (ceiling light) and single tube light.
   c) Exit (outlet) pipe from WC/Pan in a toilet is known as .... pipe.
   d) The name of drawing send to construction purpose at site is .... drawing.

5. Redraw the given ground floor plan(figure 1) including walls, columns, grid lines, dimensions, hatching and all complete information. (Scale 1:100) [12]

6. Draw the trench plan of the given plan (figure 1). Draw typical footing detail plan and section of footing B2. (Scale 1:50) [4+3+4]

   • The size of footing B2 and C2 are 3m×3m×2.5m
   • All other footing sizes are 2m×2m×2m
   • Wall thickness is 230mm and 110 refer plan
   • d) 6 number 16mm main vertical bars on pillars and 8mm diameter stirrups @5" c/c
   • e) Lowermost jali 10mm diameter bars @6"c/c both ways, grade of concrete is M20
   • f) Assume necessary data if necessary

***

N

A   B   ▷P   C   D

9960

9660

300 1645 1000 365 300 635 1000 635 300 775 2000 705 300

1 ——   —— 1

350

350

2570

1120   1000 270 1000

1000

BATH ROOM
(3150X2690)

BED ROOM
(3620X4120)

4351

D3

2000

4350

315

230

600

WASHING AREA   1040   UP

D2

2   ——   —— 2

10050

350

750

1120   1000   350

D2

350

350

2000

1000

LIVING
(5720X3620)

5350

10050

BED ROOM
(3550X5120)

3000

5350

870

D1

230

LVL

1150

860 1000 630 1200   630 1000 630

1000

150   VERANDAH

230

3   ——   —— 3

350   350

300 1560 230 2000 230 1560 300 775 2000 705 300

UP   ▷P

5880   3780

9960

A   C   D

GROUND FLOOR PLAN
FIG 1 (wall thickness is 230mm except specified)
All dimensions are in mm

INSTITUTE OF ENGINEERING

Examination Control Division

2068 Magh

Exam.	New Back (2066 & Later Batch)		
Level	BE	Full Marks	30
Programme	BCE	Pass Marks	12
Year / Part	II / II	Time	3 hrs.

Subject - Building Drawing

✓ Candidates are required to give their answers in their own words as far as practicable.
✓ Attempt *All* questions.
✓ The figures in the margin indicate **Full Marks**.
✓ *Necessary figures are attached herewith.*
✓ Assume suitable data if necessary.

1. a) Mention building types, based on structural system.   [2]

    b) Draw hatching pattern for the following material representation. Use 5cm×5cm area
        for each pattern.   [2]

        i)   Wood in section   ii)   Glass in elevation
        iii) Stone in section   iv)   Tile

    c) Draw the figure of light plane as explained in bye-laws.   [2]

2   Redraw Ground floor plan as given in figure2, based on description given below. (Scale
    1"= 8'-0")   [12]

			Doors and Window Schedule			
1. Column size – 9" x 12"		SN	Symbol	Width	Height
2. All wall thickness – 9" (External/ Internal)		1	D1	4'	7'
3. Plinth height – 2'		2	D2	3'	7'
4. Floor height – 9'4"		3	D3	2'6"	7'
5. Slab thickness – 4"		4	W1	6'	4'
6. Parapet height – 3'		5	W2	4'	4'
7. Plinth beam – 9" x 9"		6	W3	3'	4'
8. Floor beam – 9" x 14"					
9. Slab projection – 1'6"					
10. Sill height – 3'					
11. Lintel height – 7'					
12. Lintel band thickness – 6" RCC					
13. Riser height – 7"					
14. Tread width – 11"					

3. Draw the staircase with detail dimension complete labeling and using appropriate
    drafting techniques, in scale 1:20, as given in figure 3, based on the description given
    below.   [12]

    Steps:

        ● 14 risers @ 180
        ● Tread:300
        ● Stair width: 1000
        ● Waist slab: 125

7

Floor height: 2520, Beam size: 230×300, wall thickness: 230, Plinth level: 600 from ground level.

Ground floor details:

- Marble floor finish
- 20mm screed
- 75 thk PCC
- Flat brick soling
- 100mm sand filling
- Earth compaction

First floor Details:

- Marble floor finish
- 20mm screed
- Floor slab: 125
- Cement plaster: 12mm

All dimensions are in millimeter. Assume any other dimensions as required.

OR

Draw the complete section through the window from footing to parapet. Write the name of all parts and give the dimension also. Take the necessary data from question no. 2 and assume the other necessary data if required. (Scale 1"= 2'-0")   [12]
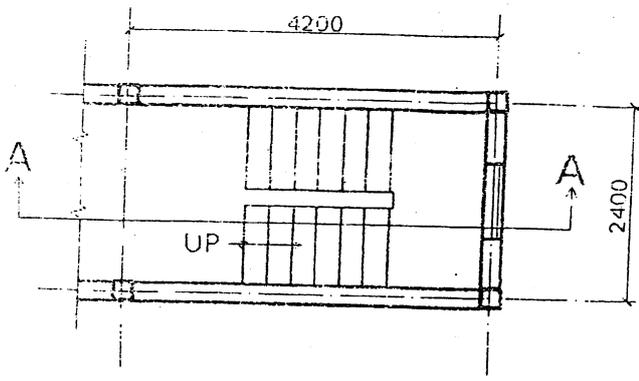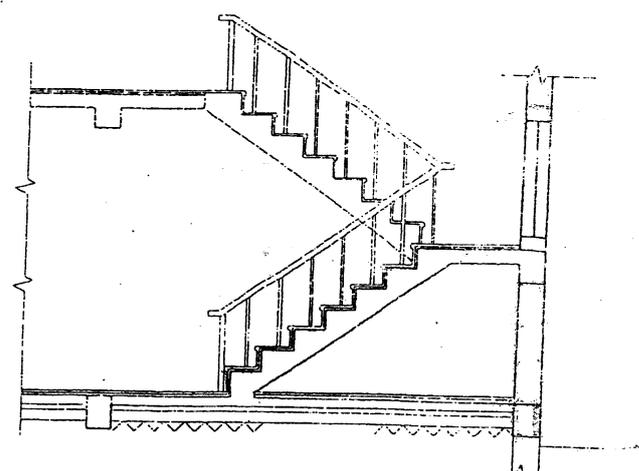
Plan   Section at A-A

Figure 3: Staircase detail
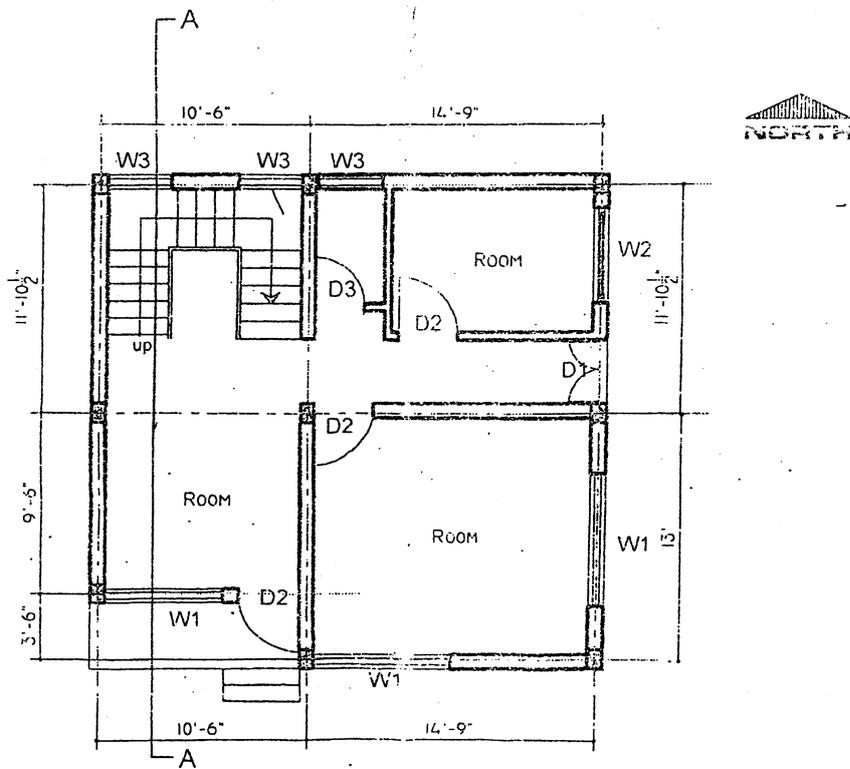
GROUND FLOOR PLAN
Floor Area =635.96 sq. ft.

Fig. 2

Building Drawing -2068 Megh

9

Exam.	Regular		
Level	BE	Full Marks	30
Programme	BCE	Pass Marks	12
Year / Part	II / II	Time	3 hrs.

Subject: - Building Drawing

✓ Candidates are required to give their answers in their own words as far as practicable.
✓ Attempt *All* questions.
✓ *The figures in the margin indicate Full Marks.*
✓ *Necessary drawing sheet are attached herewith.*
✓ Assume suitable data if necessary.

1. Write down the name of the different parts of a building as shown in the figure below.   [0.5×6]
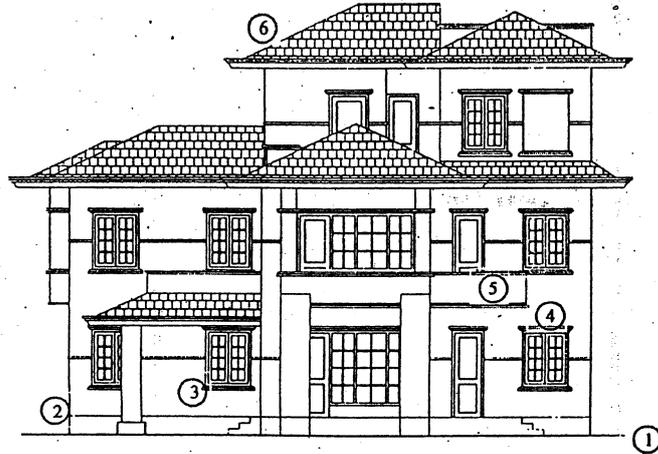
2. Draw the hatching symbol of Brick section and Earth. Box size for hatching is 4cm ×4cm. [0.5×2]

3. Redraw the given ground floor plan of figure 2 in detail including wall line, dimension, grid line, hatching and internal information. (Scale 1:100)   [7+2+1+1+1]

4. Redraw the footing detail of a column in detail including pillar reinforcement detail, footing reinforcement in plan and section as shown in the figure 3. (scale 1:10, 1:20, 1:20)   [2+5+5]

OR

Draw the plan (with appropriate drafting techniques and labeling) as shown in the figure 4, in 1:20 metric scale. Assume any dimensions as required.

a) Complete the sanitary drawing showing the following pipeline network with flow direction: [9,5]

   i) Hot water supply line   ii) Cold water supply line
   iii) Waste water line   iv) Soil pipeline

b) Identify the symbols in the electrical layout of figure 4 that are numbered.   [2.5]

5. Write short answer, use drawing sheet as answer copy.   [5×4]

a) Angle of light plane is ....
b) Set back from road side is....................
c) Draw the symbol of one gang-two way switch....................
d) If and area is 1500 sqm and ground coverage is 60%, calculate maximum ground floor area.................

***

Figure :3 (1:10, 1:20, 1:20)

Ø 8MM. @
125 MM. C/C

6 NOS. Ø 16 MM.
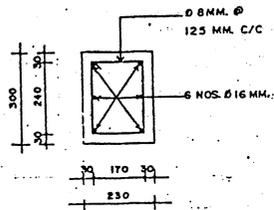
COLUMN DETAIL (C1)
(SCALE 1:10)

230

Ø 8MM. @
125 MM. c/c
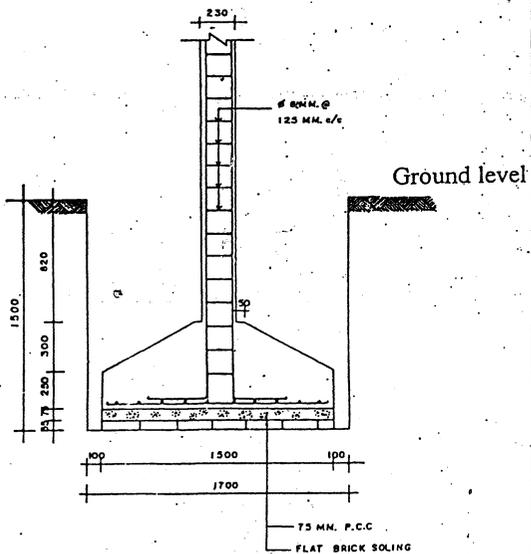
Ground level

FOOTING SECTION (F1)
(Scale 1:20)

Ø 12 MM. @ 150 MM.
BOTH WAYS

230

1500

75 MM. P.C.C
FLAT BRICK SOLING

100   1500   100
1700

635   330   635
1300
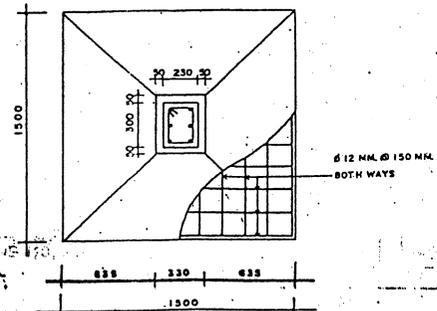
FOOTING   PLAN (F1)

Figure: 2. (1:100)

(A)   (B)   (C)

8500

3370   4300

600 230   3140   230   4070   230

RISER: 150

UP
1200

900 300 300

BED ROOM
(3260 X 3877)

KITCHEN/DINING
(4070 X 3877)

W1   W3

D2

D1

230

D1

300

D2

TOILET/BATH
(2715 X 1219)

W3

1219

4615

LIVING ROOM
(4615 X 3476)

UP

TREAD: 275
RISER: 175

900 247 900

W4

W1   MD

1925   900

RISER: 150

UP
1800

230 755   1800   585 230   1200   2870   230

3370   4300

8500

(A)   (B)   (C)
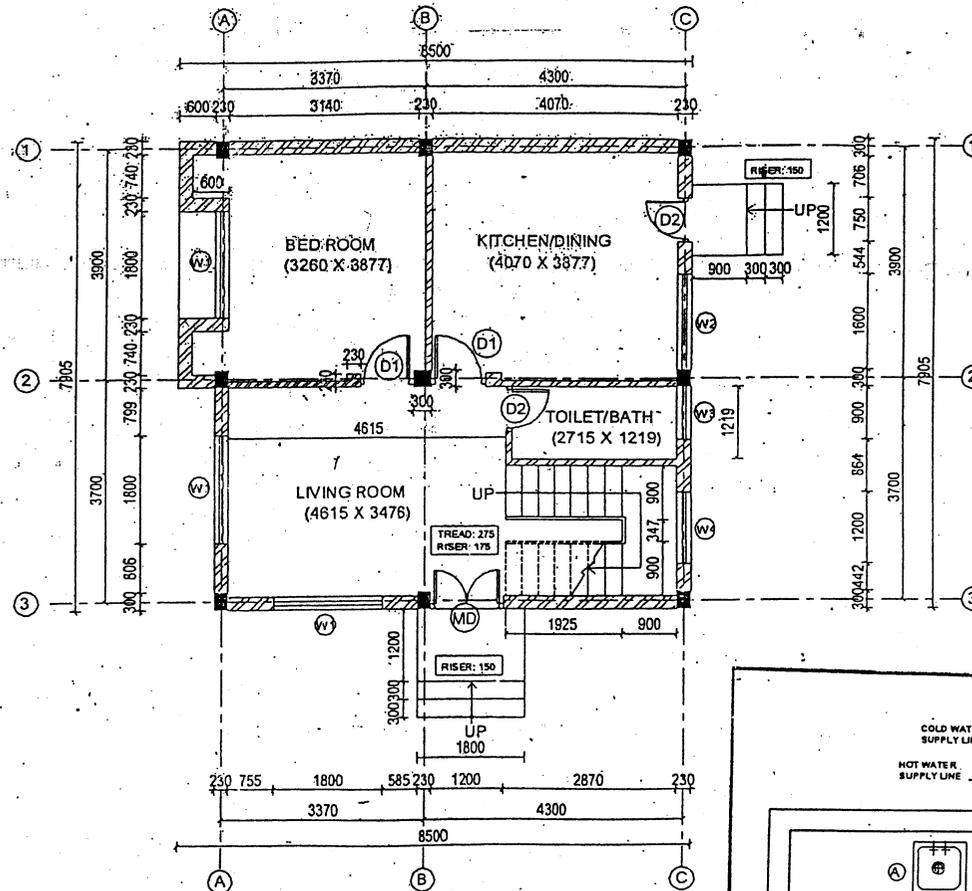
GROUND FLOOR PLAN

MD1: 1200X2100
D1: 900X2100
D2: 750X2100
W1: 1800X1350 (Sill ht. 750)
W2: 1600X1350 (Sill ht. 750)
W3: 900X1000 (Sill ht. 1100)
W4: 1200X1800 (Sill height 150 from landing level)
Wall thickness: 230 AND 110
PILLAR SIZE: 230X300

Figure 4: Sanitary and Electrical layout plan

COLD WATER
SUPPLY LINE

HOT WATER
SUPPLY LINE

TO WASTE
MANHOLE

TO SOIL
MANHOLE

(A)

KITCHEN
2500 x 2800

(B)   **TOILET** (D)
1850 x 1700

(C)
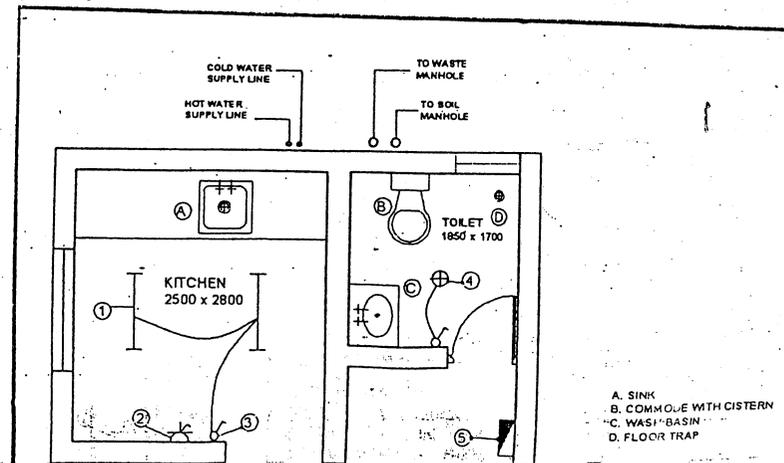
A. SINK
B. COMMODE WITH CISTERN
C. WASH BASIN
D. FLOOR TRAP

| 03 TRIBHUVAN UNIVERSITY	Exam.		Regular	
INSTITUTE OF ENGINEERING	Level	BE	Full Marks	80
Examination Control Division	Programme	BCE	Pass Marks	32
2072 Ashwin	Year / Part	II / II	Time	3 hrs.

Subject: - Theory of Structure (CE551)

✓ Candidates are required to give their answers in their own words as far as practicable.
✓ Attempt **All** questions.
✓ The figures in the margin indicate **Full Marks**.
✓ Assume suitable data if necessary.

1. a) What is principle of superposition? How is it useful in determination of deflection of beam? [4]

   b) A three hinged symmetrical parabolic arch has a span of 40 m and rise of 10 m. Draw ILD for: [12]
      i) Horizontal thrust
      ii) BM at section 8 m from left support
      iii) ILD for normal thrust and radial shear at the same section.

2. a) Explain what are conjugate beam theorems? Prove them. [4]

   b) A uniform shaft ABC is simply supported in bearings A and B and overhanging to C. AB = 1 and BC = a. When a transverse force P acts at C, show that the maximum deflection in the portion AB is $\dfrac{pal^2}{9\sqrt{3}EI}$ [12]

3. a) Explain what is dynamic multiplier and derive the formula for it when a mass falls on mid span of a simply supported beam. [4]

   b) Determine the maximum force in the member CF and BC of the truss as shown due to a live load of 28 KN/m longer than the span passing over the truss. [12]
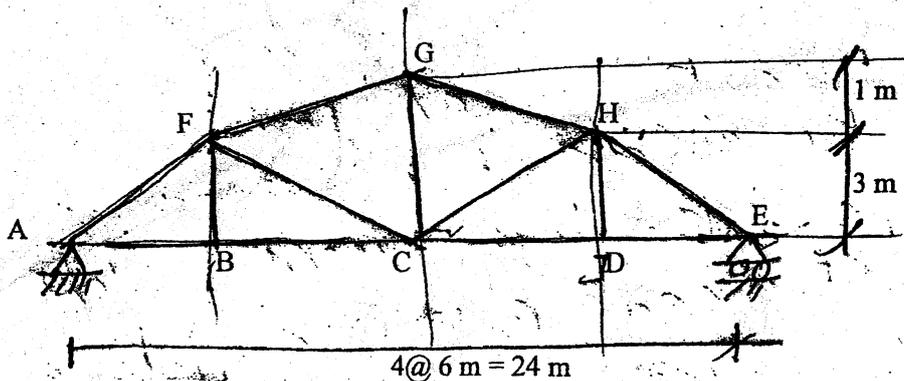
4. a) Show that there is no bending moment at any section of a parabolic arch (three hinged) subjected to load uniformly distributed over horizontal span. [4]

   b) Determine the deflection and slope at C in the overhanging beam shown in figure below by using virtual work (unit load) method. Take EI = 100000 KNm². [12]
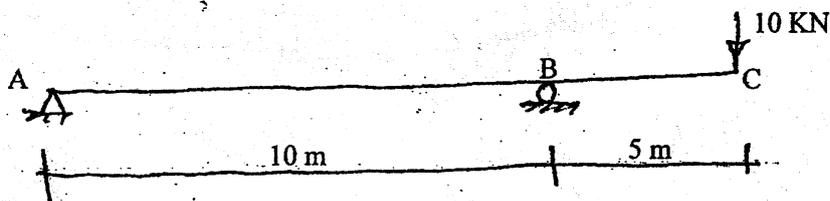
5. a) Explain how a structural quantity (bending moment, shear force etc) can be calculated from influence line diagram due to loads-concentrated force distributed load and couple. [6]

    b) A suspension bridge, 100 m span has two three hinged stiffening Girders supported by two cables with a central dip of 10 m. The dead load is a uniformly distributed load of 40 KN/m for the entire span and in addition, it supports three point loads of 200 KN each placed along the center line of the roadway, dividing the span in four equal parts. Calculate the maximum tension and minimum tension with their locations in the cable and the length of the cable, also draw shear force and bending moment diagrams for the girders. [10]

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03	TRIBHUVAN UNIVERSITY	Exam.	**New Back (2066 & Later Batch)**		
	INSTITUTE OF ENGINEERING	Level	BE	Full Marks	80
Examination Control Division		Programme	BCE	Pass Marks	32
	2072 Magh	Year / Part	II / II	Time	3 hrs.

Subject: - Theory of Structure (CE551)

✓ Candidates are required to give their answers in their own words as far as practicable.
✓ Attempt **All** questions.
✓ The figures in the margin indicate **Full Marks**.
✓ Assume suitable data if necessary.

1. a) Enunciate the principle of superposition and explain with suitable example. [4]

   b) A simply supported beam carries a point load W at mid span L. The middle one third portion of length has flexural rigidity 2 EI and rest two third portion has flexural rigidity EI. Determine the maximum deflection and slope at supports. Use conjugate beam method. [12]

2. a) A rectangular beam 25cm×50cm (b×d) is simply supported on a span of 6 m and carries a central load of 100 KN. Calculate the strain energy due to shear. Neglect self weight of the beam. Take $E = 2×10^6$ kg/cm² and $G = 0.85×10^6$ kg/cm². [4]

   b) Draw influence line diagram for forces in members BC and BG and determine maximum force in member BC when uniformly distributed load 6 KN/m of length 8 m moves. [12]
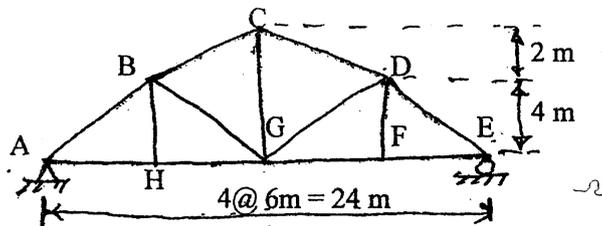
3. a) Define real work and virtual work for deformable structures. [4]

   b) A three hinged circular arch has span 40 m and rise 5 m. Make a sketch of the arch and given the equation to it. It carries a concentrated load 60 KN at 8 m from the right support and uniformly distributed load 4 KN/m over left half portion. Determine bending moment, radial shear force and normal thrust at a section 10 m from the left support. [12]

4. a) What is neutral point in an influence line diagram of an arch? Determine it for a three hinged arch for an ILD for bending moment diagram at a section. [6]

   b) Determine the vertical defection of joint E due to the increase in temperature of 20°C of member CD and member CE being 5 mm too long. [10]
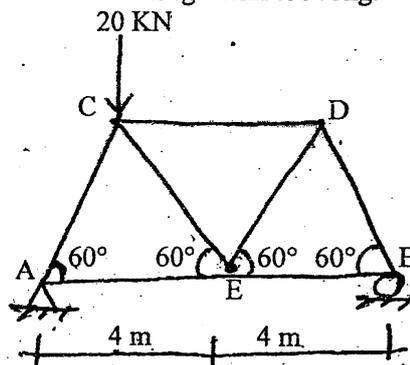
Take $E = 200$ KN/mm²
$α = 12×10^{-6}/°C$
Area = 1000 mm²
for all members

5. a) Define influence line diagram and explain how it is different from other structural quantity diagrams like bending moment diagram, shear force diagram etc. [4]

   b) A suspension cable having central dip 15 m supports a three hinged stiffening girder 150 m long which supports point loads 180 KN at 50 m from left support and 120 KN at 30 m from the right support. The dead load of the girder is 5 KN/m. Determine Bending moment and shear force at a section 30 m from the left support. Also determine the maximum tension in the cable and length of cable. [12]

***

10/10 M.

| Exam.	**OLD Back (2065 & Earlier Batch)**		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	II / II	Time	3 hrs.

Subject: - Theory of Structure I *(EG562CE)*

✓ Candidates are required to give their answers in their own words as far as practicable.
✓ Attempt any **Five** questions.
✓ The figures in the margin indicate **Full Marks**.
✓ Assume suitable data if necessary.

1. a) What is strain energy? Explain with an example real work method to calculate the deflection of a beam. [1+3]

   b) Determine the vertical deflection at point D of the frame loaded as shown in figure below: [12]
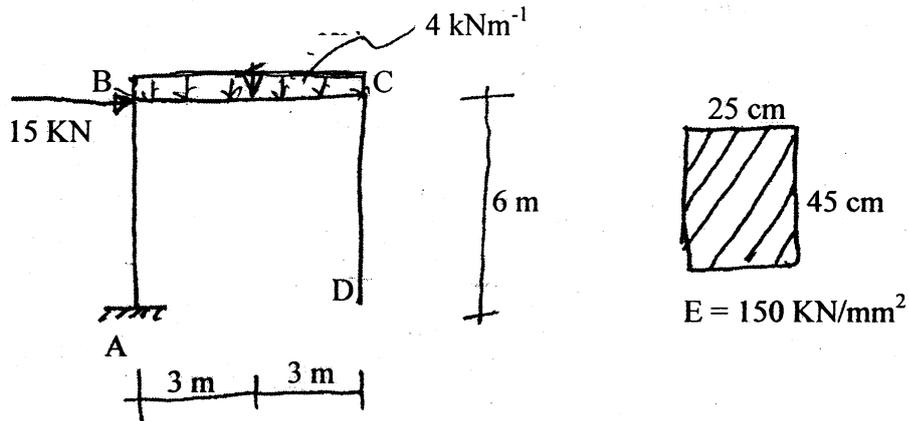
2. a) State and derive formulae for conjugate beam method. [6]

   b) Determine vertical deflection at D of the beam shown in figure below by using moment area method. Take EI to be constant. [10]
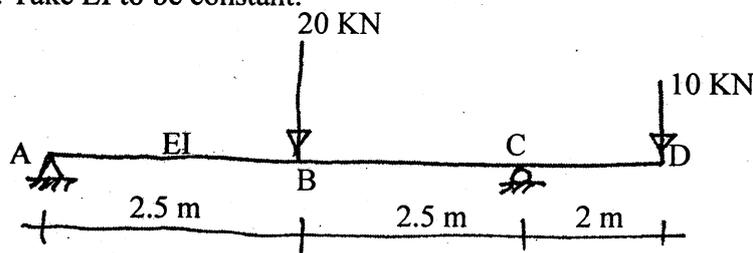

3. Determine the deflection at E of the pin-jointed Truss shown in figure below by using Virtual work method. [16]

Take area for all member
to be constant
A = 400 mm^2
E = 200×10^3 N/mm^2
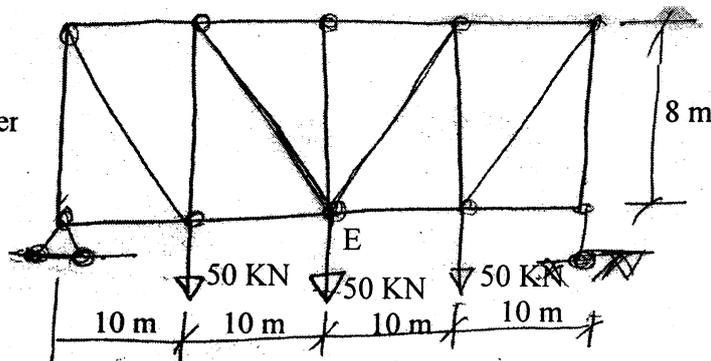
4. a) Draw influence line diagram for shear force at C of the overhanging beam shown in figure below. [6]
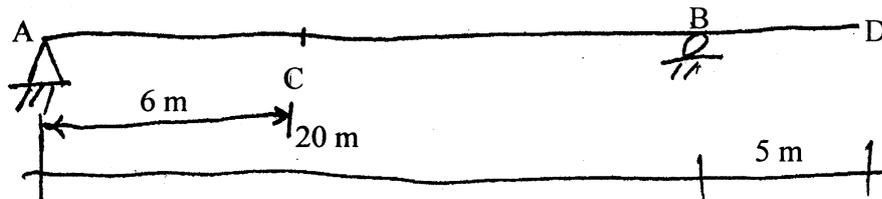
b) Determine maximum negative and positive bending moment at section C of the overhanging beam shown in Q.N. 4a when uniform distributed load of intensity 15 KN/m of length 4 m rolls over the beam from left to right. [10]

5. a) Derive the formula for determination of neutral point in influence line diagram of bending moment for a given section in a three hinged parabolic arch. [6]

b) A three hinged parabolic arch having span 80 m and central rise 8 m is loaded as shown in figure below. Determine bending moment, normal trust and radial shear force at section D. [10]
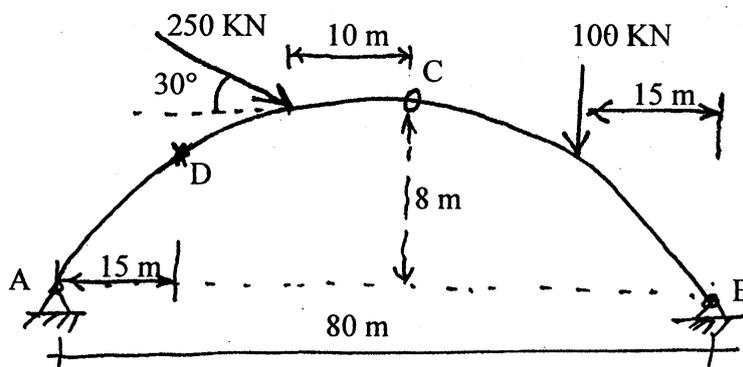

6. A suspension cable bridge has a three hinged girder supported by two cables. The roadway is 6 m wide. The girder has its self weight 5 KN/m^2. The live load consists of two concentrated loads 200 KN at 20 m from left support and 150 KN at 10 m right from the 200 KN load. The span is 120 m and central dip is 12 m. The live loads are acting at the central of the girder. Determine shear force and bending moment at section 25 m from left support of the girder. Also determine required cross sectional area of the cable if the allowable tensile stress of cable material is 120 N/mm^2. [16]

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Exam.		Regular / Back	
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	II / II	Time	3 hrs.

**Subject:** - Theory of Structure *(CE551)*

✓ Candidates are required to give their answers in their own words as far as practicable.
✓ Attempt __All__ questions.
✓ The figures in the margin indicate __Full Marks__.
✓ Assume suitable data if necessary.

1. a) Use influence line diagram to determine most critical position of a stretch of uniform distributed load and a set of concentrated forces to give maximum bending moment at a given section of a simply supported beam. Assume the length of the uniform distributed load and the set of concentrated forces to be less than the span of the beam. [6]

   b) Calculate horizontal displacement of the roller support and angular displacement of the fixed hinge of the given portal frame by using unit load (virtual work) method. Express the result in terms of sectional stiffness EI. [12]
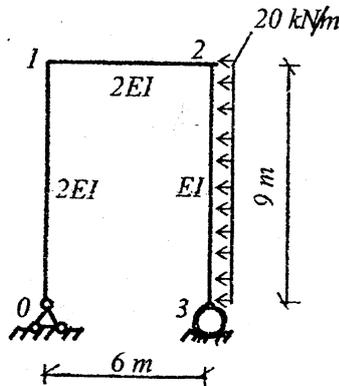
2. a) Define strain energy and explain with examples the difference between gradually and suddenly applied direct loads. Derive the expression for strain energy due to shear force in a beam in bending. [6]

   b) A simply supported beam of span 4 m with an overhang of length 2 m on right side of the beam is loaded in the span with uniform distributed load of intensity 2 kN/m. The overhang is loaded with a concentrated force of magnitude 3 kN at the free end. Calculate the deflection of the free end of the overhang and slope at the support. Use conjugate beam method. [12]

3. a) Explain the characteristics of structural mechanics and describe with suitable examples what are the two basic approaches of structural analysis. [6]

   b) Draw a simple rectangular plane truss having span of four equal bays and with horizontal, vertical and inclined members. Show required dimensions of the truss. Draw influence line diagrams for forces in one of the each horizontal vertical and inclined members. Consider the given truss is deck type. [12]

4. A three hinged symmetrical parabolic arch of span 20 m and rise 4 m is with a point load of magnitude 4 kN at 4 m distance from the left hinge. First, draw influence line diagram (ILD) for bending moment (BM), radial shear (RS), and normal thrust (NT) for the section where the point load is and then calculate the values of BM, RS and NT at the section using the ILDs. Also check these values of internal forces at the section by first principle using equilibrium equations. [13]

5. Determine the cross sectional area required for the cable loaded as shown in figure below if the permissible tensile stress of the cable material is 1500 N/mm². The self weight of the girder is 10 kN/m. Draw bending moment diagram of three hinged stiffening girder and also calculate the length of cable. [13]
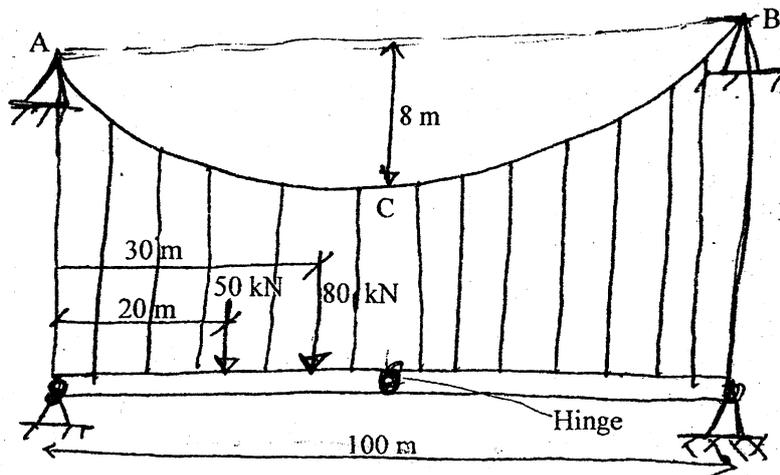

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Subject: - Theory of Structures *(CE551)*

✓ Candidates are required to give their answers in their own words as far as practicable.
✓ Attempt __All__ questions.
✓ The figures in the margin indicate __Full Marks__.
✓ Assume suitable data if necessary.

