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FACULTY OF SCIENCE & ENGINEERING
SCHOOL OF ENGINEERING
Examination paper

Module Code	:	6MA042
Module Title	:	Automotive Electronics
Date	:	26th October 2025
Examiners	:	S D R Perera
Time Allowed	:	3 Hours

INSTRUCTIONS TO CANDIDATES

- This is a closed book examination.
- Attempt All Questions
- Your responses should be recorded on the answer sheet attached.

MATERIALS REQURIED

- Eight-page answer booklets. Use a separate page for each section.
- You may use a scientific calculator. This must not be programmable, and may be inspected during the examination.

Student Number .....

Question 01

Instead of the conventional point to point wiring system, the Controller Area Network (CAN) has many advantages. Explain the main features and benefits of CAN system. **(10 marks)**

Question 02

Explain what arbitration is with respect to signal transmission on CAN **(05 marks)**

Question 03

Transmission of four signals from four different nodes at the same time on a CAN is shown in Figure Q3. Explain which signal will be transmitted. **(15 marks)**

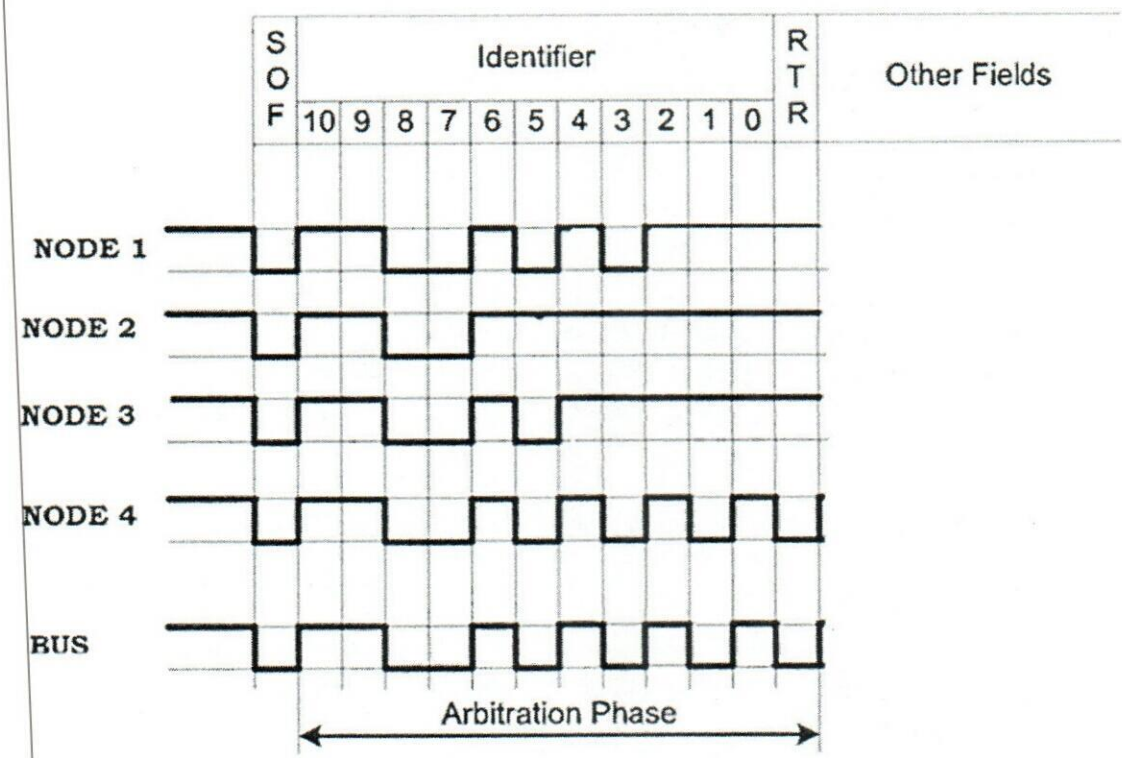


Figure Q3 – Typical four signals transmitting on a CAN

Question 04

The main functions of a typical gasoline fuel injection system can be listed as

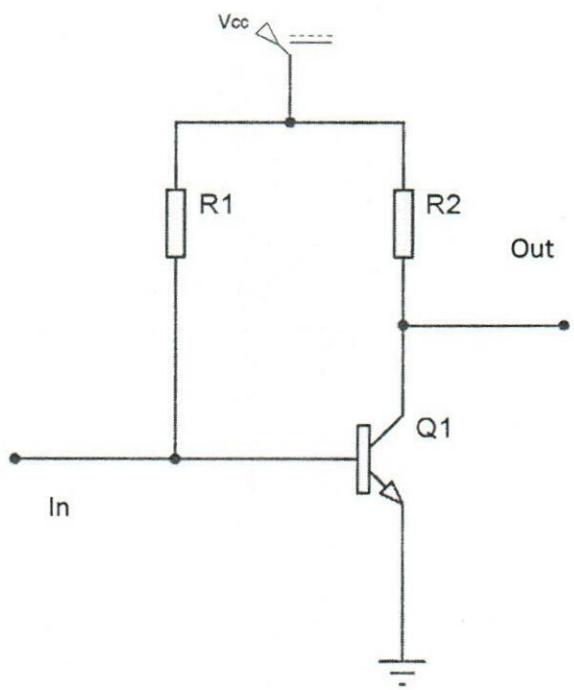
- the charging of the cylinders with air, mass of the injected fuel and the ignition angle.
- idle-speed control,
- closed-loop lambda control,
- control of evaporative-emissions control system,
- exhaust-gas recirculation for reducing NOx emissions,
- control of secondary-air system for reducing HC emissions, and
- cruise control
- OBD
- Limp home

Draw a typical block diagram that describes the connection of required sensors, actuators and data flow, hence explain the accomplishment of key functions listed above the question **(25 marks).**

Question 05

A typical transistor application is shown in Figure Q6. Determine the following for the fixed-bias configuration if β =50, Vcc = 12V, R1 = 240K and R2 = 2.2K **(15 marks)**

a. IB_Q and IC_Q.
b. VCE_Q.
c. *VB* and *VC*.
d. *VBC*.



Question 06

Explain the operating principle of a zenor diode in a typical electronic circuit **(10 marks)**

Question 07

Explain the operating principle of the following automotive sensors **(20 marks)**

a. Carmen Vortex Air Flow meter
b. Lambda sensor

Solution – reasonable explanation pertaining to the operating principle of any two automotive sensors

END.

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UNIVERSITY OF WOLVERHAMPTON

FACULTY OF SCIENCE & ENGINEERING

SCHOOL OF ENGINEERING

RE-SIT EXAMINATION PAPER

Module Code	:	**6MA043**
Module Title	:	**Aerodynamic Design and CFD**
Date	:	**26th October 2025 - Semester 1**
Examiners	:	**Dr. Geethal Siriwardana**
Time Allowed	:	**3 Hours**

INSTRUCTIONS TO CANDIDATES

- This is an unseen paper.
- This is a closed book examination.
- Attempt All questions.
- There are 5 questions in pages
- You are to write your answers in the answer books provided.
- Write your index number, the subject code and the title of the paper in each answer book. Also write your index number on each additional sheet.

MATERIALS REQUIRED

- One 12-page answer booklets
- Formula sheet at back of paper.
- You may use a Scientific calculator. This must not be programmable, may not have significant memory capability, and may be inspected during the examination.

Question 01

a. Discuss how the Reynolds number is used in determining flow regimes and in engineering applications. **[04 Marks]**

b. A capillary tube is 30 mm long and 1 mm bore. The head required to produce a flow rate of 8 mm^3/s is 30 mm. The fluid density is 800 kg/m^3. Calculate the dynamic and kinematic viscosity of the oil? **[06 Marks]**

c. Consider a U-tube mercury manometer oriented vertically. One end is completely sealed with a total vacuum above the column of mercury. The other end is open to the atmosphere where the atmospheric pressure is that for standard sea level. What is the displacement height of the mercury in centimeters, and in which end is the mercury column the highest? The density of mercury is 1.36×10^4 kg/m^3 and the standard pressure at sea level is 1.013×10^5 Pa. Use Figure Q1.1 as a reference.

[10 Marks]

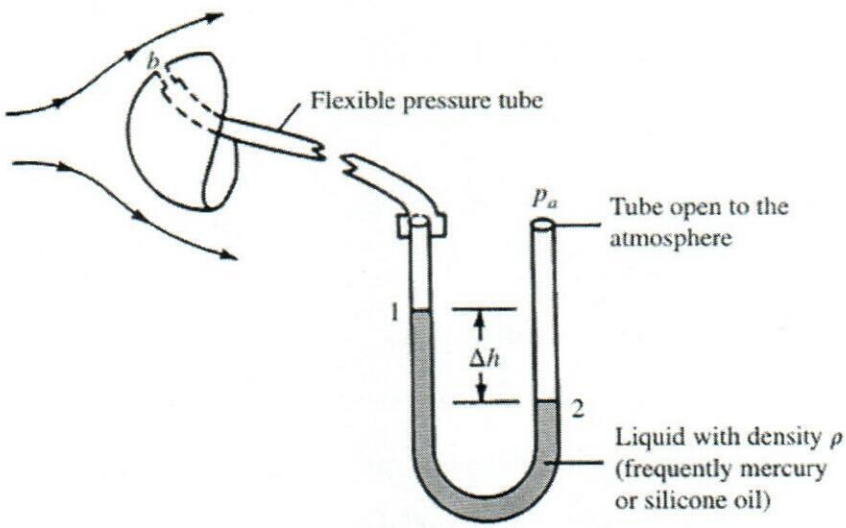


Figure Q1.1

Question 02

a. Explain how the lift and drag coefficients occurred in airfoil shapes. **[02 Marks]**

b. Explain how the flow over an airfoil differs when the fluid is considered inviscid versus when viscous effects are present. Support your answer with labeled sketches illustrating the flow behavior in each case. **[04 Marks]**

c. Consider the NACA 2412 airfoil, data for which is given in Figures Q2.A1 and Q2.A2. The data are given for two values of the Reynolds number based on chord length. For the case where $Re_c = 3.1 \times 10^6$, estimate:

i. the laminar boundary layer thickness at the trailing edge for a chord length of 1.5 m. **[02 Marks]**

ii. the net laminar skin-friction drag coefficient for the airfoil. **[02 Marks]**

d. Figure Q2.1 illustrates a horizontal nozzle discharging fluid into the atmosphere. The nozzle has an inlet bore area of 900 mm² and an exit bore area of 300 mm². If the inlet pressure is 200 Pa, determine the flow rate through the nozzle, assuming no energy losses occur. **[04 Marks]**

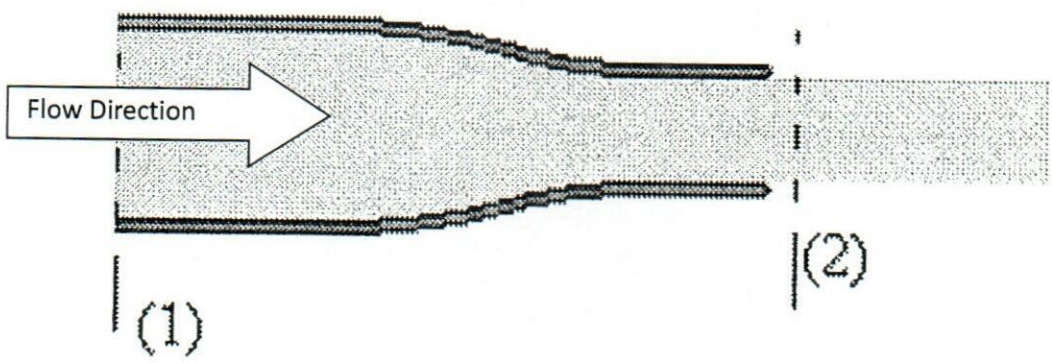


Figure Q2.1

e. A Pitot tube is used to measure the velocity of airflow in a wind tunnel. The density of air is $\rho = 1.225\ kg/m^3$ and the static pressure difference between the stagnation point and the static port is measured to be $\Delta P = 50\ Pa$.

i. Using the Bernoulli equation, calculate the velocity of airflow in the wind tunnel. **[03 Marks]**

ii. If the Pitot tube is used at a higher altitude where the air density decreases to $= 0.9\ kg/m^3$. What will be the new velocity for the same pressure difference. **[03 Marks]**

Question 03

a. Describe the conditions under which a fluid flow should be treated as compressible, emphasizing the influence of Mach number, pressure variations, and temperature effects on flow behavior. **[04 Marks]**

b. Identify and describe three practical engineering applications in which compressible flow occurs. **[03 Marks]**

c. An aircraft flies at an altitude where the speed of sound is 330 m/s. If the aircraft speed is 180 m/s, determine the Mach number. Comment on whether compressibility effects should be considered. **[05 Marks]**

d. In a compressible flow, the static pressure $P = 100kPa$, and the Mach number $M = 0.9$. Calculate the stagnation pressure assuming the isentropic relation $P_0 = P(1 + 0.5(k-1)M^2)^{\frac{k}{k-1}}$, where $k = 1.4$. **[04 Marks]**

e. Air flows steadily through a convergent nozzle from a large chamber where the stagnation pressure is 200 kPa and stagnation temperature is 300 K. The nozzle exit pressure is 100 kPa.

i. State whether the flow at the nozzle exit is subsonic, sonic, or supersonic. Justify your answer using compressible flow principles. **[02 Marks]**

ii. Estimate the nozzle exit velocity, assuming isentropic flow of an ideal gas with $\gamma = 1.4$ and $R = 287\ J/kgK$. **[02 Marks]**

Question 04

a. Explain the following terms briefly.

i. Computational Fluid Dynamics **[02 Marks]**

ii. Analytical Fluid Dynamics **[02 Marks]**

b. Briefly describe what are the available turbulent models (DNS, RANS, LES). **[08 Marks]**

c. Explain the difference between streamlines and vectors in Ansys Fluent **[04 Marks]**

d. Explain what discretization in CFD Analysis is. **[04 Marks]**

Question 05

a) Explain how Y+ value can be used to improve the CFD accuracy. **[02 Marks]**

b) Explain the use of the Courant number. **[03 Marks]**

c)

Based on the given description answer the following questions.

Description

To study the flow in a stainless-steel parallel flow shell and tube heat exchanger. Heat transfer will occur between the hot inner tube flow and the colder outer flow in the shell. The shell has a wall thickness of 10 mm and an inner diameter of 32 mm whereas the tube is 2 mm thick and has an outer diameter of 19 mm. The mass flow rate of water in the shell is 0.8 kg/s with an inlet temperature of 283.2 K and the mass flow rate of water in the tube is 0.2 kg/s at an inlet temperature of 343.2 K. The temperature distributions along the shell and tube will be shown from Flow Simulation results.

i. What type of geometry would be well suited for this analysis. (3D or 2D). You may explain your answer. **[02 Marks]**

ii. Boundary conditions use in the analysis. **[04 Marks]**

Boundary Condition (BC)	Type of BC	Properties of BC
Hot fluid inlet		
Cold fluid inlet		
Hot fluid outlet		
Cold fluid outlet		
Hot tube inner wall		
Hot tube outer wall		
Cold tube inner wall		
Cold tube outer wall		

iii. Type of the viscous model. Explain your answer. **[03 Marks]**

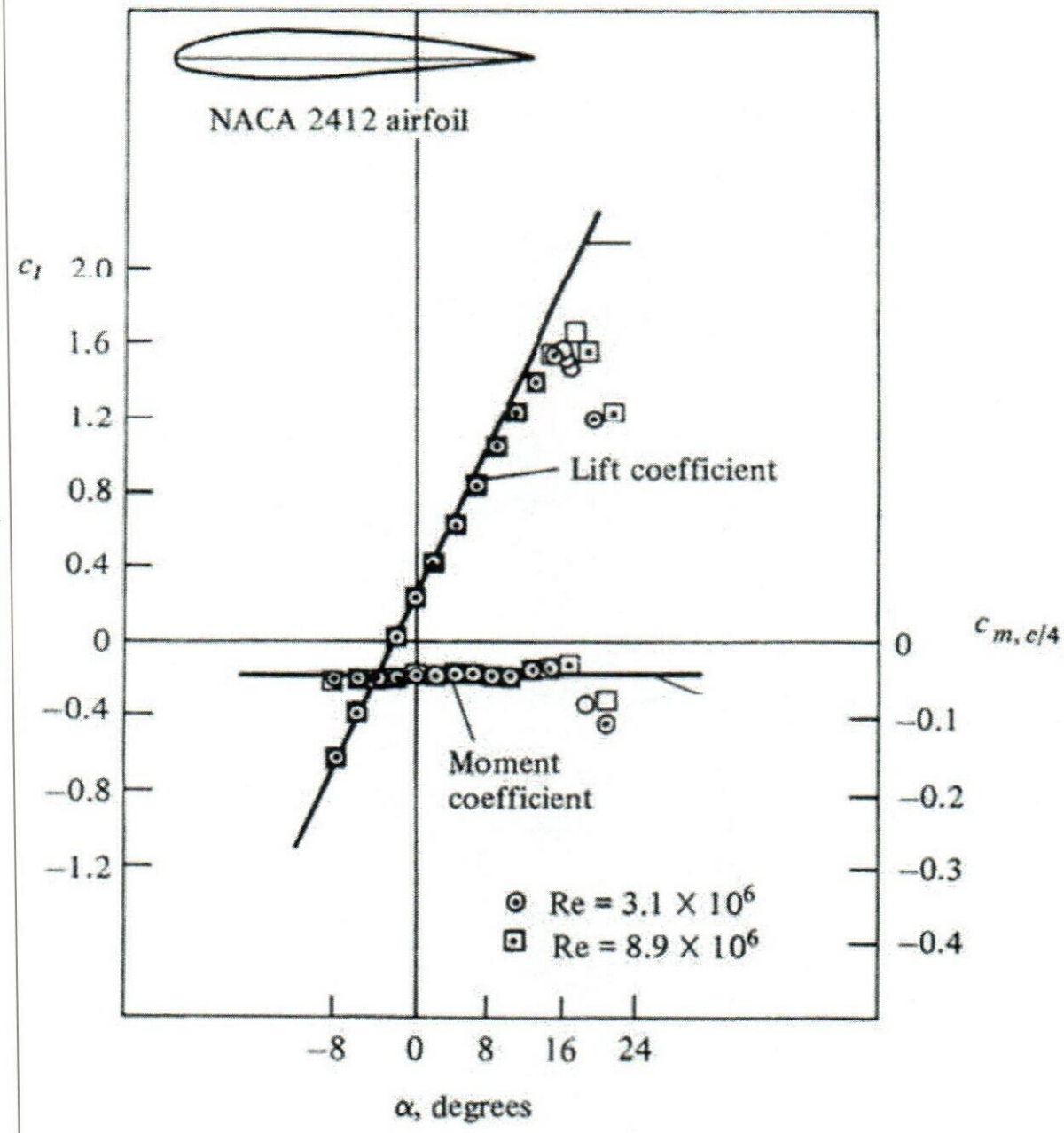
iv. State the simulation type (steady or transient). Explain your answer. **[03 Marks]**

v. Should gravity be included in this analysis? Explain your answer. **[03 Marks]**

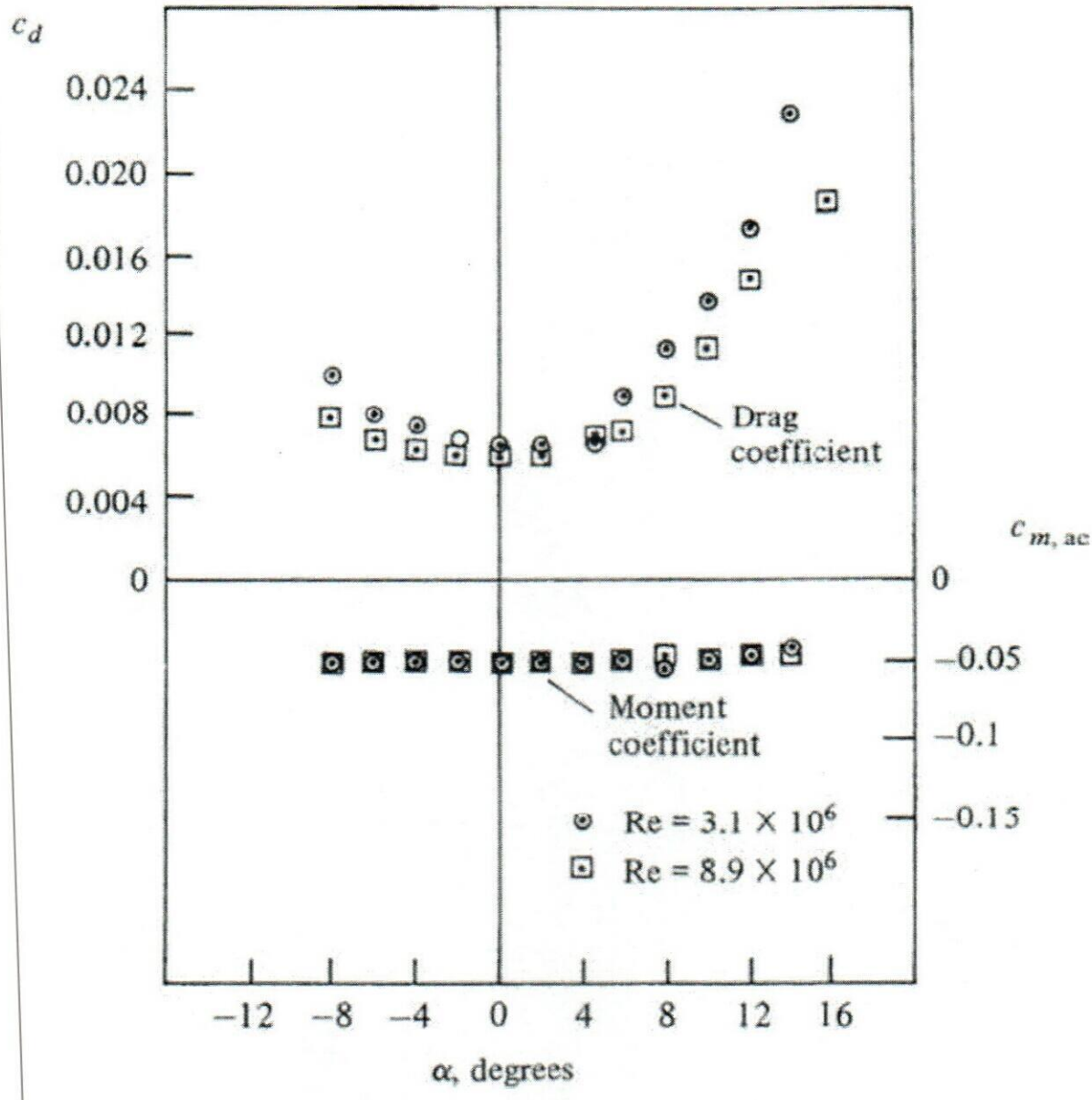
You may use figures and sketches to support your answer

DATASHEET

Notations have their general meaning.



Figures Q2.A1



Figures Q2.A2

All pressures are absolute

$$1bar = 10^5 N/m^2 = \frac{1}{1.01325} atm$$

Acceleration due to gravity

g= 9.81 m/s²

Density of water

1000 kg/m³

Bernoulli's Equation

$$\frac{p1}{\rho g} + \frac{V1^2}{2g} + Z1 = \frac{p2}{\rho g} + \frac{V2^2}{2g} + Z2$$

Continuity equation

$$A_1 V_1 = A_2 V_2$$

Mach number,

$$M = \frac{V}{C}$$

Reynolds number for the airfoil

$$Re = \frac{Velocity(V) \times Chord\ length(C)}{Kinetic\ viscosity(n)}$$

Lift force

$$Lift\ force = \frac{C_L \times \rho \times V^2 \times A}{2}$$

Drag force

$$Drag\ force = \frac{\rho \times V^2 \times C_D \times A}{2}$$

Boundary layer thickness,

$$\delta = \frac{0.38}{Re^{\frac{1}{5}}}$$

Skin friction coefficient,

$$C_f = \frac{0.059}{Re^{\frac{1}{5}}}$$

$$Skin\ friction\ drag = \frac{1}{2} \rho A V^2 C_f$$

Total dreg force = $Skin\ friction\ drag + Pressure\ drag$

$Pressure\ drag = Skin\ friction\ drag -$ Total dreg force

$$T = F\ x\ r$$

$$F = P\ x\ A$$

For an isentropic flow,

$$\frac{P_2}{P_1} = \left(\frac{\rho_2}{\rho_1}\right)^{\gamma} = \left(\frac{T_2}{T_1}\right)^{\frac{\gamma}{\gamma-1}}$$

R - Gas constant [kJ/kg.K] = 0.287

$\gamma - Specific\ heat\ ratio$

$\gamma = 1.4,$

For any flow condition

$$A_1 V_1 \rho_1 = A_2 V_2 \rho_2$$

Sound of velocity for ideal gas

$$C = \sqrt{\gamma RT}$$

$$M_2^2 = \frac{1 + \left(\frac{\gamma-1}{2}\right) M_1^2}{\gamma M_1^2 - \left(\frac{\gamma-1}{2}\right)}$$

$$M_2^2 \times \left[\gamma M_1^2 - \left(\frac{\gamma-1}{2}\right)\right] = 1 + \left(\frac{\gamma-1}{2}\right) M_1^2$$

$$\gamma M_2^2 M_1^2 - M_2^2\left(\frac{\gamma-1}{2}\right) = 1 + \left(\frac{\gamma-1}{2}\right) M_1^2$$

$$\gamma M_2^2 M_1^2 - \left(\frac{\gamma-1}{2}\right) M_1^2 = 1 + M_2^2\left(\frac{\gamma-1}{2}\right)$$

$$M_1^2 \left[\gamma M_2^2 - \left(\frac{\gamma-1}{2}\right)\right] = 1 + M_2^2\left(\frac{\gamma-1}{2}\right)$$

$$\frac{T_2}{T_1} = \left(1 + \frac{2\gamma}{\gamma+1}\left(M_1^2 - 1\right)\right)\left(\frac{2 + (\gamma-1) M_1^2}{(\gamma+1) M_1^2}\right)$$

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Student Number .....

FACULTY OF SCIENCE & ENGINEERING
SCHOOL OF COMPUTING AND MATHEMATICS

Resit EXAMINATION PAPER

Module Code	:	6CS010
Module Title	:	Digital Forensics
Date	:	28th September 2025
Examiners	:	Dr C Mbarushimana, Dr. Rajitha Tennekoon
Time Allowed	:	1.5 hrs

INSTRUCTIONS TO CANDIDATES

- This is a Closed book examination.
- You Should Attempt 3 Questions in Total

MATERIALS REQURIED

- Answer booklet.
- You may use a scientific calculator. This must not be programmable, and may be inspected during the examination.
- You should write legibly in black or blue ink

Question 1:

Explain the the four ACPO principles of computer based electronic evidence. Illustrate your answer with examples. ***(20 marks)***

Question 2:

The figure below shows the first sector of a MBR disk.

```
Offset(d) 00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15

00000000  33 C0 8E D0 BC 00 7C 8E C0 8E D8 BE 00 7C BF 00  3ÀŽÐ¼.|ŽÀŽØ¾.|¿.
00000016  06 B9 00 02 FC F3 A4 50 68 1C 06 CB FB B9 04 00  .¹..üó¤Ph..Ëû¹..
00000032  BD BE 07 80 7E 00 00 7C 0B 0F 85 0E 01 83 C5 10  ½¾.€~..|....…..ƒÅ.
00000048  E2 F1 CD 18 88 56 00 55 C6 46 11 05 C6 46 10 00  âñÍ.ˆV.UÆF..ÆF..
00000064  B4 41 BB AA 55 CD 13 5D 72 0F 81 FB 55 AA 75 09  ´A»ªUÍ.]r..ûUªu.
00000080  F7 C1 01 00 74 03 FE 46 10 66 60 80 7E 10 00 74  ÷Á..t.þF.f`€~..t
00000096  26 66 68 00 00 00 00 66 FF 76 08 68 00 00 68 00  &fh....fÿv.h..h.
00000112  7C 68 01 00 68 10 00 B4 42 8A 56 00 8B F4 CD 13  |h..h..´BŠV.‹ôÍ.
00000128  9F 83 C4 10 9E EB 14 B8 01 02 BB 00 7C 8A 56 00  ŸƒÄ.žë.¸..».|ŠV.
00000144  8A 76 01 8A 4E 02 8A 6E 03 CD 13 66 61 73 1C FE  Šv.ŠN.Šn.Í.fas.þ
00000160  4E 11 75 0C 80 7E 00 80 0F 84 8A 00 B2 80 EB 84  N.u.€~.€.„Š.²€ë„
00000176  55 32 E4 8A 56 00 CD 13 5D EB 9E 81 3E FE 7D 55  U2äŠV.Í.]ëž.>þ}U
00000192  AA 75 6E FF 76 00 E8 8D 00 75 17 FA B0 D1 E6 64  ªunÿv.è..u.ú°Ñæd
00000208  E8 83 00 B0 DF E6 60 E8 7C 00 B0 FF E6 64 E8 75  èƒ.°ßæ`è|.°ÿædèu
00000224  00 FB B8 00 BB CD 1A 66 23 C0 75 3B 66 81 FB 54  .û¸.»Í.f#Àu;f.ûT
00000240  43 50 41 75 32 81 F9 02 01 72 2C 66 68 07 BB 00  CPAu2.ù..r,fh.».
00000256  00 66 68 00 02 00 00 66 68 08 00 00 00 66 53 66  .fh....fh....fSf
00000272  53 66 55 66 68 00 00 00 00 66 68 00 7C 00 00 66  SfUfh....fh.|..f
00000288  61 68 00 00 07 CD 1A 5A 32 F6 EA 00 7C 00 00 CD  ah...Í.Z2öê.|..Í
00000304  18 A0 B7 07 EB 08 A0 B6 07 EB 03 A0 B5 07 32 E4  . ·.ë. ¶.ë. µ.2ä
00000320  05 00 07 8B F0 AC 3C 00 74 09 BB 07 00 B4 0E CD  ...‹ð¬<.t.»..´.Í
00000336  10 EB F2 F4 EB FD 2B C9 E4 64 EB 00 24 02 E0 F8  .ëòôëý+Éädë.$.àø
00000352  24 02 C3 49 6E 76 61 6C 69 64 20 70 61 72 74 69  $.ÃInvalid parti
00000368  74 69 6F 6E 20 74 61 62 6C 65 00 45 72 72 6F 72  tion table.Error
00000384  20 6C 6F 61 64 69 6E 67 20 6F 70 65 72 61 74 69   loading operati
00000400  6E 67 20 73 79 73 74 65 6D 00 4D 69 73 73 69 6E  ng system.Missin
00000416  67 20 6F 70 65 72 61 74 69 6E 67 20 73 79 73 74  g operating syst
00000432  65 6D 00 00 00 63 7B 9A BD 00 9F EC 00 00 80 20  em...c{š½.Ÿì..€
00000448  21 00 07 FE FF FF 00 08 00 00 00 30 62 03 00 FE  !..þÿÿ.....0b..þ
00000464  FF FF 0C FE FF FF 00 38 62 03 00 20 03 00 00 FE  ÿÿ.þÿÿ.8b.. ...þ
00000480  FF FF 07 FE FF FF 00 58 65 03 00 20 03 00 00 FE  ÿÿ.þÿÿ.Xe.. ...þ
00000496  FF FF 0F FE FF FF 00 78 68 03 00 80 57 00 55 AA  ÿÿ.þÿÿ.xh..€W.Uª
```

a. What information does this sector contain? ***(5 marks)***

b. How many active partitions does the disk have and how many partitions in total? Explain your answer. ***(5 marks)***

c. What is the starting sector in LBA of the first partition? ***(5 marks)***

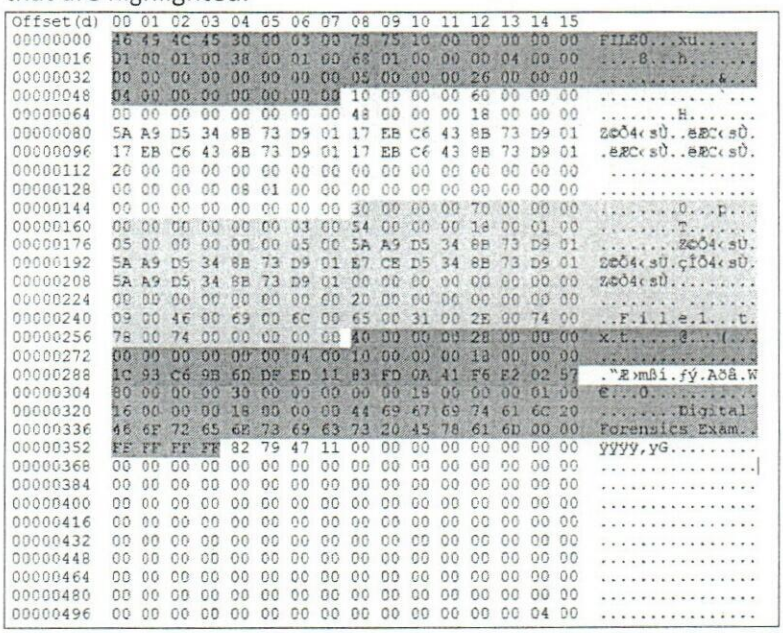
d. What is the size in MBs of the 3rd partition? ***(5 marks)***

Question 3:

NTFS is the most common file system used in Windows today.

a. With regards to NTFS, discuss the role of the Master File Table (MFT) ***(5 marks)***

b. The figure below shows a portion of an NTFS file record, explain the significance of the areas that are highlighted. ***(10 marks)***



Offset(d)	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	
00000000	46	49	4C	45	30	00	03	00	79	75	10	00	00	00	00	00	FILE0...xu.....
00000016	01	00	01	00	38	00	01	00	68	01	00	00	00	04	00	00	....8...h.....
00000032	00	00	00	00	00	00	00	00	05	00	00	00	26	00	00	00	..........&...
00000048	04	00	00	00	00	00	00	00	10	00	00	00	60	00	00	00	..........`...
00000064	00	00	00	00	00	00	00	00	48	00	00	00	18	00	00	00	........H.....
00000080	5A	A9	D5	34	8B	73	D9	01	17	EB	C6	43	8B	73	D9	01	Z©Õ4‹sÙ..ëÆC‹sÙ.
00000096	17	EB	C6	43	8B	73	D9	01	17	EB	C6	43	8B	73	D9	01	.ëÆC‹sÙ..ëÆC‹sÙ.
00000112	20	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	.....
00000128	00	00	00	00	08	01	00	00	00	00	00	00	00	00	00	00	.....
00000144	00	00	00	00	00	00	00	00	30	00	00	00	70	00	00	00	........0...p...
00000160	00	00	00	00	00	00	03	00	54	00	00	00	18	00	01	00	........T.....
00000176	05	00	00	00	00	00	05	00	5A	A9	D5	34	8B	73	D9	01	........Z©Õ4‹sÙ.
00000192	5A	A9	D5	34	8B	73	D9	01	E7	CE	D5	34	8B	73	D9	01	Z©Õ4‹sÙ.çÎÕ4‹sÙ.
00000208	5A	A9	D5	34	8B	73	D9	01	00	00	00	00	00	00	00	00	Z©Õ4‹sÙ.....
00000224	00	00	00	00	00	00	00	00	20	00	00	00	00	00	00	00	....
00000240	09	00	46	00	69	00	6C	00	65	00	31	00	2E	00	74	00	..F.i.l.e.1...t.
00000256	78	00	74	00	00	00	00	00	40	00	00	00	28	00	00	00	x.t.....@...(...
00000272	00	00	00	00	00	00	04	00	10	00	00	00	18	00	00	00	.....
00000288	1C	93	C6	9B	6D	DF	ED	11	83	FD	0A	41	F6	E2	02	57	.“Æ›mßí.fý.Aöâ.W
00000304	80	00	00	00	30	00	00	00	00	00	18	00	00	00	01	00	€...0.....
00000320	16	00	00	00	18	00	00	00	44	69	67	69	74	61	6C	20	........Digital
00000336	46	6F	72	65	6E	73	69	63	73	20	45	78	61	6D	00	00	Forensics Exam..
00000352	FF	FF	FF	FF	82	79	47	11	00	00	00	00	00	00	00	00	ÿÿÿÿ,yG.....
00000368	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	.....
00000384	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	.....
00000400	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	.....
00000416	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	.....
00000432	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	.....
00000448	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	.....
00000464	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	.....
00000480	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	.....
00000496	00	00	00	00	00	00	00	00	00	00	00	00	00	00	04	00	.....

c. Explain the concept of a resident file in the NTFS file system. ***(5 marks)***

Question 4:

Critically discuss digital antiforensics techniques and explain how these techniques may be used to mislead the forensic investigation process. ***(20 marks)***

Question 5:

Discuss what you could do to find data of interests on a seized hard disk drive. Share examples of tools you could utilise and a relevant investigation methodology. ***(20 marks)***

---------- ***End of the Examination*** ----------

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This exam paper must be submitted with your answer booklet

Student Number .....

FACULTY OF SCIENCE & ENGINEERING
SCHOOL OF COMPUTING AND MATHEMATICS

EXAMINATION PAPER

Module Code	:	6CS029
Module Title	:	Advanced Networks
Date	:	28th September 2025
Examiners	:	Dr Ian Coulson, Dr Consolee Mbarushimana, Mrs. Shanika Ekanayake
Time Allowed	:	2 hours

INSTRUCTIONS TO CANDIDATES

- This is a Closed book examination.
- Number of Questions to be attempted: Three complete questions from the Six on the paper
- All questions are equally weighted (unless otherwise stated)
- Answer to q1 part e) should be written on the exam paper on the last sheet and the **question paper submitted with your answer sheet.**
- Your responses should be recorded on the answer sheet attached.

MATERIALS REQURIED

- 1 six page answer booklet.
- You should write legibly in black or blue ink
- Check your work carefully for inaccurate spelling, punctuation and grammar

1.

a. What is meant by the term Minimum Spanning Tree? (6 marks)

b. What are the steps of Prim's algorithm (6 Marks)

c. In the graph in figure 1 of a network use Kruskal's algorithm to determine an MST for this network, and state its length. Show the order in which you select and reject edges.
(36 marks)

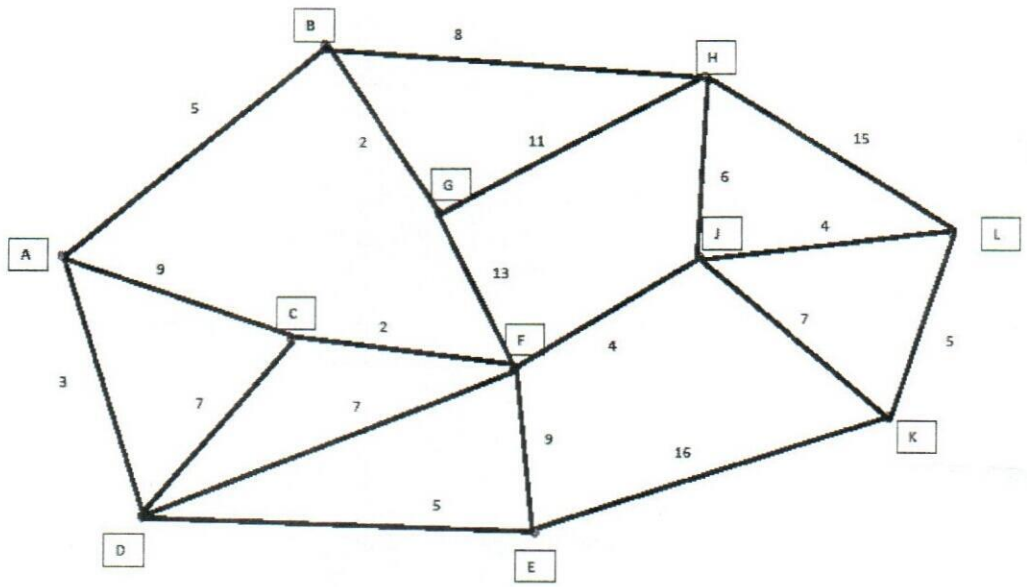


Figure 1 – Graph of a network

d. Sketch the defined MST for the graph in Figure 1.

(6 marks)

e. The network in Figure 2 shows the defined weights between nodes. Use Dijkstra's Algorithm to find the route with the lowest cost from A to H.
You should illustrate your method on the attached sheet at the back of the question paper and submit this with your answer booklet. Note marks will only be awarded if you have illustrated Dijkstra's method.

(46 marks)

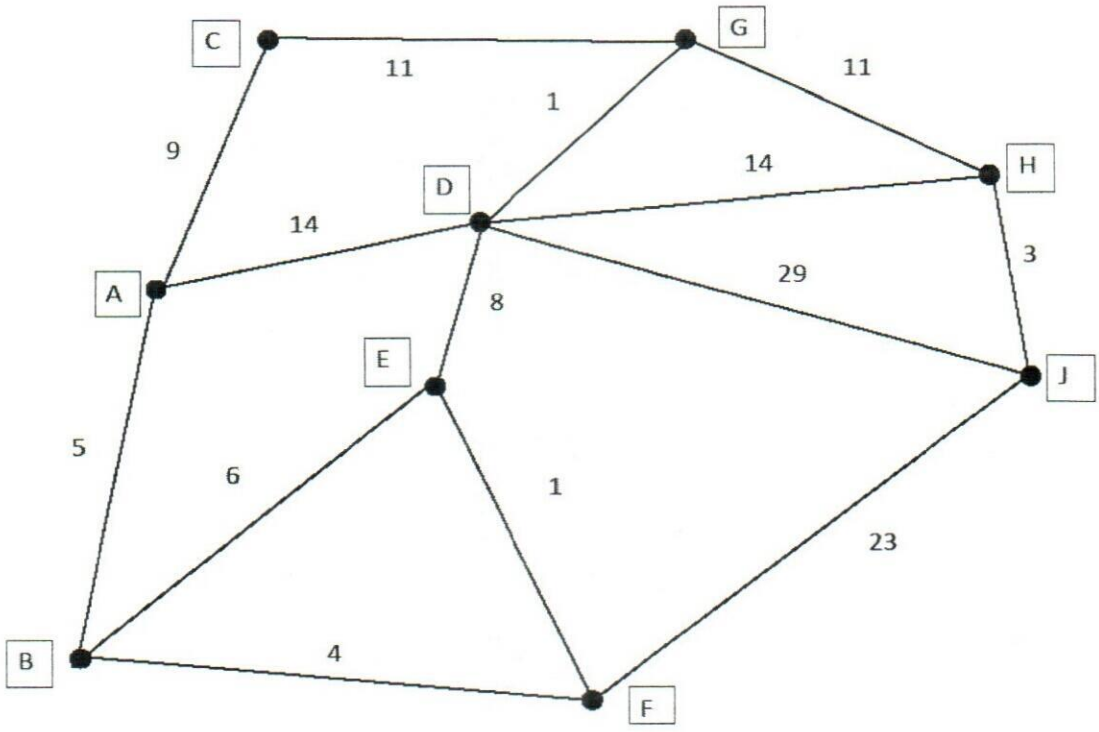


Figure 2 – Graph of a network

2.

a. Discuss with the aid of diagrams the process of a workstation obtaining an IP address through DHCP. (42 Marks)

b. Describe the domain name system and the processes involved to resolve a web address to its respective IP address. You may include diagrams to aid with this.
(36 Marks)

c. DNS servers can be used to mount an attack on a victim, describe this process.
(22 marks)

3.

a. Discuss the structure using illustrations of the different classes of IPV6 addresses. Your discussion should mention their scope and range of values.

(48 marks)

b. How are IPV6 addresses obtained when a workstation, etc. first initiates.

(9 marks)

c. What is meant by the term IPV6 tunnelling, use a sketch to illustrate this.

(13 marks)

d. Give an account using diagrams of EU-64 which is used to generate the 64 bit interface ID.

(30 marks)

4.

a. **Star Topology** currently dominates the market with regard to local area **network design**. Explain why you believe this statement **to be true or false**, referencing the other topologies as part of your discussion.

(48 marks)

b. What is a***VLAN?*** What does it mean to say that they "***communicate with each other as though they were on a single, isolated LAN***"? Define the purpose of VLAN and how VLAN help companies save time and money?

(30 marks)

c. What does it mean when mentioning that SDN decoupling hardware from software?

(22 Marks)

5.

a. What does it mean for a wireless network to be operating in "infrastructure mode?" If the network is not in infrastructure mode, what mode of operation is it in, and what is the difference between that mode of operation and infrastructure mode?
(21 Marks)

b. What are the differences between the following types of wireless channel impairments: path loss, multipath propagation and interference from other sources?
(24 Marks)

c. With the aid of a diagram, explain how collisions are avoided in CSMA/CA wireless LANs
(30 Marks)

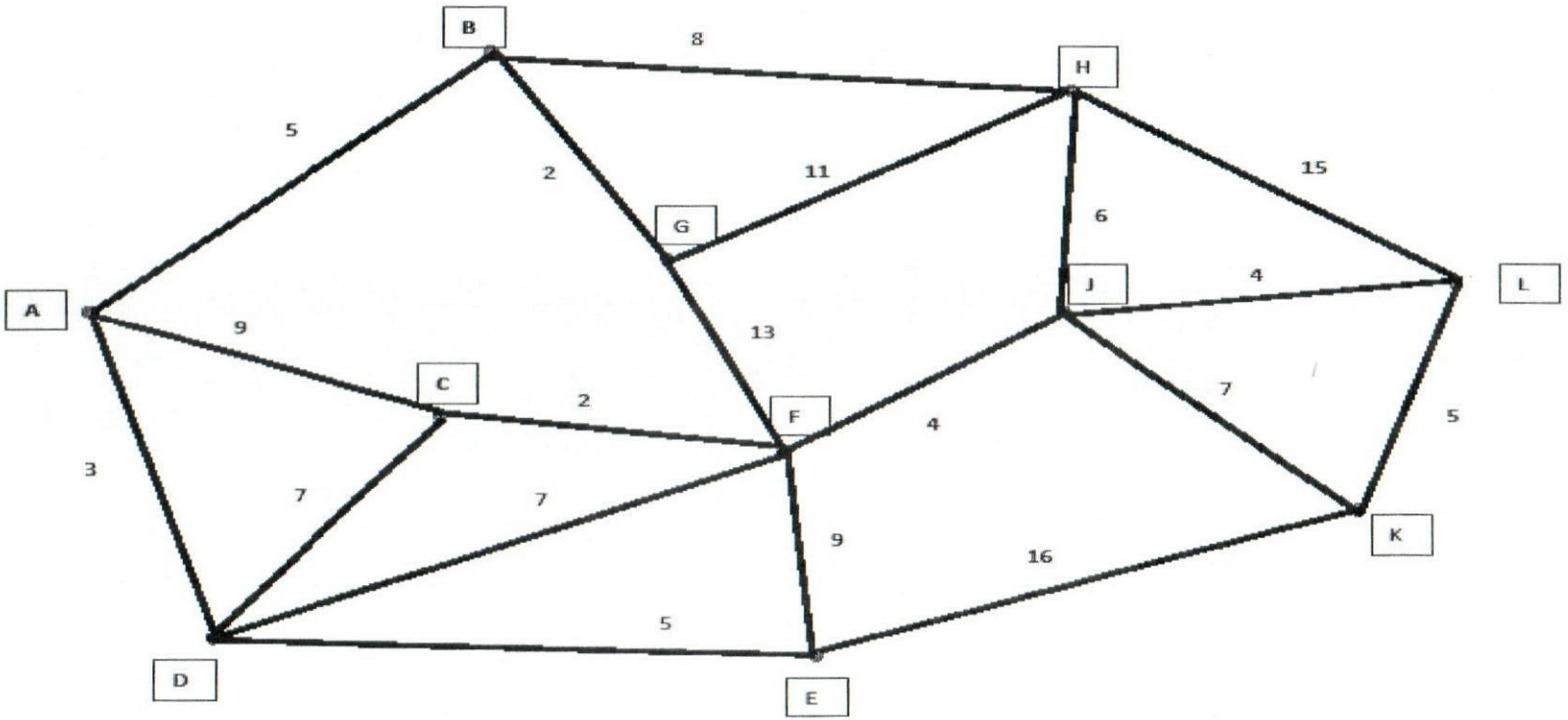
d. Describe the different steps involved in WLAN deployment planning. (25 Marks)

6.

a. In the context of Computing Networks, what is a "Directory Service" and its main functions? (30 marks)

b. Describe and explain in detail, with diagrams, the structure and functions of "Windows Active Directory". (70 marks)

Student Number .....You should document the method by using labels on this sheet, which must be submitted with your answer booklet, also Illustrate your path on the diagram.



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This exam paper must be submitted with your answer booklet

Student Number .....

FACULTY OF SCIENCE & ENGINEERING
SCHOOL OF COMPUTING AND MATHEMATICS

EXAMINATION PAPER

Module Code	:	6CS029
Module Title	:	Advanced Networks
Date	:	31th August 2025
Examiners	:	Dr Ian Coulson, Dr Consolee Mbarushimana, Ms. Shanika Ekanayake
Time Allowed	:	2 hours

INSTRUCTIONS TO CANDIDATES

- This is a Closed book examination.
- Number of Questions to be attempted: Three complete questions from the five on the paper
- All questions are equally weighted (unless otherwise stated)
- Answer to q1 part e) should be written on the exam paper on the last sheet and the **question paper submitted with your answer sheet.**
- Your responses should be recorded on the answer sheet attached.

MATERIALS REQURIED

- 1 six page answer booklet.
- You should write legibly in black or blue ink
- Check your work carefully for inaccurate spelling, punctuation and grammar

1.

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a. What is meant by the term Minimum Spanning Tree? (6 marks)

b. Why is Kruskal's algorithm known as a greedy algorithm? (6 Marks)

c. In the graph in figure 1 of a network use Kruskal's algorithm to determine an MST for this network and state its length. Show the order in which you select and reject edges.

(36 marks)

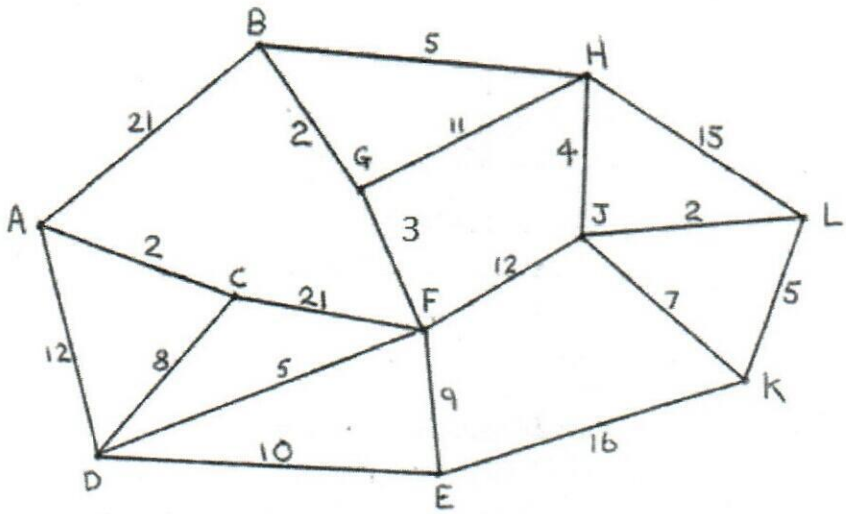


Figure 1 – Graph of a network

d. Sketch the defined MST for the graph in Figure 1. (6 marks)

e. The network in Figure 2 shows the defined weights between nodes. Use Dijkstra's Algorithm to find the route with the lowest cost from A to L.
You should illustrate your method on the attached sheet at the back of the question paper and submit this with your answer booklet. Note marks will only be awarded if you have illustrated Dijkstra's method.

(46 marks)

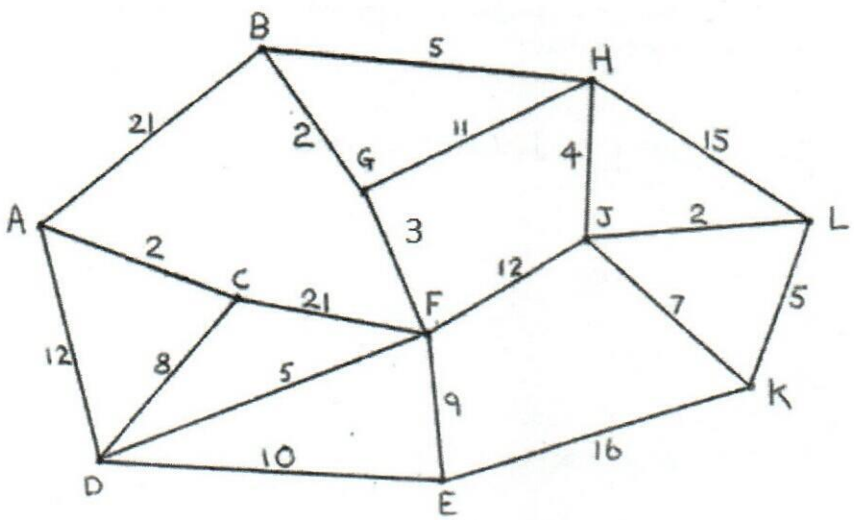


Figure 2 – Graph of a network

2.

a. Discuss with the aid of diagrams the process of a workstation obtaining an IP address through DHCP.

(55 Marks)

b. Describe the domain name system and the processes involved to resolve a web address to its respective IP address. You may include diagrams to aid with this.

(45 Marks)

3. Multicasting is a widely used technology in networks. Give an account of the following features:

a. Addressing, both IP and MAC. (50 marks)
b. Multicast routing protocols (50 marks)

4.

a. Why is QoS an important consideration in designing a network? What are the parameters used to evaluate QoS?

(35 marks)

b. Discuss VLAN implementation as a virtualization technology and their benefits

(30 marks)

c. Using diagrams, explain the difference between a traditional network and Software Defined Network (SDN). What are the main planes of a typical SDN architecture?

(35 Marks)

5.

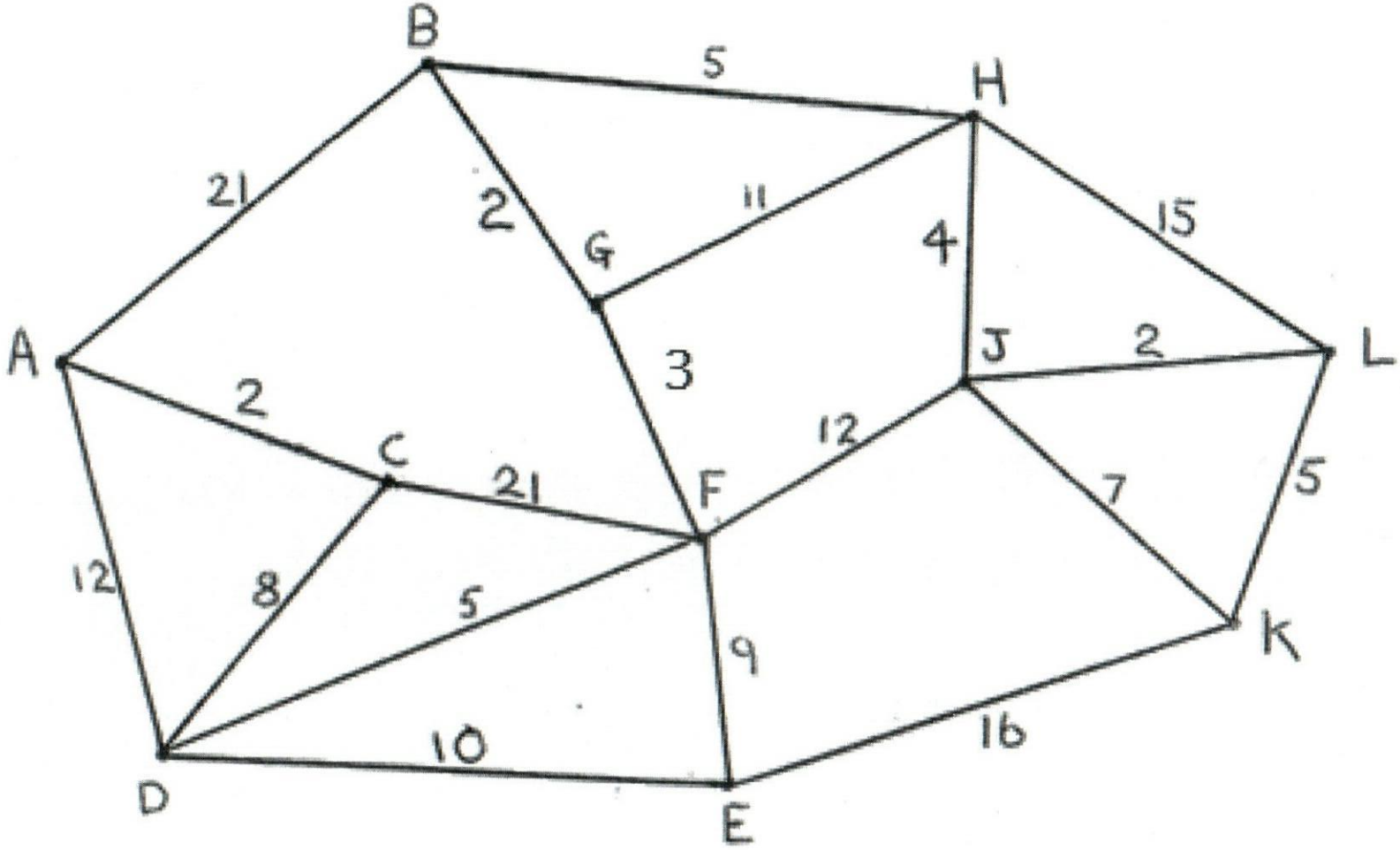
a. With the aid of a diagram, explain how collisions are avoided in CSMA/CA wireless LANs

(50 marks)

b. Explain how mobility is achieved inside an enterprise wireless network.

(50 marks)

Student Number .....You should document the method by using labels on this sheet, which must be submitted with your answer booklet, also Illustrate your path on the diagram.



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FACULTY OF ENGINEERING & TECHNOLOGY

IN-CLASS TEST 02

Module Code	:	**4MM028**
Module Title	:	**Engineering Mathematics II**
Date	:	**18th August 2025**
Examiner	:	**Ms. Hiruni Wickramasinghe**
Time Allowed	:	**3 Hours**

INSTRUCTIONS TO CANDIDATES

- This is a **closed book** examination.
- **Attempt all questions**. Your responses should be recorded on the answer booklet attached.
- You should write legibly in black or blue ink.
- You may use a scientific calculator. This must not be programmable and may be inspected during the examination.
- **Additional Information is provided on page 3 and 4.**
- You may not leave the examination room during the first hour or last 30 minutes of the exam.
- An announcement will be made when there are 30 minutes of the exam time left.

1.

