Faculty of Engineering & Technology

Bachelor of Science Honours in Engineering in Civil Engineering

CINEC CAMPUS
Beyond A Graduate

CE3315 Surveying II

Final Examination

Module Leader: Dr Gamini Abeysuriya

Academic Year: 2022

Date: 24th August 2022

Time: 1300 - 1600 hours

Instructions to Candidates:

- This paper consists of seven questions. Answer **any five** questions.
- All questions carry equal marks.
- Write clearly and legibly with a blue or black pen.
- Answers to different parts of the same question (other than any graph sheets used) should appear together.
- Indicate the number of each question clearly.
- You are advised to make a clear diagram for each question, where appropriate. This will help you to perform calculations correctly.
- Marks will be deducted for missing or incorrect measuring units.
- If you have answered more than five questions, either in part or in full, strike out the extra answers. Otherwise, only the first five answers as appearing in the book will be evaluated.
- Programmable calculators are not permitted.

1. Table 1 shows the volumes of excavation and fill contained within each block of 100 metres along a 1.6 km length of road alignment.

Table 1

Chainage (m) From - To	Cut (+) / Fill (-) Volume (m^3)	Chainage (m) From – To	Cut (+) / Fill (-) Volume (m^3)
0 – 100	+ 615	800 – 900	- 1755
100 – 200	+ 770	900 – 1000	- 2380
200 – 300	+ 805	1000 – 1100	- 495
300 – 400	+ 545	1100 – 1200	- 115
400 – 500	+ 160	1200 – 1300	+ 240
500 – 600	- 455	1300 – 1400	+ 1275
600 – 700	- 960	1400 – 1500	+ 1670
700 – 800	- 1540	1500 – 1600	+ 1380

(i) Draw the mass haul diagram for the movement of earth if the excavated material has a bulking factor of 1.10.

(45 marks)

(ii) If the surplus material is allowed to be disposed of at one of the two ends, which alternative would result in a lower haul? Give reasons.

(30 marks)

(iii) Find the free haul and over haul for the selected alternative if the free haul distance is stipulated as 500 metres.

(25 marks)

2. **(a)** Briefly explain how a simple circular curve between two straights is set out using a theodolite and a steel tape. Illustrate your answer with a clear diagram.

(20 marks)

(b) A circular curve of radius 650 metres joins two straights with whole circle bearings 82° 00' and 106° 00'. The intersection point is at chainage 1840.0 m. The curve is to be set out using two theodolites, both reading to 10".

(i) Find the chainages of the two tangent points.

(10 marks)

(ii) If points are to be located at full chain lengths (30 m), find the chainages of points at which pegs are to be fixed.

(10 marks)

(iii) Find the incremental angles to be set out from the two theodolites set up at the tangent points.

(20 marks)

(iv) Tabulate the data required to set out the curve from the two theodolites.

(40 marks)

Deflection angle for a chord of length ℓ may be taken as 1718.9 x (ℓ /R) minutes, where R is the radius of curvature.

3. A circular curve of radius 800 metres is used to join a straight with a bearing of 72° 40' on a road to another with a bearing of 133° 00'. As a subsequent development, it has been decided to change the curve in order to accommodate cubic spiral transition curves of length 144 metres at each end of the circular arc, thereby allowing the total length of the route to be increased by 50 metres.

(i) Find the new radius of the circular arc.

(45 marks)

(ii) Find the distance between existing and new tangent points on each straight.

(15 marks)

(iii) If the intersection point has a chainage of 2846.10 m, compute the data necessary for setting out the transition curve using chords of length 24 m.

(40 marks)

4. (a)

Outline the factors that influence the design of the length of a vertical crest curve, indicating the circumstances under which each one is appropriate.

(10 marks)

(b)

A level stretch of road at an elevation of 64.30 m above mean sea level is joined to a rising grade of 4.0 % by a parabolic vertical curve of length 240 m. The chainage at the intersection point is 2520.0 m.

(i) Find the mid offset of the curve.