1. a) Explain with suitable force-displacement diagram, the elastic, inelastic, linear and non-linear behaviour of structure. [4]

   b) A bar of 2 cm diameter and of length 125 cm is supported rigidly in the vertical position at the top and is provided with a holow falling mass and a collar at the bottom which supports a spring 10 cm long. Find the stress developed if the falling mass is 4 kg and it fals from the height of one meter measured from the collar top. Take $g = 9.81$ m/s^2, stiffness of the spring $(k) = 40$ KN/m and $E = 210$ GN/m^2. [6]

2. a) Use virtual work method to determine the mid-span deflection for a simply supported steel beam of depth 300 mm carrying a superimposed udl of 20 KN/m over a span of 5 m, if the temperature of the top surface is 40°C and at bottom surface is 30°C. Assume the temperature to vary linearly over the depth of the beam. Take coefficient of thermal expansion $= 11.7 \times 10^{-6}$/°C $E = 210$ GN/m^2 and moment of inertia $= 15000$ cm^4. [10]

   b) Using influence line diagram prove that for a uniformly distributed load shorter than span, the bending moment at a section is maximum when the position of the load is such that the section divides the span and the load in the same ratio. [5]

3. a) Draw influence line diagram for bending moment and shear force at mid span of the beam of span 20 m and determine bending moment and shear force at that section due to the loads shown in figure using the influence line diagram. [10]
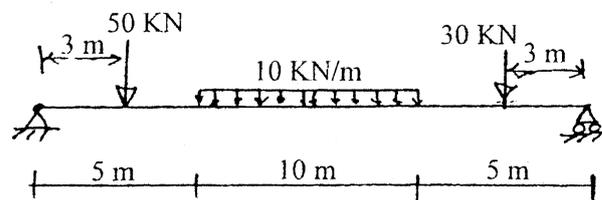

   b) Draw influence line diagram for forces in member FG and BC of the truss shown in figure below and determine maximum forces in these members when a single concentrated load 100 KN rolls over the span of the truss. [5]
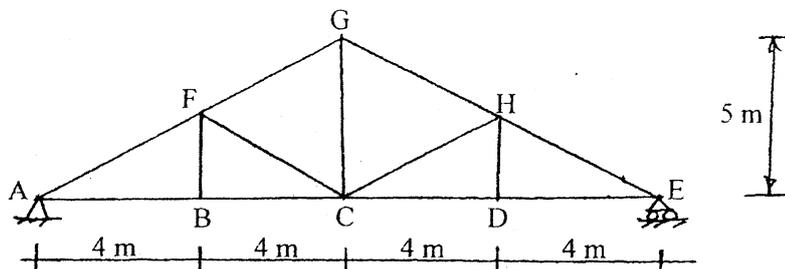
4. In the three hinged parabolic arch loaded as shown below, determine reactions at supports and also find bending moment, normal thrust and radial shear force at section D 15 m far from A. Draw influence line diagram for bending moment and normal thrust at that point and again determine the bending moment and normal thrust at D by using the ild.   [15]
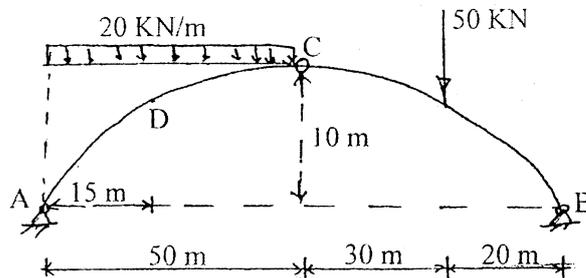
5. a) Determine the deflection at mid span of a simply supported beam subjected to uniformly distributed load w KN/m on the whole span by moment area.   [7]
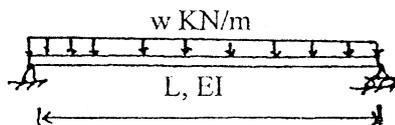
   b) Determine the vertical deflection and rotation at free end C of the overhanging beam ABC loaded as shown in figure below by using conjugate beam method.   [8]
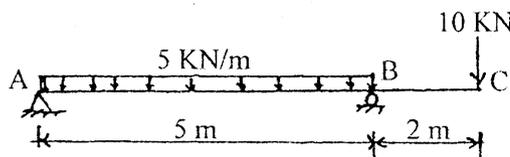
6. A cable is suspended and loaded as shown in figure. Calculate: [10]

   a) Length of cable
   b) Horizontal component of tension in cable
   c) Magnitude and position of maximum tension occurring in cable
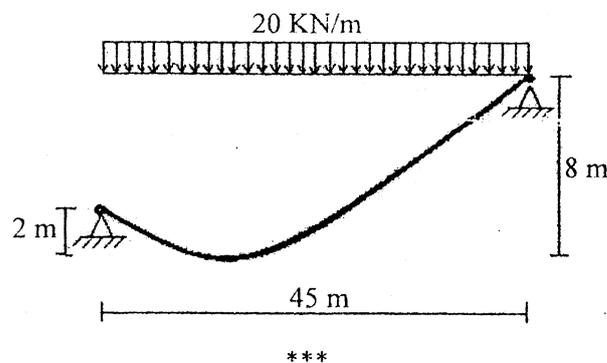
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Exam.	New Back (2066 & Later Batch)		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	II / II	Time	3 hrs.

Subject: - Theory of Structure *(CE551)*

✓ Candidates are required to give their answers in their own words as far as practicable.
✓ Attempt *All* questions.
✓ The figures in the margin indicate *Full Marks*.
✓ Assume suitable data if necessary.

1. a) Explain with an example, how would you use method of superposition in deforming deflections. Also, explain why it is necessary to determine deflections in the design of a structure. [4+2]

   b) Find slopes at supports and deflection at E of the beam given in figure below. Use conjugate beam method for deflection and slope calculations. [10]
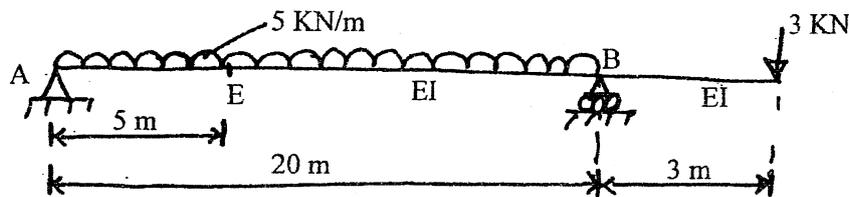
2. a) Define virtual work method and real work method with neat sketches. What are limitations of real work method? [6]

   b) Two plastics bars as shown in figure below are to absorb the same amount of energy delivered by the axial forces. Neglecting stress concentrations compare the stresses in two bars. [10]
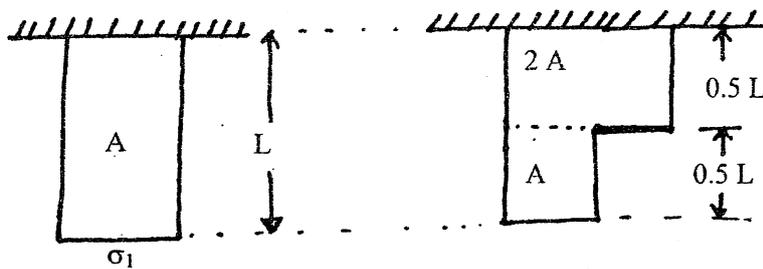
3. a) Use influence line diagram to determine most critical position of a stretch of uniform distribution load to give maximum bending moment at a given section of a simply supported beam. Assume the length of the uniform distributed load less than the span of the beam. [6]

   b) Determine R_A, R_B, S.F. at C and B.M at 'C' of the given structure as shown in figure below using influence line diagram concept. [10]
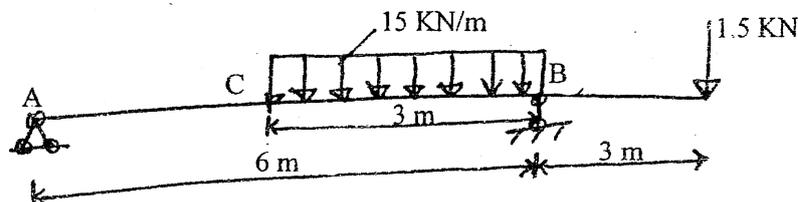
4. a) Determine B.M normal thrust, Radial shear at point D of circular arch as shown in figure below. Also draw bending moment diagram. [12]
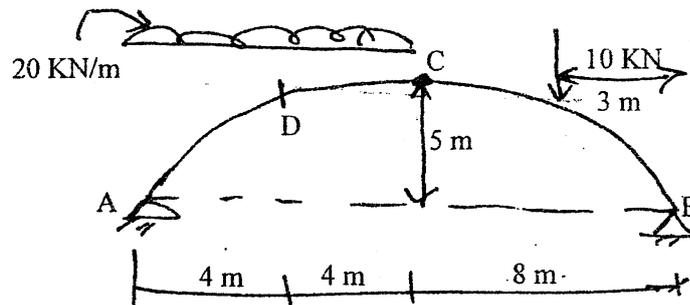
b) Explain different types of arches used in various Civil Engineering structures. [4]

5. a) Explain with a simple example the steps involved in determining displacement of a point in a structural system applying unit load method. [6]

   b) A cable is hanging from two points A and B, 80 m apart horizontally, left end A being lower than the right end by 10 m. It supports a uniform load of 1.5 KN/m along the horizontal span. Determine: [10]

   i) The position of the lowest point if it sag is 7.5 m
   ii) Length of the cable
   iii) Horizontal tension and tension at the two ends.

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| Exam.		Regular	
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	II / II	Time	3 hrs.

Subject: - Theory of Structure (CE551)

✓ Candidates are required to give their answers in their own words as far as practicable.
✓ Attempt **All** questions.
✓ The figures in the margin indicate **Full Marks**.
✓ Assume suitable data if necessary.

1. a) Explain two basic approaches of structural analysis. Also explain briefly the non-linearity in structural analysis. [3+3]

   b) A three-hinged symmetrical circular arch is of 12 m span and 4 m rise. Draw influence line diagram for bending moment, radial shear and normal thrust in the section at distance of 3 m from the left support. Use the diagrams to determine these internal forces in the section when the left half of the span is loaded with a uniformly distributed load of intensity 20 kNm^{-1} and a vertical concentrated load of magnitude 40 kN at a distance of 3 m from the right support. [10]

2. a) Write down the formula for determination of total strain energy due to axial force, bending moment, shear force and torsion in a structural system. Derive the expression for energy due to shear force in an element of a structural system. [6]

   b) Using conjugate beam method, calculate slopes at the supports and at the points beneath the loads for the given simply supported beam and also calculate the deflections of the points beneath the loads. Take EI = 3.36×10^{11} $kNmm^2$. [10]
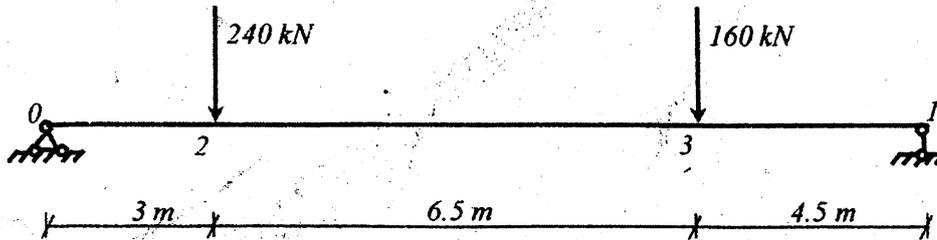
3. a) State and prove moment area theorems for determining deflections at any point of a beam. [6]

   b) Calculate the displacements in two orthogonal directions and also the slope at the free end of the given frame due to the temperature effect as shown. Take EI to be constant for the frame. [10]

4. a) Explain with necessary sketches the steps involved in determining bending moment, radial shear and normal thrust in a three hinged arch by graphical method. [6]

   b) Draw influence line diagram for the members LC, LK and LD when the load moves in the lower chord of the given truss as shown in figure. [10]
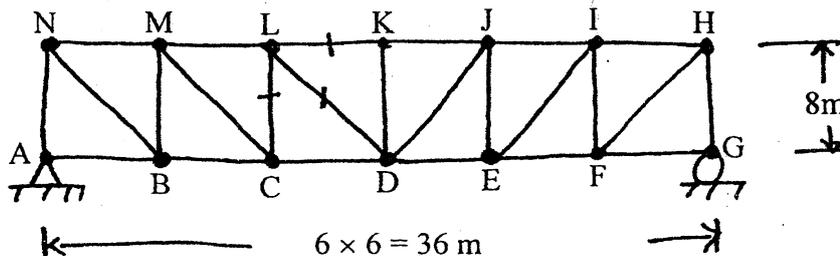
5. a) Explain with neat sketches tower structures as well as wind cables and ties. [6]

   b) Use influence line diagrams to determine reactions at the supports, bending moments and shear forces beneath the applied forces in the beam shown in Question No. 2(b). [10]

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| Exam.	New Back (2066 & Later Batch)		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	II / II	Time	3 hrs.

Subject: - Theory of Structures I *(CE551)*

✓ Candidates are required to give their answers in their own words as far as practicable.
✓ Attempt any **All** questions.
✓ The figures in the margin indicate **Full Marks**.
✓ Assume suitable data if necessary.

1. a) Differentiate between linear and non-linear behavior of structures and explain their uses in theory of structures. [6]

   b) A cable is supported at two points 20 m apart at the same level. It is used to support three equidistant loads, first load is 40 kN, second is 30kN and third is 20 kN. The central dip of the cable is 0.96 m. find the length of the cable required and its sectional area if the safe tensile stress is 250 kN/mm^2. Also give the geometry (shape and dip) of the cable when it is hanging only with its weight (without the given loads). [10]

2. a) Define and explain strain energy. Use strain energy method to show the deflection due to shear in an ordinary beam can be neglected in comparison to the deflection due to bending. Assume ratio of Young's modules to modules of rigidity to be 2.4 and shape factor for shear 1.2. [8]

   b) Determine, using virtual work method, the vertical deflection of joint L_2. The L/A values for diagonal and vertical members are 12 mm^{-1} and for horizontal members are 6 mm^{-1}. Take E = 200*10^3 N/mm^2 for all members. (i) Find vertical deflection due to loads as shown in figure (ii) Find the additional deflection if the top boom is subjected to a temperature rise of 20°C. Take the value of coeffic. of linear expansion $(\alpha) = 10.8*10^{-6}$/°C. [8]
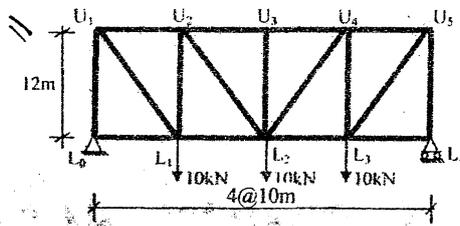
3. A horizontal girder of steel having uniform section 14 m long is simply supported at its end. It carries concentrated loads of 120 kN and 80 kN at two points 3 m and 4.5 m from the two ends supports respectively. Calculate the deflection and slopes of the girder at the point under the loads using moment area method. Take I = 16* 10^8 mm^4 and E = 210 kN/mm^2. Verify the results using conjugate beam method. Also find magnitude and location of the maximum deflection in the beam. [16]

4. A three hinged symmetrical parabolic arch has a span of 18 m and rise of 3 m. It carries a concentrated load of 80 kN at 4.5 m from the right support and a distributed load of 5 kN/m over half portion. Determine the moment, thrust and radial shear at each 3 m interval and draw their diagrams on horizontal 'X' axis for the arch. [16]

5. a) For the overhang beam determine the maximum positive and negative bending moment and shear force at D due to the three concentrated loads as shown in figure which moves in either directions. [8]

20 kN   25 kN   30 kN

|← 2 m →|← 3 m →|

C   A   D   B   E

|← 2 m →|← 3 m →|← 5 m →|← 2 m →|
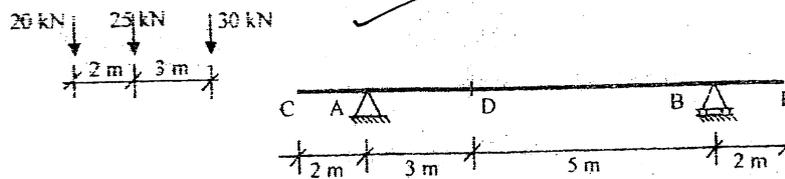
b) A suspension cable is suspended from two piers 200 m apart, left support being 5 m above the other. The cable carries a uniformly distributed load of 15 kN/m in plan and has its lowest point 10 m below the lower support. The ends of the cables are attached to saddles on rollers on top of piers and the backstays which may be assumed straight are inclined at 60° to the vertical. Determine: (i) The length of cable (ii) Maximum tension in cable and (iii) Maximum thrust and moment on pier. [8]

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Subject: - Theory of Structures I *(CE551)*

✓ Candidates are required to give their answers in their own words as far as practicable.
✓ *Attempt **All** questions.*
✓ *The figures in the margin indicate **Full Marks**.*
✓ *Assume suitable data if necessary.*

1. a) Define strain energy and complementary strain energy. Also derive relationship of strain energy due to bending. [6]

   b) Determine the vertical deflection of joint H. All the top chord members are subjected to temperature rise of 20°C and all vertical members are 10mm too long. Take $\alpha=12\times10^{-6}/°C$, $E=200KN/mm^2$. Cross sectional area of each member is $1500mm^2$. [10]

2. a) Describe the structures based on material used and methods of their analysis. [4]

   b) A suspension bridge of 120m span has two three hinged stiffening girder supported by two cables having a central dip of 12m. The road way has a width of 6m. The dead load on the bridge is $5KN/m^2$ while the live load is $10KN/m^2$ which act on the left half of span. Determine the shear force and bending moment in the girder at 30m from left end. Also find maximum tension in the cable for this position of live load. [12]

3. a) Explain difference between moment area method and conjugate beam method with suitable examples. [4]

   b) Using conjugate beam method, find slope and deflection at point (C) of following loaded beam: [12]

4. A three hinged parabolic arch has a span of 160m and a rise of 25m. A uniformly distributed load of intensity 30KN/m of length 60m rolls over the arch from left to the right. Using the influence line diagram, find the maximum bending moment at a section 50m from the right support. Also find normal thrust and radial shear at the section corresponding to the maximum bending moment. [16]

5. a) What is influence line diagram? Explain its uses and advantages in Civil Engineering field. [2+2]

   b) Using influence line diagram, obtain member force in AB, CD, EJ and FH for the following loaded pin-jointed truss as shown in figure below. [12]

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Subject: - Theory of Structures I (CE551)

✓ Candidates are required to give their answers in their own words as far as practicable.
✓ Attempt **All** questions.
✓ The figures in the margin indicate **Full Marks**.
✓ Assume suitable data if necessary.

1. a) Define strain energy and complementary strain energy. Also derive relationship of strain energy due to bending. [6]

   b) Determine the vertical deflection of joint H. All the top chord members are subjected to temperature rise of 20°C and all vertical members are 10mm too long. Take $\alpha=12\times10^{-6}/°C$, $E=200KN/mm^2$. Cross sectional area of each member is $1500mm^2$. [10]

2. a) Describe the structures based on material used and methods of their analysis. [4]

   b) A suspension bridge of 120m span has two three hinged stiffening girder supported by two cables having a central dip of 12m. The road way has a width of 6m. The dead load on the bridge is $5KN/m^2$ while the live load is $10KN/m^2$ which act on the left half of span. Determine the shear force and bending moment in the girder at 30m from left end. Also find maximum tension in the cable for this position of live load. [12]

3. a) Explain difference between moment area method and conjugate beam method with suitable examples. [4]

   b) Using conjugate beam method, find slope and deflection at point (C) of following loaded beam: [12]

J

4. A three hinged parabolic arch has a span of 160m and a rise of 25m. A uniformly distributed load of intensity 30KN/m of length 60m rolls over the arch from left to the right. Using the influence line diagram, find the maximum bending moment at a section 50m from the right support. Also find normal thrust and radial shear at the section corresponding to the maximum bending moment. [16]

5. a) What is influence line diagram? Explain its uses and advantages in Civil Engineering field. [2+2]

   b) Using influence line diagram, obtain member force in AB, CD, EJ and FH for the following loaded pin-jointed truss as shown in figure below. [12]

***

Subject: - Theory of Structure

✓ Candidates are required to give their answers in their own words as far as practicable.
✓ Attempt any **Five** questions.
✓ The figures in the margin indicate **Full Marks**.
✓ Assume suitable data if necessary.

1. a) Determine the vertical deflection of joint E of the truss due to (i) loading shown (ii) members CE and DE being 8mm too long and (iii) temperature of member CD alone is decreased by 15°C. Given: Cross-sectional area of all members = 1000mm², young' modulus = $2 \times 10^5 N/mm^2$, and coefficient of thermal expansion = $12 \times 10^{-6}/°C$. [12]

   b) Explain the use of computer based methods in structural analysis. [4]

2. a) For a beam having a rectangular cross-section and subjected to lateral loads, derive an expression for the strain energy due to shear deformation only. [8]

   b) The bottom of the beam shown below is subjected to a temperature of 200°C, while the temperature of its top is 50°C. If the coefficient of linear expansion $\alpha = 12 \times 10^{-6}/°C$, determine the vertical displacement of its free end B due to temperature gradient. The beam has a rectangular cross-section with a depth of 30cm. [8]

3. a) Explain moment area theorem with suitable example. [4]

   b) Using conjugate beam method, calculate slope and deflection at point C, free end of the beam, loaded as shown below. EI is constant. [12]

4. a) Draw the influence lines for bending moment and shear force at a section 10m from the left support of a simply supported beam of 25m span. [8]

b) Draw influence line diagrams for the forces in members AB, BC and BG of the truss. The load moves in the lower chord of the truss. [8]

4 @ 15m = 60m

5. A three hinged circular arch has a span of 120m and a rise of 15m. Two point loads of 8 KN and 12KN, spaced 10m apart, roll over the arch from left to right with 8KN load leading. Using the influence line diagram, find the maximum bending moments at a section 30m from the left support. Also find normal thrust and radial shear at the same section corresponding to the maximum bending moment. [16]

6. A suspension bridge, 400m span, has two three-hinged stiffening girders supported by two cables with a central dip of 30m. The dead load of the bridge is 30 KN/m. run and in addition, it supports three point loads of 300KN each placed along the centre line of the roadway and dividing the span in four equal parts. Calculate the maximum tension and minimum tension with their locations in the cable and the length of the cable. [16]

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Exam.		Regular	
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	II / II	Time	3 hrs.

## Subject: - Theory of Structure

✓ Candidates are required to give their answers in their own words as far as practicable.
✓ Attempt any _Five_ questions.
✓ The figures in the margin indicate _Full Marks_.
✓ Assume suitable data if necessary.

1. a) Determine the vertical deflection of joint E of the truss due to (i) loading shown (ii) members CE and DE being 8mm too long and (iii) temperature of member CD alone is decreased by 15°C. Given: Cross-sectional area of all members = 1000mm², young' modulus = 2×10^5 N/mm², and coefficient of thermal expansion = 12×10^{-6}/°C.   [12]

   b) Explain the use of computer based methods in structural analysis.   [4]

2. a) For a beam having a rectangular cross-section and subjected to lateral loads, derive an expression for the strain energy due to shear deformation only.   [8]

   b) The bottom of the beam shown below is subjected to a temperature of 200°C, while the temperature of its top is 50°C. If the coefficient of linear expansion $\alpha = 12 \times 10^{-6}$/°C, determine the vertical displacement of its free end B due to temperature gradient. The beam has a rectangular cross-section with a depth of 30cm.   [8]

3. a) Explain moment area theorem with suitable example.   [4]

   b) Using conjugate beam method, calculate slope and deflection at point C, free end of the beam, loaded as shown below. EI is constant.   [12]

4. a) Draw the influence lines for bending moment and shear force at a section 10m from the left support of a simply supported beam of 25m span. [8]

b) Draw influence line diagrams for the forces in members AB, BC and BG of the truss. The load moves in the lower chord of the truss. [8]

4 @ 15m = 60m

5. A three hinged circular arch has a span of 120m and a rise of 15m. Two point loads of 8 KN and 12KN, spaced 10m apart, roll over the arch from left to right with 8KN load leading. Using the influence line diagram, find the maximum bending moments at a section 30m from the left support. Also find normal thrust and radial shear at the same section corresponding to the maximum bending moment. [16]

6. A suspension bridge, 400m span, has two three-hinged stiffening girders supported by two cables with a central dip of 30m. The dead load of the bridge is 30 KN/m. run and in addition, it supports three point loads of 300KN each placed along the centre line of the roadway and dividing the span in four equal parts. Calculate the maximum tension and minimum tension with their locations in the cable and the length of the cable. [16]

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| Exam.		Back	
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	II / II	Time	3 hrs.

Subject: - Theory of Structure I

✓ Candidates are required to give their answers in their own words as far as practicable.
✓ Attempt any *Five* questions.
✓ The figures in the margin indicate *Full Marks*.
✓ Assume suitable data if necessary.
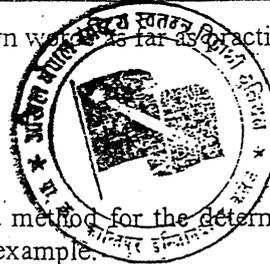
1. a) Enunciate the two theorems from the moment area method for the determination of displacements of beam and explain it with a simple example. [6]

   b) A three-hinged symmetrical circular arch is of 12m span and 4m rise. Draw influence line diagram for bending moment, radial shear and normal thrust in the section at distance of 3m from the left support. Use the diagrams to determine these internal forces in the section when the left half of the span is loaded with a uniform distributed load of intensity 20 kNm^{-1} and a vertical concentrated load of magnitude 40 kN at a distance of 3m from the right support. [10]

2. a) Write down the formula for determination of total strain energy due to axial force, bending moment, shear force and torsion in a structural system. Derive the expression for energy due to shear force in an element of a structural system. [6]

   b) Using conjugate beam method, calculate slopes at the supports and at the points beneath the loads for the given simply supported beam and also calculate the deflections of the points beneath the loads. Take EI = 3.36×10^{11} kNmm^2. [10]
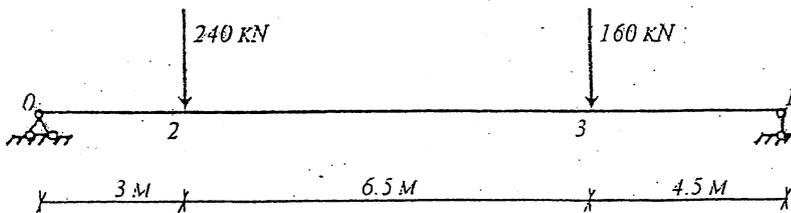
3. a) Explain with necessary sketches the steps involved in determining bending moment, radial shear and normal thrust in a three hinged arch by graphical method. [6]

   b) Calculate the displacements in two orthogonal directions and also the slope at the free end of the given frame due to the temperature effect as shown. Take EI to be constant for the frame. [10]
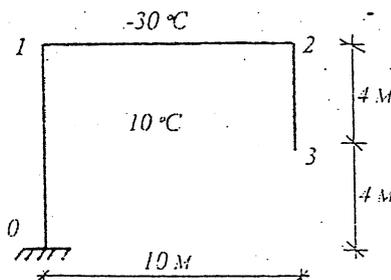
4. a) Use influence line diagram to determine most critical position of a stretch of uniformly distributed load to give maximum bending moment at a given section of a simply supported beam. Assume the length of the uniformly distributed load less than the span of the beam. [6]

b) Use strain energy method for the given frame to calculate the vertical displacement of the point with load 500 kN. The frame is made of steel rod Φ100mm. Take $E = 2\times10^5 N/mm^2$. [10]
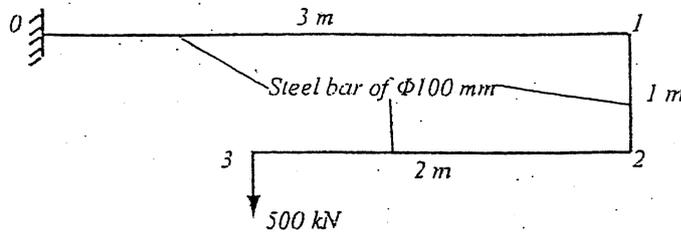
5. a) Determine the geometry of the shape and calculate the length required for a high tension line between any two towers. Take the span between the two towers and the weight per unit length of the cable to be ℓ and γ respectively. [6]

b) Use influence line diagrams to determine reactions at the supports, bending moments and shear forces beneath the applied forces in the beam shown in Question No. 2(b). [10]

6. a) Explain with a simple example the steps involved in determining the displacement of a point in a structural system applying unit load method. - [6]

b) A symmetrical suspension bridge with a three hinged stiffening girder of span 120m and having a central dip of 12m is loaded with two point loads of magnitude 240 kN and 300 kN at a distance 25m and 80m respectively from the left end. Draw bending moment diagram for the girder and also calculate bending moments at the distances 25m, 40m and 80m from the left support. [10]

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INSTITUTE OF ENGINEERING

Examination Control Division

2065 Chaitra

| Exam.		Regular/Back	
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	II / II	Time	3 hrs.

Subject: - Theory of Structures I

✓ Candidates are required to give their answers in their own words as far as practicable.
✓ Attempt any **Five** questions.
✓ The figures in the margin indicate **Full Marks**.
✓ Assume suitable data if necessary.

1. a) Determine the vertical deflection of point C of the frame shown in fig-1. [8]
   $E = 200$ KN/mm^2 $I = 30 \times 10^6$ mm^4

Fig-1
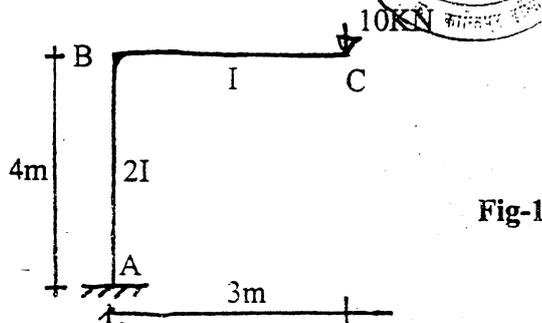
   b) Calculate the vertical deflection of free end D of the beam loaded as shown in fig-2 by using virtual work method. Take EI as constant through out. [8]

Fig-2
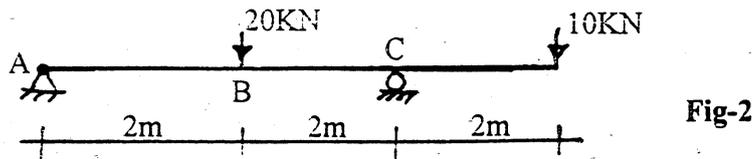
2. a) Determine the slope at A and B and deflection at D of the beam loaded as shown in fig-3 using moment area method. Take EI as constant. [8]

Fig-3
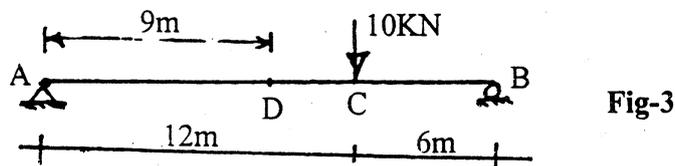
   b) Determine the rotation at A and deflection at C in the overhanging beam shown in fig-4 by using conjugate beam method. [8]

Fig-4
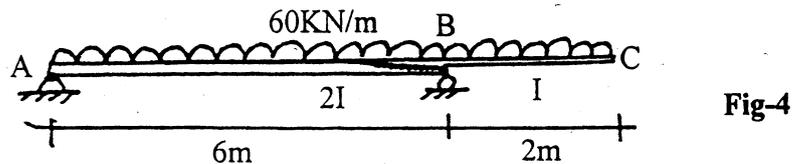
3. a) Find the maximum bending moment at C for the beam and loading as shown in fig-5. [8]

Fig-5
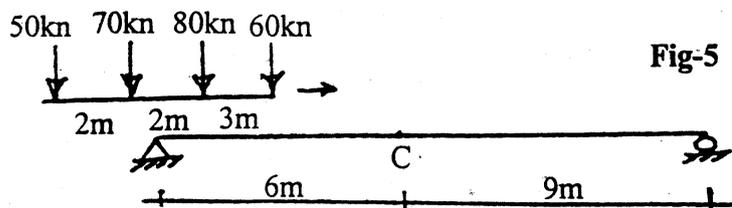
b) Draw influence line diagram for bending moment at F (5m right of A) and for the stress in the support BD of the structure shown in fig-6. [8]
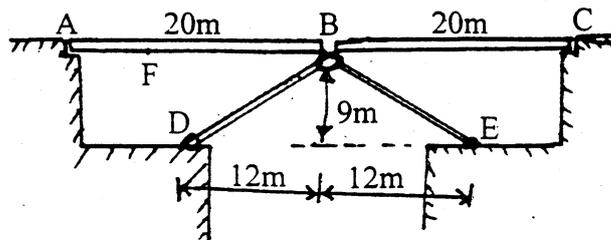
Fig-6

4. a) Draw influence line diagram and calculate the bending moment at mid span C for the beam shown in fig-7. [8]
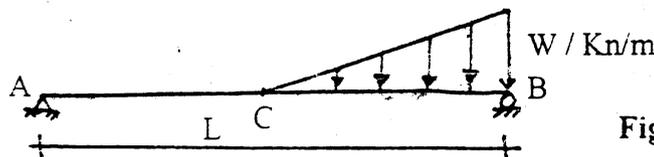
Fig-7

b) Draw influence line diagram for members U3L3 and L3L4 of the truss shown in fig-8. [8]

Fig-8

6 @ 4m = 24m
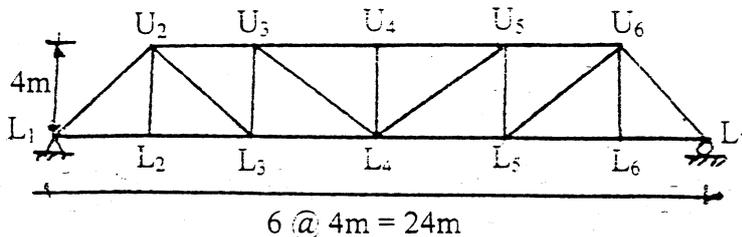
5. A three hinged parabolic arch as shown in fig-9 is loaded with udl 2 KN/m on the left 8m length. Calculate [16]

a) Direction and magnitude of reaction at supports.
b) The bending moment, normal thrust and radial shear at 4m from left end.
c) Draw bending moment diagram showing maximum positive and negative values.
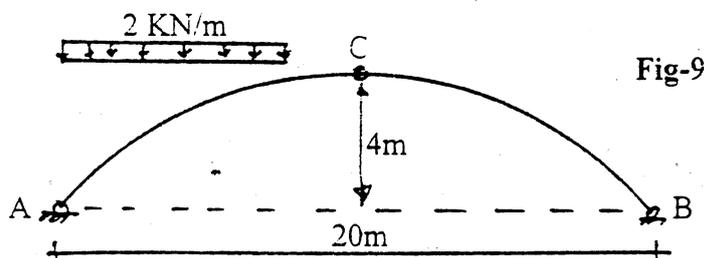
Fig-9

6. a) A suspension cable of span L has its ends at the height h_1 and h_2 above the lowest point of cable. It carries a uniformly distributed load of w per unit run of the span. Show that the horizontal reaction at each end is given by $H = \dfrac{WL^2}{2(\sqrt{h_1} + \sqrt{h_2})^2}$. [8]

b) A cable is stretched over a gap of 300m and carries uniformly distributed load of 300 kg/m horizontally. If the central dip is 1.5m. Calculate the maximum tension in the cable. Also find the length of cable. [8]

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04   TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2072 Ashwin

Exam.		Regular	
Level	BE	Full Marks	80
Programme	BCE, BME, BIE	Pass Marks	32
Year / Part	II / II	Time	3 hrs.