The Partial discharge, V, between the plates of a capacitor C charged by a steady voltage E through a resistor R is given by the equation

$$CR\frac{dv}{dt} + V = E$$

a) Solve the equation for V given that at t=0, V =0. **(70 marks)**

b) Calculate V, correct to 3 significant figures, when E =25V, C =20×10^{-6}F, R=$200\times10^{3}\Omega$ and t = 3.0 s. **(30 marks)**

2. Consider the following second order differential equation,

$$6\frac{d^2y}{dx^2} + 5\frac{dy}{dx} - 6y = 0$$

a) Determine the particular solution when x=0.y=5 and $\frac{dy}{dx} = -1$ **(45 marks)**

b) Use the Laplace transform method to solve the above second order differential equation $[y(0) = 5, y'(0) = -1]$ **(45 marks)**

c) What can you say about the solution, Comparing Part a and b. **(10 marks)**

3. Let $\frac{1}{x}\frac{dy}{dx} + 2y = 1$, y (0) =k

a) If y (0.1) = 1.11 using the **improved Euler (Euler-Cauchy) method** with a step size of h = 0.1 then find the value of k. **(30 marks)**

b) Apply the improved Euler method to find y (0.2). (Consider the step size in a) **(30 marks)**

c) Solve the above differential equation using integrating factor method. **(30 marks)**

d) Hence, find the percentage error with improved Euler method for x= 0.2 **(10 marks)**

4. $$f(x)\begin{cases} -k & when \quad -\pi < x < 0 \\ +k & when \quad 0 < x < \pi \end{cases}$$

a) Sketch a graph of f (x) in the interval $(-2\pi, 2\pi)$. **(30 marks)**

b) Find the fourier series representation of f(x) **(70 marks)**

c) Deduce a series for $\frac{\pi}{4}$ at the point where $x = \frac{\pi}{2}$

$$\left[\frac{\pi}{4} = 1 - \frac{1}{3} + \frac{1}{5} - \frac{1}{7} + \cdots\right]$$

Additional Information

Table1.1 Elementary standard Laplace transforms

	Function $f(t)$	Laplace transforms $\mathcal{L}\{f(t)\} = \int_0^\infty e^{-st} f(t)\,dt$
(i)	1	$\frac{1}{s}$
(ii)	k	$\frac{k}{s}$
(iii)	e^{at}	$\frac{1}{s-a}$
(iv)	$\sin at$	$\frac{a}{s^2+a^2}$
(v)	$\cos at$	$\frac{s}{s^2+a^2}$
(vi)	t	$\frac{1}{s^2}$
(vii)	t^2	$\frac{2!}{s^3}$
(viii)	t^n $(n = 1, 2, 3, \ldots)$	$\frac{n!}{s^{n+1}}$
(ix)	$\cosh at$	$\frac{s}{s^2-a^2}$
(x)	$\sinh at$	$\frac{a}{s^2-a^2}$

Function $e^{at} f(t)$ (a is a real constant)	Laplace transform $\mathcal{L}\{e^{at} f(t)\}$
(i) $e^{at} t^n$	$\frac{n!}{(s-a)^{n+1}}$
(ii) $e^{at} \sin \omega t$	$\frac{\omega}{(s-a)^2+\omega^2}$
(iii) $e^{at} \cos \omega t$	$\frac{s-a}{(s-a)^2+\omega^2}$
(iv) $e^{at} \sinh \omega t$	$\frac{\omega}{(s-a)^2-\omega^2}$
(v) $e^{at} \cosh \omega t$	$\frac{s-a}{(s-a)^2-\omega^2}$

Laplace Transform of the derivatives

$$L\left\{\frac{dy}{dx}\right\} = sL\{y\} - y(0)$$

$$L\left\{\frac{d^2y}{dx^2}\right\} = s^2L\{y\} - sy(0) - y'(0)$$

Euler's method Equation

$$y_1 = y_0 + \mathrm{h}\, f(x_0, y_0)$$

Improved Euler's method Equation

$$y_1 = y_0 + \frac{1}{2}h[f(x_0, y_0) + f(x_0 + h, y_0 + hf(x_0, y_0))]$$

Fourier series corresponding to f (x).

$f(x) = a_0 + \sum_{n=1}^{\infty}(a_n cosnx + b_n sinnx)$ where the range $-\pi$ to π

$$a_0 = \frac{1}{2\pi}\int_{-\pi}^{\pi} f(x)dx$$

$$a_n = \frac{1}{\pi}\int_{-\pi}^{\pi} f(x)cosnx\, dx$$

$$b_n = \frac{1}{\pi}\int_{-\pi}^{\pi} f(x)sinnx\ dx$$

n= (1,2, 3.....)

If the roots of the auxiliary equation are:

(i) **real and different**, say $m = \alpha$ and $m = \beta$, then the general solution is

$$y = Ae^{\alpha x} + Be^{\beta x}$$

(ii) **real and equal, say** $m = \alpha$ twice, then the general solution is

$$y = (Ax + B)e^{\alpha x}$$

(iii) **complex**, say $m = \alpha \pm j\beta$, then the general solution is

$$y = e^{\alpha x}\{A\cos\beta x + B\sin\beta x\}$$

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Faculty of Science and Engineering

EXAMINATION PAPER

Module Code	**4MA020**
Module Title	**Electromechanical Engineering Principles**
Date of Examination:	**14th August 2025**
Examiner:	**Kapila Khemaratne/ Dushani Munasinghe**
Examiner(s) Room:	
Time Allowed:	**3 Hours**
Number of Questions to be attempted:	**5 from 5**

All questions are equally weighted (unless otherwise stated.)

MATERIALS REQUIRED:

- One eight-page answer booklet.
- Formula sheet.
- Scientific calculator

INSTRUCTIONS TO STUDENTS:

- This is closed book examination.
- You are to write your answers in the answer books provided.

Q1 a) Determine the total complex impedance of a circuit at a frequency of $60Hz$. The circuit consists of a 50Ω resistor, a $150mH$ inductor and a $100\mu F$ capacitor all in series. 4 marks

b) A $10\,V$ peak sinusoidal voltage at $200Hz$ is applied across an inductor of $50mH$. Calculate the peak current in the inductor. 4 marks

c) A resistor of $4.7k\Omega$ is connected in series with a capacitor of $47\ \mu F$ to form an RC low-pass filter. Calculate: 6 marks

i. The time constant (τ)

ii. The cut-off frequency (fc)

d) An engineer is designing a bandpass filter for an FM receiver using a series RLC circuit. The inductor value is fixed at $5\mu H$. Determine the range of capacitor values required to tune the circuit from $88MHz$ to $108MHz$. 6 marks

Q2 a) Sketch the I-V characteristics of a PN junction diode and clearly indicate the forward and reverse regions. 4 marks

b) A Zener diode with a breakdown voltage of $6.8V$ is connected in reverse bias across a $12V$ supply through a 470Ω resistor. Calculate the current through the Zener diode. 5 marks

c) A NPN transistor is configured in a common-emitter amplifier circuit. The base resistor is $56k\Omega$, the collector resistor is $4.7k\Omega$, $VCC = 15\,V$, and $\beta = 120$. 6 marks

i. Draw the circuit diagram with all values.

ii. Calculate the base current (I_B), the collector current (I_c) and the collector – emitter voltage (V_{CE}).

d) In an inverting op-amp circuit, $Rf = 100k\Omega$ and $R1 = 10k\Omega$. Determine the voltage gain and the output voltage when $Vin = 0.25\,V$. 5 marks

Q3 a) Simplify the following logic expression using Karnaugh maps. 5 marks

$$Z = \overline{AB}C + \bar{A}B\bar{C} + A\overline{BC} + ABC$$

b) A digital security system operates with three binary inputs: 6 marks

- A: Door sensor (1 = closed)
- B: Motion sensor (1 = motion detected)
- C: Keypad code entered (1 = correct)

The alarm triggers (Z = 1) only when motion is detected and the door is open, or when the correct keypad code is entered and motion is detected.

i. Create the truth table for all input combinations.

ii. Write the SOP expression for Z.

iii. Draw the logic circuit using AND, OR, and NOT gates.

c) Describe the working principle of an LDR (Light Dependent Resistor) and one of its practical applications. 5 marks

d) A hospital patient monitor uses ECG leads connected to an amplifier. Occasionally, strong interference from nearby mains wiring is observed in the ECG traces. 4 marks

i. Define what is meant by Common Mode Rejection Ratio (CMRR) in op-amp circuits.

ii. Suggest two practical design modifications that could improve the system's immunity to such electromagnetic interference.

Q4 A gear box mounted on the chassis of a car has an input shaft rotating at $1900\ RPM$ clockwise and an output shaft rotating at a speed of $900\ RPM$ anticlockwise. The power at the output shaft is measured to be $50kW$ at an efficiency of 50%. Determine the 20 marks

i. Gear Ratio
ii. Input Power
iii. Input Torque
iv. Output Torque
v. holding torque necessary to hold the gear box in place.

Q5 The turning moment diagram of single cylinder of a three-cylinder two stroke petrol engine shown below Figure Q-5. 20 marks

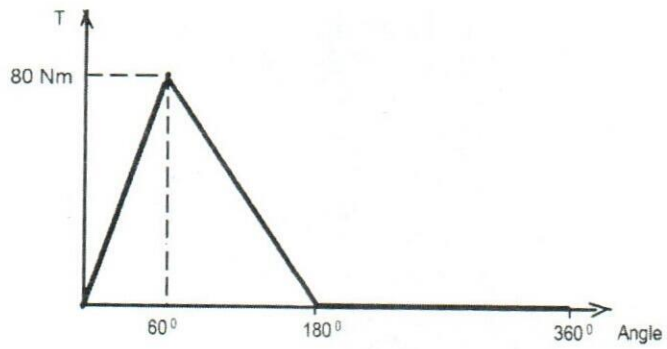


Figure Q-5

Construct the resultant turning moment diagram for the above engine.

Formula Sheet

Electronics Engineering

Resonance frequency: $f_r = \frac{1}{2\pi\sqrt{LC}}$

Inverting OP-Amp gain: $A_V = -\frac{R_f}{R_1}$

Inductive reactance: $X_L = 2\pi f L$

Capacitive reactance: $X_c = \frac{1}{2\pi f C}$

Net reactance: $X = X_L - X_C$

Cutt off frequency for a RC circuit, $f_c = \frac{1}{2\pi RC}$

Mechanical Engineering

Speed ratio = $\frac{\textit{Product of the number of teeth of on the drivens}}{\textit{Product of the number of teeth of on the drivers}} = \frac{\textit{Speed of the first Driver}}{\textit{Speed of the last Driven}}$

Power $P = \frac{2\pi NT}{60}$

Efficiency = Output power / Input power

$Total\ torque = T_1 + T_2 + T_h = 0$

Firing interval for two stoke engine = 2 * 180° / n degrees

END OF THE EXAMINATION PAPER

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FACULTY OF ENGINEERING & TECHNOLOGY

RESIT EXAMINATION PAPER

Module Code	:	**4MA014**
Module Title	:	**Engine and Chassis design**
Academic Year	:	**Semester 2/2025**
Date	:	**12th August, 2025**
Examiners	:	**Yohan Silva**
Time Allowed	:	**2 Hours**

INSTRUCTIONS TO CANDIDATES

- This is a closed book examination. The paper consists of 4 questions in 5 pages.
- You should **answer all 4 questions.** Each question carries equal marks.
- Answers should be written in the answer booklet provided Additional papers can be obtained and should be attached.
- Show all stages of your work.

MATERIALS REQUIRED

- Answer Booklet.
- You may use a Scientific calculator. This must not be programmable and may be inspected during the examination.

Answer all 4 questions

Question 01

a) According to the figure 1 below explain the operation of spark ignition four stroke engine.

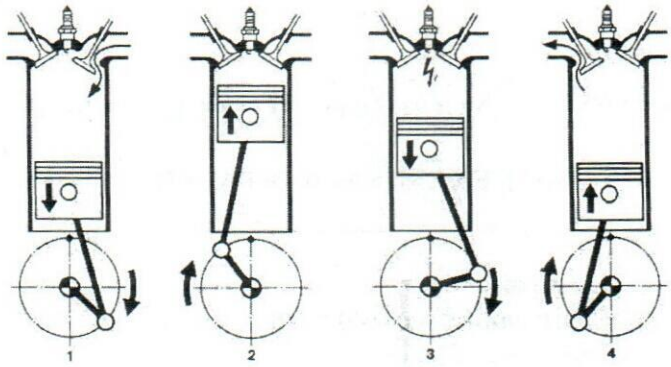


Figure 1

In your explanation cover below mentioned points;

- Piston movement in each stroke.
- Operation of intake and exhaust valve.
- Process inside the combustion chamber in each stroke.

(10 marks)

b) Figure 2 below represents a valve timing diagram of an engine.

I. Explain the details / data represents by the diagram, (5 marks)

II. Calculate the total number of degrees of crankshaft rotation when both valves are **closed** at the **same time**. (5 marks)

III. Calculate the total number of degrees of crankshaft rotation during **valve overlap period**. (5 marks)

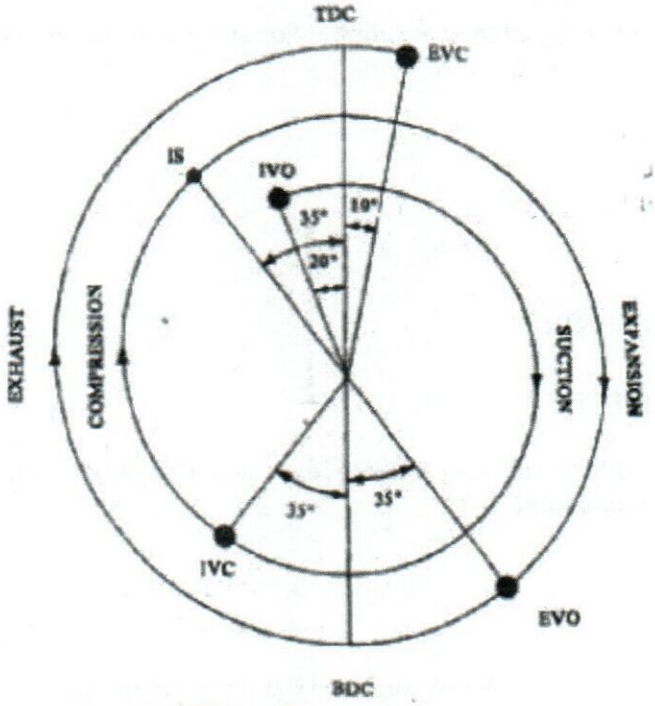


Figure 2

(Total: 25 marks)

Question 02

A vehicle of mass 1800Kg is fitted with an engine which produces 120KW power at an engine speed of 4800rpm. Total air and rolling resistance to movement is 125N. Overall transmission ratio is 4.3:1. Transmission efficiency is 85%. Wheel diameter is 0.45m. Calculate the

a) Total tractive effort.

(10 marks)

b) **Maximum** gradient which the vehicle can climb at constant speed.

(10 marks)

c) State the function of transmission of an automobile.

(5 marks)

(Total: 25 marks)

Question 3

a) What are the functions of a clutch? (2 marks)

b) State **two advantages** of diaphragm spring clutch and **two advantages** of coil spring clutch. (4 marks)

c) Figure 3 below shows an exploded view of a diaphragm spring clutch. Name components A,B,C,D,E, F and G.

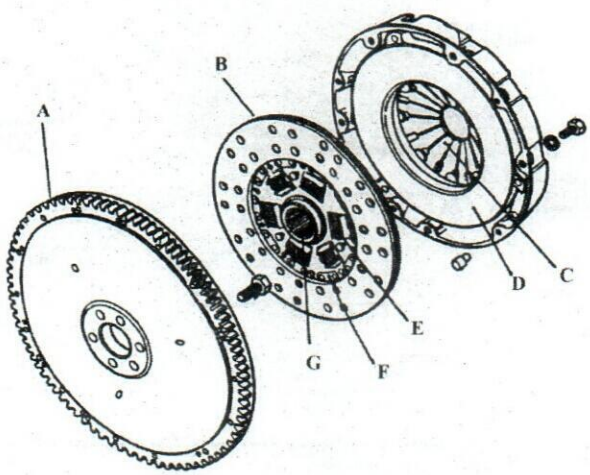


figure 3

(7 marks)

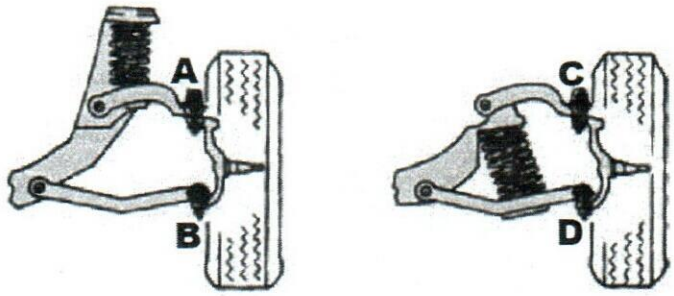


Figure 5.

(4 marks)

e) Figure 6 below shows a cut way diagram of a typical double tube shock absorber. Referring to the diagram below explain the function of the shock absorber during rebound (Extension) and jounce (Compression).

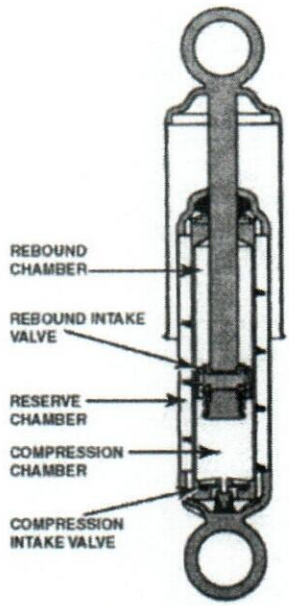


Figure 6.

(10 marks)

(Total: 25 marks)

-The end-

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FACULTY OF SCIENCE & ENGINEERING

SCHOOL OF ENGINEERING

Examination paper

Module Code	:	**5MA036**
Module Title	:	**Solid Mechanics and FEA**
Date	:	**04.08.2025 - 9.00AM to 12.00PM**
Examiners	:	**N G Amith Weerasena**
Time Allowed	:	**3 Hours**

INSTRUCTIONS TO CANDIDATES

- This is a closed book examination.
- Attempt All Questions
- Your responses should be recorded on the answer sheet attached.

MATERIALS REQURIED

- Eight-page answer booklets. Use a separate page for each section.
- Use given graph sheet where necessary.
- You may use a scientific calculator. This must not be programmable and may be inspected during the examination.

Student Number : .....

Question 01

I. Define the following terms:
   a. Yield Strength
   b. Shear Stress
   c. Factor of Safety
   d. Principal Stresses

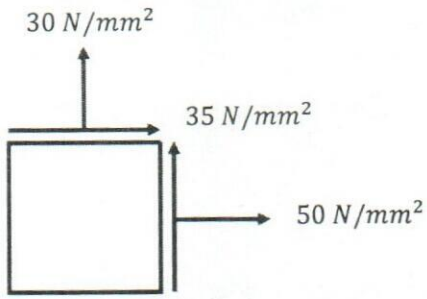
[12 Marks]

II. Discuss the following (Use sketches where appropriate)
   a. Why do we need to calculate stresses in oblique planes in a solid? Explain.
   b. Two pieces of wood, cut at an angle, and glued together. The wood is being pulled apart by a tensile force P. How do we know if the glued joint can sustain the resultant stress that this force produces?

[13 Marks]

Question 02

I. A rectangular block of material is subjected to a tensile stress of $\mathbf{50\ N/mm^2}$ on one plane and a tensile stress of $\mathbf{30\ N/mm^2}$ on a plane at right angles, together with shear stresses of $\mathbf{35\ N/mm^2}$ on the faces. Find the following terms. **[Use analytical method]**
   a. The magnitude of principal stresses and principal plane
   b. The magnitude of maximum shear stress and maximum shear plane



[10 Marks]

II. A point is subjected to a tensile stress of $\mathbf{200\ MPa}$ in the horizontal direction and another tensile stress of $\mathbf{75\ MPa}$ in the vertical direction. The point is also subjected to a simple shear stress of $\mathbf{100\ MPa}$, such that when it is associated with the major tensile stress, it tends to rotate the element in the clockwise direction. **[Use Mohr's Circle Method]**
   a. What is the magnitude of the normal and shear stresses inclined on a section at an angle of $\mathbf{15^0}$ with the major tensile stress in **clockwise** direction.

[15 Marks]

Question 03

I. State three types of loadings on structural members and show their respective forces using sketches.

[5 Marks]

II. For the beam structure shown below (Figure 3.1), construct the **Shear Force Diagram (SFD)** and **Bending Moment Diagram (BMD).** Clearly indicate key values.

[20 Marks]

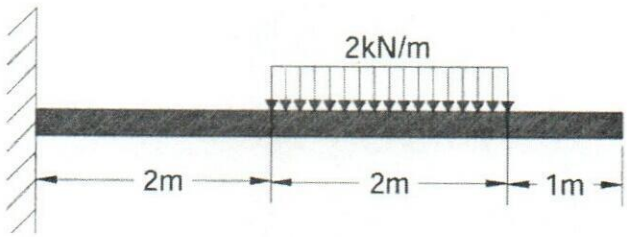


Figure 3.1: Cantilever beam with uniformly distributed load

Question 04

I. Answer following

a) State the torsion equation and define each term used.

b) List any three key assumptions underlying the derivation of the torsion equation.

[10 Marks]

II. A hollow shaft is to transmit $250kW$ at 80 rpm. If the shear stress is not to exceed $60MN/m^2$ and internal diameter is 0.5 of the external diameter, find the external and internal diameters assuming that the maximum torque is 1.4 times the mean.

[15 Marks]

Useful equations

1) Transformation Equation

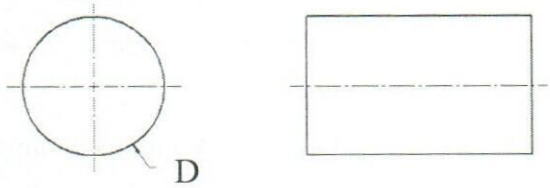
$$\sigma_n = \frac{\sigma_x + \sigma_y}{2} + \frac{\sigma_x - \sigma_y}{2}\cos(2\theta) + \tau_{xy}\sin(2\theta)$$

$$\sigma_t = \frac{\sigma_x + \sigma_y}{2} - \frac{\sigma_x - \sigma_y}{2}\cos(2\theta) - \tau_{xy}\sin(2\theta)$$

$$\tau_{nt} = -\left(\frac{\sigma_x - \sigma_y}{2}\right)\sin(2\theta) + \tau_{xy}\cos(2\theta)$$

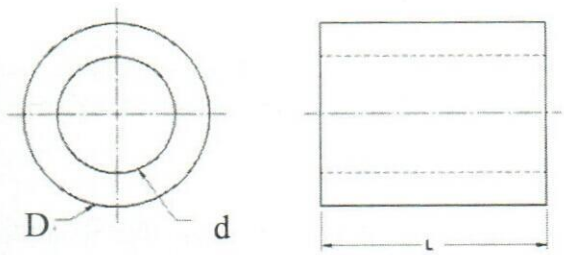
2) Polar moment of inertia for solid shaft

$$I_P = \frac{\pi}{32}D^4$$



3) Polar moment of inertia for hollow shaft

$$I_P = \frac{\pi}{32}(D^4 - d^4)$$



END.

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FACULTY OF ENGINEERING & TECHNOLOGY
QUANTITY SURVEYING FINAL EXAMINATION PAPER

Module Code	:	**6CN012**
Module Title	:	**Sustainability**
Date	:	**July 2025**
Examiner	:	**Bhawantha Wijewickrama**
Time Allowed	:	**3 Hours**

INSTRUCTIONS TO CANDIDATES

- This is a closed book examination.
- Attempt **ALL** questions in part **A** and **three** questions from part **B**. Your responses should be recorded on the answer booklet attached.
- You should write legibly in black or blue ink.
- You may not leave the examination room during the first hour or last 30 minutes of the exam.
- An announcement will be made when there are 30 minutes of the exam time left.
- All questions are equally weighted for part A and questions in part B. Please refer assigned marks for each sub parts within the question.
- You may use a scientific calculator.

PART A – Short Answer Questions (5×5 = 25 marks)

1. Define the term "sustainable construction" and briefly explain its importance for Quantity Surveyors.
2. List five sustainable systems and explain briefly.
3. A cavity wall consists of 100 mm brick (k = 0.77 W/mK), 50 mm insulation (k = 0.035 W/mK), and 13 mm plasterboard (k = 0.25 W/mK). Calculate the overall U-value (W/m²K).
4. Briefly explain how poor indoor lighting and ventilation affect building performance.
5. Describe two components of a Sustainable Urban Drainage System (SUDS) and their function.

PART B – Structured Essay Questions (Answer any THREE – 3×25 = 75 marks)

1. Critically evaluate how climate change and environmental degradation have shaped policy and practice in the construction industry. Provide examples from Sri Lanka or a selected region.

2. Discuss the integration of renewable energy systems (e.g., solar, wind, geothermal) and sustainable technologies (e.g., green roofs, smart systems) in modern construction. Evaluate their cost, efficiency, and long-term sustainability impacts.

3.
   a) Define U-value and explain its importance in sustainable building design. (5 marks)
   b) A flat roof comprises: (12 marks)
   - 120 mm concrete slab (k = 1.5 W/mK)
   - 80 mm insulation board (k = 0.04 W/mK)
   - 20 mm internal ceiling plaster (k = 0.25 W/mK) Calculate the U-value of the roof (show steps).
   c) Comment on how improving U-values contributes to occupant comfort and energy savings. (8 marks)

4.
   a) Identify major sources of construction waste. (5 marks)
   b) Critically analyze the environmental, economic, and legal implications of poor construction waste management. (12 marks)
   c) Propose two strategies for effective waste minimization and reuse. (8 marks)

5. Evaluate the use of sustainable building materials in terms of life cycle cost, carbon footprint, and material sourcing. Compare traditional vs alternative materials using real-world examples.

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Student Number .....

FACULTY OF SCIENCE & ENGINEERING
SCHOOL OF COMPUTING AND MATHEMATICS

EXAMINATION PAPER

Module Code	:	6CS010
Module Title	:	Digital Forensics
Date	:	08th June 2025
Examiners	:	Dr C Mbarushimana / Dr.Rajitha Tennekoon
Time Allowed	:	1.5 hrs

INSTRUCTIONS TO CANDIDATES

- This is a Closed book examination.
- You Should Attempt 3 Questions in Total

MATERIALS REQURIED

- Answer booklet.
- You may use a scientific calculator. This must not be programmable and may be inspected during the examination.
- You should write legibly in black or blue ink

Question 1:

Explain the the four ACPO principles of computer based electronic evidence. Illustrate your answer with examples. ***20 marks***

Question 2:

The figure below shows the first sector of a MBR disk.

```
Offset(d) 00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15

00000000  33 C0 8E D0 BC 00 7C 8E C0 8E D8 BE 00 7C BF 00  3ÀŽÐ¼.|ŽÀŽØ¾.|¿.
00000016  06 B9 00 02 FC F3 A4 50 68 1C 06 CB FB B9 04 00  .¹..üó¤Ph..ËÛ¹..
00000032  BD BE 07 80 7E 00 00 7C 0B 0F 85 0E 01 83 C5 10  ½¾.€~..|.....ƒÅ.
00000048  E2 F1 CD 18 88 56 00 55 C6 46 11 05 C6 46 10 00  âñÍ.ˆV.UÆF..ÆF..
00000064  B4 41 BB AA 55 CD 13 5D 72 0F 81 FB 55 AA 75 09  ´A»ªUÍ.]r..ûUªu.
00000080  F7 C1 01 00 74 03 FE 46 10 66 60 80 7E 10 00 74  ÷Á..t.þF.f`€~..t
00000096  26 66 68 00 00 00 00 66 FF 76 08 68 00 00 68 00  &fh....fÿv.h..h.
00000112  7C 68 01 00 68 10 00 B4 42 8A 56 00 8B F4 CD 13  |h..h..´BŠV.‹ôÍ.
00000128  9F 83 C4 10 9E EB 14 B8 01 02 BB 00 7C 8A 56 00  ŸƒÄ.žë.¸..».|ŠV.
00000144  8A 76 01 8A 4E 02 8A 6E 03 CD 13 66 61 73 1C FE  Šv.ŠN.Šn.Í.fas.þ
00000160  4E 11 75 0C 80 7E 00 80 0F 84 8A 00 B2 80 EB 84  N.u.€~.€.„Š.²€ë„
00000176  55 32 E4 8A 56 00 CD 13 5D EB 9E 81 3E FE 7D 55  U2äŠV.Í.]ëž.>þ}U
00000192  AA 75 6E FF 76 00 E8 8D 00 75 17 FA B0 D1 E6 64  ªunÿv.è..u.ú°Ñæd
00000208  E8 83 00 B0 DF E6 60 E8 7C 00 B0 FF E6 64 E8 75  èƒ.°ßæ`è|.°ÿædèu
00000224  00 FB B8 00 BB CD 1A 66 23 C0 75 3B 66 81 FB 54  .û¸.»Í.f#Àu;f.ûT
00000240  43 50 41 75 32 81 F9 02 01 72 2C 66 68 07 BB 00  CPAu2.ù..r,fh.».
00000256  00 66 68 00 02 00 00 66 68 08 00 00 00 66 53 66  .fh....fh....fSf
00000272  53 66 55 66 68 00 00 00 00 66 68 00 7C 00 00 66  SfUfh....fh.|..f
00000288  61 68 00 00 07 CD 1A 5A 32 F6 EA 00 7C 00 00 CD  ah...Í.Z2öê.|..Í
00000304  18 A0 B7 07 EB 08 A0 B6 07 EB 03 A0 B5 07 32 E4  . ·.ë. ¶.ë. µ.2ä
00000320  05 00 07 8B F0 AC 3C 00 74 09 BB 07 00 B4 0E CD  ...‹ð¬<.t.»..´.Í
00000336  10 EB F2 F4 EB FD 2B C9 E4 64 EB 00 24 02 E0 F8  .ëòôëý+Éädë.$.àø
00000352  24 02 C3 49 6E 76 61 6C 69 64 20 70 61 72 74 69  $.ÃInvalid parti
00000368  74 69 6F 6E 20 74 61 62 6C 65 00 45 72 72 6F 72  tion table.Error
00000384  20 6C 6F 61 64 69 6E 67 20 6F 70 65 72 61 74 69   loading operati
00000400  6E 67 20 73 79 73 74 65 6D 00 4D 69 73 73 69 6E  ng system.Missin
00000416  67 20 6F 70 65 72 61 74 69 6E 67 20 73 79 73 74  g operating syst
00000432  65 6D 00 00 00 00 63 7B 9A F9 1D 7B AF 00 00 80  em....c{šù.{¯..€
00000448  21 00 07 DF 13 0C 00 08 00 00 00 20 03 00 00 DF  !..ß....... ...ß
00000464  14 0C 07 FE FF FF 00 28 03 00 00 18 FC 00 00 FE  ...þÿÿ.(....ü..þ
00000480  FF FF 07 FE FF FF 00 40 FF 00 00 40 00 00 00 FE  ÿÿ.þÿÿ.@ÿ..@...þ
00000496  FF FF 0F FE FF FF 00 80 FF 00 00 78 80 06 55 AA  ÿÿ.þÿÿ.€ÿ..x€.Uª
```

a. What information does this sector contain? ***5 marks***
b. How many active partitions does the disk have and how many partitions in total? Explain your answer. ***5 marks***
c. What is the starting sector in LBA of the first partition? ***5 marks***
d. What is the size in MBs of the 3rd partition? ***5 marks***

Question 3:

NTFS is the most common file system used in Windows today.

a. With regards to NTFS, discuss the role of the Master File Table (MFT) ***5 marks***
b. What are the main components of a MFT file record? ***10 marks***
c. With the help of a diagram, explain the concept of file slack and its significance in digital forensics. ***5 marks***

Question 4:

Critically discuss digital antiforensics techniques and explain how these techniques may be used to mislead the forensic investigation process. ***20 marks***

Question 5:

a. Using a digital investigation process model of your choice, discuss the importance of adopting such a methodology and the main phases of an investigation. ***14 marks***
b. In the context of data acquisition, explain the differences between disk cloning and disk imaging. ***6 marks***

----------End of the Examination Paper----------

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EXAMINATION PAPER

Module Code	**4MA020**
Module Title	**Electromechanical Engineering Principles**
Date of Examination:	**30th May 2025**
Examiner:	**Kapila Khemaratne/ Dushani Munasinghe**
Examiner(s) Room:	
Time Allowed:	**3 Hours**
Number of Questions to be attempted:	**5 from 5**

All questions are equally weighted (unless otherwise stated.)

MATERIALS REQUIRED:

- One eight-page answer booklet.
- Formula sheet.
- Scientific calculator

INSTRUCTIONS TO STUDENTS:

- This is closed book examination.
- You are to write your answers in the answer books provided.

Q1 a) Determine the complex impedance of the circuit in Figure 1 at $50\ Hz$. 4 marks

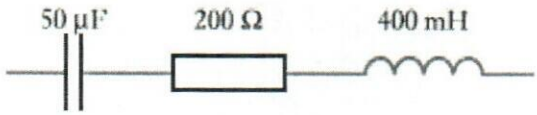


Figure 1

b) A sinusoidal voltage of $5\ V$ peak and $100\ Hz$ is applied across an inductor of $25\ mH$. What will be the peak current in the inductor? 4 marks

c) A resistor or $10\ k\Omega$ is connected in series with a capacitor of $100\ \mu F$ to form an RC filter circuit. Calculate the RC time constant (τ) and the cut-off frequency (ω_c) of the filter circuit. 6 marks

d) An electronics engineer is tasked with designing a basic frequency-selective circuit for an AM radio receiver. The objective is to develop a passive series RLC circuit that resonates at a band of frequencies. If the inductor is at a fixed value of $100\ \mu H$, calculate the range of capacitor values needed to tune the circuit across the entire AM band ($530\ kHz$ to $1710\ kHz$). 6 marks

Q2 a) Sketch the I-V characteristics of a PN junction diode and clearly indicate the forward and reverse regions. 4 marks

b) A silicon PN junction diode is connected in a simple series circuit with a $10\ V$ DC power supply and a $1\ k\Omega$ resistor. Sketch the circuit and calculate the current flowing through the circuit when the diode is in forward bias. 5 marks

c) A Silicon NPN transistor is used in a common-emitter configuration. The base resistor (R_B) is $100\ k\Omega$ and the collector resistor (R_C) is $1\ k\Omega$. The DC supply voltage at the collector (V_{CC}) is $10\ V$ and the current gain (β) of the transistor is 100. 6 marks

i. Draw a simple circuit diagram of the setup and label all values.

ii. Calculate the base current (I_B), the collector current (I_c) and the collector – emitter voltage (V_{CE}).

d) Determine the gain of the inverting amplifier shown in Figure 2. 5 marks

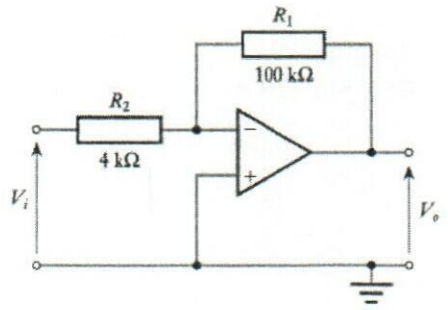


Figure 2

Q3 a) Simplify the following logic expression using Karnaugh maps. 5 marks

$$Z = \bar{A}\,\bar{B}C + \bar{A}BC + A\bar{B}C + ABC$$

b) A digital control system for an automated parking gate operates based on the following logic. The gate opens only under specific conditions based on three binary inputs, 6 marks

- A: Vehicle detected at the entrance sensor (1 = yes)
- B: Valid RFID tag is detected (1 = yes)
- C: Parking space available (1 = yes)

The system output (Z) represents logic 1 when the gate is open and logic 0 when gate is closed. The gate opens only when all the above three conditions are true.

i. Develop a truth table for all 8 combinations of the three inputs (A, B, C) and corresponding output Z.
ii. From the truth table, write the Sum-of-Products (SOP) expression for Z.
iii. Draw the logic circuit diagram using basic gates (AND, OR, NOT) based on your SOP.

c) Explain the working principle of a piezoelectric sensor. 5 marks

d) A patient monitoring system in a hospital includes sensors, a microcontroller, and a wireless module for transmitting vital signs. During testing, engineers notice that the display intermittently glitches and the wireless module sometimes drops data especially when a nearby MRI machine or defibrillator is operating. 4 marks

i. Explain what is meant by Electromagnetic Compatibility (EMC) and how it relates to this situation.
[*give the answer in two sentences]*

ii. Suggest two practical design strategies you could implement to improve the EMC of the patient monitoring device.
[*give the answer in two sentences*]

Q4 A simple gear train has 3 gears. Gear A is the input and has 50 teeth. Gear C is the output and has 150 teeth. Gear A rotated at $1500\ rev/min$ anticlockwise. Calculate, 20 marks

i. The gear ratio and the output speed.
ii. If the input torque on A is $12\ Nm$ and the efficiency is 75%, Calculate the output power and the holding torque.

Q5 The Turning moment diagram of single cylinder of a three-cylinder two stroke petrol engine shown below Figure 3. 20 marks

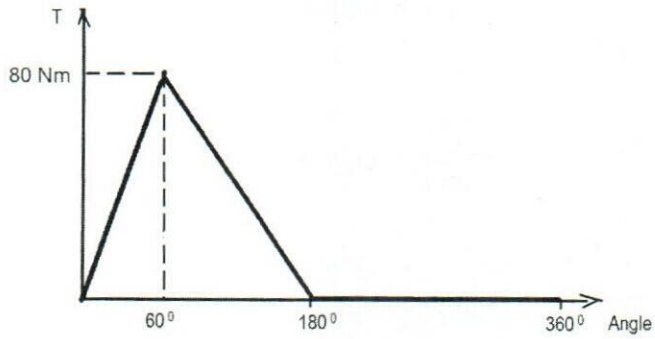


Figure 3

Construct the resultant turning moment diagram for the above engine.

Formula Sheet

Electronics Engineering

Resonance frequency: $f_r = \frac{1}{2\pi\sqrt{LC}}$

Inverting OP-Amp gain: $A_V = -\frac{R_f}{R_1}$

Inductive reactance: $X_L = 2\pi f L$

Capacitive reactance: $X_c = \frac{1}{2\pi f C}$

Net reactance: $X = X_L - X_C$

Cutt off frequency for a RC circuit, $f_c = \frac{1}{2\pi RC}$

Mechanical Engineering

Speed ratio = $\frac{\textit{Product of the number of teeth of on the drivens}}{\textit{Product of the number of teeth of on the drivers}} = \frac{\textit{Speed of the first Driver}}{\textit{Speed of the last Driven}}$

Power $P = \frac{2\pi NT}{60}$

Efficiency = Output power / Input power

$V = \pi d N / 60$

$T_1 / T_2 = e^{\mu\theta}$

Firing interval for two stoke engine = 2 * 180° / n degrees

END OF THE EXAMINATION PAPER

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EXAMINATION PAPER

Module Code	:	**4MA014**
Module Title	:	**Engine and Chassis design**
Academic Year	:	**Semester 2/2025**
Date	:	**27th May, 2025**
Examiners	:	**Yohan Silva**
Time Allowed	:	**2 Hours**

INSTRUCTIONS TO CANDIDATES

- This is a closed book examination. The paper consists of 4 questions in 5 pages.
- You should **answer all 4 questions.** Each question carries equal marks.
- Answers should be written in the answer booklet provided Additional papers can be obtained and should be attached.
- Show all stages of your work.

MATERIALS REQUIRED

- Answer Booklet.
- You may use a Scientific calculator. This must not be programmable and may be inspected during the examination.

Answer all 4 questions

Question 01

a) Explain the operation of a spark ignition four stroke engine. In your explanation cover below mentioned points;

- Piston movement in each stroke.
- Operation of intake and exhaust valve.
- Process inside the combustion chamber in each stroke.

(10 marks)

b) Refer to the following valve timing figures;

- Inlet valve opens 15^0 before TDC
- Inlet valve closes 40^0 after BDC
- Exhaust valve opens 30^0 before BDC
- Exhaust valve closes 10^0 after TDC

I. Draw a typical spiral valve timing diagram, according to the above data if the engine rotates in clockwise direction.

(5 marks)

II. Calculate the total number of degrees of crankshaft rotation when both valves are **closed** at the **same time**.

(5 marks)

III. Calculate the total number of degrees of crankshaft rotation during **valve overlap period**.

(5 marks)

(Total: 25 marks)

Question 02

A vehicle of mass 1800Kg is fitted with an engine which produces 120KW power at an engine speed of 4800rpm. Total air and rolling resistance to movement is 125N. Overall transmission ratio is 4.3:1. Transmission efficiency is 85%. Wheel diameter is 0.45m. Calculate the

a) Total tractive effort.

(10 marks)

b) **Maximum** gradient which the vehicle can climb at constant speed.

(10 marks)

c) State the function of transmission of an automobile.

(5 marks)

(Total: 25 marks)

Question 3

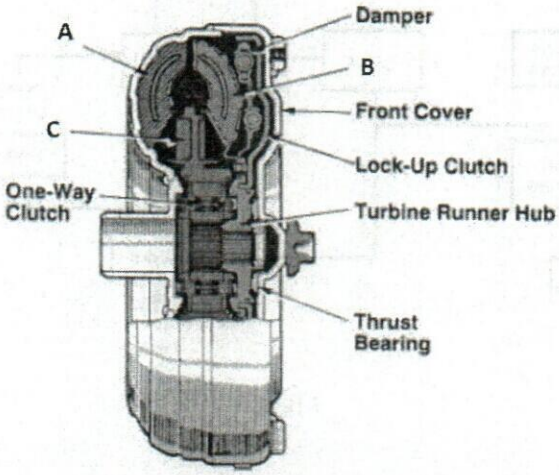


Figure 1.

a) Figure 1 above represents a torque converter. Name and describe the function of component A, B and C.

In your explanation cover below mentioned points;

- Name of the component.
- Functions of the component.
- Construction and operation.

(9 marks)

b) Figure 2 below represents three holding devices used in an automatic transmission system. Referring to the diagram below, explain the operation and function of these holding devices.

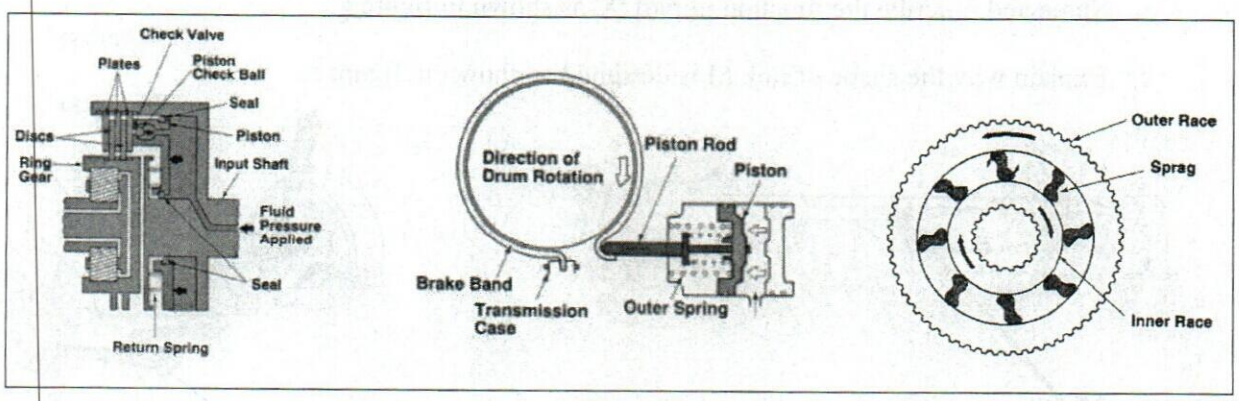


Figure 2.

(4 marks)

c) Figure 3 below represents a block diagram of a Hydraulic control system of an automatic transmission. Name and state the function of **Valve A, Valve B, Valve C** and **Valve D.**

(12 marks)

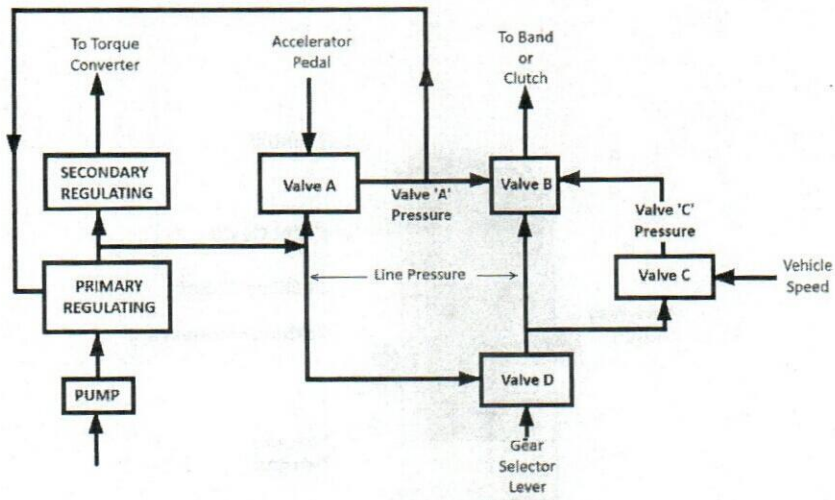


Figure 3.

(Total: 25 marks)

Question 4

a) Explain the functions / objectives of a vehicle suspension system?

(5 marks)

b) Explain with an aid of a sketch What is meant by "Sprung" and "Unsprung" weight.

(3 marks)

c) What are the types of springs used for automotive suspension systems.

(3 marks)

d) Describe the operation and the advantages / disadvantages of any **two** types of springs used in automotive suspension system from the answers in part c) above.

(7 marks)

e) Name and describe the function of part 'X' as shown in figure 4.

(4 marks)

f) Explain why the shape of link M is designed as shown in figure 5.

(3 marks)

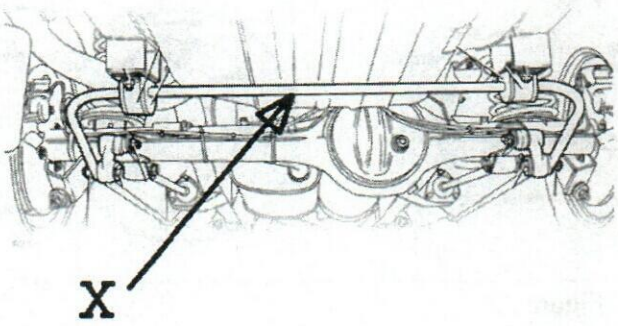


Figure 4.

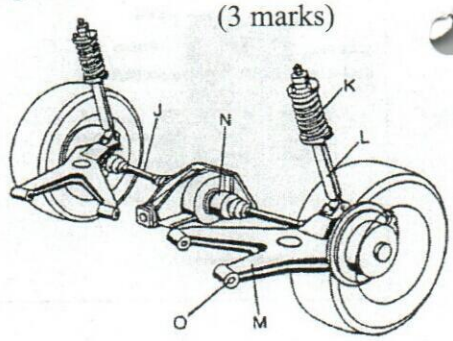


Figure 5.

(Total: 25 marks)

Formula Sheet

- Amount of weight transfer (W)

$$W=\frac{hF_i}{b}$$

- Amount of weight transfer when cornering (W)

$$W=\frac{F_c h}{t}$$

- Sliding velocity

$$V=\sqrt{\mu rg}$$

- Sliding velocity on banking

Sliding velocity $V = \sqrt{\tan(\theta + \emptyset) rg}$

where ; $\tan\emptyset = \mu$

$$\emptyset = tan^{-1}\mu$$

r= radius of the curve / bend

$\theta = banked\ angle$

- Tractive effort = $\frac{T}{r}$

- Torque at the wheels = T × n × f × e

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EXAMINATION PAPER

Module Code	:	**5MA039**
Module Title	:	**Thermodynamics and Fluids**
Date	:	**May, 2025**
Examiners	:	**Asiri Manchanayaka**
Time Allowed	:	**3 Hours**

INSTRUCTIONS TO CANDIDATES.

- This is a closed book examination.
- You should attempt 5 out of 6 questions given.
- All questions carry equal marks.
- Each question should be answered on a new page.

MATERIALS REQURIED

- Eight-page answer booklets.
- You may use a scientific calculator. This must not be programmable and may be inspected during the examination.
- Data sheet, including property tables will be provided.

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01. (i) Air at 10 ^{0}C and 80 kPa enters the diffuser of a jet engine steadily with a velocity of 200 m/s. The inlet area of the diffuser is 0.4 m^2. The air leaves the diffuser with a velocity that is very small compared with the inlet velocity. Determine;

(a) the mass flow rate of the air. **05%**

(b) the temperature of the air leaving the diffuser. **05%**

(ii) Steam at a pressure of 2 MN/m^2 and a temperature of 300 ^{0}C and flowing at a rate of 2 kg/s is throttled to a pressure of 800 kN/m^2. It is then mixed with steam at a pressure of 800 kN/m^2 and 0.9 dry which flows at a rate of 5 kg/s. Determine:

(a) Specific enthalpy of the steam mixture. **07%**

(b) The condition of the steam mixture. **03%**

02. (i) (a) What is a blackbody? Explain how real bodies differ from blackbodies. **(02%)**

(b) Consider heat gain through the two walls of a house on a hot day. The walls are identical, except that one of them has a tightly fit glass window. Through which wall will the house gain more heat? Explain. **(02%)**

(ii) The composite wall of an oven shown in the figure Q1 consists of three materials, two of which are of known thermal conductivity, k_A = 20 W/m K and k_C = 50 W/m K, and known thickness, L_A = 0.30 m and L_C = 0.15 m. The third material, B, which is sandwiched between materials A and C, is of known thickness, L_B = 0.15 m, but unknown thermal conductivity k_B.

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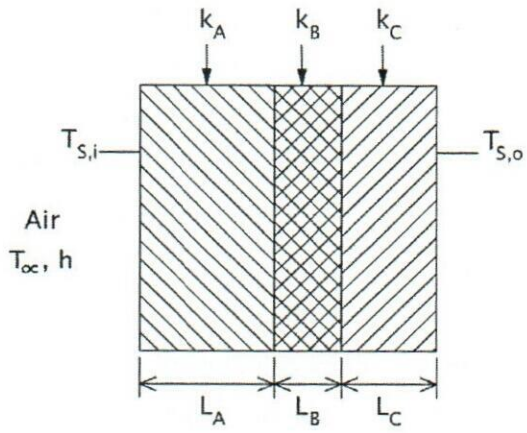


Figure Q2

Under steady-state operating conditions, measurements reveal an outer surface temperature of T_{so} = 20 ^{0}C, an inner surface temperature of T_{si} = 600 ^{0}C, and an oven air temperature of T_∞ = 800 ^{0}C. The inside convection coefficient h is known to be 25 W/m^2 K.

(a) Model the problem using Thermal - Electrical analogy. **(04%)**

(b) Calculate the rate of heat loss per unit area through the composite wall. **(05%)**

(c) Determine the value of k_B. **(07%)**

03. Water is used as the working fluid in an ideal Rankine cycle. Superheated vapor enters the turbine at 8 MPa, 500 ^{0}C. The condenser pressure is 7.5 kPa. The net power output of the cycle is 100 MW.

(a) Draw the T – s diagram for this Rankine cycle. **(03%)**

(b) Find the specific enthalpy values after each process in the cycle. **(10%)**

(c) Determine the mass flow rate through the cycle. **(03%)**

(d) Calculate the rate of heat transfer to the working fluid passing through the boiler. **(02%)**

(e) What is the thermal efficiency of the cycle? **(02%)**

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04. A refrigerator uses refrigerant-134a as the working fluid and operates on an ideal vapor-compression refrigeration cycle between a cold region at 0 ^{0}C and a warm region at 700 kPa. Saturated vapor enters the compressor at 0 ^{0}C and saturated liquid leaves the condenser at 700 kPa. The mass flow rate of the refrigerant is 0.08 kg/s.

Determine;

(a) power input to the compressor. **(08%)**

(b) the rate of heat rejection to the environment from the condenser. **(04%)**

(c) The rate of heat removal from the refrigerated space, in tons. **(04%)**

(d) the coefficient of performance. **(04%)**

05. Air enters the compressor of an ideal air-standard Brayton cycle at 100 kPa, 305 K, with a volumetric flow rate of 10 m^3/s. The compressor pressure ratio is 16. The turbine inlet temperature is 1600 K.

Universal gas constant = 8.314 J K^{-1} mol^{-1} ; Molar mass of air = 28.07 g mol^{-1}

Determine

(a) the thermal efficiency of the cycle. **(08%)**

(b) the back work ratio. **(04%)**

(c) Mass flow rate through the cycle. **(04%)**

(d) the net power developed, in kW. **(04%)**

06. (a) Discuss the main differences between fans, blowers, and compressors in terms of pressure rise and volume flow rate. **(04%)**

(b) Discuss the primary difference between a positive displacement turbomachine and a dynamic turbomachine. Give an example of each for both pumps and turbines. **(08%)**

(c) A three-lobe rotary positive-displacement pump, illustrated in Figure Q5, moves 0.45 cm^3 of tomato sauce in each lobe volume V_{lobe}, as sketched in the figure. Calculate the volume flow rate of sauce in m^3/s for the case where the pump speed is 800 rpm. **(04%)**

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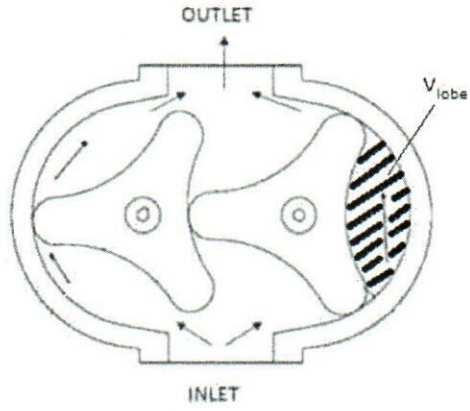


Figure Q6

(d) Discuss the most widely used hydro-turbine in today's hydropower industry among Pelton wheel, Francis turbine and Kaplan turbine. **(04%)**

END OF PAPER

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RE- SIT EXAMINATION PAPER

Module Code	:	**6MA036**
Module Title	:	**ESEE - Economic, Social, Ethical and Environmental**
Date & Time	:	**25/05/2025 from 9.00 to 12.00 noon**
Examiners	:	**Andrew Barnett**
Time Allowed	:	**3 Hours**

INSTRUCTIONS TO CANDIDATES

- This is a Closed Book examination.
- You Should Attempt *ALL FIVE* Questions.
- All questions carry equal marks.
- Assessment weighting 50%.
- Answers to be written in the answer booklet provided.

MATERIALS REQUIRED

- 2 Six pages answer booklets.
- You may use a scientific calculator. This must not be programmable and may be inspected during the examination.

Examination Brief

As part of the 6MA036 module, you have looked at the Ethical, Social, Economic & Environmental impacts of meeting engineering challenges, and the legal frameworks that Professional Engineers must work within. During the module, as an example of an engineering challenge, you were tasked with generating a Concept Product that sat within a circular economy and was environmentally friendly.

Utilizing this same individual concept product, as the subject of your analysis, you are required to complete each of the FIVE questions, as instructed. Each question relates to an aspect of the performance, design, operation, or impact of your concept product, and how well it provided a solution to the engineering challenge given.

For reference only, the original Concept Product Assignment Brief is shown below.

Original Concept Product Assignment Brief – FOR REFERENCE ONLY

As part of the overall work for the module, we will be looking Ethical and Environmental impact of New Product Development.

Below is a basic Product Design Specification (PDS). It requires the development of the following concept.

- A draft design for a consumer product.
- Product must fit within a circular economy framework.
- It is to be manufactured only with the following biodegradable materials / components.

SCALITE
Banana Leaves
Pineapple leaves
Grape by-products
Mycelium
Bagasse
Polylactic Acid (PLA)
Palm leaf
Mater-Bi
Potato by-products

- It must have a significant % of recycled or recyclable material within its construction.
- Raw materials must be sustainably sourced.
- Product must conform to an ethical procurement policy. Evidence is required as to where you might source your materials

Submit a 1-page document (Datasheet) that outlines the following.

- What the product is.
- What it does.
- What market it is aimed at.
- How the product addresses each of the above PDS points.
- States what legal requirements the product conforms to.

The product will need a name and the virtual company that will be making it will also need a name. You need to include a sketch/illustration/image or drawing of your product for reference.

Note: This is an individual assignment so the concept product should be individual to you. The data this assignment contains will be reused in the examination. Since this is a virtual exercise the drawing etc is only required to illustrate the product concept, not fully engineer it.

Questions

1		Outline what ethical issues your concept product potentially provided a solution to? (Max 800 words)	20 marks
2		Identify at least 5 examples of relevant UK/ Sri Lanka (SL) legislation (Laws), that would directly affect the design, manufacture, and sale of your concept product. To be a valid answer, both the title and the year of enactment must be stated. E.g., Pension Schemes Act 2021.	20 marks
3		Assuming your product were to be manufactured and sold in the UK/ SL. Outline, how the proposed design of your product would mitigate the environmental impact of its end-of-life disposal? (Max 800 words)	20 marks
4		In order to assess the social impacts your product generates; outline what data, sources of information, and methodology you might use to arrive at a statement of impact? (Max 800 words)	20 marks
5		Assuming your product were to be manufactured and sold in the UK/ SL. Assess what the economic impact would be of its predicted sales within the UK/ SL? A single, total sales figure in pounds (£/ LKR) is required, for the first year of sales, along with an outline of how you have calculated this value and, what data you have based your calculations on. Calculations used in this assessment to arrive at the first-year sales figure must also be shown.	20 marks

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Final Examination

Module Code	:	**4MM028**
Module Title	:	**Engineering Mathematics II**
Date	:	**25th May 2025**
Examiner	:	**Ms. Hiruni Wickramasinghe**
Time Allowed	:	**3 Hours**

INSTRUCTIONS TO CANDIDATES

- This is a **closed book** examination.
- **Attempt all questions**. Your responses should be recorded on the answer booklet attached.
- You should write legibly in black or blue ink.
- You may **use a scientific calculator.** This must not be programmable and may be inspected during the examination.
- **Additional Information is provided on page 3 and 4.**
- You may not leave the examination room during the first hour or last 30 minutes of the exam.
- An announcement will be made when there are 30 minutes of the exam time left.

1. A 20-gram sample of salt is initially placed in a beaker containing 1 liter of a certain chemical. Over time, the salt begins to dissolve.

   The amount of salt M (in grams) that remains undissolved after t seconds is modeled by the differential equation:

$$\frac{dM}{dt} + \frac{2M}{20 - t} = 0$$

   a) Show that the solution to this differential equation is: $M = \frac{1}{20}(20 - t)^2$ **(70 marks)**

   b) Using this model, calculate the amount of salt that remains undissolved after 5 seconds. **(30 marks)**

2. Consider the following second order differential equation,

$$\frac{d^2y}{dx^2} + 16y = 10$$

   a) Determine the particular solution when $x = 0, y = 3$ and $\frac{dy}{dx} = 4$. **(45 marks)**

   b) Use the Laplace transform method to solve the second order differential equation above. $[y(0) = 3 \ , y'(0) = 4]$ **(45 marks)**

   c) What can you say about the solution, Comparing Part a and b. **(10 marks)**

3. Let $\frac{1}{x}\frac{dy}{dx} + 2y = 1 \, , \ y(0) = k$

   a) If y (0.2) = 0.98 using the improved Euler (Euler-Cauchy) method with a step size of h = 0.2 then find the value of k. **(30 marks)**

   b) Apply the improved Euler method to find y (0.4). (Consider the step size in part a). **(30 marks)**

   c) Solve the above differential equation using integrating factor method. **(30 marks)**

   d) Hence, find the percentage error with the improved Euler method for x= 0.4. **(10 marks)**

4.

$$f(x) = \begin{cases} 0 & when \quad -\pi < x < 0 \\ 1 & when \quad 0 < x < \pi \end{cases}$$

   a) Sketch a graph of f (x) in the interval $(-2\pi, 2\pi)$. **(30 marks)**

   b) Find the fourier series representation of f(x). **(70 marks)**

Additional Information

Table1.1 Elementary standard Laplace transforms

	Function $f(t)$	Laplace transforms $\mathcal{L}\{f(t)\} = \int_0^\infty e^{-st} f(t)\,dt$
(i)	1	$\frac{1}{s}$
(ii)	k	$\frac{k}{s}$
(iii)	e^{at}	$\frac{1}{s-a}$
(iv)	$\sin at$	$\frac{a}{s^2+a^2}$
(v)	$\cos at$	$\frac{s}{s^2+a^2}$
(vi)	t	$\frac{1}{s^2}$
(vii)	t^2	$\frac{2!}{s^3}$
(viii)	$t^n\ (n = 1, 2, 3, \ldots)$	$\frac{n!}{s^{n+1}}$
(ix)	$\cosh at$	$\frac{s}{s^2-a^2}$
(x)	$\sinh at$	$\frac{a}{s^2-a^2}$

Table1.2 Laplace transforms of the form e^{at}f (t)

Function $e^{at} f(t)$ (a is a real constant)	Laplace transform $\mathcal{L}\{e^{at} f(t)\}$
(i) $e^{at} t^n$	$\frac{n!}{(s-a)^{n+1}}$
(ii) $e^{at} \sin \omega t$	$\frac{\omega}{(s-a)^2+\omega^2}$
(iii) $e^{at} \cos \omega t$	$\frac{s-a}{(s-a)^2+\omega^2}$
(iv) $e^{at} \sinh \omega t$	$\frac{\omega}{(s-a)^2-\omega^2}$
(v) $e^{at} \cosh \omega t$	$\frac{s-a}{(s-a)^2-\omega^2}$

Laplace Transform of the derivatives

$$L\left\{\frac{dy}{dx}\right\} = sL\{y\} - y(0)$$

$$L\left\{\frac{d^2y}{dx^2}\right\} = s^2L\{y\} - sy(0) - y'(0)$$

Euler's method Equation

$$y_1 = y_0 + \mathrm{h}\, f(x_0, y_0)$$

Improved Euler's method Equation

$$y_1 = y_0 + \frac{1}{2}h[f(x_0, y_0) + f(x_0 + h, y_0 + hf(x_0, y_0))]$$

Fourier series corresponding to f (x).