(10 marks)

(ii) Find the offsets to the curve from the first tangent at 20 m intervals.

(25 marks)

(iii) Calculate the levels along the curve in order to set it out.

(25 marks)

(iv) Locate the points at which the gradient is 1.5 % and 2.5 % respectively, and find the levels on the curve at these points.

(30 marks)

5. (a)

(i) Describe, using clear diagrams, how a horizontal angle measured with a theodolite having a side mounted auxiliary telescope, is affected.

(15 marks)

(ii) How would you overcome this effect in order to obtain the correct value of the angle?

(5 marks)

(b)

Two wires P and Q, 3.603 m apart, were suspended from the collar of a vertical shaft to mark the centre line of a tunnel to be drilled. Clockwise angles were measured to the wires P and Q using a theodolite set up at a point A on the surface (closer to P than to Q), off the centre line of the tunnel. Angles measured to P and Q from a reference direction AB were 125° 00' 03.5" and 124° 59' 50.2" respectively. The length PA was 3.015 m.

A theodolite was then set up at station C inside the tunnel, and clockwise angles 102° 10' 24.3" and 102° 10' 11.5" respectively were measured to wires P and Q from a reference direction CD. Length PC was found to be 3.320 m.

(i) If the whole circle bearing of the line AB is 192° 20' 30.0", find the bearing of the reference line CD inside the tunnel.

(40 marks)

(ii) Find the coordinates of the underground station C with respect to the surface station A.

(40 marks)

6. (a)

(i) Define the terms *true error*, *residual error* and the *most probable value* in relation to a survey observation.

(05 marks)

(ii) Explain the significance of the most probable value of an observed quantity.

(10 marks)

(b)

A, B, C and D are four stations which are widely spaced from one another. Differential levelling was carried out between each pair of stations, and the level differences, along with the relative weights of observations, are shown in Table 6.

Table 6

From station	To station	Difference in level (m)	Weight
A	B	+ 3.82	1
A	C	+ 6.23	1
A	D	+ 2.10	1
B	C	+ 2.45	2
B	D	- 1.73	2
C	D	- 4.16	2

(i) If the reduced level of station A is 88.240 m, find the most probable values of the reduced levels at the other three stations.

(70 marks)

(ii) Carry out the relevant checks.

(15 marks)

7. (a) State the purpose of a triangulation survey, and indicate the circumstances in which different classes of such surveys are used.

(10 marks)

(b) Angles marked 1 – 25 in the interlocked triangulation network shown in the Fig. 7 have been measured accurately with the help of a precision theodolite. The length and bearing of the line AB were also measured.

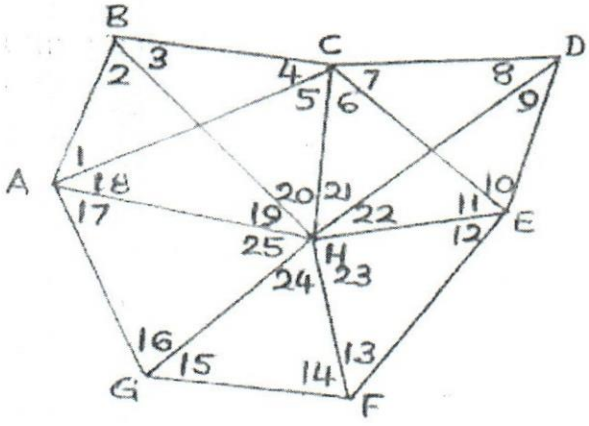

Fig. 7

(i) Identify the geometrical figures that make up the above network.

(10 marks)

(ii) Write down all condition equations applicable to the network.

(40 marks)

(iii) Show the complete procedure in adjusting the observed angles of the network.

(20 marks)

(iv) Briefly describe how the coordinates of the remaining stations are computed, if those of station A are known.