Subject: - Probability and Statistics *(SH552)*

✓ Candidates are required to give their answers in their own words as far as practicable.
✓ *Attempt __All__ questions.*
✓ *The figures in the margin indicate __Full Marks__.*
✓ __*Necessary tables are attached herewith.*__
✓ *Assume suitable data if necessary.*

1. Mention and discuss the significance of statistics in engineering. In a moderately asymmetrical distribution the value of mean and median are 20 and 24 respectively. Find the value of mode. [3+3]

2. Define conditional probability. A manufacturing firm produces steel pipes in three plants with daily production volumes of 500, 1000 and 2000 units respectively. According to experience, it is known that the fractions of defective output produced by the three plants are respectively 0.005, 0.008, 0.010. If a pipe is selected from a day's total production and found to be defective, find out the probability that the pipe might have come from plant II and III. [6]

3. What are the characteristics of Hypergeometric probability Distribution? How does it differ from Binomial probability distribution? [3+2]

4. It is found that a Cricketer hit a century in a game is 25%. He declared that he will retire from cricket after 6th century from now. By using Negative Binomial distribution find the probability that [5]

   i)   He will lose none of the game
   ii) He will lose only game
   iii) He will lose exactly two games
   iv) He will lose at least two games.

5. Define standard normal distribution and write the condition for normal approximation to the Binomial and Poisson probability distribution. [5]

OR

If the probability density function of a random variable is given by

$$f(x) = kx^3, 0 \le x \le 1$$
$$= 0, \quad \text{otherwise}$$

Find:

i)   The value of k
ii) P(X>2/3)
iii) P(1/4<X<3/4) and mean of distribution

6. Incomes of a group of 10,000 persons were found to be normally distributed with mean Rs. 1,520 and s.d Rs 160. Find the number of persons whose incomes will be [5]

   i)   Between Rs.1400 and Rs.1520
   ii) More than Rs. 1600
   iii) Lowest income of richest 1000 persons

7. What do you mean by Sampling Distribution of a Statistical and Standard Error? [5]

8. From a population of 5 members 3, 6, 9, 12, 15 draw all possible random sample of size 3 without replacement. Obtain the sampling distribution of sample mean and calculate expectation of sample mean. [5]

9. Define partial and multiple correlations with examples. Write down the properties of partial and multiple correlation. [5]

10. The following data gives the experience of machine operators in years and their performance as given by the number of good parts turned out per 100 pieces. [5]

Experience (X)	16	12	18	4	3	10	5	12
Performance (Y)	87	88	89	68	78	80	75	83

i) Fit the regression equation of performance ratings on experience and estimate the probable performance if an operator has 8 years experience.

ii) Calculate 95% confidence interval for the regression coefficient (i.e., slope)

OR

A household survey on monthly expenditure on food yield following data:

Monthly expenditure(100 Rs.)	10	15	20	25	30	35	40
Monthly income(1000 RS.)	2	4	5	7	6	6	5
Size of the family	4	5	7	10	8	11	4

i) Obtain the multiple correlation coefficient

ii) Find coefficient of multiple determination and interpret it.

11. Differentiate between (a) confidence level and significance level (b) Type I and type II errors of hypothesis testing. [5]

OR

Describe the procedure of testing of hypothesis for single men for large sample.

12. The following table represents the sales of three salesmen in four different districts: [5]

Districts	Sales figure		
A	14	20	16
B	12	23	15
C	10	20	10
D	8	18	12

Perform an Analysis of Variance to test whether there is any significant difference in the sales of different district at the 0.05 level of significance.

13. A study shows that 16 of 200 tractors produced on one assembly line required extensive adjustment before they could be shipped, while the same was true for 14 of 400 tractors produced on another assembly line. At the 0.05 level of significance, does this support the claim that the second production line does superior work? [5]

14. To determine whether there is really relationship between an employee's performance in the training program and his ultimate success in the job, it takes a sample of 400 cases from its very extensive files and obtains the result shown in the following table: [5]

Performance in training program

		Below average	Average	Above average
	Poor	23	60	29
Success in job	Average	28	79	60
	Very good	9	49	63

Use the 0.05 level of significance to test whether performance in training program and success in the job are independent.

15. A study was done on a diesel powered light duty pickup truck to see if humidity influence emission of nitrous oxide. Emission measurements were taken at different times, with varying experimental conditions. The data are as follows: [8]

Nitrous oxide	Humidity
0.90	72.4
0.91	41.6
0.96	34.3
0.89	35.1
1.00	10.7
1.10	12.9
1.15	8.3
1.03	20.1
0.77	72.2
1.07	24.0
1.07	23.2
0.94	47.4
1.10	31.5
1.10	10.6
1.10	11.2
0.91	73.3
0.87	75.4
0.78	96.6
0.82	107.4
0.95	54.9

a) Find the mean and variance of given data.
b) Calculate degree of relationship between them
b) Calculate coefficient of determination and interpret the given data.

***

TABLE A-4	Chi-Square (χ^2) Distribution

Degrees of Freedom	Area to the Right of the Critical Value									
	0.995	0.99	0.975	0.95	0.90	0.10	0.05	0.025	0.01	0.005
1	—	—	0.001	0.004	0.016	2.706	3.841	5.024	6.635	7.879
3	0.072	0.115	0.216	0.352	0.584	6.251	7.815	9.348	11.345	12.838
5	0.412	0.554	0.831	1.145	1.610	9.236	11.071	12.833	15.086	16.750
7	0.989	1.239	1.690	2.167	2.833	12.017	14.067	16.013	18.475	20.278
9	1.735	2.088	2.700	3.325	4.168	14.684	16.919	19.023	21.666	23.589
11	2.603	3.053	3.816	4.575	5.578	17.275	19.675	21.920	24.725	26.757
13	3.565	4.107	5.009	5.892	7.042	19.812	22.362	24.736	27.688	29.819
15	4.601	5.229	6.262	7.261	8.547	22.307	24.996	27.488	30.578	32.801
17	5.697	6.408	7.564	8.672	10.085	24.769	27.587	30.191	33.409	35.718
19	6.844	7.633	8.907	10.117	11.651	27.204	30.144	32.852	36.191	38.582
21	8.034	8.897	10.283	11.591	13.240	29.615	32.671	35.479	38.932	41.401
23	9.260	10.196	11.689	13.091	14.848	32.007	35.172	38.076	41.638	44.181
25	10.520	11.524	13.120	14.611	16.473	34.382	37.652	40.646	44.314	46.928
27	11.808	12.879	14.573	16.151	18.114	36.741	40.113	43.194	46.963	49.645
29	13.121	14.257	16.047	17.708	19.768	39.087	42.557	45.722	49.588	52.336
40	20.707	22.164	24.433	26.509	29.051	51.805	55.758	59.342	63.691	66.766
60	35.534	37.485	40.482	43.188	46.459	74.397	79.082	83.298	88.379	91.952
80	51.172	53.540	57.153	60.391	64.278	96.578	101.879	106.629	112.329	116.321
100	67.328	70.065	74.222	77.929	82.358	118.498	124.342	129.561	135.807	140.169

Degrees of Freedom

$n - 1$	for confidence intervals or hypothesis tests with a standard deviation or variance
$k - 1$	for multinomial experiments or goodness-of-fit with k categories
$(r - 1)(c - 1)$	for contingency tables with r rows and c columns
$k - 1$	for Kruskal-Wallis test with k samples

Exam.	New Back (2066 & Later Batch)		
Level	BE	Full Marks	80
Programme	BCE, BME, BIE	Pass Marks	32
Year / Part	II / II	Time	3 hrs.

04   TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2072 Magh

Subject: - Probability and Statistics (SH552)

✓ Candidates are required to give their answers in their own words as far as practicable.
✓ Attempt **All** questions. -
✓ The figures in the margin indicate **Full Marks**.
✓ **Necessary tables are attached herewith.**
✓ Assume suitable data if necessary.

1. What are the chief measures of central tendency and measures of dispersion? The mean weight of 100 students in a certain class is 59 kg. The mean weight of boys in the class is 65 kg and that of girls is 50 kg. Find the number of boys and girls in the class.   [2+4]

2. A box containing 5000 IC chips, of which 1000 are manufactured by company A and the rest by company B. Ten percentage of chips made by company A and five percentage of the chips by company B are defective. If we select a chip at a random   [6]

   i) What is the probability that the chips chosen is defective?
   ii) if a randomly chosen chip are found to be defective, what is the probability that it comes from company A

3. Define hypergeometric probability distribution with an example. Describe the conditions for the binomial approximation to hypergeometric distribution?   [2+3]

4. In a certain factory turning out optical lenses, there is a small chance, 1/500 for any lens to be defective. The lenses are supplied in packets of 10 each. What is the probability that a packet will contain   [5]

   i) No defective lens
   ii) At least one defective lenses
   iii) At most two defective lenses

OR

   Define mathematical expectation of a discrete random variable. A probability distribution is given

X = x	0	1	2	3	4	5
P(X=x)	0.26	0.25	0.11	0.02	0.25	0.11

   Find (a) $P(X \geq 4)$; (b) $P(0 < X < 4)$; (c) $P(X = 4 \cap X = 5)$; (d) $F(3)$

5. Define Gamma Distribution and write the chief characteristics of it.   [5]

6. In a photo graphic process, the developing time of prints may be looked upon as a random variable having the normal distribution with a mean of 16.28 second and a standard deviation of 0.12 second. Find the probability that it will take   [5]

   i) Anywhere from 16.00 to 16.50 seconds to develop one of the prints
   ii) At least 16.20 seconds to develop one of the prints
   iii) At most 16.35 seconds to develop one of the prints

OR

The distribution of amount of the gravel (in ton) sold by a particular construction supply company in a given week is continuous random variable X with the probability density function.

$$f(x) = \begin{cases} \left(\dfrac{3}{2}\right)(x^2 + 1) & \text{for } 0 \le x \le 1 \\ 0 & \text{otherwise} \end{cases}$$

   a) Find the cumulative distribution function of sales
   b) What is the expected value and variance of sales

7. Define sampling distribution of proportion with suitable example.   [5]

8. A population consists of the four numbers 2, 3, 4, 5   [5]

   i) Write down all possible sample size of two without replacement
   ii) verify that the population mean is equal to the mean of the sample mean
   iii) Calculate the standard error of the sampling distribution of the sample mean

9. As part of an industrial training program, some trainees are instructed by Method A, which is straight teaching-machine instruction, and some are instructed by Method B, which also involves the personal attention of an instructor. If random sample of size 10 are taken from large group of trainees instructed by each of these two methods and the scores which they obtained in an appropriate achievement test are   [5]

Method A	71	75	65	69	73	66	68	71	74	68
Method B	72	77	84	78	69	70	77	73	65	75

Use the 0.05 level of significance to test the claim that method B is more effective.

10. Hotel's manager in Kathmandu wants to know the hotels average daily registration. The following table presents the numbers of guest registered each of 27 randomly selected days. Calculate the sample mean standard errors of mean and 95% confidence limits of population mean.   [5]

61	57	53	60	64	57	54	58	63
61	50	59	50	60	57	58	62	63
60	54	54	61	51	53	62	57	60

OR

Shyam and Co. produces three varieties of products: deluxe, fine and ordinary. A recent market survey is conducted for preference of products. The preference was found as follow:

Product	Production			
Deluxe	15	14	19	18
Fine	17	12	20	16
Ordinary	16	18	16	17

Is there a significant difference in the preference of products using ANOVA test. Use $\alpha = 5\%$

Exam.	OLD Back (2065 & Earlier Batch)		
Level	BE	Full Marks	80
Programme	BCE, BME	Pass Marks	32
Year / Part	II / II	Time	3 hrs.

Subject: - Probability and Statistics *(EG571SH)*

✓ Candidates are required to give their answers in their own words as far as practicable.
✓ Attempt any *Seven* questions selecting *Four from Group A* and *Three from Group B*.
✓ *Necessary tables are attached herewith.*
✓ The figures in the margin indicate *Full Marks*.
✓ Assume suitable data if necessary.

Group A

1. a) Write the differences between diagram and graph. Write the importances of diagrammatic presentation of data . [6]

    b) Following is the distribution of monthly wages of employees of two factories. Which factory pays more money to the employees and in which factory the monthly wages is more consistent? [5]

Wages (Rs.)	200-400	400-600	600-800	800-1000	1000-1200	1200-1400	1400-1600
Factory A	4	8	11	6	5	3	3
Factory B	7	12	9	4	4	3	1

2. a) Define the terms:(i) Exhaustive event (ii) Favorable event (iii) Mutually exclusive events (iv) Equally likely events and (v) Independent events [6]

    b) Two third of the students in a class are boys and rest are girls. It is known that the probability of a girl getting first division mark is 0.25 and that of boy getting first division mark is 0.28. Find the probability that a student chosen at random will get first division mark ? [5]

3. a) Differentiate between discrete random variable and continuous random variable with examples. [5]

    b) In a gambling, a man is paid Rs.5 if he gets all heads or all tails when three coins are tossed and he pays out Rs.3 if either one or two of head shows, what is his expected gain? [6]

4. a) What are the differences and similarities between binomial. distribution and negative binomial distribution? [6]

    b) Assuming the probability of a male birth is ½, find in how many of 160 families with 4 children each would you expect to have [5]
    I.   at least one boy
    II.   at least one boy and one girl

5. a) Define normal distribution? Also state its important properties.   [6]

    b) The breakdown voltage X of a randomly chosen diode of a particular type is known   [5]
    to be normally distributed with $\mu = 40$ volts and $\sigma = 1.5$ volts
      (i) What is the probability that the break down voltage will be between 39 and 42
           volts
      (ii) What is the probability that the break down voltage will be between 40 and 43
           volts

6. a) Define joint probability mass function and marginal probability mass function.   [6]

    b) The Joint probability distribution of the number X of car and the number Y of buses
    per signal cycle of a proposed left turn lane in displayed in the accompanying joint   [5]
    probability table:

p(x,y)		y		
		0	1	2
x	0	0.025	0.015	0.01
	1	0.05	0.03	0.02
	2	0.125	0.075	0.05
	3	0.15	0.09	0.06
	4	0.1	0.06	0.04
	5	0.05	0.03	0.02

      (i)   What is the probability that there is exactly one car and exactly one bus during a
            cycle?
      (ii) What is the probability that there is at most one car and at most one bus during a
            cycle?
      (iii) What is the probability that there is exactly one car during a cycle?

Group B

7. a) What are the estimator and estimates? Describe the criteria for a good estimator.   [6]

    b) A quality control manager needs to estimate the average hours of life of light bulbs.
    The population standard deviation is known to be 100 hours. A random sample of 64   [6]
    light bulbs indicated a sample average life of 350 hours. Set up 95% and 99%
    confidence interval of true average life of bulbs.

8. a) Describe the types of error that arises in testing of hypothesis. Describe the test [6]
    procedure of test of significance of mean for large sample.

    b) The sample average unrestrained compressive strength for 45 specimens of [6]
    particular type of bricks was computed to be 3107 psi and sample standard deviation
    was 188 psi. The distribution of unrestrained compressive strength may be somewhat
    sewed. Does the data strongly indicate that the true average unrestrained compressive
    strength is less than design value of 3200? Test using 1% level of significance.

Exam.	Regular / Back		
Level	BE	Full Marks	80
Programme	BCE, BME, BIE	Pass Marks	32
Year / Part	II / II	Time	3 hrs.

Subject: - Probability and Statistics *(SH552)*

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✓ Attempt __All__ questions.
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1. What are the differences between measures of central tendency and measures of dispersion? The mean and standard deviation of 20 items is found to be 10 and 2 respectively. At the time of checking it was found that one item 8 was incorrect. Calculate the mean and standard deviation if : (a) the wrong item is omitted (b) it is replaced by 12. [2+4]

2. Differentiate between equally likely events and mutually exclusive events with suitable example. A consulting firm rents cars from three agencies, 20% from agency D, 20% from agency E, and 60% from agency F. If 10% of the cars from D, 12% of the cars from E, and 4% of the cars from F have bad tires, what is the probability that the firm will get a car with bad tires? [6]

3. Define Negative Binomial Distribution. Write the conditions for Negative Binomial Distribution. [2+3]

4. A shipment of 20 digital voice recorders contains 5 that are defective. If 10 of them are randomly chosen for inspection, what is the probability that 2 of the 10 will be defective? Also, find the mean and variance of the distribution. [5]

5. Define Standard Normal Distribution. Write the normal approximation to the (a) Binomial Distribution and (b) Poission Distribution. [4]

OR

A college professor never finishes his lecture before the bell rings to end the period, and always finishes his lectures within one minute after the bell rings. Let X = the time which elapses between the bell and the end of the lecture. Suppose that the p.d.f. of X is [4]

$f(x) = kx^2, 0 \le x \le 1$

$= 0$, otherwise

a) Find the value of k
b) What is the probability that the lecture ends within ½ minute of the bell ringing?
c) What is the probability that the lecture continues beyond the bell for between 15 and 30 seconds?
d) What is the probability that the lecture continuous for at least 40 seconds beyond the bell?

6. Suppose that the pH of soil samples taken from a certain geographic region is normally distributed with mean pH 6.00 and standard deviation 0.10. If the pH of a randomly selected soil sample from this region is determined: [6]

a) What is the probability that the resulting pH is between 5.90 and 6.15?
b) What is the probability that the resulting pH exceeds 6.10?
c) What is the probability that the resulting pH is at most 5.95?

7. What is sampling distribution? Construct frequency distribution table of sample mean in population 2, 4, 6, 8, 10 with sample size two. Also prove that sample mean is unbiased estimate of population mean. [4]

8. Define Central Limit Theorem. An auditor for a large credit card company, knows that, on average, the monthly balance of any given customer is \$112, and the standard deviation is \$56. If the auditor audits 50 randomly selected accounts, what is the probability that the sample average monthly balance is (a) below \$100 (b) between \$100 and \$130? [2+4]

9. An article in the Tappi Journal (March, 1986) presented data on green liquor Na_2S concentration (in grams per liter) and paper machine production (in tons per day). The data (read from a graph) are shown as follows: [6]

y	40	42	49	46	44	48	46
x	825	830	890	895	890	910	915
y	43	53	52	54	57	58	
x	960	990	1010	1030	1030	1050	

a) Fit a simple linear regression model with y = green liquor Na_2S concentration and x = production.
b) Find the fitted value of y corresponding to x = 910 tons.

OR

The following show the improvement (gain in reading speed) of eight students in a speed-reading program, and the number of weeks they have been in program.

No. of weeks	3	5	2	8	6	9	3	4
Speed gain (word/minute)	86	118	49	193	164	232	73	109

Estimate the parameters of a simple linear regression model with No. of weeks as independent variable.

10. Define the correlation coefficient and mention its important properties. What does the coefficient of determination measure? [4]

11. Describe the procedure of the test of significance of two means for small sample. [4]

12. As part of the investigation of the collapse of the roof of a building, a testing laboratory is given all the available bolts that connected the steel structure at three different positions on the roof. The forces required to shear each of these bolts (coded values) are as follows: [6]

Position 1	90	82	79	98	83	91	-
Position 2	105	89	93	104	89	95	86
Position 3	83	89	80	94	-	-	-

Perform an Analysis of Variance to test at the 0.05 level of significance whether the differences among the sample means at the three positions are significant.

13. Define point estimate. Write down the properties of good estimator with examples. [5]

14. In 40 tosses of a coin, 24 heads were obtained. Find 95% and 99% confidence limit for proportion of heads. [5]

15. The following table shows the number of hours 45 hospital patients slept following the administration of a certain anesthetic. [8]

7	10	12	4	8	7	3	8	5
12	11	3	8	1	1	13	10	4
4	5	5	8	7	7	3	2	3
8	13	1	7	17	3	4	5	5
3	1	17	10	4	7	7	11	8

a) Find sample mean, sample variance and sample standard deviation.
b) Compute a value that measures the amount of variability relative to the value of mean.

***

Subject: - Probability and Statistics *(SH552)*

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12	11	3	8	1	1	13	10	4
4	5	5	8	7	7	3	2	3
8	13	1	7	17	3	4	5	5
3	1	17	10	4	7	7	11	8

a) Find sample mean, sample variance and sample standard deviation.

b) Compute a value that measures the amount of variability relative to the value of mean.

***

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Subject: - Probability and Statistics *(SH552)*

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✓ *Assume suitable data if necessary.*

1. What are the chief measures of central tendency? Also describe the techniques to measure the consistency. [6]

2. Five coins are tossed 320 times. If coins are unbiased construct the probability distribution table of the result. Also find mean and variance of the given probability distribution. [6]

3. Define binomial probability distribution with its important characteristics. [5]

4. It has been claimed that in 60% of all solar-heat installations the utility bill will be reduced by at least one-third. Accordingly what are the probabilities that the utility bill will be reduced by at least one third in (a) four of five installations (b) at least four of five installations? [5]

5. Define continuous random variable and probability density function. The probability density function of a random variable is $f(x) = \frac{3}{4}x \quad 0 \le x \le 2$ $= 0 \quad \text{otherwise}$. Find mean and variance of the variable x. [4]

6. The time for a super glue to set can be treated as a random variable having a normal distribution with mean 30 seconds. Find its standard deviation if the probability is 0.20 that it will take on a value greater than 39.2 seconds. [6]

OR

The daily consumption of water in a certain place follow a gamma-distribution with parameters $\alpha = 2$ and $\beta = 3$. If the daily capacity of this city is 9 million gallon of water, what is the probability that on any given day the water supply is inadequate?

7. Define sampling distribution. Write the difference between population and sample. A population consists of 3, 7, 11, 15. Consider all possible samples of size two which can be drawn without replacement from this population. Find population mean and population standard deviation [4]

8. State central limit theorem. If a 1-gallon can of paint covers on the average 513.3 sq.ft. with a standard deviation of 31.5 sq.ft., what is the probability that the sample mean area covered by a sample of 40 of these 1-gallon cans be anywhere from 510 to 520 sq.ft.? [6]

9. Define Pearsonian's correlation coefficient. Write down two differences between correlation and regression coefficient. [4]

10. The following are the measurements of the air velocity and evaporation coefficient of burning fuel droplets in an impulse engine. [6]

Air velocity cm/sec (x)	20	60	100	140	180	220	260	300	340	380
Evaporation coefficient mm²/sec (y)	0.18	0.37	0.35	0.78	0.56	0.75	1.18	1.36	1.17	1.65

Fit the straight line by method of least square and find the value of evaporation coefficient when air velocity is 200 cm/sec.

11. Write down the steps for testing hypothesis on difference between two population means for the large sample size. [4]

12. An examination was given to 50 students at college A and 60 students at college B. At A mean grade was 75 with standard deviation of 9. At B mean grade was 79 with a standard deviation of 7. Is there significant difference between the performance of students at A and those at B, given that $\alpha = 0.05$? [6]

OR

Three randomly selected groups of chickens are fed on three different diets. Each group consists of five chickens. Their weight gains during a specified period of time are as follows:

Diet I	4	4	7	7	8
Diet II	3	4	5	6	7
Diet III	6	7	7	7	8

Test the hypothesis that mean gains of weight due to the three diets are equal.

13. Write the properties of good estimators with examples. [5]

14. In random sample of 400 industrial accidents, it was found that 231 were due to at least partially to unsafe working conditions. Construct 99% and 95% confidence intervals for the corresponding true proportion. [5]

15. An article in computer and industrial engineering describes the time-failure data (in hours) for jet engines. Some of the data observed are presented below. [8]

Engine	Failure Time	Engine	Failure Time
1	150	13	213
2	291	14	271
3	93	15	197
4	53	16	200
5	2	17	262
6	65	18	255
7	183	19	286
8	144	20	206
9	223	21	179
10	197	22	232
11	187	23	165
12	197	24	155
		25	203

a) Find sample mean, sample variance and sample standard deviation.
b) Exclude the lowest six data and compute (a) again.
c) Analyze the result (a) and (b). Draw you conclusion.

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Exam.	OLD Back (2065 & Earlier Batch)		
Level	BE	Full Marks	80
Programme	BCE, BME	Pass Marks	32
Year / Part	II / II	Time	3 hrs.

Subject: - Probability and Statistics *(EG571SH)*

✓ Candidates are required to give their answers in their own words as far as practicable.
✓ Attempt any _Seven_ questions selecting _Four from Group A_ and _Three from Group B_.
✓ _Necessary tables are attached herewith._
✓ The figures in the margin indicate _Full Marks_.
✓ Assume suitable data if necessary.

Group A

1. a) Write the differences between diagram and graph. Write the importances of diagrammatic presentation of data . [6]

    b) Following is the distribution of monthly wages of employees of two factories. Which factory pays more money to the employees and in which factory the monthly wages is more consistent? [5]

Wages (Rs.)	200-400	400-600	600-800	800-1000	1000-1200	1200-1400	1400-1600
Factory A	4	8	11	6	5	3	3
Factory B	7	12	9	4	4	3	1

2. a) Define the terms:(i) Exhaustive event (ii) Favorable event (iii) Mutually exclusive events (iv) Equally likely events and (v) Independent events [6]

    b) Two third of the students in a class are boys and rest are girls. It is known that the probability of a girl getting first division mark is 0.25 and that of boy getting first division mark is 0.28. Find the probability that a student chosen at random will get first division mark ? [5]

3. a) Differentiate between discrete random variable and continuous random variable with examples. [5]

    b) In a gambling, a man is paid Rs.5 if he gets all heads or all tails when three coins are tossed and he pays out Rs.3 if either one or two of head shows, what is his expected gain? [6]

4. a) What are the differences and similarities between binomial distribution and negative binomial distribution? [6]

    b) Assuming the probability of a male birth is ½, find in how many of 160 families with 4 children each would you expect to have [5]

        I.   at least one boy
        II.   at least one boy and one girl

5. a) Define normal distribution? Also state its important properties. [6]

b) The breakdown voltage X of a randomly chosen diode of a particular type is known [5]
to be normally distributed with $\mu = 40$ volts and $\sigma = 1.5$ volts
   (i) What is the probability that the break down voltage will be between 39 and 42 volts
   (ii) What is the probability that the break down voltage will be between 40 and 43 volts

6. a) Define joint probability mass function and marginal probability mass function. [6]

b) The Joint probability distribution of the number X of car and the number Y of buses
per signal cycle of a proposed left turn lane in displayed in the accompanying joint [5]
probability table:

p(x,y)		y		
		0	1	2
x	0	0.025	0.015	0.01
	1	0.05	0.03	0.02
	2	0.125	0.075	0.05
	3	0.15	0.09	0.06
	4	0.1	0.06	0.04
	5	0.05	0.03	0.02

   (i) What is the probability that there is exactly one car and exactly one bus during a cycle?
   (ii) What is the probability that there is at most one car and at most one bus during a cycle?
   (iii) What is the probability that there is exactly one car during a cycle?

Group B

7. a) What are the estimator and estimates? Describe the criteria for a good estimator. [6]

b) A quality control manager needs to estimate the average hours of life of light bulbs.
The population standard deviation is known to be 100 hours. A random sample of 64 [6]
light bulbs indicated a sample average life of 350 hours. Set up 95% and 99%
confidence interval of true average life of bulbs.

8. a) Describe the types of error that arises in testing of hypothesis. Describe the test [6]
procedure of test of significance of mean for large sample.

b) The sample average unrestrained compressive strength for 45 specimens of [6]
particular type of bricks was computed to be 3107 psi and sample standard deviation
was 188 psi. The distribution of unrestrained compressive strength may be somewhat
sewed. Does the data strongly indicate that the true average unrestrained compressive
strength is less than design value of 3200? Test using 1% level of significance.

Exam.		Regular	
Level	BE	Full Marks	80
Programme	BCE, BME, BIE	Pass Marks	32
Year / Part	II / II	Time	3 hrs.

Subject: - Probability and Statistics (SH552)

✓ Candidates are required to give their answers in their own words as far as practicable.
✓ Attempt __All__ questions.
✓ The figures in the margin indicate __Full Marks__.
✓ __Necessary tables are attached herewith.__
✓ Assume suitable data if necessary.

1. What are the merits and demerits of positional average median? Calculate mean, median and mode from the following data of rainfall. [6]

Rainfall (in mm)	20-30	30-40	40-50	50-60	60-70
No. of days	15	16	20	24	15

2. Define addition theorem of probability. In a group of equal number of men and women, 20% of men and 30% of women are unemployed. If a person selected is random. [6]

   a) What is the probability that the selected person is an employed?
   b) What is the probability that the selected person is men employed?

3. Write down the differences between a binomial and a negative binomial distribution with an example. [5]

4. In a certain factory turning out optical lenses, there is a small chance, 1/500 for any lens to be defective. The lenses are supplied in packets of 10 each. What is the probability that a packet will contain [5]

   a) no defective lens   b) at least one defective lenses   c) at most two defective lenses

5. Define the normal distribution. Give the condition for normal approximation of binomial distribution. [2+3]

6. The mean weight of products is 68.22 grams with variance of 10.8 grams. How many products in a batch of 1000 would you expect (a) to be over 72 grams (b) between 70 and 72 grams (c) below 65 grams? [5]

OR

A college professor never finishes his lecture before the bell rings to end of the period, and always finishes his lecture within one minute after the bell rings. Let X be the time that elapse between the bell and the end of the lecture, and suppose the probability density function of X is

$$\begin{cases} kx^2 & 0 \le x \le 1 \\ 0 & \text{Otherwise} \end{cases}$$

   a) Find the value of k.
   b) What is the probability that the lecture ends within 20 seconds of bell rings?
   c) What is the probability that the lecture continue beyond the bell for between 20 to 40 seconds?

7. Define sampling distribution of proportion with example. [4]

8. State the central limit theorem. Write two applications of it. [6]

9. Write down the properties of regression coefficient and correlation coefficient. [5]

10. The following data gives the experience of machine operators in years and their performance as given by the number of good parts turned out per 100 pieces. [5]

Experience (X)	16	12	18	4	3	10	5	12
Performance (Y)	87	88	89	68	78	80	75	83

   a) Fit the regression equation of performance ratings on experience and estimate the probable performance if an operator has 8 years experience.
   b) Calculate coefficient of determination and interpret it.

An Addison-Wesley product ...

OR

A sample of 10 values of three variables X_1, X_2 and X_3 were obtained as

$\Sigma X_1 = 10$	$\Sigma X_2 = 20$	$\Sigma X_3 = 30$
$\Sigma X_1^2 = 20$	$\Sigma X_2^2 = 68$	$\Sigma X_3^2 = 170$
$\Sigma X_1 X_2 = 10$	$\Sigma X_1 X_3 = 15$	$\Sigma X_2 X_3 = 64$

Find:

a) Partial correlation between X_1 and X_3 eliminating the effect of X_2.

b) Multiple correlation between X_1, X_2 and X_3 assuming X_1 as dependent.

11. A company produces automobile tyres, the manager of the company want to estimate the limits in which expected trend life of his tyres will probably lie. A test sample of 64 tyres was taken and a test run showed the average trend life of 50000 miles. Find the 95% and 99% confidence limits for population mean. Given that population standard deviation is 3000 miles. [4]

12. The following data represents the units of production per day turned out by three different brands of machines used by three mechanists: [6]

Machines	Production			
1	15	14	19	18
2	17	12	20	16
3	16	18	16	17

Using ANOVA test whether the differences in performances of the three brands of machines are significant. Use $\alpha = 5\%$.

OR

The average hourly wage of sample of 150 workers in a plant 'A' was Rs. 2.56 with a standard deviation of Rs. 1.08. The average wage of a sample of 200 workers in plant 'B' was Rs. 2.87 with a standard deviation of Rs. 1.28. Can an applicant safely assume that the hourly wages paid by plant 'B' are higher than those paid by plant 'A'? Use $\alpha = 0.05$.

13. Define critical value and critical region. A manufacturer claimed that at least 95% of the pumps supplied to the ABC company confirmed to specifications. However, the production manager at ABC company wasn't satisfied with the claim of the manufacturer. Hence, to test the claim, the manager examined a sample to 250 pumps supplied last month and found that 228 pumps as per the specifications. Can you conclude that the production manager is right to doubt on the claim of the manufacture? $(a = 0.01)$ [5]

14. Define chi-square distribution. A sample of 500 workers of a factory according to gender and nature of work is follow: [5]

Nature of work	Gender	
	Male	Female
Technical	200	100
Non-technical	50	150

Test at 5% level of significance whether there exist any relationship between gender and nature of work.

15. The heights of male and female students are given below. [8]

Height	Sex of the person	
	Male	Female
145-150	0	3
150-155	2	8
155-160	6	15
160-165	17	12
165-170	21	4
170-175	10	0
175-180	2	0
180-185	2	0

a) Calculate mean height for male and female students.

b) Calculate sample standard deviation and sample variance for given data.

c) Which data for height is consistent?