$f(x) = a_0 + \sum_{n=1}^{\infty}(a_n cosnx + b_n sinnx)$ where the range $-\pi$ to π

$$a_0 = \frac{1}{2\pi}\int_{-\pi}^{\pi} f(x)dx$$

$$a_n = \frac{1}{\pi}\int_{-\pi}^{\pi} f(x)cosnx\, dx$$

$$b_n = \frac{1}{\pi}\int_{-\pi}^{\pi} f(x)sinnx\, dx$$

n= (1,2, 3.....)

If the roots of the auxiliary equation are:

(i) **real and different**, say $m = \alpha$ and $m = \beta$, then the general solution is

$$y = Ae^{\alpha x} + Be^{\beta x}$$

(ii) **real and equal**, say $m = \alpha$ twice, then the general solution is

$$y = (Ax + B)e^{\alpha x}$$

(iii) **complex**, say $m = \alpha \pm j\beta$, then the general solution is

$$y = e^{\alpha x}\{A\cos\beta x + B\sin\beta x\}$$

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EXAMINATION PAPER

Module Code	**4MM029**
Module Title	**Engineering Mathematics I**
Date of Examination:	**25th of May 2025**
Examiner:	Ms.B.S Wijerathne
Examiner(s) Room:	06
Time Allowed:	3 Hours
Number of Questions to be attempted:	Attempt **ALL** questions

Marks awarded for each question are stated at the end of each question

Materials Required:

One eight-page answer book.
Additional information is provided on page 5 and 6.

Instructions to Students:

- Mobile phones are not permitted in the exam.
- Approved calculator only.
- You should write legibly in black or blue ink.
- Check your work carefully for inaccurate spelling, punctuation and grammar.
- You may not leave the examination room during the first hour or last 30 minutes of the exam.
- An announcement will be made when there are 30 minutes of the exam time left

1. a) Solve the following system of equations using **Inverse matrix method**. (You should show all the steps in your calculations.)

$$x - y + z = 1$$

$$-x + 2y - z = 2$$

$$2x + 3y - 2z = -3$$

(20 Marks)

b) In a mechanical system, acceleration $a\ ms^{-2}$, velocity $v\ ms^{-1}$ and distance $x\ m$ are related by the simultaneous:

$$3.4a - 7v - 13.2x = -11.39$$
$$6a + 4v + 3.5x = 4.98$$
$$2.7a + 6v + 7.1x = 15.91$$

(17 Marks)

Use **Cramer's rule** to find acceleration, velocity, and displacement for the system correct upto 2 decimal places.

2. a) The instantaneous voltage v_t in a capacitive circuit is related to time t by the equation,

$$v_t = Ve^{-t/CR}$$

where V, C and R are constants.

i) Determine v_t, correct to 2 decimal places, when $t = 60$ms, $C = 35\mu$F, $R = 60$k and $V = 320$ volts.

ii) Determine the time at the instant where $v_t = 300$ volts (V, C and R are constants and same as part i.

(13 Marks)

b) In a heat exchanger, the temperature difference between the hot and cold fluids decreases exponentially along the length of the exchanger. The temperature difference $\Delta T(x)$ at a distance x is from the inlet is given by:

$$\Delta T(x) = \Delta T_0 e^{-kx}$$

Where,

$\Delta T(x)$ = Temperature difference at position x (in meters)

ΔT_0 = Initial temperature difference at the inlet

k =Heat transfer constant (in m^{-1})

If the initial temperature difference ΔT_0 is 100°C and the temperature difference reduces to 40°C at a distance of 3 meters, calculate the heat transfer constant k .

(06 Marks)

3.a) If $Z_1 = 1 + 2j$ and $Z_2 = -2 + 3j$.

i. Display above complex numbers on Argand diagram.
ii. Express Z_1 and Z_2 in polar form.
iii. Find $Z_1 Z_2$ and $\frac{Z_2}{Z_1}$ in polar form.
iv. Deduce ${Z_1}^2$ using De Moivre's theorem. (17 Marks)

b) An alternating voltage of 240V, 50Hz is connected across an impedance of $(40 + j\,150)\Omega$. Determine the resistance and the inductance.

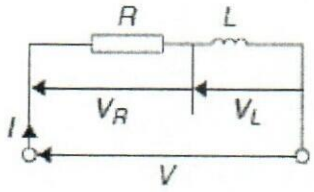


Figure 1:R-L circuit (6 Marks)

4. a) Solve in the range $0 \leq x \leq 2\pi$

i) $\sin x = 0.4$

ii) $\cos x = 0.5$

Sketch the above curves in two separate graphs in the given range and mark your solutions to the above equations on the curves.

(10 Marks)

b) From a window 4.2 m above the horizontal ground the angle of depression of the foot of a building across the road is 24^0 and the angle of elevation of the top of the building is 34^0. Determine, correct to the nearest centimeter, the width of the road and the height of the building.

(11 Marks)

Additional Information

$Z = \boldsymbol{R} + j\boldsymbol{X}$,

Where,

$Z = Impedence$

$R = Resistance$

$X = Reactance$

$\boldsymbol{X} = \boldsymbol{X_L} - \boldsymbol{X_C}$ Where,

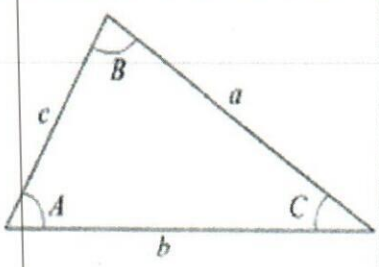
$X_L(inductive\ reactance) = 2\pi f L\ ohms$

$X_C(capacitive\ reactance) = \frac{1}{2\pi fC}\ ohms$

$where, f = frequency$

$L = inductance$

$C = capacitance$



Sine Rule

$$\frac{a}{\sin(A)} = \frac{b}{\sin(B)} = \frac{c}{\sin(C)} \quad or \quad \frac{\sin(A)}{a} = \frac{\sin(B)}{b} = \frac{\sin(C)}{c}$$

(For finding sides) (For finding angles)

Cosine Rule

$$a^2 = b^2 + c^2 - 2bc\cos A \qquad \cos A = \frac{b^2 + c^2 - a^2}{2bc}$$

$$b^2 = a^2 + c^2 - 2ac\cos B \qquad \cos B = \frac{a^2 + c^2 - b^2}{2ac}$$

$$c^2 = a^2 + b^2 - 2ab\cos C \qquad \cos C = \frac{a^2 + b^2 - c}{2ab}$$

General Solutions of Trigonometric Equations

- **Sin(x) = y**

$x = n\pi + (-1)^n \sin^{-1} y$

- **Cos (x) = y**

$x = \pm \cos^{-1} y + 2n\pi$

- **Tan (x) = y**

$x = \tan^{-1} y + n\pi$

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EXAMINATION PAPER

Module Code	:	**4MA017**
Module Title	:	**Mechanical Engineering principles**
Examiner	:	**Kapila Khemaratne**
Date & Time	:	**23- 05-2025 9.00am. to 12.00 noon**
Time Allowed	:	**3 Hours**

INSTRUCTIONS TO CANDIDATES

- This is a Closed book examination.
- You Should attempt **ALL** Questions
- Each answer to start on a new page.

MATERIALS REQURIED

- Answer booklets
- Graph sheets will be provided
- You may use a scientific calculator. This must not be programmable and may be inspected during the examination.

Student Number .....

Q.01 A heavy car plunges into a lake during an accident and lands at the bottom of the lake on its wheels as shown in **Figure-Q-1**. The door is 1.2 m high and 1 m wide, and the top edge of the door is 8 m below the free surface of the water. Determine

a) the hydrostatic force on the door, **(5 marks)**
b) the location of the pressure center and, **(5 marks)**
c) discuss whether the driver can open the door if a strong person can lift 100 kg, which is a weight of 981 N or about 1 kN. **(6 marks)**

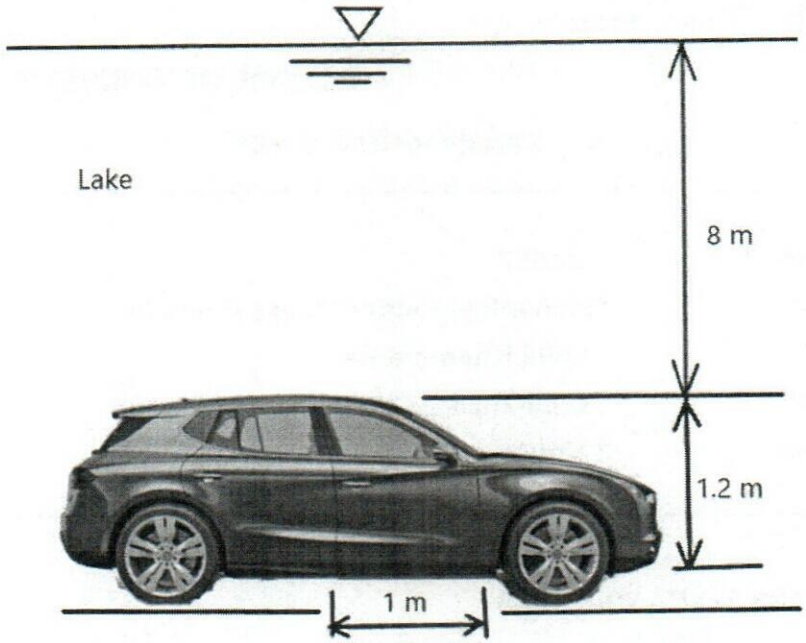


Figure Q-1

Q.02 Water at 20 °C (ρ=999.7 kg/ m^3 μ = 1.307* 10^{-3} kg/ m-s) is flowing steadily through a 2 mm diameter 15 m long horizontal pipe at an average velocity of 1.2 m/ s. Determine

a) Renould's number of the flow,
b) friction factor,
c) the head loss,
d) the pressure drop, and
e) the pumping power requirement to overcome this pressure drop.

(5*4=20 marks)

Q. 03 A 0.5 mole ideal gas is filled in a 0.5 m^3 container at 30 °C. The gas is isothermally (constant Temperature) compressed to a volume of 0.3 m^3. Then the gas expands isobarically (constant Pressure) to its original volume.

a) Sketch a p-V diagram of these two thermodynamic processes. **(8 marks)**
b) Calculate the total work done in the processes. **(8 marks)**

Q. 04 A simple gear train has 3 gears. Gear A is the input and has 50 teeth. Gear C is the output and has 150 teeth. Gear A rotated at 1500 rev/min anticlockwise. Calculate;

a) the gear ratio and the output speed, **(4 marks)**
b) If the input torque on A is 12 Nm and the efficiency is 75%, Calculate the output power and the holding torque. **(12 marks)**

Q. 05 Find the power transmitted by a belt running over a pulley of 600 mm diameter at 200 r.p.m. The coefficient of friction between the belt and pulley is 0.25, angle of lap 160° and maximum tension in the belt is 2500 N.

(12 marks)

Q. 06 The Turning moment diagram of single cylinder of a three-cylinder two stroke petrol engine shown below **Figure Q-5**.

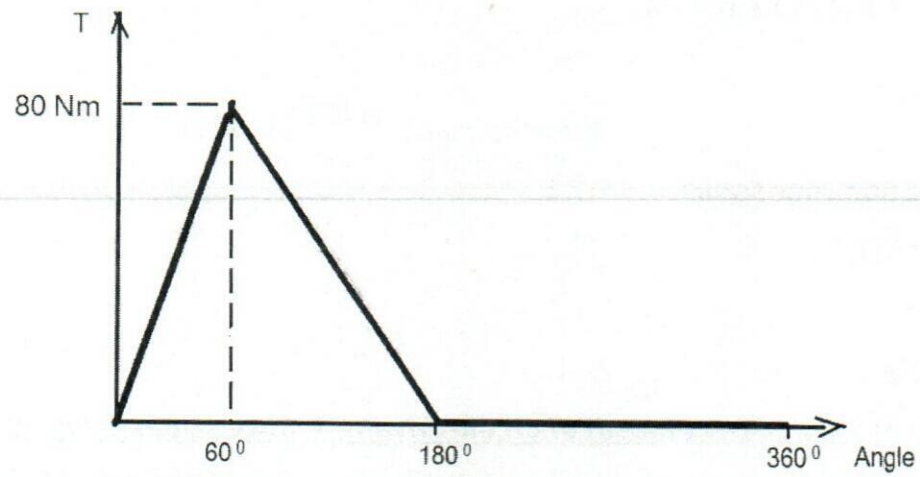


Figure Q-5

Construct the resultant turning moment diagram for the above engine.

(20 marks)

Examination Formula Sheet

$$F_R = \gamma A y_c \sin\theta = (\gamma h_c) A$$ where $\gamma = \rho g$

$$y_R = \frac{I_{xc}}{y_c A} + y_c$$

I_{xc} for rectngular section = $bd^3 / 12$

Q= AV

$$h_L = \frac{\Delta P_L}{\rho g} = f \frac{L}{D} \frac{V_m^2}{2g}$$

f = 64/Re

Pumping power = $Q \rho g h_L$

For Isothermal processes;

$$PV = n\bar{R}T;$$

$\bar{R}' = 8.3143$ kJ kmol^{-1} K^{-1}

$$P_1V_1 = P_2V_2$$

$$WIsothermal = n\bar{R}T \ln V2/V1$$

For Isobaric processes

$V_1 / T_1 = V_2/T_2$

W = PΔV

Speed ratio

= ***Product of the number of teeth of on the drivens*** = ***Speed of the first Driver***

Product of the number of teeth of on the drivers ***Speed of the last Driven***

Power P = 2π NT/ 60

Efficiency = Output power / Input power

V= π d N / 60

$T_1 / T_2 = e^{\mu\theta}$

Firing Interval for Two Stoke engine = 2 * 180° / n degrees

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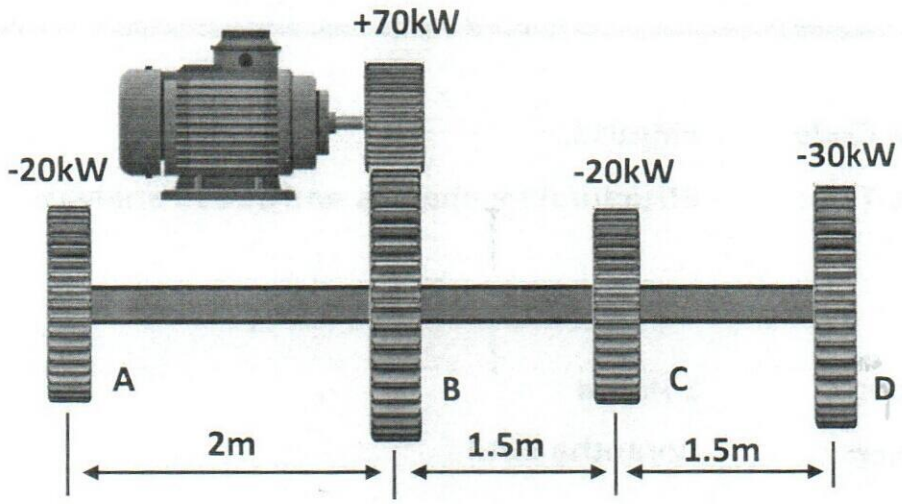
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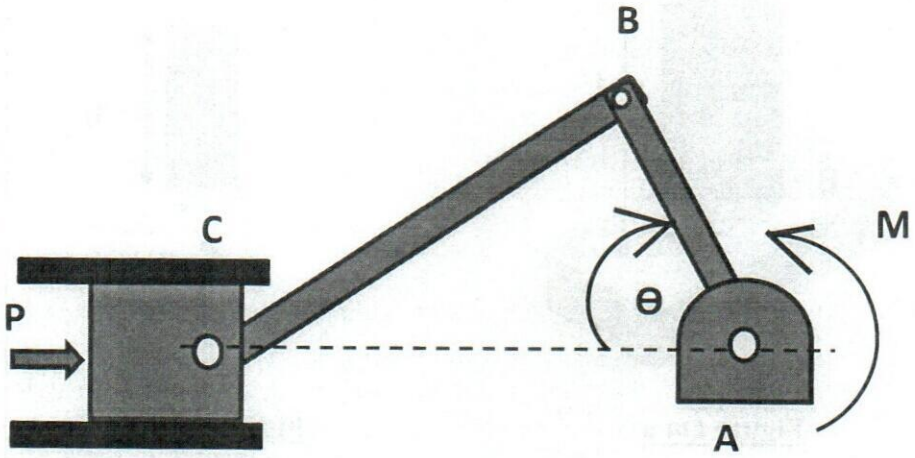
Faculty of Science and Engineering
Session 2025
Semester 5

Module Code:	**6MA016**
Module Title:	**Structural mechanics and stress analysis**
Date:	
Time:	
Duration:	**3 Hours**
Examiner:	**Virantha E.A.I**
Extension:	

INSTRUCTIONS TO CANDIDATES

- This is a closed book examination.
- A scientific calculator can be used in this exam. This must not be programmable.
- **Four questions** should be attempted out of five questions.
- Answers to each question to start on a separate page.
- All questions are equally weighted.
- Any data which is not given should be assumed and clearly mentioned.

Q1	A 5-meter-long steel shaft rotating at 2 Hz receives 70 kW of power at gear **B**, located 2 meters from the left end. At the left end, gear **A** removes 20 kW of power. At the right end, gear **D** removes 30 kW, and an additional 20 kW is removed at gear **C**, which is located 1.5 meters from the right end. Find the uniform shaft diameter so that the shearing stress will not exceed 60 MPa. (Use G = 83 GPa)  **Figure Q1**	(Total 100%)
Q2	An external pressure of 10 MN/m^2 is applied to a thick cylinder of internal diameter **160 mm** and external diameter **320 mm**. If the maximum hoop stress permitted on the inside wall of the cylinder is limited to 30 MN/m^2. i. what maximum internal pressure can be applied assuming the cylinder has closed ends? ii. What will be the change in outside diameter when this pressure is applied? (E = 207 GN/m^2, Poisson ratio = 0.29)	(Total 100%)

Q3	A **4 kN** force **P** is applied as shown to the piston of the engine system. Knowing that **AB** = 50 mm and **BC** = 200 mm, Using the principle of virtual work determines the couple **M** required to maintain the equilibrium of the system when θ=30°,  **Figure Q3**	(Total 100%)
`Q4	An **aluminum** column of length ***L*** and rectangular cross section has a fixed end ***B*** and supports a centric load **P** at ***A*** end. Two smooth and rounded fixed plates restrain the movement of the **A** end in one of the vertical planes of symmetry of the column but allow it to move in the other vertical plan. (Figure Q4 a). Figure Q4 b shows the beam cross section. i) Determine the ratio ***a/b*** of the two sides of the cross section corresponding to the most efficient design against buckling. ii) Design the most efficient cross section for the column, knowing that the L=500mm, E=70GPa, P=22kN and that a factor of safety of 2.5 is required.	

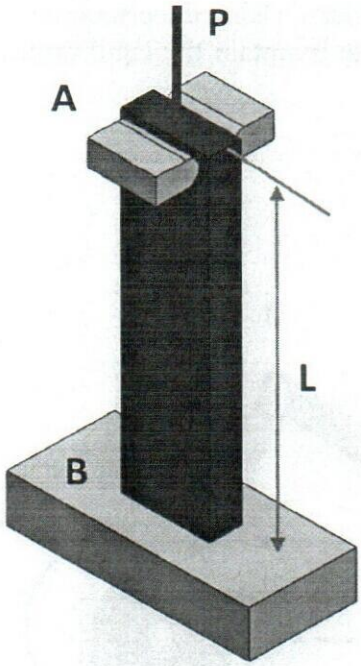


Figure Q4 a

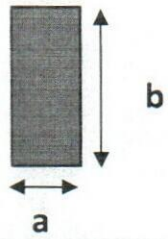


Figure Q4 b

(Total 100%)

Q5 The two-dimensional truss shown in Figure Q5 is subjected to external load of 10 kN as shown in Figure Q5. The cross-sectional area of the two beams is 300mm^2 per each and elastic modules of the beam material is 200GPa and Poisson's ratio is 0.3.

(a) using the finite element method solve for the horizontal and vertical components of displacement at node 3.

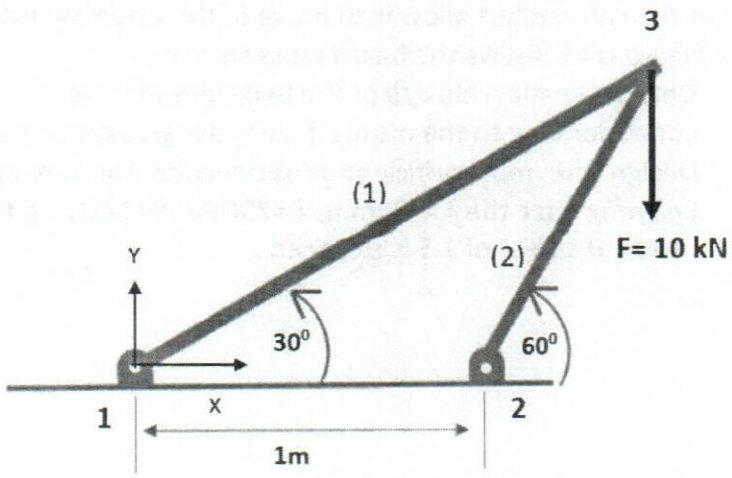


Figure Q5

(Total 100%)

Data Sheet

Torsion

$$\frac{\tau}{r} = \frac{T}{J} = \frac{G\theta}{L} \qquad P = \frac{2\pi NT}{60} \qquad J = \frac{\pi d^4}{32} \qquad T = Frn$$

Thin Shells

Cylinder $\sigma_C = \frac{Pd}{2t}$ $\sigma_L = \frac{Pd}{4t}$ Vol Strain = 2 × Hoop Strain + Axial Strain

Sphere $\sigma = \frac{Pd}{4t}$ Vol Strain = 3 × Hoop strain

$$\varepsilon = \frac{\sigma_x}{E} - \upsilon\frac{\sigma_y}{E} - \upsilon\frac{\sigma_z}{E} \qquad \Delta V = \frac{V \times P}{K}$$

Principal Stresses

$$\sigma_\theta = \sigma_x \cos^2\theta + \sigma_y \sin^2\theta + \tau \sin 2\theta \qquad \tau_\theta = \frac{1}{2}(\sigma_y - \sigma_x)\sin 2\theta + \tau\cos 2\theta$$

$$\sigma_1, \sigma_2 = \frac{1}{2}(\sigma_y + \sigma_x) \pm \frac{1}{2}\sqrt{(\sigma_y - \sigma_x)^2 + 4\tau^2} \quad \text{or} \quad (\sigma_x - \sigma)(\sigma_y - \sigma) = \tau^2$$

$$\tan\theta = \frac{(\sigma - \sigma_y)}{\tau} \qquad \tau_{max} = \pm\frac{1}{2}\sqrt{(\sigma_y - \sigma_x)^2 + 4\tau^2} \quad \text{or} \quad \pm\frac{(\sigma_1 - \sigma_2)}{2}$$

Strain energy

$$u = \frac{1}{2}\sigma_x\varepsilon_x \qquad U = \frac{P^2L}{2AE}$$

Bar element stiffness

$$K = \frac{EA}{L}\begin{bmatrix} 1 & -1 \\ -1 & 1 \end{bmatrix}$$

$$k = \frac{AE}{L}\begin{bmatrix} C^2 & CS & -C^2 & -CS \\ CS & S^2 & -CS & -S^2 \\ -C^2 & -SC & C^2 & CS \\ -CS & -S^2 & CS & S^2 \end{bmatrix}$$

Thick-walled Cylinders

$$\sigma_r = \frac{a^2 p_i - b^2 p_o}{b^2 - a^2} - \frac{(p_i - p_o)a^2 b^2}{r^2\left(b^2 - a^2\right)}$$

$$\sigma_t = \frac{a^2 p_i - b^2 p_o}{b^2 - a^2} + \frac{(p_i - p_o)a^2 b^2}{r^2\left(b^2 - a^2\right)}$$

$$\frac{bp}{E}\left(\frac{b^2 + c^2}{c^2 - b^2} + \mu\right) + \frac{bp}{E}\left(\frac{a^2 + b^2}{b^2 - a^2} - \mu\right) = \delta \text{.....eqn. 32}$$

or

$$p = \frac{E\delta}{b}\frac{\left(b^2 - a^2\right)\left(c^2 - b^2\right)}{2b^2\left(c^2 - a^2\right)} \text{.....eqn. 33}$$

$$u = \frac{1-\mu}{E}\frac{a^2 p_i - b^2 p_0}{b^2 - a^2} r + \frac{1+\mu}{E}\frac{a^2 b^2 (p_i - p_o)}{\left(b^2 - a^2\right) r} \text{.....eqn 27}$$

Radial Deformation

$$u = \frac{1-\mu}{E}\frac{a^2 p_i - b^2 p_0}{b^2 - a^2} r + \frac{1+\mu}{E}\frac{a^2 b^2 (p_i - p_o)}{\left(b^2 - a^2\right) r}$$

Shrink-fit Interface Pressure in Cylinders

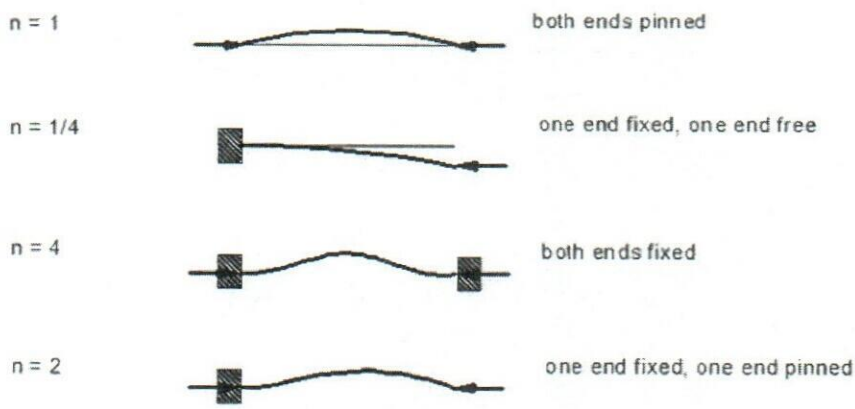
$$\frac{bp}{E}\left(\frac{b^2 + c^2}{c^2 - b^2} + \mu\right) + \frac{bp}{E}\left(\frac{a^2 + b^2}{b^2 - a^2} - \mu\right) = \delta$$

or

$$p = \frac{E\delta}{b}\frac{\left(b^2 - a^2\right)\left(c^2 - b^2\right)}{2b^2\left(c^2 - a^2\right)}$$

Buckling

$$P_E = \frac{n\pi^2 EI}{L^2} \qquad P_R = \frac{\sigma_C A}{1+\frac{a}{n}\left(\frac{l}{k}\right)^2} \qquad I = Ak^2$$





$p_E = 0$ $\qquad p_E = \frac{\pi^2 EI}{L^2}$ $\qquad p_E = \frac{4\pi^2 EI}{L^2}$ $\qquad p_E = \frac{9\pi^2 EI}{L^2}$

Biaxial Plane Stress

$$\varepsilon_x = \frac{\sigma_x}{E} - \nu\frac{\sigma_y}{E}$$

$$\varepsilon_y = \frac{\sigma_y}{E} - \nu\frac{\sigma_x}{E}$$

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RESIT-EXAMINATION PAPER

Module Code :	:	5MA034
Module Title	:	Engine Design and Thermodynamics
Date	:	Semester 1/Year 2024/5
Examiners	:	Janaka Perera
Time Allowed:	:	3 Hours

INSTRUCTIONS TO CANDIDATES

- This is an unseen paper.
- This is a closed book examination.
- Attempt **FOUR** Questions out of **FIVE**.
- You are to write your answers in the answer books provided.

MATERIALS REQUIRED

- Answer booklets.
- Formula sheet at back of paper.
- You may use a Scientific calculator. This must not be programmable, may not have significant memory capability, and may be inspected during the examination.

1. (a) Explain the steady flow using a schematic diagram clearly mentioning inlet and outlet mass flow rate for a incompressible fluid. **(5 marks)**

(b) Write down the steady flow power equation with usual notations for a turbine with a schematic diagram. **(5 marks)**

(c) Air having a specific volume of 1.25 kg/m^3 enters a gas turbine at a velocity of 105 m/s through an inlet area of 0.05 m^2. The air stream exits from the gas turbine at a velocity of 135 m/s and a specific volume of 0.67 kg/m^3. During the flow process, air loses 27 kJ/kg of heat and its specific enthalpy comes down by 145 kJ/kg. **(15 marks)**

Determine,

(i) the mass flow rate of air though the turbine,

(ii) the turbine exit area,

(iii) the power developed by the turbine.

2. (a) Explain the function of gas turbine by explaining the function of each component using a schematic diagram. **(4 marks)**

(b) Explain the twin spool gas turbine, with schematic diagram. **(4 marks)**

(c) A gas turbine has an overall pressure ratio of 5 and a maximum cycle temperature of 550 ºC. The turbine drives the compressor and an electric generator. The ambient temperature is 20 ºC and air enters the compressor at a rate of 15 kg/s. The isentropic efficiencies of the compressor and turbine are 80% and 83% respectively. By neglecting changes in kinetic energy calculate the power output of the system. **(9 marks)**

(d) Calculate the cycle efficiency of the system in part (c) **(8 marks)**

3. (a) What is a perfect gas ? **(5 marks)**

(b) A volume of 0.15 m^3 of air at 1.2 bar and 80° C is compressed isothermally to a volume of 0.015 m^3. Heat is then added at a constant volume until the pressure rises to 24 bar.

(i) Sketch the processes on a *p-V* diagram.

(ii) Determine the pressure at the end of the isothermal process, and the temperature at the end of the constant volume heat addition. **(20 marks)**

(iii) Determine the heat transfers during the isothermal process and the constant volume process.

4. A fluid at 0.7 bar occupying 0.09 m^3 is compressed reversibly to a pressure of 3.5 bar according to a law pv^n = constant. The fluid is then heated reversibly at constant volume until the pressure is 4 bar. The specific volume is then 0.5 m^3/kg. A reversible expansion according to a law pv^2 = constant restores the fluid to its initial state.

(a) Sketch the cycle on a p-v diagram. **(4 marks)**

(b) Calculate the mass of fluid present **(9 marks)**

(c) Calculate the value of n in the first process. **(4 marks)**

(d) Calculate the net work of the cycle. **(8 marks)**

5. (a) With schematic diagrams explain bore, stroke, TDC and BDC for a piston engine. **(8 marks)**

(b) A two-cylinder, four-stroke gas engine has a bore of 380 mm and a stroke of 585 mm. At 240 rpm the torque developed is 11.86 kN m. Calculate the bp , the mean piston speed in m/s and bmep. **(5 marks)**

(c) A test on a 4cyl, 4 stroke engine, bore of 49mm, stroke of 60mm, had the following readings taken;

Speed = 3000 rpm

IMEP = 750 KPa

Effective brake load = 135N @ 0.5m **(12 marks)**

From these readings find the following

a) Indicated power

b) Brake power

c) Frictional power

d) Mechanical efficiency

End of the Examination

Data Sheet

The ideal gas equations

$pv=RT$ $\quad Q=mC_p(T_2-T_1)$

$pV=mRT$ $\quad Q=mC_v(T_2-T_1)$

$pV=n\bar{R}T$ $\quad \bar{R}= 8.3145$ kJ/kmol.K

$Cp - Cv = R$

$\gamma = Cp/Cv$

Reciprocating IC Engines

$ip = p_iALNn/2$ Four stroke Engines

$bp= 2\pi NT$

$\eta_M= bp/ip$

$bp= P_bALNn/2$

$\eta_{otto}= 1- 1/(r_v)^{\gamma-1}$

For air

$\gamma = 1.4$

$C_p = 1.005$ kJ/kg.K

For combustion & expansion

$\gamma = 1.333$

$C_p = 1.15$ kJ/kg.K

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FINAL EXAMINATION PAPER

Module Code	:	**5CV004**
Module Title	:	**Civil Engineering analysis**
Date	:	**May 2025**
Examiner	:	**Supun Walpita**
Time Allowed	:	**3 Hours**

INSTRUCTIONS TO CANDIDATES

- This is a closed book examination.
- Attempt **ALL** questions. Your responses should be recorded on the answer booklet attached.
- You should write legibly in black or blue ink.
- You may not leave the examination room during the first hour or last 30 minutes of the exam.
- An announcement will be made when there are 30 minutes of the exam time left.
- All questions are not equally weighted. Please refer assigned marks for each subparts within the question

MATERIALS REQUIRED

- 12 page answer booklets.
- You may use a scientific calculator.

1.

a) The deflection y at the centre of a circular plate suspended at the edge and uniformly loaded is given by $y = \frac{kWd^4}{t^3}$, where w =totals load, d =diameter of plate, t =thickness and k is a constant. Determine the percentage change of y, given that w increases by 3%, d decreases by 2.5%, and t increases by 4%. (5%)

b) Solve the following differential equations

I. $x\frac{dy}{dx} = y(x^2 - 1)$ (4%)

II. $x\frac{dy}{dx} - 4y = e^x x^6$ (6%)

III. $xy\frac{dy}{dx} = y^2 - x^2$ (6%)

2. (a) Find the complete solution of the differential equation

$$\frac{d^2y}{dt^2} + 5\frac{dy}{dt} + 6y = 4e^{3t}$$

Given that $y(0) = 1$ and $y'(0) = 0$.

(10%)

(b) Find the inverse Laplace transforms of the following expressions

i) $\frac{3}{s^2+49}$ (2%)

ii) $\frac{7}{s+41}$ (2%)

iii) $\frac{s-5}{s^2-16}$ (4%)

iv) $\frac{2s+5}{s^2+4s+13}$ (4%)

3. (a) Find the Laplace transforms of the following expressions

i) $t(3t^2 + 4t + 1)$ (2%)

ii) $e^{-2t}Cos5t$ (2%)

iii) $Sin^2 2t$ (3%)

iv) $t^2 cost$ (5%)

(b) Find the solution to the differential equation

$$y'' + 5y' + 6y = t$$

given than $y(0) = 0$ and $y'(0) = 0$

i) Using the complementary function and the particular integral (12%)

ii) Using Laplace transforms (12%)

4. (a) Suppose that the rate of settlement of a particular building is inversely proportional to the time (t) after construction. The building has undergone an initial settlement of 0.15 m during the construction time of 1 year. After 2 years, the settlement was recorded as 0.25m, Find the settlement after 10 years (9%)

(b) A mass weighing 0.5 Kg attached to a spring which has a spring constant k = 8kg/s^2. At t = 0 the mass is released from a point 0.1m below the equilibrium position with an upward velocity of 0.2ms^{-1}. Determine the equation of motion (12%)

Additional Information

Integration by parts equations	$\int u\frac{dv}{dx}dx = uv - \int v\frac{du}{dx}dx$ $\int_a^b u\frac{dv}{dx}dx = [uv]_b^a - \int_a^b v\frac{du}{dx}dx$
Integrating factor equations	$m = e^{\int P(x)dx}$ $my = \int mQ(x)dx$

Second Order Differential Equations – Homogeneous Equations

auxiliary equation type of solutions	Solution to the ODE
Real and different roots	$y = Ae^{m_1 x} + Be^{m_2 x}$
Real and equal roots	$y = e^{mx}(A + Bx)$
Complex roots (p+ iq ,p-iq)	$y = e^{px}(A\cos qx + B\sin qx)$

Second Order Differential Equations – Inhomogeneous Equations

form of $f(x)$	**assumed general form for y**
$f(x) = k....$	$y = C$
$f(x) = kx....$	$y = Cx + D$
$f(x) = kx^2....$	$y = Cx^2 + Dx + E$
$f(x) = k\sin x$ or $k\cos x$	$y = C\cos x + D\sin x$
$f(x) = e^{kx}$	$y = Ce^{kx}$

Laplace Transform Definition: $\mathcal{L}\{f(t)\} = \int_0^\infty f(t)e^{-st}\,dt = F(s)$

Table of Laplace transforms

Function $f(t)$	Laplace transform $\mathcal{L}\{f(t)\} = F(s)$
a	$\frac{a}{s},\ s > 0$
t	$\frac{1}{s^2},\ s > 0$
t^n	$\frac{n!}{s^{n+1}},\ s > 0, n \in \mathbb{N}$
e^{at}	$\frac{1}{s-a},\ s > a$
$\sin(at)$	$\frac{a}{s^2+a^2},\ s > 0$
$\cos(at)$	$\frac{s}{s^2+a^2},\ s > 0$

Laplace transforms of derivatives and theorems

Function	Laplace transform
$f(t)$	$F(s)$
$t^n f(t)$	$(-1)^n \frac{d^n}{ds^n}\{F(s)\}$
$\mathcal{L}\{f'(t)\}$	$s\,\mathcal{L}\{f(t)\} - f(0)$
$\mathcal{L}\{f''(t)\}$	$s^2\mathcal{L}\{f(t)\} - sf(0) - f'(0)$

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FINAL EXAMINATION PAPER

Module Code	:	**5CV007**
Module Title	:	**Structural Design**
Date	:	**30th of April 2025**
Examiner	:	**Dr. Pasindu Weerasinghe**
Time Allowed	:	**3 Hours**

INSTRUCTIONS TO CANDIDATES

- This is an open book examination.
- Attempt **ALL** questions. Your responses should be recorded on the answer booklet attached.
- You should write legibly in black or blue ink.
- You may not leave the examination room during the first hour or last 30 minutes of the exam.
- An announcement will be made when there are 30 minutes of the exam time left.
- All questions are not equally weighted. Please refer assigned marks for each subpart within the question.
- You may use a scientific calculator.
- You may assume reasonable values for any data not given in or with the examination paper. Clearly state such assumptions made on the script.

Question 1 **(35 marks)**

The grid arrangement selected for a two-storey building is shown in Figure Q1. This building will be used as an office building. Hence, the first-floor slab will be designed for an imposed load of 2.0 kN/m^2. An allowance of 1 kN/m^2 is made for finishes and no allowance is made for services.

In order to achieve a reasonable economy, a two way spanning slab system has been selected for this building. C25/30 concrete will be used with 500 MPa reinforcement for the construction. The unit weight of concrete is 25 kN/m^3. The required fire resistance period for this building is 2 hours for the floor slabs and beams. The building is designed for a working life of 50 years.

A computer model is used to analyze the different load patterns on beam **B;1-4**, it was found that the design moments and shear forces given in Table Q1 could be obtained from the bending moment and shear force envelopes (with 10% moment redistribution).

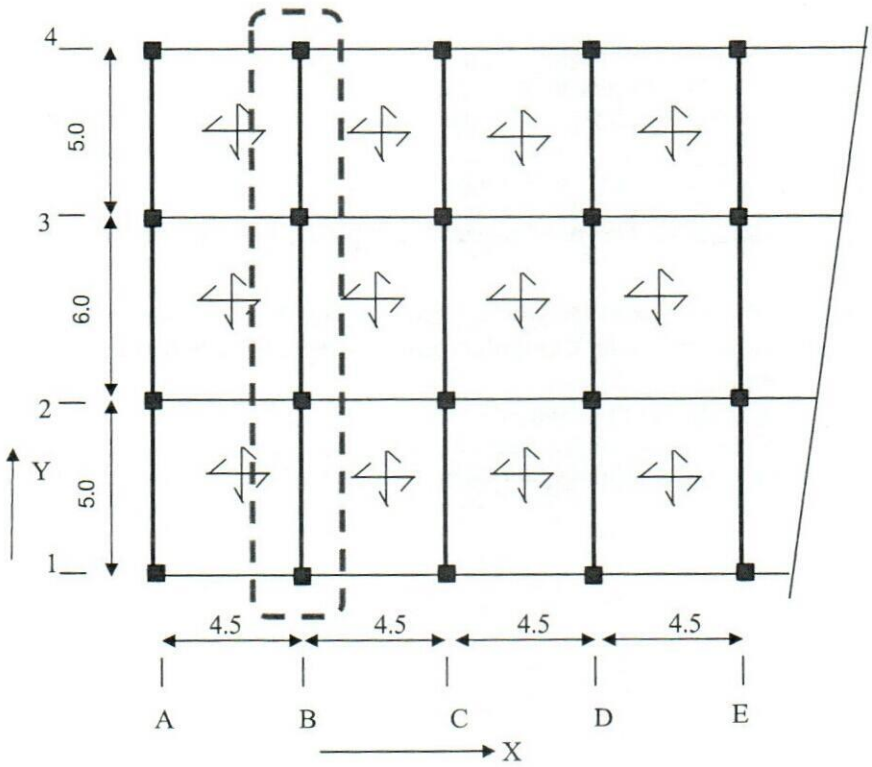


Figure Q1: Plan view of the building indicating the grid

Table Q1: Bending moments and shear forces at critical sections

	At outer support	Near middle of end span	At first interior support	Middle of interior span
Bending moment (kNm)	-90	100	-160	110
Shear force (kN)	115	-	150	-

i. Determine a suitable cover thickness for the beam. [04 marks]

ii. An initial size of 450mm x 300mm is selected for designing beam **B;1-4.** Calculate the effective depth of the beam. You may assume the main reinforcement consists of 20 mm diameter bars with 8 mm diameter shear links. [02 marks]

iii. The beam will be designed by considering a rectangular section at the first interior support. Describe the reasons for this. [03 marks]

iv. Check whether the beam has to be designed as singly or doubly reinforced at the first interior support. Find the lever arm and hence the reinforcement required at this section. [08 marks]

v. The shear force values at the centrelines of the supports are given in Table Q1. Determine a suitable shear reinforcement arrangement near the first interior support. You may assume that $V_{Rd,C} < V_{Ed}$. [10 marks]

vi. Which span would you consider for the deflection check? Check the beam for deflection within that span. Take $\rho = 0.0025$ and $\frac{310}{\sigma_s} > 1.0$. [08 marks]

Question 2 **(35 marks)**

a) A reinforced concrete one-way spanning slab has a span of 4.0 m. It is continuous over four spans. The slab thickness is 150 mm. The loads acting on the slab will include self-weight, an allowance for finishes of 0.75 kN/m^2 and partitions 1 kN/m^2. The imposed load is 3.5 kN/m^2. C25/30 concrete will be used. A cover of 25 mm is specified, given the exposure conditions. The density of concrete is 25 kN/m^3 and the characteristic yield strength of steel (f_{yk}) is 500 N/mm^2.

i. Determine the design load on the slab. [03 marks]

ii. Obtain the critical bending moments and shear forces using the guidelines given in IStructE Manual. [05 marks]

iii. Assume a suitable bar diameter for the flexural reinforcement and determine the effective depth of the slab. [02 marks]

iv. Design the required flexural reinforcement at one of the critical spans. [04 marks]

b) Figure Q3 shows a plan view of a typical floor on a 3-storey building (GF, 1F, 2F and Roof). You are supposed to design the column "P" at ground level, assuming that the column is subjected to an axial load only. The floor-to-floor height is 3.6 m. The density of concrete is 25 kN/m^3. C30/37 concrete will be used.

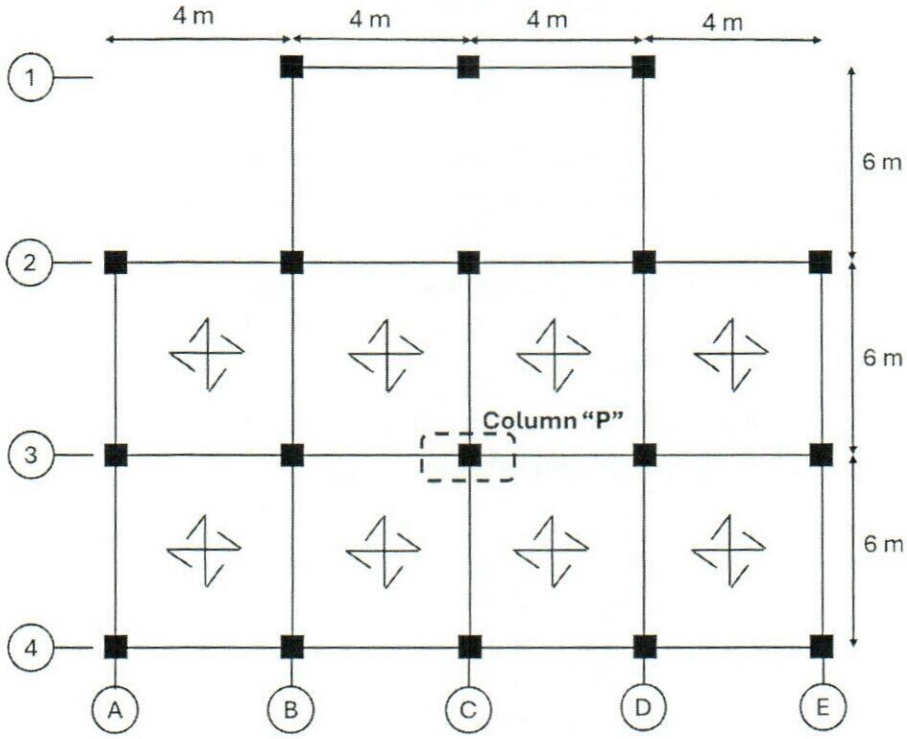


Figure Q3

i. Determine the load that would be transferred to the internal column "P" from **a typical floor**. The column size is 350 mm x 350 mm. All beams are 500 mm x 350 mm. Consider the ultimate limit state total load of the slab, including the self weight is 20 kN/m^2.
Hint: Consider the tributary area of the column and take all the loads acting on that area, along with the self-weight of the column. [05 marks]

ii. Determine the total axial load that will act at the ground floor level on column P. Consider the roof load to be the same as the typical floor load. [03 marks]

iii. Check whether the column part on the ground floor level is short or slender. The pad foundation is 1m below the ground level, and it is designed to resist moment. For this, you may take the slenderness limit (λ_{lim}) as 40. [08 marks]

iv. If the column is axially loaded short column, then determine the reinforcement requirement using the charts given in IStructE manual.
Hint: You may need to assume a reasonable cover and determine the effective depth in order to select the appropriate chart. [05 marks]

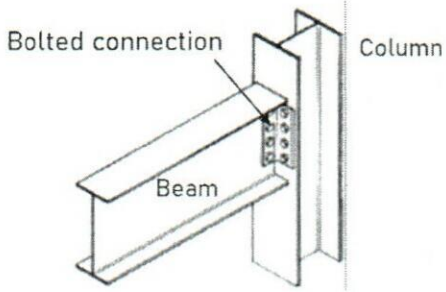
Question 3 **(30 marks)**

a) In order to address an urgent business requirement, a typical single-storey warehouse structure is to be constructed in less than 2 months in the Bentota area. The site is located 1 km from the coastline. The structure is expected to have large open spaces. The client is in the stage of choosing between using Reinforced Concrete or Steel to construct this building.

i. Based on your knowledge of these two construction materials, provide two advantages and two disadvantages of using steel as opposed to using concrete, for this specific case. [04 marks]

ii. Two possible types of connections that can be used between the beams and columns of this structure are shown in Figure Q3.A. Giving reasons, explain whether these connections can be categorized as either shear connection, moment connection or shear and moment connection. [04 marks]

Connection 1



Connection 2

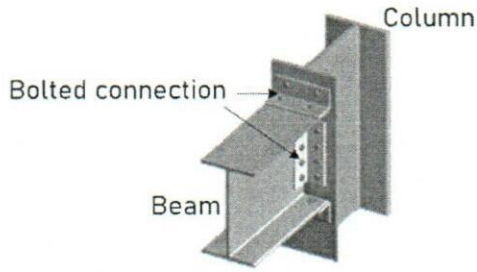


Figure Q3.A

b) A Steel deck is to be constructed as a walkway between two buildings. The deck consists of Steel beams of S275 steel, where each beam is 4 m in length and can be considered as simply supported at the two ends. It has been estimated that each beam is subjected to a uniformly distributed characteristic dead load of 3 kN/m throughout the beam and a characteristic imposed load of 4 kN/m. It is to be evaluated if the UB section 127 x 76 x 13 is adequate to be used as a beam for this deck.

i. Calculate the maximum bending moment of the beam under the Ultimate Limit State. [05 marks]

ii. Determine if the UB section 127 x 76 x 13 is safe in flexure. The beam is restrained in the lateral direction, hence there is no risk of lateral torsional buckling. [06 marks]

iii. Check the beam for shear failure. [07 marks]

iv. It was later identified that the span of the beams should be increased to 6 m. Without performing any calculations, but providing relevant reasoning, indicate if bending or deflection would be the most critical check to evaluate if the same UB section 127 x 76 x 13 can be used for the new scenario. [04 marks]

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RE-SIT EXAMINATION PAPER

Module Code :	:	6MA043
Module Title	:	Aerodynamic Design and CFD
Date	:	27th April 2025
Examiners	:	Janaka Perera/ Geethal Siriwardana
Time Allowed:	:	3 Hours

INSTRUCTIONS TO CANDIDATES

- This is an unseen paper.
- This is a closed book examination.
- Attempt **FOUR** questions by selecting **TWO** Questions from **Part-A** & **TWO** Questions from **Part-B.**
- You are to write your answers in the answer books provided.
- Write your index number, the subject code and the title of the paper in each answer book. Also write your index number on each additional sheet.

MATERIALS REQUIRED

- Two 12 page answer booklets
- Formula sheet at back of paper.
- You may use a Scientific calculator. This must not be programmable, may not have significant memory capability, and may be inspected during the examination.

PART - A

1.

(a) Define the following terms:

(i) static pressure,
(ii) dynamic pressure.

(4 marks)

(b) Describe how static and total pressure can be measured in the pitot-static system of an aircraft. Explain how airspeed can be obtained from the static and total pressure measurements.

(4 marks)

(c) A low-speed wind tunnel consists of a convergent nozzle, test section and a divergent diffuser. Explain, with the applications of Bernoulli's and continuity equations, why the velocity is maximum and static pressure is minimum at the test section if the flow is incompressible.

(4 marks)

(d) Consider the low speed flow inside a wind tunnel as shown in figure Q1. The cross-sectional areas for the inlet of the convergent nozzle and test section are $A_1 = 8m^2$ and $A_2 = 2m^2$, respectively. Two static pressure holes are located on the walls at the inlet section 1 and at the test section 2. A U-manometer (filled with white spirit having density of ρ_{spirit} =760 kg/ m^3) is used to measure the static pressure difference across these two points. The difference between the height of the spirit columns reads Δh = 0.2 m. Take air density ρ =1.225 kg/ m^3.

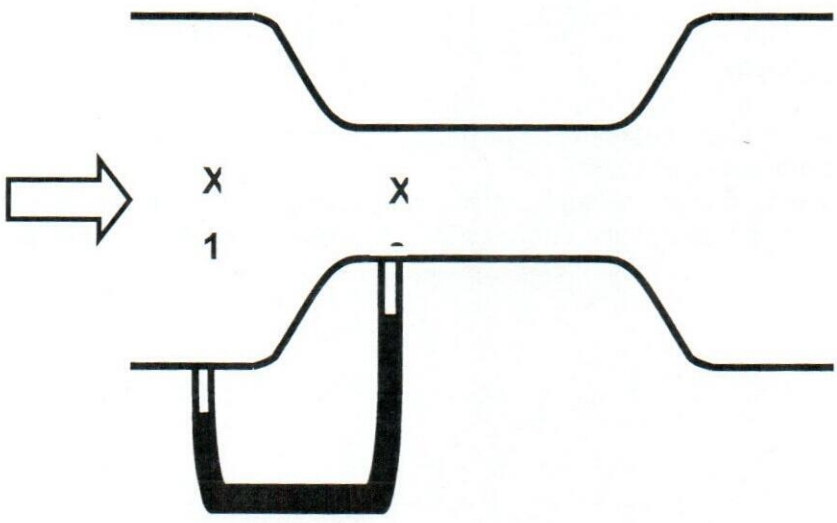


Figure Q1

(i) Find the static pressure difference ($p_1 - p_2$) between the inlet section 1 and test section 2.

(ii) By applying Bernoulli's and continuity equations, find the velocities u_1 and u_2 at the inlet and test sections, respectively.

(13 marks)

2.

A series of wind tunnel tests shows that an aerofoil has the lift characteristics shown below in figure Q2.

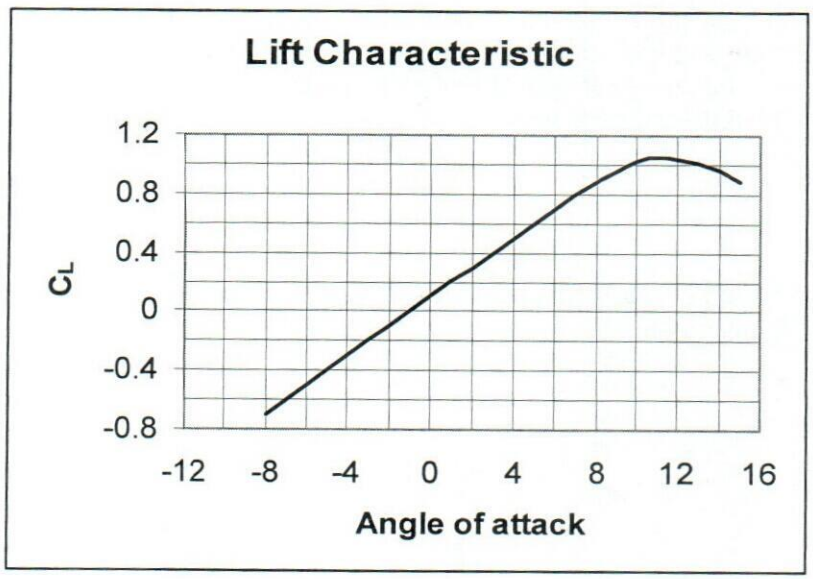


Figure Q2

(a) Find the lift coefficient at an angle of attack of 4°, maximum lift coefficient and stall angle of the aerofoil.

(3 marks)

(b) Determine the lift per unit span if the angle of attack is 4°. Assume that the chord is 1.6 m and the aerofoil is flying at a speed of 80 m/s at an altitude of 3000 m. ISA table is attached in the formula sheet.

(5 marks)

(c) Determine the drag per unit span of the aerofoil if the drag coefficient is 0.02 with the same conditions as part (b).

(2 marks)

(d) Sketch the free body force diagram of an aircraft in steady level flight. Indicate all the forces acting on the aircraft. State the relationships between all these forces.

(4 marks)

(e) Assuming that the maximum lift coefficient of the wing of an aircraft has the same value as the aerofoil shown above in figure Q2. Determine the stall speed at sea level and at 3000 m in the ISA if the aircraft mass is 20000 kg and the wing area is 100 m^2.

(6 marks)

(f) Describe, with the aid of a sketch, what happen to the air flow on the aerofoil during stall.

(5 marks)

3.

a) The velocity and temperature behind a normal shock wave are 329 m/s and 1500 K respectively. Calculate the velocity in front of the shock wave.

(25 marks)

PART-B

4.

a) Explain the following terms briefly.
   i. Eulerian Framework in CFD **(05 Marks)**
   ii. Fluid Modelling **(05 Marks)**

b) Briefly describe what are the available turbulent models (DNS, RANS, LES, DES). **(08 Marks)**

c) Explain following terms
   i. Patch Conforming method **(04 Marks)**
   ii. Patch Independent method

d) Describe the necessity of discretization in CFD Analysis. **(03 Marks)**

5.

a) Explain how different physics can include CFD modelling. **(02 Marks)**

b) Briefly express the meaning of the initial boundary value problem and its usage in CFD. **(02 Marks)**

c) Identify the boundary conditions for following CFD Analysis.
Problem Description
The setup will use Flow Simulation to study the thermal two-dimensional laminar flow on a vertical flat plate and compare with the theoretical boundary layer solution. This will be using air as the fluid for the flow calculations. The temperature of the vertical hot wall will be set to 296.2 K while the temperature of the surrounding air is 293.2 K. Determine temperature and velocity profiles and plot the same profiles using similarity variables. The variation of the local Nusselt number will be determined. **(06 Marks)**

d) Explain the procedure to study the flow in a stainless-steel parallel flow shell and tube heat exchanger. Heat transfer will occur between the hot inner tube flow and the colder outer flow in the shell. The shell has a wall thickness of 10 mm and an inner diameter of 32 mm whereas the tube is 2 mm thick and has an outer diameter of 19 mm. The mass flow rate of water in the shell is 0.8 kg/s with an inlet temperature of 283.2 K and the mass flow rate of water in the tube is 0.2 kg/s at an inlet temperature of 343.2 K. The temperature distributions along the shell and tube will be shown from Flow Simulation results. Identify the following when conducting a CFD analysis.

i. What type of geometry would be well suited for this analysis. (3D or 2D). You may explain your answer. **(02 Marks)**

ii. Boundary conditions use in the analysis. **(04 Marks)**

Boundary Condition (BC)	Type of BC	Properties of BC
Hot fluid inlet		
Cold fluid inlet		
Hot fluid outlet		
Cold fluid outlet		
Hot tube inner wall		
Hot tube outer wall		
Cold tube inner wall		
Cold tube outer wall		

iii. Type of the viscous model. Explain your answer. **(03 Marks)**

iv. State the simulation type (steady or transient). Explain your answer. **(03 Marks)**

v. Should gravity be included in this analysis? Explain your answer. **(03 Marks)**

You may use figures and sketches to support your answer

END OF THE EXAMINATION PAPER

Formula sheet

H	T	P	ρ	a	ν	μ
km	K	$N.m^{-2}$	$kg.m^{-3}$	$m.s^{-1}$	$m^2.s^{-1}$	$N.s.m^{-2}$
0	288.2	1.0133E+05	1.2252	340.3	1.4634E-05	1.7930E-05
1	281.7	8.9866E+04	1.1117	336.4	1.5837E-05	1.7607E-05
2	275.2	7.9480E+04	1.0065	332.5	1.7169E-05	1.7280E-05
3	268.7	7.0088E+04	0.9090	328.5	1.8647E-05	1.6950E-05
4	262.2	6.1616E+04	0.8190	324.5	2.0290E-05	1.6617E-05
5	255.7	5.3993E+04	0.7359	320.5	2.2122E-05	1.6280E-05
6	249.2	4.7153E+04	0.6594	316.4	2.4170E-05	1.5939E-05
7	242.7	4.1032E+04	0.5892	312.2	2.6466E-05	1.5593E-05
8	236.2	3.5571E+04	0.5248	308.0	2.9046E-05	1.5244E-05
9	229.7	3.0714E+04	0.4660	303.8	3.1955E-05	1.4891E-05
10	223.2	2.6408E+04	0.4123	299.4	3.5246E-05	1.4534E-05
11	216.7	2.2605E+04	0.3636	295.0	3.8980E-05	1.4172E-05
12	216.7	1.9308E+04	0.3105	295.0	4.5638E-05	1.4172E-05
13	216.7	1.6491E+04	0.2652	295.0	5.3434E-05	1.4172E-05
14	216.7	1.4085E+04	0.2265	295.0	6.2560E-05	1.4172E-05
15	216.7	1.2030E+04	0.1935	295.0	7.3246E-05	1.4172E-05
16	216.7	1.0275E+04	0.1653	295.0	8.5756E-05	1.4172E-05
17	216.7	8.7763E+03	0.1411	295.0	1.0040E-04	1.4172E-05
18	216.7	7.4959E+03	0.1206	295.0	1.1755E-04	1.4172E-05
19	216.7	6.4024E+03	0.1030	295.0	1.3763E-04	1.4172E-05
20	216.7	5.4684E+03	0.0879	295.0	1.6114E-04	1.4172E-05

ISA table

All pressures are absolute

$1bar = 10^5 N/m^2 = \frac{1}{1.01325} atm$

Acceleration due to gravity

g= 9.81 m/s^2

Density of water

1000 kg/m^3

Bernoulli's Equation

$$\frac{p1}{\rho g} + \frac{V1^2}{2g} + Z1 = \frac{p2}{\rho g} + \frac{V2^2}{2g} + Z\,2$$

Continuity equation

$$A_1 V_1 = A_2 V_2$$

Mach number,

$$M = \frac{V}{C}$$

Reynolds number for the airfoil

$$Re = \frac{Velocity(V) \times Chord\ length(C)}{Kinetic\ viscosity(n)}$$

Lift force

$$Lift\ force = \frac{C_L \times \rho \times V^2 \times A}{2}$$

Drag force

$$Drag\ force = \frac{\rho \times V^2 \times C_D \times A}{2}$$

Boundary layer thickness,

$$\delta = \frac{0.38}{Re^{\frac{1}{5}}}$$

Skin friction coefficient,

$$C_f = \frac{0.059}{Re^{\frac{1}{5}}}$$

$$Skin\ friction\ drag = \frac{1}{2}\rho A V^2 C_f$$

$$\text{Total dreg force} = Skin\ friction\ drag + Pressure\ drag$$

$$Pressure\ drag = Skin\ friction\ drag - \text{Total dreg force}$$

$$\frac{p1}{\rho g} + \frac{V1^2}{2g} + Z1 = \frac{p2}{\rho g} + \frac{V2^2}{2g} + Z\,2$$

$$T = F\ x\ r$$

$$F = P\ x\ A$$

For an isentropic flow,

$$\frac{P_2}{P_1} = \left(\frac{\rho_2}{\rho_1}\right)^{\gamma} = \left(\frac{T_2}{T_1}\right)^{\frac{\gamma}{\gamma-1}}$$

R - Gas constant [kJ/kg.K] = 0.287

$\gamma - Specific\ heat\ ratio$

$\gamma = 1.4,$

For any flow condition

$$A_1 V_1 \rho_1 = A_2 V_2 \rho_2$$

Sound of velocity for ideal gas

$$C = \sqrt{\gamma RT}$$

$$M_2^2 = \frac{1 + \left(\frac{\gamma-1}{2}\right) M_1^2}{\gamma M_1^2 - \left(\frac{\gamma-1}{2}\right)}$$

$$M_2^2 \times \left[\gamma M_1^2 - \left(\frac{\gamma-1}{2}\right)\right] = 1 + \left(\frac{\gamma-1}{2}\right) M_1^2$$

$$\gamma M_2^2 M_1^2 - M_2^2\left(\frac{\gamma-1}{2}\right) = 1 + \left(\frac{\gamma-1}{2}\right) M_1^2$$

$$\gamma M_2^2 M_1^2 - \left(\frac{\gamma-1}{2}\right) M_1^2 = 1 + M_2^2\left(\frac{\gamma-1}{2}\right)$$

$$M_1^2 \left[\gamma M_2^2 - \left(\frac{\gamma-1}{2}\right)\right] = 1 + M_2^2\left(\frac{\gamma-1}{2}\right)$$

$$\frac{T_2}{T_1} = \left(1 + \frac{2\gamma}{\gamma+1}(M_1^2 - 1)\right)\left(\frac{2 + (\gamma-1) M_1^2}{(\gamma+1) M_1^2}\right)$$

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FACULTY OF SCIENCE & ENGINEERING
SCHOOL OF ENGINEERING

RE-SIT EXAMINATION PAPER

Module Code	:	**4MA008**
Module Title	:	**Engineering Sciences**
Batch	:	**26**
Date	:	**2025-03-28**
Examiners	:	**Mr. K Khemaratne / Mr. MGJP Fernando**
Time Allowed	:	**03 Hours**

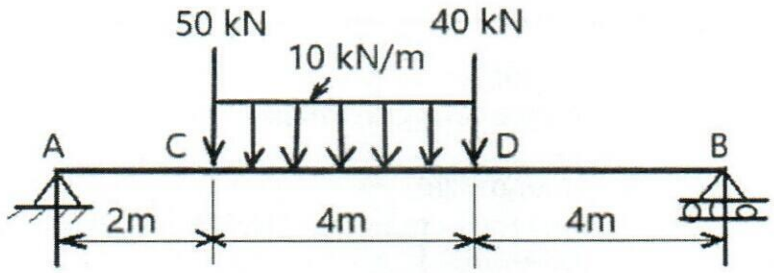
INSTRUCTIONS TO CANDIDATES

- This is a **closed book** examination.
- This paper consists of **04** questions. You Should Answer **ALL** questions.
- Write clearly legibly with a blue or black pen.
- Use only the **CINEC Answering Booklet**. Additional sheets can be requested from the invigilators.
- This paper contains 04 pages.