(20 marks)

Library

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Beyond A Graduate

Faculty of Engineering& Technology

Bachelor of Science Honours in Engineering in Civil Engineering

CE3312 Soil Mechanics & Engineering Geology - II

Module Leader: Mr. Supun Walpita/ Ms. Iromi Diyes

Academic Year 2022

Wednesday, 17th August 2022 from 1:00 pm to 4:00 pm

Final Examination

Note:

- Attempt **all** questions
- Closed book test,
- Write your name and student number on any additional sheets
- Give all answers to 2 decimal points
- Take $g = 10\ m/s^2$
- Marks will be deducted for missing or wrong units.
- Graph sheets may require answering some questions
- Any required additional documents are attached at the end of the questions

1)

a) Define terms "flow line" & "equipotential" **(10 marks)**

b) Figure 1 given below shows a flow net drawn for a sheet pile wall on an isotropic sandy soil layer (thickness of 10m) with a permeability of 3×10^{-4} cm/s. The water table in upstream & downstream located 5m & 0m from the ground level.

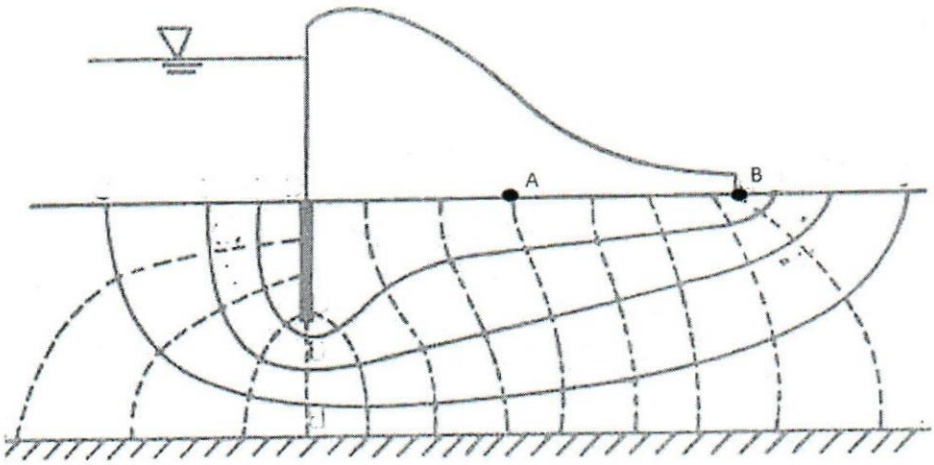


Figure 1

I. Determine the seepage loss (m^3/s) per meter length of the dam **(20 marks)**

II. Find the pressure heads at points A & B. **(10 marks)**

III. Explain the advantage of having a cutoff wall. If the cutoff wall being removed, comment on (by giving reasons) what happens to the number of flow lines and number of potential drops for any particular flow net drawn for this problem. **(25 marks)**

c)

I. Given the soil of the permeable layer has a specific gravity 2.65 and void ratio 0.5, determine whether the dam is safe against piping. **(25 marks)**

II. Suggest two methods to improve the safety against piping **(10 marks)**

2)

a) In the Figure 2 given below, the ground water level located 4m from the surface while point A located at 2m below the ground water level.(Assume γ_w as $10kN/m^3$)

I. Find both total and effective stresses at ground water level & point A and draw a diagram that shows the variation of total stress, effective stresses & pore water pressure with the depth in the same axis of coordinates. **(35 marks)**

II. Suppose that the ground water level is raised by 5m from the original level due to a flood event. Find the total and effective stresses at point A **(20 marks)**