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Exam.	Regular (2066 & Later Batch)		
Level	BE	Full Marks	80
Programme	BCE, BME, BIE	Pass Marks	32
Year / Part	II / II	Time	3 hrs.

Subject: - Probability and Statistics *(SH552)*

✓ Candidates are required to give their answers in their own words as far as practicable.
✓ Attempt __All__ questions.
✓ The figures in the margin indicate __Full Marks__.
✓ __Necessary tables are attached herewith.__
✓ Assume suitable data if necessary.

1. A civil engineer tested six samples of each of three types of brick for use in a particular construction project. The following data are the compressive strength of bricks in psi.

Type I	2900	3105	2950	2859	3155	3132
Type II	2805	2985	3067	3204	3250	3119
Type III	3207	2825	2836	3222	3121	3218

   i) Calculate the average compressive strength and the standard deviation for each type.
   ii) Which type of brick is best and why?   [2x3=6]

2. State 'Bayes' theorem for conditional probability. A company produces certain type of sophisticated items by three machines. The respective daily production figures are: Machine A 300 units, Machine B 450 units and Machine C 250 units. Past experience shows that the percentages of defective in the three machines are 0.1, 0.2 and 0.7 respectively for the machines A, B and C. An item is drawn at random from a day's production and is found to be defective. What is the probability that it is not produced by machine C?   [1+5]

3. Define hypergeometric distribution. Write down the differences between hypergeometric and binomial distribution.
                                                                                [2+2]

4. Write any two conditions that a function is a probability mass function. If 6 of 18 new buildings in a city violate the building code, what is the probability that a building inspector, who randomly selects 4 of the new buildings for inspection, will catch
   a) none of the buildings that violate the building code.   [2+2+2]
   b) at least 3 of the new buildings that violate the building code.

                                     OR

   Define Poisson probability distribution with the condition for poisson distribution.
   A local booth of Nepal Telecom receives on an average 2 calls per minute. Find the probability
   of (i) no phone call (ii) exactly 4 calls (iii) at least three calls.

5. Define standard normal distribution with area property.   [4]

6. The length of life of 600 dry battery cells are normally distributed with mean 12 hours and standard deviation 2.5 hours. Find the number of battery cells that are expected to have life i) more than 15 hours; ii) between 10 and 14 hours iii) less than 6 hours.   [6]

                                     OR

   If X has a probability density function:
   $f(x)=k(1-x^2)$ for $-1 < x < 1$
   $= 0$ ，Otherwise
   Find (i) k (ii) P(0.5<x<1) (iii) The distribution function of random variable x.

7. Define population, sample, parameter and statistic with examples. [2 + 4]
8. The lifetime of a certain brand of an electric bulb may be considered a random variable with mean 1200 hours and standard deviation 150 hours. Using the *Central Limit Theorem*, find the probability that the sample mean, of the lifetime with a sample of size 36, is between 1100 hours and 1300 hours. [4]

OR

From a population of 3 members 1, 3, 5 draw all possible simple random samples of size 3 without replacement. Obtain the sampling distributions of sample mean and from it calculate expectation of sample mean. [4]

9. The simple correlation coefficient between fertilizer (X1), seeds (X2) and productivity (X3) are $r_{12}=0.69$, $r_{13}=0.64$ and $r_{23}=0.85$. Calculate the partial correlation coefficient $r_{12.3}$ and multiple correlation $R_{1.23}$. [4]

10. Ten Steel wires of diameter 0.5 mm and length 2.5m were extended in a laboratory by applying vertical forces of varying magnitudes. Results are as follows:

Force(kg)	15	19	25	35	42	48	53	56	62	65
Increase in length (mm)	1.7	2.1	2.5	3.4	3.9	4.9	5.4	5.7	6.6	7.2

Determine correlation coefficient and coefficient of determination between force and increase in length and interpret the result using coefficient of determination. [6]

OR

Suppose a statistics professor is interested in predicting final exam score (Y) from SAT mathematics score (X), using the following data student.

SAT score X	440	465	282	521	535	552	572	590	607
Final Score Y	40	47	43	54	64	52	59	68	44

(i) Determine the regression equation for predicting scores on the final (Y) from SAT score (X).
(ii) From a SAT score of 500, predict the score on the final.

11. The following are the lifetimes of three types of tires in miles. [6]

Tire	Life times(000) miles			
I	28	27.4	26	27
II	26.9	25.6	24.9	27.7
III	27	28.4	26.6	25

Construct ANOVA table and test for equality of the meanlife times.

OR

Define critical value and test statistic value. A moped manufacturer hypothesized that the mean miles per gallon for its moped is 115.2. it takes the samples of 49 moped and find the sample mean to be 117.4 per gallon. If the population standard deviation is known to 8.4, test the hypothesis that the true mean miles per gallon is significantly greater than 115.2 using 0.05 significance level.

12. Describe the procedure of test of significance between two population proportions. [4]
13. The distribution of number of error page was given below as. [5]

No. of error	0	1	2	3	4	5
No. of pages	275	138	75	7	4	1

Using Chi-square test of goodness of fit, verify whether the distribution of error follow a poisson distribution.

14. In a factory, 2% steel rods were fount defective in a lot of 2000 and in another factory,2.5% steel rods were found defective in a lot of 3000 rods. Do you find that the rods in the second factory are significantly inferior compared to the rods in the first factory? (Use $\alpha=1\%$) [5]

15. An article in computer and industrial engineering describes the time-to-failure data (in hours) for jet engines. Some of the data observed are presented below: [3+3+2]

Engine	Failure Time	Engine	Failure time
1	150	13	213
2	291	14	271
3	93	15	197
4	53	16	200
5	2	17	262
6	65	18	255
7	183	19	286
8	144	20	206
9	223	21	179
10	197	22	232
11	187	23	165
12	198	24	203

a) Find sample mean, sample variance and sample standard deviation.
b) Exclude the lowest six data and compute (a) again.
c) Analyze the results (a) and (b). Draw your conclusion.

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INSTITUTE OF ENGINEERING

Examination Control Division

2068 Jestha

Exam.		Back	
Level	BE	Full Marks	80
Programme	BCE, BME	Pass Marks	32
Year / Part	II / II	Time	3 hrs

Subject: - Probability and Statistics

✓ Candidates are required to give their answers in their own words as far as practicable.
✓ Attempt any *Seven* questions selecting *Four from Group A* and *Three from Group B*.
✓ The figures in the margin indicate *Full Marks*.
✓ *Necessary tables are attached herewith.*
✓ Assume suitable data if necessary.

Group A

[(6+5)×4]

1. a) What do you mean by measures of central tendency? Describe briefly the requisites of a good measure of central tendency.

   b) Two automatic filling machines A and B are used to fill tea in 500gms cartons. A random sample of 100 cartons on each machine showed the following:

Tea Contents: (In gms)		485-490	490-495	495-500	500-505	505-510	510-515
No. of Cartons filled by	Machine A	12	18	20	22	24	4
	Machine B	10	15	24	20	18	13

   Find:

   i) Which machine is better?
   ii) Which machine has a consistent performance?

2. a) Define the following terms with a suitable example:

   i) Mutually exclusive events
   ii) Independent events
   iii) Exhaustive cases

   b) Suppose that in a particular city, airport A handles 50% of all airline traffic, and airports B and C handle 30% and 20% respectively. The detection rates for a passenger for carrying weapons at the three airports are 0.9, 0.5 and 0.4 respectively. If a passenger at any one of the airports is selected at random, what is the probability that he or she carrying a weapon? If he or she is found carrying a weapon through the boarding gate, what is the probability that passenger is using airport A?

3. a) Differentiate discrete and continuous random variables with suitable examples.

   b) A box contains 8 good bulbs and 5 defective bulbs. Three bulbs are drawn at random. Find the probability distribution of the number of defective bulbs drawn. Also calculate mean and variance of the distribution.

4. a) Define negative binomial distribution. Through a suitable example, indicate the difference that it has with binomial distribution.

   b) On an average 1 house in 1000 in a certain district has a fire during a year. If there are 2000 houses in that district, indicate the probability that:

   i) Exactly 5 houses will have a fire during the year.
   ii) No houses will have a fire during the year.
   iii) At least one house will have a fire during the year.
   iv) At the most 2 houses will have a fire during the year.

5. a) Define normal distribution. State the area properties of a normal curve.

   b) 1000 candidates appeared in a test. The average score in the test is 14 and standard deviation is 2.5. Assuming the normality of the distribution, find:

   i) The probability that a candidate selected at random will score above 15.
   ii) How many candidates score between 12 and 15?
   iii) How many score below 8?

6. a) Define joint probability mass function and marginal probability density function. Give two examples in which the case of joint distribution arise.

   b) If two random variables X and Y have the joint density

   $$f(x, y) = \begin{cases} \dfrac{6}{5}(x + y^2) & \text{for } 0 < x < 1,\ 0 < y < 1 \\ 0 & \text{elsewhere,} \end{cases}$$

   Find:

   i) Marginal density function for X
   ii) Marginal cumulative distribution function for Y.

Group B

[(6+6)×3]

7. a) Explain the concept of point estimation and interval estimation.

   b) A random sample of 900 members has mean 3.4cm and standard deviation 2.61cm. If the population is normal, find 95% and 98% confidence limits for population mean.

8. a) Explain with illustrations, the types of error that arise in testing hypothesis.

   b) In a random sample of 400 men, it is found that 200 men consume brand 'X' of a commodity. On the other hand, in a random sample of 600 women, it is found that 325 consume the same commodity. Test the hypothesis that the data shows a significant difference between men and women so far as the proportion of the commodity consumer is concerned. [Use 5% level of significance].

9. a) Differentiate between z-test and t-test of hypothesis. Also state the conditions underlying t-test.

   b) The means of two random samples of size 9 and 7 are 196.42 and 198.82 respectively. The sum of squares of the deviations from the mean are 26.94 and 18.73 respectively. Can the samples be considered to have drawn from the same normal population? Test the hypothesis at 5% level of significance.

10. a) Define correlation between two variables. Also explain the significance of the study of correlation in statistical analysis?

   b) The following table gives the aptitude test scores and productivity indices of 10 workers selected at random:

Aptitude Scores (X)	60	62	65	70	72	48	53	73	65	82
Productivity index (Y)	68	60	62	80	45	40	52	62	60	81

   Find the regression equation of Y on X and estimate the productivity index of a worker whose test score is 92.

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Exam.	New Back (2066 & Later Batch)		
Level	BE	Full Marks	80
Programme	BCE, BME, BIE	Pass Marks	32
Year / Part	II / II	Time	3 hrs.

Subject: - Probability and Statistics

✓ Candidates are required to give their answers in their own words as far as practicable.
✓ Attempt **All** questions.
✓ The figures in the margin indicate **Full Marks**.
✓ *Necessary tables are attached herewith.*
✓ Assume suitable data if necessary.

1. Describe the methods of construction of pie diagram. Compute the coefficient of variation from the data given below.   [3+3]

X	10	11	12	13	14
Frequency	3	12	18	12	3

OR

Write the importance and application of statistics in the field of engineering. Following are duration in minutes that a person had to wait for a bus go to work on 15 working days:

10, 1, 13, 9, 5, 9, 2, 10, 3, 8, 6, 17, 2, 10 and 15.

Find the mean and variance.

2. Define mutually exclusive and independent events. A manufacturing firm produces steel pipes in three plants with daily production volumes of 500, 1000 and 2000 units respectively. According to past experience, it is known that the fraction of defective output produced by the three plants are respectively 0.005, 0.008, 0.010. If a pipe is selected from a day's total production and found to be defective. Find out the probability that the pipe might have come from plant II.   [3+3]

3. Define Binomial distribution. Write the condition for Binomial distribution.   [2+3]

4. Suppose that we are investigating the safety of a dangerous intersection of a road. Past police records indicate a mean of 5 accidents per month at this intersection. Suppose the number of accidents is distributed according to a Poisson distribution. Calculate the probability in any month of exactly 0 and between 2 to 4 accidents.   [5]

5. Define Continuous Probability distribution function. Write down the properties of continuous probability distribution function.

The proportion of people who respond to a certain mail-order solicitation is a continuous random variable X has the probability density function.   [2+3]

$$f(x) = \begin{cases} \dfrac{2(x+2)}{5}, & 0 < x < 1 \\ 0 & \text{elsewhere} \end{cases}$$

a) Show that $P(0 < x < 1) = 1$
b) Find the probability that more that 1/4 but fewer than 1/2 of the people contacted will respond to this type of solicitation.

15

The average diameter of a certain type of pipe is 2.5 inches and standard deviation is 0.75. Assuming that the diameter of pipes is normally distributed, find the probability of pipes with diameters

a) greater than 2 inches
b) less than 2.75 inches
c) between 2.4 and 2.7 inches

6. Define normal distribution and standard normal distribution. Write down area properties of normal distribution. [2+3]

7. Define the following terms with suitable examples. [4]

   a) Statistics
   b) Parameter

8. A population consists of 3, 7, 11, 15. Consider all possible samples of size two which can be drawn without replacement from this population. Find [2×3]

   a) Population mean
   b) Mean of sampling distribution of mean
   c) Standard error of sampling distribution of mean

9. Past experience shows the following result of productivity per hectare with the respective uses of chemical fertilizers and seeds. Fit the multiple linear regression equation of Y on X1 and X2 from the given data: [6]

Fertilizer (X1), kgs	45	30	70	75	65	80
Seeds (X2), kgs	2	1.8	3	2.5	2	3
Productivity kgs (Y)	2000	2100	1800	1900	2400	2500

10. Define regression coefficient. Mention the properties of regression coefficient. [4]

11. Explain in brief the properties of good estimator. [4]

12. Suppose that three drying formula for curing glue are studied and the following times are observed. [6]

Formula	Time					
A	13	10	8	11	8	–
B	13	11	14	14	–	–
C	4	1	3	4	2	4

Construct ANOVA table and test for the equality of the mean curing times.

OR

A consumer group selected independent random samples of supermarkets located throughout a country for the purpose of comparing the retail prices per pound of coffee of brands A and B. The results of the investigation are summarized in table below. Does this evidence indicate that the mean retail price per pound of brand A coffee is significantly higher than the mean retail price per pound of brand B coffee? Use significance level 0.1.

	Brand A	Brand B
Sample size	75	64
Mean	$3.00	$2.95
Standard deviation	$0.11	$0.09

13. The table given below shows the data obtained during outbreak of small-pox in a locality. [5]

	Attacked	Not Attacked
Vaccinated	31	469
Not Vaccinated	185	1315

Test the effectiveness of vaccination in preventing the attack from small pox at significance level $\alpha = 0.05$.

OR

Two bonding agents, A and B are available for making a laminated beam. Out of 50 beams made with Agent A, 11 failed a stress test, whereas 19 of the 50 beams made with Agent B failed. At the 0.05 level, can we conclude that Agent A is better than Agent B?

14. Write down the steps for testing hypothesis of population proportion for a large sample size. [5]

15. An article in computer and industrial engineering (in 2001) describes the time-to-failure data (in hours) for jet engines. Some of the data observed are presented below: [3+3+2]

Engine	Failure Time	Engine	Failure Time
1	150	13	213
2	291	14	271
3	93	15	197
4	53	16	200
5	2	17	262
6	65	18	255
7	183	19	286
8	144	20	206
9	223	21	179
10	197	22	232
11	187	23	165
12	197	24	155
		25	203

a) Find Sample mean, sample variance and sample standard deviation.
b) Exclude the lowest six data and compute (a) again.
c) Analysis the results (a) and (b). Draw your conclusion.

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INSTITUTE OF ENGINEERING

Examination Control Division

2068 Bhadra

Exam.	Regular / Back		
Level	BE	Full Marks	80
Programme	BCE, BME, BIE	Pass Marks	32
Year / Part	II / II	Time	3 hrs.

Subject: - Probability and Statistics

✓ Candidates are required to give their answers in their own words as far as practicable.
✓ Attempt _All_ questions.
✓ The figures in the margin indicate _Full Marks_.
✓ _Necessary tables are attached herewith._
✓ Assume suitable data if necessary.

1. An engineer tested nine samples of each of three designs of a certain for bearing a new electrical winch. The following data are the number of hours it took for each bearing to fail when the winch motor was run continuously at maximum output, with a load on the winch equivalent 1, 9 times the intended capacity. .   [2×3]

A	16	16	53	21	17	25	30	21	45
B	18	27	34	34	32	19	34	17	43
C	21	17	23	32	21	18	21	28	19

   i) Calculate the mean and the median for each group
   ii) Calculate the standard deviation for each group
   iii) Which design is best and why?

2. Define mutually exclusive and independent events with examples. A manufacturing firm produces steel pipes in three plants with daily production volumes of 500, 1000 and 2000 units respectively. According to past experience, it is know that the fraction of defective output produced by the three plants are respectively 0.005, 0.008, 0.010. If a pipe is selected from a day's total production and found to be defective, find out the probability that the pipe might have come from plant II and III.   [6]

3. Define Poisson probability distribution with the condition for Poisson distribution. A shipment of 20 digital voice recorders contains 5 that are defective. If 10 of them are randomly chosen for inspection, what is the probability that 2 of the 10 will be defective?   [4+6]

OR

Which probability distribution is most likely the appropriate one to use for following variables: Binomial, Poisson?

   a) The number of auto passing throw a tollbooth.
   b) The number of defective radios in a lot of 100.
   c) A box contains 8 good bulbs and 4 defective bulbs, 3 bulbs are drawn at random. Let X be the random variable devoting the number of deflective bulbs drawn. Find the probability distribution of X. What are the mean and variance of it?

4. Write down the four important properties of normal distribution.   [4]

OR

Define gamma-distribution. Write its two applications.

5. If X has a probability density function: [6]

   $$f(x) = ke^{-3x} \quad \text{for } X > 0$$
   $$0 \quad \text{Otherwise}$$

Find: (i) k (ii) p(0.5 ≤ x ≤ 1) (iii) The distribution function of random variable x.

OR

The burning time of an experimental rocket is a random variable having a normal distribution with mean 4.76 sec and standard deviation 0.04 sec. What is the probability that this kind of rocket will burn. (i) less than 4.66 sec (ii) More than 4.8 sec (iii) Between 4.7 to 4.8 sec

6. What do you mean by the sampling distribution of sample mean? [4]

7. A population consists of 3, 7, 11, 15. Consider all possible samples of size two which can be drawn without replacement from this population. Find: [2×3]
   a) Population mean and population standard deviation.
   b) Mean of sampling distribution of mean.
   c) Standard error of sampling distribution of mean.

8. Ten steel wires of diameter 0.5mm and length 2.5m were extended in a laboratory by applying vertical forces of varying magnitudes. Results are as follows: [5]

Force (kg)	15	19	25	35	42	48	53	56	62	65
Increase in length (mm)	1.7	2.1	2.5	3.4	3.9	4.9	5.4	5.7	6.6	7.2

   a) Estimate the parameters of a simple linear regression model with force as the explanatory variable.
   b) Find 95% confidence limits for the slope of line.

OR

The following concentration of pollutants were recorded at eight stations of the monitoring system for pollution control located in the downtown area of Milan, Italy:

$NO_2(\mu g/m^3)$	130	130	115	120	135	142	90	116
CO (mg/m^3)	2.9	4.4	3.6	4.1	3.3	5.7	4.8	7.3

Determine correlation coefficient and coefficient of determination between the pollutants and interpret the result using coefficient of determination.

9. Distinguish between correlation and regression. Write down the important properties of correlation coefficient and regression coefficients. [5]

10. Discuss on type I error and type II error of test of hypothesis. The mean of two large samples of size 1000 and 2000 are 67.5 and 68 respectively. Test the equality of means of two population mean with standard deviation 2.5 at 0.01 level of significance. [6]

11. The output of three varieties of wheat each grown on 4 plots of land is given below. Analyze the data and setup an ANOVA table. State if the variety differences are significant at $\alpha = 0.05$ level. [6]

Varieties of wheat	Yeild tones/ hactre			
A	6	7	3	8
B	5	5	3	7
C	5	4	3	4

12. Write down the steps for testing hypothesis of population for the large sample size. [4]

13. A random sample of 700 units from a large consignment showed that 200 were damaged. Find 95% and 99% confidence limits for the proportion of damaged unit in the consignment. [4]

14. The following measurements were taken of the horizontal legs x and vertical legs y of numerous welding joints for steel buildings. The main objective was to make the legs equal to 6mm. A part of the results is listed below in millimeters. [2×4]

x =	5.5	5.0	5.0	6.0	7.0	5.2	5.5	5.5	6.0	6.0
	4.5	6.0	5.5	7.7	7.5	6.0	5.6	5.0	5.5	5.5
	6.0	6.5	5.5	5.0	5.5	5.5	6.5	6.5	7.0	5.5
y =	6.5	6.5	5.5	7.5	6.0	7.0	5.0	8.0	6.7	7.8
	5.7	6.5	5.5	8.0	8.0	6.3	6.0	6.0	6.0	5.5
	6.5	6.0	6.0	6.0	6.0	6.5	6.5	6.0	6.0	6.5

Find: (i) $\sum X$, $\sum X^2$, mean of leg X (ii) $\sum Y$, $\sum Y^2$, mean of leg Y (iii) σ_n, σ_{n-1} for leg X and leg Y (iv) Which leg is consistent?

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Exam.		Regular / Back	
Level	BE	Full Marks	80
Programme	BCE, BME	Pass Marks	32
Year / Part	II / II	Time	3 hrs.

Subject: - Probability and Statistics

✓ Candidates are required to give their answers in their own words as far as practicable.
✓ Attempt any **Seven** questions selecting **Four** from **Group A** and **Three** from **Group B**.
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✓ **Necessary charts are attached herewith.**
✓ Assume suitable data if necessary.

Group A

1. a) Discuss the importance and limitation of statistical chart. Write the procedure of construction of pie chart. [5]

   b) The following are the annual maximum flows in m³/s in the Colorado river at black canyon for the 11 year period from 1990 to 2000: [6]

   1980 1130 3120 2120 1700 2550 8500 3260 3960 2270 1700

   i) Compute mean maximum flow of the 11 years
   ii) Compute the variation of flow

2. a) State Baye's theorem and write the suitable example. [5]

   b) Orders for a computer are summarized by the optional features that are requested as follows: [6]

	Proportion of orders
no optional features	0.3
one optional feature	0.5
more than one optional feature	0.2

   i) What is the probability that an order requests at least one optional feature?
   ii) What is the probability that an order does not request more than one optional feature?

3. a) Distinguish between probability mass function and probability density function with one example each. [5]

   b) In computing work, I must get on a bus near my house and then transfer to second bus. If the waiting time (in minute) at each bus stop has uniform distribution A = 0 and B = 5. Then it can be shown that my total waiting time Y has probability density function. [6]

   $f(x) = (1/25)y$ for $0 < y < 5$
   $= (2/5) - (1-25) y$ for $5 < y < 10$

   i) What is the probability that waiting time is at most three minutes?
   ii) What is the probability that total waiting time is at most 8 minutes?

4. a) Define the Poisson distribution with suitable example. Discuss the limiting case of Poisson distribution as Binomial distribution. [5]

   b) Suppose that we are investigating the safety of a dangerous intersection. Past police records indicate a mean of 5 accidents per month at this intersection. Suppose the number of accidents is distributed according to a Poisson distribution. Calculate the probability in any month of exactly (i) Zero (ii) More than 1 (iii) $P(2 \leq x \leq 3)$. [6]

5. a) Explain the area property of normal distribution and give the conditions for Binomial distribution tends to normal distribution. [5]

b) An industrial engineer has found that the standard household light bulbs produced by a certain manufacturer have a useful life that is normally distributed with a mean of 250 hours and a variance of 400. [5]

   i) What is the probability that a randomly selected bulb from this production process will have a useful life in excess of 300 hours?

   ii) What is the probability that a randomly selected bulb from this production process will have a useful life between 190 and 270 hours?

   iii) What is the probability that a randomly selected bulb from this production process will have a useful life of not exceeding 260 hours?

6. a) Define joint marginal probability mass function and joint marginal probability density function for random variables X and Y. [6]

b) If two random variables X and Y have the joint density [5]

$$f(x, y) = \begin{cases} 2 - x - y; & 0 \le X \le 1, \quad 0 \le Y \le 1 \\ 0 & \text{otherwise} \end{cases}$$

Find the
i) marginal probability density function for X.
ii) mean E(X,Y) for X and Y

Group B

7. a) What are the criteria for the best estimator? Find the maximum likelihood estimator for the function $f(x) = \lambda e^{-\lambda x}$. [6]

b) The breaking strength of yarn used in manufacturing drapery material is required to be at least 100 psi. Past experience has indicated that breaking strength is normally distributed and that $\sigma = 2$ psi. A random sample of nine specimens is tested, and the average breaking strength is found to be 98 psi. Find a 95% two-sided confidence interval for the true mean breaking strength and infer the result. [6]

8. a) Explain the following terms in connection with testing of hypothesis: [6]

   i) null hypothesis   ii) alternate hypothesis   iii) critical region

b) A sample of heights of 6,400 Englishmen has a mean of 67.85 inches and standard deviation of 2.56 inches, while sample heights of 1600 Austrians has a mean of 68.55 inches and standard deviation of 2.52 inches. Do the data indicate that Austrians are on an average taller than Englishmen? Test the hypothesis at 5% level of significance. [6]

9. a) Describe briefly the procedure of t-test for the difference of means. [6]

b) A study shows that 12 workers using Design A have a mean assembly time of 300 seconds with standard deviation of 12 seconds and that 15 workers using Design B have mean and standard deviation of 335 and 15 seconds respectively. Test whether assembly time for Design A is less than that for Design B at 5% level of significance. [6]

10. a) What is the linear regression analysis? Write the application of regression analysis in engineering field, supporting your logic with one suitable example. [6]

b) An article in the Journal of Environmental Engineering (Vol. 115, No. 3, 1989, pp. 608-619) reported the results of a study on the occurrence of sodium and chloride in surface streams in central Rhode Island. The following data are chloride concentration y (in milligrams per liter) and roadway area in the watershed x (in percentage). [6]

X	4.4	6.6	9.7	10.6	10.8	10.9	11.8	12.1
Y	0.19	0.15	0.57	0.70	0.67	0.63	0.47	0.70

Find the correlation coefficient and coefficient of determination of given data and draw your conclusion.

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Exam.		Regular/Back	
		Full Marks	80
Level	BE	Pass Marks	32
Programme	BCE, BME		
Year / Part	II / II	Time	3 hrs.

Subject: - Probability and Statistics

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✓ Attempt any **Seven** questions selecting **Four** from **Group A** and **Three** from **Group B**.
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✓ Assume suitable data if necessary.

Group A

1. a) Discuss the significant differences between mean, median and mode. In a set of 10 data, one of them is very high, which central measure is suitable and why? [6]

   b) The means of two samples of size 50 and 100 respectively are 54.1 and 50.3 and the standard deviations are 8 and 7. Obtain the standard deviation of the sample size 150 obtained by combining the two samples. [5]

2. a) State and prove Baye's theorem. [6]

   b) A husband and wife appear in an interview for the two vacancies in the same post. The probability of husband's selection is 1/7 and that of wife's selection is 1/5. What is the probability that [5]

   i) none of them will be selected
   ii) only one of them will be selected
   iii) both of them will be selected

3. a) Define probability mass function for a random variable X. A random variable X has the following probability function: [6]

X	0	1	2	3	4	5	6	7
P(X)	K	K	2K	2K	3K	K^2	$2K^2$	$7K^2$

   Find: i) K   ii) $P(X \geq 1)$ iii) $P(3 \leq X < 6)$ [5]

   b) If the probability density of a random variable X is given by

   $$f(x) = \begin{cases} x & \text{for } 0 < x < 1 \\ 2-x & \text{for } 1 \leq x < 2 \\ 0 & \text{otherwise}; \end{cases}$$

   Obtain the corresponding cumulative distribution function and compute

   i) $P(0.6 < X < 1.2)$ ii) $P(X > 0.5)$

4. a) Write similarities and dissimilarities between Binomial distribution and Negative Binomial distribution. [6]

   b) Suppose that 70% of the first-class mail from New York to California is delivered within 4 days after being mailed. If 20 pieces of first-class mail are mailed from New York to California. [5]

   i) Find the probability that at least 15 pieces of mail arrive within 4 days of the mailing date.
   ii) Find the probability that 10 or fewer pieces of mail arrive later than 4 days after the mailing date.

5. a) Define the Normal distribution and standard Normal distribution. Write the properties of Normal distribution. [6]

6. a) A restaurant serves three fixed price dinners costing $7, $9 and $10. For a randomly selected couple dining at this restaurant, let X = the cost of the man's dinner, Y = the cost of woman's dinner. The joint p.m.f. of X and Y is given in the following table: [5]

P(x,y)		y		
		7	9	10
	7	0.05	0.05	0.10
x	9	0.05	0.01	0.35
	10	0.00	0.20	0.10

   i) Compute the marginal probability mass functions of X and Y.
   ii) What is the expected total cost of the dinner for the two people?
   iii) Are X and Y independent?

   b) Each front tire on a particular type of automobile is supposed to be filled to a pressure of 26Ψ. Suppose the actual air pressure in each tire is a random variable X for the right tire and Y for the left tire with joint p.d.f. [6]

$$f(x,y) = \begin{cases} K(x^2 + y^2) & , \quad 20 \le x \le 30, \ 20 \le y \le 30 \\ 0 & , \quad \text{otherwise} \end{cases}$$

   i) What is the value of K?
   ii) What is the probability that both tires are under-filled?
   iii) What is the probability that the difference in air pressure between the two tires is at most 2 p.s.i.?

Group B

7. a) Explain the terms : (i) the standard error of estimate and the sample size (ii) point estimation and interval estimation (iii) confidence level and significance level. [6]

   b) Find the maximum likelihood estimator for μ and σ^2 from a normal distribution

$$f(x; \mu, \sigma^2) = \frac{1}{\sigma\sqrt{2\pi}} e^{-(x-\mu)^2/2\sigma^2}; \quad -\infty < x < \infty.$$ [6]

8. a) What is a statistical hypothesis? Discuss the steps involved in testing a hypothesis. [6]

   b) A television manufacturer claims that at most 250 microamperes of current are needed to attain a certain brightness level with a particular type of set. A sample of 20 sets yeilds a sample average $\bar{X} = 257.3$. Let μ denote the true average current necessary to achieve the desired brightness with sets of this type and assume that μ is the mean of normal population with $\sigma^r = 15$. [6]

   i) Test at level $\alpha = 0.05$ the null hypothesis that μ is at most 250 against the appropriate alternative.
   ii) If $\mu = 260$, what is the probability of type II error?

9. a) Distinguish between large sample and small sample tests of significance. Also list the assumptions made for large sample tests. [6]

   b) A study was conducted to investigate the effect of two diets on the weight gain of a 14-year old children suffering from malnutrition. Ten children were subject to diet X and nine to diet Y. The gain in weight over a nine month period are shown in the table below: [6]

Diet X	14.0	11.2	12.5	15.0	10.2	22.0	9.8	13.0	10.5	9.6
Diet Y	14.4	11.6	18.2	12.8	19.5	13.1	21.2	11.3	15.3	

   Use the data to determine if there is evidence to indicate a difference between the mean gain in weight for children fed on two diets. (use $\alpha = 0.05$)

10. a) Write down the properties of correlation coefficient r and discuss the application of it in engineering field. [6]

   b) The following table shows the ages x and systolic B.P. y of 12 women. Determine the least squares regression line of y on x. Estimate the BP of a woman whose age is 45 year. [6]

Age (x)	56	42	72	36	63	47	55	49	38	42	68	60
BP (y)	147	125	160	118	149	128	150	145	115	140	152	155

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Exam.		Back	
Level	BE	Full Marks	80
Programme	BCE, BME	Pass Marks	32
Year / Part	II / II	Time	3 hrs.

Subject: - Probability and Statistics

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✓ Assume suitable data if necessary.

Group A

1. a) What are the sources of statistical data? Discuss the importance of diagrammatical and graphical representation of these data. [5]

   b) The following are some of the particulars of the distribution of weights of boys and girls in a class: [6]

	Boys	Girls
No. of Students	100	50
Mean weight	60 kg	45 kg
Variance	9	4

      i) Find the mean and standard deviation of combined data.
      ii) Which of the two distributions is more variable?

2. a) State the axioms of probability. Define with examples the conditional probabilities and independent events. [5]

   b) State Baye's theorem. A test shows that 99% of time if one has plague virus and shows positive 10% of time it has no virus. Assume that only 1% of the population has virus. [6]

      i) What is the probability that the test will show positive?
      ii) If a randomly selected person is tested and the result is positive, what is the probability that the person has the virus?

3. a) Define the discrete and continuous random variables and their corresponding probabilities distributions with examples. [5]

   b) A computer store has purchased 3 computers of a certain type at $500 apiece to sell at $1000 apiece. The manufacturer has agreed to repurchase any unsold computers at the end of two-month period at $200 apiece. Let X = the number of computers sold and has the p.m.f. as follows: [6]

x	0	1	2	3
p(x)	0.1	0.2	0.3	0.4

   Compute: (i) mean sell (ii) variance of the sell (iii) the expected profit.

4. a) Define the binomial experiment and the binomial probability distribution of a discrete random variable X. State the basic differences of this distribution with the hyper geometric and negative binomial distribution. [5]

   b) Let a continuous random variable X be defined by $f(x) = \begin{cases} 2(1-x) & , \quad 0 \le x \le 1 \\ 0 & , \quad \text{otherwise} \end{cases}$ [6]

   Show that f(x) is the probability distribution function of x.

   Also compute: (i) the density function f(x) (ii) P(0.25 ≤ x ≤ 0.5) (iii) the mean μ

5. a) Define the normal distribution. Describe in brief its characteristics and applications. [5]

   b) Suppose that the pH of soil samples taken from a certain geographic region is normally distributed with mean pH 6.0 and standard deviation 0.10. If the pH of a randomly selected soil sample from this region is determined [6]

      i) What is the probability that the resulting pH is between 5.90 and 6.15?
      ii) What is the probability that the resulting pH exceeds 6.10?
      iii) What is the probability that the resulting pH is at most 5.95?

6. a) A restaurant serves three fixed price dinners costing $7, $9 and $10. For a randomly selected couple dining at this restaurant, let X = the cost of the man's dinner, Y = the cost of woman's dinner. The joint p.m.f. of X and Y is given in the following table: [5]

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	7	0.05	0.05	0.10
x	9	0.05	0.01	0.35
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   i) Compute the marginal probability mass functions of X and Y.
   ii) What is the expected total cost of the dinner for the two people?
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   b) Each front tire on a particular type of automobile is supposed to be filled to a pressure of 26Ψ. Suppose the actual air pressure in each tire is a random variable X for the right tire and Y for the left tire with joint p.d.f. [6]

$$f(x,y) = \begin{cases} K(x^2 + y^2) & , \quad 20 \le x \le 30, \ 20 \le y \le 30 \\ 0 & , \qquad \text{otherwise} \end{cases}$$

   i) What is the value of K?
   ii) What is the probability that both tires are under-filled?
   iii) What is the probability that the difference in air pressure between the two tires is at most 2 p.s.i.?