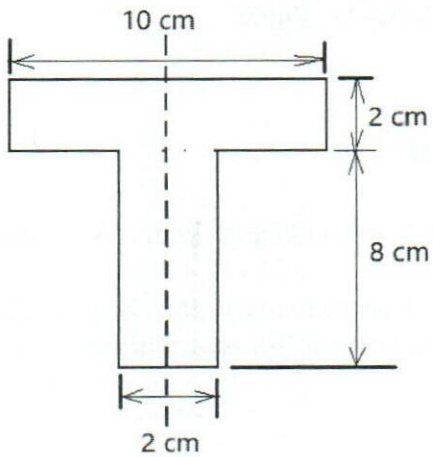
MATERIALS REQURIED

- CINEC Answering Booklet and Extra Answering Paper
- You may use a scientific calculator. This must not be programmable. This may be examined during the examination.

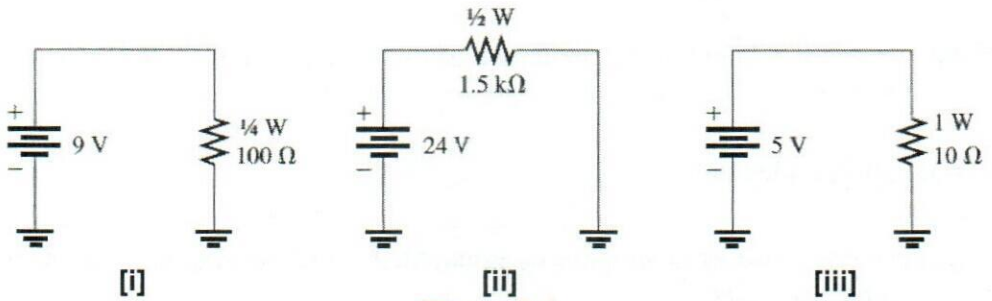
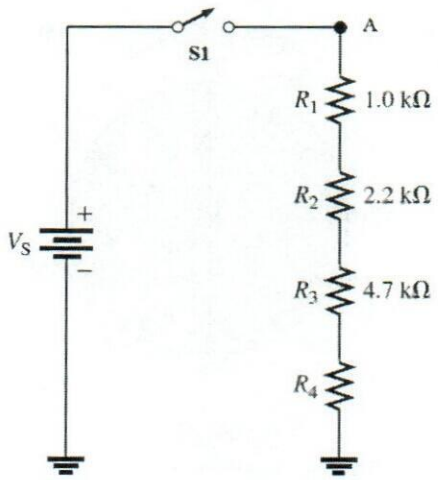
QUESTION 01 [25 Marks]

	A simply supported beam of length 10m, carrying the uniformly distributed load and two point loads as shown in **Figure 1.1.**  **Figure 1.1**	
[a]	Determine the magnitude of the reaction forces at the two supports A and B.	**05**
[b]	Analyse the shear force along the length of the beam by using a shear force diagram.	**08**
[c]	Analyse the bending moment along the length of the beam and represent it using a bending moment diagram.	**12**

QUESTION 02 [25 Marks]

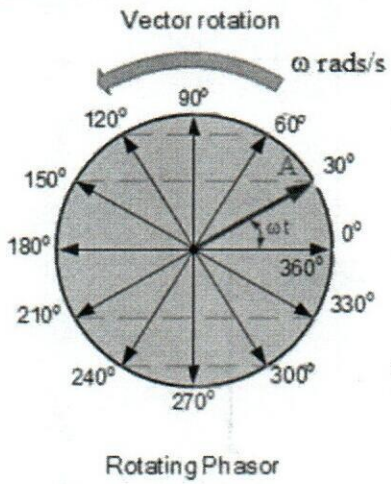
	Figure 2.1 shows a T-section with flange as 10 cm × 2 cm and web as 8 cm × 2 cm.  **Figure 2.1**	
[a]	Determine the Centre of gravity of the above section.	**05**
[b]	Determine the second moment of area of the section about the horizontal axis, passing through the Centre of gravity of the section	**08**
[c]	A hollow shaft of external diameter 120 mm transmits 300 kW power at 200 r.p.m. Determine the maximum internal diameter if the maximum stress in the shaft is not to exceed 60 N/mm^2.	**12**

QUESTION 03 [25 Marks]

[a]	Three resistors are connected in circuits as shown in **Figure 3.1** and their power ratings are 0.25 W, 0.5 W, and 1 W. Determine which resistor may have been possibly damaged by overheating.  **Figure 3.1**	**06**
[b]	Describe how energy can be dissipated or stored by resistors, capacitors, and inductors.	**03**
[c]	State **three** applications of Capacitors.	**03**
[d]	In the circuit shown in **Figure 3.2**, when Switch S1 is turned on, total resistance at Point A is measured as 17.9 kΩ. If the supply voltage is 12 V, **[i]** Determine the value of R_4. **[ii]** Using *Voltage Divider* principle, determine the voltage drops across each resistor.  **Figure 3.2**	**05**
[e]	A student decides to construct a capacitor using two square conducting plates 10 cm on a side. He separates the plates with a paper dielectric ($\varepsilon_r = 2.5$) that is 8×10^{-5} m thick. If the absolute permittivity of a vacuum ε_0 is equal to 8.85×10^{-12} F/m, what is the capacitance of his capacitor?	**03**

[f]	An air-core inductor has a total inductance of 5mH. **[i]** What is the inductance if the only change is to increase the number of turns by a factor of three? **[ii]** What is the inductance if the only change is to increase the length by a factor of three? **[iii]** What is the inductance if the area is doubled, the length cut in half, and the number of turns doubled?	**03**
[g]	Explain why AC is used for long distance power transmission instead of DC.	**02**

QUESTION 04 [25 Marks]

[a]	Explain the difference between a Fuse and a MCB and state three reasons which can cause MCB tripping.	**04**
[b]	A 2200 watts Electric kettle is used in a household for 2 hours (on average) per day. Determine the energy consumed by the kettle in terms of kilowatt-hours per a day and per a month.	**02**
[c]	Describe the difference between a primary cell and a secondary cell.	**02**
[d]	State **four** factors to be considered when selecting a battery for an application	**04**
[e]	Draw the Sinusoidal Waveform with 30° steps for the given rotating phasor and state the equation of the waveform.  Rotating Phasor	**03**
[f]	Define the 'rms value' of a sinusoidal voltage	**03**
[g]	State the differences between a Stepper motor and a Servo motor.	**04**
[h]	What are the losses that can be observed in a Real Transformer?	**03**

End of the Paper

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FACULTY OF ENGINEERING & TECHNOLOGY
RESIT EXAMINATION PAPER

Module Code : **4MM018**

Module Title : **Core Techniques in Mathematics**
Date : **March 2025**

Examiner : **Dr. Shelton Perera**
Time Allowed : **2 Hours**

INSTRUCTIONS TO CANDIDATES

- This is a closed book examination.
- Answer ALL questions.
- Your responses should be recorded on the answer booklet provided.
- Formula sheets are included at the back of this question paper.
- You should write legibly in black or blue ink.
- The overall grade for this Examination contributes 80% towards the module.

MATERIALS REQURIED

- One answer booklet (ask for extra paper if required).
- You may use a standard scientific calculator.
- You will not require graph paper.

Student Number .....

ANSWER ALL QUESTIONS

1. Let $f(x) = 3x - 2$. Find $f^{-1}(x)$ and the value of $f^{-1}(2f(1))$.

(4 marks)

2. Find the derivative of $f(x) = x^2 + 2$ with respect to x **from the first principles**.

(8 marks)

3. Find $\frac{dy}{dx}$ for each of the following:

   (i) $y = 3\sqrt{x} + \frac{2}{x} + 3x^2 + 5,$

   (ii) $y = x\,(x^4 + 1)^5 + \frac{\ln x}{\cos x},$

   (iii) $2x^2 + xy + 3y^2 = 6.$

(10 marks)

4. Sketch the graph of $y = \frac{x+1}{x(x-3)}$ indicating the asymptotes and the stationary points.

   Using this graph, solve the inequality $\frac{x+1}{x(x-3)} > 0.$

(15 marks)

5. Find each of the following integrals:

   (i) $\int x\,(x^2 + 1)^6 dx\,,$

   (ii) $\int xe^{2x}\,dx\,,$

   (iii) $\int_0^1 \frac{x}{(x+2)(x+3)}\,dx.$ (Hint: First express $\frac{x}{(x+2)(x+3)}$ in partial fractions.)

(14 marks)

6. **(a)** Evaluate the determinant $\begin{vmatrix} 2 & 1 & 4 \\ 3 & 1 & 0 \\ 4 & -1 & 1 \end{vmatrix}$. **(4 marks)**

(b) Factorize the determinant $\begin{vmatrix} x & a & a \\ a & a & x \\ a & x & a \end{vmatrix}$. **(6 marks)**

7. Let $A = \begin{pmatrix} 2 & 0 & -1 \\ 1 & 2 & 3 \end{pmatrix}$ and $B = \begin{pmatrix} 1 & 1 \\ -1 & 0 \\ 2 & 1 \end{pmatrix}$.

Find $2A^T - B$.

Let $C = AB$. Find C and C^{-1}.

Also, find the matrix D such that $DC = B$.

(10 marks)

8. Let $\mathbf{a} = \mathbf{i} + 2\mathbf{j} - 3\mathbf{k}$ and $\mathbf{b} = 2\mathbf{i} + \mathbf{j} + \mathbf{k}$.

(i) Find $\mathbf{a} \cdot \mathbf{b}$ and hence find the angle between the vectors **a** and **b.**

(ii) Find $\mathbf{a} \times \mathbf{b}$ and hence find the area of the parallelogram with sides given by the vectors **a** and **b.**

(12 marks)

9. Find the solution of the following recurrence relation that satisfies the given initial conditions:

$$x_{n+2} - 2x_{n+1} - 3x_n = 0;\ x_0 = 1 \text{ and } x_1 = 2.$$

(8 marks)

10. Find the binomial expansion of $\sqrt{1-3x}$ in ascending powers of x up to and including the term in x^3.

(5 marks)

11. Find the Maclaurin series expansion of the function $f(x) = x\cos 2x + 1$.

(4 marks)

End of Questions

DATA & FORMULAE

Differentiation

Function $y = y(x)$	$\frac{dy}{dx}$	Function $y = y(x)$	$\frac{dy}{dx}$
x^n	nx^{n-1}	e^x	e^x
$\sin x$	$\cos x$	$\log_e x$	$\frac{1}{x}$
$\cos x$	$-\sin x$	$\sinh x$	$\cosh x$
$\tan x$	$\sec^2 x$	$\cosh x$	$\sinh x$
$\operatorname{cosec} x$	$-\operatorname{cosec} x \cot x$	$\tanh x$	$\operatorname{sech}^2 x$
$\sec x$	$\sec x \tan x$	$\operatorname{cosech} x$	$-\operatorname{cosech} x \coth x$
$\cot x$	$-\operatorname{cosec}^2 x$	$\operatorname{sech} x$	$-\operatorname{sech} x \tanh x$
$\sin^{-1} x$	$\frac{1}{\sqrt{1-x^2}}$	$\coth x$	$-\operatorname{cosech}^2 x$
$\cos^{-1} x$	$\frac{-1}{\sqrt{1-x^2}}$	$\sinh^{-1} x$	$\frac{1}{\sqrt{1+x^2}}$
$\tan^{-1} x$	$\frac{1}{1+x^2}$	$\cosh^{-1} x$	$\frac{1}{\sqrt{x^2-1}}$
$\operatorname{cosec}^{-1} x$	$\frac{-1}{x\sqrt{x^2-1}}$	$\tanh^{-1} x$	$\frac{1}{1-x^2}$
$\sec^{-1} x$	$\frac{1}{x\sqrt{x^2-1}}$	$\operatorname{cosech}^{-1} x$	$\frac{-1}{x\sqrt{1+x^2}}$
$\cot^{-1} x$	$\frac{-1}{1+x^2}$	$\operatorname{sech}^{-1} x$	$\frac{-1}{x\sqrt{1-x^2}}$
		$\coth^{-1} x$	$\frac{1}{1-x^2}$

Product Rule

$$\frac{d}{dx}(uv) = \frac{du}{dx}.v + u.\frac{dv}{dx}$$

Quotient Rule

$$\frac{d}{dx}\left(\frac{u}{v}\right) = \frac{v.\frac{du}{dx} - u.\frac{dv}{dx}}{v^2}$$

Function of a Function Rule

If $y = y(u)$ and $u = u(x)$ then $\frac{dy}{dx} = \frac{dy}{du}.\frac{du}{dx}$

Integration

Function $y = y(x)$	$\int y\,dx$	Function $y = y(x)$	$\int y\,dx$
x^n	$\frac{x^{n+1}}{n+1}(n \neq -1)$	e^{ax}	$\frac{1}{a}e^{ax}$
$(ax+b)^n$	$\frac{(ax+b)^{n+1}}{a(n+1)}(n \neq -1)$	$\sinh x$	$\cosh x$
$\frac{1}{x}$	$\log_e x$	$\cosh x$	$\sinh x$
$\frac{1}{ax+b}$	$\frac{1}{a}\log_e(ax+b)$	$\tanh x$	$\log_e \cosh x$
$\sin x$	$-\cos x$	$\text{sech}^2 x$	$\tanh x$
$\sin(ax+b)$	$\frac{-1}{a}\cos(ax+b)$	$\text{cosech}^2 x$	$-\coth x$
$\cos x$	$\sin x$	$\text{sech}\,x \tanh x$	$-\text{sech}\,x$
$\tan x$	$-\log_e \cos x$	$\text{cosech}\,x \coth x$	$-\text{cosech}\,x$
$\sec^2 x$	$\tan x$	$\frac{1}{\sqrt{a^2+x^2}}$	$\sinh^{-1}\frac{x}{a} = \log\left(\frac{x+\sqrt{x^2+a^2}}{a}\right)$
$\text{cosec}^2 x$	$-\cot x$	$\frac{1}{\sqrt{a^2-x^2}}$	$\sin^{-1}\frac{x}{a}$
$\sec x \tan x$	$\sec x$	$\frac{1}{\sqrt{x^2-a^2}}$	$\cosh^{-1}\frac{x}{a} = \log\left(\frac{x+\sqrt{x^2-a^2}}{a}\right)$
$\text{cosec}\,x \cot x$	$-\text{cosec}\,x$	$\frac{1}{a^2+x^2}$	$\frac{1}{a}\tan^{-1}\frac{x}{a}$
$\frac{f'(x)}{f(x)}$	$\log_e f(x)$	$\frac{1}{a^2-x^2}$	$\frac{1}{a}\tanh^{-1}\frac{x}{a} = \frac{1}{2a}\log\left(\frac{a+x}{a-x}\right)$

Integration by parts: $\int u\frac{dv}{dx}dx = uv - \int v\frac{du}{dx}dx$

Other Formulae

Binomial Series: $(1+x)^n = 1 + nx + \frac{n(n-1)}{2!}x^2 + \frac{n(n-1)(n-2)}{3!}x^3 + \cdots.$

Maclaurin's Series: $f(x) = f(0) + xf'(0) + \frac{x^2}{2!}f''(0) + \frac{x^3}{3!}f'''(0) + \cdots.$

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EXAMINATION PAPER

FACULTY OF SCIENCE & ENGINEERING
SCHOOL OF ARCHITECTURE AND BUILT ENVIRONMENT

EXAMINATION PAPER

Module Code	:	**6CV016 (CINEC)**
Module Title	:	**Structural Analysis II**
Date	:	**23rd February 2025**
Examiners	:	**Dr. Pasindu Weerasinghe**
Time Allowed	:	**3 Hours**

INSTRUCTIONS TO CANDIDATES

- This is a closed book examination.
- You should answer all 04 questions.
- Paper contains total of 7 pages.
- Your responses should be recorded in the answer booklet provided.

MATERIALS REQURIED

- Eight-page answer booklets provided.

You may use a scientific calculator. This must not be programmable and may be inspected during the examination.

Question 01 **[25 marks]**

Truss is an efficient structural form which can span large distances. The Figure Q1 shows a truss that is used as a bridge. Bridge deck is connected to joints and the loads are transferred as concentrated loads at discrete locations as indicated in the figure.

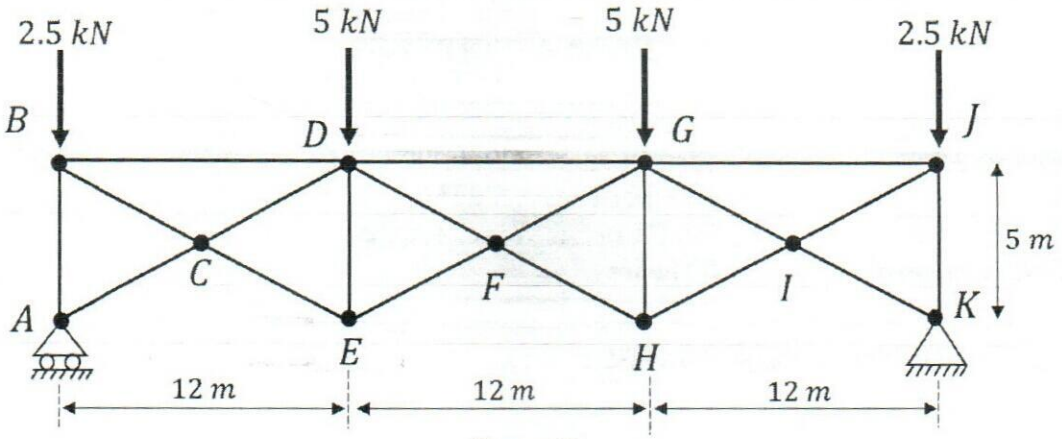


Figure Q1

i. Determine whether this is a simply stiff truss or an indeterminate truss. [2 marks]

ii. In analysis, joints are assumed to be frictionless pin joints. Can the same be expected in the real truss? Give reasons for your answer. [3 marks]

iii. If you are modelling this truss in a structural analysis software such as SAP 2000, how would you ensure joints are considered as frictionless pin joints during the analysis? [3 marks]

iv. Determine the support reactions at A and K [2 marks]

v. Determine the member forces in DG, DF and EF. [12 marks]

vi. If the member forces you calculate differ from the member forces that you obtain from the structural analysis software, what are the possible reasons for that? [3 marks]

Question 02 **[25 marks]**

Figure Q2 presents the idealized loading on a simply supported beam at a building.

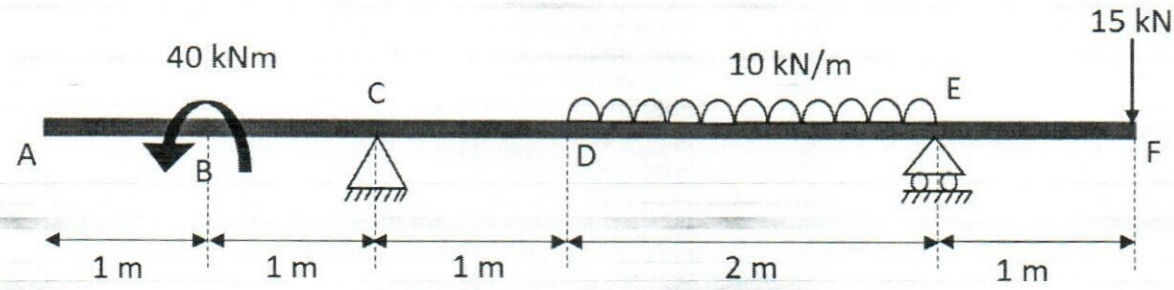


Figure Q2

i. Find the support reactions at A and F. [4 marks]

ii. Draw the Shear Force and Bending Moment diagrams for the beam. [10 marks]

iii. Identify points of contraflexure (if there are any). Comment on the practical use of identifying such locations. [3 marks]

iv. If the same beam is subjected to a moving load, construct the influence line for the Bending Moment at point D. [6 marks]

v. If the magnitude of the moving load is 60 kN, what is the maximum Bending Moment at point D ? State whether it is sagging or hogging. [2 marks]

Question 03 **[25 marks]**

Idealized view of a simply supported beam having EI = 2000 kNm, supporting two concentrated loads is shown in Figure Q3. Additional information is provided as a datasheet at the end of the paper.

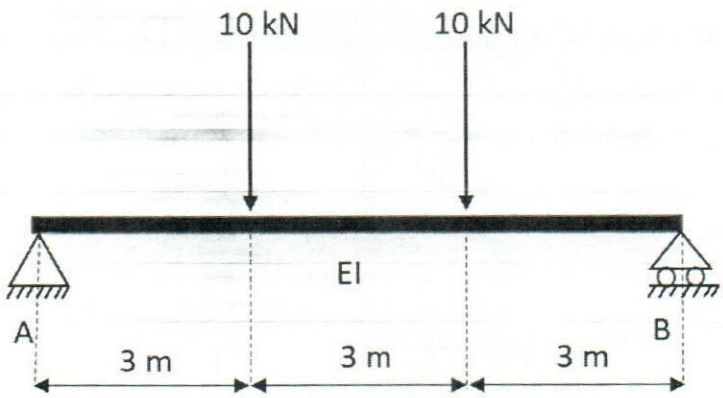
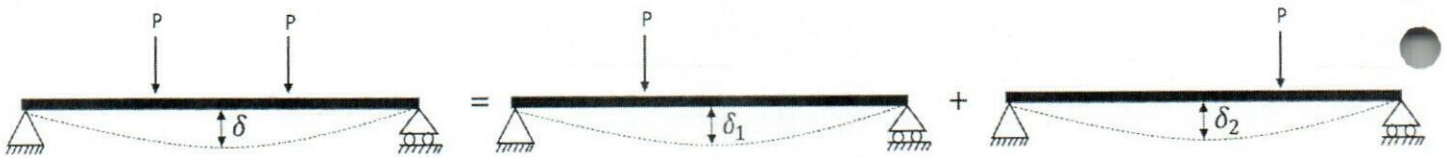


Figure Q3

i. Using the principle of virtual work, determine the deflection at the mid span of the beam AB. [12 marks]

ii. Compare the value that you found in part i. with the deflection calculated using the deflection formulas. [10 marks]

Hint;



$$\delta = \delta_1 + \delta_2$$

iii. The allowable deflection at the serviceability conditions for this beam is L/240 where L is the span. Comment on the performance of the beam in terms of deflection at serviceability conditions. [3 marks]

Question 04 **[25 marks]**

The continuous beam ABC shown in Figure Q4 is to be analysed for its internal forces; bending moments and shear forces. The loading, boundary conditions and geometric properties of the beam segments AB and BC are given in Figure Q4.

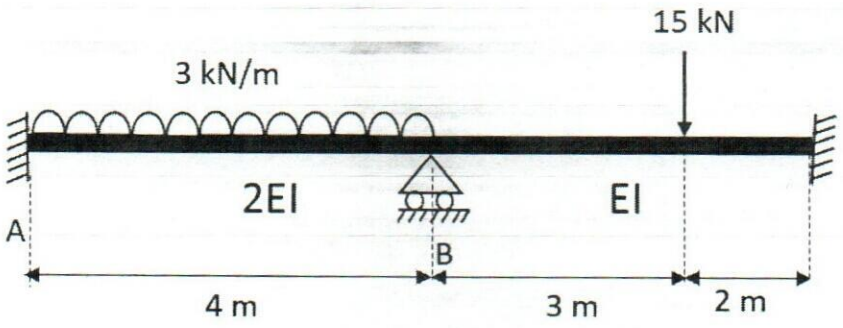


Figure Q4

i. Comment whether this beam is statically determinate or indeterminate. [2 marks]

ii. Using the moment distribution method of analysis, find the reaction forces and joint moments of beam ABC. State any assumptions made. [8 marks]

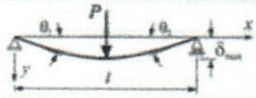
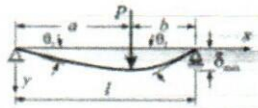
iii. Sketch the bending moment and shear force diagrams. [8 marks]

iv. Consider this beam is made out of a steel channel section having an overall depth of 100 mm and a second moment of area (I) about its axis of bending as 4×10^6 mm^4. Find the maximum bending stress of the beam. [5 marks]

v. If the strength of steel is 200 MPa, comment on the flexural failure of this beam for the given loading arrangement. [2 marks]

Data Sheet

Deflection formulas for a simply supported beam

BEAM TYPE	SLOPE AT ENDS	DEFLECTION AT ANY SECTION IN TERMS OF x	MAXIMUM AND CENTER DEFLECTION
6. Beam Simply Supported at Ends – Concentrated load P at the center			
	$\theta_1 = \theta_2 = \frac{Pl^2}{16EI}$	$y = \frac{Px}{12EI}\left(\frac{3l^2}{4} - x^2\right)$ for $0 < x < \frac{l}{2}$	$\delta_{max} = \frac{Pl^3}{48EI}$
7. Beam Simply Supported at Ends – Concentrated load P at any point			
	$\theta_1 = \frac{Pb(l^2 - b^2)}{6lEI}$ $\theta_2 = \frac{Pab(2l - b)}{6lEI}$	$y = \frac{Pbx}{6lEI}\left(l^2 - x^2 - b^2\right)$ for $0 < x < a$ $y = \frac{Pb}{6lEI}\left[\frac{l}{b}(x-a)^3 + (l^2 - b^2)x - x^3\right]$ for $a < x < l$	$\delta_{max} = \frac{Pb(l^2 - b^2)^{3/2}}{9\sqrt{3}\,lEI}$ at $x = \sqrt{(l^2 - b^2)/3}$ $\delta = \frac{Pb}{48EI}(3l^2 - 4b^2)$ at the center, if $a > b$

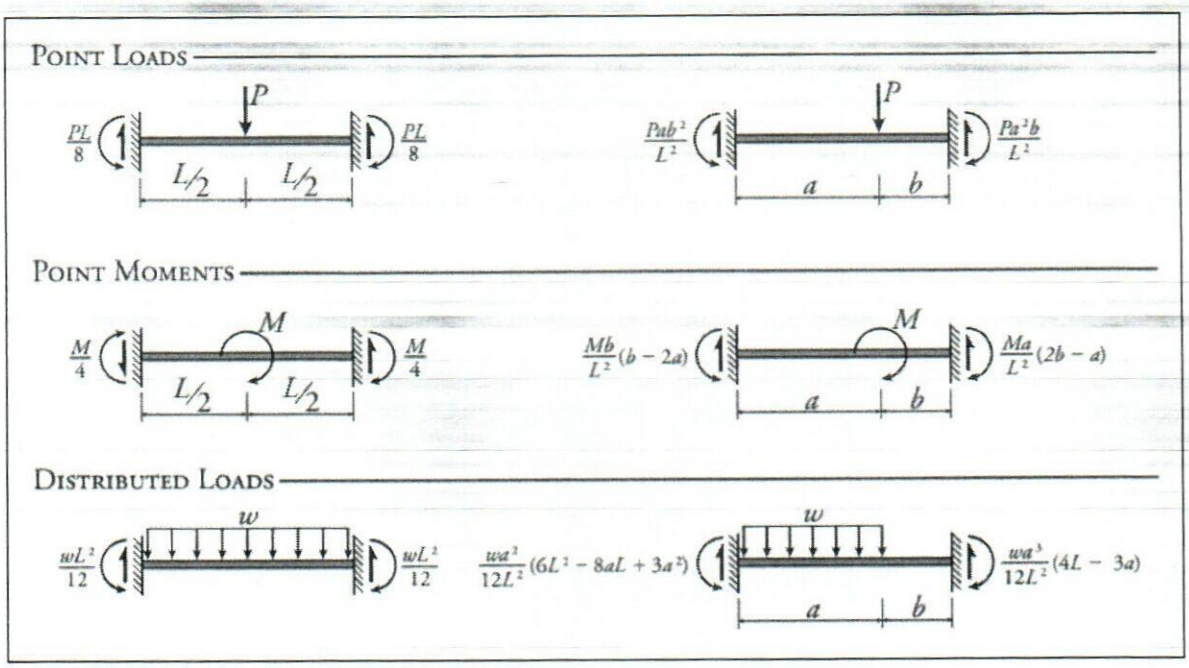
Virtual work for beams;

$$1 \times \Delta = \int \frac{mM\,dx}{EI}$$

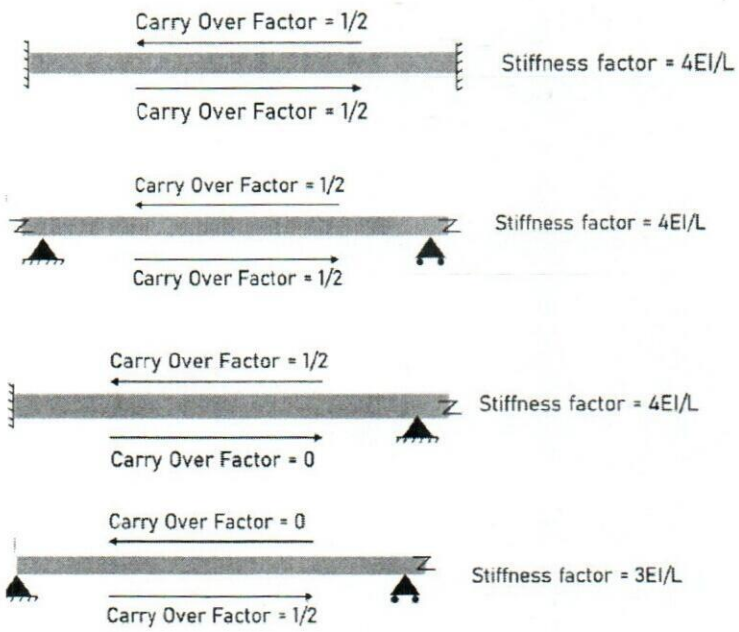
Table for: $\int_0^L M\,Q\,dx$ The values in the table represent the integration of the product of the two shapes with a common length L.

	Rectangle Q, L	Triangle Q, L	Triangle Q, L	Trapezoid Q_a, Q_b, L
Rectangle M, L	LMQ	$\frac{LMQ}{2}$	$\frac{LMQ}{2}$	$\frac{LM}{2}(Q_a + Q_b)$
Triangle M, L	$\frac{LMQ}{2}$	$\frac{LMQ}{3}$	$\frac{LMQ}{6}$	$\frac{LM}{6}(Q_a + 2Q_b)$
Triangle M, L	$\frac{LMQ}{2}$	$\frac{LMQ}{6}$	$\frac{LMQ}{3}$	$\frac{LM}{6}(2Q_a + Q_b)$
Triangle a, b, M, L	$\frac{LMQ}{2}$	$\frac{MQ}{6}(L + a)$	$\frac{MQ}{6}(L + b)$	$\frac{M}{6}\left[Q_a(L + b) + Q_b(L + a)\right]$
Trapezoid M_a, M_b, L	$\frac{LQ}{2}(M_a + M_b)$	$\frac{LQ}{6}(M_a + 2M_b)$	$\frac{LQ}{6}(2M_a + M_b)$	$\frac{L}{6}\left[Q_a(2M_a + M_b) + Q_b(M_a + 2M_b)\right]$

Fixed end moments



Carry over factors



-END OF THE PAPER-

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Student Number .....

FACULTY OF SCIENCE & ENGINEERING
SCHOOL OF COMPUTING AND MATHEMATICS

FINAL EXAMINATION PAPER

Module Code	:	6CS010
Module Title	:	Digital Forensics
Date	:	19th January 2025
Examiners	:	Dr C Mbarushimana, Mr. Uchitha Jayathissa
Time Allowed	:	1.5 hrs

INSTRUCTIONS TO CANDIDATES

- This is a Closed book examination.
- You Should Attempt 3 Questions in Total

MATERIALS REQURIED

- Answer booklet.
- You may use a scientific calculator. This must not be programmable, and may be inspected during the examination.
- You should write legibly in black or blue ink

Question 1:

Explain the the four ACPO principles of computer based electronic evidence. Illustrate your answer with examples. ***20 marks***

Question 2:

The figure below shows the first sector of a MBR disk.

```
Offset(d) 00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15

00000000  33 C0 8E D0 BC 00 7C 8E C0 8E D8 BE 00 7C BF 00  3ÀŽÐ¼.|ŽÀŽØ¾.|¿.
00000016  06 B9 00 02 FC F3 A4 50 68 1C 06 CB FB B9 04 00  .¹..üó¤Ph..ËÛ¹..
00000032  BD BE 07 80 7E 00 00 7C 0B 0F 85 0E 01 83 C5 10  ½¾.€~..|.…..ƒÅ.
00000048  E2 F1 CD 18 88 56 00 55 C6 46 11 05 C6 46 10 00  âñÍ.ˆV.UÆF..ÆF..
00000064  B4 41 BB AA 55 CD 13 5D 72 0F 81 FB 55 AA 75 09  ´A»ªUÍ.]r..ûUªu.
00000080  F7 C1 01 00 74 03 FE 46 10 66 60 80 7E 10 00 74  ÷Á..t.þF.f`€~..t
00000096  26 66 68 00 00 00 00 66 FF 76 08 68 00 00 68 00  &fh....fÿv.h..h.
00000112  7C 68 01 00 68 10 00 B4 42 8A 56 00 8B F4 CD 13  |h..h..´BŠV.‹ôÍ.
00000128  9F 83 C4 10 9E EB 14 B8 01 02 BB 00 7C 8A 56 00  ŸƒÄ.žë.¸..».|ŠV.
00000144  8A 76 01 8A 4E 02 8A 6E 03 CD 13 66 61 73 1C FE  Šv.ŠN.Šn.Í.fas.þ
00000160  4E 11 75 0C 80 7E 00 80 0F 84 8A 00 B2 80 EB 84  N.u.€~.€.„Š.²€ë„
00000176  55 32 E4 8A 56 00 CD 13 5D EB 9E 81 3E FE 7D 55  U2äŠV.Í.]ëž.>þ}U
00000192  AA 75 6E FF 76 00 E8 8D 00 75 17 FA B0 D1 E6 64  ªunÿv.è..u.ú°Ñæd
00000208  E8 83 00 B0 DF E6 60 E8 7C 00 B0 FF E6 64 E8 75  è.f.°ßæ`è|.°ÿædèu
00000224  00 FB B8 00 BB CD 1A 66 23 C0 75 3B 66 81 FB 54  .û¸.»Í.f#Àu;f.ûT
00000240  43 50 41 75 32 81 F9 02 01 72 2C 66 68 07 BB 00  CPAu2.ù..r,fh.».
00000256  00 66 68 00 02 00 00 66 68 08 00 00 00 66 53 66  .fh....fh....fSf
00000272  53 66 55 66 68 00 00 00 00 66 68 00 7C 00 00 66  SfUfh....fh.|..f
00000288  61 68 00 00 07 CD 1A 5A 32 F6 EA 00 7C 00 00 CD  ah...Í.Z2öê.|..Í
00000304  18 A0 B7 07 EB 08 A0 B6 07 EB 03 A0 B5 07 32 E4  . ·.ë. ¶.ë. µ.2ä
00000320  05 00 07 8B F0 AC 3C 00 74 09 BB 07 00 B4 0E CD  ...‹ð¬<.t.».´.Í
00000336  10 EB F2 F4 EB FD 2B C9 E4 64 EB 00 24 02 E0 F8  .ëòôëý+Éädë.$.àø
00000352  24 02 C3 49 6E 76 61 6C 69 64 20 70 61 72 74 69  $.ÃInvalid parti
00000368  74 69 6F 6E 20 74 61 62 6C 65 00 45 72 72 6F 72  tion table.Error
00000384  20 6C 6F 61 64 69 6E 67 20 6F 70 65 72 61 74 69   loading operati
00000400  6E 67 20 73 79 73 74 65 6D 00 4D 69 73 73 69 6E  ng system.Missin
00000416  67 20 6F 70 65 72 61 74 69 6E 67 20 73 79 73 74  g operating syst
00000432  65 6D 00 00 00 63 7B 9A BD 00 9F EC 00 00 80 20  em...c{š½.Ÿì..€
00000448  21 00 07 FE FF FF 00 08 00 00 00 30 62 03 00 FE  !..þÿÿ.....0b..þ
00000464  FF FF 0C FE FF FF 00 38 62 03 00 20 03 00 00 FE  ÿÿ.þÿÿ.8b.. ...þ
00000480  FF FF 07 FE FF FF 00 58 65 03 00 20 03 00 00 FE  ÿÿ.þÿÿ.Xe.. ...þ
00000496  FF FF 0F FE FF FF 00 78 68 03 00 80 57 00 55 AA  ÿÿ.þÿÿ.xh..€W.Uª
```

a. What information does this sector contain? ***5 marks***

b. How many active partitions does the disk have and how many partitions in total? Explain your answer. ***5 marks***

c. What is the starting sector in LBA of the first partition? ***5 marks***

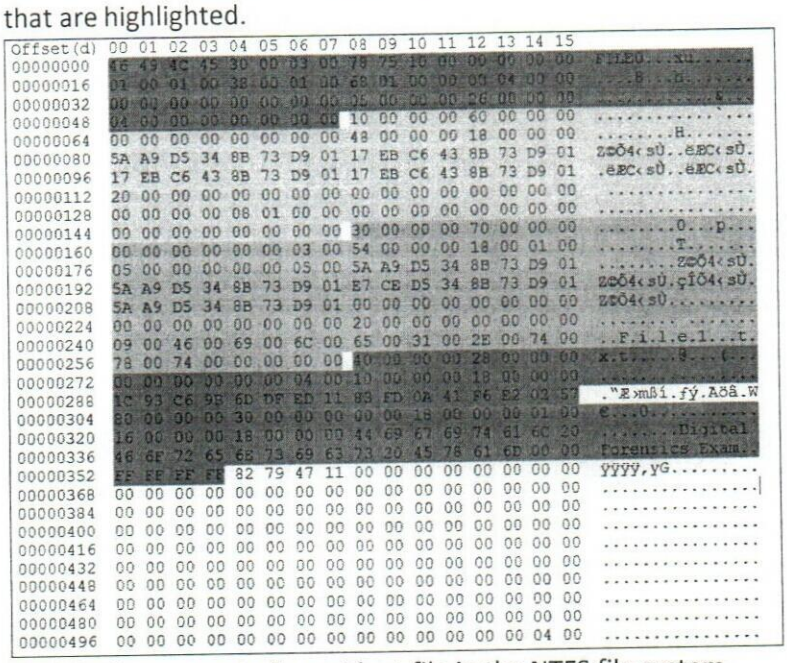
d. What is the size in MBs of the 3rd partition? ***5 marks***

Question 3:

NTFS is the most common file system used in Windows today.

a. With regards to NTFS, discuss the role of the Master File Table (MFT) ***5 marks***

b. The figure below shows a portion of an NTFS file record, explain the significance of the areas that are highlighted. ***10 marks***



Offset(d)	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	
00000000	46	49	4C	45	30	00	03	00	78	75	10	00	00	00	00	00	FILE0...xu.....
00000016	01	00	01	00	38	00	01	00	68	01	00	00	00	04	00	00	....8...h.....
00000032	00	00	00	00	00	00	00	00	05	00	00	00	26	00	00	00	..............&...
00000048	04	00	00	00	00	00	00	00	10	00	00	00	60	00	00	00	..............`...
00000064	00	00	00	00	00	00	00	00	48	00	00	00	18	00	00	00	........H.....
00000080	5A	A9	D5	34	8B	73	D9	01	17	EB	C6	43	8B	73	D9	01	Z©Õ4‹sÙ..ëÆC‹sÙ.
00000096	17	EB	C6	43	8B	73	D9	01	17	EB	C6	43	8B	73	D9	01	.ëÆC‹sÙ..ëÆC‹sÙ.
00000112	20	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	.....
00000128	00	00	00	00	08	01	00	00	00	00	00	00	00	00	00	00	.....
00000144	00	00	00	00	00	00	00	00	30	00	00	00	70	00	00	00	........0...p...
00000160	00	00	00	00	00	00	03	00	54	00	00	00	18	00	01	00	........T.....
00000176	05	00	00	00	00	00	05	00	5A	A9	D5	34	8B	73	D9	01	........Z©Õ4‹sÙ.
00000192	5A	A9	D5	34	8B	73	D9	01	E7	CE	D5	34	8B	73	D9	01	Z©Õ4‹sÙ.çÎÕ4‹sÙ.
00000208	5A	A9	D5	34	8B	73	D9	01	00	00	00	00	00	00	00	00	Z©Õ4‹sÙ.....
00000224	00	00	00	00	00	00	00	00	00	20	00	00	00	00	00	00	....
00000240	09	00	46	00	69	00	6C	00	65	00	31	00	2E	00	74	00	..F.i.l.e.1...t.
00000256	78	00	74	00	00	00	00	00	40	00	00	00	28	00	00	00	x.t.....@...(...
00000272	00	00	00	00	00	00	04	00	10	00	00	00	18	00	00	00	.....
00000288	1C	93	C6	9B	6D	DF	ED	11	83	FD	0A	41	F6	E2	02	57	.“Æ›mßí.ƒý.Aöâ.W
00000304	80	00	00	00	30	00	00	00	00	00	18	00	00	00	01	00	€...0.....
00000320	16	00	00	00	18	00	00	00	44	69	67	69	74	61	6C	20	........Digital
00000336	46	6F	72	65	6E	73	69	63	73	20	45	78	61	6D	00	00	Forensics Exam..
00000352	FF	FF	FF	FF	82	79	47	11	00	00	00	00	00	00	00	00	ÿÿÿÿ‚yG.....
00000368	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	.....
00000384	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	.....
00000400	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	.....
00000416	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	.....
00000432	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	.....
00000448	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	.....
00000464	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	.....
00000480	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	.....
00000496	00	00	00	00	00	00	00	00	00	00	00	00	00	00	04	00	.....

c. Explain the concept of a resident file in the NTFS file system. ***5 marks***

Question 4:

Critically discuss digital antiforensics techniques and explain how these techniques may be used to mislead the forensic investigation process. ***20 marks***

Question 5:

Discuss what you could do to find data of interests on a seized hard disk drive. Share examples of tools you could utilise and a relevant investigation methodology. ***20 marks***

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Faculty of Science and Engineering

EXAMINATION PAPER

Module Code	**5MA044**
Module Title	**Applied Instrumentation and Control**
Date of Examination:	**January 15th 2024**
Examiner:	**Mr. Randeera Liyanage**
Examiner(s) Room:	
Time Allowed:	**3 Hours**
Number of Questions to be Attempted:	**4 from 4**

This Paper Contains 07 Pages

All Questions are Equally Weighted (Unless Otherwise Stated)

Materials Required:

- One eight-page answer booklet
- Formula sheet
- Scientific calculator
- Log-Liner Sheet

Instructions to Students:

- This is a closed book examination.
- You are to write your answers in the answer booklet provided.
- Start each question on a new page.

Question 01

a) Figure 1 (a) contains a rotational spring mass damper system along with its individual components.

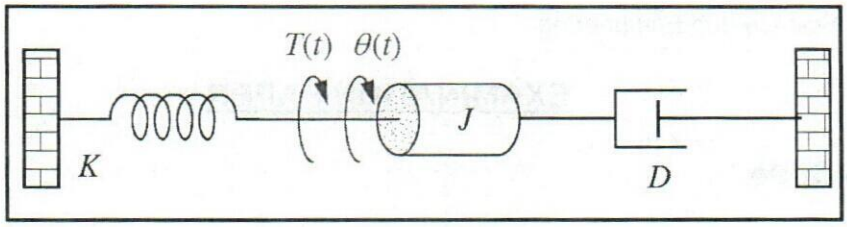


Figure 1 (a)

a) Derive the transfer function for the given system. (06 Marks)

b) If K = 5 N/m, J = 0.26 kg.m^2, and D = 1.04 N.m.s/rad, substitute the values to the transfer function obtained in (a), draw the pole zero diagram and comment on the stability of the system. (06 Marks)

c) Comment on the nature of oscillations in the system with reference to the values and the illustrated pole zero diagram in (b). (03 Marks)

e) Calculate the steady state error using the open loop transfer function of the system for a unit step input. (04 Marks)

f) To improve the steady state error and overall response, a proportional gain is introduced to the original system "G(s)" as shown in Figure 1 (b). If the proportional gain Kp is 5, determine the steady state error for a unit step input. (06 Marks)

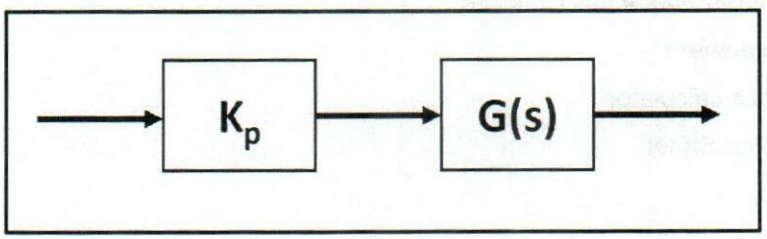


Figure 1 (b)

[Total – 25%]

Question 02

A unity feedback control system has the following open loop transfer function.

$$G(s) = \frac{1}{s(s+1)(s+2)}$$

a) Determine the frequency response (magnitude and phase) of the open loop transfer function shown above. (06 Marks)

b) Plot the bode diagram for both magnitude and phase. (Range of ω – 0.1 : 10) (13 Marks)

c) Measure and calculate the resultant phase and gain margins. (06 Marks)

[Total – 25%]

Question 3

$$G(s) = \frac{1}{s^4 + s^3 + 2s^2 + 2s + 3}$$

a) State and explain the term "BIBO Stability" and its suitability to measure the stability in a linear time invariant system. (Answer is expected in 2 sentences) (04 Marks)

b) Write down the characteristic equation of the system G(s) shown above. (04 Marks)

c) Determine the Routh-Hurwitz table for the characteristic equation obtained in part (b). (12 Marks)

d) Using your simplified Routh-Hurwitz table, determine the number of right hand the poles in the s-plane and comment on the stability of the system. (05 Marks)

[Total – 25%]

Question 4

An analogue controller is designed with the following transfer function G(s). The design engineers have decided to implement a digital version of the controller. Initially, a sample increment of $T = \frac{1}{2}$ seconds is used to check the compatibility of the digital controller for a step input. The digital controller's response to a step input should closely resemble the corresponding response of the analogue controller.

$$G(s) = \frac{1}{2s + 1}$$

a) Using bilinear transform or a similar method, obtain the equivalent Z transfer function.

(05 Marks)

b) Using the Z transfer function, determine the corresponding difference equation and plot the unit step response of the digital controller for a period of 0s ≤ t ≤ 6s.

(08 Marks)

c) Calculate and plot the step response of the analogue controller G(s) for a period of 0s ≤ t ≤ 6s.

(08 Marks)

d) Compare the responses of analogue and digital controllers for a step input and discuss the compatibility of the chosen sampling increment of the digital controller. Hence, discuss the practical hardware and software aspects that influence the selection of the sampling increment.

(04 Marks)

[Total – 25%]

-END OF EXAMINATION PAPER-

CONTROL DATA SHEET

First Order System Standard Form

$$G(s) = \frac{k_{ss}}{\tau s + 1}$$

Second Order System Standard Form

$$G(s) = \frac{K_{ss}\omega_n^2}{s^2 + 2\zeta\omega_n s + \omega_n^2}$$

Standard Performance of a Second Order System

$$Time\ to\ first\ peak; \quad T_p = \frac{\pi}{\omega_n\sqrt{1-\zeta^2}}$$

$$Settling\ time; \quad T_s = \frac{4}{\zeta\omega_n}$$

$$Rise\ time; \quad T_r = \frac{1.8}{\omega_n}$$

$$Percentage\ Overshoot; \quad \%OS = e^{-\left(\zeta\pi/\sqrt{1-\zeta^2}\right)} \times 100$$

$$\zeta \cong 0.01 \times PM$$

$$\left(\frac{\omega_c}{\omega_n}\right)^2 \cong \sqrt{4\zeta^4 + 1} - \zeta^2$$

Where ζ is the damping ratio, ω_n is the natural frequency, ω_c is the crossover frequency and PM is the Phase Margin.

Bode Plot

$$GM = 0 - x$$

$$PM = \phi + 180$$

$$-x\ dB = 20\log(K)$$

Modelling Equations

$$Spring; \qquad F = kx(t)$$

$$Damper; \qquad F = b\dot{x}(t)$$

$$Capacitor\ Current; \qquad I = C.\frac{dV_c}{dt}$$

$$Inductor\ Voltage; \qquad V = L.\frac{dI_L}{dt}$$

Steady State Error

$$E(s) = R(s) - X(s)$$

$$E(s) = \frac{R(s)}{1 + G(s)}$$

$$e_{ss} = \lim_{s \to 0} s.E(s)$$

Where "G(s)" is the open loop transfer function, and "R(s)" is the system input.

TABLE OF LAPLACE AND Z TRANSFORMS

f(t)	F(s)	f(k)	F(z)
unit impulse: $\delta(t)$	1	$\delta(k)$	1
delayed unit impulse: $\delta(t-NT)$	e^{-NTs}	$\delta(k-N)$	z^{-N}
unit step: 1	$\frac{1}{s}$	1	$\frac{z}{z-1}$
unit ramp: t	$\frac{1}{s^2}$	kT	$\frac{Tz}{(z-1)^2}$
e^{-at}	$\frac{1}{s+a}$	e^{-akT}	$\frac{z}{z-e^{-aT}}$
-	-	α^k	$\frac{z}{z-\alpha}$
$\frac{1}{\tau}\cdot e^{-t/\tau}$	$\frac{1}{1+\tau s}$	$\frac{1}{\tau}\cdot e^{-kT/\tau}$	$\frac{1}{\tau}\cdot\frac{z}{z-e^{-T/\tau}}$
$1-e^{-t/\tau}$	$\frac{1}{s(1+\tau s)}$	$1-e^{-kT/\tau}$	$\frac{(1-e^{-T/\tau})z}{(z-1)(z-e^{-T/\tau})}$
$1-e^{-at}$	$\frac{a}{s(s+a)}$	$1-e^{-akT}$	$\frac{(1-e^{-aT})z}{(z-1)(z-e^{-aT})}$
-	-	$1-\alpha^k$	$\frac{z(1-\alpha)}{(z-1)(z-\alpha)}$
sin (ωt)	$\frac{\omega}{s^2+\omega^2}$		$\frac{z\sin\omega T}{z^2-2z\cos\omega T+1}$
cos (ωt)	$\frac{s}{s^2+\omega^2}$		$\frac{z(z-\cos\omega T)}{z^2-2z\cos\omega T+1}$
$e^{-at}\sin\omega t$	$\frac{\omega}{(s+a)^2+\omega^2}$		$\frac{ze^{-aT}\sin\omega T}{z^2-2ze^{-aT}\cos\omega T+e^{-aT}}$
$e^{-at}\cos\omega t$	$\frac{(s+a)}{(s+a)^2+\omega^2}$		$\frac{z^2-ze^{-aT}\sin\omega T}{z^2-2ze^{-aT}\cos\omega T+e^{-aT}}$

-END OF CONTROL DATA SHEET-

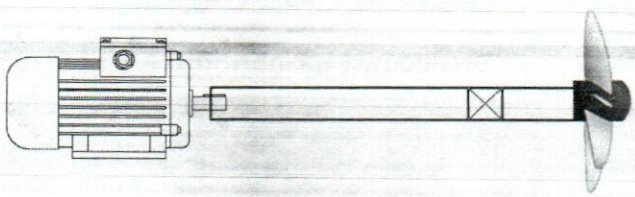
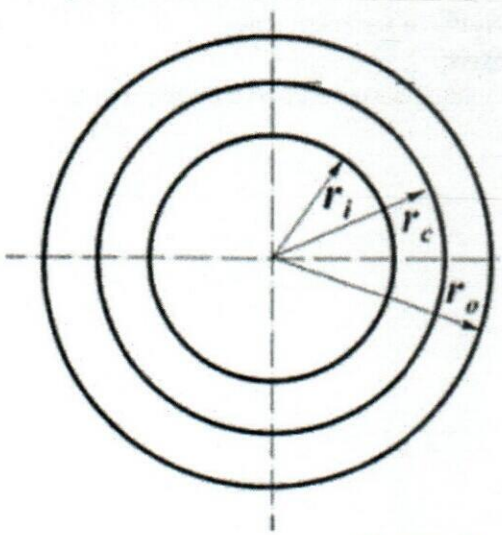
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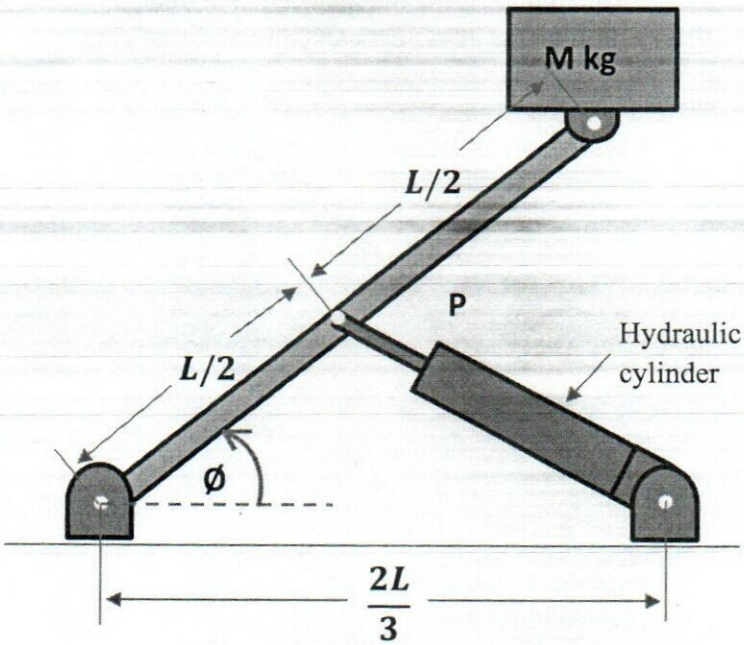
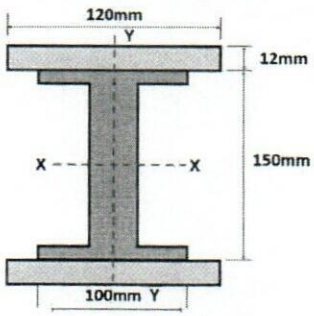
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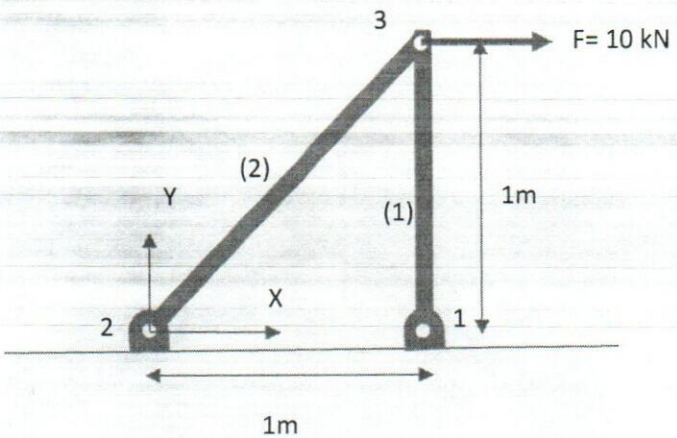
Module Code:	**6MA016**
Module Title:	**Structural mechanics and stress analysis**
Date:	
Time:	
Duration:	**3 Hours**
Examiner:	**Virantha E.A.I**
Extension:	

INSTRUCTIONS TO CANDIDATES

- This is a closed book examination.
- A scientific calculator can be used in this exam. This must not be programmable.
- **Four questions** should be attempted out of five questions.
- Answers to each question to start on a separate page.
- All questions are equally weighted.
- Any data which is not given should be assumed and clearly mentioned.