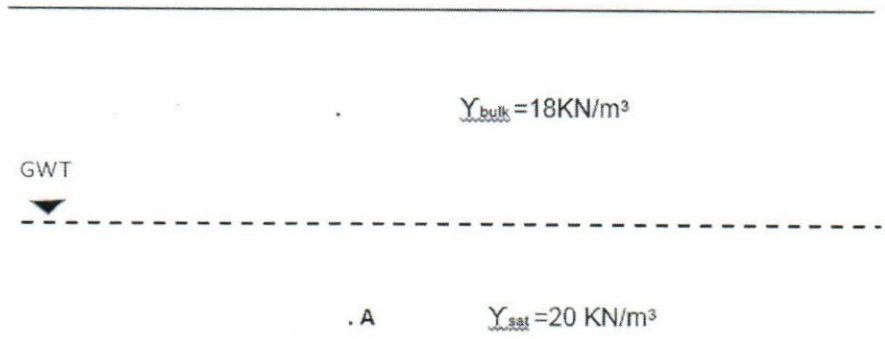


Figure 2

b) A rectangular foundation exerts a uniform pressure of 200kPa on a soil as shown in the figure 3. Point A is located at the center of the foundation and point B Is located in an axis of symmetry,5m away from point A. Find the vertical stress increments at points A & B at a depth of 6m below the foundation **(45marks)**

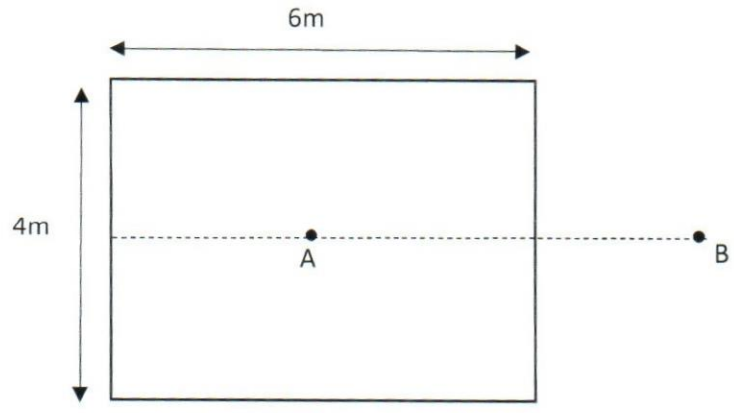


Figure 3

3)

a) For the stressed soil element shown in Figure 4, draw a Mohr's circle and determine

I. Major principal stress
II. Minor principal stress
III. Normal and shear stresses on the plane EF

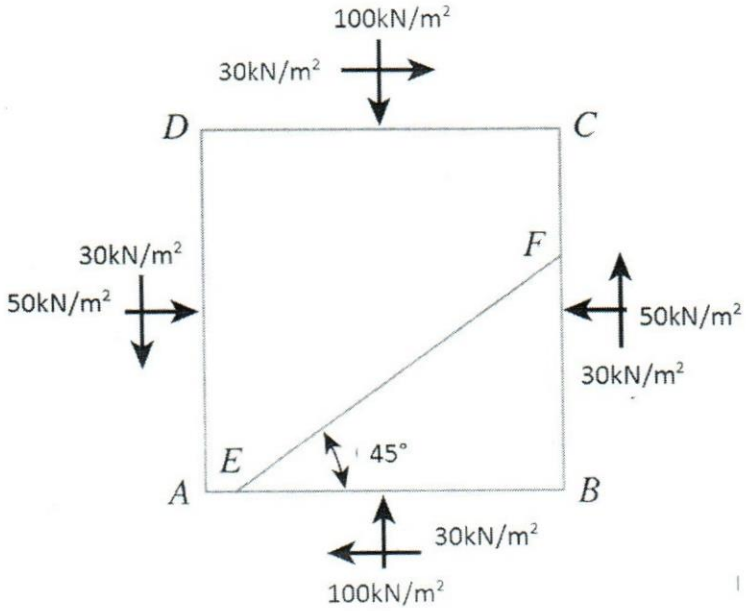


Figure 4

(40 marks)

b) List the main disadvantages of direct shear test over triaxial test **(15 marks)**
c) Differentiate consolidated undrained test and consolidated drained test with regard to their function and the nature of shear strength parameters obtained. **(25 marks)**
d) State why there is no such test as "unconsolidated drained". Explain your answer with adequate reasoning. **(20 marks)**