Group B

7. a) Explain the terms : (i) the standard error of estimate and the sample size (ii) point estimation and interval estimation (iii) confidence level and significance level. [6]

   b) Find the maximum likelihood estimator for μ and σ^2 from a normal distribution [6]

   $$f(x; \mu, \sigma^2) = \frac{1}{\sigma\sqrt{2\pi}} e^{-(x-\mu)^2/2\sigma^2}; \quad -\infty < x < \infty.$$

8. a) What is a statistical hypothesis? Discuss the steps involved in testing a hypothesis. [6]

   b) A television manufacturer claims that at most 250 microamperes of current are needed to attain a certain brightness level with a particular type of set. A sample of 20 sets yeilds a sample average $\bar{x} = 257.3$. Let μ denote the true average current necessary to achieve the desired brightness with sets of this type and assume that μ is the mean of normal population with $\sigma^r = 15$. [6]

   i) Test at level $\alpha = 0.05$ the null hypothesis that μ is at most 250 against the appropriate alternative.
   ii) If $\mu = 260$, what is the probability of type II error?

9. a) Distinguish between large sample and small sample tests of significance. Also list the assumptions made for large sample tests. [6]

   b) A study was conducted to investigate the effect of two diets on the weight gain of a 14-year old children suffering from malnutrition. Ten children were subject to diet X and nine to diet Y. The gain in weight over a nine month period are shown in the table below: [6]

Diet X	14.0	11.2	12.5	15.0	10.2	22.0	9.8	13.0	10.5	9.6
Diet Y	14.4	11.6	18.2	12.8	19.5	13.1	21.2	11.3	15.3	

   Use the data to determine if there is evidence to indicate a difference between the mean gain in weight for children fed on two diets. (use $\alpha = 0.05$)

10. a) Write down the properties of correlation coefficient r and discuss the application of it in engineering field. [6]

    b) The following table shows the ages x and systolic B.P. y of 12 women. Determine the least squares regression line of y on x. Estimate the BP of a woman whose age is 45 year. [6]

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INSTITUTE OF ENGINEERING

Examination Control Division

2065 Kartik

Exam.		Back	
Level	BE	Full Marks	80
Programme	BCE, BME	Pass Marks	32
Year / Part	II / II	Time	3 hrs.

Subject: - Probability and Statistics

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Group A

1. a) Point out limitations of statistics. Explain how statistics is liable to be misused and how can the wrong uses of statistics be avoided? [5]

   b) Samples of polythene bags from two manufactures, A and B are tested by a prospective buyer for bursting pre-structure and the results are as follows: [6]

Bursting Pressure (lb)		5-9	10-14	15-19	20-24	25-29	30-34
Number of	A	2	9	29	54	11	5
bags	B	9	11	18	32	27	13

   Which set of bags has uniform pressure? If prices are same which manufacture's bags would be preferred by the buyers?

2. a) State and prove Baye's theorem of probability. [5]

   b) A university has to select an examiner from a list of 50 persons: 20 of them are women and 30 men; 10 of them know Nepali and 40 not; 15 of them are teachers and 35 not. What is the probability that a Nepali knowing woman teacher is selected by the university? [6]

3. a) Differentiate discrete and continuous random variables with relevant examples. [5]

   b) What do you mean by probability distribution of a discrete random variable? Three defective items are mixed with seven good ones. Three items are drawn at random. Find the probability distribution of number of defective items. Also, find the mean and variance of the distribution. [6]

4. a) Define negative binomial distribution and state condition of applicability for it. How does negative binomial distribution differ from binomial distribution? [5]

   b) The probability that an individual suffers from a bad reaction from a particular injection is 0.001. Find the probability that out of 1500 individuals (i) exactly two (ii) none (iii) at least one (iv) at most two will suffer from a bad reaction. [6]

5. a) Define normal distribution for a continuous random variable. Discuss the area property and importance of the normal curve. [5]

   b) A corporation installs 10000 electric lamps in the street of a city. If these lamps have an average life of 1850 burning hours with a standard deviation of 200 hours, what number of lamps may be expected to burn for (i) more than 2000 hours (ii) less than 1600 hours (ii) between 1540 and 1800 hours? [6]

5. a) The number of a group of 10,000 persons was found to be normally distributed with mean Rs. 750/- per month and standard deviation Rs. 50/-. Find (i) the number of persons with income less than Rs. 700/- per month (ii) the number of persons with income between Rs. 700/- and Rs. 800/- per month.

   b) At a certain examination, 10% of the students who appeared for the paper in statistics get less than 30 marks and 97% of the students got less than 62 marks. Assuming the distribution to be normal, find the mean and standard deviation of the distribution.

6. a) Find K so that f(x,y) = k xy, $1 \le x \le y \le 2$ will be a probability density function.

   b) If two random variable X and Y have for X = x and Y = y, then joint probability density function. $f(x,y) = \dfrac{1}{2x^2y}$; for $1 \le x < \alpha$ and $1/x < y < x$

   Derive marginal distribution of X and Y. Further obtain the conditional distribution of Y for X = x and also that of X given Y = y.

Group B

7. a) Define point estimate and interval estimate with suitable examples.

   b) It has been estimated by cable companies that 60% of all Nepalese households are wired to receive cable T.V. You would like to test this claim within 5% error and 99% level of confidence. How large a sample would you require?

8. a) An education claims that the average I.Q. of a city college students is at most 110 and that in a study made to test this claim 150 college students, selected at random, had an average I.Q. of 111.2 with a standard deviation of 7.2. Use a level of significance of 0.01 to test the claim of education.

   b) In random sample of 1000 persons from town A, 40% were found to be consumer of rice. In another random sample of 1000 persons from town B, 50% were found to be consumers of rice. Do these data reveal a significant difference in the proportion of rice consumers in these two towns?

9. a) Two types of batteries are tested for their length of life and the following data are obtained.

	No. of samples	Mean life in hrs.	Variance
Type A	9	600	121
Type B	8	640	144

   Is there a significant difference in the two means?

   b) In a manufacturing company the new modern manager is in a belief that music enhances the productivity of the workers. He made observation on six workers for a week and recorded the production before and after the music was installed from the data below, can you conclude that the productivity has indeed changed due to music.

Employee	1	2	3	4	5	6
Week without music	219	205	226	198	209	216
Week with music	235	186	240	203	221	205

10. a) Define regression lines. Write about the properties of regression coefficients.

    b) The production supervisor of a Brigham Container Company is convinced of the need to assign strenuous jobs - according to age. He randomly selected 10 workers and measure the amount of time they were able to maintain a strenuous loading capacity.

Strenuous minutes	2	7	5	9	10	4	4	8	6	5
Age in yrs	42	27	36	25	22	39	19	19	33	30

    i) Develop the equation which describes the best relationship between age and physical stamina.
    ii) How long might a 30 years old man be expected to maintain strenuous physical activity.

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Exam.	Regular/Back		
Level	BE	Full Marks	80
Programme	BCE, BME	Pass Marks	32
Year / Part	II / II	Time	3 hrs.

Subject: - Probability and Statistics

✓ Candidates are required to give their answers in their own words as far as practicable.
✓ Attempt any **Seven** questions selecting **Four** from **Group A** and **Three** from **Group B**.
✓ **All** questions carry equal marks.
✓ **Necessary figures are attached herewith.**
✓ Assume suitable data if necessary.

Group A

1. a) An analysis of the monthly wages paid to workers in two firms A and B belonging to the same industry gives the following result.

	Firm A	Firm B
No. of workers	160	150
Average wage	260	275
Variance of wage distributor	100	121

Calculate the mean and variance of all the workers taken together.

b) The lives of two models of refrigerators in a recent survey are

Life (No. of yrs)	0-2	2-4	4-6	6-8	8-10	10-12
Model X	5	16	13	7	5	4
Model Y	2	7	12	19	9	1

2. a) State and proof Bayes' theorem. (A) which model has longer average life?

b) A factory produces a certain type of output by three machines respecting. Daily production figures are Machine X : 1500 units; Machine Y : 3000 units; Machine Z : 4500 units. Past experiences show that 1.5% of the output produced by Machine X, 2% of the output produced by Machine Y and 2.2% produced by Machine Z are defective. An item is drawn at random, what is the probability that it comes from the output of Machine Y.

3. a) A die is thrown 6 times. If getting an odd number is a success. What is the probability of getting (i) 5 successes (ii) at least 5 successes (iii) at most 5 successes?

b) A manufacture finds that the average demand per day for the mechanics to repair his new product is 1.5 over a period of one year and demand per day is distributed as Poisson variate. He employs two mechanics. In how many days in one year (i) both the mechanics would be free (ii) some demand is refused.

4. a) A continuous random variable X has the probability density function $f(x) = A + Bx$; $0 \le x \le 1$. If the mean of the distribution is ½; find A and B.

b) A continuous distribution of a variable X is defined by

$$f(x) = \frac{1}{16}(3 + x)^2; \quad -3 \le x \le -1$$

$$= \frac{1}{16}(6 - 2x^2); \quad -1 \le x \le 1$$

$$= \frac{1}{16}(3 - x)^2; \quad 1 \le x \le 3$$

i) Verify that the area under the curve is unity.
ii) Find the mean and variance of the above distribution.

a) Define the joint probability mass function and marginal probability function for a bivariate distribution. [5]

b) Let X denote the reaction time in seconds, to a certain stimulant and Y denote the temperature (°F) at which a certain reaction starts to take place. Suppose that two random variable X and Y have the joint density. [6]

$$f(x,y) = \begin{cases} 4x, \dots\dots 0 < x < 1; 0 < y < 1 \\ 0 \dots\dots\dots Elsewhere \end{cases}$$

Find   i) $P(0 \le X \le \frac{1}{2}$ and $\frac{1}{4} \le Y \le \frac{1}{2})$

ii) $P(X<Y)$

Group B

7. a) Explain, with illustrations, the concept of (i) Point estimation and (ii) Interval estimation. [6]

b) In 39 soil samples tested for trace elements, the average amount of copper was found to be 22 milligrams, with a standard deviation of 4 milligrams. Find a 90%, 95% and 99% confidence interval for the true mean copper content in the soils from which these samples were taken. [6]

8. a) Explain the following terms: $(23.05\,36,\ 20.946)$, $(23.255, 20.744)$ [6]

i) Statistic and parameter $(23.649, 20.3506)$
ii) Level of significance
iii) Critical region

b) A machine shop is interested in determining a measure of the current year's sales revenue in order to compare it with known results from last year. From the 9682 sales invoices for the current year to date, the management randomly selected invoices and from each recorded x, the sales revenue per invoice. Using the following data summary, test the hypothesis that the mean revenue per invoice is $6.35, the same as last year, versus the alternative hypothesis that the mean revenue per invoice is different from $6.35, with n = 400, α = 0.05. [6]

Data Summary:

$$n = 400 \quad \sum_{i=1}^{400} x_i = \$2464.40 \quad \sum_{i=1}^{400} x_i^2 = 16,156.728$$

9. a) Explain the assumption of t test, distinguish clearly between large sample and small sample test of significance. [6]

b) To investigate a possible "built-in" sex bias in a graduate school entrance examination, 50 male and 50 female graduate students who were rated as above average graduate students by their professors were selected to participate in the study by actually taking this test. Their test results on this examination are summarized in the following table. [6]

$\mu_n - \mu_n > 0$

	Males	Females
$\bar{x}$	720	693
s^2	104	85
n	50	50

$z_{cal} - 1\,3\,.83$
$z_{tab} = 1\cdot 645$

Do these data indicate that males will, on the average, score higher than females of the same ability on this exam? Use α = 0.05.

10. a) Prove that the Karl Pearson's coefficient of correlation cannot exceed the limits $-1 < \gamma \le 1$. [6]

b) The Report "refuse derived fuel evaluation in an Industrial Spreader - Stoker Boiler" reported the accompanying data on x = % refuse derived fuel (RDF) heat input and Y = % efficiency for certain boiler. [6]

X:	37	30	48	29	27	16	0	20
Y:	78.0	77.2	74.4	77.7	76.9	79.0	82.1	76.5

Obtain the equation of the estimated regression line. Estimate the true % efficiency when % RDF heat input is 25.

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Subject: - Hydraulics (CE555)

✓ Candidates are required to give their answers in their own words as far as practicable.
✓ Attempt **All** questions.
✓ The figures in the margin indicate **Full Marks**.
✓ Assume suitable data if necessary.

1. A horizontal pipe 60mm in diameter carries oil of specific gravity 0.8. The pressure difference between two sections 5km apart is found to be 200 kPa. The oil flowing through the pipe is collected in a tank. It is found that 1962 N of oil is collected in 4 minutes. Compute the dynamic viscosity of the oil. Assume the flow to be laminar and verify it. Also, find the velocity at a distance of 20 mm from the pipe wall. [4+2+2]

2. Two reservoirs are connected by a pipe 1000 m long of diameter 300 mm. The pipe passes over a hill whose height is 5 m above the level of water in the upper reservoir. The difference in water levels in the two reservoirs is 13 m. If the absolute pressure of water anywhere in the pipe is not allowed to fall below 1.2 m of water in order to prevent cavitations, calculate the length of pipe in the portion between the upper reservoir and the hill summit; and also the discharge through the pipe. Assume the reservoirs are open to the atmosphere having atmospheric pressure of 760 mm of mercury. Take friction factor, $f = 0.032$ and neglect bend losses. [8]

3. For the three reservoir system of figure below $Z_1 = 29$ m, $L_1 = 80$ m, $Z_2 = 129$ m, $L_2 = 150$ m, $Z_3 = 69$ m and $L_3 = 110$ m. All pipes are 250 mm diameter concrete with roughness height 0.5 mm. Compute the flow rates. Take $\upsilon = 1.02\times16^{-6}m^2/s$. You are not allowed to use the Moody's chart. [10]
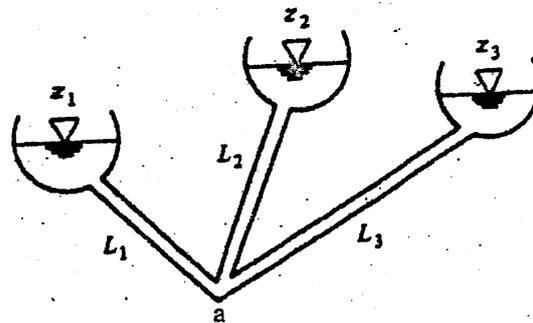
4. Explain the water hammer phenomenon and mention its causes. Derive the momentum equation for unsteady flow through pipe. [3+5]

5. Define the following; non-perismatic channel, spatially varied flow, hydraulic slope, gradually varied flow. [4]

6. a) Determine the most economical section of a trapezoidal channel with side slope of 2:1, carrying a discharge of $9m^3/s$ with a velocity of 0.75 m/s. Take Manning's $n = 0.025$. For conveying the same discharge, if a rectangular channel 1.2 m deep and 3 m wide is provided, what would be the saving in power per km length of channel? [4+2]

b) Using Manning's equation, show that the depth of flow is equal to 94% of the diameter for the partially filled most economical circular channel considering maximum discharge. [4]

7. A trapezoidal channel of base width 6 m and side slope of 2 horizontal to 1 vertical carries a flow of 60 cumecs at a depth of 2.5 m. There is a smooth transition to a rectangular section 6 m wide accompanied by a gradual lowering of the channel bed by 0.6 m (i) Find the depth of water in the rectangular section and the change in water surface level. (ii) In case the drop in water surface level is to be restricted to 0.3 m. What is the amount by which the bed must be lowered? Assume no losses. [6+6]

8. a) Sketch the flow profile. [3]
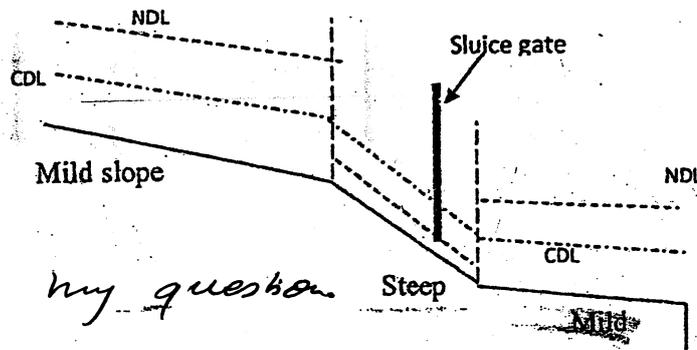
b) Justify analytically the nature of surface profiles in critical sloped channels. [5]

9. Water in a horizontal channel accelerates smoothly over a bump and then undergoes a hydraulic jump as in figure below, if $y_1 = 1$ m, $y_3 = 30$ cm, estimate v_1, v_3, y_4 and bump height h. Neglect friction. [6]
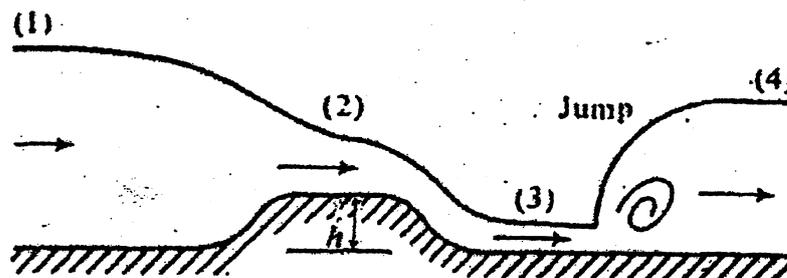
10. a) Explain the Tractive Force Method of designing Mobile boundary channel. [3]

b) Design a regime channel for a discharge of 75 m³/s and soil particle size of 0.65 mm using Lacey's method. Assume suitable side slope of channel. [3]

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06   TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2072 Magh

Exam.		New Back (2066 & Later Batch)	
Level	BE	Full Marks	80
Programme	BCE, B. Agri.	Pass Marks	32
Year / Part	II / II	Time	3 hrs.

Subject: - Hydraulics *(CE555)*

✓ Candidates are required to give their answers in their own words as far as practicable.
✓ Attempt _All_ questions.
✓ The figures in the margin indicate _Full Marks_.
✓ _Necessary figures are attached herewith._
✓ Assume suitable data if necessary.

1. Water flows by gravity in two open stand pipes shown in figure. Estimate the rate of change of water level in left standpipe. [8]
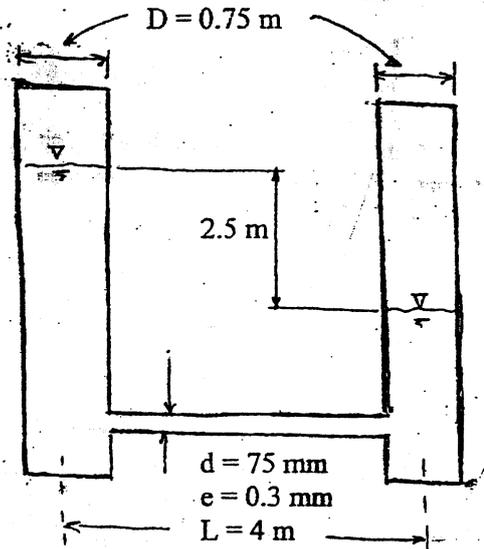
2. Water from a main canal is siphoned to a branch canal over an embankment by means of a wrought iron pipe of 100 mm diameter. The length of the pipeline up to the summit is 30 m and the total length is 90 m. Water surface elevation in the branch canal is 10 m below that of main canal. Take $f = 0.025$ and consider all losses. [4+4]

   a) If the total quantity of water required to be conveyed is 0.05 m^3/s, how many pipelines are needed?

   b) What is maximum permissible height of the summit above the water level in the main canal so that the water pressure at the summit may not fall below 20 kPa absolute, the barometer reading being 10 m of water?

3. Verify whether the following suggested distribution of discharge in the pipelines of the network shown in figure below is satisfactory by using Hardy-cross method. If not, determine the proper distribution. If the elevation at point B is 50 m and pressure head is 40 m and the elevation at D is 40 m, find the pressure at D. [8+2]

Line	AB	BC	CD	DA	AC
Suggested discharge (units)	58	42	32	18	20
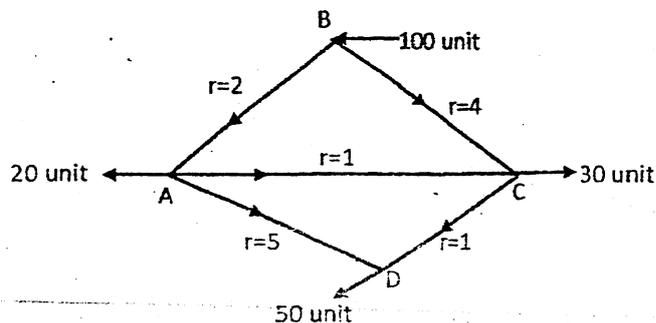
4. a) In the figure below, water flowing through a pipe from the reservoir is suddenly stopped by closing a valve at point B. Draw pressure-time diagram at the 2/3 L form valve of the pipe for one cycle of wave motion. [2]
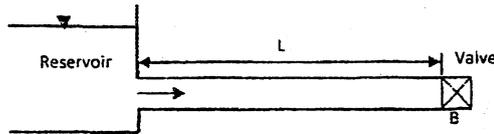
b) Water flows through a 25 cm diameter 1500m long pipe at rate of 75 lps. The static pressure of water in the pipe is 200m at the downstream end of the pipe and the thickness of the pipe material is 6 mm. If a valve at the downstream end closed in 3 sec estimate the stress in the pipe wall. Take Bulk modulus of water $= 2.2 \times 10^9$ N/m^2 and Young's modulus of elasticity of steel $= 2.1 \times 10^{11}$ N/m^2. [6]

5. Define the following; Hydraulic depth, Energy slope, gradually varied flow and spatially varied flow. [4]

6. a) In a partially full channel having a triangular section as shown in figure, the rate of discharge $Q = KAR^{2/3}$, in which K = a constant; A = flow area and R = hydraulic radius. Determine the depth at which the discharge is maximum. [5]
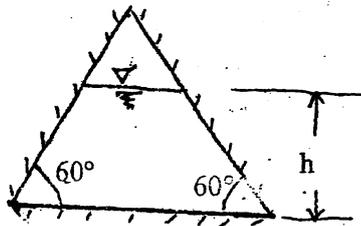
b) The velocity distribution in a channel section may be approximated by the equation $u = u_o(d/d_0)^n$ in which u is the flow velocity at depth d; u_0 is the flow velocity at depth d_0 and n = a constant. Derive expression for the energy and momentum coefficient. [5]

7. a) Define specific energy. Show that the flow is critical when the discharge is maximum for the given specific energy. Water flows at a depth of 1.8 m and velocity of 1.5 m/s in a 3 m wide rectangular channel. Find the width at contraction which just causes critical flow without a change in the upstream depth. [1+4+3]

b) An open rectangular channel carrying a discharge of 4.25 m^3/s is flowing at a depth of 1.15m with energy of 1.2 m and a width of 3 m. The flow encounters a simultaneous gradual contraction to a width of 1.5 m and a smooth downwards step of 0.6 m. With these flow conditions, determine the depth of the downstream flow. [4]

8. a) Sketch the flow profile: [4]
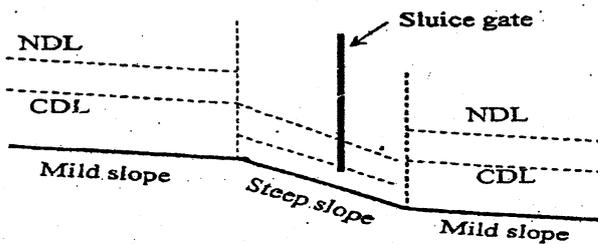
b) Justify analytically that A$_3$ curve meets the y_c line and channel bottom normally. [4]

9. What is hydraulic jump? Why is energy principle not applied for the analysis of the jump? Water flows in a 5 m wide rectangular channel at Froude number 3.5; the depth of flow is 1.2 m. If water undergoes a hydraulic jump, what is the Froude number downstream of jump? [1+1+4]

10. Explain the Tractive Force Method of designing Mobile boundary channel. Show the shear stress distribution on the Alluvial channel boundary with values. [3+3]

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Exam.	Regular / Back		
Level	BE	Full Marks	80
Programme	BCE, B.Agri.	Pass Marks	32
Year / Part	II / II	Time	3 hrs.

INSTITUTE OF ENGINEERING

Examination Control Division

2071 Bhadra

Subject: - Hydraulics *(CE555)*

✓ Candidates are required to give their answers in their own words as far as practicable.
✓ *Attempt* ___All___ *questions.*
✓ *The figures in the margin indicate* ___Full Marks___.
✓ ___Moody diagram provided.___
✓ *Assume suitable data if necessary.*

1. A total 12 liters per sec of oil is pumped through 2 pipes in parallel, one 12 cm in diameter and the other 10 cm in diameter, both pipes 1000 m long. The specific gravity of oil is 0.85, average roughness height is 0.26 mm for both pipes and kinematic viscosity is 9 cm²/sec. Calculate the flow rate through each pipe, and power generated by pump.   [8]

2. a) Small swimming pool is drained with velocity of 1.2 m/sec using a pipe with hose diameter 20 mm, length 30 m, and absolute roughness e = 0.2 mm. Find the water depth "d" at instant shown in figure below considering minor head loss coefficient at entrance K = 0.5.   [5]
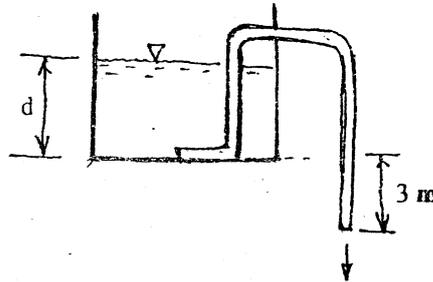
   b) Draw HGL and EGL diagram for the flow system shown in the figure considering all major and minor losses.   [1.5+1.5]

$d_1 < d_3 < d_2$
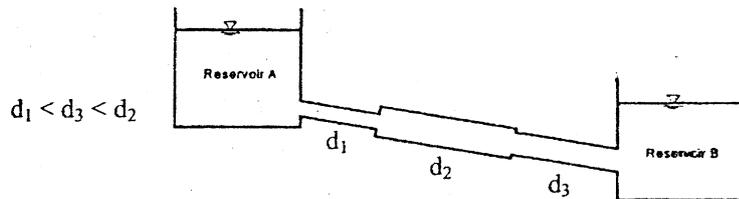
3. a) What do you understand by branching pipe system? Explain. Describe the solution procedures for three possible different cases of three reservoir problem.   [6]

   b) A pipe network is shown in figure in which Q and h represents the discharge and head losses respectively. Determine head losses and discharge indicated by a question mark, for this pipe network.   [4]
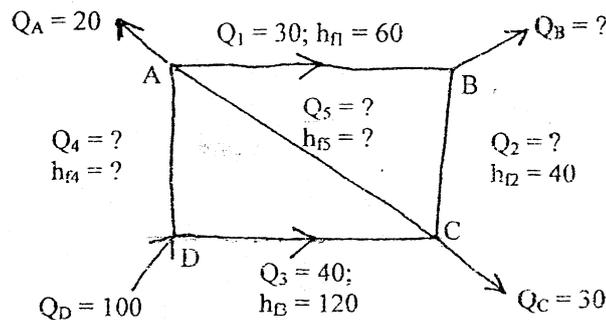
4. Water is flowing from a reservoir in a pipe of 600 mm diameter, 3000 m long and 6 mm thick at a velocity of 3.5 m/s. Assuming the value of bulk modulus of elasticity for water as 2.06 GPa, modulus of elasticity for pipe material 206 GPa and velocity of pressure wave 1400 m/s. Draw pressure-time diagram at location 1200 m from reservoir if the valve located at the end of the pipe is closed in 1 second. [8]

5. Define bed slope, hydraulic slope and energy slope. Why for non-uniform flow, these slopes are not parallel to each other, explain with neat sketch. [4]

6. a) Prove that for compound open channel, velocity distribution coefficient (momentum correction factor) $\beta = \dfrac{\sum\left(\dfrac{K_i^2}{A_i}\right)\left(\sum A_i\right)}{\left(\sum K_i\right)^2}$, where K_i = Conveyance factor of ith section, A_i = Cross section area of ith section. [4]

   b) For given channel section shown in the figure below with bed slope = 0.00017, Manning's roughness coefficient = 0.018, discharge 8.97 m^3/s, and side slope as 1:1, determine the normal depth of flow for uniform flow. [6]
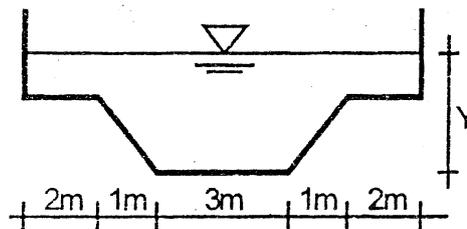
7. A rectangular channel with a bottom width of 5 m, bottom slope of 0.00076 and energy correction factor of 1.1 has a discharge of 1.85 m^3/s. In a Gradually varied flow in this section the depth at certain location is found to be 0.25 m, considering Manning's roughness coefficient as 0.0165 determine the type of GVF profile. How far upstream or downstream will the depth be 0.40 m from depth 0.25 m. Use direct step method using increment equals to 0.05 m. [8]

8. a) A 3.5 m rectangular channel carries discharge of 4 m^3/s of water at a depth of 1.2 m. If the width is reduced to 2.0 m and bed raised by 0.15 m, determine the depth of flow at reduced section and upstream of the reduced section. [6]

   b) Find the expression for the specific force. Show that the flow is critical when the specific force is minimum. Explain the use of this concept in open channel flow. [4+2]

9. A rectangular channel with width 1.1 m carrying a flow discharge of 7.2 m^3/s changes its bed slope from 0.065 to 0.0085. Show that the hydraulic jump occurs and if so find the location of jump. Take Manning's roughness as 0.025. [6]

10. Define an alluvial channel and incipient motion. Find the expression for the shear reduction factor "K" and explain the physical meaning of this factor. [1+3+2]

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| Exam.	**New Back (2066 & Later Batch)**		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	II / II	Time	3 hrs.

Subject: - Hydraulics (CE555)

✓ Candidates are required to give their answers in their own words as far as practicable.
✓ Attempt *All* questions.
✓ The figures in the margin indicate *Full Marks*.
✓ *Necessary Moody's diagram is attached herewith.*
✓ Assume suitable data if necessary.

1. Explain Prandtl Mixing length theory. Show that the velocity distribution in pipe for turbulent flow is Logarithmic. Derive an expression of head loss to sudden expansion of pipe. [2+3+3]

2. Water from a main canal is siphoned to a branch canal over an embankment by means of a wrought iron pipe of 100 mm diameter. The length of the pipeline up to the summit is 30 m and the total length is 90 m. Water surface elevation in the branch canal is 10 m below that of main canal. [8]

   a) If the total quantity of water required to be conveyed is 0.05 m³/s, how many pipelines are needed?

   b) What is the maximum permissible height of the summit above the water level in the main canal so that the water pressure at the summit may not fall below 20 Kpa absolute, the barometer reading being 10 m of water?

   Take f = 0.025 and consider all losses.

3. a) Derive the expression of correction factor $\Delta Q = -\dfrac{\sum (rQ_0^2)}{\sum (2rQ_0)}$ for solution of pipe network using Hardy Cross method. Whether r is resistance coefficient of pipe and Q_0 is initial assumed discharge. [2]

   b) Determine the piezometric head at D for the following three reservoir problem. [8]

   WS El 100 m

   Where, f is the friction factor of the Darcy-Weisbach equation used in Moody diagram.

4. A steel pipeline (ϵ = 0.046 mm) 61 cm in diameter and 3.2 km long discharges freely at its lower end under a head of 61 m. What water-hammer pressure would develop if a valve at the outlet were closed in 4 sec? 60 sec? Wall thickness = 0.5 cm for both case of closure. Compute the stress that would develop in the walls of the pipe near the valve. If the working stress of steel is taken as 16,000 psi, what would be the minimum time of safe closure? Consider $E_{water} = 2.17 \times 10^9$ N/m² and $E_p = 1.9 \times 10^{11}$ N/m². [8]

5. Give the two practical examples of following flow regimes. [4]

   a) uniform and non-uniform flow
   b) spatially varied flow, gradually varied flow

6. Explain specific energy diagram and show that at minimum specific energy, the flow is critical. A rectangular channel 2 m wide has a flow of 2.4 m^3/s at a depth of 1.0 m. Determine if critical depth occurs (a) at the section where a hump of $\Delta Z = 20$ cm high is installed across the bed, (b) a side wall constriction (no hump) reducing the channel width to 1.7 m, and (c) both the hump and side wall constriction combined. Will the upstream depth be affected for case (c)? If so, to what extent? Neglect head losses of the hump and constriction caused by friction, expansion and contraction. [6+2+2+2]

7. What are the conditions of uniform flow in open channel? A trapezoidal channel having side slope of 1:1 has to carry a flow of 15 m^3/s. The bed slope is 1 in 1000. Chezy's C is 45 if the channel is unlined and 70 if the channel is lined with concrete. The cost per m^3 of excavation is 3 times cost per m^2 of lining. Find which arrangement is economical. [2+8]

8. Sketch possible water surface profiles for the channel in figure below. First locate and mark the control points, then sketch the profiles, marking each profile with the appropriate designation. Show any hydraulic jumps that occur. [8]

9. The depth of uniform flow in a rectangular channel is 5 m wide ($n = 0.02$, $S_0 = 0.04$) is 0.5 m. A low dam raises the water depth of 2 m. Find whether a hydraulic jump takes place and if so at what distance upstream of the dam. [6]

10. A stream has a sediment bed of median size 0.35 mm. The slope of the channel is 1.5×10^{-4}. Stream is considered as trapezoidal with base width 3 m and side slope 1.5 H : 1 V. [6]

    a) If the depth of flow in the channel is 0.25 m, examine whether the bed particles will be in motion or not.

    b) Calculate minimum size of gravel that will not move in the bed of channel. Use empirical equation of critical shear stress as: $\tau_c (N/m^2) = 0.155 + \dfrac{0.409 d_{mm}^2}{(1 + 0.177 d_{mm}^2)^{1/2}}$.

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| Exam.		Regular	
Level	BE	Full Marks	80
Programme	BCE, B.Agri.	Pass Marks	32
Year / Part	II / II	Time	3 hrs.

Subject: - Hydraulics (CE555)

✓ Candidates are required to give their answers in their own words as far as practicable.
✓ Attempt All questions.
✓ The figures in the margin indicate Full Marks.
✓ Assume suitable data if necessary.