Q1		An induction motor is used to drive a fan which is connected to the motor using the solid circular shaft as shown in the Figure Q1 . Motor dilevers the 300kW of power at 100 r.p.m. (a) If the shaft shear stress is not to exeed 80 N/mm^2, find the diameter of the shaft. (b) What percentage in saving would be obtained if this shaft is replaced by a hollow one, whose internal diameter is equal to 0.8 of the external diameter, the length, the material and the allowable maximum shearing stress being same  **Figure Q1**	50% 50% (Total 100%)
Q2		A compound tube is made by shrinking one tube of 100 mm internal diameter and 25 mm wall thickness on to another tube of 100 mm external diameter and 25 mm wall thickness. The shrinkage allowance, based on radius, is 0.01 mm. If both tubes are of steel (with E = 208 GN/m^2), (a) Calculate the radial pressure (interface pressure) set up at the junction owing to shrinkage. (b) If the compound cylinder is then subjected to a 30 MPa internal pressure calculate the tangential stress developed at the inner cylinder inner surface.  **r_i=75mm** **r_c=100 mm** **r_o=125 mm** **Figure Q2**	50% 50% (Total 100%)

Q3		A hydraulic lift is used to elevate the mass of M **kg** as shown in Figure Q3. Using the principle of virtual work obtain an expression for the force **P** exerted by the hydraulic cylinder when the lifting bar is at an angle **Ø.**  **Figure Q3**	(Total 100%)
Q4		(a) What are the factors effecting to the critical buckling load. (b) Figure Q4 shows a built-up column consisting of standard RSJ (rolled steel joists) beam of 150 mm × 100 mm. with 120 mm × 12 mm plate riveted to each flange. Calculate the safe load, the column can carry, if it is 4 m long having one end fixed and the other end hinged with a factor of safety 3.5. Take the properties of the RSJ beam cross-section as Area = 2167 mm^2, $I_{XX} = 8.391 \times 10^6$ mm^4, $I_{YY} = 0.948 \times 10^6$ mm^4.  **Figure Q4**	10% 90% (Total 100%)

Q5		The two-dimensional truss shown in Figure Q5 is subjected to external loading as shown. The cross-sectional area of the two beams is $500mm^2$ and elastic modulus of the beam material is 150GPa and Poisson's ratio is 0.3.	
		(a) using the finite element method solve for the horizontal and vertical components of displacement at node 3.	70%
		(b) Determine the stress developed in each bar.	30%
			
		Figure Q5	(Total 100%)

Torsion

$$\frac{\tau}{r} = \frac{T}{J} = \frac{G\theta}{L} \qquad P = \frac{2\pi NT}{60} \qquad J = \frac{\pi d^4}{32} \qquad T = Frn$$

Thin Shells

Cylinder $\sigma_C = \frac{Pd}{2t}$ $\sigma_L = \frac{Pd}{4t}$ Vol Strain = 2 × Hoop Strain + Axial Strain

Sphere $\sigma = \frac{Pd}{4t}$ Vol Strain = 3 × Hoop strain

$$\varepsilon = \frac{\sigma_x}{E} - \upsilon\frac{\sigma_y}{E} - \upsilon\frac{\sigma_z}{E} \qquad \Delta V = \frac{V \times P}{K}$$

Principal Stresses

$$\sigma_\theta = \sigma_x \cos^2\theta + \sigma_y \sin^2\theta + \tau \sin 2\theta \qquad \tau_\theta = \frac{1}{2}(\sigma_y - \sigma_x)\sin 2\theta + \tau\cos 2\theta$$

$$\sigma_1, \sigma_2 = \frac{1}{2}(\sigma_y + \sigma_x) \pm \frac{1}{2}\sqrt{(\sigma_y - \sigma_x)^2 + 4\tau^2} \quad \text{or} \quad (\sigma_x - \sigma)(\sigma_y - \sigma) = \tau^2$$

$$\tan\theta = \frac{(\sigma - \sigma_y)}{\tau} \qquad \tau_{max} = \pm\frac{1}{2}\sqrt{(\sigma_y - \sigma_x)^2 + 4\tau^2} \quad \text{or} \quad \pm\frac{(\sigma_1 - \sigma_2)}{2}$$

Strain energy

$$u = \frac{1}{2}\sigma_x\varepsilon_x \qquad U = \frac{P^2L}{2AE}$$

Bar element stiffness

$$K = \frac{EA}{L}\begin{bmatrix} 1 & -1 \\ -1 & 1 \end{bmatrix}$$

$$k = \frac{AE}{L}\begin{bmatrix} C^2 & CS & -C^2 & -CS \\ CS & S^2 & -CS & -S^2 \\ -C^2 & -SC & C^2 & CS \\ -CS & -S^2 & CS & S^2 \end{bmatrix}$$

Thick-walled Cylinders

$$\sigma_r = \frac{a^2 p_i - b^2 p_o}{b^2 - a^2} - \frac{(p_i - p_o)a^2 b^2}{r^2(b^2 - a^2)}$$

$$\sigma_t = \frac{a^2 p_i - b^2 p_o}{b^2 - a^2} + \frac{(p_i - p_o)a^2 b^2}{r^2(b^2 - a^2)}$$

$$\frac{bp}{E}\left(\frac{b^2 + c^2}{c^2 - b^2} + \mu\right) + \frac{bp}{E}\left(\frac{a^2 + b^2}{b^2 - a^2} - \mu\right) = \delta \text{.....eqn. 32}$$

or

$$p = \frac{E\delta}{b}\frac{(b^2 - a^2)(c^2 - b^2)}{2b^2(c^2 - a^2)} \text{.....eqn. 33}$$

$$u = \frac{1-\mu}{E}\frac{a^2 p_i - b^2 p_0}{b^2 - a^2} r + \frac{1+\mu}{E}\frac{a^2 b^2 (p_i - p_o)}{(b^2 - a^2)r} \text{.....eqn 27}$$

Radial Deformation

$$u = \frac{1-\mu}{E}\frac{a^2 p_i - b^2 p_0}{b^2 - a^2} r + \frac{1+\mu}{E}\frac{a^2 b^2 (p_i - p_o)}{(b^2 - a^2)r}$$

Shrink-fit Interface Pressure in Cylinders

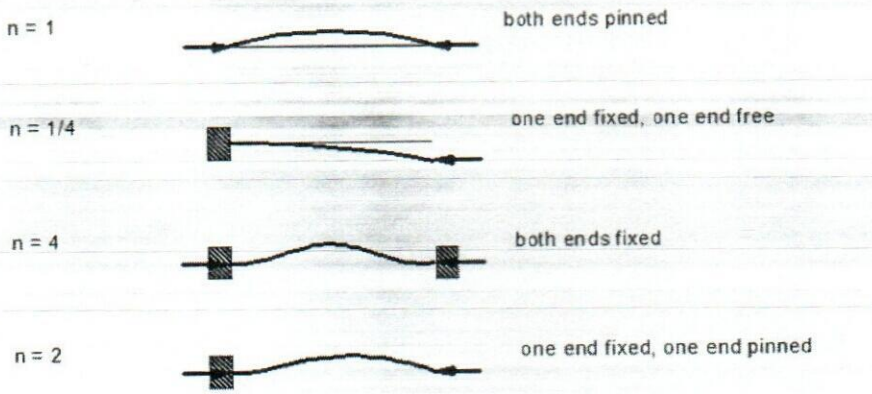
$$\frac{bp}{E}\left(\frac{b^2 + c^2}{c^2 - b^2} + \mu\right) + \frac{bp}{E}\left(\frac{a^2 + b^2}{b^2 - a^2} - \mu\right) = \delta$$

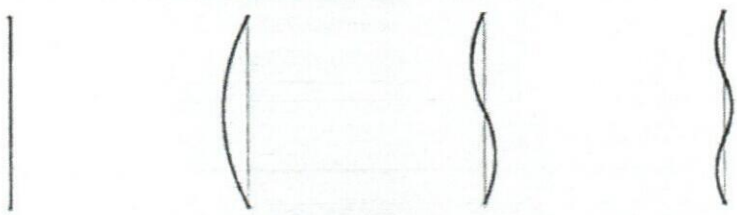
or

$$p = \frac{E\delta}{b}\frac{(b^2 - a^2)(c^2 - b^2)}{2b^2(c^2 - a^2)}$$

Buckling

$$P_E = \frac{n\pi^2 EI}{L^2} \qquad P_R = \frac{\sigma_C A}{1+\frac{a}{n}\left(\frac{l}{k}\right)^2} \qquad I = Ak^2$$





$p_E = 0$ $\qquad p_E = \frac{\pi^2 EI}{L^2}$ $\qquad p_E = \frac{4\pi^2 EI}{L^2}$ $\qquad p_E = \frac{9\pi^2 EI}{L^2}$

Biaxial Plane Stress

$$\varepsilon_x = \frac{\sigma_x}{E} - \nu\frac{\sigma_y}{E}$$

$$\varepsilon_y = \frac{\sigma_y}{E} - \nu\frac{\sigma_x}{E}$$

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EXAMINATION PAPER

FACULTY OF SCIENCE & ENGINEERING

SCHOOL OF ARCHITECTURE AND BUILT ENVIRONMENT

Module Code	:	**6CN024 (CINEC)**
Module Title	:	**Commercial Project Management**
Date	:	**16th February 2025**
Time Allowed	:	**3 Hours**

INSTRUCTIONS TO CANDIDATES

- This is a **closed book** exam.
- This paper consists of five (5) questions. Each question carries 25 marks.
- Question 1 is compulsory and must be answered by all candidates.
- From the remaining four (4) questions, you are required to answer any three (3).
- Clearly state any assumptions made in your answers.

MATERIALS REQURIED

- Twelve-page answer booklets provided.
- The use of a calculator is allowed

Question 1 (Mandatory)

A. Briefly explain the commercial manager role in project life cycle and impotence of commercial management to achieve project goals. (5 marks)

B. Read the following scenario and provide your advice using your knowledge in RICS Code of Conduct.

i) ABC QS Company was engaged to prepare an estimate for a hotel development project based on information provided by the client for bank loan approval and permit applications. One year later, Nimal, an employee of ABC QS Company, was assigned to re-estimate the project for the same purpose. During the process, Nimal discovered that the information originally provided by the client was false.

Please advise Nimal on the ethical issues involved in this situation and outline the appropriate course of action he should take in accordance with the RICS Code of Conduct. Your response should reference relevant RICS ethical principles and professional obligations. (5 marks)

ii) Sunil, a Quantity Surveyor with over 20 years of experience in commercial management, was hired as a freelance QS by his friend to prepare a Bill of Quantities (BOQ) and cost estimate for a four-story commercial building. While reviewing the drawings, Sunil identified a potential issue in the structural design based on his past experience with similar projects. He advised his friend to have the structural design reviewed by a qualified professional. However, his friend later asked him to prepare the structural design for an additional fee, despite Sunil not having any formal structural engineering qualifications.

Advise Sunil on the ethical and professional implications of this request. (5 marks)

iii) Ahamed, a Quantity Surveyor working for a consulting firm, has recently been assigned to assist in the tender evaluation process for the XYZ construction project. During the evaluation, he discovers that one of the bidding companies is owned by his former batchmate. Although Ahamed believes he can remain impartial, he is unsure whether this situation constitutes a conflict of interest.

1. Explain whether Ahamed's situation constitutes a conflict of interest (5 marks)
2. Advice Ahamed how should he manage this situation professionally and ensure compliance with ethical and procurement best practices. (5 marks)

Question 2

A. Tulip Hotel Company is constructing a hotel project in Kandy. Two generator brands have submitted proposals, and the client seeks advice on the most cost-effective option over a 10-year life span. The hotel will be operated by the same client, and the generators will be replaced after 10 years.

Using the Life Cycle Costing (LCC) method, analyze and recommend the most suitable generator based on the information provided in the table below. The discount rate is 5%.

- Clearly show all steps of calculations.
- Use Present Value (PV) or Net Present Value (NPV) for comparison.
- Make and state any necessary assumptions.

	Generator Brand A	Generator Brand B
Initial cost	10 Million	7 Million
Routine Maintenance	1 Million per year	1.5 million per year
Overhaul	5 Million at 5th Year	4 Million at 5th year

(20 Marks)

B. Although life cycle cost analysis (LCCA) helps in identifying the most sustainable and cost-effective option over a project's lifespan, it is often overlooked in decision-making. Explain the key reasons why life cycle cost analysis is not commonly used for decision making in construction projects. *(5 Marks)*

Question 3

A. Outline the key steps in the risk management process. *(5 Marks)*

B. Qualitative risk analysis techniques provide a descriptive evaluation of risks based on expert judgment and are used to prioritize risks. SWOT analysis is one such technique.

LP Associate, a leading construction consultancy firm in Sri Lanka, has successfully delivered major hospitality and mixed-use development projects over two decades. However, due to the recent economic crisis, large-scale construction investments in Sri Lanka have significantly declined, posing a major risk to the company.

Using the SWOT analysis technique, conduct a risk assessment for LP Associate, identifying relevant strengths, weaknesses, opportunities, and threats in this situation. *(10 Marks)*

C. Using the 4T's risk response principles (Transfer, Tolerate, Treat, and Terminate), explain risk management in a road construction project by providing two examples for each risk response technique. *(10 Marks)*

Question 4

A. The statement "Value Management is not cost cutting" emphasizes that Value Management focuses on maximizing function and performance rather than merely reducing costs.

- Elaborate on this statement by explaining the concept of Value Management, its key principles, and the systematic process involved in its application.
- Discuss how Value Management contributes to better decision-making in construction projects without compromising quality.

(20 Marks)

B. Identify and discuss the key challenges of implementing the Value Management process in the Sri Lankan built environment.

(5 Marks)

Question 5

A. In the Sri Lankan construction industry, the government is the largest client, initiating numerous projects annually using taxpayer funds. However, many government projects are often criticized for not being user-friendly or fit for purpose, leading to concerns over inefficiency and waste of public money.

Discuss how the UK Government Soft Landings (GSL) principles can be applied to enhance the usability, operational efficiency, and long-term value of government buildings in Sri Lanka. Support your answer with relevant examples. *(10 Marks)*

B. Write a minimum 400-word report discussing the importance of management accounts, financial accounts, and knowledge of financial ratios to commercial managers in the construction industry. *(15 marks)*

-End of Questions-

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Student Number .....

FACULTY OF SCIENCE & ENGINEERING
SCHOOL OF COMPUTING AND MATHEMATICS

FINAL EXAMINATION PAPER

Module Code	:	5CS031
Module Title	:	Network Security
Date	:	09th February 2025
Examiners	:	Dr C Mbarushimana / Mr. Uchitha Jayathissa
Time Allowed	:	02 hrs

INSTRUCTIONS TO CANDIDATES

- This is a Closed book examination.
- Answer all questions
- There are 13 pages in the TCA

MATERIALS REQURIED

- No Calculators should be provided in this TCA
- You should write legibly in black or blue ink

Question 01

A flaw or weakness in a system's design, implementation, or operation and management that could be exploited to violate the system's security policy is a(n) _____.

- vulnerability
- countermeasure
- adversary
- risk

Question 02

A(n) _____ is an attempt to learn or make use of information from the system that does not affect system resources.

- passive attack
- inside attack
- active attack
- outside attack

Question 03

A(n) _____ is an action, device, procedure, or technique that reduces a threat, a vulnerability, or an attack by eliminating or preventing it, by minimizing the harm it can cause, or by discovering and reporting it so that correct action can be taken.

- countermeasure
- attack
- adversary
- protocol

Question 04

A _____ is any action that compromises the security of information owned by an organization.

- security attack
- security mechanism
- security policy
- security service

Question 05
The assurance that data received are exactly as sent by an authorized entity is _____.

- data integrity
- data confidentiality
- authentication
- access control

Question 06
A flaw or weakness in a system's design, implementation, or operation and management that could be exploited to violate the system's security policy is a(n) _____.

- vulnerability
- countermeasure
- risk
- adversary

Question 07
An assault on system security that derives from an intelligent act that is a deliberate attempt to evade security services and violate the security policy of a system is a(n) _____.

- attack
- asset
- risk
- vulnerability

Question 08
The original message or data that is fed into the algorithm is _____.

- plaintext
- encryption algorithm
- secret key
- decryption algorithm

Question 09

The most important symmetric algorithms, all of which are block ciphers, are the DES, triple DES, and the _____.

- AES
- SHA
- RSA
- DSS

Question 10

If the only form of attack that could be made on an encryption algorithm is brute-force, then the way to counter such attacks would be to _____ .

- use more keys
- use shorter keys
- use longer keys
- use less keys

Question 11

The purpose of a _____ is to produce a "fingerprint" of a file, message, or other block of data.

- secret key
- digital signature
- hash function
- keystream

Question 12

Presenting or generating authentication information that corroborates the binding between the entity and the identifier is the _____.

- identification step
- verification step
- authentication step
- corroboration step

Question 13
The _____ strategy is when users are told the importance of using hard to guess passwords and provided with guidelines for selecting strong passwords.

- reactive password checking
- proactive password checking
- user education
- computer-generated password

Question 14
To counter threats to remote user authentication, systems generally rely on some form of _____ protocol.

- eavesdropping
- challenge-response
- Trojan horse
- denial-of-service

Question 15
A _____ strategy is one in which the system periodically runs its own password cracker to find guessable passwords.

- user education
- proactive password checking
- reactive password checking
- computer-generated password

Question 16
An individual's signature is not unique enough to use in biometric applications.

- True
- False

Question 17

_____ implements a security policy that specifies who or what may have access to each specific system resource and the type of access that is permitted in each instance.

- Audit control
- Resource control
- Access control
- System control

Question 18

_____ is verification that the credentials of a user or other system entity are valid.

- Adequacy
- Authentication
- Authorization
- Audit

Question 19

A _____ is an entity capable of accessing objects

- group
- object
- subject
- owner

Question 20

The _____ component deals with the management and control of the ways entities are granted access to resources.

- resource management
- access management
- policy management
- privilege management

Question 21

_____ involves an attempt to define a set of rules or attack patterns that can be used to decide if a given behavior is that of an intruder

- Profile based detection
- Signature detection
- Anomaly detection
- Threshold detection

Question 22

The _____ is the ID component that analyzes the data collected by the sensor for signs of unauthorized or undesired activity or for events that might be of interest to the security administrator.

- data source
- operator
- sensor
- analyzer

Question 23

_____ involves the collection of data relating to the behavior of legitimate users over a period of time.

- Profile based detection
- Signature detection
- Anomaly detection
- Threshold detection

Question 24

A _____ gateway sets up two TCP connections, one between itself and a TCP user on an inner host and one between itself and a TCP user on an outside host.

- packet filtering
- stateful inspection
- circuit-level
- application-level

Question 25

Typically the systems in the _____ require or foster external connectivity such as a corporate Web site, an e-mail server, or a DNS server.

- DMZ
- IP protocol field
- VPN
- boundary firewall

Question 26

_____ scans for attack signatures in the context of a traffic stream rather than individual packets.

- Pattern matching
- Protocol anomaly
- Stateful matching
- Traffic anomaly

Question 27

A _____ consists of a set of computers that interconnect by means of a relatively unsecure network and makes use of encryption and special protocols to provide security

- proxy
- VPN
- UTM
- stateful inspection firewall

Question 28

The wireless environment lends itself to a _____ attack because it is so easy for the attacker to direct multiple wireless messages at the target.

- DoS
- man-in-the-middle
- identity theft
- network injection

Question 29

A(n) _____ is any entity that has station functionality and provides access to the distribution system via the wireless medium for associated stations.

- ESS
- MPDU
- access point
- distribution system

Question 30

In order to accelerate the introduction of strong security into WLANs the Wi-Fi Alliance promulgated _____, a set of security mechanisms that eliminates most 802.11 security issues, as a Wi-Fi standard.

- WPA
- WEP
- RSN
- MAC

Question 31

A _____ is a secret key shared by the AP and a STA and installed in some fashion outside the scope of IEEE 802.11i.

- pre-shared key
- master session key
- group master key
- pairwise master key

Question 32

_____ is the recommended technique for wireless network security.

- Using encryption
- Using anti-virus and anti-spyware software
- Turning off identifier broadcasting
- All of the above

Question 33
The function of the _____ layer is to control access to the transmission medium and to provide an orderly and efficient use of that capacity.

- CRC
- MAC
- MPDU
- MSDU

Question 34
ESP supports two modes of use: transport and _____.

- padding
- tunnel
- payload
- sequence

Question 35
IPsec can assure that _____.

- a router advertisement comes from an authorized router
- a routing update is not forged
- a redirect message comes from the router to which the initial packet was sent
- all of the above

Question 36
The most complex part of TLS is the _____.

- signature
- message header
- handshake protocol
- payload

Question 37
Search engines support HTTPS.

- True
- False

Question 38
Defensive programming is sometimes referred to as _____.

- variable programming
- secure programming
- chroot programming
- interpretive programming

Question 39
_____ is a program flaw that occurs when program input data can accidentally or deliberately influence the flow of execution of the program

- PHP attack
- Format string injection attack
- Injection attack
- XSS attack

Question 40
The intent of _____ is to determine whether the program or function correctly handles all abnormal inputs or whether it crashes or otherwise fails to respond appropriately.

- shell scripting
- fuzzing
- deadlocking
- canonicalization

Question 41
A _____ is a pattern composed of a sequence of characters that describe allowable input variants.

- canonicalization
- race condition
- regular expression
- shell script

Question 42

_____ attacks are vulnerabilities involving the inclusion of script code in the HTML content of a Web page displayed by a user's browser.

- PHP file inclusion
- Mail injection
- Code injection
- Cross-site scripting

Question 43

_____ requires that a user prove his or her identity for each service invoked and, optionally, requires servers to prove their identity to clients.

- FIM
- Kerberos
- PKI
- X.509

Question 44

Kerberos uses the _____ encryption algorithm

- AES
- PKI
- DES
- TGS

Question 45

_____ certificates are used in most network security applications, including IP security, secure sockets layer, secure electronic transactions, and S/MIME.

- X.509
- PKI
- SCA
- FIM

Question 46
A principal element of an identity management system is _____.

- workflow automation
- delegated administration
- authentication
- all of the above

Question 47
Unsolicited bulk e-mail is referred to as _____.

- propagating
- spam
- crimeware
- phishing

Question 48
_____ will integrate with the operating system of a host computer and monitor program behavior in real time for malicious actions.

- Fingerprint-based scanners
- Behavior-blocking software
- Heuristic scanners
- Generic decryption technology

Question 49
A _____ virus is explicitly designed to hide itself from detection by anti-virus software.

- stealth
- botnet
- mobile
- rootkit

Question 50
A Trojan horse is an apparently useful program containing hidden code that, when invoked, performs some harmful function.

- True
- False

----------**End of the Examination**----------

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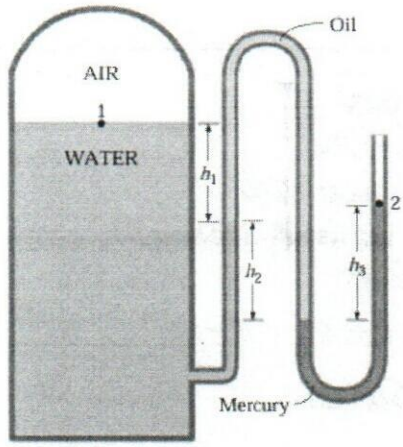
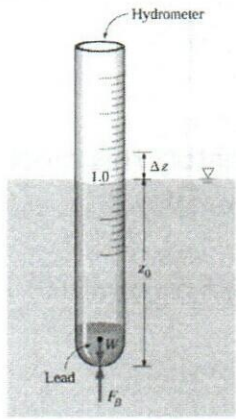
Module Code	**: 5CV005**
Module Title	**: Hydraulics**
Date	**: 6th January 2025**
Examiners	**: Ms. Luckshi Ranasinghe**
Time Allowed	**: 2 Hours**

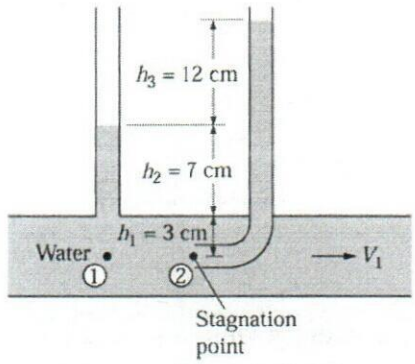
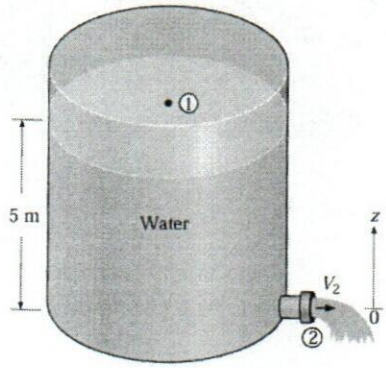
INSTRUCTIONS TO CANDIDATES

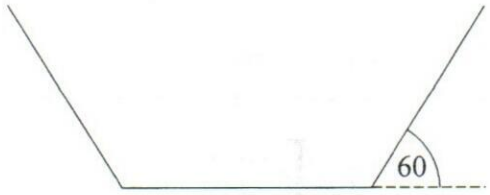
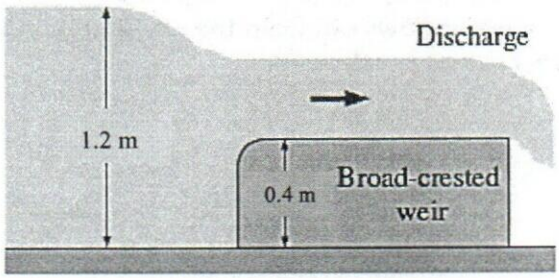
- This is a closed book examination.
- You should attempt all questions
- All questions are equally weighted.

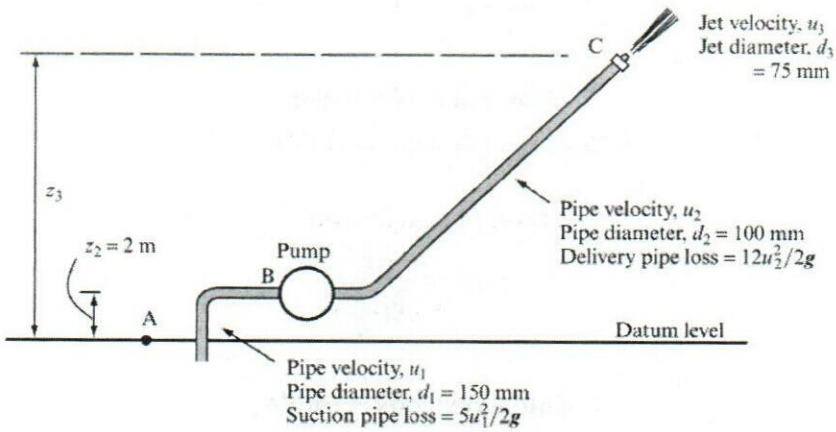
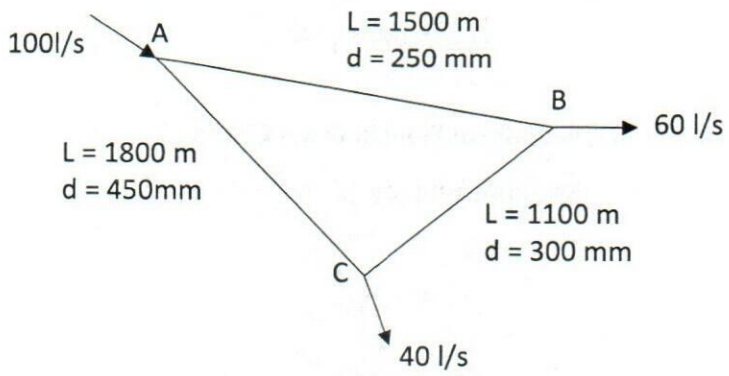
MATERIALS REQURIED

- Eight-page answer booklets
- You may use a scientific calculator. This must not be programmable and may be inspected during the examination.
- Additional information is given on pages 6.

Q1		
a)	The water in a tank is pressurized by air, and the pressure is measured by a multifluid manometer as shown in Figure 1-1. The tank is located on a mountain at an altitude of 1400 m where the atmospheric pressure is 85.6kPa. Determine the air pressure in the tank if $h_1 = 0.1$ m, $h_2 = 0.2$ m, and $h_3 = 0.35$ m. Take the densities of water, oil, and mercury to be 1000 kg/m^3, 850 kg/m^3, and 13,600 kg/m^3, respectively.  Figure 1-1: Multifluid Manometer	60%
b)	A hydrometer, which is a small cylindrical glass tube with some lead-weight at its bottom, is used to measure the salinity of water. As shown in Figure 1-2, the top part of the hydrometer extends above the liquid surface, and the divisions on it allow one to read the specific gravity. The hydrometer is calibrated such that in pure water it reads 1.0 at the air–water interface. Clearly state any assumptions made and determine the mass of lead that must be poured into a 1-cm-diameter, 20-cm-long hydrometer if it is to float at the 10 cm mark in pure water.  Figure 1-2: Hydrometer	40%

Q2		
a)	A piezometer and a Pitot tube are tapped into a horizontal water pipe, as shown in Figure 2–1, to measure static and stagnation (static dynamic) pressures. For the indicated water column heights, determine the velocity at the center of the pipe.  Figure 2-1	50%
b)	A large tank open to the atmosphere is filled with water to a height of 5 m from the outlet tap as shown by Figure 2-2. A tap near the bottom of the tank is now opened, and water flows out from the smooth and rounded outlet. Determine the water velocity at the outlet.  Figure 2-2	50%

Q3		
a)	An open channel of economic trapezoidal cross section given in Figure 3-1 has sides inclined at 60° to the horizontal is required to give a discharge of 10 m^3s^{-1} when the slope of the bed is 1 in 1600. Calculate the dimensions of the cross-section assuming $v = 74*i^{(1/2)}m^{(2/3)}$.  Figure 3-1	50%
b)	Water flows across a broad-crested weir in a rectangular channel 5 m wide. The depth of the water just upstream of the weir given in Figure 3-2 is 1.2 m and the crest is 0.40 m above the channel bed. Calculate the minimum flow depth above the weir and the corresponding discharge.  Figure 3-2	50%

Q4		
a)	A fire engine pump develops a head of 50 m in the flow. The pump draws water from a sump at A given in Figure 4-1, through a 150 mm diameter pipe in which there is a loss of energy per unit weight due to friction $h_1 = 5u_1^2/2g$ varying with the mean velocity u_1 in the pipe, and discharges it through a 75 mm nozzle at C, 30 m above the pump, at the end of a 100 mm diameter delivery pipe in which there is a loss of energy per unit weight $h2 = 12u_2^2/2g$. Calculate, (i) the velocity of the jet issuing from the nozzle at C and (ii) the pressure in the suction pipe at the inlet to the pump at B  Figure 4-1	70%
b)	Determine the flow rate in the pipe network given in Figure 4-2 to the neatest L/sec **after only one iteration**. Use the Hazen-Williams formula to determine head losses due to friction with C = 100 for all pipes. Show your results using a tabular format.  Figure 4-2	30%

Additional Information

Resultant Force acting on a submerged surface

$$R = \rho g A \bar{y}$$

Vertical distance

$$D = sin^2 \phi \left(\frac{I_{GG} + A \left(\frac{\bar{y}}{sin\phi} \right)^2}{A \bar{y}} \right)$$

Bernoulli's Equation

$$Z_1 + \frac{P_1}{\rho g} + \frac{V_1^2}{2g} = Z_2 + \frac{P_2}{\rho g} + \frac{V_2^2}{2g}$$

Momentum Principles

$$\text{Resultant Force} = \rho Q (V_2 - V_1)$$

Hardy Cross Method

$$\Delta q = \frac{-\Sigma hf}{2\Sigma(\frac{hf}{Q})}$$

Hazen-Williams Formula

$$hf = \frac{6.784 * L}{d^{4.865}} (\frac{4}{C * \pi})^{1.85} Q^{1.85}$$

Darcy's Formula

$$hf = \frac{4 . f . L . v^2}{D . 2g} \text{ or } hf = \frac{\lambda . L . v^2}{D . 2g}$$

Manning's Equation

$$V = \frac{1}{n} R^{2/3} S^{1/2}$$

Non-Uniform Flow in Open Channels

$$\text{Specific Energy (E)} = \frac{V^2}{2g} + y$$

$$yc = \sqrt[3]{\frac{Q^2}{B^2 g}}$$

$$Vc = \sqrt{yc . g}$$

Library

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This exam paper must be submitted with your answer booklet

Student Number .....

FACULTY OF SCIENCE & ENGINEERING
SCHOOL OF COMPUTING AND MATHEMATICS

EXAMINATION PAPER

Module Code	:	6CS029
Module Title	:	Advanced Networks
Date	:	05.01.2025
Examiners	:	Dr Ian Coulson, Dr Consolee Mbarushimana, Ms. Waruni Rajapaksha
Time Allowed	:	2 hours

INSTRUCTIONS TO CANDIDATES

- This is a Closed book examination.
- Number of Questions to be attempted: Three complete questions from the Six on the paper
- All questions are equally weighted (unless otherwise stated)
- Answer to q1 part e) should be written on the exam paper on the last sheet and the **question paper submitted with your answer sheet.**
- Your responses should be recorded on the answer sheet attached.

MATERIALS REQURIED

- 1 six page answer booklet.
- You should write legibly in black or blue ink
- Check your work carefully for inaccurate spelling, punctuation and grammar

1.

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a. What is meant by the term Minimum Spanning Tree? (6 marks)
b. Why is Kruskal's algorithm known as a greedy algorithm? (6 Marks)

c. In the graph in figure 1 of a network use Kruskal's algorithm to determine an MST for this network and state its length. Show the order in which you select and reject edges.

(36 marks)

5cs024 lo 3 = LO3 Demonstrate awareness of the information security issues surrounding the design, development and use of

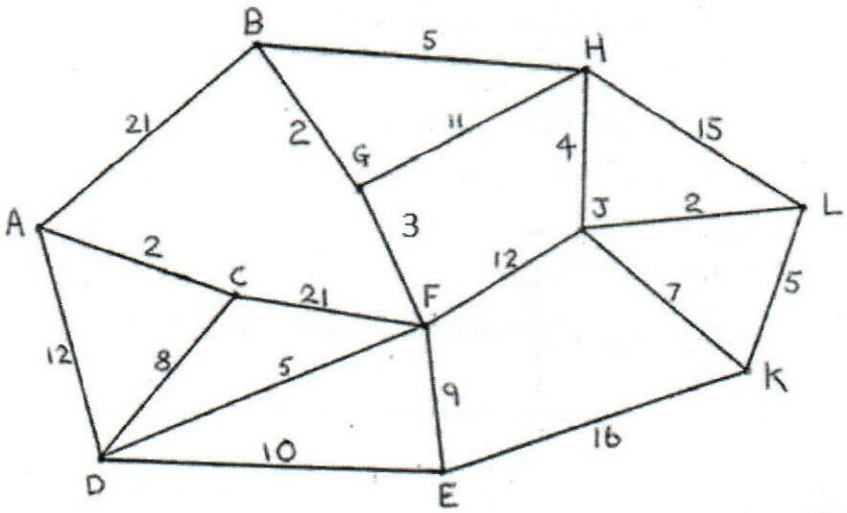


Figure 1 – Graph of a network

d. Sketch the defined MST for the graph in Figure 1.

(6 marks)

e. The network in Figure 2 shows the defined weights between nodes. Use Dijkstra's Algorithm to find the route with the lowest cost from A to L.
You should illustrate your method on the attached sheet at the back of the question paper and submit this with your answer booklet. Note marks will only be awarded if you have illustrated Dijkstra's method.

(46 marks)

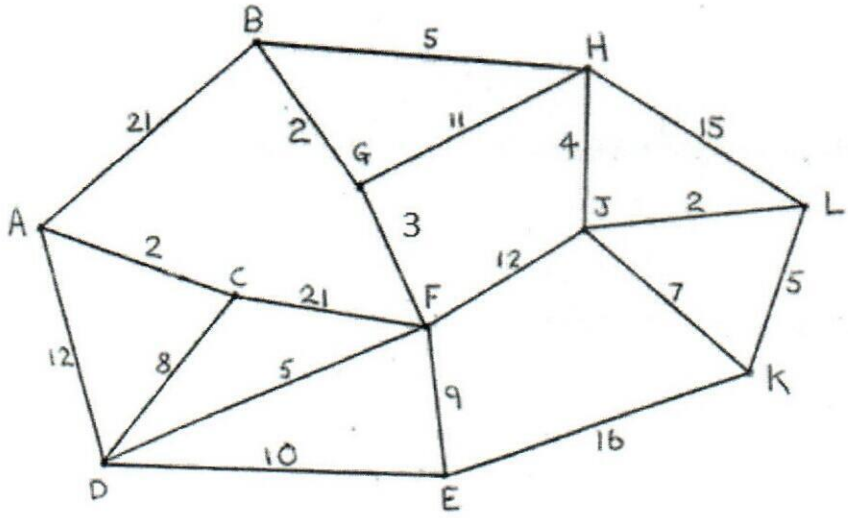


Figure 2 – Graph of a network

2.

a. Discuss with the aid of diagrams the process of a workstation obtaining an IP address through DHCP. (55 Marks)

b. Describe the domain name system and the processes involved to resolve a web address to its respective IP address. You may include diagrams to aid with this. (45 Marks)

3. Multicasting is a widely used technology in networks. Give an account of the following features:

a. Addressing, both IP and MAC. (50 marks)
b. Multicast routing protocols (50 marks)

4.

a. Why is QoS an important consideration in designing a network? What are the parameters used to evaluate QoS? (35 marks)

b. Discuss VLAN implementation as a virtualization technology and their benefits (30 marks)

c. Using diagrams, explain the difference between a traditional network and Software Defined Network (SDN). What are the main planes of a typical SDN architecture? (35 Marks)

5.

a. With the aid of a diagram, explain how collisions are avoided in CSMA/CA wireless LANs

(50 marks)

b. Explain how mobility is achieved inside an enterprise wireless network.

(50 marks)

6.

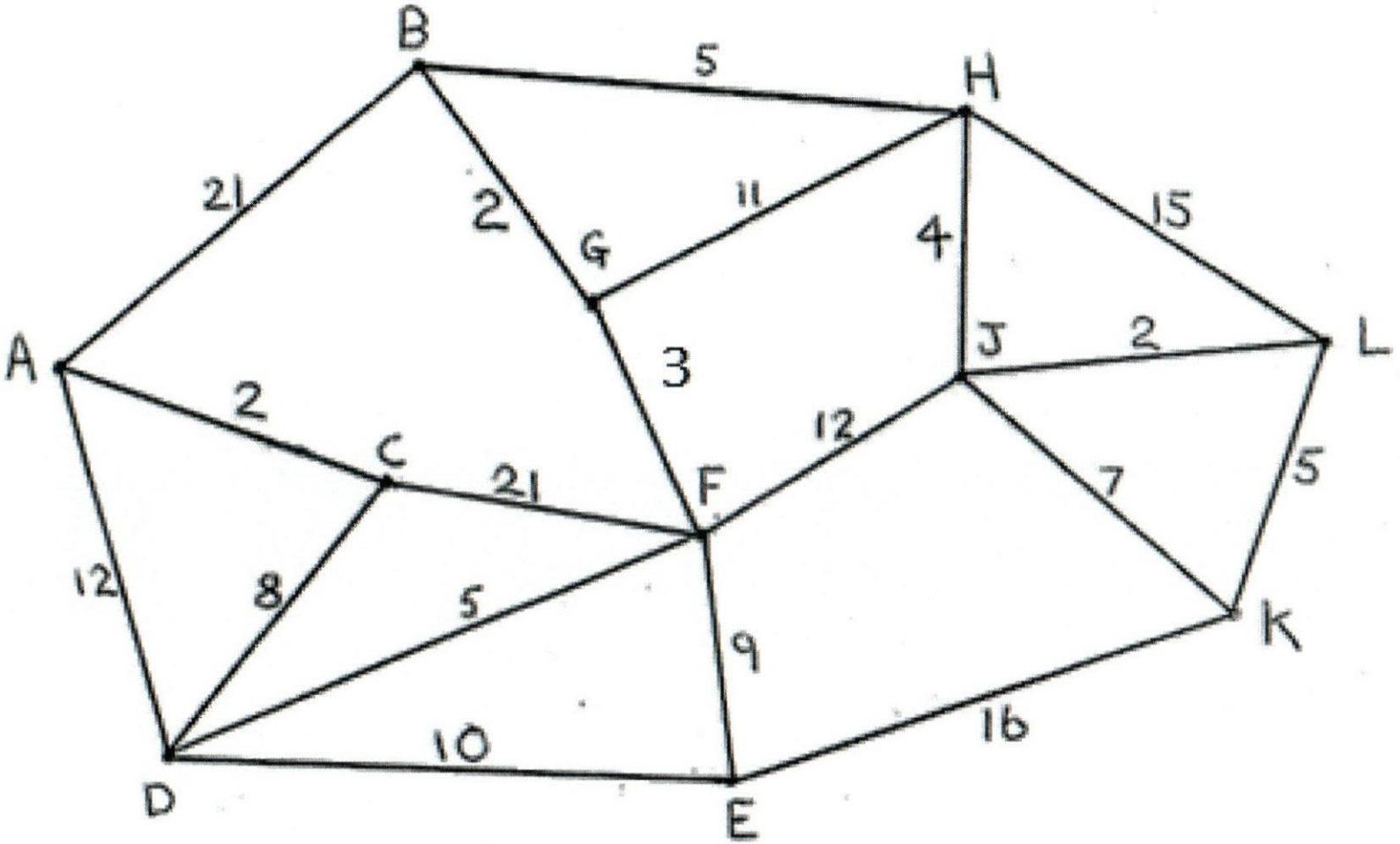
a. In the context of Computing Networks, what is a "Directory Service" and its main functions?

(30 marks)

b. Describe and explain in detail, with diagrams, the structure and functions of "Windows Active Directory".

(70 marks)

Student Number **.....You should document the method by using labels on this sheet, which must be submitted with your answer booklet, also Illustrate your path on the diagram.**



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School of Engineering, Computing and Mathematical Sciences

Exam Paper

EXAM DETAILS	
Module Code	6CV014
Module Title	International Geotechnical Design
Date of Exam	20th October 2024
Duration (incl. reading time)	3 hours
Module Leader / Examiner	Ms. Iromi Diyes

INSTRUCTIONS FOR STUDENTS

- This is an Open Book exam.
- Attempt 4 Questions from 5. All questions carry EQUAL marks.
- Clearly show all intermediate steps taken to achieve results.
- You are to write your answers in the answer books provided.

MATERIALS REQUIRED

- Answer booklet.
- Data sheet at back of paper.
- Graph sheets
- You may use a Scientific calculator.

EXAM INFORMATION – PLEASE READ

- **DO NOT OPEN THIS PAPER UNTIL YOU ARE INSTRUCTED TO DO SO BY THE INVIGILATOR.**
- All electronic devices must be SWITCHED OFF and placed with your belongings (incl. mobiles and wearable technology).
- You must not have any unauthorised materials on your person or on your desk.
- Place your ID on your desk.
- You will not be allowed to leave the exam room within the first hour, or the final 30 minutes.
- Raise your hand if you need to get the attention of an Invigilator.
- This paper MUST NOT be removed from the exam room.

1 (a) Some individual pad footings (2m x 2m) of a five -storey building show signs of failure as indicated below.

Footing	Signs of failure
A	No apparent bulging of soil. Some vertical deformation is visible around the periphery of the footing
B	Bulging of soil is clearly visible near the footing
C	Some bulging of soil is visible with considerable vertical deformation of the footing

20%

Identify the failure modes of three footings and discuss their load settlement behaviour

(b) It is proposed to construct a square footing of 2m x 2m at a depth of 1.5 m below ground level. The subsurface consists of uniform soil up to a considerable depth. Soil strength parameters are estimated as c' = 5 kN/m^2 and φ = 32^0. The bulk unit weight of the soil is 16 kN/m^2. The above footing will be subjected to an inclined load at the centre with a horizontal component parallel to width of foundation as shown in Figure Q1. Maximum expected water table at the site would be 2 m below the ground surface.

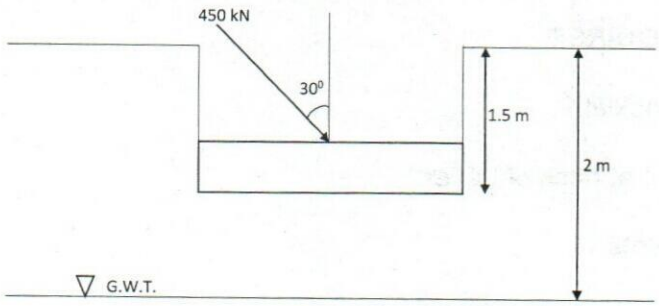


Figure Q 1

i) Determine the factor of safety of the footing against shear failure using Meyerhof equation.

60%

ii) Calculate the factor of safety of the footing against sliding failure, assuming no passive resistance from the surrounding soil

20%

2 (a) Describe the limitations of Terzaghi's bearing capacity equations and hence the reasons for developments in bearing capacity equations.

10%

(b) A 800 mm diameter bored, concrete pile is to be installed into a loose, saturated sand to a depth of 15 m. Determine the ultimate capacity of the pile. You may assume the following parameters. Φ' = 30 and Y_{sat} = 20kN/m^3, justify all other design parameters.

50%

(c) Describe with the use of a suitable sketch, the settlement effect that may occur with groups of pile within cohesive soil. *15%*

(d) State the two common field tests that can be used to estimate pile capacities *5%*

(e) Both Terzaghi's and Meyerhof's equations assume that soil conditions are homogeneous. Describe how bearing capacities can be determined when there are non-homogeneous soil conditions present. *20%*

3 (a) Emphasise the reasons for the differential settlement between parts of a structure. *15%*

(b) Explain briefly the difference between the 'free earth support' and 'fixed earth support' method of analysing the stability of anchored sheet piling. *15%*

(c) A one-dimensional consolidation test was carried out on a sample of saturated clay, 18 mm thick, with drainage taking place from both ends of the sample. The time – settlement readings observed for a pressure increase from 100 kN/m^2 to 200 kN/m^2 are given in Table Q3. Using Taylor's 'square root of time' fitting method, calculate the coefficient of consolidation and volume decrease. *40%*

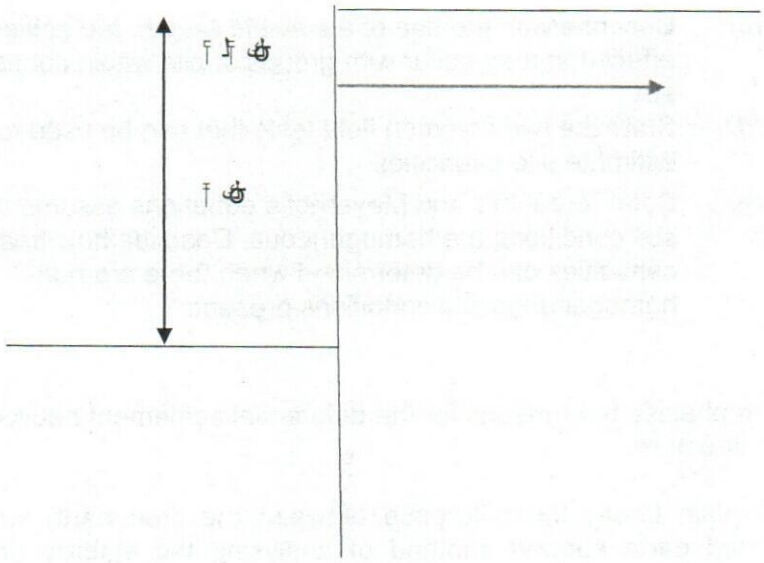
(d) State the model law of consolidation.
The time required for 50% consolidation of a 25mm thick clay layer (drained at both top and bottom) in the laboratory is 2 min 20 sec. How long (in days) will take for a 3-m thick layer of the same clay in the field under the same pressure increment to reach 50% consolidation? In the field, there is a rock layer at the bottom of the clay. *20%*

(e) Explain the methods of accelerating consolidation in the field. *10%*

4 (a) An anchored sheet pile wall retains soil of height 6m, the piles having a total length of 10 m. the soil has a density of 18.5 kN/m^3 and an angle of friction 30 ^{0}. The surface of the retained side is level with the top of the wall. Anchor rods are at 1.1 m the surface and are spaced at 3 m apart horizontally. Neglecting the friction of the surface of the piling and using the free earth support method, determine:

(i) Factor of safety against mobilization of possible resistance *80%*

(ii) Pull of the anchor ties *20%*



End of questions

Settlement of sample (0.002mm)	Time (min)
0	0
22	4
45	16
67	36
89	64
111	100
129	144
143	196
155	256
164	324
171	400
189	24hours

Table Q3

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EXAMINATION PAPER

Module Code :	:	6MA043
Module Title	:	Aerodynamic Design and CFD
Date	:	Oct 2024 Semester 1
Examiners	:	Janaka Perera/ Geethal Siriwardana
Time Allowed:	:	3 Hours

INSTRUCTIONS TO CANDIDATES

- This is an unseen paper.
- This is a closed book examination.
- Attempt **FOUR** questions by selecting **TWO** Questions from **Part-A** & **TWO** Questions from **Part-B.**
- You are to write your answers in the answer books provided.
- Write your index number, the subject code and the title of the paper in each answer book. Also write your index number on each additional sheet.

MATERIALS REQUIRED

- Two 12 page answer booklets
- Formula sheet at back of paper.
- You may use a Scientific calculator. This must not be programmable, may not have significant memory capability, and may be inspected during the examination.

PART- A

1 . The lift and drag characteristics of an aerofoil are shown below in figure Q1 .1 and Q1 .2 respectively. For this question, assume that the aerofoil is mounted on an aircraft and that the chord of the aerofoil is 1.8 m. To simplify the problem, ignore the three dimensional effects of the wing on the lift and drag coefficients.

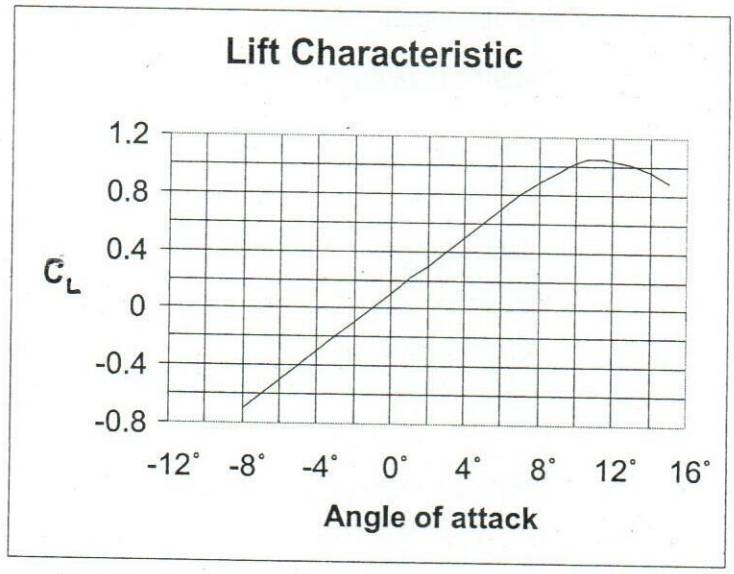


Figure Q1 .1

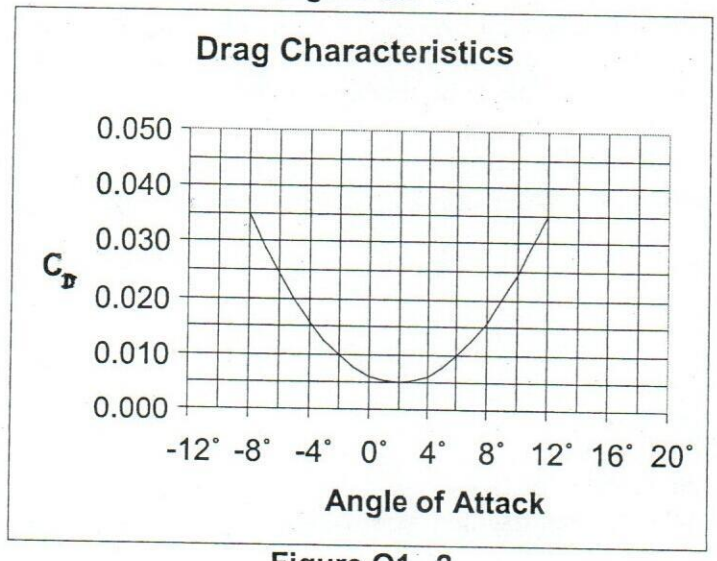


Figure Q1 .2

(a) Determine the lift per unit span the aerofoil can generate if it has an angle of attack of 5°. It is mounted on an aircraft that is cruising at a speed of 90 m/s at an altitude of 3 km in the ISA.

(7 marks)

(b) Assuming that the maximum lift coefficient of the wing of an aircraft is equal to the same value as the aerofoil shown above in figure Q1 .1, ignoring the three dimensional wing effects. Determine the stall speed at 3 km if the aircraft mass is 15000 kg and wing area is 60 m^2.

(7 marks)

(c) Determine the drag per unit span of the wing at stall speed with the same conditions as part (b).

(5 marks)

(d) Discuss the flight conditions and symptoms of a stall to occur in an aircraft. State what pilot actions would be needed to recover from a stall.

(6 marks)

2.

(a) Distinguish between static pressure and dynamic pressure.

(4 marks)

(b) A Venturi tube consists of a converging section, throat and a diverging section. Explain why the velocity is large and static pressure is low at the throat if the flow is incompressible.

(4 marks)

(c) Sketch the variations of dynamic, static and total pressure along the center axis of a Venturi tube.

(3 marks)

(d) A Venturi tube is used to measure airspeed as shown in Figure Q2. The cross-sectional areas for the inlet and the narrow section are A_1= 0.01 m^2 and A_2= 0.0025 m^2, respectively. Two static pressure holes are located on the walls at the inlet (point 1) and at the test section (point 2). A U-manometer (filled with white spirit having density of ρ_{spirit} =760 kg/ m^3) is used to measure the static pressure difference across these two points. The difference between the height of the spirit columns reads Δh = 0.05m. Take air density ρ =1.225 kg/ m^3 and g = 9.81m/s^2.

(i) Find the static pressure difference ($p_1 - p_2$) between the point 1 and point 2.

(ii) Calculate the ratio between the velocities at the narrow section and at the inlet (u_2/u_1) by applying the continuity equation.

(iii) By applying Bernoulli's equation and using the relations from part (i) and (ii), find the velocity u_2 at the narrow section.

(14 marks)

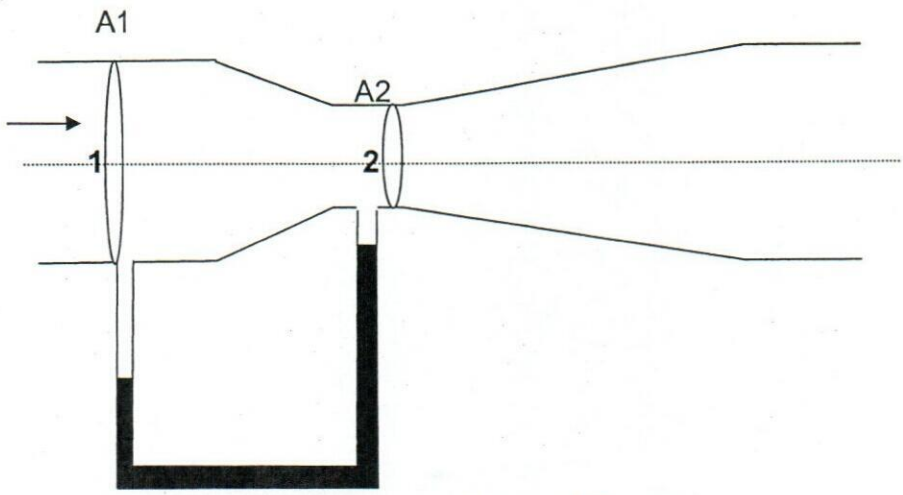


Figure Q2

3.

(a) Define the following terms:

(i) Compressible flow
(ii) Mach number
(iii) Shock waves

(6 marks)

(b) State the approximate Mach number range and main characteristics of:

(i) Subsonic flow
(ii) Supersonic flow
(iii) Transonic flow,

(6 marks)

(c) The velocity and temperature of the flow ahead of a normal shock wave are 1215 m/s and 300 K, respectively. Calculate the velocity of the flow behind the shock.

(13 marks)

PART-B

4.

a) *Explain the significance of the Reynolds number in characterizing fluid flow, particularly for distinguishing between laminar and turbulent flow regimes.* **(06 Marks)**

b) *Discuss the role of turbulence modeling in CFD, and why it is essential for realistic simulations of high-Reynolds-number flows?* **(05 Marks)**

c) *Explain following terms*
   i. *Finite Volume Method (FVM)*
   ii. *Finite Difference Method (FDM)* **(04 Marks)**

d) *Compare the k-ε turbulence model and the k-ω turbulence model used in CFD. Highlight their respective advantages, disadvantages, and areas of application.* **(02 Marks)**

e) *Consider a 2D turbulent flow of water inside a horizontal pipe with a length of 5 meters and a diameter of 0.1 meters. The water enters the pipe with a fully developed turbulent velocity profile and a flow rate of 0.05 m^3/s at a temperature of 320 K. The pipe wall is thermally insulated, preventing heat transfer through the wall. The outlet is located at the right end of the pipe, where the flow exits into the atmosphere.* **(08 Marks)**

Using this scenario, identify and define the appropriate boundary conditions for each region of the computational domain:
   i. *Inlet (left boundary)*
   ii. *Outlet (right boundary)*
   iii. *Pipe walls (top and bottom boundaries)*

Note: Specify the type of boundary conditions (e.g., velocity, pressure, temperature, turbulence quantities) and provide the appropriate values for each based on the scenario. Discuss how these boundary conditions influence the flow characteristics, including turbulence and heat transfer (if applicable), in your CFD simulation.