4)

a. Results obtained from a one dimensional consolidation test on a clay sample for a pressure increment of 150-250 kPa are presented in Table 1. With the use of a settlement vs square root time plot, determine the coefficient of consolidation, C_v, of the soil. You may assume that the test specimen is drained at the top and bottom. Present your answer as mm^2/ min. **(40 marks)**
b. How long would a layer of this clay soil, 17.5m thick and drained on its top only, take to reach 80% consolidation? Present your answer in years. **(10 marks)**

c. Comment on the reasons why Terzarghi's equation is still used, when more numerically advanced methods are available. **(5 marks)**

d. Give examples for 1-D, 2-D and 3-D features/ Structures in Geology. **(15 marks)**

e. What do you mean by the terms "faults" and "folds" in geology **(15 marks)**

f. Show the difference between, (you may use diagrams): **(15 marks)**

   i. Strike slip and dip slip faults:
   ii. Anticline and syncline folds:
   iii. Open and closed joints

Table 1

Thickness of sample (mm)	Time (min)
18.950	0
18.891	0.25
18.857	1
18.825	2.25
18.796	4
18.735	9
18.672	16
18.615	25
18.577	36
18.559	49
18.550	64

-End of Questions-

Supplementary documents

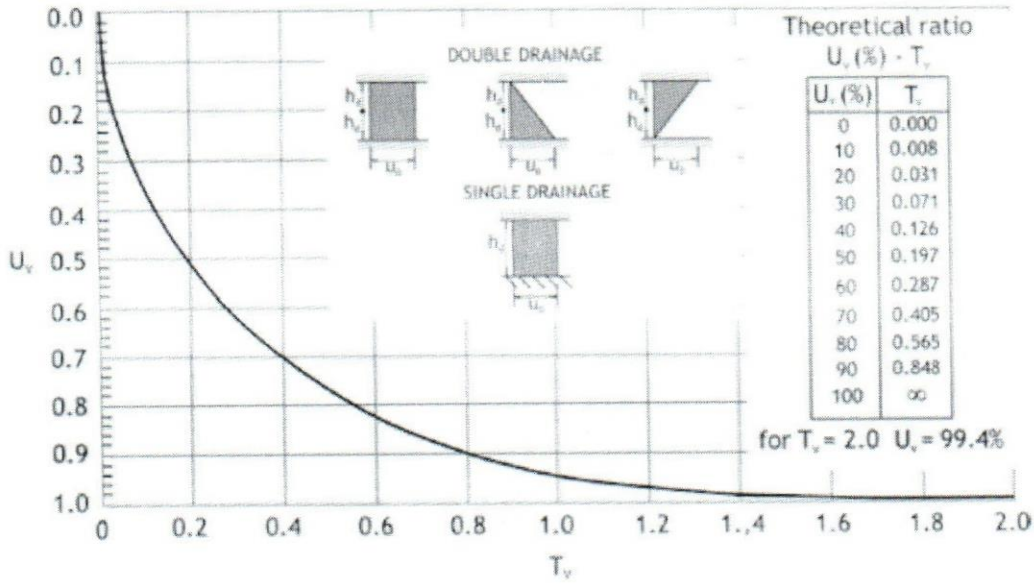
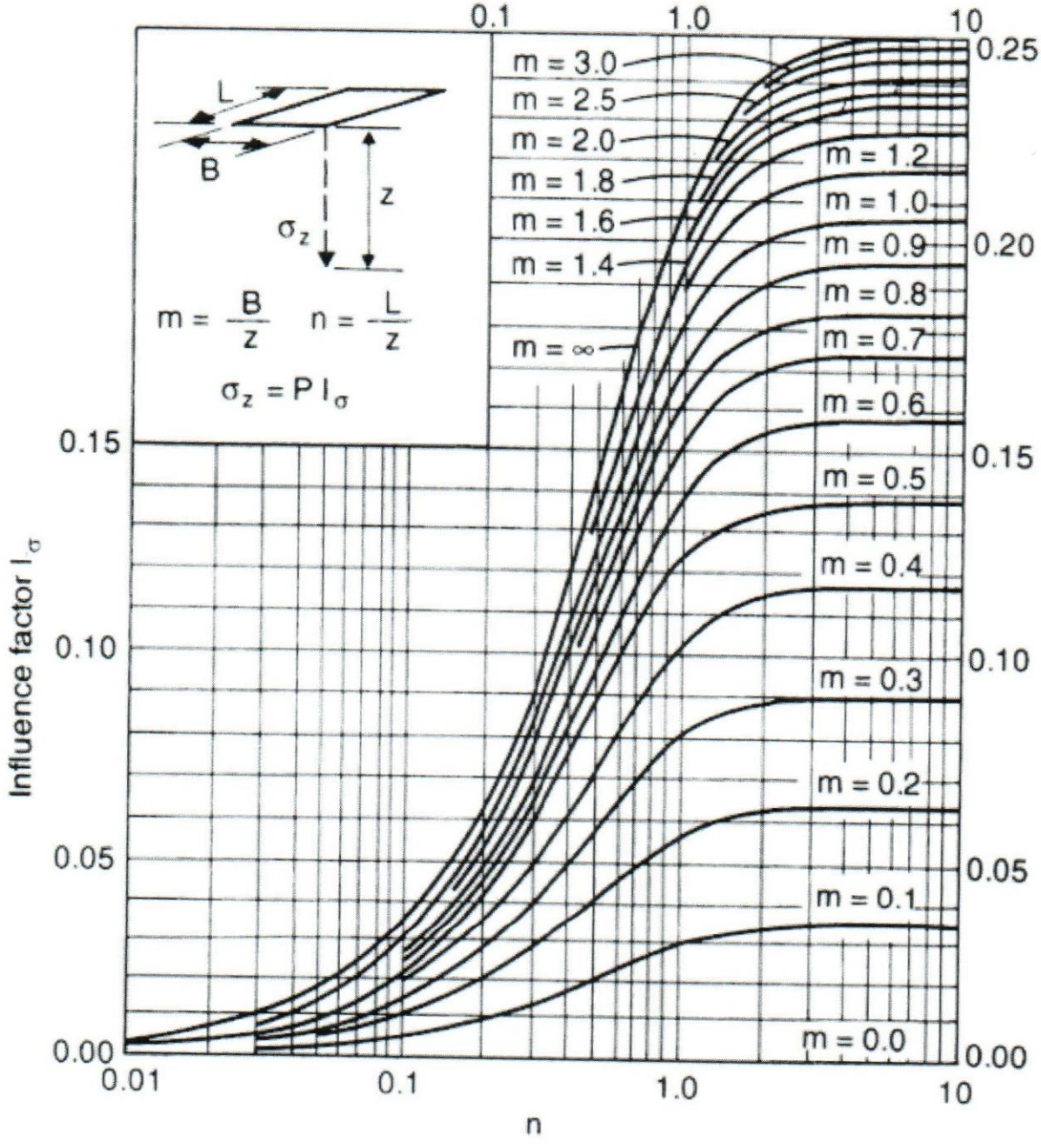


Figure – Variation of average degree of consolidation with time factor T_v (U_0 Constant with depth)

$$i=h/L=\frac{G-1}{1+e} \qquad k\frac{h}{Nd}=\frac{q}{Nf}$$


0.1
1.0
10
0.25
0.20
0.15
0.10
0.05
0.00
L
B
z
σ_z
$m = \frac{B}{z}$ $n = \frac{L}{z}$
$\sigma_z = P I_\sigma$
m = 3.0
m = 2.5
m = 2.0
m = 1.8
m = 1.6
m = 1.4
m = ∞
m = 1.2
m = 1.0
m = 0.9
m = 0.8
m = 0.7
m = 0.6
m = 0.5
m = 0.4
m = 0.3
m = 0.2
m = 0.1
m = 0.0
Influence factor I_σ
0.01
0.1
1.0
10
n