1. Show that for turbulent flow in rough pipes $\dfrac{V}{V*} = 5.75 \log\left(\dfrac{R}{K}\right) + 4.75$. [8]

   Where,

   V = Mean velocity

   V* = Shear velocity

   R = Radius of pipe

   K = Average height of surface protrusions

2. Liquid (s.g. = 0.6, $v = 5.0 \times 10^{-7}$ m²/s) is drawn from a tank through a hose of inside diameter 25 mm (see figure). The relative roughness for the hose is 0.0004. Calculate the volumetric flow and the minimum pressure in the hose. The total length of hose is 9 m and the length of hose to point A is 3.25 m. Neglect minor losses at head entrance. [8]
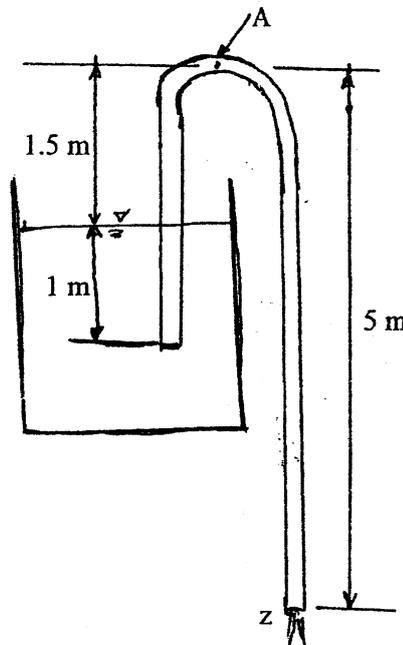
3. Three reservoirs A, B and C are interconnected by three pipes which all meet at junctions J. The water surface of reservoir B is 20 m above the surface of C whilst the surface of A is 40 m above the surface of B. A flow control valve is fitted just before junction J in pipe AJ. [10]

The head loss h_L through pipes and components can be written as $h_L = rQ^2$ where r is the resistance coefficient. The value of r for the valve and the pipes are $r_{AJ} = 150$, $r_{BJ} = 200$, $r_{CJ} = 300$, $r_{valve} = (400/n)^2$.

Where n is the percentage valve opening. Find the value of n which will make the discharge into reservoir C twice into reservoir B.

4. a) Explain the importance of surge tank. Describe the types of surge tank. [1.5+1.5]

   b) A 300 mm diameter pipe of mild steel having 6 mm thickness carries water at the rate of 200 l/s. What will be the rise in pressure if the valve at the downstream end is closed instantaneously? Compare results assuming the pipe to be rigid as well as elastic. What should be the maximum closing time for the computed results to be valid? Take pipe length as 5.0 km, Modulus of elasticity of pipe material as 2.25×10^{11} N/m^2, Bulk modulus of elasticity of water as 2.0×10^9 N/m^2. [5]

5. Explain GVF, RVF and spatially varied flow with appropriate sketches. [4]

6. What condition make open channel flow uniform? The area of cross-section of flow in a channel is 6 m^2. Calculate the dimensions of the most efficient section if the channel is (a) triangular, (b) rectangular and (c) trapezoidal (2:1). Which has the least perimeter? [2+8]

7. a) A flow of 2 m^3/s is carried in a rectangular channel 1.8 wide at a depth of 1.0 m. Will critical depth occur at a section where (a) a frictionless hump 15 cm high is installed across the bed? (b) a frictionless sidewall reduces the channel width to 1.3 m? (c) the hump and the sidewall construction are installed together? [9]

   b) Define conjugate depths. Sketch the specific force curve showing conjugate depths and the zones of subcritical, critical and supercritical flow. [1+2]

8. A rectangular channel with a bottom width of 4 m, bottom slope of 0.00075 and energy correction factor of 1.1 has a discharge of 2.0 m^3/s. In a Gradually varied flow in this section the depth at certain location is found to be 0.2 m, considering Manning's roughness coefficient as 0.016 determine the type of GVF profile. How far upstream or downstream will the depth be 0.40 m from depth 0.20 m. Use Graphical Integration Method using increment equals to 0.1 m. [8]

9. For a hydraulic jump in a horizontal triangular channel show that $3Fr_1^2 = \dfrac{r^2(r^3-1)}{r^2-1}$,

   where $Fr_1^2 = \dfrac{v_1^2}{gy_1}$ and $r = \dfrac{y_2}{y_1}$. [6]

10. Write down the design procedures of mobile boundary channel using maximum permissible velocity method, tractive force method and regime theory approaches with appropriate expressions. [6]

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Exam.	New Back (2066 & Later Batch)		
Level	BE	Full Marks	80
Programme	BCE, B.Agri.	Pass Marks	32
Year / Part	II / II	Time	3 hrs.

Subject: - Hydraulics *(CE555)*

✓ Candidates are required to give their answers in their own words as far as practicable.
✓ Attempt **_All_** questions.
✓ The figures in the margin indicate **_Full Marks_**.
✓ Assume suitable data if necessary.

1. Show that in both smooth and rough pipes for turbulent flow $\dfrac{u-v}{v^*}=5.75\log\left(\dfrac{y}{R}\right)+3.75$

   Where v = mean velocity; u = point velocity at distance y from boundary. v* = shear velocity; R = Radius of pipe.   [8]

2. Calculate the magnitude and direction of the manometer reading when water is flowing with velocity of 4.5 m/s for figure below. Consider minor losses also.   [8]

3.
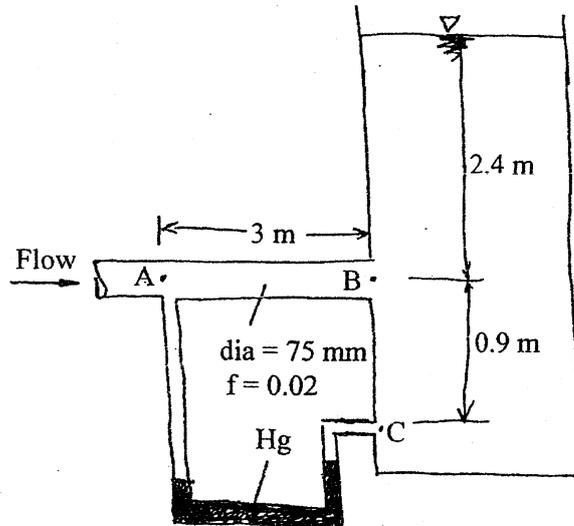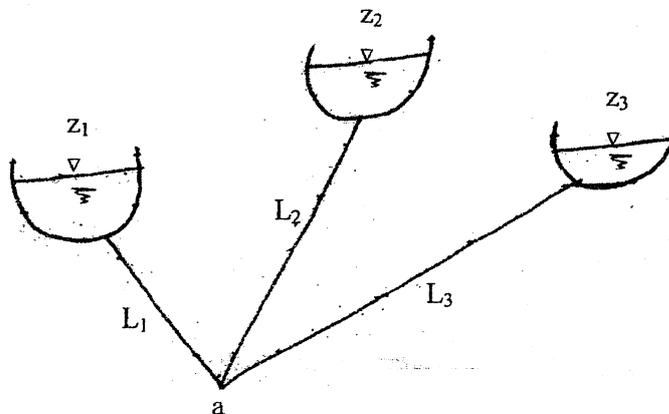
   For the three reservoir system of above figure, z_1 = 29 m, L_1 = 80 m, z_2 = 129 m, L_2 = 150 m, z_3 = 69 m and L_3 = 110 m. All pipes are 250 mm diameter concrete with roughness height 0.5 mm. Compute the flow rates for water.   [10]

4. a) Define water hammer and write down continuity equation and momentum equation for unsteady flow in pipe. [3]

   b) A value is closed in 4.5 s at the down stream end of a 3200 m pipeline carrying water at 2.7 m/s, What is the peak pressure developed by the closure, if the wave travels with velocity of 1000 m/s? Determine the length of pipe subject to the peak discharge. [5]

5. Given a practical example for each of the following open channel flow: (a) GVF (b) RVF (c) Spatially varied flow (d) Non uniform flow. [4]

6. a) Prove that for compound open channel, velocity distribution coefficient (Energy correction factor) $\alpha = \dfrac{\sum \left(\dfrac{K_i^3}{A_i^2}\right)\left(\sum A_i^2\right)}{\left(\sum K_i\right)^3}$, where k_i = Conveyance factor of ith section, A_i = Cross section area of ith section. [4]

   b) Set up a general expression for wetted perimeter p_w of a trapezoidal channel in terms of the cross-sectional area A. depth y and angle of side slope ϕ. Then differentiate p_w with respect to y with A and ϕ held constant. From this, prove that R = y/2 for the section of greatest hydraulic efficiency (i.e, smallest p_w for a given A). [6]

7. What are the different conditions to be fulfilled when flow is critical open channel? A 3m wide rectangular channel carries 3 m^3/s of water at a depth of 1 m. If the width is to be reduced to 2 m and bed raised by 10 cm, what would be the depth of flow in the contracted section? What maximum rise in the bed level of the contracted section is possible without affecting the depth of flow upstream of transition? Neglect loss of energy in transition. What would be the change in water surface elevations if the rise in bed is 30 cm? [3+3+3+3]

8. The clean earth (n = 0.020) channel in figure below is 6m wide and laid on a slope of 0.005236. Water flows at 30m^3/s in the channel and enters a reservoir so that the channel depth is 3 m just before the entry. Assuming gradually varied flow, calculate the distance L. [8]
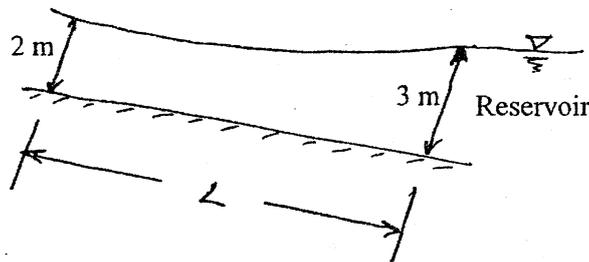
9. Water in a horizontal channel accelerates smoothly over a bump and then undergoes a hydraulic jump, as in figure below. If y_1 = 1 m and y_2 = 30 cm, estimate v_1, v_2 and y_4. Neglect friction. [6]
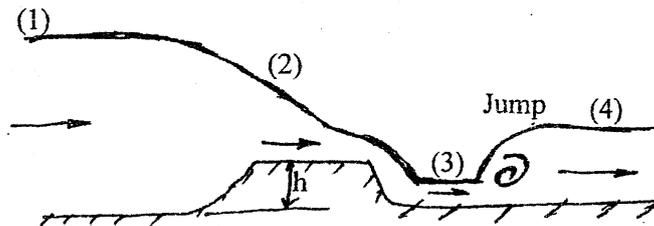
10. Describe the application of shield diagram for designing mobile boundary channel. [6]

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Exam.	**New Back (2066 & Later Batch)**		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	II / II	Time	3 hrs.

Subject: - Hydraulics *(CE555)*

✓ Candidates are required to give their answers in their own words as far as practicable.
✓ Attempt __All__ questions.
✓ The figures in the margin indicate __Full Marks__.
✓ __Necessary Moody's diagram is attached herewith.__
✓ Assume suitable data if necessary.

1. Explain Prandtl Mixing length theory. Show that the velocity distribution in pipe for turbulent flow is Logarithmic. Derive an expression of head loss to sudden expansion of pipe. [2+3+3]

2. Water from a main canal is siphoned to a branch canal over an embankment by means of a wrought iron pipe of 100 mm diameter. The length of the pipeline up to the summit is 30 m and the total length is 90 m. Water surface elevation in the branch canal is 10 m below that of main canal. [8]

   a) If the total quantity of water required to be conveyed is 0.05 m^3/s, how many pipelines are needed?

   b) What is the maximum permissible height of the summit above the water level in the main canal so that the water pressure at the summit may not fall below 20 Kpa absolute, the barometer reading being 10 m of water?

   Take f = 0.025 and consider all losses.

3. a) Derive the expression of correction factor $\Delta Q = -\dfrac{\sum (rQ_0^2)}{\sum (2rQ_0)}$ for solution of pipe network using Hardy Cross method. Whether r is resistance coefficient of pipe and Q_0 is initial assumed discharge. [2]

   b) Determine the piezometric head at D for the following three reservoir problem. [8]

   Where, f is the friction factor of the Darcy-Weisbach equation used in Moody diagram.

4. A steel pipeline (ϵ = 0.046 mm) 61 cm in diameter and 3.2 km long discharges freely at its lower end under a head of 61 m. What water-hammer pressure would develop if a valve at the outlet were closed in 4 sec? 60 sec? Wall thickness = 0.5 cm for both case of closure. Compute the stress that would develop in the walls of the pipe near the valve. If the working stress of steel is taken as 16,000 psi, what would be the minimum time of safe closure? Consider $E_{water} = 2.17 \times 10^9$ N/m² and $E_p = 1.9 \times 10^{11}$ N/m². [8]

5. Give the two practical examples of following flow regimes. [4]

   a) uniform and non-uniform flow
   b) spatially varied flow, gradually varied flow

6. Explain specific energy diagram and show that at minimum specific energy, the flow is critical. A rectangular channel 2 m wide has a flow of 2.4 m^3/s at a depth of 1.0 m. Determine if critical depth occurs (a) at the section where a hump of $\Delta Z = 20$ cm high is installed across the bed, (b) a side wall constriction (no hump) reducing the channel width to 1.7 m, and (c) both the hump and side wall constriction combined. Will the upstream depth be affected for case (c)? If so, to what extent? Neglect head losses of the hump and constriction caused by friction, expansion and contraction. [6+2+2+2]

7. What are the conditions of uniform flow in open channel? A trapezoidal channel having side slope of 1:1 has to carry a flow of 15 m^3/s. The bed slope is 1 in 1000. Chezy's C is 45 if the channel is unlined and 70 if the channel is lined with concrete. The cost per m^3 of excavation is 3 times cost per m^2 of lining. Find which arrangement is economical. [2+8]

8. Sketch possible water surface profiles for the channel in figure below. First locate and mark the control points, then sketch the profiles, marking each profile with the appropriate designation. Show any hydraulic jumps that occur. [8]

9. The depth of uniform flow in a rectangular channel is 5 m wide (n = 0.02, $S_0 = 0.04$) is 0.5 m. A low dam raises the water depth of 2 m. Find whether a hydraulic jump takes place and if so at what distance upstream of the dam. [6]

10. A stream has a sediment bed of median size 0.35 mm. The slope of the channel is 1.5×10^{-4}. Stream is considered as trapezoidal with base width 3 m and side slope 1.5 H : 1 V. [6]

   a) If the depth of flow in the channel is 0.25 m, examine whether the bed particles will be in motion or not.
   b) Calculate minimum size of gravel that will not move in the bed of channel. Use empirical equation of critical shear stress as: $\tau_c (N/m^2) = 0.155 + \dfrac{0.409 d_{mm}^2}{(1 + 0.177 d_{mm}^2)^{1/2}}$.

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| Exam.	Regular (2066 & Later Batch)		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	II / II	Time	3 hrs.

Subject: - Hydraulics *(CE555)*

✓ Candidates are required to give their answers in their own words as far as practicable.
✓ Attempt **All** questions.
✓ The figures in the margin indicate **Full Marks**.
✓ Assume suitable data if necessary.

1. Describe with appropriate expressions (a) Prandtl's mixing length theory (b) Hagen poisseuille equation (c) Nikuradse's experiments and (d) Colebrook-white equation. · [8]

2. Two pipes have a length L each. One of them has diameter D_1 and the other has diameter D_2. If the pipes are arranged in parallel, the loss of head when a total quantity of water Q flows through them is H_1. If the pipes are arranged in series and the same quantity Q flows through them, the loss of head is H_2. If $D_2 = D_1/2$, find the ratio of H_1 to H_2, neglecting minor losses and assuming same f. [8]

3. A reservoir A discharges through a pipe 450mm in diameter and 900m long which is connected to two pipes, one 1200m long leading to reservoir B 36m below A and the other 1500m long leading to reservoir C 45m below A. Calculate the diameters of these two pipes if they have equal discharges which together equal that of a 450mm diameter pipe of length 2100m connected directly from reservoir A 'to reservoir B. Neglect all losses except those due to friction and assume that the friction factor f is the same for all pipes. [10]

4. Derive an expression for the pressure rise due to instantaneous closure of valve considering the pipe to be elastic. From the derived expression for elastic pipe, obtain the pressure rise for rigid pipe. · · ' [7+1]

5. Explain Gradually varied and spatially varied flow with one practical example for each. [4]

6. a) Develop the relationship between Chézy's coefficient, Manning's coefficient and Darcy's coefficient. [4] ·

   b) A rectangular channel 8m wide and 1.5m deep has a slope of 0.001 and in lined with smooth plaster. It is desired to enhance the discharge to a maximum by changing the dimension of the channel, but keeping the same amount of lining. Work out the new dimension and the percentage increase in discharge. Take roughness coefficient n = 0.015. [6]

7. What is specific force? Prove that for a given specific force the discharge in a given channel section is maximum when the flow is in the critical state. A venturiflume in a rectangular channel of width of "B" has the throat width of 'b'. The depth of liquid at entry is H and at the throat is h. Prove that following relation exists for the discharge and width ratio: [2+4+3+3]

$$Q = 3.13 b H^{3/2} \left(\frac{h}{H}\right)^{3/2}$$

$$\frac{b}{B} = \sqrt{3}\left(\frac{h}{H}\right) - \sqrt{3}\left(\frac{h}{H}\right)^{3/2}$$

8. Derive the dynamic equation of Gradually varied flow (GVF) and convert the derived equation for the case of wide rectangular channel, using Manning's equation, into following form: [8]

$$\frac{dy}{dx} = \frac{S_0\left[1-(y_n/y)^{10/3}\right]}{1-(y_c/y)^3}$$ Where S_0 = bed slope, y_n = normal depth, y_c = critical depth.

9. Draw a hydraulic jump profile and indicate depths and energy loss using specific energy and specific force diagram. Also derive momentum equation for the hydraulic jump in rectangular channel. · [6]

10. A trapezoidal channel 1.5m deep, 10m bed width, with 2:1 side slopes is excavated in gravel of median size of 60mm. What is the maximum permissible channel slope and what discharge can the channel carry without disturbing its stability? Take angle of repose(ϕ) = 37° and K_2 = 0.9. [6]

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Exam.		Back	
Level	BE	Full Marks	80
Programme	BCE, B.Agri.	Pass Marks	32
Year / Part	II / II	Time	3 hrs.

Subject: - Hydraulics

✓ Candidates are required to give their answers in their own words as far as practicable.
✓ Attempt any **Five** questions.
✓ The figures in the margin indicate **Full Marks**.
✓ Assume suitable data if necessary.

1. a) Obtain an expression for pressure rise due to closure of valve at the end of the pipe line when the valve is instantaneously closed. [8]

   b) A flow of 30m³/s is carried in a 5m wide rectangular channel at a depth of 1.0m. Find the slope necessary to sustain uniform flow at this depth if n = 0.012. What change in roughness would produce uniform critical flow at this discharge on this given slope? [8]

2. a) Derive an expression for the momentum equation in the case of hydraulic jump in the rectangular channel. Hence derive the relation between initial and sequent depths. [8]

   b) A rectangular concrete channel 4m wide has a slope of 9 × 10⁻⁴. It carries a flow of 18m³/s and has a depth of 2.3m at one section. By using the direct step method and taking one step, compute the depth 300m downstream. Take n = 0.012. What is the type of surface curve obtained? [8]

3. a) Differentiate between mobile boundary and rigid boundary channel. Hence define critical tractive stress and incipient motion condition. [6]

   b) A reservoir A with surface level 60m above datum supplies to a junction box through a 300mmφ pipe 600m long. From the junction box, 300mm and 200mm diameter pipes branch off. The 300 mm diameter pipe is 600m long and connected to a reservoir B of level 48.19m while 200mm diameter pipe is 300m long and is connected to a reservoir C of level 45.38m. Find the discharge into or from the reservoir B and C. Take f = 0.03. [10]

4. a) Derive the discharge equation for the trapezoidal weir. Discuss also the impact of approach velocity and end contraction while deriving such equation. [8]

   b) A smooth pipe carries 0.30m³/s of water discharge with a head loss of 3m per 100m length of the pipe. Determine the diameter of the pipe. Use friction factor equation for smooth pipe as $f = 0.0032 + \dfrac{0.221}{Re^{0.237}}$ and assume $\dfrac{\mu}{\rho} = 10^{-6} m^2/s$. [8]

5. a) Prove that the condition for most economical partially filled circular channel section for maximum velocity is h = 0.81D, Where h = depth for maximum velocity and D is diameter of the channel. [8]

   b) Pipes of 50mm diameter are to be used to siphon water from a main canal to a branch canal, the differences of water level between the two canals being 12m. The length from the main canal to the summit of the pipe line is 18m. The total length of the pipe being 45m. Determine the number of pipes required to discharge at least 60 liters/sec to the branch canal. Find also the maximum heigh of the summit above the water level of the main canal so that the pressure at the summit may not fall below 20KPa (absolute). Take f = 0.03. Ignore minor losses. [8]

6. a) Derive Darcy-Weisbach equation for the friction head loss in the pipe. What are Hydraulic grade and Total Energy lines? [8]

   b) For the purpose of discharge measurement, the width of a rectangular channel is reduced from 2.75 m to 2 m and the floor is raised by 0.3m at a given section. What rate of flow is indicated by a drop of 0.15 m in the water surface elevation at the contracted section when the depth of the approach flow is 2 m? [8]

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Subject: - Hydraulics

✓ Candidates are required to give their answers in their own words as far as practicable.
✓ Attempt __All__ questions.
✓ The figures in the margin indicate __Full Marks__.
✓ __Necessary figure is attached herewith.__
✓ Assume suitable data if necessary.

1. Explain Prandtl mixing length theory. Starting from the expression for turbulent shear stress derive the velocity distribution in the region of turbulent flow near hydrodynamically smooth boundaries in the form $\dfrac{u}{u*} = 5.75 \log_{10}\left(\dfrac{u*y}{D}\right) + 5.5$.   [2+6]

2. What size of new cast iron pipe is needed to transport 400 lps of water for 1 km long pipe with 2m head loss? Take roughness height of the pipe is 0.26mm and the viscosity of water 0.0014 Pa.S.   [8]

3. Reservoir A, water surface elevation 120m is connected to reservoir B and C having surface elevation 70m and 50m respectively. A pipe line 150mm diameter and 400m long connects reservoir A to Junction D: Reservoir B and C are connected to Junction D by 75mm diameter 100m long and 100mm diameter 250m long pipeline respectively. Assuming friction factor f = 0.04 for all pipes, estimate the rate of flow for each pipe, neglecting minor head losses.   [10]

4. A 20m long, 75mm diameter, steel pipeline, wall thickness 6mm, carries water from a large reservoir tank, held at a constant head of 6m. Discharge is 0.022m3/s through a variable speed valve positioned 10m from the supply tank. Discharge is to a second constant head tank held at 2m head as shown in figure below. If the valve closure is instantaneous, determine the theoretical magnitudes of the pressure wave propagated away from the valve under frictionless conditions. Draw pressure (both steady and unsteady) time curve at point 5m, 2.5m and 0.5m from the upstream tank. Take K = 2×10^9 N/m^2 and E = 204×10^9 N/m^2.   [8]
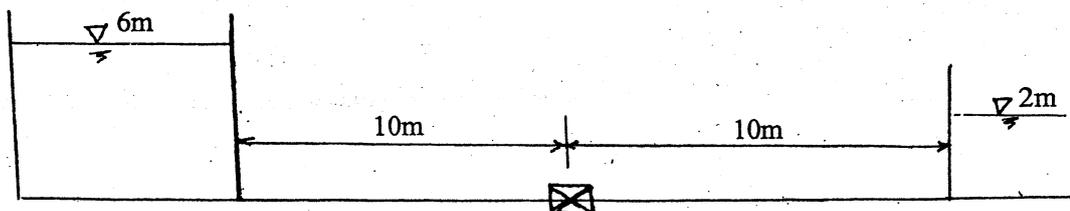
5. Differentiate gradually, rapidly and spatially varied flow with neat sketches and examples. What is energy slope?   [3+1]

6. Find a expression for the theoretical depth for maximum velocity in a closed circular channel in terms of the diameter "d". Compare the discharge at maximum velocity with that when the channel is running full, assuming that the Chezy's coefficient is unaltered, and the pressure remains atmospheric.   [5+2]

OR

Write algorithm and programme coding in any high level language (C or Fortran) for calculating uniform depth for rectangular channel.   [2+5]

7. Draw and explain the velocity profile in a cross-section of rectangular, triangular and trapezoidal channel shapes.   [3]

8. Why the critical depth varies for the constriction flow analysis and does not vary for the hump flow analysis? A rectangular channel 2m wide has a flow of 2.4 m^3/s at a depth of 1.0m. Determine if critical depth occurs (a) a section where a hump of $\Delta Z = 20$cm high is installed across the channel bed, (b) a side wall constriction (with no humps) reducing the channel width to 1.7m, and (c) both the hump and side wall constrictions combined. Will the upstream depth be affected for case (c)? If so, to what extent? Neglect head losses of the hump and constriction caused by friction, expansion and contraction. [2+2+3+3+2]

9. A rectangular channel conveying a discharge of 30 m^3/sec is 12m wide with a bed slope 1 in 6000 and having Manning's n = 0.025. The depth of flow at a section is 1.5m. Find how far upstream or downstream of this section the depth of flow will be 2m. Find also the types of profile. Use direct step method for calculation and take only two steps for calculation. [7+1]

10. A wide channel with uniform rectangular section has a change of slope from 1 in 95 to 1 in 1420 and the flow is 3.75m^3/s per m width. Determine the normal depth of flow corresponding to each slope and show that a hydraulic jump will occur in the region of the junction. Calculate the height of the jump and sketch the surface profiles between the upstream and downstream regions of uniform flow. Manning's coefficient n = 0.013 and it may be assumed that the channel is wide in comparison with the depth of flow, so that the hydraulic mean depth is approximately equal to the depth of flow. [6]

OR

Find the pre jump and post jump heights of the hydraulic jump formed at the toe of the spillway. Neglect energy loss due to flow over spillway. [6]

Height of the crest above D/S bed level = 3m
Discharge = 80 m^3/s
Width of the canal = 10.0m
Head over the crest level = 2.47m

Explain the formation condition of repelled and submerged jump for the above flow condition.

11. A channel which is to carry 10 m^3/s through moderately rolling topography on a slope of 0.0016 is to be excavated in coarse alluvium with 50% of particles being 3cm or more in diameter. Assume that channel is to be unlined and of trapezoidal section. Find suitable value of base width and side slope. Take $\varphi = 34°$ and K_2 (ratio between bed shear stress and critical shear stress) = 0.75. Use tractive force method. [6]

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$E_1 = E_2 + \Delta z$,

$E_1 = E_2$

| Exam.		Back	
Level	BE	Full Marks	80
Programme	BCE, B.Agri.	Pass Marks	32
Year / Part	II / II	Time	3 hrs.

Subject: - Hydraulics

✓ Candidates are required to give their answers in their own words as far as practicable.
✓ *Attempt any **Five** questions.*
✓ *The figures in the margin indicate **Full Marks.***
✓ *Assume suitable values of necessary.*

1. a) Describe the variation of pressure with time near the valve, with neat sketches, when flowing fluid in the long pipe is brought to rest by the valve at the downstream end of pipe. [8]

   b) Distinguish between most economical and most efficient channel section. Show that the most of economical trapezoidal channel section has its side slope equal to 60°. [8]

2. a) Starting from dynamic equation of GVF, prove that the flow profile slope for wide rectangular channel, using Manning's equation, will be:

$$\frac{dy}{dx} = S_0 \frac{1-\left(\dfrac{y_n}{y}\right)^{10/3}}{1-\left(\dfrac{y_c}{y}\right)^{3}}$$

   Where S_0 = bed slope, y_n = normal depth, y_c = critical depth [4]

   b) Derive the equation for jump height calculation through the specific energy analysis. [6]

   c) There is a pressure loss of $300 KN/m^2$ when water is pumped through a pipeline A at a rate of 2 m^3/s and there is a pressure loss of 250 KN/m^2 when water is pumped at a rate of 1.4 m^3/s through pipeline B. Calculate pressure loss which will occur when 1.5 m^3/s of water are pumped through pipes A and B jointly if they are connected (i) in series, (ii) in parallel, assuming that junction losses may be neglected. In the latter case calculate the discharge through each pipe. [6]

3. a) Why the critical depth varies for the constriction flow analysis and does not vary for the hump flow analysis? Describe the specific discharge curve for the study of constriction flow analysis. [8]

   b) A pipe line 30m long connects two tanks which have a difference of water level of 12m. The first 10m of pipeline from the upper tank is of 40 mm diameter and the next 20m is of 60mm diameter. At the change in section a valve is fitted. Calculate the rate of flow when the valve is fully open assuming that its resistance is negligible and that f for both pipes is 0.0216. In order to restrict the flow, the valve is then partially closed. If K for the valve is now 5.6, find the percentage reduction in flow. [8]

4. a) Why it is necessary to include kinetic energy correction factor (α) in Bernoulli's equation and momentum correction factor (β) in momentum equation for the fluid flow analysis? Derive the expressions for kinetic energy correction factor and momentum correction factor. [8]

b) Using Hadry-Cross method find the discharge for each pipe as shown in figure below.   [8]

Q = 50 unit

B

r = 4   r = 3

Q = 100 unit   r = 3   C

A   Q = 25 unit

r = 3   r = 2

D

Q = 75 unit
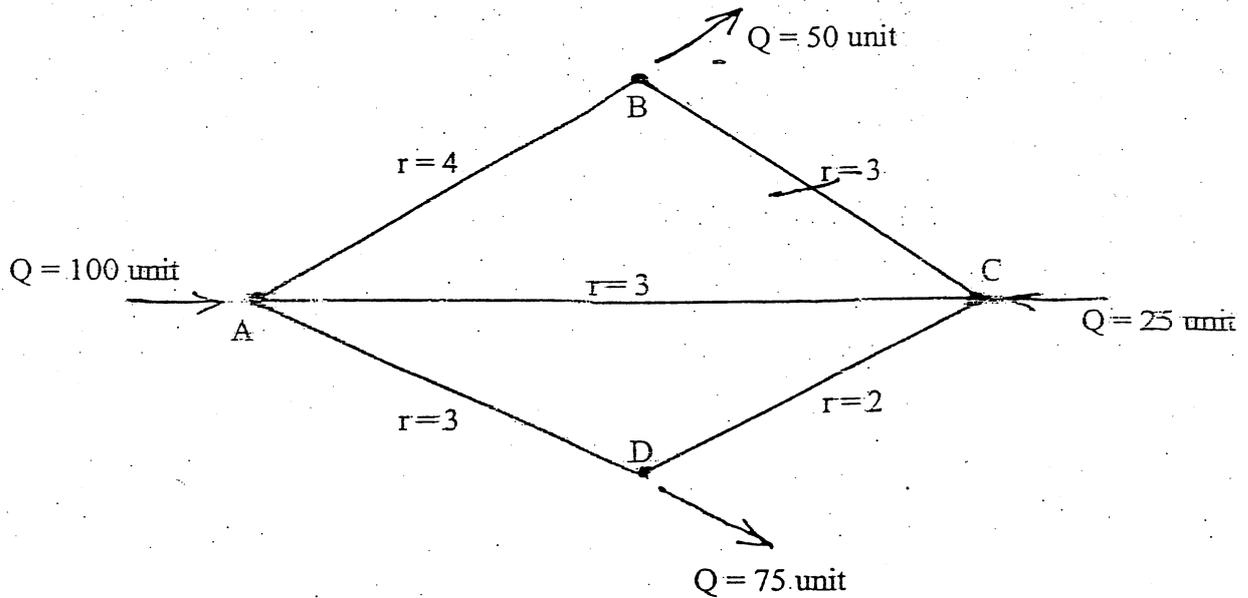
5. a) Define mobile boundary channel. Explain the use of shield diagram for designing mobile boundary channel.   [6]

   b) A wide rectangular channel having a bottom slope of $5×10^{-3}$ has a constant value of Chezy's coefficient equal to 76. If discharge per unit width is $4.5m^2/s$ and channel ends as an abrupt drop, find the length of surface curve. Use direct step method taking maximum of 5 steps.   [10]

6. a) What is Moody's chart? Describe the different flow zones in Moody's chart with necessary governing equations.   [2+4]

   b) Distinguish between major and minor head losses. Find the expression for minor head losses.   [6]

   c) The behavior of a river with discharge of 2000 m^3/s is required to be studied by making distorted model having horizontal scale ratio 1/1000 and vertical scale ratio 1/100. Find the discharge of the model.   [4]

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Subject: - Surveying II (CE554)

✓ Candidates are required to give their answers in their own words as far as practicable.
✓ Attempt __All__ questions.
✓ The figures in the margin indicate __Full Marks__.
✓ Assume suitable data if necessary.

1. a) Explain the procedure of computation of omitted measurement, when two affected sides of traverse are not adjacent. [6]

   b) The following observations are made in a traverse ABCDA. [10]

Traverse Leg	Horizontal Distance (m)	Traverse Station	Horizontal Angle		
			°	'	"
AB	71.5	A	78	41	25
BC	42.0	B	101	18	38
CD	70.0	C	89	59	41
DA	56.0	D	90	00	21

   Bearing of CD = 314°58'04" Coordinate of C (500 m N, 500 mE)
   Complete the Gale's Table with final adjusted length and bearing of each line.

2. a) Describe about the working principle of subtense bar tacheometry and derive subtense bar formula for computing horizontal and vertical distances when line of sight is inclined upward. [2+4]

   b) It is required to determine the height (clear) of a Flood light tower in an arena by using a transit theodolite and for this zenith angles observation taken at 5 m and 2 m height on a target vane held on the plinth level of tower were 87°45' and 88°30' respectively. From the same instrument, zenith angle observed at top of the tower was found as 67°45'. If the RL of the instrument axis was 1200.00 m, Calculate the clear height (plinth to top) of the tower. [10]

3. a) Explain contour, contour interval, horizontal equivalent, index contour and the characteristics of contour with appropriate neat sketches. [8]

   b) The following are the co-ordinates of three known station points whose directions are observed from the unknown instrument station P. [8]

	A	B	C
Easting (m)	5,000	10,000	15,000
Northing (m)	10,000	15,000	10,000

   If observed horizontal angle APB = 45° and BPC = 52°

   Determine (i) Length and Bearings of AP, BP and CP (ii) Co-ordinates of P.

4. a) Derive the expression that in a parabolic shaped vertical curve, RL of any curve point 'P' is equal to $y_p = \dfrac{(g_2 - g_1)x^2}{200L} + \dfrac{g_1 x}{100} + RL$ of BVC

   Where, g_1 and g_2 are percentage of grade of two tangents, L is the total length of curve and x is the chord distance taken from BVC. Also find the formula to determine lowest and highest point of the curve. [6]

b) A road 8 m wide is to deflect through an angle of 60° with the center line radius of 300 m, the chainage of intersection point being (3+605) Km. A transition curve is to be used at each end of the circular curve of such a length that the rate of change of radial acceleration is 50 cm/sec^3, when the speed of design vehicle is 70 Kmph, find out: [10]

     i) Length of transition curve

     ii) Super elevation

     iii) Chainage of tangent points and junction points

     iv) Deflection angles for first two points of transition curves and circular curve.