5.

a) *Explain the significance of mesh refinement in CFD simulations and its impact on accuracy and computational cost.* **(02 Marks)**

b) *Briefly explain the differences between the Eulerian and Lagrangian frameworks in Computational Fluid Dynamics (CFD).* **(02 Marks)**

c) *Discuss the role of CFD in the automotive industry, particularly in the design and optimization of vehicle aerodynamics.* **(06 Marks)**

d) *What are the core governing equations of fluid mechanics used in CFD? Mention these equations in their general form.* **(05 Marks)**

e) *Describe how the Navier-Stokes equations are applied in modeling incompressible and compressible flows in CFD simulations.* **(05 Marks)**

f) *Outline the steps involved in validating and verifying a CFD simulation. Discuss why these steps are critical in the CFD process.* **(05 Marks)**

You may use figures and sketches to support your answer

End of Examination Paper

Formula sheet

H	T	P	ρ	a	ν	μ
km	K	$N.m^{-2}$	$kg.m^{-3}$	$m.s^{-1}$	$m^2.s^{-1}$	$N.s.m^{-2}$
0	288.2	1.0133E+05	1.2252	340.3	1.4634E-05	1.7930E-05
1	281.7	8.9866E+04	1.1117	336.4	1.5837E-05	1.7607E-05
2	275.2	7.9480E+04	1.0065	332.5	1.7169E-05	1.7280E-05
3	268.7	7.0088E+04	0.9090	328.5	1.8647E-05	1.6950E-05
4	262.2	6.1616E+04	0.8190	324.5	2.0290E-05	1.6617E-05
5	255.7	5.3993E+04	0.7359	320.5	2.2122E-05	1.6280E-05
6	249.2	4.7153E+04	0.6594	316.4	2.4170E-05	1.5939E-05
7	242.7	4.1032E+04	0.5892	312.2	2.6466E-05	1.5593E-05
8	236.2	3.5571E+04	0.5248	308.0	2.9046E-05	1.5244E-05
9	229.7	3.0714E+04	0.4660	303.8	3.1955E-05	1.4891E-05
10	223.2	2.6408E+04	0.4123	299.4	3.5246E-05	1.4534E-05
11	216.7	2.2605E+04	0.3636	295.0	3.8980E-05	1.4172E-05
12	216.7	1.9308E+04	0.3105	295.0	4.5638E-05	1.4172E-05
13	216.7	1.6491E+04	0.2652	295.0	5.3434E-05	1.4172E-05
14	216.7	1.4085E+04	0.2265	295.0	6.2560E-05	1.4172E-05
15	216.7	1.2030E+04	0.1935	295.0	7.3246E-05	1.4172E-05
16	216.7	1.0275E+04	0.1653	295.0	8.5756E-05	1.4172E-05
17	216.7	8.7763E+03	0.1411	295.0	1.0040E-04	1.4172E-05
18	216.7	7.4959E+03	0.1206	295.0	1.1755E-04	1.4172E-05
19	216.7	6.4024E+03	0.1030	295.0	1.3763E-04	1.4172E-05
20	216.7	5.4684E+03	0.0879	295.0	1.6114E-04	1.4172E-05

ISA table

DATA SHEET

All pressures are absolute

$$1bar = 10^5 N/m^2 = \frac{1}{1.01325} atm$$

Acceleration due to gravity

g= 9.81 m/s^2

Density of water

1000 kg/m^3

Bernoulli's Equation

$$\frac{p1}{\rho g} + \frac{V1^2}{2g} + Z1 = \frac{p2}{\rho g} + \frac{V2^2}{2g} + Z\,2$$

Continuity equation

$$A_1 V_1 = A_2 V_2$$

Mach number,

$$M = \frac{V}{C}$$

Reynolds number for the airfoil

$$Re = \frac{Velocity(V) \times Chord\ length(C)}{Kinetic\ viscosity(n)}$$

Lift force

$$Lift\ force = \frac{C_L \times \rho \times V^2 \times A}{2}$$

Drag force

$$Drag\ force = \frac{\rho \times V^2 \times C_D \times A}{2}$$

Boundary layer thickness,

$$\delta = \frac{0.38}{Re^{\frac{1}{5}}}$$

Skin friction coefficient,

$$C_f = \frac{0.059}{Re^{\frac{1}{5}}}$$

$$Skin\ friction\ drag = \frac{1}{2}\rho A V^2 C_f$$

$$\text{Total dreg force} = Skin\ friction\ drag + Pressure\ drag$$

$$Pressure\ drag = Skin\ friction\ drag - \text{Total dreg force}$$

$$\frac{p1}{\rho g} + \frac{V1^2}{2g} + Z1 = \frac{p2}{\rho g} + \frac{V2^2}{2g} + Z\,2$$

$$T = F\ x\ r$$

$$F = P\ x\ A$$

For an isentropic flow,

$$\frac{P_2}{P_1} = \left(\frac{\rho_2}{\rho_1}\right)^{\gamma} = \left(\frac{T_2}{T_1}\right)^{\frac{\gamma}{\gamma-1}}$$

R - Gas constant [kJ/kg.K] = 0.287

$\gamma - Specific\ heat\ ratio$

$\gamma = 1.4,$

For any flow condition

$$A_1 V_1 \rho_1 = A_2 V_2 \rho_2$$

Sound of velocity for ideal gas

$$C = \sqrt{\gamma R T}$$

$$M_2^2 = \frac{1 + \left(\frac{\gamma-1}{2}\right) M_1^2}{\gamma M_1^2 - \left(\frac{\gamma-1}{2}\right)}$$

$$M_2^2 \times \left[\gamma M_1^2 - \left(\frac{\gamma-1}{2}\right)\right] = 1 + \left(\frac{\gamma-1}{2}\right) M_1^2$$

$$\gamma M_2^2 M_1^2 - M_2^2\left(\frac{\gamma-1}{2}\right) = 1 + \left(\frac{\gamma-1}{2}\right) M_1^2$$

$$\gamma M_2^2 M_1^2 - \left(\frac{\gamma-1}{2}\right) M_1^2 = 1 + M_2^2\left(\frac{\gamma-1}{2}\right)$$

$$M_1^2 \left[\gamma M_2^2 - \left(\frac{\gamma-1}{2}\right)\right] = 1 + M_2^2\left(\frac{\gamma-1}{2}\right)$$

$$\frac{T_2}{T_1} = \left(1 + \frac{2\gamma}{\gamma+1}(M_1^2 - 1)\right)\left(\frac{2 + (\gamma-1) M_1^2}{(\gamma+1) M_1^2}\right)$$

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EXAMINATION PAPER

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FACULTY OF SCIENCE & ENGINEERING
SCHOOL OF ARCHITECTURE AND BUILT ENVIRONMENT

EXAMINATION PAPER

Module Code	:	**6CV016 (CINEC)**
Module Title	:	**Structural Analysis II**
Date	:	**13th October 2024**
Examiners	:	**Dr. Sumudu Herath**
Time Allowed	:	**3 Hours**

INSTRUCTIONS TO CANDIDATES

- This is a closed-book examination.
- You should answer all 04 questions.
- Paper contains total of 5 pages.
- Your responses should be recorded in the answer booklet provided.

MATERIALS REQURIED

- Eight-page answer booklets provided.

You may use a scientific calculator. This must not be programmable and may be inspected during the examination.

Question 01 **(25 marks)**

Loading on structures can be classified based on the nature of its application as static and moving loads.

i. Considering the types of loading acting on a multi-span bridge, explain the difference between static loads and moving loads. (04 marks)

An idealised crane beam CADB is to be checked for its resistance against a single point load 3 kN moving from C to B. Based on the geometric and material properties of the beam, its bending and shear capacities at D are calculated as 10 kNm and 25 kN.

ii. Sketch the influence line for the vertical reaction at A considering a unit load moving from C to B. (06 marks)

iii. Sketch the bending moment influence lines at D considering a unit load moving from C to B. (06 marks)

iv. Sketch the shear force influence lines at D considering a unit load moving from C to B. (06 marks)

v. Based on the given bending and shear capacities, determine whether point B of the beam is safe to undertake a real point load of 3 kN. (03 marks)

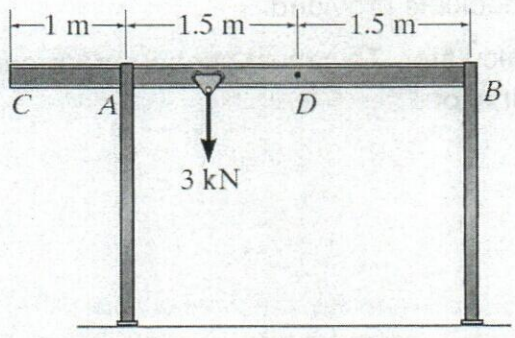


Figure Q1

Question 02 **(25 marks)**

i. Using a rectangular cross-section, explain how plastic analysis of beams leads to efficient designs over elastic analysis. (04 marks)

ii. Using neat sketches, explain the independent beam and sway mechanisms of plastic failure in steel frames. (06 marks)

iii. Clearly stating all calculation steps, assumptions and idealisations; find the critical load that will lead to plastic failure of the frame shown in Figure Q2. Use L = 4 m, and the plastic moment capacity (M_p) of the elements as 20 kNm. (10 marks)

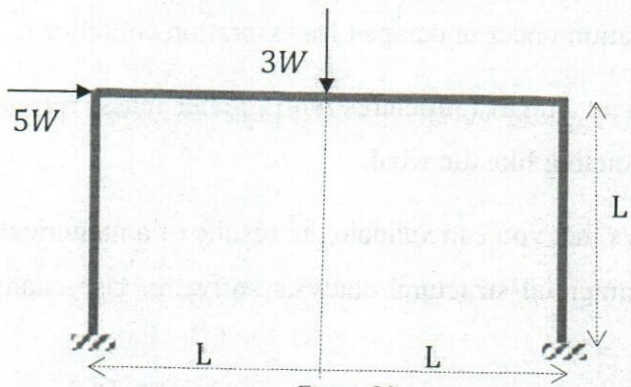


Figure Q2

iv. Both supports of the frame in Figure Q2 are now converted to pin supports. Explain the expected differences in calculating the critical failure load (no calculations are needed). (05 marks)

Question 03 **(25 marks)**

i. Using three points, differentiate static loading versus dynamic loading acting on a structure. (03 marks)

ii. List three examples of dynamic loads that should be considered in the design process of a 80 m tall floating wind turbine in the Indian ocean. (03 marks)

iii. The idealisation of a structure to a lumped mass is shown in Fig. Q3, where the total mass (m) is 15000 kg and a single column stiffness is given by $12EI/h^3$. Further EI = 6.5×10^9 Nmm^2 and h = 4.0 m. Calculate the natural frequency (f) and period (T) of vibration under undamped free vibration conditions. (10 marks)

iv. Explain how ancient Stupas (structures with greater mass) respond and withstand against dynamic loading like the wind. (04 marks)

v. Explain three ways that you can validate the results of a numerical structural model developed in commercial structural analysis software. Use examples to illustrate each method. (05 marks)

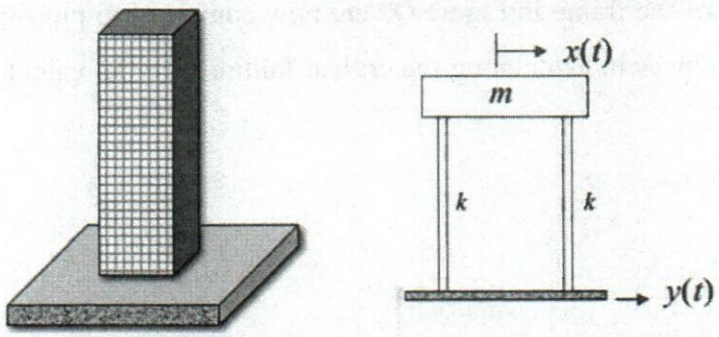


Figure Q3

Question 04 **(25 marks)**

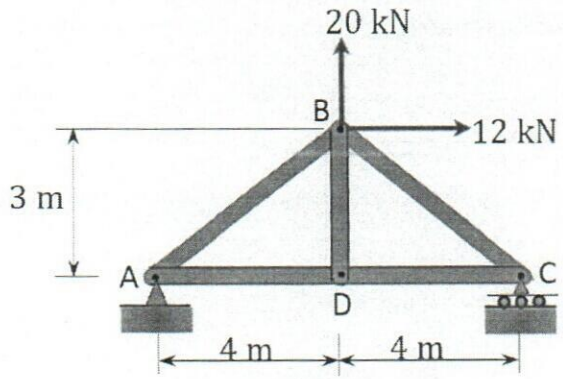


Figure Q4 (a)

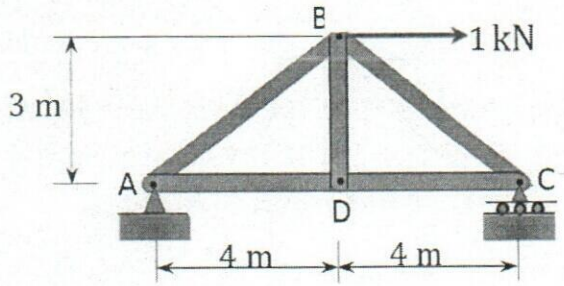


Figure Q4 (b)

i. Solve the member forces of the trusses shown in Figure Q4 (a) and Q4 (b). Clearly state the sign convention used. (15 marks)

ii. Using the answers in (a), find the horizontal displacement of joint B using the principle of virtual work. You may use the axial stiffness EA = 500,000 kN for all members. In standard notations, the principle of virtual work for trusses is given by $1.\Delta = \sum nNL/EA$. (06 marks)

iii. Explain the importance of member BD in resisting the vertical deflections of the truss at joint D. (04 marks)

-END OF THE PAPER-

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EXAMINATION PAPER

Module Code: **4MA009**

Module Title: **Computer Aided Design**

Date of Examination:

Examiner: **Geethal Siriwardana**

Time Allowed: **3 HOURS**

Materials Required:

- **Computer Laboratory**
- **SolidWorks 2020**
- **Autodesk Eagle CAD**

Instructions to Students:

- Students are required to produce files utilising the aforementioned software in accordance with the provided tasks in the examination paper.
- It is mandatory for students to organise the saved files by question number. (For instance, the file name should be Q2.3 if the subtask is 3 and the question number is 02).
- It is mandatory for students to uphold distinct folders for every major question.
- It is mandatory for students to create a compressed folder from the files they save in a folder. Your student ID should be appended to the folder's name. (Eg: 2211233)
- It is mandatory for students to save the compressed folder to the network folder that has been specifically designated for their computers.

Note: It is the responsibility of the students to ensure that the submissions are accurate and that the created files can be read. Submission attempts that contain corrupted or unusable files or unorganized files according to the instructions will be deemed unsuccessful. When such an incident occurs, it is the students' complete responsibility to accept it.

Question 1 (All dimensions are in millimeters) **[20 Marks]**

Part 1

a. Generate a SolidWorks part file according to the given dimensions in Figure Q1.1
b. Generate a 3D PDF File of part 1 using SolidWorks.
c. Define a new coordinate system as indicated in Figure Q1.1 and calculate the center of gravity with respect to the newly defined coordinate system.
d. Generate an engineering drawing using SolidWorks with all the dimensions.

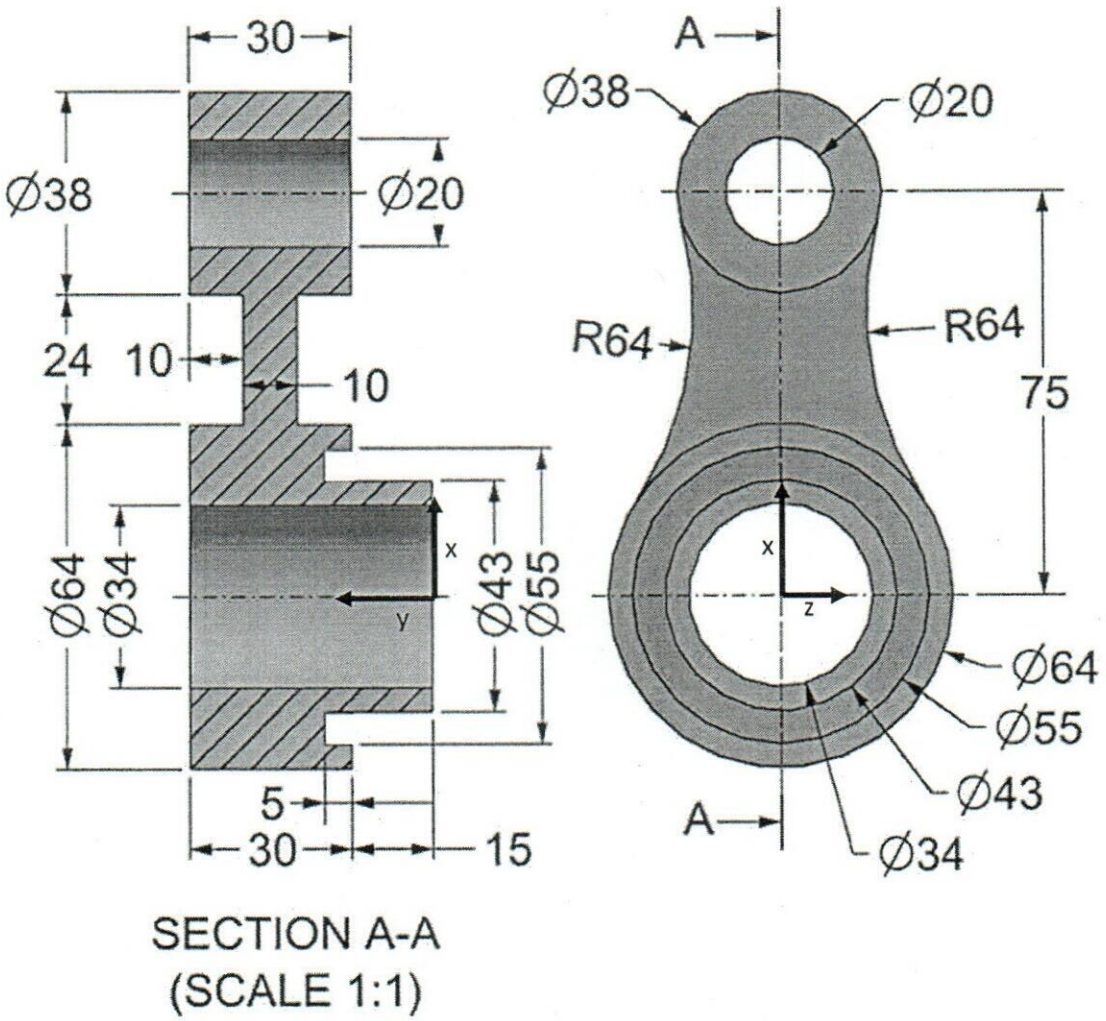


Figure Q1.1

Part 2 **[20 Marks]**

a. Generate a SolidWorks part file according to the given dimensions in Figure Q1.2
b. Generate a 3D PDF File of part 1 using SolidWorks
c. Define a new coordinate system as indicated in Figure Q1.2 and calculate the center of gravity with respect to the newly defined coordinate system.

d. Generate an engineering drawing using SolidWorks with all the dimensions.

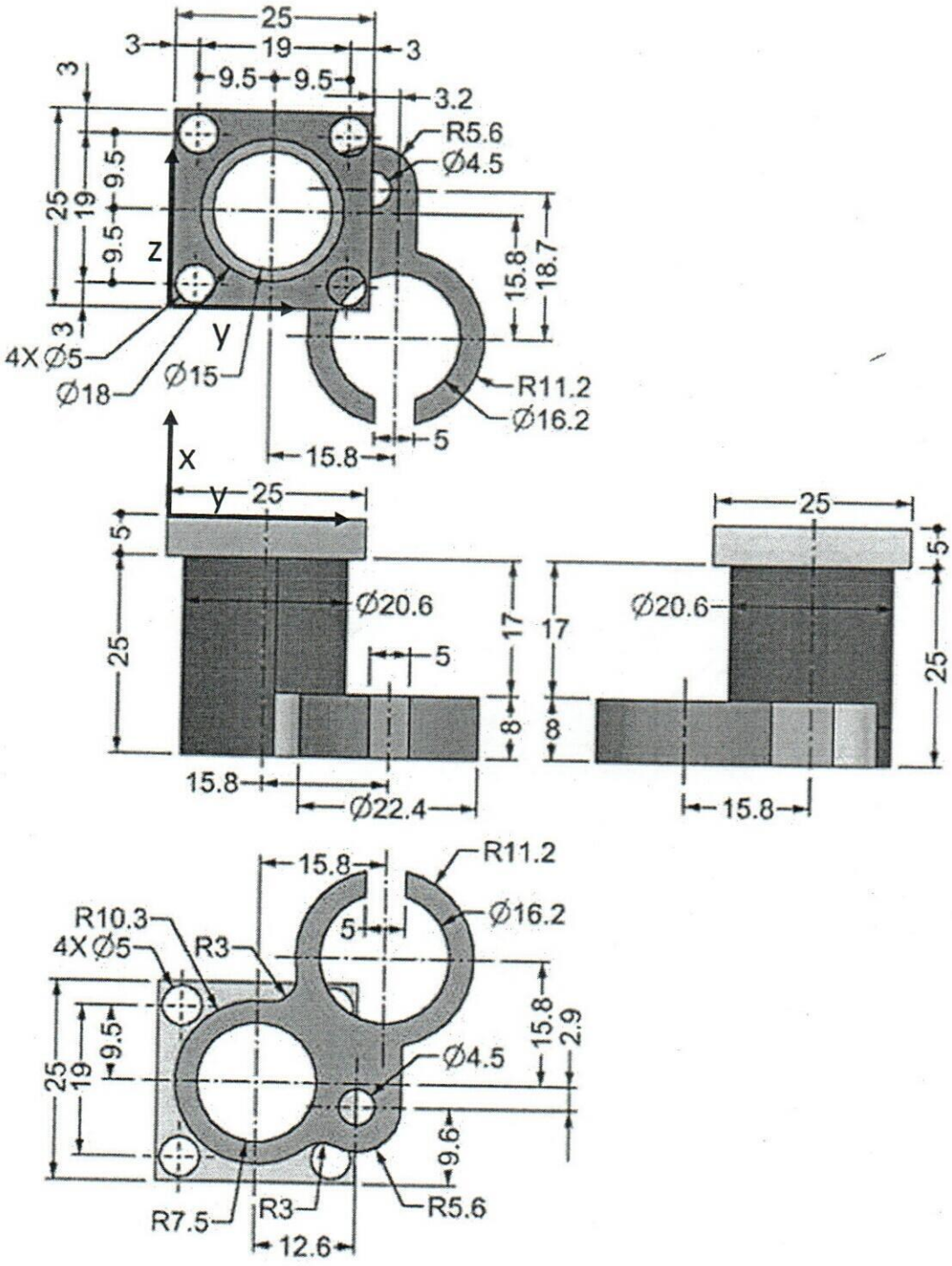


Figure Q1.2

Question 02 **[20 Marks]**

Part 1 - Low Voltage Boosters

a. Develop schematic diagram for the circuit given in figure Q2.1 using EAGLE software. Note: Q1 can be any common small signal device such as the 2N5457, MPF102, or 2N3904
b. Develop a PCB Design using EAGLE for the above task.
c. Convert both Schematic and PCB design to two PDFs Files.
Note: Students can use any similar components if the listed components are not available in the default EAGLE library.

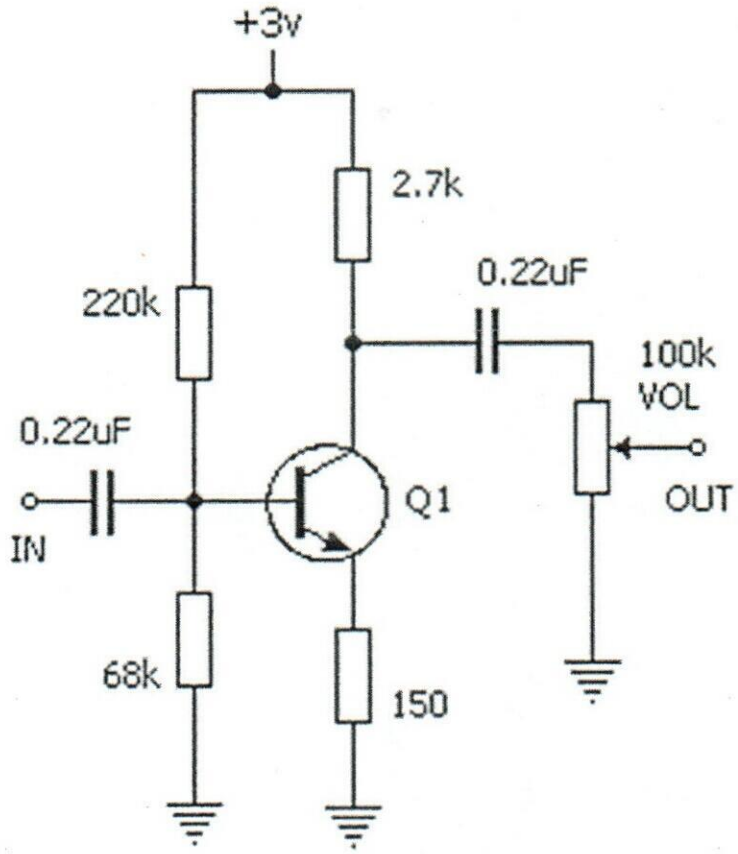


Figure Q2.1

Part 2 **[30 Marks]**

a. Develop schematic diagram for the circuit given in figure Q2.2 using EAGLE software.
b. Develop a PCB Design using EAGLE for the above task.
c. Convert both Schematic and PCB design to two PDFs Files.
Note: Marks will be given for the creativity and optimization of the development of the given circuit. Students can use any similar components if the listed components

are not available in the default EAGLE library. Q1 and Q2 are 2N3904 and 2N3906 transistors respectively.

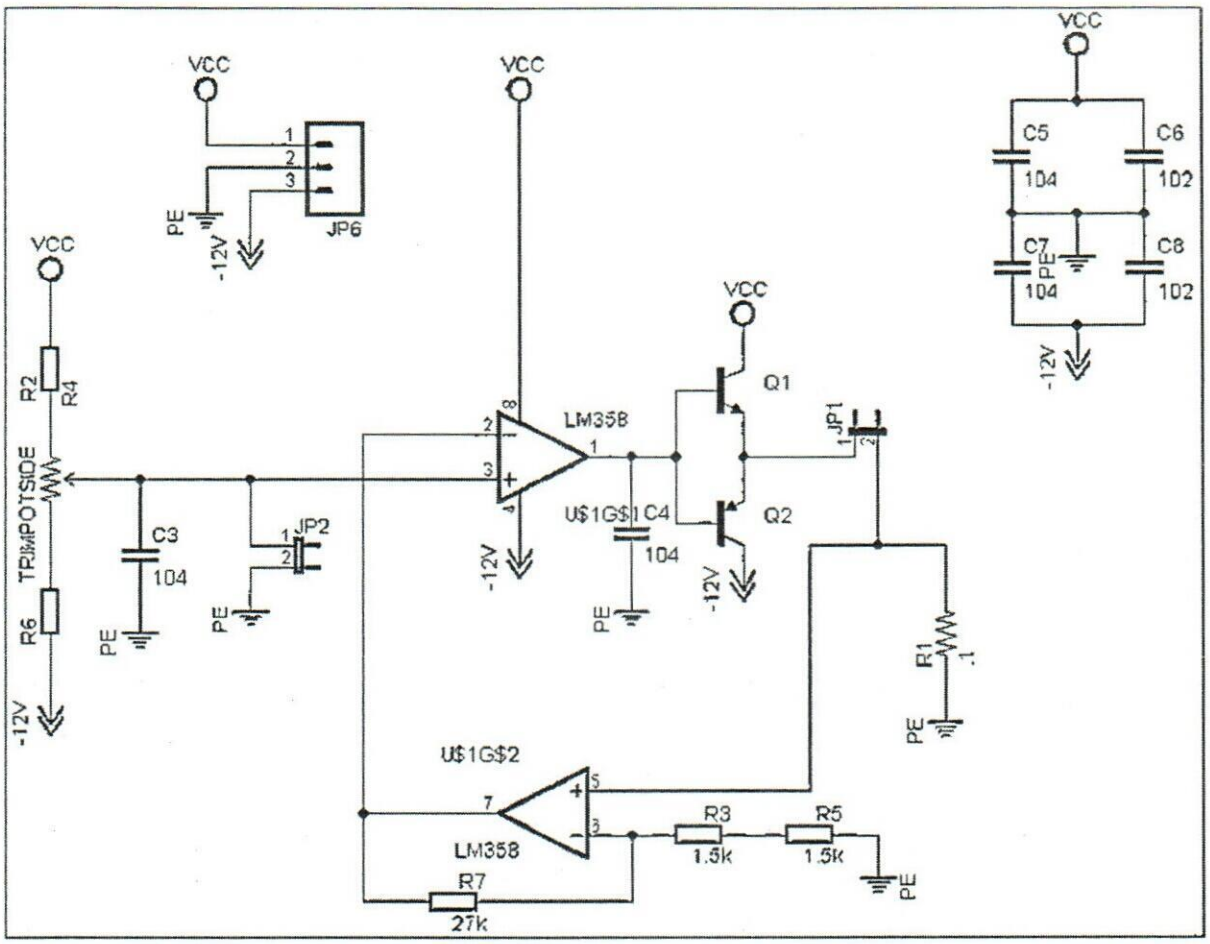


Figure Q2.2

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Faculty of Science and Engineering

RESIT EXAMINATION PAPER

Module Code	**7MA026**
Module Title	**Robotics, Sensors and Control**
Date of Examination:	**Semester 1, 2024**
Examiner:	**Dr. Darshana Makavita**
Examiner(s) Room:	
Time Allowed:	**3 Hours**
Number of Questions to be attempted:	**4 from 4**

All questions are equally weighted (unless otherwise stated).

Materials Required:

- One eight-page answer book

Instructions to Students:

- Mobile phones are not permitted in the exam.
- Approved calculator only.
- You should write legibly in black or blue ink.
- Check your work carefully for inaccurate spelling, punctuation and grammar.
- You may not leave the examination room during the first hour or last 30 minutes of the examination.
- An announcement will be made when there are 30 minutes of the examination time left.
- Data sheet is provided.

Q1. **[Total 25 marks]**

a) Consider the reference frames given in Fig. Q1.1

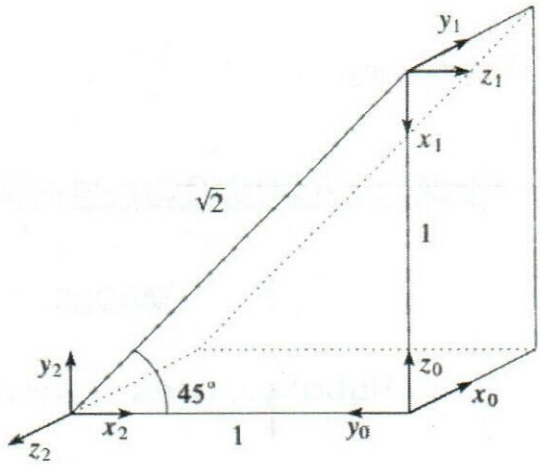


Figure Q1.1

i) Find the homogeneous transformations ${}^0T_1$; ${}^2T_0$; ${}^2T_1$ representing the transformations among the three frames shown. [3 marks]

ii) Derive the composition of ${}^2T_1$ and ${}^0T_1$, i.e. ${}^2T_1\,{}^0T_1$, and show its equal to ${}^2T_0$. [2 marks]

b)

i) Figure Q1.2. shows the frame {B}, which is rotated relative to the frame {A} about $\hat{Z}_A$ axis by 30 deg, translated 10 units in $\hat{X}_A$, and translated 5 units in $\hat{Y}_A$. Find A_P, where $B_P = [3\ \ 7\ \ 0]^T$. [4 marks]

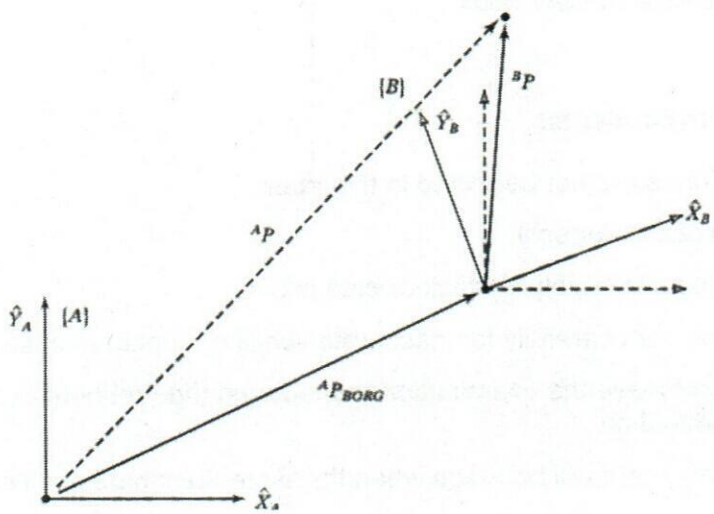


Figure Q1.2

ii) Figure Q1.3. shows a vector ${}^{A}P_1$. We wish to rotate it about $\hat{Z}_A$ by 30 degrees and translate it 10 units in $\hat{X}_A$, and 5 units in $\hat{Y}_A$. Find ${}^{A}P_2$, where ${}^{A}P_1 = [3 \ 7 \ 0]^T$. [3 marks]

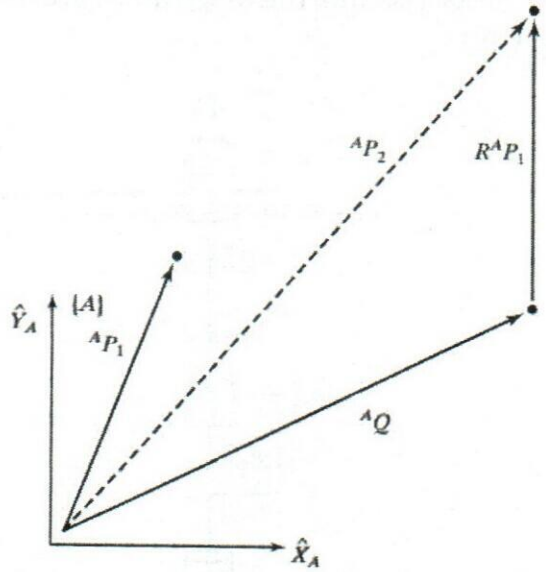


Figure Q1.3

c) Assume your arm, from your shoulder to your palm, has 7 degrees of freedom. You are carrying a tray like a waiter on the palm, and you must keep the tray horizontal to avoid spilling drinks on the tray. How many degrees of freedom does your arm have while satisfying the constraint that the tray stays horizontal? Explain your answer. [6 marks]

d) Find the number of degrees of freedom of the Slider-crank mechanism given in Figure Q1.4 using the appropriate Grubler's formula. [7 marks]

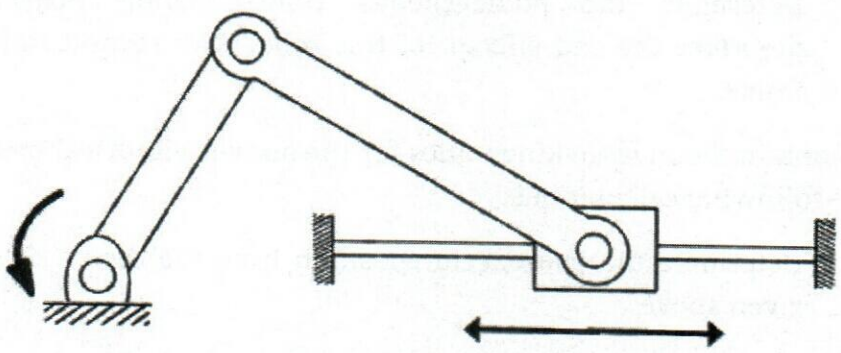


Figure Q1.4: Slider-crank mechanism

Q2. **[Total 25 marks]**

a) Modern robotic manipulators possess the features necessary for performing work with precision, speed, and accuracy. Therefore, they are widely used in industrial assembly tasks. Assume the link frames are assigned to a cylindrical manipulator as in Fig. Q2.1.

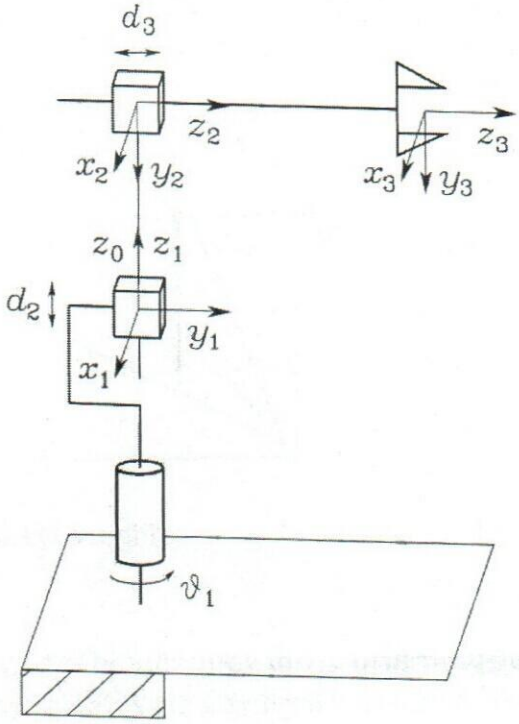


Figure Q2.1: 3-DOF cylindrical arm manipulator

i. Develop the Denavit-Hartenberg table of parameters that describe the forward kinematics of this robot. [6 marks]

ii. Hence or otherwise obtain the homogeneous transformation matrices for the three joints. [6 marks]

iii. Determine the homogeneous transformation matrix that describes the end effector of this robot with respect to its base frame. [3 marks]

b) To obtain the inverse kinematics for the above cylindrical manipulator carry out the following calculations.

i. Determine the end-effector position from the direct kinematics given above. [2 marks]

ii. Determine the expression for the first joint variable. [3 marks]

iii. Determine the expression for the second joint variable. [3 marks]

iv. Determine the expression for the third joint variable. [2 marks]

Q3.

[Total 25 marks]

a) For the cylindrical manipulator as in Fig. Q3.1, find the geometric Jacobian. [6 marks]

b) Compare and contrast trajectories in cartesian space vs joint space. [4 marks]

c) A single-link robot with a rotary joint has θ = 15 deg and θ =1 deg/s at t=0 seconds. It is desired to smoothly reach θ = 75 deg at t=3 seconds and stop. Find the coefficients of a cubic polynomial that accomplishes this motion.

i. Given the general function of a cubic polynomial representing the joint position as $\theta = a_0 + a_1 t + a_2 t^2 + a_3 t^3$ derive the general function of the joint velocity and acceleration. [4 marks]

ii. Using the four desired constraints given derive four equations in four unknown polynomial coefficients. [4 marks]

iii. Solving the above four equations and obtain the four coefficients. [4 marks]

iv. Plot the position, velocity, and acceleration of the joint as a function of time. [3 marks]

[Total 25 marks]

Q4.

[Total 25 marks]

a) Block diagram of the components of a robotic joint control system is given in Fig 4.1.

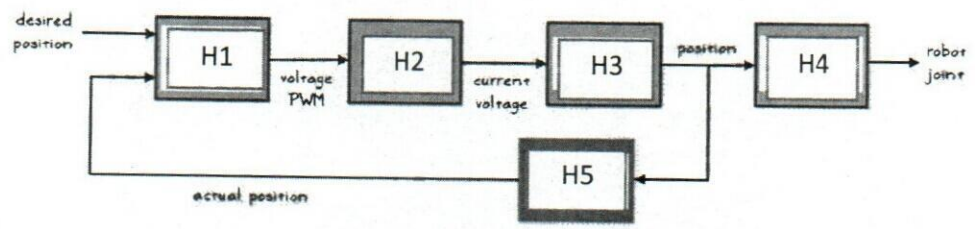


Figure 4.1: Components of a robotic joint control system

i. Name the components indicated by H1, H2, H3, H4 and H5. [5 marks]

ii. Explain the operation of H5 using diagrams. [5 marks]

b) Transfer function block diagram of robotic joint control systemis given in Fig. 4.2.

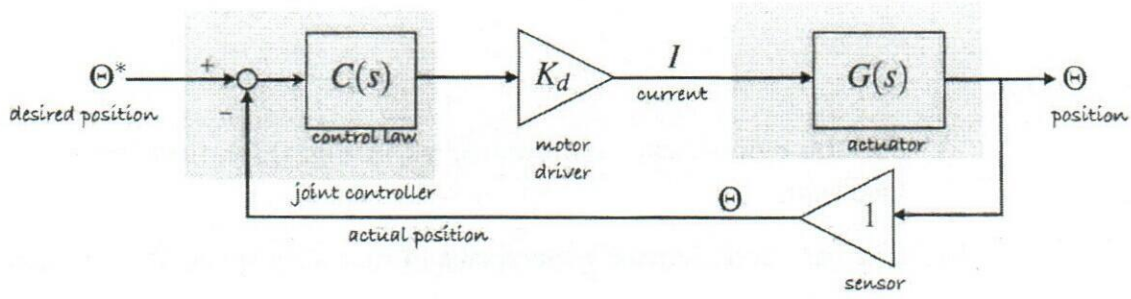


Figure 4.2 Transfer function block diagram of robotic joint control

i. Redraw the block diagram to include the disturbance term that represents external disturbances. [4 marks]

ii. Name two control methods to overcome the external disturbance. [2 marks]

e) i. What is meant by non-independent joint control? [2 marks]

ii. Name 2 issues that arise in non-independent joint control. [2 marks]

iii. Draw a block diagram showing torque feedforward control that is used to overcome the issue mentioned in Q4.e).ii. [5 marks]

DATASHEET

For all rotation matrices:

$$RR^T = I$$

For homogeneous transformations:

$${}^{B}T_{O} = \left({}^{B}T_{W}\right)\left({}^{W}T_{O}\right)$$

Geometric Jacobian

$$\begin{bmatrix} \mathbf{v} \\ \boldsymbol{\omega} \end{bmatrix} = J\,\dot{\mathbf{q}} \qquad \begin{bmatrix} \mathbf{v} \\ \boldsymbol{\omega} \end{bmatrix} = \begin{bmatrix} J_v \\ J_\omega \end{bmatrix}\dot{\mathbf{q}}$$

Analytical Jacobian

$$J_A(\mathbf{q}) = \frac{\partial f(\mathbf{q})}{\partial \mathbf{q}} \qquad \begin{bmatrix} \dot{\mathbf{x}}_p \\ \dot{\mathbf{x}}_o \end{bmatrix} = J_A\dot{\mathbf{q}} \qquad \begin{bmatrix} \dot{\mathbf{x}}_p \\ \dot{\mathbf{x}}_o \end{bmatrix} = \begin{bmatrix} J_p \\ J_o \end{bmatrix}\dot{\mathbf{q}}$$

Elementary Rotation Matrices

$$R_z(\alpha) = \begin{bmatrix} \cos\alpha & -\sin\alpha & 0 \\ \sin\alpha & \cos\alpha & 0 \\ 0 & 0 & 1 \end{bmatrix} \quad R_y(\beta) = \begin{bmatrix} \cos\beta & 0 & \sin\beta \\ 0 & 1 & 0 \\ -\sin\beta & 0 & \cos\beta \end{bmatrix}$$

$$R_x(\gamma) = \begin{bmatrix} 1 & 0 & 0 \\ 0 & \cos\gamma & -\sin\gamma \\ 0 & \sin\gamma & \cos\gamma \end{bmatrix}$$

ZYZ Rotation matrix

$$R(\phi) = R_z(\varphi)R_{y'}(\vartheta)R_{z''}(\psi) = \begin{bmatrix} c_\varphi c_\vartheta c_\psi - s_\varphi s_\psi & -c_\varphi c_\vartheta s_\psi - s_\varphi c_\psi & c_\varphi s_\vartheta \\ s_\varphi c_\vartheta c_\psi + c_\varphi s_\psi & -s_\varphi c_\vartheta s_\psi + c_\varphi c_\psi & s_\varphi s_\vartheta \\ -s_\vartheta c_\psi & s_\vartheta s_\psi & c_\vartheta \end{bmatrix}$$

Electric Motor Transfer Function

$$\frac{\Theta(s)}{I(s)} = \frac{K_m}{Js^2 + Bs}$$

Denavit-Hartenberg Convention

(1) Assigning a Reference Frame

- Number joint axes: 1 to n (from the base to the end effector) showing the axis of motion for each joint
- Base reference frame: assign frame {0} to the base, with axis z_0 along the axis of motion of joint 1 (arbitrary origin)
- Axis z_i: align z_i with the axis of motion of joint i+1
- Origin of frame {i}: find the origin of frame {i} at the intersection of z_i & z_{i-1}, or at the intersection of z_i with the common normal between z_i & z_{i-1}
- Axis x_i: assign x_i in the direction of $z_{i-1} \times z_i$. If they are parallel, assign x_i along the common normal between z_{i-1} & z_i
- Axis y_i: assign y_i to complete the frame (following the right hand rule)
- End effector frame {n}: x_n must be orthogonal to z_{n-1} and it must intersect it

(2) Assigning the DH Parameters

Joint Parameters

- Joint angle (θ_i): rotation angle from axis x_{i-1} to axis x_i about axis z_{i-1}

  → It is the joint variable if the i-th joint is revolute

- Joint displacement (d_i): distance from the origin of frame {i-1} to the intersection of axis z_{i-1} to axis x_i along axis z_{i-1}

  → It is the joint variable if the i-th joint is prismatic

Link Parameters (constants)

- Link length (a_i): distance from the intersection of axis z_{i-1} and axis x_i to the origin of frame {i} along axis x_i
- Link rotation angle (α_i): rotation angle from axis z_{i-1} to axis z_i about axis x_i

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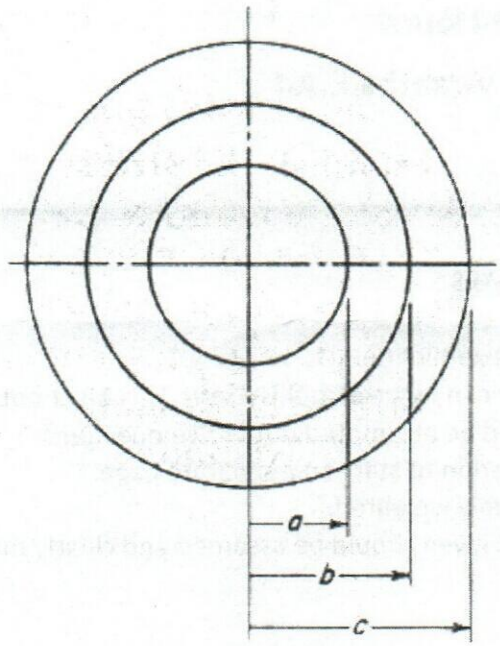
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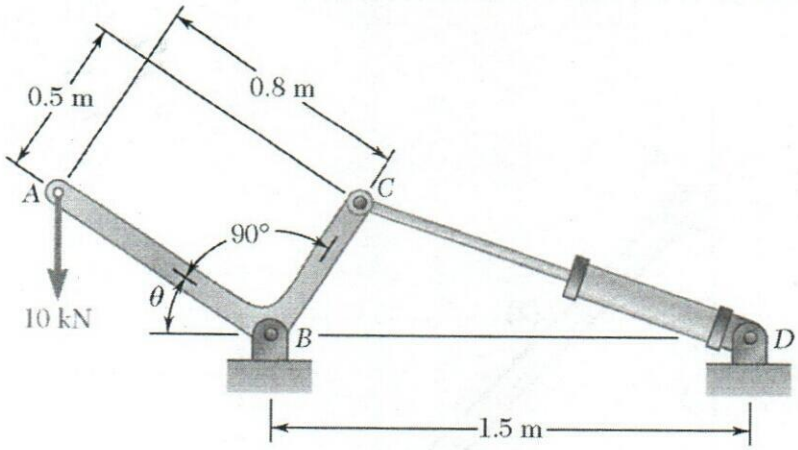
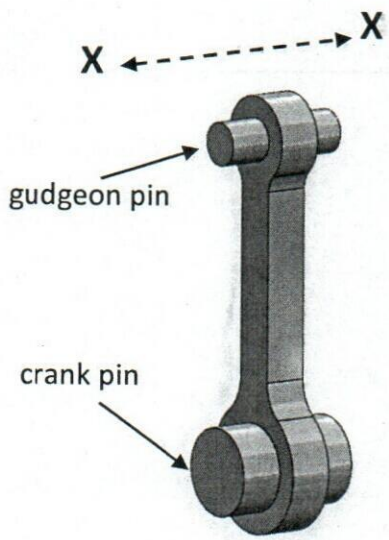
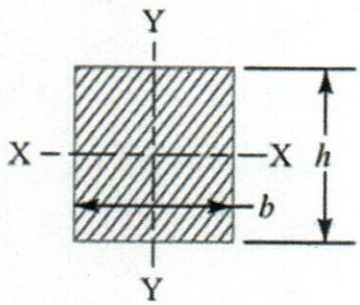
Faculty of Science and Engineering
Session 2024
Semester 1&2

Module Code:	**6MA016**
Module Title:	**Structural mechanics and stress analysis**
Date:	
Time:	
Duration:	**3 Hours**
Examiner:	**Virantha E.A.I**
Extension:	

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Q1		A solid cylindrical shaft is to transmit 300 kW power at 100 r.p.m. (a) If the shear stress is not to exceed 80 N/mm^2, find its diameter. (b) What percent saving in weight would be obtained if this shaft is replaced by a hollow one whose internal diameter equals to 0.6 of the external diameter, the length and material and maximum shear stress being the same?	100%
Q2		Determine the tangential stresses at the inner surfaces of the built-up steel cylinder of Figure Q2 subjected to an internal pressure P_i = 38MPa when a = 154mm, b = 203mm, c = 254mm, E = 206GPa, and shrinkage δ = 0.1mm.  **Figure Q2**	100%

Q3	a	The position of member ABC is controlled by the hydraulic cylinder CD. Using the virtual work principle determine the angle θ knowing that the hydraulic cylinder exerts a 15-kN force on pin C.  **Figure Q3**	100%
Q4		A connecting rod of length *l* may be considered as a strut with the ends free to turn on the crank pin and the gudgeon pin In the directions of the axes of these pins (x-x axis). However, it may be considered as having fixed ends perpendicular to that axis (around Y-Y axis). Assuming that Euler's formula is applicable, determine the ratio of the sides (h/b) of the rectangular cross-section so that the connecting rod is equally strong in both planes of buckling.  **connecting rod**  **cross-section of the connecting rod** **Figure Q4**	100%

Q5		For the truss shown in Figure: Q5, using the finite element method solve for the horizontal and vertical components of the displacement at node 2. The cross-sectional area of the two beam is $400mm^2$ and elastic modulus of the beam material is 205GPa.	100%

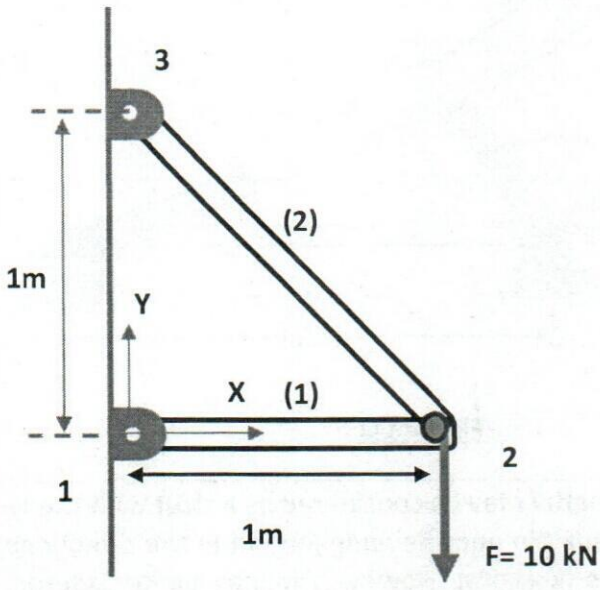


Figure Q5

Torsion

$$\frac{\tau}{r} = \frac{T}{J} = \frac{G\theta}{L} \qquad P = \frac{2\pi NT}{60} \qquad J = \frac{\pi d^4}{32} \qquad T = Frn$$

Thin Shells

Cylinder $\sigma_C = \frac{Pd}{2t}$ $\sigma_L = \frac{Pd}{4t}$ Vol Strain = 2 × Hoop Strain + Axial Strain

Sphere $\sigma = \frac{Pd}{4t}$ Vol Strain = 3 × Hoop strain

$$\varepsilon = \frac{\sigma_x}{E} - \upsilon\frac{\sigma_y}{E} - \upsilon\frac{\sigma_z}{E} \qquad \Delta V = \frac{V \times P}{K}$$

Principal Stresses

$$\sigma_\theta = \sigma_x \cos^2\theta + \sigma_y \sin^2\theta + \tau \sin 2\theta \qquad \tau_\theta = \frac{1}{2}(\sigma_y - \sigma_x)\sin 2\theta + \tau\cos 2\theta$$

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Strain energy

$$u = \frac{1}{2}\sigma_x\varepsilon_x \qquad U = \frac{P^2L}{2AE}$$

Bar element stiffness

$$K = \frac{EA}{L}\begin{bmatrix} 1 & -1 \\ -1 & 1 \end{bmatrix}$$

$$k = \frac{AE}{L}\begin{bmatrix} C^2 & CS & -C^2 & -CS \\ CS & S^2 & -CS & -S^2 \\ -C^2 & -SC & C^2 & CS \\ -CS & -S^2 & CS & S^2 \end{bmatrix}$$

Thick-walled Cylinders

$$\sigma_r = \frac{a^2 p_i - b^2 p_o}{b^2 - a^2} - \frac{(p_i - p_o)a^2 b^2}{r^2\left(b^2 - a^2\right)}$$

$$\sigma_t = \frac{a^2 p_i - b^2 p_o}{b^2 - a^2} + \frac{(p_i - p_o)a^2 b^2}{r^2\left(b^2 - a^2\right)}$$

$$\frac{bp}{E}\left(\frac{b^2 + c^2}{c^2 - b^2} + \mu\right) + \frac{bp}{E}\left(\frac{a^2 + b^2}{b^2 - a^2} - \mu\right) = \delta \text{.....eqn. 32}$$

or

$$p = \frac{E\delta}{b}\frac{\left(b^2 - a^2\right)\left(c^2 - b^2\right)}{2b^2\left(c^2 - a^2\right)} \text{.....eqn. 33}$$

$$u = \frac{1-\mu}{E}\frac{a^2 p_i - b^2 p_0}{b^2 - a^2} r + \frac{1+\mu}{E}\frac{a^2 b^2 (p_i - p_o)}{\left(b^2 - a^2\right) r} \text{.....eqn 27}$$

Radial Deformation

$$u = \frac{1-\mu}{E}\frac{a^2 p_i - b^2 p_0}{b^2 - a^2} r + \frac{1+\mu}{E}\frac{a^2 b^2 (p_i - p_o)}{\left(b^2 - a^2\right) r}$$

Shrink-fit Interface Pressure in Cylinders

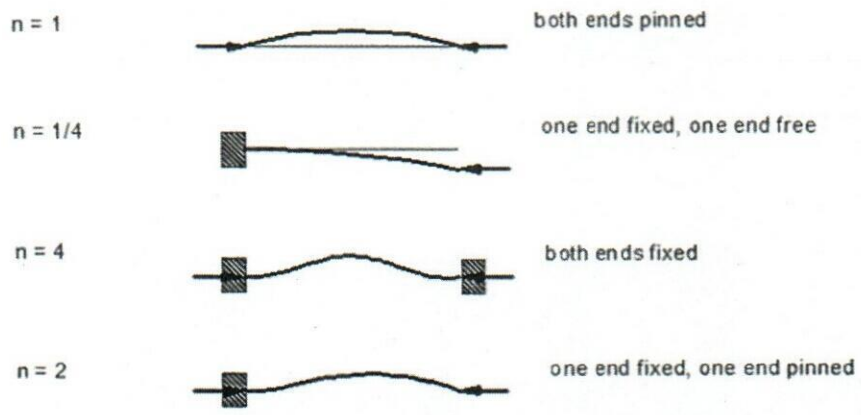
$$\frac{bp}{E}\left(\frac{b^2 + c^2}{c^2 - b^2} + \mu\right) + \frac{bp}{E}\left(\frac{a^2 + b^2}{b^2 - a^2} - \mu\right) = \delta$$

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Buckling

$$P_E = \frac{n\pi^2 EI}{L^2} \qquad P_R = \frac{\sigma_C A}{1+\frac{a}{n}\left(\frac{l}{k}\right)^2} \qquad I = Ak^2$$





$p_E = 0$ $\qquad p_E = \frac{\pi^2 EI}{L^2}$ $\qquad p_E = \frac{4\pi^2 EI}{L^2}$ $\qquad p_E = \frac{9\pi^2 EI}{L^2}$

Biaxial Plane Stress

$$\varepsilon_x = \frac{\sigma_x}{E} - \nu\frac{\sigma_y}{E}$$

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Library.