CINEC CAMPUS

Faculty of Engineering & Technology
Department of Civil Engineering
BSc Hons in Engineering
2022 Semester-1 Class Test - 1

Module Code	:	**CE1314**
Module Title	:	**Mechanics**
Date/Time	:	**24th November 2022 / 13:30hrs to 16:30hrs**
Examiners	:	**Dr. Janaka Liyanagama**
Time Allowed	:	**Three Hours**

INSTRUCTIONS TO CANDIDATES

- This is a closed book physical examination.
- You Should Attempt **ALL** questions
- Show all the working on the answer paper
- Please commence answering a new question on a new sheet on the answering booklet
- This paper contains 4 pages

MATERIALS REQURIED

- CINEC provided answer booklet
- You may use a scientific calculator. This must not be programmable. The calculator may be examined by the invigilator staff. Having any data, equations, material pertaining to any module pasted or inscribed or included in the calculator will be an examination offence.

ADDITIONAL INFORMATION

- Give your answers to **two decimal places**.
- Acceleration due to gravity, **$g = 9.81 m/s^2$**.
- Figures are given in page 4.

Answer All Questions

Q-1
(30 Marks)

(a) A steel wire of diameter **1.8mm** and length **6.5m**, stretches by **8.6mm** when subjected to an axial load of **880N**. Determine the Modulus of Elasticity, **E** for the wire. (06 Marks)

(a) Calculate the allowable load for a timber tie of a rectangular cross section **70 mm x 50 mm**, if the allowable stress for timber is **9 N/mm²**. Also, determine the diameter of a steel bar, to carry the same load, if the allowable maximum stress for the steel is **170 N/mm²**. (06 Marks)

(b) Consider a cylindrical specimen of some metal alloy that has a diameter of **10 mm**. A tensile force of **1500 N** produces an elastic reduction in diameter of **6.7×10^{-4} mm**. Compute the **Modulus of Elasticity** of this alloy, if the Poisson's ratio is **0.35**. (06 Marks)

(c) The connection between a tractor and trailer is made from a length of steel with a rectangular cross-section **112 mm** by **10 mm**. The load is transmitted to the bar via a pin through a **20 mm** diameter hole at each end, as shown in **Figure 1(b)**. If the maximum permissible stress in the steel is **160 N/mm²**, determine the maximum load that can be taken by the bar. (06 Marks)

(d) A mild steel column is hollow and circular in cross section with an external diameter of **350 mm** and a thickness of **20 mm**. It carries a compressive axial load of **2000 kN**. Determine the direct stress in the column. What diameter of a solid circular rod would be able to carry the same stress. (06 Marks)

Q-2
(15 Marks)

(a) **Figure 2(a)** shows a series of forces acting on a connecting plate. Determine the resultant force acting on the connecting plate and its direction. (5 Marks)

(b) **Figure 2(b)** shows a beam subjected to various loads. Determine all **reaction forces** and demonstrate a check on your work. (10 Marks)

Q-3 **Figure 3** shows a beam subjected to a number of loads. Self-weight of the beam is 305.81 kg/m.

(28 Marks)

(a) Determine all the **reaction forces** and demonstrate a check on your work. (3 Marks)

(b) Produce a fully labelled **Shear Force Diagram** (6 Marks)

(c) Produce a fully labelled **Bending Moment Diagram**, clearly showing the bending moments at **A, B, C, D** and **E**. (13 Marks)

(d) Determine the position of maximum bending moment and calculate the bending moment at this position. Clearly show this position on your shear force and bending moment diagrams. (6 Marks)

Q-4 A pin-jointed frame is shown in **Figure 4.**

(27 Marks)

(a) Determine the support Reactions. (3 Marks)

(b) Determine the force in members **AC, AD and CE** using the Method of Joints. (12 Marks)

(c) Determine the force in members **EG, EH and FH** using Method of Sections. (12 Marks)

Your answers must be presented in a table similar to that given below.