Take peg interval for transition curve = 10 m and circular curve = 20 m.

5. Attempt any four: [4×4]

     a)   Feature of total station and its importance
     b)   Working principle and components of GPS
     c)   Field procedure of aerial photogrammetry
     d)   Application of remote sensing in engineering and mapping
     e)   Components of GIS and its application

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INSTITUTE OF ENGINEERING

Examination Control Division

2072 Magh

Exam.	New Back (2066 & Later Batch)		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	II / II	Time	3 hrs.

Subject: - Surveying II *(CE554)*

✓ Candidates are required to give their answers in their own words as far as practicable.
✓ Attempt *All* questions.
✓ The figures in the margin indicate *Full Marks*.
✓ Assume suitable data if necessary.

1. a) Describe consecutive and independent coordinates. Explain the plotting method of traverse by grid coordinates. [3+3]

   b) In a four sided closed traverse ABCDA the following informations are given. [10]

Side	Length (m)	Deflection angle	Bearing	Coordinates
AB	280.00	?	S50°W	?
BC	360.00	85°00' Left	?	?
CD	320.00	135°00' Left	?	C=2500mE, 2500mN
DA	?	?	?	?

   i) Compute all missing figures.
   ii) Compute the coordinates of other points with respect to C.

2. a) Develop expression for H, V, and R.L for the tangential system of tachometry when the both sightings are angles of depression. [4]

   b) Determine gradient and bearing of PQ. The staff was held vertical. K = 100, C = 0. [6]

Inst. St.	Staff St.	Bearing	Zenithal Angle	Staff Readings (m)		
				T	M	B
R	P	S60°E	79°28'	2.36	1.81	1.25
	Q	S30°W	95°06'	2.94	2.12	1.30

   c) The top (Q) of a tower was sighted from two stations at very different level and in same vertical plane with Q. Find R.L of the top of tower from the following observed data: [6]

Inst. St.	H.I	R.L	Target	Zenithal angle
P	1.87 m	-	Q	51°39'
R	1.64 m	112.78 m	Q	68°42'

   The distance between instrument stations P and R is 120 m.
   The angle of elevation from R to 2 m. above the root of the staff held at P was 15°11'

3. a) Explain the factors that affect the contour interval. [4]

   b) In a trigonometrical levellings a hill station "P" was sighted from two instrument station A and B which were at very different level but with same line of sight to that of target and following information were noted. [6]

Inst. st[n]	HI (m)	Target	Zenith	Angle	Distance
			FL	FR	
A	1.42	P	65°18'	304°36'	120.00m
B	1.47	P	69°52'	290°00'	(st[n] A to St[n] B)
A	1.42	B	102°52'	257°16'	

   Determine the RL of P, if RL of ground point B was 1280.00 m and vane height while sighting from A to B was 2.50 m above the foot of the vane.

c) In two point resection problem, if two known points A and B having coordinates (6928.474 mN, 7464.418 mE) and (5363.275 mN, 9602.054 mE) are given. From two points C and D located south and west of AB, angles observations are: $\angle$ ACB = 70°35'48", $\angle$ DCA = 52°25'35", $\angle$ ADB = 65°27'35" and $\angle$ BDC = 32°16'42". Determine the coordinates of resection point "C" [6]

4. a) Derive the formula for deflection angle (α) in transition curve, $\alpha = 573\ l^2/RL$ minute. [4]

b) Calculate the R.L.s of pegs on a vertical curve connecting two grades of -0.5% and +0.7% at the intersection point which has chainage = 1000 m and R.L = 500 m. The rate of change of grade is 0.1% per 30 m. Take peg interval = 20. [6]

c) Compute the data for setting out a simple circular curve by Rankines deflection angle method from the following informations: [6]

      Angle of intersection = 145°0'
      Chainage of point of intersection = 1580 m
      Degree of curve = 5°
      Least count of the theodolite = 10"
      Peg interval = 30 m

5. Write short note on: (any four) [4×4]

a) Field procedure of aerial photogrammetric
b) Application of remote sensing in engineering and mapping
c) Working principle and components of GPS
d) Components of GIS and its application
e) Features of total station and its importance

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Examination Control Division
2071 Bhadra

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	II / II	Time	3 hrs.

Subject: - Surveying II *(CE554)*

✓ Candidates are required to give their answers in their own words as far as practicable.
✓ Attempt _All_ questions.
✓ The figures in the margin indicate _Full Marks_.
✓ Assume suitable data if necessary.

1. a) Define closed loop and closed link traverse. Also explain angular misclosure balancing process in linked traverse.   [6]

   b) A traverse ABCDA was conducted and the following data were obtained. It was required to connect the midpoint E of CD to the midpoint F of AB. Find the length and bearing of EF.   [10]

Line	Length	Bearing
AB	610.00	N 80°10′ E
BC	510.00	N 13°00′ E
CD	1130.00	S 80°10′ W
DA	450.00	S 15°30′ E

2. a) State the principle of stadia tacheometry and describe the field procedure of tacheometry survey for preparing topographic map.   [8]

   b) A tachometric survey was done to find the gradient between X and Y. Tacheometer consist of an anallatic lens was used and following observations were made from section R on vertical staff.   [8]

Inst. Stn.	Staff point	Stadia hair readings	Vertical angle	Bearing
R	X	0.915, 1.750, 2.585	+15°	345°
	Y	0.760, 2.240, 3.715	+10°	75°

3. a) How can you measure the horizontal distance and elevation of an inaccessible object when the instrument positions are at very different levels; instrument stations and the elevated object are in the same vertical plane.   [8]

   b) The co-ordinates of three known stations Swayambhu, Dharara and Chovar temple is given below.   [8]

Known station	Horizontal angle	Easting	Northing
Swayambhu (S)	∠S × D = 41°20′21″	627464.718	3066928.474
Dharara (D)	∠D × C = 97°56′41″	629602.054	3065363.275
Chovar Temple (C)	∠C × S = 220°42′58″	627611.753	3061479.468

   A theodolite is set up over an unknown point X. Calculate the co-ordinates of station X using the Tienstra method.

4. a) Describe index contour and explain indirect method of contouring for field control. [1+5]

   b) A road 8m wide is to deflect through an angle of 60° with the center line radius of 300m, the chainage of intersection point being 3605m. A transition curve is to be used at each end of circular curve of such a length that the rate of gain of radial acceleration is 0.5 m/s³, when the speed is 50 km/h. Find out: [10]

      i) length of transition curve
      ii) superelevation
      iii) chainage of all tangent points and junction points
      iv) Calculate the first two deflection angles for transition curve, and first two deflection angles for circular curve. Take peg interval = 10m for transition curve and 20m for circular curve.

5. Write short notes on: (any four) [4×4]

   a) Working principle and components of GPS
   b) Relief displacement and its expression
   c) Application of remote sensing in civil engineering
   d) Features of total station and its importance
   e) Component of GIS and its application

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INSTITUTE OF ENGINEERING

Examination Control Division

2071 Magh

Exam.	New Back (2066 & Later Batch)		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	II / II	Time	3 hrs.

Subject: - Surveying II *(CE554)*

✓ Candidates are required to give their answers in their own words as far as practicable.
✓ Attempt **All** questions.
✓ The figures in the margin indicate **Full Marks**.
✓ Assume suitable data if necessary.

1. a) When would you suggest a theodolite traversing by the method of deflection angles? Explain with neat sketches. [6]

   b) The following data refers to a traverse ABCDE. Determine the bearings of the sides DE and EA. [10]

Line	AB	BC	CD	DE	EA
Length (m)	230.50	250.20	210.80	240.30	265.40
Bearing	N 36°45′ E	S 82°48′ E	S 10°15′ E	?	?

2. a) The co-ordinates of stations S and A are (1309.12 m E, 1170.50 m N) and (1525.43 m E and 956.87 m N) respectively. Calculate the co-ordinates of point B which has been located by intersection from stations S and A observing the following angles. $\angle BSA = 85°38′49″$ and $\angle SAB = 55°50′33″$. [8]

   b) Calculate the elevation difference and gradient between stations A and B from the given data which are observed by a tacheometer from station R. Staff was vertically held at A and subtense bar at B. The subtended angle between the instrument and 2m long subtense bar was $00°42′15″$ [8]

Instrument Station	Sighted to	Bearing	Zenith angle	Staff readings (m)	Subtense bar height
R	A	345°00′	96°30′	0.650, 1.250, 1.850	X
R	B	225°00′	85°00′	X	1.180 (m)

3. a) Explain the direct method of contouring and write the uses of contour map. [6]

   b) In a road alignment a falling grade of 1% is followed by rising grade of 0.5%. The chainage and RL of the intersection point are 500 and 350 m respectively. The rate of change of grade is 0.1% per 20 m. Calculate the necessary data required for setting out the vertical curve, take peg interval of 30 m. [10]

4. a) Explain degree of curve with neat sketch. Derive the formula of Tangential angle, $\alpha = \dfrac{90°C}{\pi R}$ and deflection angle $\Delta_n = \delta_1 + \delta_2 + \delta_3 + \ldots\ldots + \delta_n$. [8]

   b) The top of temple was sighted from two stations A and B at very different level. The observed vertical angle from A and B to top of temple 'P' were 30°36′ and 20°12′ respectively. The vertical angle B to A to a vane at 1.5 m above the foot of the vane was 4°15′. The height of instrument at A and B were 1.47 m and 1.42 m. The distance between two instrument station was 112 m. RL of B was 1280.00 m. Find the RL of the top of the temple. Also apply the correction for refraction and curveturate. [8]

5. Write short notes on: (any four) [4×4]
   a) Working principle and components of GPS
   b) Importance and uses of photogrammetry
   c) Application of remote sensing in Civil Engineering
   d) Features, importance and uses of Total Station
   e) Component and subsystem of GIS and its application

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Exam.		Regular	
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	II / II	Time	3 hrs.

Subject: - Surveying II (CE554)

✓ Candidates are required to give their answers in their own words as far as practicable.
✓ Attempt *All* questions.
✓ The figures in the margin indicate *Full Marks*.
✓ Assume suitable data if necessary.

1. a) Write the field measurements required in theodolite traversing and explain closed and open traverses. [4+4]

   b) Balance the following coordinates and compute the total coordinates for a link traverse XABCY using Bowditch's rule. The given coordinates of X and Y are (1877.51 mN, 1290.20 mE) and (1626.50 mN, 1578.87 mE) respectively. If permissible closing error is 1:500, justify your assessment. Other observed data are as follows: [8]

Lines	XA	AB	BC	CY
Length (m)	120.00	111.50	132.40	97.60
Bearing	135°00'	119°30'	175°00'	77°30'

2. a) The following observation were made with a tacheometer. The staff was held vertical (constants are 100 and 0). [8]

Inst. St	Staff St	Bearing	Vertical angle	Staff	Readings	
R	P	100°	+8°20'	2.60	1.85	1.10
	Q	200°	−2°30'	2.50	1.91	1.32

   Find the gradient between P and Q.

   b) Explain the method of trigonometrical levelling to determine the elevation of inaccessible object when the instrument stations and the object are in different vertical plane. [8]

3. a) Explain about the characteristics of contour lines with clear supporting sketches. [8]

   b) Explain any one method of analytical resection. [8]

4. a) Prepare a table giving all necessary data for setting out a vertical curve. [10]

   In a road alignment a grade of −4.5% followed by +3.5%, R.L. of I.P. = 1000 m chainage of IP = 1500 m connect the two grade by a parabolic curve 200 m long. Take peg interval = 20 m.

   b) Determine the expression for the scale of vertical photograph. [6]

5. Write short notes on: (any two)

   a) Write the working principle of GPS, its components and uses. [8]

   b) Working principle of total station, its importance and uses in surveying and mapping. [8]

   c) Write the components of GIS. [8]

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Exam.	New Back (2066 & Later Batch)		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	II / II	Time	3 hrs.

Subject: - Surveying II *(CE557)*

✓ Candidates are required to give their answers in their own words as far as practicable.
✓ Attempt **All** questions.
✓ The figures in the margin indicate **Full Marks**.
✓ Assume suitable data if necessary.

1. a) Explain in brief field procedure of traverse survey between two known stations. [6]

   b) Below given table lists measured angles to the right for the traverse. The bearings A-X and E-Y have known value of 139°05'45'' and 86°20'47'' respectively. Adjust this traverse for departure and latitude misclosure. [10]

Status	Length	Measured angle
A	-	283°50'10''
	1045.50	
B	-	25617'18''
	1007.38	
C	-	98°12'41''
	897.81	
D	-	103°30'34''

2. a) In what situation reciprocal trigonometrically levelling is conducted? Derive a relation for determing the reduced level of a hill top when two instrument stations and target point are at different vertical plane. [6]

   b) A 2 m long subtense bar was placed above station B and the angle subtended at station A was read as 02°40'20''. Intermediate level information was later recorded using a theodolite with tachemetric constants 100 and 0 at station C and the staff was held vertical. The following data were recorded on to stations A and B. [10]

Inst st^n	Sighted to	Horizontal circle	vertical angle	Staff readings (m)
C	A	00°00'00''	-05°10'00''	1.459, 1.649, 1.839
hi = 1.55 m	B	80°24'20''	+10°23'30''	-, 1.235, -

   Find the difference in elevation and distance between A and B, the horizontal angle ACB was 60°0'00''

3. a) What is mean by contour interpolation? Which method do you suggest for contour interpolation in large volume of work and how would you applied it? [6]

   b) A, B and C are three visible stations in a location survey. The computed sides of the triangle ABC are AB = 1200 m, BC = 1442 m and CA = 1960 m. A station '0' is established outside the triangle and its position is to be determined by resection on A, B and C. The angles AOB and BOC being 45°30' and 52°15' respectively. Determine the distances of OA and OC. [10]

4. a) Describe elements of transition curve. [6]

   b) A road curve of 180 m radius is to be set out to connect two tangents. The maximum speed of this part of the road will be 13.2m/sec. Transition curves are to be introduced each end of the curve. Find a suitable length of transition curve and circular curve including the value of first two deflection angles of each curve. [10]

5. a) With the help of neat sketch describe relief displacement on a vertical photograph. [6]

   b) Explain in brief GPS field procedure. [5]

   c) Describe the uses and advantages of satellite imagery. [5]

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Exam.	Regular (2066 & Later Batch)		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	II / II	Time	3 hrs.

Subject: - Surveying II *(CE554)*

✓ Candidates are required to give their answers in their own words as far as practicable.
✓ Attempt **All** questions.
✓ The figures in the margin indicate **Full Marks**.
✓ Assume suitable data if necessary.

1. a) For a closed traverse ABCDA, compute the missing data. [8]

Line	Length(m)	Bearing
AB	100.00	N 45° 30′ W
BC	605.00	N 5° 30′ E
CD	95.00	N 88° 20′ E
DA	?	?

b) What are closed and open traverse? Explain consecutive and independent co-ordinates with examples. [8]

2. a) The following readings were taken by a tacheometer with the staff held vertical. The tacheometer is fitted with an anallactic lens and the multiplying constant is 100. find out the horizontal distance from A to B and gradient of AB. [10]

Instrument station	Staff Station	Vertical angle	Staff readings	Remarks
A	BM	–6°30′	1.100, 1.153, 2.060	RL of BM =970.00m
	B	+10°0′	0.982, 1.105, 1.188	

b) Derive an expression to find the RL of an inaccessible object when the instrument and the object are not in the same vertical plane. [6]

3. a) What are the methods of contouring? Explain briefly. Write the uses of contour maps. [8]

b) What is analytical resection? Derive an expression to find the co-ordinates of unknown points by observations to three known points. [8]

4. a) Calculate the RLs of pegs on a vertical curve connecting two grades of +0.5% and – 0.7% at the point of intersection. The chainage and RL of intersection point are 500m and 350.750m respectively. The rate of change of grade is 0.1% per 30m. [8]

b) Find the elements of simple circular curve. [4]

c) Define: (i) Tilted photograph (ii) Side overlap (iii) Principal point (iv) Flying height [4]

5. a) What is GPS? Write the components and working principle of GPS. [8]

b) Explain the working principle of total station. Write its importance and uses in surveying and mapping. [8]

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17

Exam.		Regular	
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	II / II	Time	3 hrs.

Subject: - Surveying II

✓ Candidates are required to give their answers in their own words as far as practicable.
✓ Attempt __All__ questions.
✓ The figures in the margin indicate __Full Marks__.
✓ Assume suitable data if necessary.

1. a) What are closed and open traverses? Explain transit rule for balancing the traverse. [7]

   b) Balance the coordinates of a link traverse XABCY using Bowditch's rule. The coordinates of stations X and Y are (1162.510N, 775.250E) and (1043.610N, 1043.610E) respectively and permissible closing error is 1:500. Other observed data are given below: [9]

Lines	XA	AB	BC	CY
Length (m)	120.00	111.50	132.40	97.60
Bearings	135°00'	119°30'	175°00'	77°30'

2. a) What is contour gradient? Write characteristics of contours with suitable sketches. [7]

   b) The following observations were taken from the traverse station A and B. The staff was held vertical. The tachometer is fitted with anallactic lens. Multiplicative constant = 100. [9]

Traverse station	H.I. (m)	Staff Station	Bearing	Vertical angle	Staff reading
A	1.50	C	15°14'	+8°9'	2.60 1.85 1.10
B	1.53	D	340°18'	+2°3'	2.50 1.91 1.32

   Independent coordinates of A is (800, 1800)
   Independent coordinates of B is (950, 2500)
   Compute the length and bearing of CD.

3. a) What is degree of curve? Describe the elements of simple circular curve. [7]

   b) Design a composite curve with the following data: Deflection angle = 60°, Maximum speed of vehicle = 40km/hr, centrifugal ratio = 1/8, rate of change of radial acceleration = 0.30m/sec^3, chainage of IP = 1150m. Also calculate the setting out data of circular curve by Rankine's method. Take peg interval = 20m. [9]

4. a) What is GPS? Write about the principles of GPS and its components and applications. [9]

   b) Explain any one method of analytical resection to calculate the position of instrument station. [7]

5. Write short notes on: (any two) [8×2]

   a) Components of GIS and applications of GIS in Civil engineering
   b) Features of total station and it's operations
   c) Remote sensing and it's applications

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TRIBHUVAN UNIVERSITY

INSTITUTE OF ENGINEERING

Examination Control Division
2066 Magh

Exam.	Regular/Back		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	II / II	Time	3 hrs.

Subject: - Surveying II

✓ Candidates are required to give their answers in their own words as far as practicable.
✓ Attempt any *Five* questions.
✓ The figures in the margin indicate *Full Marks*.
✓ Assume suitable data if necessary.

1. a) What are the field measurements necessary in theodolite traversing? Explain Bowditch's rule for balancing the traverse. [6]

   b) In a four sided closed traverse ABCDA, the following informations are given: [10]

Side	Length (m)	Deflection angle	Bearing	Coordinates		Remarks
				Northing	Easting	
AB	160	?	S 40°00' W	?	?	
BC	340	116°00' (L)	?	26500	22400	Coordinates of B.
CD	210	60°00' (L)	?	?	?	
DA	?	?	?	?	?	

   Find the missing data.

2. a) Describe the working principle of subtense bar. Derive an expression to find the horizontal distance and height difference between the instrument station and staff point in the case of fixed hair method, line of sight is inclined and staff held vertical. [7]

   b) A tachometer is placed at a station A and readings on a staff held upon a B.M. of R.L. = 1000.00 and station B are 0.640, 2.200, 3.760 and 0.010, 2.120, 4.230 respectively. The angle of depression of the telescope in the first case is $-6°19'$ and in the second case $-7°42'$. Find the horizontal distance from A to B and R.L. of the station B. (Constants are 100 and 0.3) [9]

3. a) Describe the principle characteristics of contour lines with supporting sketches and uses of contour map. [8]

   b) The top of a hill station P was sighted from two stations A and B at a different level and at the same vertical plane with the target. The zenith angle from A to P and B to P were 59°15' and 69°45' respectively. The zenith angle from A to B to a vane 1.5m above the foot of the vane was 105°30'. If the height of instrument of A and B were 1.45m and 1.35m respectively and distance between A and B was 150m, and RL of B was 120.00m. Find the RL of hill station (if target is 3.5m above the ground). [8]

4. a) Derive the expression of the three point analytical resection. [8]

   b) Two tangents which deflect at an angle of 37°46' are to be connected by a circular curve of 2000m radius with a transition curve at either end. The chainage of the point of intersection is (3436+26) chains. Find the chainages of the beginning and end of the three curves and draw a table of the deflection angles for chords of 15m for each transition curve. Assume velocity = 160 km/hr, rate of change of radial acceleration = 0.3m/sec³, chain used was 30m length. [8]

5. a) Define vertical and horizontal control. Describe the process of measurement of velocity and flow of stream. [8]

   b) A down grade of 3.5% is followed by an upgrade of 4.5%. The reduced level and chainage of IP are 900.00m and 2450.00m respectively. A vertical parabolic curve 180m long is to be introduced to connect the two grades. The pegs are to be fixed at 20m intervals. Calculate the RLS of curve points including lowest point [8]

6. Write short notes on: (any two) [8×2]
   a) Global Positioning System
   b) Photogrammetry its limitation and uses
   c) Location of sounding point in hydrographic survey
   d) Setting out vertical curve

INSTITUTE OF ENGINEERING

Examination Control Division

2065 Kartik

Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	II / II	Time	3 hrs.

Subject: - Surveying II

✓ Candidates are required to give their answers in their own words as far as practicable.
✓ Attempt any **Five** questions.
✓ The figures in the margin indicate **Full Marks**.
✓ Assume suitable data if necessary.

1. a) What is traverse? Explain in brief about traverse computation process. [6]

   b) Given the following latitudes and departures of traverse ABCDEA, the bearings of AB and EA having been omitted. [10]

Line	Latitude (m)	Departure (m)	Length (m)
AB	– – –	– – –	1970
BC	+841.11	+336.71	
CD	+877.18	–311.74	
DE	–700.60	–727.88	
EA	– – –	– – –	1181

   Determine the bearings of AB and EA.

2. a) What is the use of subtense bar? Write the working principles of subtense bar. [6]

   b) Discuss importance of trigonometrical levelling. Derive an expression to find the R.L. of an inaccessible object when the instrument stations are in the different vertical plane. [10]

3. a) Discuss about the principal characteristics of contour lines with supporting neat sketches. [6]

   b) The following observations were made on a vertically held staff with a tacheometer fitted anallactic lens having multiplying constant of 100. [10]

Instrument Station	Height of Instrument	Staff Station	Bearing	Zenith Angle	Hair Reading	Remarks
O	1.55	A	30°30′	85°30′	1.155, 1.755, 2.355	RL of
		B	75°30′	101°15′	1.250, 2.000, 2.750	0 = 450.80m

   Calculate the distance AB and RL$_S$ of A and B. Find the gradient of the line AB.

4. a) Derive the expression for three point resection problem. [8]

   b) A down grade of 4.5% is followed by an upgrade of 3.5%. The reduced level and chainage of the point of intersection level and chainage of the point of intersection are 900.00m and 450.00m respectively. A vertical parabolic curve 180m long is to be introduced to connect the two grades. The pegs are to be fixed at 20m intervals. Calculate including lowest point also. [8]

5. a) Describe about the setting out techniques of right hand side composite curve. [6]

   b) Two straights AB and BC intersect at the chainage (1+400) kilometer, the deflection angle being 40°00′. It is proposed to layout a circular curve of 400m radius with a cubic parabola of 90m length at each end. Peg intervals for circular and transition curve re 20m and 30m respectively. Calculate tangential angles for first two points on transition curve, deflection angles for two points on the circular curve and chainage at the beginning and at the end of this composite curve. [10]

6. Write short notes on any two: [8×2]
   a) Global positioning system (GPS) b) Location of sounding points
   c) Remote sensing and its application

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Exam.		Regular/Back	
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	II / II	Time	3 hrs.

Subject: - Surveying

✓ Candidates are required to give their answers in their own words as far as practicable.
✓ *Attempt any **Five** questions.*
✓ *The figures in the margin indicate **Full Marks**.*
✓ *Assume suitable data if necessary.*

1. a) What are closed and open traverses? Explain Bowditch's rule for balancing the traverse. [7]

   b) The following data refers to a traverse ABCDE. Determine the bearings of the sides BC and CD. [9]

Line	Length in (m)	Bearing
AB	306.00	164°00′
BC	432.00	?
CD	324.00	?
DE	302.40	328°00′
EA	629.43	269°06′

2. a) Write working principle of a subtense bar. How precision can be increased by using substence bar for computed distance. [7]

   b) The following observations were taken in a tacheometric survey from a station A of R.L. 1086.550, the height of instrument being 1.385m. [9]

Instrument Station	Height of Instrument	Staff Station	Bearing	Zenithol	Stadia Reading
A	1.385	B	18°00′	71°30′	1.295, 1.820, 2.345
		C	127°′	96°00′	1.010, 1.790, 2.570

   The instrument is fitted with an anallactic lens and the multiplying constant is 100. Determine the R.L. of B and C and the gradient of the line BC.

3. a) Write characteristics of contours and illustrate with suitable sketches. [9]

   b) Explain the method of determining the R.L. of an in accessible object when the instrument stations and object are in different vertical plane. [7]

4. a) What is degree of curve? Find the elements of a composite curve including sketch. [7]

   b) Two tangents intersect at chainages 1190m, the deflection angle being 36°. Calculate all the necessary data for setting out a curve with a radius of 300m, by deflection angle method. Take peg interval of 30m. Also provide check to support the calculation during setting out. [9]

5. a) Derive the expression that the tangential angle for points on the circular curve is equal to $1718.87 \times C/R$ and also express about the deflection angles for laying out of circular curve. [6]

   b) A 2% down gradient meets a 3% up gradient at a chainage of 2600m, the RL of the point of intersection being 1200.00m. A vertical parabolic curve is to be setout to connect two grades with pegs at 20m interval. The rate of change of grade is 0.5% per 20m chain. Tabulate the chainages and RLS of the station pegs including lowest point on the curve. [10]

6. Write short notes on (any two): [8×2]

   a) Analytical resection   b) Under water mapping   c) Global Positioning System (GPS)

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06 TRIBHUVAN UNIVERSITY	Exam.	Regular		
INSTITUTE OF ENGINEERING	Level	BE	Full Marks	80
Examination Control Division	Programme	BCE	Pass Marks	32
2072 Ashwin	Year / Part	II / II	Time	3 hrs.

Subject: - Soil Mechanics (CE552)

✓ Candidates are required to give their answers in their own words as far as practicable.
✓ Attempt **All** questions.
✓ The figures in the margin indicate **Full Marks**.
✓ Necessary log-scale and simple graph papers are provided.
✓ Assume suitable data if necessary.

1. Explain briefly the different Civil engineering and infrastructure development problem related to soils. [2]

2. Sandy soil in a borrow pit has unit weight of solids as 25.8 kN/m^3, water content equal to 11% and bulk unit weight equal to 16.4 kN/m^3. How many cubic meter of compacted fill could be constructed of 3500 m^3 of sand excavated from borrow pit, if required value of porosity in the compacted fill is 30%. Also calculate the change in degree of saturation. [8]

3. What is the purpose of classifying soils? What are the basic requirements of a soil classification? Draw the plasticity chart incorporate in Indian standard soil classification system and give group symbols of various regions in the chart. [1+2+5]

4. Describe the types of possible soil structures. [4]

5. What are the factors affecting compaction? How will you control the compaction in the field? [2+4]

6. Obtain the expression for the critical hydraulic gradient necessary for a quick condition to develop by using effective stress approach. Why is there more likelihood of quick condition in sands than in clay? For a field pumping test, a well was sunk through a horizontal stratum of sand 14.5 m thick and underline by a clay stratum. Two observation wells were sunk at horizontal distances of 16 m and 34 m respectively from the pumping well. The initial position of the water table was 2.2 m below ground level. At a steady state pumping rate of 925 liters/minute, the drawdowns in the observation wells were found to be 2.45 m and 1.20 m respectively. Calculate the coefficient of permeability of the sand. [3+1+6]

7. What is unconfined flow in seepage flow? Show the process of calculation of uplift force at base of concrete dam due to seepage flow between dam and impervious layer using flow net. [2+6]

8. A water tank is supported by a ring foundation having outer diameter of 10 m and inner diameter of 7.5 m. The ring foundation transmits uniform load intensity of 160 kN/m^2. Compute the vertical stress induced at depth of 4 m, below the center of ring foundation. [8]

9. What is the governing differential equation in one dimensional consolidation theory?   [3+3+4]

The results of a laboratory consolidation test on a clay sample are given below:

Pressure P $((kN/m^2)$	void ratio, e
23.94	1.112
47.88	1.105
95.76	1.080
191.52	0.985
383.04	0.850
766.08	0.731

i. Draw an e-log p plot.
ii. Determine the pre-consolidation pressure (p_c).
iii Find the compression index (c_c).

(Provide log scale graph paper)

10. Two identical soil specimen were tested in a triaxial apparatus. First specimen failed at a deviator stress of 770 kN/m^2 when the cell pressure was 2000 kN/m^2. Second specimen failed at a deviator stress of 1370 kN/m^2 under a cell pressure of 400 kN/m^2. Determine the value of c and ϕ analytically. If the same soil is tested in a direct shear apparatus with a normal stress of 600 kN/m^2 estimate the shear stress at failure.   [10]

11. What types of slope failures are common in soils? What factors provoke slope failure? What methods of analysis are used to estimate the factor of safety of a slope?   [1+2+3]

✗✗✗

Exam.	New Back (2066 & Later Batch)		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	II / II	Time	3 hrs.

Subject: - Soil Mechanics *(CE552)*

✓ Candidates are required to give their answers in their own words as far as practicable.
✓ Attempt __All__ questions.
✓ The figures in the margin indicate __Full Marks__.
✓ __Necessary log-scale and simple graph papers are provided.__
✓ Assume suitable data if necessary.

1. In what way does the knowledge of soil mechanics help in civil engineering practice?   [2]

2. A project engineer receives a laboratory report with tests performed on central material testing laboratory, IOE, Pulchowk. The engineer suspects that one of the measurements is in error. Are the engineers suspicions correct? If so, which one of these values is wrong and what should be its correct value?   [8]

   γ = unit weight of sample = 18.4 kN/m^3

   γ_s = unit weight of solids = 26.1 kN /m^3

   w = water content = 40%

   e = voids ratio = 1.12

   S = degree of saturation = 95%

3. Compare the Plasticity chart provided to classify fine grained soil in USCS, ISSCS and BSCS.   [8]

4. What is the effect of increased surface area on the properties of soils? Illustrate by schematic diagrams how the clay minerals Kaolinite, Illite and Montmorillonite are formed.   [1+3]

5. An embankment for a highway 30 m wide and 1.5 m compacted thickness is to be constructed from a sandy soil trucked from a borrow pit. The water content of the sandy soil in the borrow pit is 15% and its void ratio is 0.69. The specification requires the embankment be compacted to a dry unit weight of18 KN/m^3. Determine for 1 km length of embankment the following: [2+2+2]

   i) The weight of sandy soil from the borrow pit required to construct the embankment
   ii) The number of 10 m^3 truck loads of sandy soil required for the construction
   iii) The degree of saturation of the sandy soil in -situ

6. Determine the effective stress at 2m, 4m, 6m 8m and 10m in a soil mass having γ_{sat} = 21 kN/m^3. Water table is 2 m below ground surface. Above water table there is capillary rise up to ground surface. Also draw total stress diagram up to 10.00m.   [10]

7. What is a flow net? Describe its properties and uses. Prove that the discharge through an earth mass is given by, q = K*h*(N$_f$/N$_d$)   [1+2+5]
   K = coefficient of permeability
   h = head
   Nf = number of flow channels
   Nd = Number of equipotential drops

8. An elevated structure with a total weight of 10,000 KN is supported on a tower with 4 legs. The legs rest on piers located at the corners of a square 6 m on a side. What is the vertical stress increment due to this loading at point 7 m beneath the center of the structure? [8]

9. A building is constructed in site having 4 m thick clay layer. The effective stress in mid of clay layer is 60 KN/m^2. The oedometer test analysis gives preconsolidation pressure of clay is 100 KN/m^2, coefficient of compression 0.32, coefficient of recomprerssion 0.12 and intial void ratio 0.27. Calculate the settlement due to consolidation if [5+5]

   i) Building increase 30 KN/m^2 stress at mid of clay layer
   ii) Building increase 80 KN/m^2 stress at mid of clay layer

10. Draw a typical stress-strain and volume change characteristics curves for loose sands and dense sands from consolidated drained test. An unconfined compression test was carried out on a saturated clay sample. The maximum load the clay sustained was 127 N and the vertical displacement was 0.8 mm. The size of the sample was 38 mm diameter and 76mm long. Determine the undrained shear strength. Draw Mohr's circle of stress for the test and locate undrained shear strength (c_u). [3+7]

11. Define factor of safety. How can you calculate the factor of safety in C-ϕ analysis? [1+5]

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| Exam.		Regular / Back	
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	II / II	Time	3 hrs.

Subject: - Soil Mechanics *(CE552)*

✓ Candidates are required to give their answers in their own words as far as practicable.
✓ Attempt *All* questions.
✓ *The figures in the margin indicate **Full Marks**.*
✓ *Assume suitable data if necessary.*

1. Compare the soil classification criteria for fine soil in Indian standard soil classification system and unified soil classification system. [8]

2. The following results refer to the liquid limit test. [8]

No. of blow	33	23	18	11
Water content (%)	41.5	49.5	51.5	55.6

   The plastic limit form two tests were 23% and 24% respectively. Determine the plasticity index and toughness index for the soil.