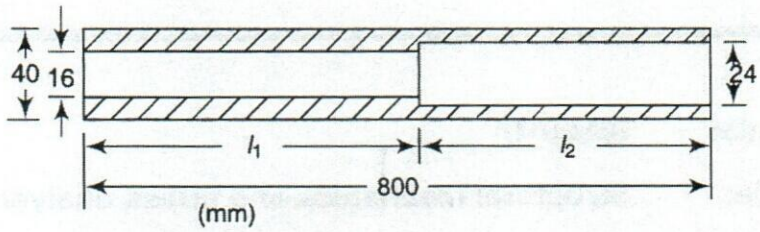
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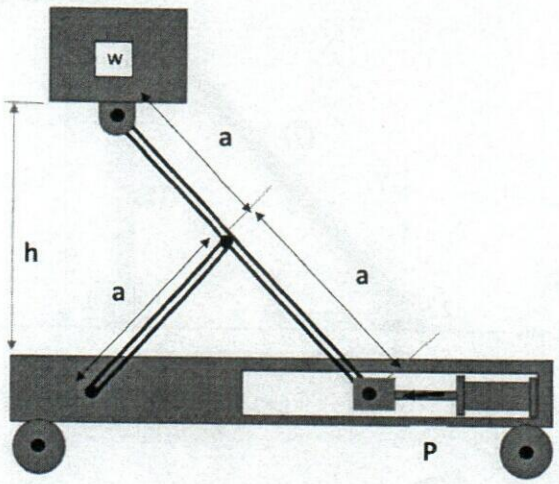
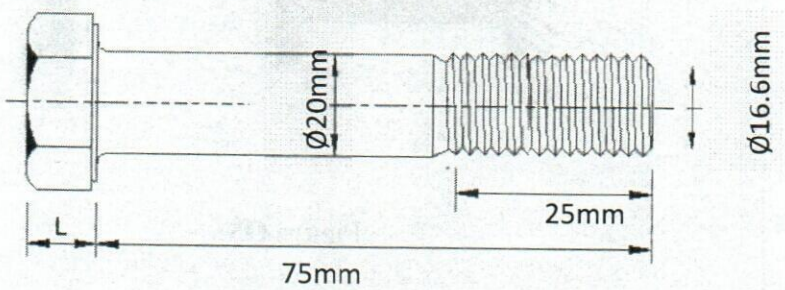
Faculty of Science and Engineering
Session 2023/24
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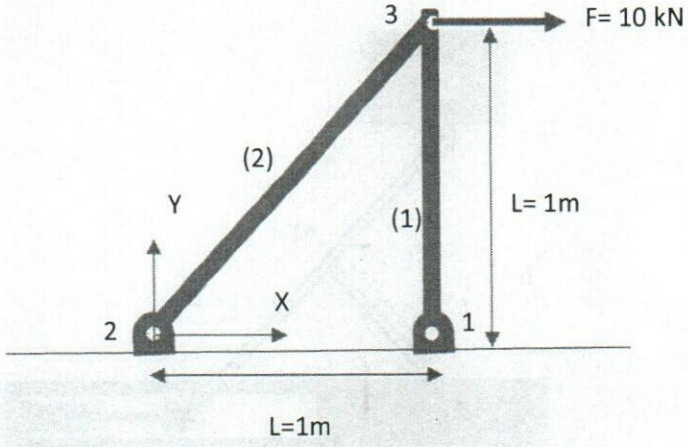
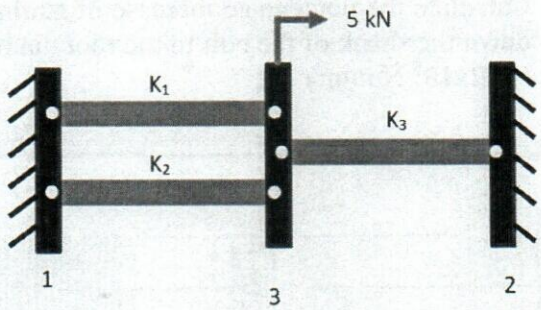
Module Code:	**6MA016**
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Q1		A hollow shaft is shown in figure Q1. (All dimensions are in mm) i.) Determine the maximum power transmitted by the shaft at 200 r.p.m if the shear stress is not to exceed 70 MPa. ii.) Find the length of the two portions which the twist produced in the two portions of the shaft are equal.  **Figure Q1**	100%
Q2		A compound cylinder is formed by shrinking of 240mm internal diameter and 320mm external diameter on a cylinder of 160mm internal diameter and 240mm external diameter. The shrinking pressure (interface pressure) is 12 MPa. Determine the minimum temperature to which the outer cylinder must be heated to slip it over inner cylinder. E=205 GPa and $\alpha = 6x10^{-6}/\ °C$.	100%

Q3	a	A movable hydraulic lift is used to elevate the weight of **W** as shown in the Figure Q3a. Using the principle of virtual work obtain an expression for force **P** exerted by the hydraulic cylinder when the load **W** at height **h**.  **Figure Q3a**	50%
	b	The hexagonal headed bolt is shown in Figure Q3b. i. Calculate the strain energy of the bolt under the tensile load of 16 kN. ii. Calculate the percentage increase of strain energy by turning down the shank of the bolt to the root diameter of the tread. ($E=2x10^5$ N/mm^2)  **Figure Q3b**	50%

Q4		For the truss shown in Figure Q4, using the finite element method solve for the horizontal and vertical components of displacement at node 3. The cross-sectional area of the two bar is $500mm^2$ and elastic modulus of the bar material is 150GPa.  **Figure Q4**	100%
Q5		Pin jointed bar assembly is shown in Figure Q5. The left and right ends are pinned to the fixed support. There is a force of 5kN acting on the middle node. Using the finite element method find the displacement of node 3. (K_1= K_2 200kN/m and K_3=300kN/m)  **Figure Q5**	100%

Torsion

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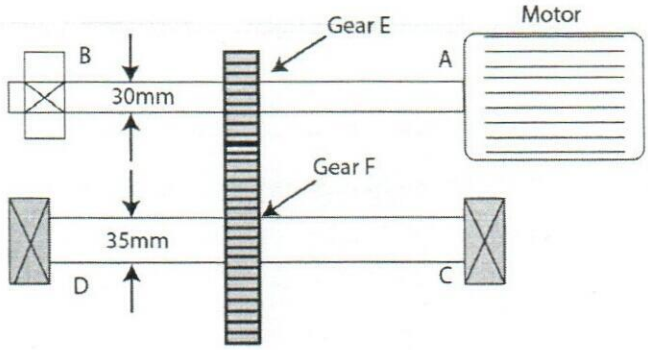
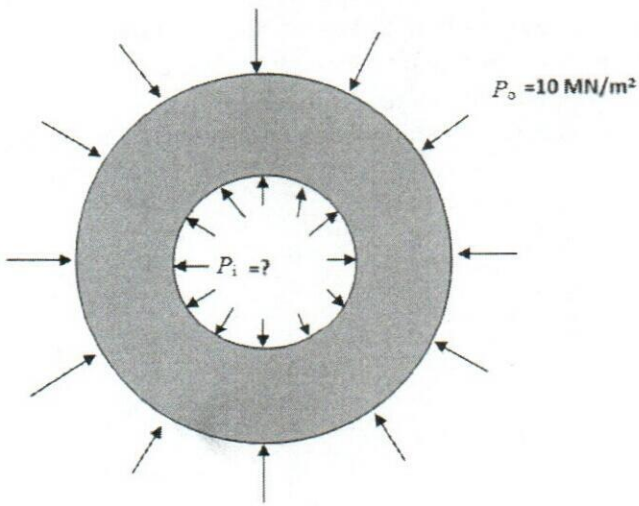
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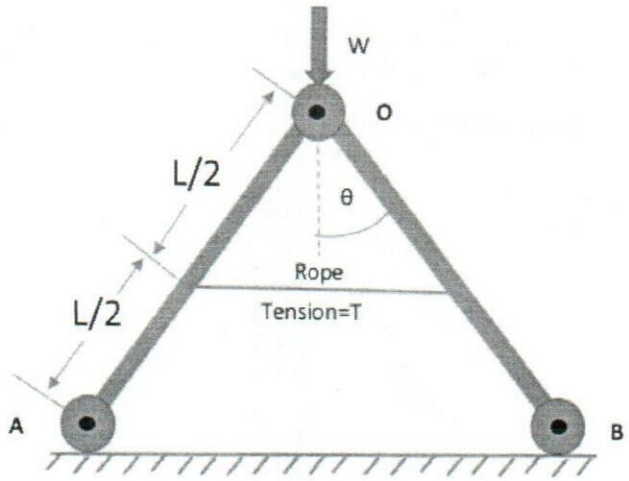
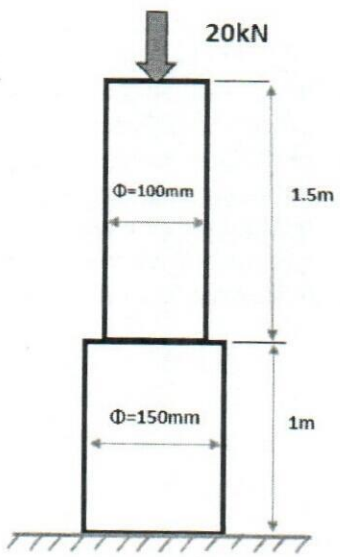
Faculty of Science and Engineering
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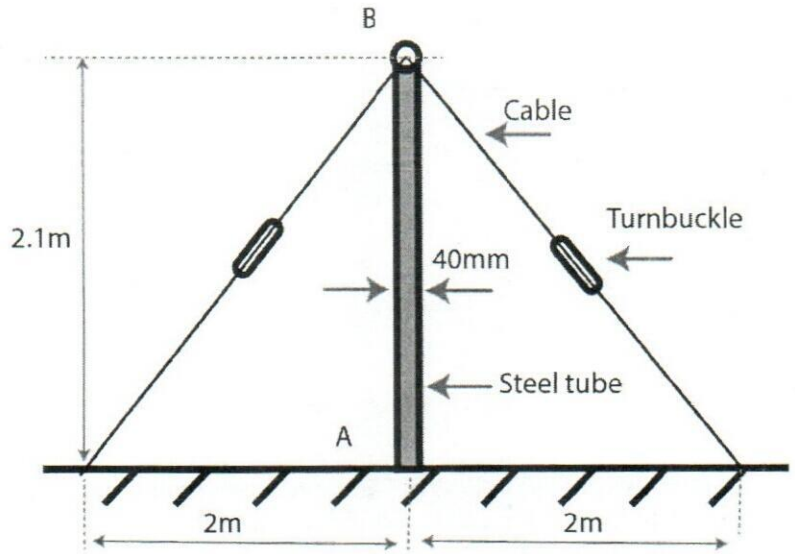
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Q1		The motor delivers a torque of 50 N.m to the shaft **AB**. This torque is transmitted to shaft **CD** using the gears at **E** and **F**. Determine the equilibrium torque **T** on shaft **CD** and the maximum shear stress in each shaft. The bearings **B, C,** and **D** allow free rotation of the shafts. Gear **E** is 100mm in diameter and gear **F** is 250mm in diameters. Shaft AB and DC are 30mm and 35mm in diameter respectively.  **Figure Q1**	100%
Q2		An external pressure of 10 MN/m^2 is applied to a thick cylinder of internal diameter 160 mm and external diameter 320 mm. If the maximum hoop stress permitted on the inside wall of the cylinder is limited to 30 MN/m2, what maximum internal pressure can be applied assuming the cylinder has closed ends? What will be the change in outside diameter when this pressure is applied? E = 207 GN/m^2, poisson ratio = 0.29.  **Figure Q2**	100%

Q3	a	Two pin-jointed bars are held on a frictionless plane by a rope as shown in Figure: Q3a.Using the virtual work principal find the tension T in the rope in terms of the load W and the angle θ.  **Figure Q3a**	50%
	b	The column shown in the Figure: Q3b consist with two parts as the top cylindrical part and the bottom cylindrical part. The top cylindrical part material's elastic modulus is 200Gpa and the bottom cylindrical part material's elastic modulus is 300Gpa. Calculate the total strain energy stored in the column structure.  **Figure Q3b**	50%

Q4		A vertical post AB is embedded in a concrete foundation and held at the top by two cables (see figure). The post is a hollow steel tube with modulus of elasticity 200 GPa, outer diameter 40 mm, and thickness 5 mm. The cables are tightened equally by turnbuckles. If a factor of safety of 3.0 against Euler buckling in the plane of the figure is desired, what is the maximum allowable tensile force T allow in the cables?  **Figure Q4**	100%
Q5		The two-dimensional truss shown in the Figure: Q5 is subjected to external loading as shown. The element (1) 20mm^2 in cross-sectional area and 6m in length and the element (2) 20 mm^2 in cross-sectional area and 3m in length. Using the same node and element numbering as in the Figure: Q5 I. Determine the displacement components of node2 II. Determine the reaction force components at node 1 and 3 Assume all members are manufactured from steel (E=200Gpa)	

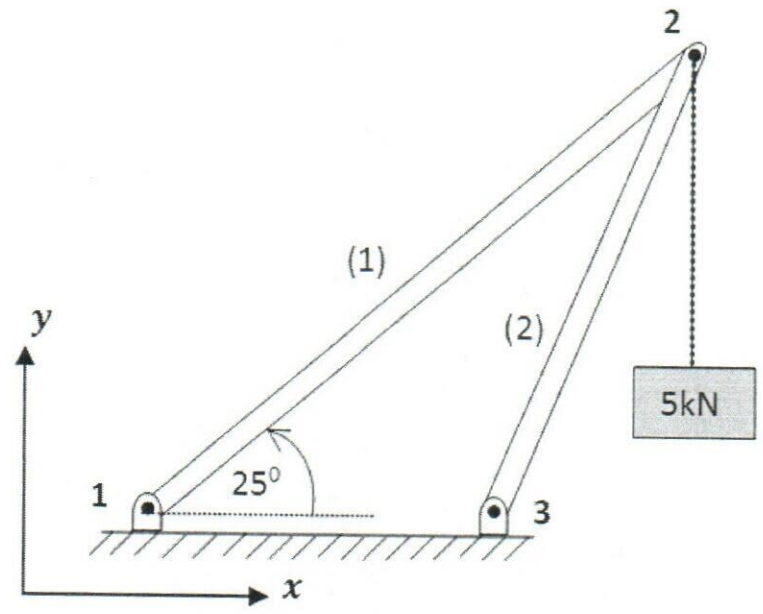


Figure Q5

100%

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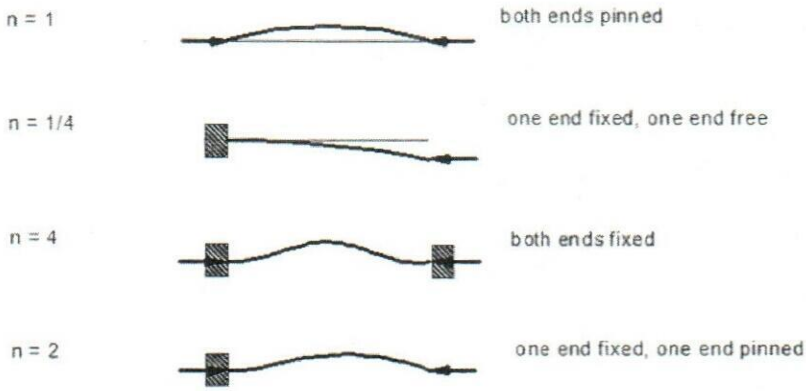
$$\frac{bp}{E}\left(\frac{b^2 + c^2}{c^2 - b^2} + \mu\right) + \frac{bp}{E}\left(\frac{a^2 + b^2}{b^2 - a^2} - \mu\right) = \delta$$

or

$$p = \frac{E\delta}{b}\frac{\left(b^2 - a^2\right)\left(c^2 - b^2\right)}{2b^2\left(c^2 - a^2\right)}$$

Buckling

$$P_E = \frac{n\pi^2 EI}{L^2} \qquad P_R = \frac{\sigma_C A}{1+\frac{a}{n}\left(\frac{l}{k}\right)^2} \qquad I = Ak^2$$





$p_E = 0$ $\qquad p_E = \frac{\pi^2 EI}{L^2}$ $\qquad p_E = \frac{4\pi^2 EI}{L^2}$ $\qquad p_E = \frac{9\pi^2 EI}{L^2}$

Biaxial Plane Stress

$$\varepsilon_x = \frac{\sigma_x}{E} - \nu\frac{\sigma_y}{E}$$

$$\varepsilon_y = \frac{\sigma_y}{E} - \nu\frac{\sigma_x}{E}$$

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FACULTY OF SCIENCE & ENGINEERING

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Repeat Examination paper

Module Code	:	**6MA042**
Module Title	:	**Automotive Electronics**
Date	:	**1st September 2024**
Examiners	:	**S D Perera**
Time Allowed	:	**2 Hours**

INSTRUCTIONS TO CANDIDATES

- This is a closed book examination.
- Attempt All Questions from Each Section
- You Should Attempt All Sections.
- Your responses should be recorded on the answer sheet attached.

MATERIALS REQURIED

- Eight-page answer booklets. Use a separate page for each section.
- You may use a scientific calculator. This must not be programmable, and may be inspected during the examination.

Student Number .....

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Question 1:

1. Sketch the symbols for **10** basic electronic components. (5 marks)
2. A circuit consists of four resistors (R_1, R_2, R_3, R_4) with values 1000Ω, 1200Ω, 4700Ω, 5600Ω respectively connected to a 10V DC voltage source across the four resistors. (6 marks)
   a. Calculate the series resistance of the four resistors
   b. Calculate the current flowing through the resistors.
   c. Calculate the voltage across each resistor.

   Now amend your circuit to be a parallel arrangement of the same four resistors. (6 marks)

   d. Calculate the parallel resistance of the combined four resistors.
   e. Calculate the current flowing through the combined four resistors.
   f. Calculate the current flowing through each resistor.
3. Design a non-inverting operational amplifier having resistors R_1 (feedback resistor) and R_2 (inverting input resistor) with a closed loop gain of 25. (9 marks)

Question 2:

1. The step angle of a step motor is 1.8 °. Calculate the rotation angle when there are 10 impulses as inputs to the step motor.

   (2 marks)
2. List **six** sensors and **two** actuators used by motor vehicle systems. Please give a brief description of function for each component.

   (8 marks)
3. Draw a comparator circuit used to detect when a throttle potentiometer is at the 'idle' position (indicated by a 'HIGH' output voltage) and describe its operation. (10 marks)

Question 3:

1. Describe basic concepts of CAN (Controller Area Network).

   (5 marks)

2. List five typical outputs of a trip computer and the inputs required to calculate each of them.

(10 marks)

3. Draw a diagram of a full vehicle control system.

(10 marks)

Question 4:

1. Draw a typical control layout for a fuel injection system.

(8 marks)

2. Draw a block diagram of inputs and outputs common to most fuel injection systems

(10 marks)

3. Draw a program flow chat to determine the best injector open duration as well as control of engine idle speed.

(12 marks)

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RE-SIT EXAMINATION PAPER

Module Code :	:	6MA043
Module Title	:	Aerodynamic Design and CFD
Date	:	1st September 2024
Examiners	:	Janaka Perera/ Dr. Geethal Siriwardana
Time Allowed:	:	3 Hours

INSTRUCTIONS TO CANDIDATES

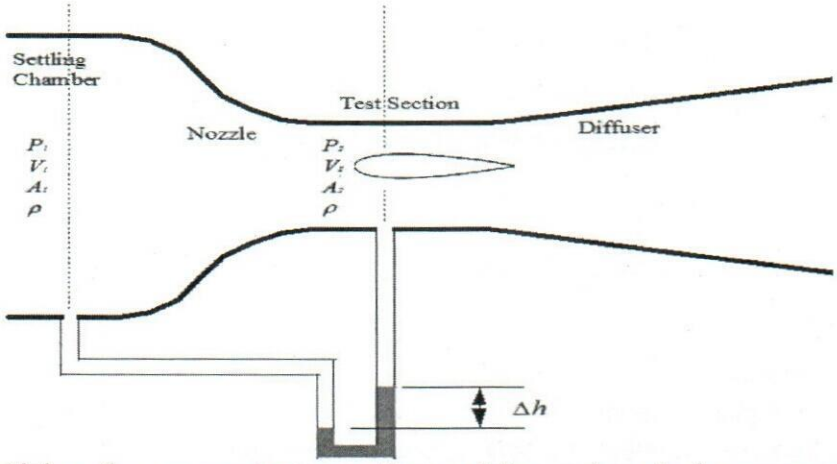
- This is an unseen paper.
- This is a closed book examination.
- Attempt **FOUR** questions by selecting **TWO** Questions from **Part-A** & **TWO** Questions from **Part-B.**
- You are to write your answers in the answer books provided.
- Use a separate book for each PART.
- Write your index number, the subject code and the title of the paper in each answer book. Also write your index number on each additional sheet.

MATERIALS REQUIRED

- Two 12 page answer booklets
- Formula sheet at back of paper.
- You may use a Scientific calculator. This must not be programmable, may not have significant memory capability, and may be inspected during the examination.

PART-A

1 In the nozzle section of a wind tunnel shown in Figure 1, the throat to inlet area ratio is 0.07. The tunnel is turned on, and the pressure difference between the inlet (the settling chamber) and the test section is read as a height difference of 22 mm on a U-tube water manometer. The inlet section of the wind tunnel is connected to a reservoir which contains air at a standard altitude of 1 km.



(a) Using the governing equations of the subsonic incompressible flow, express the velocity of air in the test section as a function of height difference of the manometer, density of fluid in the manometer, density of the air, and the throat to inlet area ratio of the nozzle **(10 Marks)**

(b) Calculate the velocity and Mach number of the flow in the test section. **(15 Marks)**

2 A boundary layer is created on the surface of the airfoil specimen when tested with wind tunnel. Following aerodynamic parameters were considered.

Velocity of air	= 47 m/s
Kinematic viscosity	= 1.68×10^{-5} m^2/s
Chord length	= 165 mm
Span	= 450 mm

(a) Explain the terms laminar boundary layer and turbulent boundary layer

(10 Marks)

(b) By assuming a complete turbulent flow around the wing, calculate

(i) The boundary layer thickness at the trailing edge

(ii) Total skin - friction drag on the wing

(iii) Total drag force

(15 Marks)

3 The specific flow properties, a normal shockwave are formed in the divergent (Downstream) zone of the wind tunnel. The velocity and temperature of the flow ahead of the normal shock wave are 550 m/sec and 115 K respectively.

(a) Calculate the temperature of air behind the shock wave.

(10 Marks)

(b) Calculate the velocity of the flow behind the shock wave.

(15 Marks)

PART-B

4.

a) Discuss the role of initial and boundary value problems in CFD, particularly in the context of simulating laminar flow over a flat plate. **(06 Marks)**

b) Describe the importance of discretization in CFD analysis. Why is it necessary for accurate simulations? **(05 Marks)**

c) Explain following terms
   i. Patch Conforming method **(04 Marks)**
   ii. Patch Independent method

d) Compare the Direct Numerical Simulation (DNS) and Large Eddy Simulation (LES) approaches in modeling turbulent flows. Discuss their respective advantages and limitations. **(10 Marks)**

5.

a) Explain how different physical phenomena (e.g., heat transfer, fluid flow, turbulence) can be incorporated into a CFD model. **(02 Marks)**

b) Briefly explain the differences between the Eulerian and Lagrangian frameworks in Computational Fluid Dynamics (CFD). **(02 Marks)**

c) Discuss the role of CFD in the automotive industry, particularly in the design and optimization of vehicle aerodynamics. **(06 Marks)**

d) What are the core governing equations of fluid mechanics used in CFD? **(05 Marks)**

e) Describe how the Navier-Stokes equations are applied in modeling incompressible and compressible flows in CFD simulations. **(05 Marks)**

f) Outline the general steps involved in setting up a CFD simulation, from problem definition to post-processing. Discuss the importance of each step. **(05 Marks)**

You may use figures and sketches to support your answer

END OF THE EXAMINATION PAPAR

Formula sheet

H	T	P	ρ	a	ν	μ
km	K	$N.m^{-2}$	$kg.m^{-3}$	$m.s^{-1}$	$m^2.s^{-1}$	$N.s.m^{-2}$
0	288.2	1.0133E+05	1.2252	340.3	1.4634E-05	1.7930E-05
1	281.7	8.9866E+04	1.1117	336.4	1.5837E-05	1.7607E-05
2	275.2	7.9480E+04	1.0065	332.5	1.7169E-05	1.7280E-05
3	268.7	7.0088E+04	0.9090	328.5	1.8647E-05	1.6950E-05
4	262.2	6.1616E+04	0.8190	324.5	2.0290E-05	1.6617E-05
5	255.7	5.3993E+04	0.7359	320.5	2.2122E-05	1.6280E-05
6	249.2	4.7153E+04	0.6594	316.4	2.4170E-05	1.5939E-05
7	242.7	4.1032E+04	0.5892	312.2	2.6466E-05	1.5593E-05
8	236.2	3.5571E+04	0.5248	308.0	2.9046E-05	1.5244E-05
9	229.7	3.0714E+04	0.4660	303.8	3.1955E-05	1.4891E-05
10	223.2	2.6408E+04	0.4123	299.4	3.5246E-05	1.4534E-05
11	216.7	2.2605E+04	0.3636	295.0	3.8980E-05	1.4172E-05
12	216.7	1.9308E+04	0.3105	295.0	4.5638E-05	1.4172E-05
13	216.7	1.6491E+04	0.2652	295.0	5.3434E-05	1.4172E-05
14	216.7	1.4085E+04	0.2265	295.0	6.2560E-05	1.4172E-05
15	216.7	1.2030E+04	0.1935	295.0	7.3246E-05	1.4172E-05
16	216.7	1.0275E+04	0.1653	295.0	8.5756E-05	1.4172E-05
17	216.7	8.7763E+03	0.1411	295.0	1.0040E-04	1.4172E-05
18	216.7	7.4959E+03	0.1206	295.0	1.1755E-04	1.4172E-05
19	216.7	6.4024E+03	0.1030	295.0	1.3763E-04	1.4172E-05
20	216.7	5.4684E+03	0.0879	295.0	1.6114E-04	1.4172E-05

ISA table

All pressures are absolute

$1bar = 10^5 N/m^2 = \frac{1}{1.01325} atm$

Acceleration due to gravity

g= 9.81 m/s^2

Density of water

1000 kg/m^3

Bernoulli's Equation

$$\frac{p1}{\rho g} + \frac{V1^2}{2g} + Z1 = \frac{p2}{\rho g} + \frac{V2^2}{2g} + Z\,2$$

Continuity equation

$$A_1 V_1 = A_2 V_2$$

Mach number,

$$M = \frac{V}{C}$$

Reynolds number for the airfoil

$$Re = \frac{Velocity(V) \times Chord\ length(C)}{Kinetic\ viscosity(n)}$$

Lift force

$$Lift\ force = \frac{C_L \times \rho \times V^2 \times A}{2}$$

Drag force

$$Drag\ force = \frac{\rho \times V^2 \times C_D \times A}{2}$$

Boundary layer thickness,

$$\delta = \frac{0.38}{Re^{\frac{1}{5}}}$$

Skin friction coefficient,

$$C_f = \frac{0.059}{Re^{\frac{1}{5}}}$$

$$Skin\ friction\ drag = \frac{1}{2}\rho A V^2 C_f$$

$$\text{Total dreg force} = Skin\ friction\ drag + Pressure\ drag$$

$$Pressure\ drag = Skin\ friction\ drag - \text{Total dreg force}$$

$$\frac{p1}{\rho g} + \frac{V1^2}{2g} + Z1 = \frac{p2}{\rho g} + \frac{V2^2}{2g} + Z\ 2$$

$$T = F\ x\ r$$

$$F = P\ x\ A$$

For an isentropic flow,

$$\frac{P_2}{P_1} = \left(\frac{\rho_2}{\rho_1}\right)^{\gamma} = \left(\frac{T_2}{T_1}\right)^{\frac{\gamma}{\gamma-1}}$$

R - Gas constant [kJ/kg.K] = 0.287

$\gamma - Specific\ heat\ ratio$

$\gamma = 1.4,$

For any flow condition

$$A_1 V_1 \rho_1 = A_2 V_2 \rho_2$$

Sound of velocity for ideal gas

$$C = \sqrt{\gamma R T}$$

$$M_2^2 = \frac{1 + \left(\frac{\gamma-1}{2}\right) M_1^2}{\gamma M_1^2 - \left(\frac{\gamma-1}{2}\right)}$$

$$M_2^2 \times \left[\gamma M_1^2 - \left(\frac{\gamma-1}{2}\right)\right] = 1 + \left(\frac{\gamma-1}{2}\right) M_1^2$$

$$\gamma M_2^2 M_1^2 - M_2^2\left(\frac{\gamma-1}{2}\right) = 1 + \left(\frac{\gamma-1}{2}\right) M_1^2$$

$$\gamma M_2^2 M_1^2 - \left(\frac{\gamma-1}{2}\right) M_1^2 = 1 + M_2^2\left(\frac{\gamma-1}{2}\right)$$

$$M_1^2 \left[\gamma M_2^2 - \left(\frac{\gamma-1}{2}\right)\right] = 1 + M_2^2\left(\frac{\gamma-1}{2}\right)$$

$$\frac{T_2}{T_1} = \left(1 + \frac{2\gamma}{\gamma+1}(M_1^2 - 1)\right)\left(\frac{2 + (\gamma-1) M_1^2}{(\gamma+1) M_1^2}\right)$$

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EXAMINATION PAPER

Module Code	:	**5MA037**
Module Title	:	**Material Science & Manufacturing**
Date	:	**September 2024**
Examiners	:	**T.S.Peiris**
Time Allowed	:	**3 Hours**

INSTRUCTIONS TO CANDIDATES.

- **Answer all 6 questions.**
- **Use Answer sheet for Q5 and Answer sheet for Q6 attached at the end of question paper to answer the relevant questions. Fill the Index number on these sheets.**
- Each Question should be answered on a new page. Only your handwritten answer scripts will be accepted.

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Q1.

(a) Explain (with Diagram) Neils Bohr Atomic Model. 9 Marks

(b) List at least two limitations of Bohr's atomic Model 6 Marks

Total Marks 15%

Q2. Describe with examples and diagrams the three types of 'Primary Interatomic Bonds'?

Total Marks 15%

Q3. Answer the following, with diagrams

(a) What is a Unit Cell? 5 Marks

(b) Describe Face cantered cube crystal structure. 5 Marks

(c) Describe Body Cantered cube Crystal structure. 5 Marks

Total Marks 15%

Q4. (a) Explain what an Impurity in Solids. Give Examples. 5 Marks

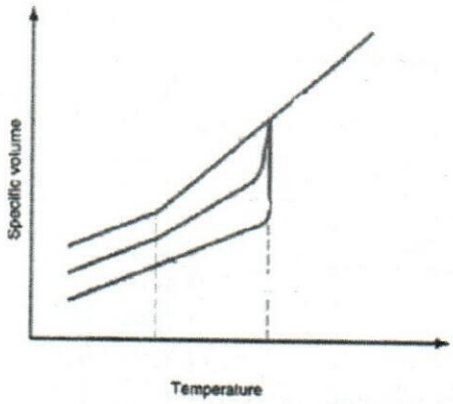
(b) Describe Substitutional and Interstitial impurity point defect, with diagrams. 10 Marks

Total Marks 15%

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Q5.

(a) Label the following on the diagram given in **Figure Q5**



5 Marks

Figure Q5

Use an additional figure provided for your answer at the end of this question paper.

(i) Amorphous polymer,
(ii) Partially crystalline polymer,
(iii) Crystalline polymer,
(iv) Glass transition Temperature and
(v) Melting temperature.

(b) Discuss the characteristics of crystalline and amorphous polymers with the aid of the graph of specific volume Vs temperature.

10 Marks

Total Marks 15%

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06 In the following Figure Q6, shows a Phase Diagram of Fe – FeC (Steel):
Use an additional figure provided for your answer at the end of this question paper.

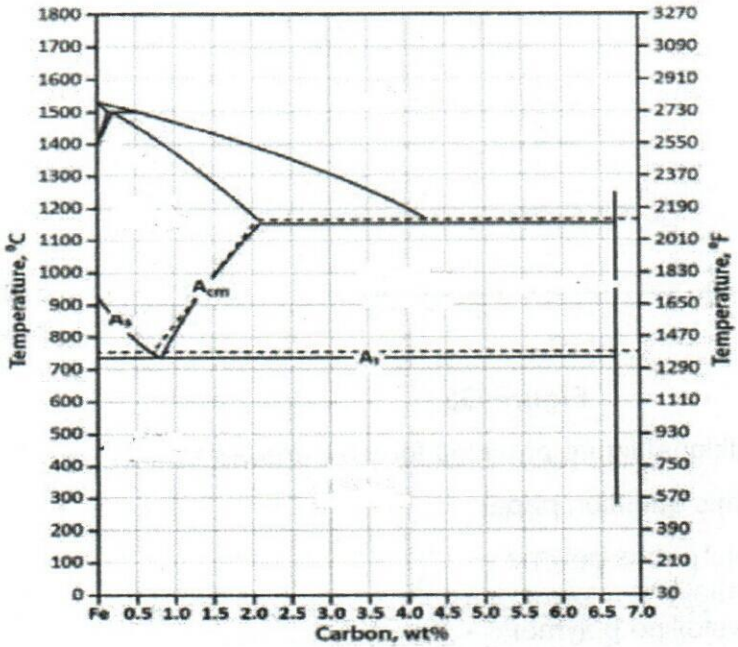


Figure Q6

(a) Explain the changes in Microstructure in Pure Iron from Room Temperature to Its melting Point. **5 Marks**

(b) Label the following zones on the copy of the iron carbon phase diagram shown in Figure Q6.
Use the additional copy of the iron carbon phase diagram attached at the end of question paper for this answer. **10 Marks**

1. Liquid (L)
2. Austenite (γ)
3. Ferrite (α)
4. Cementite (Fe_3C)
5. δ
6. γ +L
7. γ + Fe_3C
8. α + γ
9. α + Fe_3C

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(c) Identify three main reactions in the Phase diagram and explain the significance of each. Label these points on the diagram. **10 Marks**

Total Marks 25%

END OF PAPER

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Answer sheet for Q5

Index Number.....

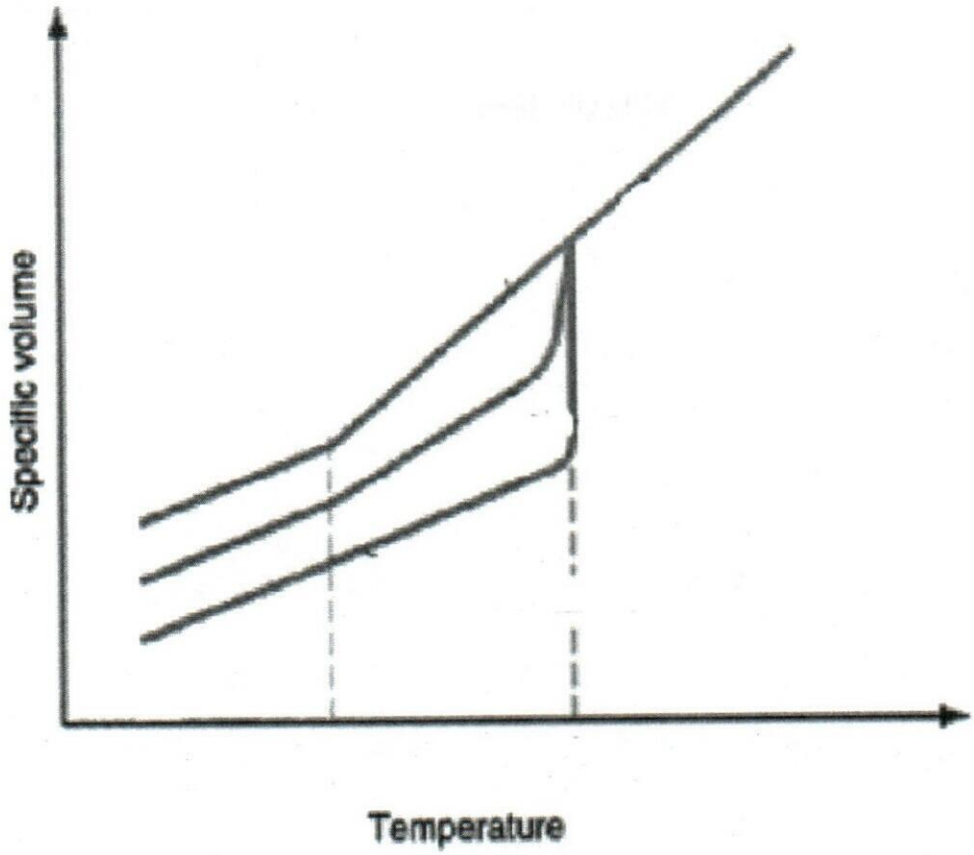


Figure Q5

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Answer sheet for Q6 **Index Number.....**

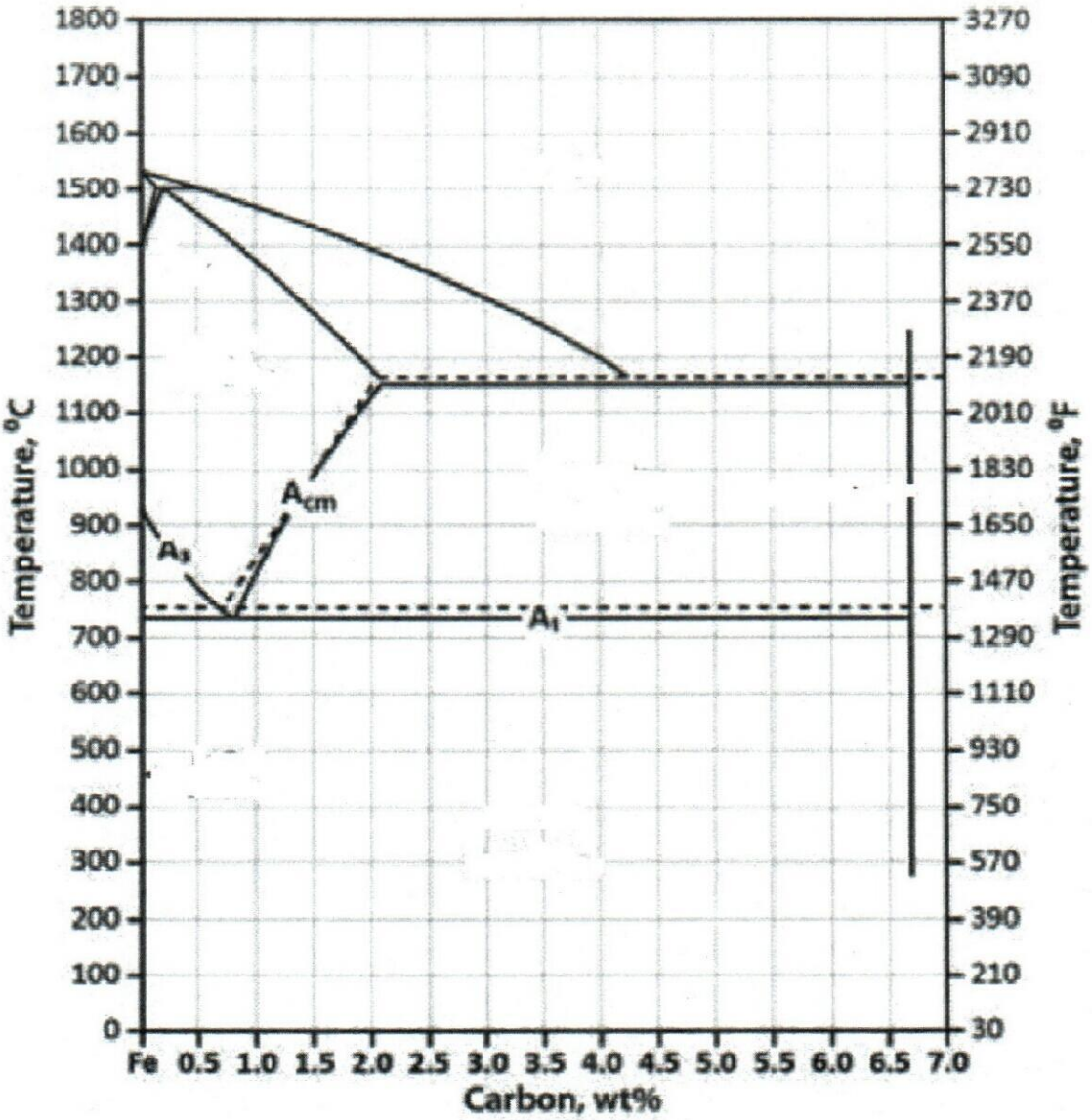


Figure Q6

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EXAMINATION PAPER

Module Code: 6MA040
Module Title: Crash Structures & Vehicle Dynamics
Date: 24th September 2024
From 1.30 pm – 4.30 pm
Examiners: Dr S D R Perera
Time Allowed: 3 Hours

INSTRUCTIONS TO CANDIDATES

Attempt ALL Questions
Total numbers of questions = 6
MATERIALS REQURIED
A Six page answer booklet
You may use a calculator but pre-programmed calculators are not permitted
Special requirements:
Mathematical Formulae
(Some may need to be derived)
Student Number

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Question 01

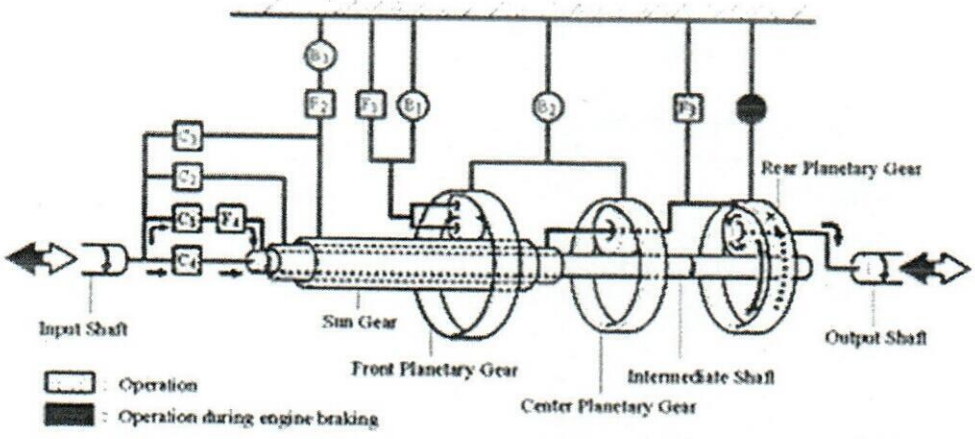
A light weight car with curb weight of 800kg has been designed to carry a 500 kg load including the driver. The un-laden (when not loaded) ground clearance is 190 mm and should maintain minimum 130 mm under fully laden (loaded with 500kg load) condition. In order to maintain a good ride, comfort the natural frequency has to be maintained around 1 Hz to 2 Hz. To provide good adhesion with road and for passenger comfort the damping ratio has to be 0.2.

i. Express the natural frequency in radians per second **(5 marks)**
ii. Determine the appropriate stiffness of the spring and the damping coefficient for the damper when the natural frequency is around 120 cycles per second. **(10 marks)**
iii. Discuss the interaction of conflicting parameters that need to be adjusted in order to provide dynamic performance and passenger comfort of an automobile quoting the analytical solution in part a. **(5 marks)**

Question 02

The configuration and no of teeth in each gear for a typical automatic transmission is given in Figure Q2 at its first gear. Determine the gear ratio. **(15 marks)**

Front Planetary Gear	The No. of Sun Gear Teeth 33
	The No of Pinion Gear Teeth
	The No of Pinion Gear Teeth Inner 19
	The No of Pinion Gear Teeth Outer 18
	The No. of Ring Gear Teeth 75
Center Planetary Gear	The No. of Sun Gear Teeth 26
	The No. of Pinion Gear Teeth 20
	The No. of Ring Gear Teeth 66
Rear Planetary Gear	The No. of Sun Gear Teeth 26
	The No. of Pinion Gear Teeth 20
	The No. of Ring Gear Teeth 66



C_1	C_2	C_3	C_4	B_1	B_2	B_3	B_4	F_1	F_2	F_3	F_4
○			○				(○)			○	○

○: Operation (○): Operation during engine braking (only in the S mode [1st])

Figure 02

Question 03

During manufacture of an automotive crankshafts, a crack of1.2 mm was detected by Non Destructive testing. the crankshaft is estimated to undergo a cyclic stress of 170 MPa. the Crankshaft has following material properties

$Kc = 45$ MN $m^{-3/2}$

$A = 1.5 \times 10^{-12}$ m/(MN $m^{-3/2})^m$

$m = 2.5$

Y=1

Determine the Critical crack size and fatigue life **(10 marks)**

Question 04

i. Explain the following: **(15 marks)**

a) component tests,
b) sled tests, and
c) full-scale barrier impacts

ii. A vehicle of mass 1300kg impacting a rigid barrier at 70 km/h and average crush load of 400 kN. Calculate crash acceleration, time and deformation. **(10 marks)**

Question 05

A typical ABS modulator is shown in Figure Q5.

i. Explain its operation during pressure build up, pressure hold and pressure release conditions. **(10 marks)**

ii. Explain the pressure build up, pressure hold and pressure release cycle affect to reduce the stopping distance. **(10 marks)**

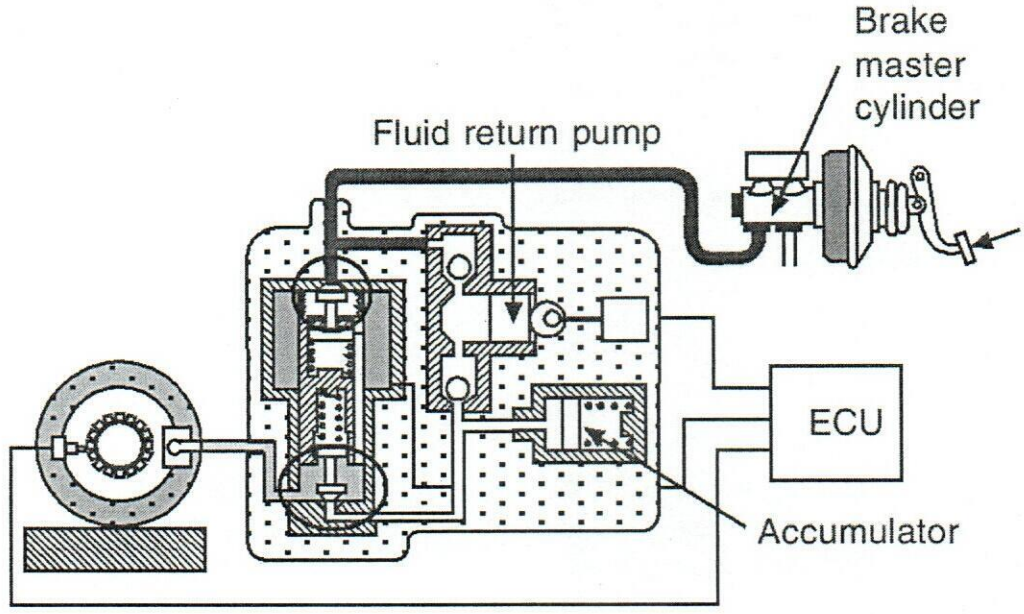


Figure 05

Question 06

A plate clutch having a single driving plate with contact surfaces on each side is required to transmit 60 kW at 1800 r.p.m. The outer diameter of the contact surfaces is to be 260 mm. The coefficient of friction is 0.4. Assuming a uniform pressure of 0.08 Nmm^2 determine the inner diameter of the friction surfaces. **(10 marks)**

Formulae

$$\sigma = \frac{My}{I} = \frac{M}{Z}$$

$$X' = \frac{F_0}{\sqrt{(k - m\omega_0^2)^2 + c^2\omega_0^2}}$$

$$\dot{\epsilon}_{ss} = A\sigma^n e^{-(Q/\bar{R}T)}$$

$$K = Y\sigma\sqrt{\pi a} \quad \frac{da}{dN} = A(\Delta K)^m$$

$$N_f = \frac{1}{A\pi^{m/2}(\Delta\sigma)^m Y^m} \int_a^{a_c} a^{-m/2} da$$

$$N_f = \frac{1}{A\pi^2(\Delta\sigma)^4 Y^4} \int_{a_o}^{a_c} a^{-2} da \quad = -\frac{1}{A\pi^2(\Delta\sigma)^4 Y^4}\left[\frac{1}{a_c} - \frac{1}{a_o}\right]$$

$$T = 2\pi.\mu \times \frac{W}{\pi\left[(r_1)^2 - (r_2)^2\right]}\left[\frac{(r_1)^3 - (r_2)^3}{3}\right]$$

$$R = \frac{2}{3}\left[\frac{(r_1)^3 - (r_2)^3}{(r_1)^2 - (r_2)^2}\right]$$

$$\frac{X}{Y} = \frac{\sqrt{1 + 4\zeta^2 \frac{f^2}{f^2}}}{\sqrt{\left\{1 - \left(\frac{f}{f_n}\right)^2\right\}^2 + 4\zeta^2\left(\frac{f}{f_n}\right)^3}}$$

$$\omega_n = \sqrt{K / M}$$

END.

$$f_d = f_n\sqrt{1 - \zeta^2}$$

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FACULTY OF ENGINEERING AND TECHNOLOGY

RESIT EXAMINATION PAPER

Module Code	:	3MM004
Module Title	:	Foundation Mathematics II
Date	:	August 2024
Examiner(s)	:	Mr. Ramees Tharik
Time Allowed	:	2 Hours

INSTRUCTION TO CANDIDATES

- You should answer all four questions. Each question carries equal marks.
- You should write legibly in black or blue ink.
- This paper contain 3 pages

MATERIALS REQUIRED

- Two eight-page answer booklets
- Calculators are not allowed.

1.

a) Let $A = \begin{pmatrix} y & 2 \\ x+z & x+y \end{pmatrix}$, $B = \begin{pmatrix} 1 & -4 \\ 7 & 2 \end{pmatrix}$ and $C = \begin{pmatrix} -4 & 2 \\ 0 & 1 \end{pmatrix}$

i) If $A + B = \begin{pmatrix} 5 & -2 \\ -2 & 3 \end{pmatrix}$ then find x, y and z. [20 Marks]

ii) Find $A - B^T$ [15 Marks]

iii) Find CB [25 Marks]

b) Solve the following system **using matrices.**

$$3x + 4y = 6$$
$$2y - x = 8$$

[40 Marks]

2.

a) Compute each of the following limits.

i.) $\lim_{x \to 3} \frac{\sqrt{x+13}-4}{x-3}$ [25 Marks]

ii.) $\lim_{x \to -\infty} \frac{\sqrt{4x^2-2x+3}}{2x-1}$ [25 Marks]

b) Compute the derivative **from first principles** of the following function.

$$f(x) = x^3 - 5x + 1$$

[50 Marks]

3.

a) Compute the derivative of each of the following functions with respect to x.

i) $f(x) = 3x^9 + x^{-4} + 2024^2$ [15 Marks]

ii) $g(x) = (x^2 - 3x + 2)(x^3 + 15)$ [20 Marks]

iii) $h(x) = \frac{x+1}{(x^2+1)^2}$ [25 Marks]

b) Evaluate $\int_0^2 2x\sqrt{x^2+1}\, dx$ [40 Marks]

4.

a) Express the following in the form $x + iy$:

$$\frac{3-2i}{1-i} + \frac{3}{2+3i}$$

[40 Marks]

b) Find all solutions to the following equation.

$$x^3 + 3x^2 - 49x + 45$$

[60 Marks]

Formulae

You may find some of the following formulae useful.

- Let $A = \begin{pmatrix} a & b \\ c & d \end{pmatrix}$. The **inverse** of A denoted A^{-1} is given by

$$A^{-1} = \frac{1}{ad - bc} \begin{pmatrix} d & -b \\ -c & a \end{pmatrix}.$$

- The **derivative from first principles** of $f(x)$ at any point x is given by

$$f'(x) = \lim_{h \to 0} \frac{f(x+h) - f(x)}{h}$$

- **The product rule:** Let $f(x) = u(x)v(x)$ then

$$f'(x) = u(x)v'(x) + v(x)u'(x).$$

- **The quotient rule:** If $f(x) = \dfrac{u(x)}{v(x)}$ then

$$f'(x) = \frac{v(x)u'(x) - u(x)v'(x)}{(v(x))^2}$$

- The **solutions** of $ax^2 + bx + c = 0$ are given by

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

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Student Number .....

FACULTY OF SCIENCE & ENGINEERING
SCHOOL OF COMPUTING AND MATHEMATICS

EXAMINATION PAPER

Module Code	:	6CS010
Module Title	:	Digital Forensics
Date	:	11th August 2024
Examiners	:	Dr C Mbarushimana, Mr. Nimesh Pollwaththage
Time Allowed	:	1.5 hrs

INSTRUCTIONS TO CANDIDATES

- This is a Closed book examination.
- You Should Attempt 3 Questions in Total

MATERIALS REQURIED

- Answer booklet.
- You may use a scientific calculator. This must not be programmable, and may be inspected during the examination.
- You should write legibly in black or blue ink

Question 1:

Explain the the four ACPO principles of computer based electronic evidence. Illustrate your answer with examples. ***(20 marks)***

Question 2:

The figure below shows the first sector of a MBR disk.

```
Offset(d) 00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15

00000000  33 C0 8E D0 BC 00 7C 8E C0 8E D8 BE 00 7C BF 00  3ÀŽÐ¼.|ŽÀŽØ¾.|¿.
00000016  06 B9 00 02 FC F3 A4 50 68 1C 06 CB FB B9 04 00  .¹..üó¤Ph..Ëû¹..
00000032  BD BE 07 80 7E 00 00 7C 0B 0F 85 0E 01 83 C5 10  ½¾.€~..|....…..ƒÅ.
00000048  E2 F1 CD 18 88 56 00 55 C6 46 11 05 C6 46 10 00  âñÍ.ˆV.UÆF..ÆF..
00000064  B4 41 BB AA 55 CD 13 5D 72 0F 81 FB 55 AA 75 09  ´A»ªUÍ.]r..ûUªu.
00000080  F7 C1 01 00 74 03 FE 46 10 66 60 80 7E 10 00 74  ÷Á..t.þF.f`€~..t
00000096  26 66 68 00 00 00 00 66 FF 76 08 68 00 00 68 00  &fh....fÿv.h..h.
00000112  7C 68 01 00 68 10 00 B4 42 8A 56 00 8B F4 CD 13  |h..h..´BŠV.‹ôÍ.
00000128  9F 83 C4 10 9E EB 14 B8 01 02 BB 00 7C 8A 56 00  ŸƒÄ.žë.¸..».|ŠV.
00000144  8A 76 01 8A 4E 02 8A 6E 03 CD 13 66 61 73 1C FE  Šv.ŠN.Šn.Í.fas.þ
00000160  4E 11 75 0C 80 7E 00 80 0F 84 8A 00 B2 80 EB 84  N.u.€~.€.„Š.²€ë„
00000176  55 32 E4 8A 56 00 CD 13 5D EB 9E 81 3E FE 7D 55  U2äŠV.Í.]ëž.>þ}U
00000192  AA 75 6E FF 76 00 E8 8D 00 75 17 FA B0 D1 E6 64  ªunÿv.è..u.ú°Ñæd
00000208  E8 83 00 B0 DF E6 60 E8 7C 00 B0 FF E6 64 E8 75  èƒ.°ßæ`è|.°ÿædèu
00000224  00 FB B8 00 BB CD 1A 66 23 C0 75 3B 66 81 FB 54  .û¸.»Í.f#Àu;f.ûT
00000240  43 50 41 75 32 81 F9 02 01 72 2C 66 68 07 BB 00  CPAu2.ù..r,fh.».
00000256  00 66 68 00 02 00 00 66 68 08 00 00 00 66 53 66  .fh....fh....fSf
00000272  53 66 55 66 68 00 00 00 00 66 68 00 7C 00 00 66  SfUfh....fh.|..f
00000288  61 68 00 00 07 CD 1A 5A 32 F6 EA 00 7C 00 00 CD  ah...Í.Z2öê.|..Í
00000304  18 A0 B7 07 EB 08 A0 B6 07 EB 03 A0 B5 07 32 E4  . ·.ë. ¶.ë. µ.2ä
00000320  05 00 07 8B F0 AC 3C 00 74 09 BB 07 00 B4 0E CD  ...‹ð¬<.t.».´.Í
00000336  10 EB F2 F4 EB FD 2B C9 E4 64 EB 00 24 02 E0 F8  .ëòôëý+Éädë.$.àø
00000352  24 02 C3 49 6E 76 61 6C 69 64 20 70 61 72 74 69  $.ÃInvalid parti
00000368  74 69 6F 6E 20 74 61 62 6C 65 00 45 72 72 6F 72  tion table.Error
00000384  20 6C 6F 61 64 69 6E 67 20 6F 70 65 72 61 74 69   loading operati
00000400  6E 67 20 73 79 73 74 65 6D 00 4D 69 73 73 69 6E  ng system.Missin
00000416  67 20 6F 70 65 72 61 74 69 6E 67 20 73 79 73 74  g operating syst
00000432  65 6D 00 00 00 63 7B 9A F9 1D 7B AF 00 00 80 20  em...c{šù.{¯..€
00000448  21 00 07 DF 13 0C 00 08 00 00 00 20 03 00 00 DF  !..ß....... ...ß
00000464  14 0C 07 FE FF FF 00 28 03 00 00 18 FC 00 00 FE  ...þÿÿ.(....ü..þ
00000480  FF FF 07 FE FF FF 00 40 FF 00 00 40 00 00 00 FE  ÿÿ.þÿÿ.@ÿ..@...þ
00000496  FF FF 0F FE FF FF 00 80 FF 00 00 78 80 06 55 AA  ÿÿ.þÿÿ.€ÿ..x€.Uª
```

a. What information does this sector contain? ***(5 marks)***
b. How many active partitions does the disk have and how many partitions in total? Explain your answer. ***(5 marks)***
c. What is the starting sector in LBA of the first partition? ***(5 marks)***
d. What is the size in MBs of the 3rd partition? ***(5 marks)***

Question 3:

NTFS is the most common file system used in Windows today.

a. With regards to NTFS, discuss the role of the Master File Table (MFT) ***(5 marks)***
b. What are the main components of a MFT file record? ***(10 marks)***
c. With the help of a diagram, explain the concept of file slack and its significance in digital forensics. ***(5 marks)***

Question 4:

Critically discuss digital antiforensics techniques and explain how these techniques may be used to mislead the forensic investigation process. ***(20 marks)***

Question 5:

a. Using a digital investigation process model of your choice, discuss the importance of adopting such a methodology and the main phases of an investigation. ***(14 marks)***
b. In the context of data acquisition, explain the differences between disk cloning and disk imaging. ***(6 marks)***

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Faculty of Science and Engineering

EXAMINATION PAPER

Module Code	**4MA020**
Module Title	**Electromechanical Engineering Principles**
Date & Time of Examination:	**05th August 2024 9.00 am.**
Examiner:	**Kapila Khemaratne/ Dushani Munasinghe**
Examiner(s) Room:	
Time Allowed:	**3 Hours**
Number of Questions to be attempted:	**5 from 5**

All questions are equally weighted (unless otherwise stated.)

MATERIALS REQUIRED:

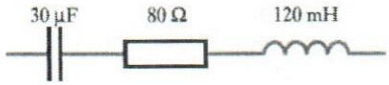
- One eight page answer booklet.
- Formula sheet.
- Scientific calculator

INSTRUCTIONS TO STUDENTS:

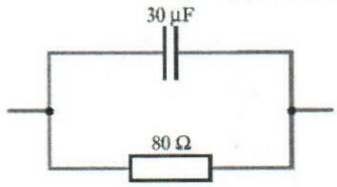
- This is closed book examination.
- You are to write your answers in the answer books provided.

1. (**a**) Define, "resistance" and "reactance" in your own words. 2 marks

(**b**) Determine the complex impedances of the following series (Figure 1.1 (a)) and parallel (Figure 1.1 (b)) arrangements for a signal frequency of 200Hz. 8 marks



(a)



(b)

Figure 1.1

(**c**) The switch in the circuit shown in Figure 1.2 is closed at $t = 0$. The output voltage (v) across the capacitor after $t = 25s$ is $18.36V$. Calculate the RC time constant (T) and the supply voltage (V) using the transient behavior of the RC circuit. 10 marks

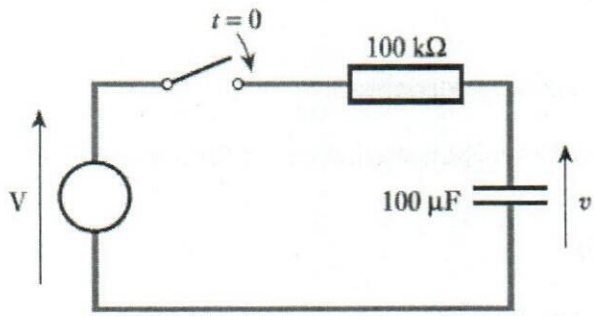


Figure 1.2

2. (**a**) Explain the working of semiconductor diode in forward bias. 4 marks

(**b**) Calculate the resistor value R for the voltage regulator circuit given in Figure 2.1 if Zenner current, $I_Z = 2.67mA$. Hence calculate the power dissipated from the Zenner diode (P_z). 8 marks

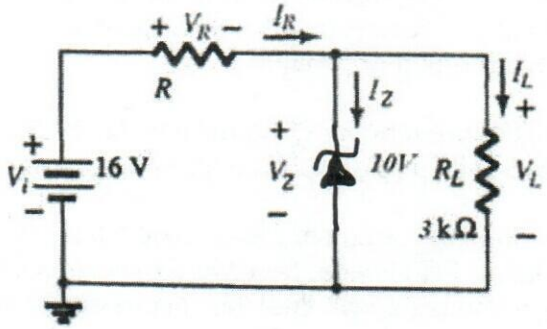


Figure 2.1

(**c**) Consider the fixed bias circuit of a Silicon transistor given in Figure 2.2. Calculate the following. 8 marks

I. I_C
II. R_C
III. R_B
IV. V_{CE}

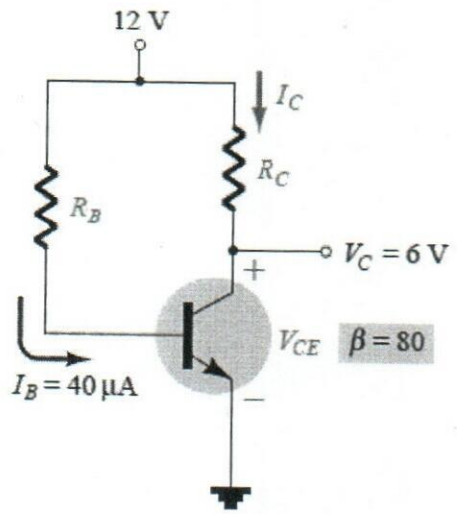


Figure 2.2

3. (**a**) Explain the working principles of a sensor and an actuator of your choice. 4 marks

(**b**) I. Compare and contrast the characteristics of Class A and Class B power amplifiers. 8 marks

II. Explain crossover distortion using a suitable diagram. Which power amplifier configuration was introduced to reduce crossover distortion and why?

(**c**) I. What is Electromagnetic Compatibility (EMC)? Explain its importance in electronic circuit design and prototyping. 8 marks

II. If you are making a custom PCB to develop an embedded systems based IoT device, how would you ensure that your PCB design complies with the EMC standards? Discuss.

4. **(a)** Calculate the output voltage (V_o) of the non-inverting amplifier shown in Figure 4.1 where, $V_1 = 2V, R_f = 250k\Omega$, and $R_1 = 50k\Omega$. 4 marks

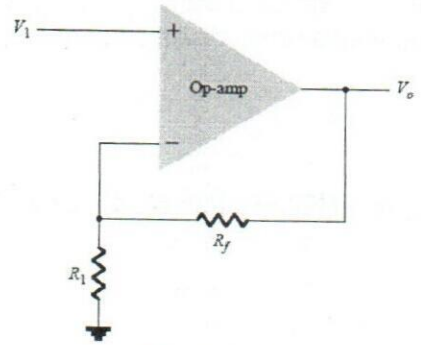


Figure 4.1

(b) I. Write the Product of Sum (POS) expression for the output (Y) in the truth table shown in Table 4.1. 8 marks

A	B	C	Y
0	0	0	0
0	0	1	1
0	1	0	0
0	1	1	1
1	0	0	0
1	0	1	1
1	1	0	1
1	1	1	1

Table 4.1

II. Draw the logic circuit for the above output (Y)

(c) I. Simplify the following Boolean expression using Boolean algebra to show that, $F = A$. 8 marks

$$F = A(A + \bar{B}C) + A(\bar{B} + C)$$

II. Represent the following Boolean expression in Karnaugh maps and apply K-map rules to simply.

$$Y = \bar{A}\bar{B}\bar{C}\bar{D} + \bar{A}\bar{B}C\bar{D} + \bar{A}B\bar{C}D + \bar{A}BCD + A\bar{B}\bar{C}\bar{D} + A\bar{B}C\bar{D} + AB\bar{C}D + ABCD$$

5. A gear box mounted on the chassis of a car has an input shaft rotating at 1900 RPM clockwise and an output shaft rotating at a speed of 900 RPM anticlockwise. The power at the output shaft is measured to be 50 kW at an efficiency of 50%. Determine the holding torque necessary to hold the gear box in place. 20 marks

END OF THE EXAMINATION PAPER

Formula Sheet

Electronics Engineering

Transients: $v = V(1 - e^{-t/T})$

Non-inverting OP-Amp gain: $A_V = 1 + \frac{R_f}{R_1}$

Mechanical Engineering

Speed ratio = $\frac{\textit{Product of the number of teeth of on the drivens}}{\textit{Product of the number of teeth of on the drivers}}$ = $\frac{\textit{Speed of the first Driver}}{\textit{Speed of the last Driven}}$

Power $P = \frac{2\pi NT}{60}$

Efficiency = Output power / Input power

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FACULTY OF ENGINEERING & TECHNOLOGY

RESIT EXAMINATION PAPER

Module Code	:	**4MA014**
Module Title	:	**Engine and Chassis design**
Academic Year	:	**Semester 2/2024**
Date	:	**02/08/2024**
Examiners	:	**Yohan Silva**
Time Allowed	:	**3 Hours**

INSTRUCTIONS TO CANDIDATES

- This is a closed book examination. The paper consists of 4 questions in 6 pages.
- You Should Answer **All 4 questions**. Each question carries equal marks.
- Answers should be written in the answer booklet provided Additional papers can be obtained and should be attached.
- Show all stages of your work.