Member	Force (kN)	Compression or Tension
AC		
AD		
CE		
EG		
EH		
FH		

Figures

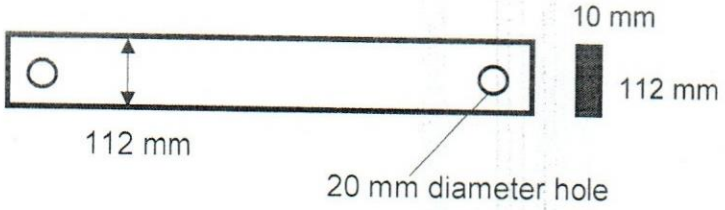


Figure 1(d)

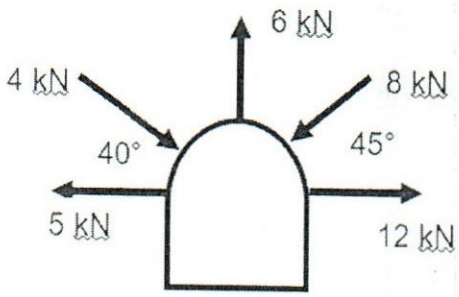


Figure 2(a)

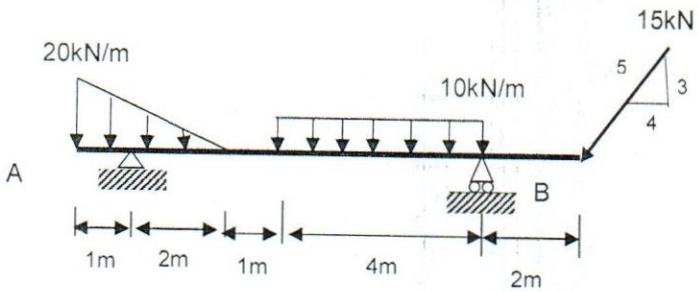


Figure 2(b)

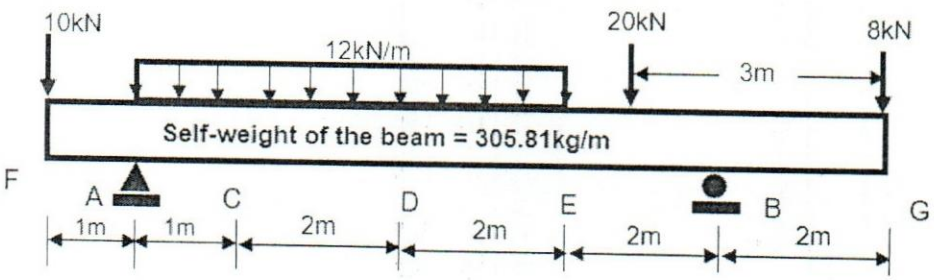


Figure 3

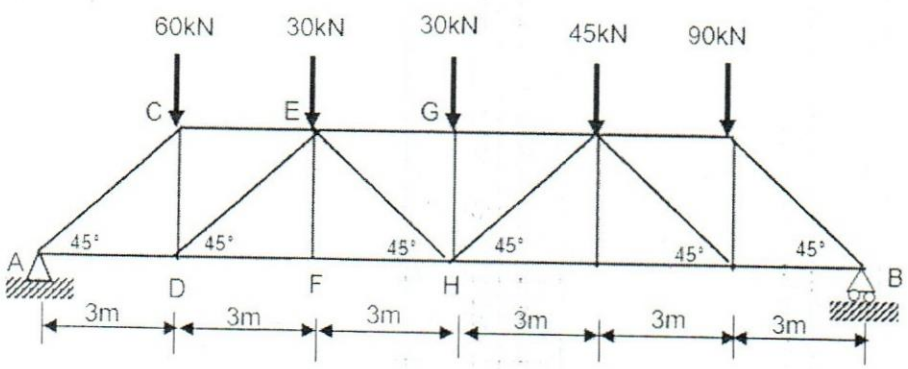


Figure 4