3. List the types of soil depending on its formation. Describe the possible soil structures in natural soil mass. [2+4]

4. What is the effect of compaction on the engineering properties of the soil? How would you decide whether the soil should be compacted the dry of the optimum or the wet of optimum? [6]

5. For the subsoil conditions as shown in figure below, plot the total, neutral and effective stress distribution up to the bottom of the clay layer. [10]
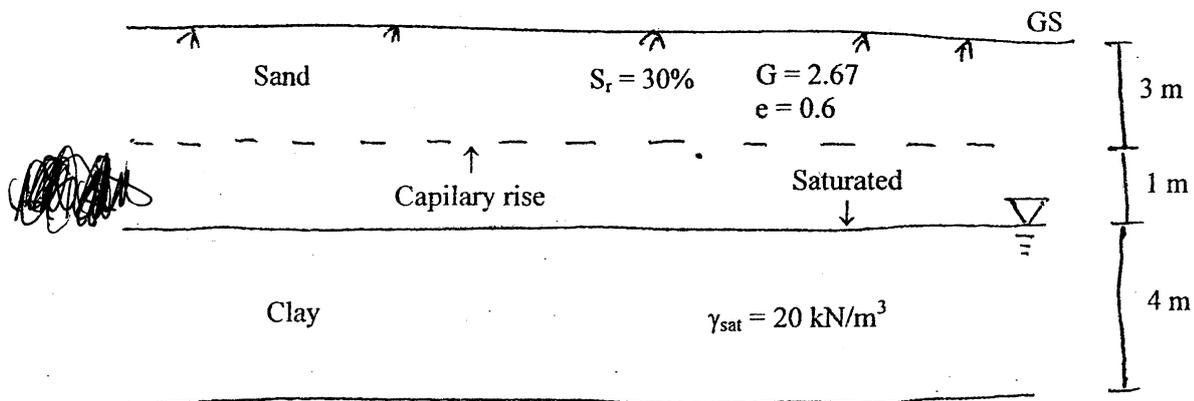
6. Derive an equation for topmost flow line in case of a homogeneous earth dam. [8]

7. A rectangular area 4 m × 2 m is uniformly loaded with a load intensity of 100 KN/m^2 at a ground surface. Determine the vertical pressure at a depth 3 m below a point within the loaded area 1 m away from the short edge and 0.5 m away from the long edge. Use equivalent point load method. [8]

8. A 25 mm thick clay sample was used in oedometer consolidation test. During test it takes one month for 50% consolidation. If same clay of 5 m thick is in between rock layer and sand layer in site. Calculate the time required for 90% consolidation in site after construction of building in site. [10]

9. A consolidated undrained test was conducted on a clay specimen and the following result were obtained. [10]

Cell pressure (KN/m^2)	200	400	600
Deviator stress (KN/m^2)	118	240	352
Pore water pressure at failure (KN/m^2)	110	220	320

Determine the shear strength parameter with respect to effective stress.

10. An embankment is to be made from a soil with C_u = 20 kN/m^2, ϕ_u = 20° and γ = 20 kN/m^2. If a factor of safety of 1.5 with respect to shear strength is required for the embankment slope, determine the limiting height of the slope, if built at a slope angle of 25°. [6]

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Exam.	New Back (2066 & Later Batch)		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	II / II	Time	3 hrs.

Subject: - Soil Mechanics (CE552)

✓ Candidates are required to give their answers in their own words as far as practicable.
✓ Attempt **All** questions.
✓ The figures in the margin indicate **Full Marks**.
✓ Assume suitable data if necessary.

1. a) Define Soil Mechanics and write its importance. What type of Geo-technical problems may occur in Civil Engineering and Infrastructure Development, describe in brief. [2+3+3]

   b) A clay sample, containing its natural moisture content, weighs 0.333 N. The specific gravity of solids of this soil is 2.70. After oven-drying, the soil sample weighs 0.2025 N. The volume of the moist sample, before oven-drying, found by displacement of mercury is 24.30 cm^3. Determine the moisture content, void ratio and degree of saturation of the soil. [8]

2. a) What is compaction? Explain the salient features of modified AASHTO compaction test. How will you control the compaction in the field? [1+2+5]

   b) A permeameter of diameter 82.5 mm contains a column of fine sand 460 mm long. When water flows through it under constant head at a rate of 191 ml/min, the loss of head between two points 250 mm apart is 380 mm. Calculate coefficient of permeability. If falling head test is made on same sample using a stand pipe of diameter 30 mm, in what time the water level in stand pipe will fall from 1560 mm to 1060 mm? [4+4]

3. a) Define phreatic line and write down the procedure to construct pheratic line on any Earthen Dam with neat sketch. [8]

   b) A point load of 140 kN is applied at the ground surface. Construct a pressure bulb when the stress imposed becomes 20% of the applied load. [8]

4. a) Define shear strength of soil. Using the result of triaxial test, derive the relation for major principle stress (σ_1) in terms of minor principle stress (σ_3) and shear strength parameters (i.e. c and φ). [8]

   b) An open layer of clay 4 m thick is subjected to loading that increases the average effective vertical stress from 185 kPa to 310 kPa. Given m_v = 0.00025 m^2/KN, C_v = 0.75 m^2/year, determine [8]

      i)   the total settlement,
      ii) the settlement at the end of 1 year,
      iii) the time in days for 50% consolidation,
      iv) the time in days for 25 mm of settlement to occur.

5. a) Draw the void ratio effective stress diagram and define coefficient of compressibility and compression Index. Define Normally Consolidated and Over Consolidated Clay. [3+2+3]

   b) An infinite slope has an inclination of 26° with the horizontal. It is underlain by a firm cohesive soil having Gs = 2.72 and e = 0.52. There is a thin weak layer 6 m below and parallel to the slope (c' = 25 kPa, φ' = 16°). Compute the factors of safety when (i) the slope is dry, and (ii) ground water flows parallel to the slope at the slope level. [8]

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Exam.		Regular	
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	II / II	Time	3 hrs.

Subject: - Soil Mechanics *(CE552)*

✓ Candidates are required to give their answers in their own words as far as practicable.
✓ Attempt __All__ questions.
✓ The figures in the margin indicate __Full Marks__.
✓ Assume suitable data if necessary.

1. a) Define soil and soil mechanics. Also define flow index and toughness index of soil. [2+2]

   b) A sample of soil with liquid limit of 72.8% was found to have a liquidity index of 1.21 and water content of 81.3%. What are its plastic limit and plasticity index? [6]

2. A sample of inorganic soil has the following grain size characteristics. [8]

   Size (mm)   Percent passing
   0.075 (No. 200)   55

   The liquid limit is 50% and plastic limit 40%.

   Classify the soil according to the AASHTO classification system.

3. What are soil structure and fabrics? Explain electrical charges on clay minerals. [4]

4. Enlist the reasons for the maximum dry density obtained in field not being equal to that obtained in the laboratory. Also prove that the energy applied in the modified proctor test is 4.56 times greater than that of the standard proctor test. [4+2]

5. a) Mention the effect of the seepage flow on the effective stress. [4]

   b) A tube well is driven in a confined aquifer of 24 m thick. The aquifer is met 25 m below ground level. The static water table is 15 m below ground level. The discharge of tube well is found to be 6000 m^3/day when the draw down in the well is 12.25 m. Find the diameter of the tube well when the radius of the circle of influence (R) is 300 m. Take the permeability 24.5 m/day. [6]

6. Derive an equation for topmost flow line in case of a homogeneous earth dam with horizontal filter at the base. [8]

7. What is significant depth? Draw the stress contour for the significant depth for a single concentrated load of 1000 kN acting at the ground surface. [2+6]

8. a) Explain the factors that affect the degree of consolidation. [4]

   b) A stratum of clay is 2 m thick and has an initial overburden pressure of 50 KN/m^2 at its middle. Determine the final settlement due to an increase in pressure of 40 KN/m^2 at the middle of the clay layer. The clay is over consolidated, with a pre-consolidation pressure of 75 KN/m^2. The values of the coefficients of recompression and compression index are 0.05 and 0.25 respectively. Take the initial void ratio as 1.40. [6]

9. a) Explain Mohr Coulomb failure criterion. State major principle plane, intermediate plane and minor principle plane. [5]

   b) Explain with figure the procedure of triaxial shear test. [5]

10. a) Explain the various types of factor of safety related in stability of slope. Write differences between finite and infinite slope. [2+1]

    b) Explain friction circle method of stability of slope. [3]

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Exam.	New Back (2066 & Later Batch)		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	II / II	Time	3 hrs.

Subject: - Soil Mechanics *(CE552)*

✓ Candidates are required to give their answers in their own words as far as practicable.
✓ Attempt **All** questions.
✓ The figures in the margin indicate **Full Marks**.
✓ Assume suitable data if necessary.

1. a) Explain the types of problems that geotechnical engineer faces. What are the types of clay minerals of engineering interest? [2+4]

   b) The following results refer to the liquid limit test [8]

No of blows	33	23	18	11
Water content (%)	41.5	49.5	51.5	55.6

   The plastic limit from two tests were 23% and 24% respectively. Determine the plasticity index and toughness index for the soil.

2. How do you identify the fine grain soil in the field? Explain the process of the classification of the fine soil with the help of plasticity chart. [4+4]

3. a) What is difference between compaction and consolidation? [3]

   b) How will engineering properties of soil be improved by compaction. [3]

4. State quick sand condition. A sand deposit consists of two layers the top layer is 3 m thick (ρ=1800 kg/m^3) and the bottom layer is 3.5 m thick (ρsat = 2500 kg/m^3). The water table is at a depth of 4 m from the surface and zone of capillary saturation is 1 m above the water table. Draw the diagram showing the variation of total stress, neutral stress and effective stress. [2+8]

5. State the flow net in a non-homogeneous soil mass. Prove that the stream function satisfies the laplace equation. Explain the protective filters for prevention of erosion. [2+4+2]

6. a) Mention the process of the drawing the pressure bulb. [4]

   b) A strip footing of width 2 m carries a load of 400 KN/m. Calculate the maximum stress at a depth of 5 m below the center line of the footing. Compare the results with 2:1 distribution method. [2+2]

7. Drive the general equation for the calculation of settlement from one-dimensional primary consolidation. How can you differentiate log time method with square root of time method? [6+4]

8. a) State the Mohr failure theory and derive the Mohr Coulomb equation. [4]

   b) In a CD test, a specimen of saturated sand fails under an additional stress of 250 KN/m^2 when the cell pressure was 100 KN/m^2. Draw the Mohr circle and determine: [6]

      i) Angle of shearing resistance
      ii) Inclination of failure plane with the horizontal
      iii) Values of shear and normal stress on the Failure plane.

9. A granular soil has Υ_{sat} = 19 KN/m^3, ϕ=35°. A slope has to be made of this material. If a factor of safety of 1.30 is needed against the failure, determine the safe angle of the slope. [6]

   i) When the slope is dry
   ii) If the seepage occurs at and parallel to the surface of the slope

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Exam.	Regular (2066 & Later Batch)		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	II / II	Time	3 hrs.

Subject: - Soil Mechanics (CE552)

✓ Candidates are required to give their answers in their own words as far as practicable.
✓ Attempt **All** questions.
✓ The figures in the margin indicate **Full Marks**.
✓ Assume suitable data if necessary.

1. a) What is soil fabric? Why are the space between mineral particles important for geotechnical engineers and what is it called? [4]

   b) The results of a particle size analysis are shown in the table below:

| Sieve size, (mm)	63	37.5	19	13.2	9.5	6.7	4.75	2.36	1.18	0.6	0.212	0.075
Mass retained, (g)	0	26	28	18	20	49	50	137	46	31	34	30

   The total mass was 469g. Plot the particle size distribution curve and determine the coefficient of uniformity, coefficient of curvature and soil description as per BSCS and AASHTO. [8]

2. a) What are different types of soil structure which can occur in nature? Describe in brief. [4]

   b) The moisture content of a specimen of a clay is 22%. The specific gravity of solid is 2.70. (i) Plot the variation of void ratio with degree of saturation and calculate the void ratio and wet densities at 50% saturation. (ii) A sample of this soil with initial degree of saturation of 50% is isotropically compressed to achieve a void ratio of 0.55. Calculate the volume change in terms of percentage of the initial volume. How much of this volume change is due to the outward flow of water from the sample? [8]

3. a) How would you check whether the desired compaction is achieved in the field? [6]

   b) For the subsoil conditions shown in figure below draw the total, neutral and effective stress diagram up to a depth of 8m. Neglect capilary flow. [10]
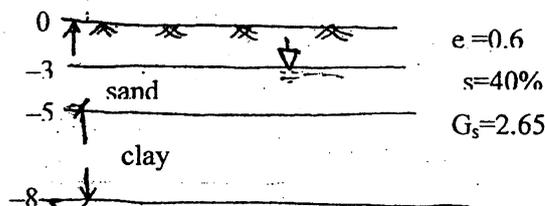
4. a) What are the basic assumptions in Boussinesq's theory of stress distribution in soils? Determine vertical pressure distribution on a horizontal plane at given depth below the ground surface due to point load applied at the ground surface. [8]

   b) A flow net for seepage under the sheet piling is shown in figure below. Estimate approximately the quantity of seepage in cum/day/m length of the piling, if the permeability of the sand is 5×10^{-3}cm/s. If the saturated unit weight of sand is 19kN/m^3, what is the factor of safety against piping in front of the piles. [8]
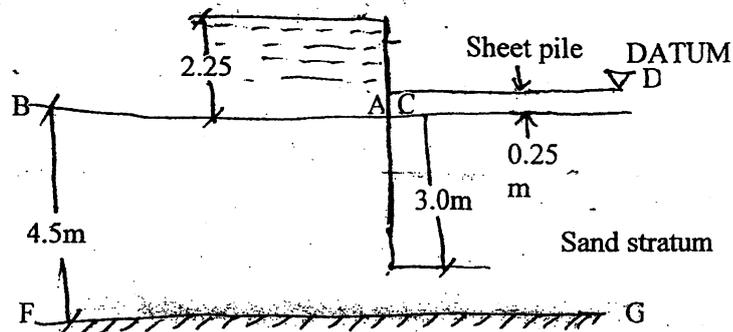
5. Why do we need to carry out consolidation tests, how are they conducted, and what parameters are deduced from the test results? What factors determine the consolidation settlement of soils? How are time of settlement and consolidation settlement calculated? [10]

6. What are the differences between drained and undrained shear strengths? Under what conditions should the drained shear strength or the undrained shear strength parameters be used? What laboratory and field tests are used to determine shear strength? What are the differences among the results of various laboratory and field tests? [8]

7. Explain the factors that can cause the failure of the slope. Explain the different types of slope failure. [3+3]

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Exam.	New Back (2066 & Later Batch)		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	II / II	Time	3 hrs.

Subject: - Soil Mechanics *(CE552)*

✓ Candidates are required to give their answers in their own words as far as practicable.
✓ Attempt __All__ questions.
✓ The figures in the margin indicate __Full Marks__.
✓ Assume suitable data if necessary.

1. a) Define the term 'soil' and 'soil mechanics'. Write down its importance. [2]

   b) A sample of clay was coated with paraffin wax and its mass, including the mass of wax was found to be 697.5gm. The sample was immersed in water and the volume of the water displaced was found to be 355 ml. The mass of the sample without wax was 690.0 gm, and the water content representative specimen was 18%. Determine the bulk density, dry density, void ratio and the degree of saturation. The specific gravity of the solids was 2.70 and that of wax was 0.89. [8]

2. a) Differentiate the standard and modified proctor test. Explain the role of water in the compaction. [4+2]

   b) A fine sand deposit is located between the ground surface to a depth of 10m. The soil has an average void ratio of 0.70 and specific gravity of solids of 2.65. The water table is found at a depth of 4m below the ground level. Above the water table the degree of saturation of sand is 55%. Determine the total stress, pore water pressure and effective stress at a depth of 8 m below the ground surface. Calculate also the change in the effective stress if the soil gets saturated up to a height of 1m above the water table due to capillary action. [5+5]

3. a) How can the soil be classified by the textural soil classification system? Explain it with neat diagrams. [8]

   b) What are the various minearls in the clay soil? Describe them. [4]

4. a) Describe the properties of flow nets. Explain the process of flow net construction in an earthen dam. [3+5]

   b) An elevated structure with a total weight of 10,000 kN is supported on a tower with 4 legs. The legs rest on piers located at the corners of a square 6 m on a side. What is the vertical stress increment due to this loading at a point 7 m beneath the centre of the structure. [8]

5. a) Discuss Terzahi's theory of consolidation, stating the various assumption and their validity. [4]

   b) Calculate the final settlement of the clay layer shown in figure due to an increase of pressure of 30 kN/m^2 at mid-height of the layer. Take $\gamma_w = 10$kN/m^3. [6]

GS

Sand $r_s = 20kN/m^3$

4m

clay
$r_c = 18kN/m^3$

A $C_C = 0.22$ 2.5
$l_o = 1.3$
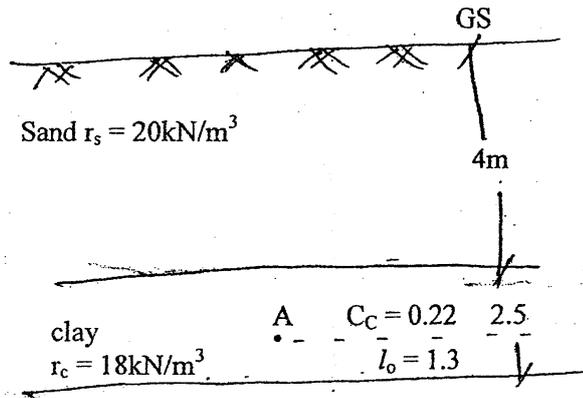
6. a) What is Mohr's strength theory for soils? Sketch typical strength envelops for a clean sand.   [4]

b) A series of direct shear test was conducted on a soil, each test carried out till the sample failed. The following results were obtained.   [6]

Sample no.	Normal stress (kN/m^2)	Shear stress kN/m^2
1	15	18
2	30	25
3	45	32

Determine the cohesion intercept and the angle of shearing resistance.

7. What are the assumption that are generally made in the analysis of slopes? Discuss briefly their validity.   [6]

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Exam.	Regular / Back		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	III / I	Time	3 hrs.

Subject: - Soil Mechanics

✓ Candidates are required to give their answers in their own words as far as practicable.
✓ Attempt any *Five* questions.
✓ The figures in the margin indicate *Full Marks*.
✓ Assume suitable data if necessary.

1. a) The saturated unit weight, γ_{sat} of a soil is $19.5 KN/m^3$ and the specific gravity of soil solids is 2.65. [6+2]

   i) Derive an expression for γ_d in terms of γ_{sat}, γ_w and G_s.
   ii) Using the expression derive in part (i) determine the dry unit weight of the soil.

   b) A 1000cc container was filled with sand in its loosest possible state and the densest possible state. The dry weights of sand occupying the container space were 1520gm and 1830gm, respectively. The sand in-situ has a void ratio of 0.64. If the specific gravity of the sand particles is 2.65, determine the limiting void ratio and relative density in-situ. [8]

2. a) Define grading of soil? What do you mean by uniformity coefficient and coefficient of curvature? Explain consistency limits. [2+2+4]

   b) Enumerate the different methods of applying compaction to a soil in the field and in the laboratory. Give an account of the differences in soil characteristics such as structure, permeability upon saturation, shear strength, stress strain behavior, compressibility and swelling when it is compacted on the dry side of OMC and wet side of OMC? [2+6]

3. a) Differentiate between confined and unconfined aquifer. Derive an expression for determining k, coefficient of permissibility by falling head method. [3+5]

   b) A sand deposit consists of two layers. The top layer is 2.5m thick ($\rho = 1709.67 kg/m^3$) and the bottom layer is 3.5m thick ($\rho_{sat} = 2064.52 kg/m^3$). The water table is at a depth of 3.5m from the surface and the zone of capillary saturation is 1m above the water table. Draw the diagrams showing the variation of total stress, neutral stress and effective stress. [8]

   a) What is a flow net? Describe its properties and application. Prove that the discharge through an earth mass is given by $q = k*h*(N_f/N_d)$, where notations carry their usual meanings. [1+2+5]

   b) An elevated structure with a total weight of 12000 kN is supported on a tower with 4 legs. The legs rest on piers located at the corners of a square 6m a side. What is the vertical stress increment due to the loading at a point 6m beneath the centre of the structure? [8]

5. a) Define Mohr-coulomb theory on the basis of effective stress principle? How triaxial compression test is conducted in laboratory to determine shear strength of soil? Write it's procedure. [2+6]

b) A clay soil, tested in a consolidometer, showed a decrease in void ratio from 1.20 to 1.10 when the pressure was increased from 0.25 to 0.50 kgf/cm^2. Calculate the coefficient of compressibility and coefficient of volume compressibility. If the coefficient of consolidation determined in the test for the given increment was $10m^2/year$, calculate the coefficient of permeability in cm/sec. If the sample tested at the site was taken from a clay layer 3.0m in thickness, determine the consolidation settlement resulting from the given stress increment. [1+2+2+3]

6. Write short notes on: [4×4]

   a) Historical development of soil mechanics
   b) Quick sand conditions
   c) Determination of coefficient of consolidation by Log time method
   d) Causes of slope instability and types of slope failure

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Exam.		Regular	
Level	BE	Full Marks -	80
Programme	BCE	Pass Marks	32
Year / Part	II / II	Time	3 hrs.

Subject: - Soil Mechanics

✓ Candidates are required to give their answers in their own words as far as practicable.
✓ Attempt *All* questions.
✓ The figures in the margin indicate *Full Marks*.
✓ *Semi-log graph paper will be provided.*
✓ All notations are as usual.
✓ Assume suitable data if necessary.

1. a) Explain the different modes of soil formation. Differentiate between 'residual' and 'transported' soils. What is clay mineral? Mention the types of clay minerals and explain any one of it with neat sketch. [8]

   b) Two soils A and B are mixed dry in proportion of 30%:70% by mass. The specific gravity of soil A and B are 2.60 and 2.70 respectively. If the bulk density of mixed soil is 1.8 gm/cc at 15% water content, determine void ratio and degree of saturation. [8]

2. a) Why classification of soil is required in Civil Engineering? What are common classification systems? How do you classify a soil by the B.S. classification system? Explain with neat sketch. [8]

   b) A pumping test was made in a medium sand having depth of saturation 20m, where a bed of clay was encountered. The normal ground water level was at the surface. Observation wells were located at 4m and 10m from the pumping well. At a discharge of 2m^3/min from the pumping well, a steady state was attained in 24 hours. The draw down at 4mtr well was 1mtr and at 10 mtr was 0.5mtr. Draw neat sketch and compute the permeability of soil. If draw down is 6m in the main well and dia of tube-well is 30cm then what is the distance between center of well and zero draw down. [4+4]

3. a) Define Flow net, write its characteristics and derive the expression for seepage discharge through any earten structure in terms of N_d (Number of potential drop) and N_f (Number of flow channel), k (coeff. of permeability) and H (head of water). [2+2+4]

   b) The following results were obtained from a standard compaction test: [8]

Mass of compacted soil, g	1920.5	2051.5	2138.5	2147.0	2120	2081.5
Density, kg/m^3	11.0	12.1	12.8	13.6	14.6	16.3

   The specific gravity of the solids is 2.68, and the volume of the compaction mould is 1000cm^3. Plot the compaction curve and obtain the maximum dry density and optimum moisture content. Plot also the 0%, 5% and 10% air voids curves. At the maximum dry density, calculate the void ratio, degree of saturation and air content. If the natural moisture content in the field is 11.8%, what will be the possible maximum dry density if the soil is compacted with its natural moisture content?

4. a) What are the different standard triaxial shear tests with respect to drainage conditions? Explain with reasons the situations for which each test is preferred. Explain the Mohr-Coulomb strength envelope. Sketch and explain the stress-strain relationship for dense and loose sand. [8]

b) A raft foundation of 8m diameter is placed on the ground surface and carries a load of 10000kN including self weight. A 2m thick soft clay layer exists 5m below the ground surface. Take $m_v = 3*10^{-4}$ m²/kN. Compute (i) The vertical stress increment at the centre of clay layer using Boussinq's theory, (ii) Consolidation settlement of clay layer. Take $\gamma = 15$kN/m³. [4+4]

5. a) Derive the expression to obtain consolidation settlement of any cohesive soil deposit having initial thickness Ho, initial void ratio, e_o, initial overburden pressure, σ_o, compression index (Cc), if there is increase in effective stress of $\Delta\sigma$ due to the construction of building. [8]

b) Determine the factor of safety for a 1 vertical to 2 horizontal slope 5m high using a trial toe circle for which $X_c = 4.5$m and $Y_c = 8$m as shown in the figure below. The cross sectional area of the sliding mass is 40.22m² and its centroid is located 2.96m to the right of the center of the trial circle. The soil properties are: $C_u = 18$kPa, $\phi_u = 0$ and
$\gamma = 18$kN/m³. [8]
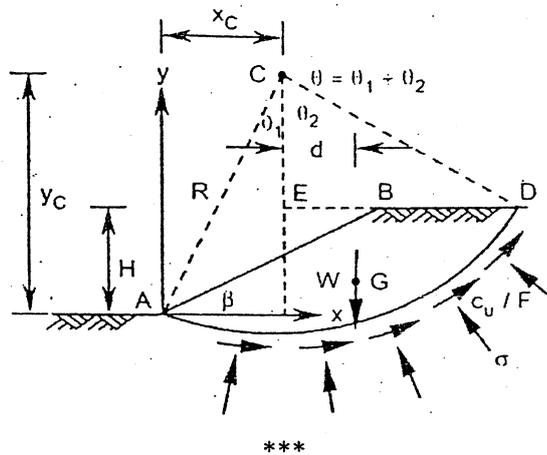
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Exam.		Regular/Back	
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	III / I	Time	3 hrs.

Subject: - Soil Mechanics

✓ Candidates are required to give their answers in their own words as far as practicable.
✓ Attempt any *__Five__* questions.
✓ The figures in the margin indicate *__Full Marks__*.
✓ Assume suitable data if necessary.

1. a) Using the phase relationship diagram prove that   [4+4]

    i) $\gamma_d = (1 - \eta)G\gamma_w$

    ii) $\gamma_{sat} = \left(\dfrac{e}{w}\right)\left(\dfrac{1+w}{1+e}\right)\gamma_w$

    Where notations carry their usual meanings.

   b) A 1000cc core cutter weighing 946.80gm was used to find out the in-situ unit weight of an embankment. The weight of core cutter filled with soil was noted to be 2770.60gm. Laboratory tests on the sample indicated a water content of 10.45 percent and specific gravity of solids of 6.25. Determine the bulk unit weight, dry unit weight, void ratio and degree of saturation of the sample. If the embankment becomes saturated due to rains, calculate the water content and the saturated unit weight (assume there is no volume change in sample on saturation). Use phase diagram.   [8]

2. a) Differentiate between soil's physical and engineering properties with examples. Describe the field identification test for fine grained soils. Does sandy soil experience shrinkage?   [3+4+1]

   b) For a field pumping test, a well was sunk through a stratum of sand 14.5m thick overlying an impervious stratum. Two observation wells were sunk at a horizontal distances of 16m and 34m respectively from the pumping well. The initial position of the water table was 2.2m below ground level. At a steady-state pumping rate of 925 litres/min, the drawdowns in the observation wells were found to be 2.45m and 1.20m respectively. Calculate the coefficient of permeability of the sand.   [8]

3. a) Define flownets. What are its application? Prove Laplace's equation for two dimensional flow through soils.   [1+2+5]

   b) For the sub soil conditions shown in figure below, calculate the effective stress values at 1m, 2m, and 4m depths? Draw the stress distributions diagram for total, effective and neutral stresses.   [8]
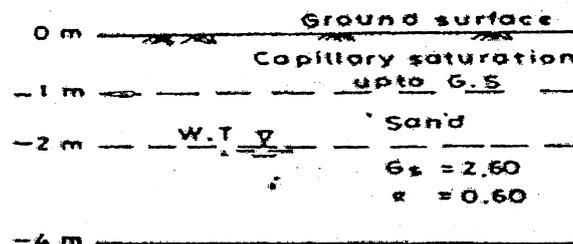
4. a) State the assumptions made by Boussinesq to determine the vertical stress in a soil due to a point load and discuss their validity. What is the basis of the construction of the New mark's influence chart? How is it used? [2+2+2+2]

b) An unconfined compression test was conducted on an undisturbed sample of clay. The sample had a diameter of 37.5mm and was 80mm long. The load at failure measured by proving ring was 28N and the axial deformation of the sample at failure was 13mm. Determine the unconfined compressive strength and the undrained shear strength of the clay. [8]

5. a) How do you conduct direct shear test in laboratory at its top and bottom. Explain. [8]

b) A clay layer 12m thick lies between two free draining sand layers. The final settlement of clay due to loading was calculated to be 0.3m. The coefficient of consolidation is 10^{-4}cm^2/sec. Determine [8]

   i) The time needed to reach the settlement of 0.1m
   ii) The settlement after 5 years of consolidation

6. Write short notes on: (any four) [4×4]
   a) Historical development of soil mechanics
   b) Quick sand condition
   c) Classification of triaxial tests according to drainage conditions
   d) Log time method for the determination of coefficient of consolidation
   e) Effect of compaction on engineering properties of soils

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Exam.		Regular / Back	
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	III / I	Time	3 hrs.

Subject: - Soil Mechanics

✓ Candidates are required to give their answers in their own words as far as practicable.
✓ Attempt any *Five* questions.
✓ The figures in the margin indicate *Full Marks*.
✓ Assume suitable data if necessary.

1. a) Derive a relationship between the void ratio, water content, specific gravity of soil particles and degree of saturation. [8]

   b) A pycnometer weighing 640 gms was used in the following measurements on samples 'A' and 'B' of the same oil. Sample 'A' was oven dried and 'B' was completely saturated. Weight of pycnometer when filled with water only was 1495 gms. [8]

Samples	A	B
Weight of sample only (gms.)	1000	1344
Weight of pycnometer full of soil sample and water	2125	2200

   Find: i) the specific gravity of the soil
          ii) the water content and void ratio of sample B.

2. a) Describe what laboratory tests should be conducted to determine the classification of soils according to the Unified Soil Classification System (USCS). Draw a sketch of Plasticity Chart and denote the symbols of the different types of fine grained soil in the chart according to USCS. Explain the basis of symbolization in the chart. [2+4+2]

   b) From consistency limit tests on a fine grained soil, the following data has been obtained. [2+2+2+2]

   Weight of crumbled threads of 3mm diameter = 20.11gm
   Weight of oven dried soil threads = 14.82gm
   Liquid limit of soil sample = 64.2%

   Determine the plastic limit and plasticity index of the soil. Determine also the classification of the soil according to the USCS, state also the USCS symbol for the soil. If the natural water content of the soil is 37.2%, determine the liquidity index of the soil. Is the consistency of the soil in its natural state stiff or soft? Explain your answer. The equation of the A line is $I_P = 0.73(W_L - 20)$.

3. a) Prove that the seepage force per unit volume is equal to the product of the hydraulic gradient and the unit weight of water. What are the factors that affect permeability of soils? [6+2]

   b) A sand stratum is 10m thick. The water table is 2m below the ground level. The unit weights of sand layer above and below water table are 17 kN/m^3 and 21 kN/m^3 respectively. The capillary rise above water table is 1m. Draw the effective stress, pore water pressure and total stress diagrams for the sand stratum. [8]

Exam.		Regular/Back	
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	III / I	Time	3 hrs.

Subject: - Soil Mechanics

✓ Candidates are required to give their answers in their own words as far as practicable.
✓ Attempt any **Five** questions.
✓ **All** questions carry equal marks.
✓ Assume suitable data if necessary.

1. a) Define the term void ratio, specific gravity of soil particles, degree of saturation and dry unit weight. Differentiate between:

   i) Percentage air voids and air content
   ii) Specific gravity of solids and mass specific gravity
   iii) Void ratio and porosity
   iv) Dry sieve analysis and wet sieve analysis

   b) A sample of clay weighing 700 gms was coated with paraffin wax. The combined weight of the clay and the wax was found to be 708 gms. The volume of the displaced water when the soil was immersed in water was 345 ml. The sample was then broken open. The water content and specific gravity of the soil sample was found to be 15% and 2.7 respectively. Calculate the bulk unit weight, void ratio and degree of saturation. Take specific gravity of paraffin as 0.89.

2. a) Describe briefly the Unified Soil Classification System. List the various factors upon which this classification system is based on.

   b) The following index properties were determined for the two soils X and Y:

Property	X	Y
Liquid limit (%)	62	34
Plastic limit (%)	26	19
Water content (%)	38	25
Specific gravity	2.72	2.67
Degree of saturation	100	100

   Determine which of these soils:

   i) Contains more clay particles
   ii) Has a greater wet density
   iii) Has a greater dry density
   iv) Has a greater void ratio

   Give reasons in your answers.

3. a) Describe the procedure of determining the coefficient of permeability of a soil using Variable Head Method. Derive an expression for finding the coefficient of permeability to be used in the experiment.

   b) In order to determine the average coefficient of permeability of a bed of sand 4 meters thick, overlying on impermeable stratum, a well was sunk through the sand and a pumping test was carried out. After a certain interval the discharge was found to be 12.4 liters per second. The draw downs in the observation wells at 16 meters and 33 meters away from the pumping well were found to be 1.787m and 1.495m respectively. If the GWT was originally 2.14m below the ground surface, find (a) the permeability of the sand layer and (b) an approximate value for the effective grain size.

Exam.		Back	
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	III / I	Time	3 hrs.

Subject: - Soil Mechanics

✓ Candidates are required to give their answers in their own words as far as practicable.
✓ *Attempt any **Five** questions.*
✓ *The figures in the margin indicate **Full Marks**.*
✓ *Assume suitable data if necessary.*

1. a) Describe the importance of soil mechanics. [8]

   b) Describe the method of determination of field density of soil by sand replacement. [8]

2. a) Describe textural soil classification system. [8]

   b) A sample of soil with a liquid limit of 72.8% was found to have a liquidity index of 1.21 and water content of 81.3%. What are its plastic limit and plasticity index? Comment on the consistency of the soil. [8]

3. a) How do you control compaction in field? [8]

   b) For a field pumping test, a well was sunk through a horizontal stratum of sand 14.5m thick and underlain by a clay stratum. Two observation wells were sunk at horizontal distances of 16m and 34m respectively from the pumping well. The initial position of the water table was 2.2m below ground level. At a steady state pumping rate of 925 litres/min, found to be 2.45m and 1.20m respectively. Calculate coeff. of permeability of sand. [8]

4. a) Describe vane shear test. [6]

   b) The results of a series of $\overline{CU}$ tests on undisturbed samples of an over consolidated clay were as below. [10]

Cell pressure (KN/m^2)	100	200	400	600
Deviator stress at failure (KN/m^2)	300	410	610	850
Pore water pressure (KN/m^2)	–45	–15	50	110

   Determine the shear strength parameters in terms of effective stress.

5. Explain any four: [4×4]

   a) Differences between standard and modified proctor test
   b) Determination of pre-consolidated pressure
   c) Types of water which occur in a soil mass
   d) Causes of slope movement and failure
   e) Quick sand condition
   f) Design of filter

6. a) Explain remedial measures against slope failure problems. [6]

   b) A clay soil, tested in a consolidometer, showed a decrease in void ratio from 1.20 to 1.10 when the pressure was increased from 0.25 to 0.50 kgf/cm^2. Calculate the coefficient of compressibility and the coefficient of volume change. If the coefficient of consolidation determined in the test for the given stress increment was 10m^2/year, calculate the coefficient of permeability in cm/sec. If the sample tested at the site was taken from a clay layer 3.0m in thickness, determine the consolidation settlement resulting from the given stress increment. [10]

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