MATERIALS REQUIRED

- Answer Booklet.
- You may use a Scientific calculator. This must not be programmable and may be inspected during the examination.

Attempt all questions.

Question 01

a) Using annotated sketches explain the operation of spark ignition four stroke engine. Clearly identifying Piston motion, valve action and processes inside combustion chamber for each stroke.

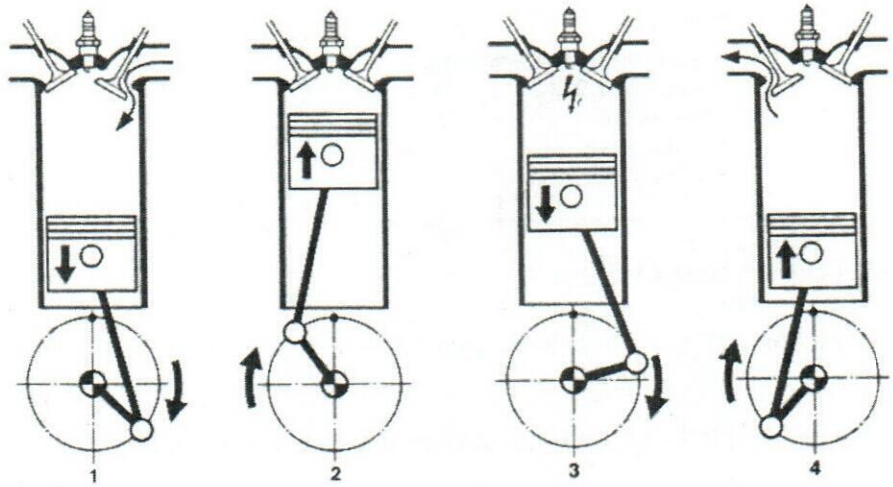


Figure 1

(10 marks)

Figure 2 below represents a valve timing diagram of an engine.

a) Explain the details / data represents by the diagram, (5 marks)

b) Calculate the total number of degrees of crankshaft rotation when both valves are **closed** at the **same time**. (5 marks)

c) Calculate the total number of degrees of crankshaft rotation during **valve overlap period**. (5 marks)

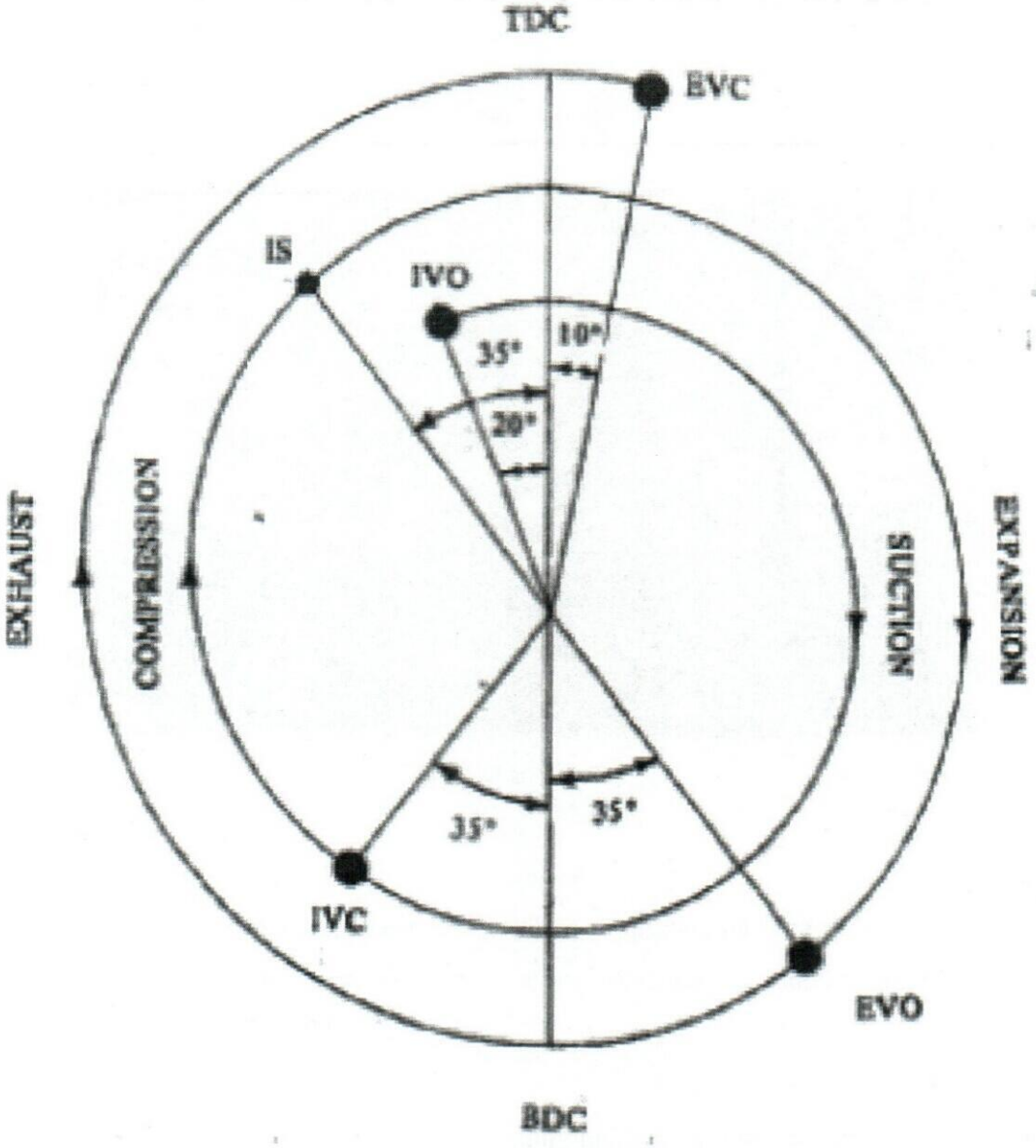


Figure 2

(Total: 25 marks)

Question 02

For the Lamborghini Luxury Sport car shown below

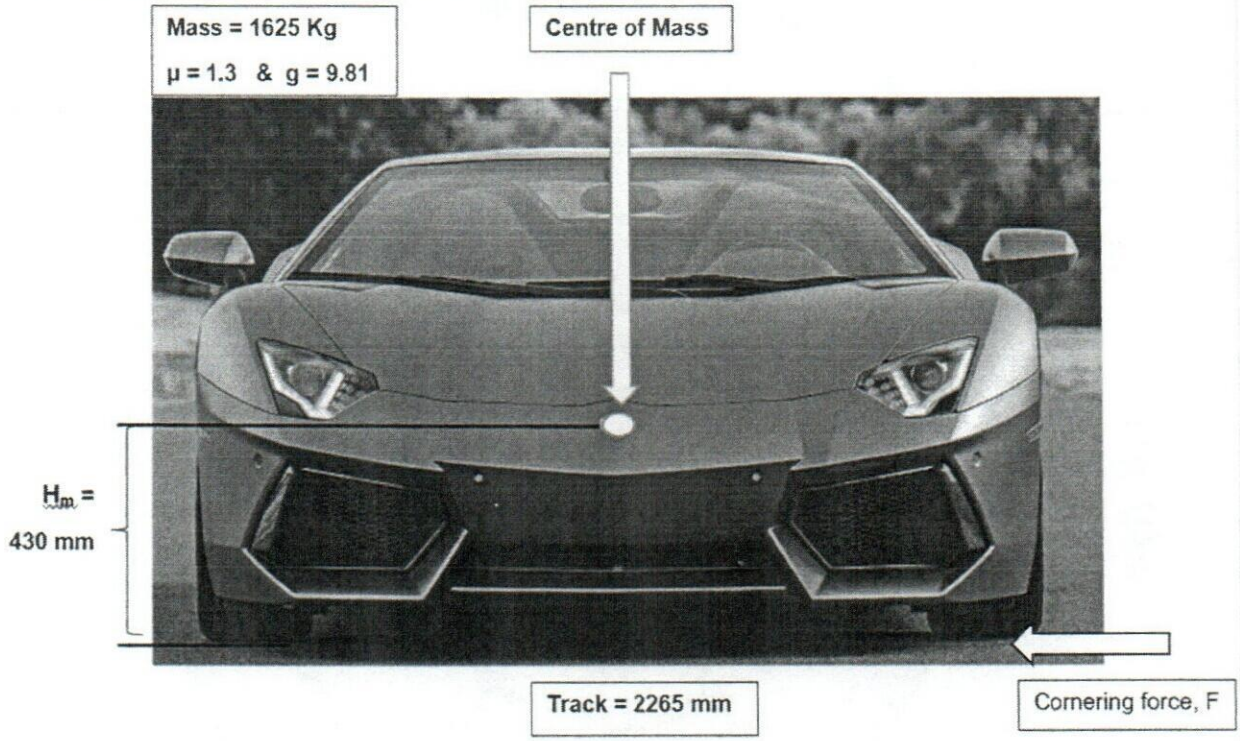


Figure 3

The driver is going to fill the fuel tank up to 75 litres. The fuel density is 847 kg/m^3. Filling up the tank cause reduction of centre of mass from 430 mm to 395 mm. Considering all information to calculate:

(i) Value of combined cornering force. **(5 marks)**

(ii) The maximum lateral weight transfers in total. **(10 marks)**

(iii) Calculate the maximum velocity in km/hr that the car can travel before the wheels slide when the corner radius is 65 m. **(10marks)**

(Total: 25 marks)

Question 3

a) What are the functions of a clutch?. (2 marks)

b) State **two advantages** of diaphragm spring clutch and **two advantages** of coil spring clutch. (4 marks)

c) Figure 2 below shows an exploded view of a diaphragm spring clutch. Name components A,B,C,D,E, F and G.

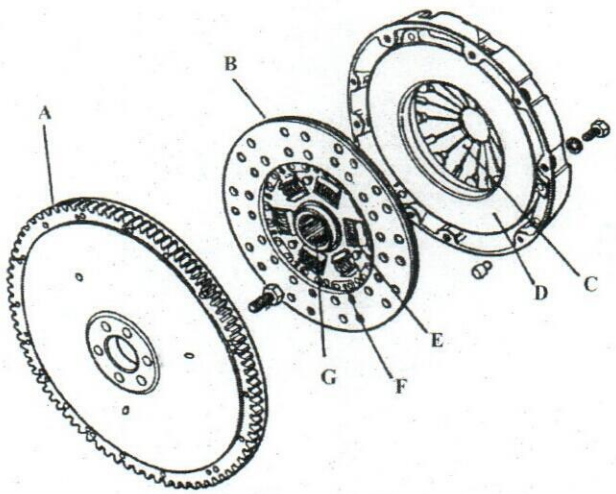


figure 4

(7 marks)

b) State the function of the 'cooling system' of an internal combustion engine.

(2 marks)

c) With an aid of a block diagram explain the oil flow sequence of an engine lubrication system.

(5 marks)

d) What are the functions of an engine lubrication system?

(2 marks)

e) In the drive train what is the significant for a differential? Use sketches to annotate your answer as needed.

(3 marks)

(Total: 25 marks)

Question 4

a) Explain the difference between independent suspension system and rigid axle (Solid axle) suspension system. Use sketches to annotate your answer as needed.

(4 marks)

b) Define "wheel track" and "wheel base" use sketches for your explanation.

(3 marks)

c) State the name and purpose / function of component labeled 'X' in the figure 3 below.

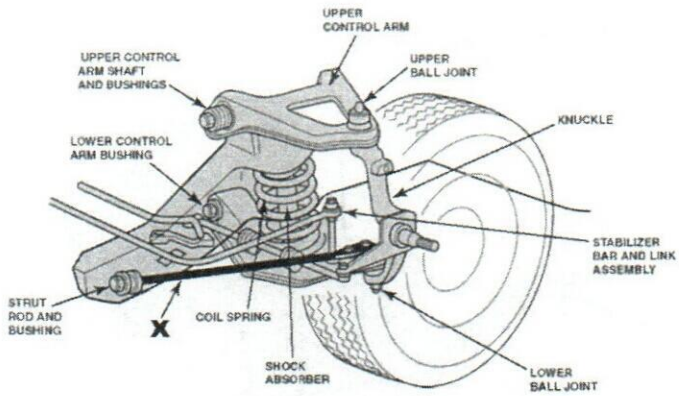


Figure 5.

(4 marks)

d) From the figure 4 below, list the load carrying ball joints and non-load carrying (friction) ball joints.

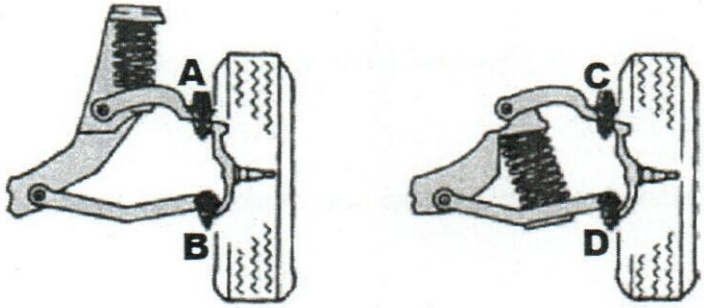


Figure 6.

(4 marks)

e) Figure 5 below shows a cut way diagram of a typical double tube shock absorber. Referring to the diagram below explain the function of the shock absorber during rebound (Extension) and jounce (Compression).

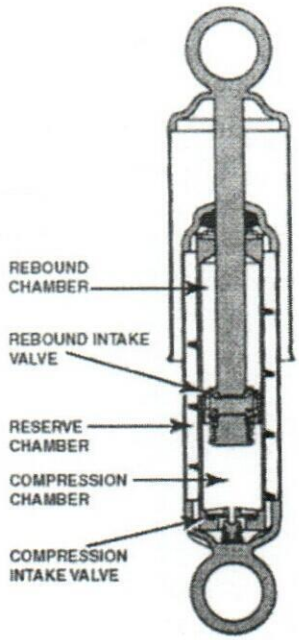


Figure 7.

(10 marks)

(Total: 25 marks)

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RE-SIT EXAMINATION PAPER

Module Code	:	**6MA036**
Module Title	:	**ESEE - Economic, Social, Ethical and Environmental**
Date	:	**09:00 Hrs 28/07/2024**
Examiners	:	**Andrew Barnett**
Time Allowed	:	**3 Hours**

INSTRUCTIONS TO CANDIDATES

- This is a Closed Book examination.
- You Should Attempt ***ALL FIVE*** Questions.
- All questions carry equal marks.
- Assessment weighting 50%.
- Answers to be written in the answer booklet provided.

MATERIALS REQUIRED

- 2 Six page answer booklets.
- You may use a scientific calculator. This must not be programmable and may be inspected during the examination.

Examination Brief

As part of the 6MA036 module, you have looked at the Ethical, Social, Economic & Environmental impacts of meeting engineering challenges, and the legal frameworks that Professional Engineers must work within. During the module, as an example of an engineering challenge, you were tasked with generating a Concept Product that sat within a circular economy and was environmentally friendly.

Utilizing this same individual concept product, as the subject of your analysis, you are required to complete each of the FIVE questions, as instructed. Each question relates to an aspect of the performance, design, operation, or impact of your concept product, and how well it provided a solution to the engineering challenge given.

For reference only, the original Concept Product Assignment Brief is shown below.

Original Concept Product Assignment Brief – FOR REFERENCE ONLY

As part of the overall work for the module, we will be looking Ethical and Environmental impact of New Product Development.

Below is a basic Product Design Specification (PDS). It requires the development of the following concept.

- A draft design for a consumer product.
- Product must fit within a circular economy framework.
- It is to be manufactured only with the following biodegradable materials / components.

SCALITE
Banana Leaves
Pineapple leaves
Grape by-products
Mycelium
Bagasse
Polylactic Acid (PLA)
Palm leaf
Mater-Bi
Potato by-products

- It must have a significant % of recycled or recyclable material within its construction.
- Raw materials must be sustainably sourced.
- Product must conform to an ethical procurement policy. Evidence is required as to where you might source your materials

Submit a 1-page document (Datasheet) that outlines the following.

- What the product is.
- What it does.
- What market it is aimed at.
- How the product addresses each of the above PDS points.
- States what legal requirements the product conforms to.

The product will need a name and the virtual company that will be making it will also need a name. You need to include a sketch/illustration/image or drawing of your product for reference.

Note: This is an individual assignment so the concept product should be individual to you. The data this assignment contains will be reused in the examination. Since this is a virtual exercise the drawing etc is only required to illustrate the product concept, not fully engineer it.

Questions

1		Outline what ethical issues your concept product potentially provided a solution to? (Max 800 words)	20 marks
2		Identify at least 5 examples of relevant UK/ Sri Lanka legislation (Laws), that would directly affect the design, manufacture, and sale of your concept product. To be a valid answer, both the title and the year of enactment must be stated. E.g., Pension Schemes Act 2021.	20 marks
3		Assuming your product were to be manufactured and sold in the UK. Outline, how the proposed design of your product would mitigate the environmental impact of its end-of-life disposal? (Max 800 words)	20 marks
4		In order to assess the social impacts your product generates; outline what data, sources of information, and methodology you might use to arrive at a statement of impact? (Max 800 words)	20 marks
5		Assuming your product were to be manufactured and sold in the UK. Assess what the economic impact would be of its predicted sales within the UK? A single, total sales figure in pounds (£) is required, for the first year of sales, along with an outline of how you have calculated this value and, what data you have based your calculations on. Calculations used in this assessment to arrive at the first-year sales figure must also be shown.	20 marks

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FACULTY OF ENGINEERING & TECHNOLOGY
DEPARTMENT OF CIVIL ENGINEERING

FINAL EXAMINATION RESIT PAPER

Module Code	:	4CV001
Module Title	:	Fundamentals of Geotechnics (Civil Engineering) (SL)
Date	:	July 2024
Examiner	:	Iromi Diyes / Supun Walpita
Time Allowed	:	2.5 Hours

INSTRUCTIONS TO CANDIDATES

- This is a closed book examination.
- Attempt **ALL** questions. Your responses should be recorded on the answer booklet attached.
- You should write legibly in black or blue ink.
- You may not leave the examination room during the first hour or last 30 minutes of the exam.
- An announcement will be made when there are 30 minutes of the exam time left.
- All questions are equally weighted. Please refer assigned marks for each subparts within the question.
- Graph sheets are required.
- You may use a scientific calculator.

1)

a) Explain the terms "Soil belt "&"Capillary fringe" **(10 Marks)**

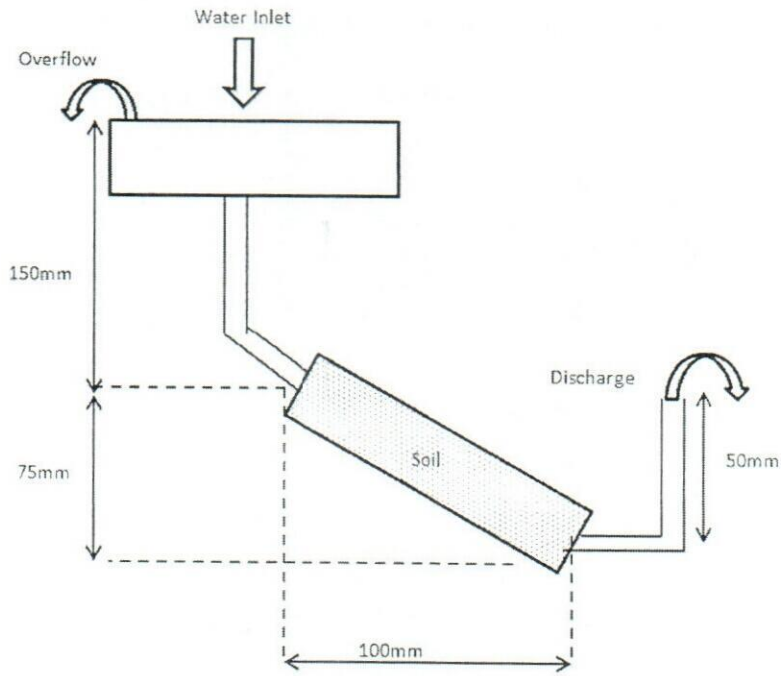
b) For a layered soil deposit (consist of three layers), derive an equation for average permeability Kz, for flow perpendicular to the bedding planes as

$$Kz = \frac{H}{\frac{H1}{K1} + \frac{H1}{K1} + \frac{H3}{K3}}$$

Here H_1, H_2, H_3 & K_1, K_2, K_3 represents the thickness and hydraulic conductivity of each layer, while H is the total thickness of the deposit. **(40 Marks)**

c) A horizontal stratified soil deposit consists of three layers. Hydraulic conductivity and thicknesses of these layers are 8×10^{-4}cm/s, 5.2×10^{-3}cm/s, and 6×10^{-4}cm/s. Thicknesses of these layers are 7m, 3m & 10 m respectively. Find the effective average permeability of the deposit when the flow is perpendicular to the bedding planes.**(20 Marks)**

d) A cylinder of cross-sectional area 2500 mm^2 is filled with sand of permeability 5.0 mm/s as shown in the figure below. Water is caused to flow through sand under a constant head using the arrangement shown in Figure given below Determine the quantity of water discharged in 5 minutes. **(30 Marks)**



2)

a) A sample of clay taken from a natural stratum was found to be partially saturated and when tested in the laboratory gave the following results. Compute the degree of saturation by assuming unit weight of water as 10 kN/m^3. **(30 Marks)**

Specific gravity of soil particles = 2.6
Wet weight of sample = 2.50 N
Dry weight of sample = 2.10 N
Volume of sample = 150 cm^3

b) The soil in a borrow pit has a bulk unit weight of 18.5 kN/m^3 and a water content of 10%. Volume of constructed fill is 20,000 m^3 with an in-situ dry unit weight of 18.84 kN/m^3. If the owner of borrow pit is to be compensated at Rs. 2.50 per cubic meter of excavated soil from borrow pit, determine the total cost of compensation. **(30 Marks)**

c) State two disadvantages of direct shear test **(10 Marks)**

d) The following data were obtained in a direct shear test at failure. Represent the data by Mohr's Circle and compute the principal stresses **(30 Marks)**

Normal stress = 20 kN/m^2
Shear stress = 15.3 k N/m^2.
Friction angle = 20°
Cohesion = 8 kN/m^2.

3)

a) Name the types of soil according to the modes of formation. **(15 Marks)**
b) Following are the results of a sieve analysis and atterberg limit test conducted on a soil sample. Make the necessary calculations, draw a particle-size distribution curve & classify the soil according to unified soil classification system **(50 Marks)**

Sieve (mm)	Retained Mass (g)
10.0	30
6.3	30
2.0	40
1.00	120
0.60	130
0.30	132
0.150	111
0.075	251
pan	156

Liquid limit = 49% Plastic limit = 19%

c) The bottom of a lake can be found 6m below the surface of water. The bottom soil consists of soft clay with a thickness 15 m. The saturated unit weight of soft clay is 17 k N/m^3.

I. Determine the total stress & pore water pressure at the center of the soft clay layer **(15 Marks)**

II. In the dry season, the water level will decrease until it reaches the bottom surface of the lake. Determine the total stress, pore water pressure & effective stress at the center of the soft clay layer in the dry season **(20 Marks)**

Additional Information

$$G_s = \frac{W_s}{V_s \gamma_w} = \frac{M_s}{V_s \rho_w}$$

$$\rho_b = \rho_w \frac{(G_s + eS_r)}{1+e}$$

$$\rho_d = \frac{\rho_w G_s}{1+e} = \frac{\rho_b}{1+w}$$

$$\rho_{sat} = \rho_w \frac{(G_s + e)}{1+e}$$

$$\rho' = \rho_w \frac{(G_s - 1)}{1+e}$$

$$\gamma_b = \gamma_w \frac{(G_s + eS_r)}{1+e}$$

$$w = \frac{W_w}{W_s} = \frac{M_w}{M_s}$$

$$e = \frac{V_v}{V_s}$$

$$e = wG_s \quad \text{(saturated)}$$

$$e = \frac{wG_s}{S_r} \quad \text{(partially saturated)}$$

$$n = \frac{V_v}{V} = \frac{e}{1+e}$$

$$S_r = \frac{V_w}{V_v}$$

$$\gamma_d = \frac{\gamma_w G_s}{1+e} = \frac{\gamma_b}{1+w}$$

$$\gamma_{sat} = \gamma_w \frac{(G_s + e)}{1+e}$$

$$\gamma' = \gamma_w \frac{(G_s - 1)}{1+e}$$

$$I_D = \frac{e_{max} - e}{e_{max} - e_{min}}$$

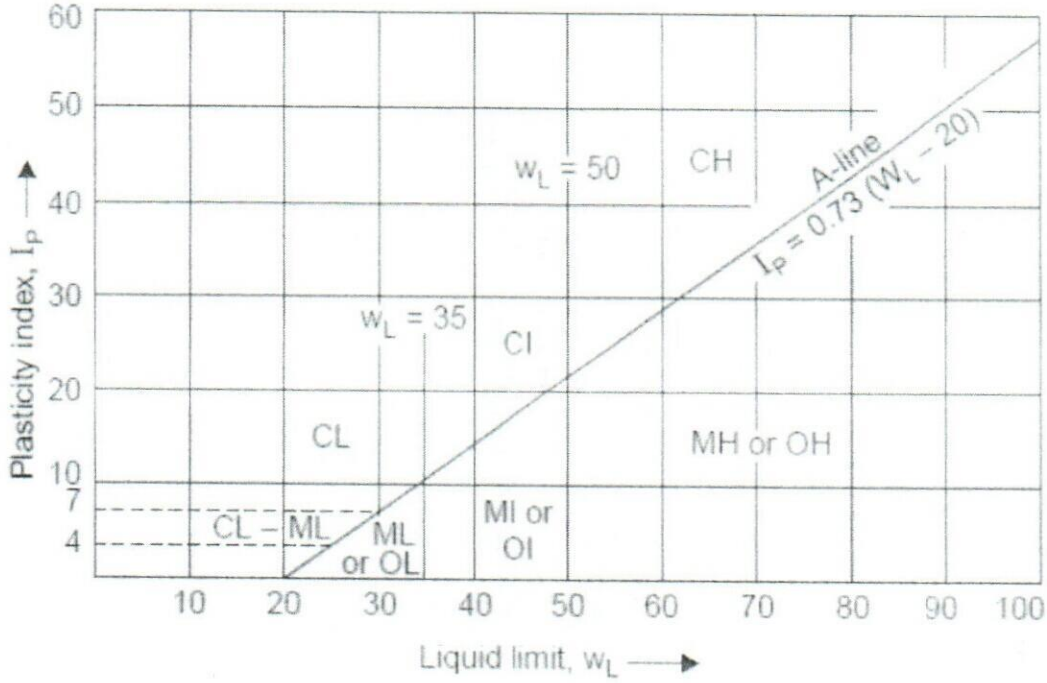
$$k_z = \frac{H}{\frac{H_1}{k_1} + \frac{H_2}{k_2} + \frac{H_3}{k_3} + \cdots + \frac{H_n}{k_n}}$$

$$k = \frac{q \ln r_2 / r_1}{\pi (h_2^2 - h_1^2)}$$

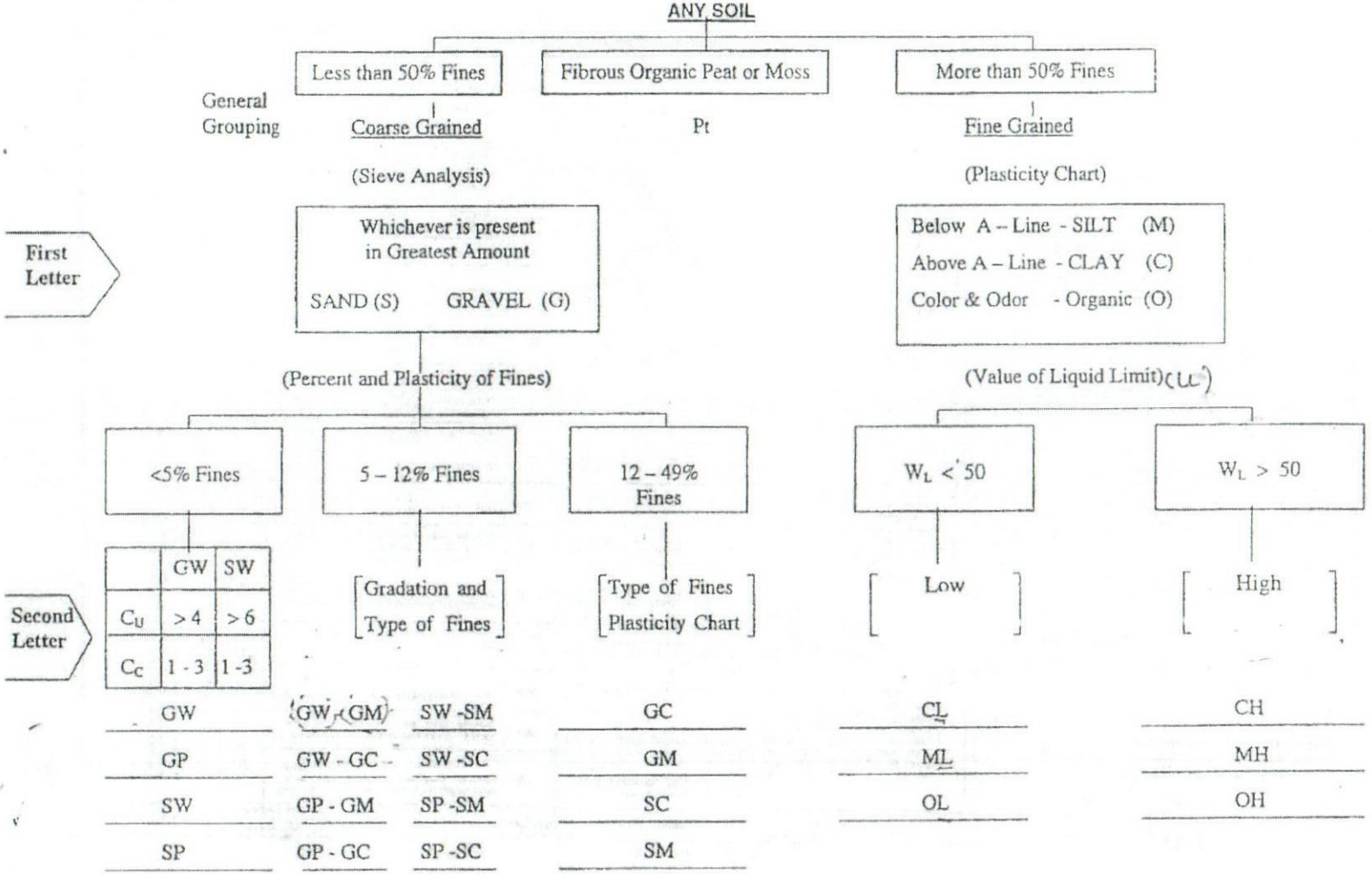
$$k_x = \frac{H_1 k_1 + H_2 k_2 + H_3 k_3 + \cdots + H_n k_n}{H}$$

$$k = \frac{al}{At} \ln \frac{h_1}{h_2} \qquad k = \frac{Ql}{tAh}$$

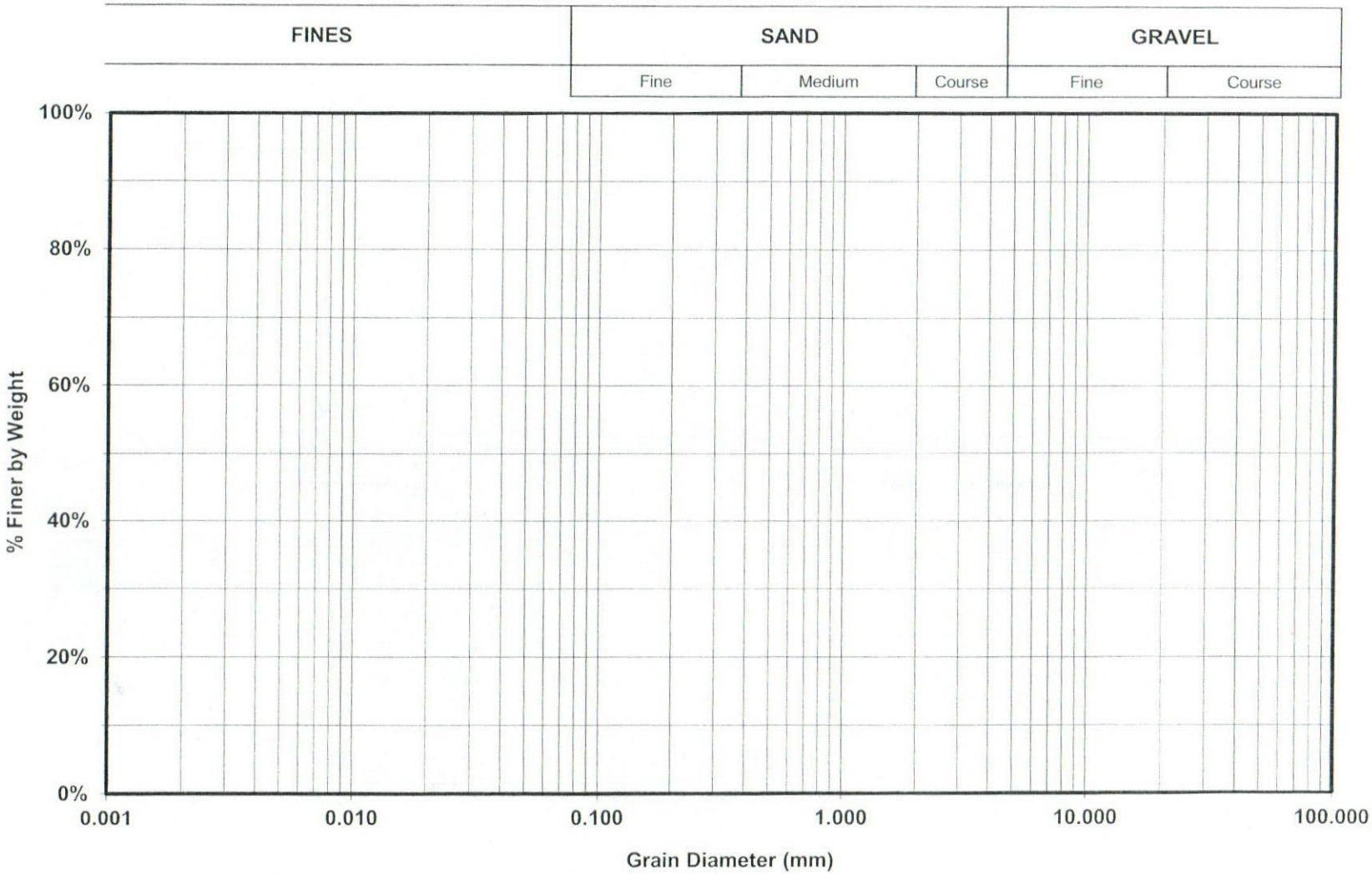
Plasticity Chart



UNIFIED SOIL CLASSIFICATION SYSTEM
CLASSIFICATION PROCEDURE



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FINES
SAND
GRAVEL
Fine
Medium
Course
Fine
Course
100%
80%
60%
40%
20%
0%
% Finer by Weight
0.001
0.010
0.100
1.000
10.000
100.000
Grain Diameter (mm)

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UNIVERSITY OF WOLVERHAMPTON

STUDENT NUMBER

Faculty of Science and Engineering
School of Computing and Mathematics

Examination Paper

EXAM DETAILS	
Module Code	6CS029
Module Title	Advanced Networks
Date of Exam	02nd June 2024
Duration (incl. reading time)	2 Hours
Module Leader / Examiner	Dr Ian Coulson, Mr. Nimesh Pollwaththage

INSTRUCTIONS FOR STUDENTS

- This is a Closed book examination.
- Answer three complete questions from the five on the paper
- All whole questions are equally weighted.
- All questions should be answered in the supplied 6 page booklets
- However, the answer to q1 part e) should be written on the exam paper on the last sheet and the **question paper submitted with your answer sheet.**

EXAM INFORMATION – PLEASE READ

- **DO NOT OPEN THIS PAPER UNTIL YOU ARE INSTRUCTED TO DO SO BY THE INVIGILATOR.**
- All electronic devices must be SWITCHED OFF and placed with your belongings (incl. mobiles and wearable technology).
- You must not have any unauthorised materials on your person or on your desk.
- Place your ID on your desk.
- You will not be allowed to leave the exam room within the first hour, or the final 30 minutes.
- Raise your hand if you need to get the attention of an Invigilator.
- This paper MUST NOT be removed from the exam room.

1.

a. What is meant by the term Minimum Spanning Tree? (6 marks)

b. What are the steps of Prim's algorithm (6 Marks)

c. In the graph in figure 1 of a network use Kruskal's algorithm to determine an MST for this network, and state its length. Show the order in which you select and reject edges. (36 marks)

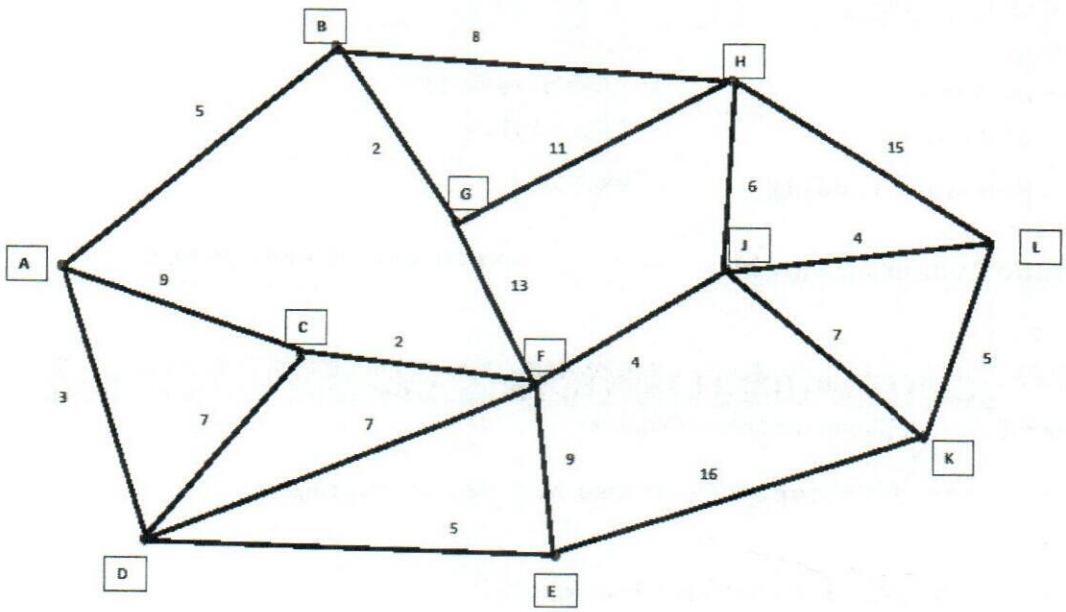


Figure 1 – Graph of a network

d. Sketch the defined MST for the graph in Figure 1.

(6 marks)

e. The network in Figure 2 shows the defined weights between nodes. Use Dijkstra's Algorithm to find the route with the lowest cost from A to H.
You should illustrate your method on the attached sheet at the back of the question paper and submit this with your answer booklet. Note marks will only be awarded if you have illustrated Dijkstra's method.

(46 marks)

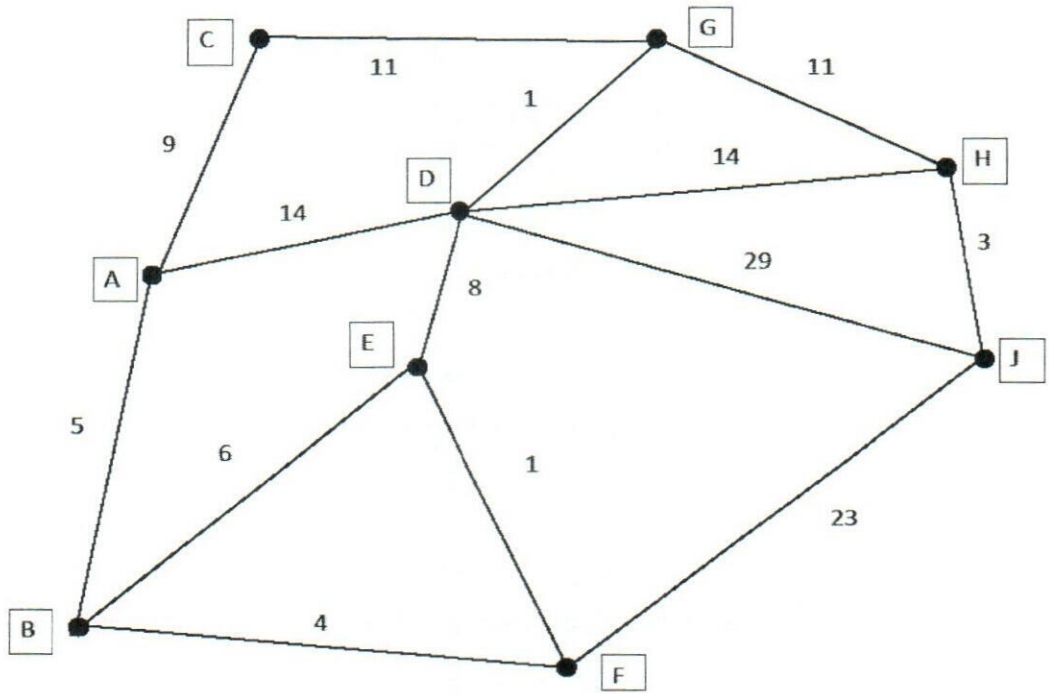


Figure 2 – Graph of a network

2.

a. Discuss with the aid of diagrams the process of a workstation obtaining an IP address through DHCP. (42 Marks)

b. Describe the domain name system and the processes involved to resolve a web address to its respective IP address. You may include diagrams to aid with this.

(36 Marks)

c. DNS servers can be used to mount an attack on a victim, describe this process.

(22 marks)

3.

a. Discuss the structure using illustrations of the different classes of IPV6 addresses. Your discussion should mention their scope and range of values.

(48 marks)

b. How are IPV6 addresses obtained when a workstation, etc. first initiates.

(9 marks)

c. What is meant by the term IPV6 tunnelling, use a sketch to illustrate this.

(13 marks)

d. Give an account using diagrams of EUI-64 which is used to generate the 64 bit interface ID.

(30 marks)

4.

a. **Star Topology** currently dominates the market with regard to local area **network design**. Explain why you believe this statement **to be true or false**, referencing the other topologies as part of your discussion.

(48 marks)

b. What is a***VLAN?*** What does it mean to say that they "***communicate with each other as though they were on a single, isolated LAN***"? Define the purpose of VLAN and how VLAN help companies save time and money?

(30 marks)

c. What does it mean when mentioning that SDN decoupling hardware from software?

(22 Marks)

5.

a. What does it mean for a wireless network to be operating in "infrastructure mode?" If the network is not in infrastructure mode, what mode of operation is it in, and what is the difference between that mode of operation and infrastructure mode?

(21 Marks)

b. What are the differences between the following types of wireless channel impairments: path loss, multipath propagation and interference from other sources?

(24 Marks)

c. With the aid of a diagram, explain how collisions are avoided in CSMA/CA wireless LANs

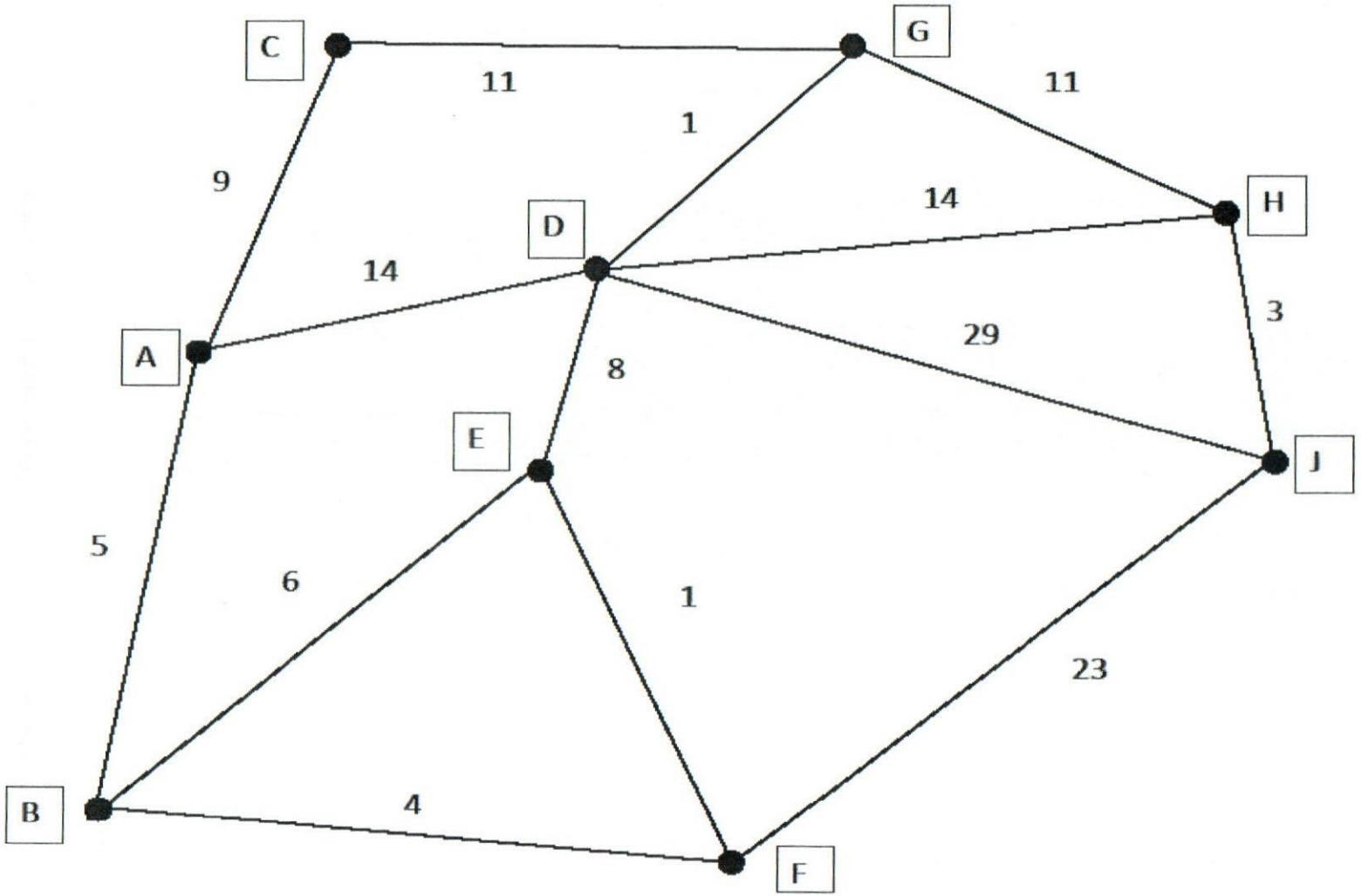
(30 Marks)

d. Describe the different steps involved in WLAN deployment planning.

(25 marks)

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Student Number .....**You should document the method by using labels on this sheet, which must be submitted with your answer booklet, also Illustrate your path on the diagram. Zero marks will be allocated if Dijkstra's method is not illustrated.**



END OF PAPER

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EXAMINATION PAPER

FACULTY OF SCIENCE & ENGINEERING
SCHOOL OF ARCHITECTURE AND BUILT ENVIRONMENT

EXAMINATION PAPER

Module Code	:	**6CV016 (CINEC)**
Module Title	:	**Structural Analysis II**
Date	:	**16th May 2024**
Examiners	:	**Dr. Sumudu Herath**
Time Allowed	:	**3 Hours**

INSTRUCTIONS TO CANDIDATES

- This is a closed book examination.
- You should answer all 04 questions.
- Paper contains total of 5 pages.
- Your responses should be recorded in the answer booklet provided.

MATERIALS REQURIED

- Eight-page answer booklets provided.

You may use a scientific calculator. This must not be programmable and may be inspected during the examination.

Question 01 **(25 marks)**

Loading on structures can be classified based on the nature of its application as static and moving loads.

i. Differentiate the static and moving loads on structures by giving three examples for each. (06 marks)

ii. Differentiate the bending moment diagram and the bending moment influence line at a specific location of a simply supported beam. You may use sketches to aid your answer. (04 marks)

An idealised beam ABCD is to be checked for its resistance against a single point load 15 kN moving from A to D and D to A. Based on the geometric and material properties of the beam, its bending and shear capacities at B are calculated as 20 kNm and 17 kN.

iii. Sketch the bending moment influence lines at B considering a unit load moving from both A to D and D to A. (06 marks)

iv. Sketch the shear force influence lines at B considering a unit load moving from both A to D and D to A. (06 marks)

v. Based on the given bending and shear capacities, determine whether point B of the beam is safe to undertake a real point load of 15 kN. (03 marks)

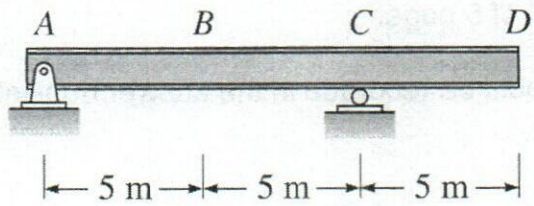


Figure Q1

Question 02 **(25 marks)**

Columns of a building are vital structural elements that play a major role in the load path. Columns transfer the loads from beams to the foundation by means of pure axial forces or axial plus bending actions.

i. Using near sketches, illustrate the load path of a single-storey frame building subjected to an area load on a slab panel. (04 marks)

ii. What are the two failure modes of pure compression members? Use sketches of practical structural engineering applications to support your answer. (04 marks)

iii. A both-end pinned steel column of 4 m height is subjected to a pure axial compressive force of 500 N. If the Young's modulus of steel (E) is 200 GPa and the second moments of area of the section are $I_{major} = 24000\ mm^4$, $I_{minor} = 9000\ mm^4$, find the Euler buckling load of the column and interpret. You may refer to Figure Q2 for effective lengths under various end conditions.

In standard notations, the Euler buckling load is given by $P_{cr} = \pi^2 EI/L_e^2$ (08 marks)

iv. Due to severe corrosion caused by improper maintenance of the steel building, the bottom support of the column is now restricted in both displacements and rotations. What is the implication of this on the Euler buckling load of the columns? (03 marks)

v. Calculate the new Euler buckling load of the column after corrosion. State your structural idealizations clearly. (06 marks)

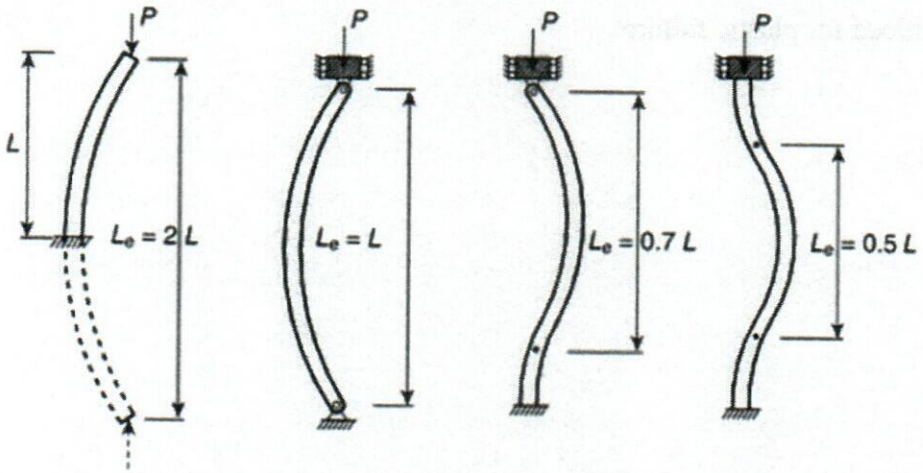


Figure Q2

Question 03 **(25 marks)**

i. "Elastic analysis of steel structures is preferred over plastic analysis when designing steel structures. The resulting design using elastic analysis will not be conservative".

a. Do you agree with the above statement (Yes/No)? (02 marks)

b. List two reasons to justify your decision above. (04 marks)

ii. The steel beam shown in Fig. Q3 is to be analysed using plastic theories. Without performing any calculations, sketch the shape of the bending moment diagram and clearly denote the extreme bending moments developed in the beam. (06 marks)

iii. Clearly stating all calculation steps, assumptions and idealisations; find the critical load that will lead to failure caused by plastic hinge formation of the beam. Use L = 4 m, and the plastic moment capacity (M_p) of the beam as 20 kNm. (08 marks)

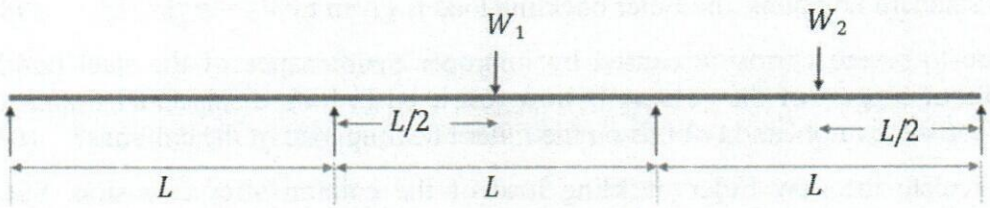


Figure Q3

iv. The right-hand side support is now converted to a fixed support. Calculate the new critical load for plastic failure. (05 marks)

Question 04 **(25 marks)**

i. Using three points, differentiate static loading versus dynamic loading acting on a structure. (03 marks)

ii. List three examples of dynamic loads that should be considered in the design process of a multi-span bridge across the Mahaweli river. (03 marks)

iii. As per the National Annexe of Sri Lanka (NA - SLS EN 1991-1-4-2019) developed for wind loading, explain how you differentiate the calculation of peak pressures in country and town terrains. (03 marks)

iv. The idealisation of a structure to a lumped mass is shown in Fig. Q4, where the total mass (m) is 5000 kg and a single column stiffness is given by $12EI/h^3$. Further $EI = 1.5 \times 10^9$ Nmm^2 and h = 3.5 m. Calculate the natural frequency (f) and period (T) of vibration under undamped free vibration conditions. (08 marks)

v. Explain how ancient Stupas (structures with greater mass) respond and withstand against dynamic loading like the wind. (03 marks)

vi. Explain three ways that you can validate the results of a numerical structural model developed in commercial structural analysis software. Use examples to illustrate each method. (05 marks)

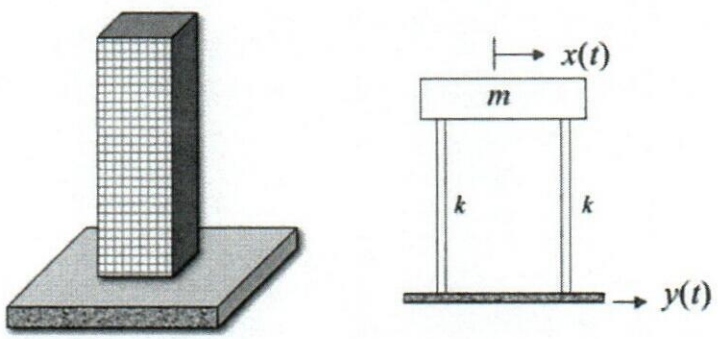


Figure Q4

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FACULTY OF ENGINEERING & TECHNOLOGY

DEPARTMENT OF CIVIL ENGINEERING

FINAL EXAMINATION PAPER

Module Code	:	**4CV009**
Module Title	:	**Site Surveying**
Date	:	**22nd April 2024**
Examiner	:	**Ms. Luckshi Ranasinghe**
Time Allowed	:	**2 Hours**

INSTRUCTIONS TO CANDIDATES

- This is a closed book examination.
- Attempt all questions. Your responses should be recorded on the answer booklet attached.
- You should write legibly in black or blue ink.
- You may not leave the examination room during the first hour or last 30 minutes of the exam.
- An announcement will be made when there are 30 minutes of the exam time left.
- All questions are not equally weighted. Please refer assigned marks for each subpart within the question

MATERIALS REQUIRED

- 12 page answer booklets.
- Level Sheet
- You may use a scientific calculator.

Question 1

a) Briefly explain the objective of surveying

(2 marks)

b) Differentiate between accuracy and precision

(3 marks)

c) A map of the Colombo district is drawn to a scale of 1:100,000 to select 5cm x 15cm rectangular plot near CINEC Campus for future development activities. If the calculated area is to be compiled on a separate map sheet of scale 1:50,000 calculate the mapped area of the mentioned rectangular plot.

(5 marks)

d) A straight survey line PQR crosses a river, where the point Q being on the nearest riverbank to the point P and the point R being on the opposite bank. A perpendicular SQ is ranged at point Q to the left from point Q. Bearing of R and P from point S were observed to be 30^0 and 120^0 respectively. The chainages of P and Q were 375.15m and 447.32m along the survey line. Calculate the chainage of point R.

(15 marks)

Question 2

Linear measurements play a vital role in any construction project. Most surveyors still incorporate the chain/tape for measurement of horizontal distances. However, the effect of temperature, sag and the effect of pull. The effect of temperature is calculated by $(T_m - T_o)KL$, sag by $\frac{W^2L^3}{24P^2}$ and the effect of pull by $\frac{(P-P_o)L}{AE}$.

a) If the distance between two survey stations is greater than 50m, ranging method should be used. Briefly explain uses of ranging in surveying activities.

(5 marks)

b) Explain the effect of temperature, sag, and effect of pull over linear measurements including its calculation notations

(5 marks)

c) A 50m steel tape was used to take horizontal distance measurements of a 20^0C and under a pull of 5kg. The tape was used in measuring 30m length at a temperature of 30^0C under a pull of 8kg. Calculated the correct horizontal distance.

Cross sectional area of the steel tape	= 0.02cm^2
Young's modulus of steel	= 207 kN/mm^2
Coefficient of linear expansion of steel	= 1.15 x 10^{-5} per ^{0}C
Weight per unit length	= 20g/m

(15 marks)

Question 3

Define the relative position of one point with respect to another. It's not normally used as absolute coordinates such as eastings and northings on a rectangular coordinate system. When the coordinates are known, the horizontal distance and whole circle bearing can be computed.

a) Briefly explain following terms used in compass surveying
   i) Polar coordinates
   ii) True meridian
   iii) Reduced bearing
   iv) Local attraction
   v) Fore and back bearing

(2x5 marks)

b) Local attraction is one significant source of error in compass surveying. Two methods can be used to minimize the effect of local attraction. Explain the interior angle method.

(05 marks)

c) P, Q, R ns S are four stations whose coordinates are as shown in table Q4. Another station X is to be fixed at the intersection of the lines PR and QS. Calculate the coordinates of X.

Station	Easting (m)	Northing (m)
P	1000.00	1000.00
Q	1180.94	1075.18
R	1021.98	1215.62
S	939.70	1102.36

(10 marks)

Question 4

a) There are two methods to complete a level. Explain why the collimation method is less preferred?

(05 marks)

b) A level was conducted using the preferred method of leveling. However, a few readings that have been recorded in a field book are not visible. Draw the given table on your answer sheet and fill in the blanks.

Station points	BS	IS	FS	Rise	Fall	RL	Remarks
1	2.362					X1	BM A
2		1.335		1.027		X2	Lamp post
3	1.451		1.325	A		X3	CP 1
4	C		1.889		B	X4	CP 2
5	1.442		1.674		0.399	X5	CP 3
6		D			0.025	100.175	Lamp post
7		1.202		0.265		X6	Curb
8	E		1.691		0.489	X7	CP 4
9			1.275	0.059		X8	BM A
	7.864		**F**	**G**	**H**		

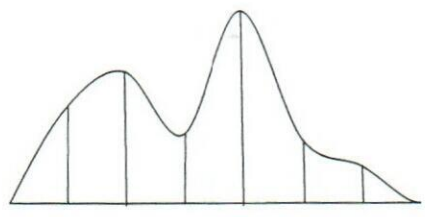
(10 marks)

c) Illustrate the role of Trapezoidal rule for the determination of areas

(05 marks)

d) The figure given below shows the offsets from boundary AB. Compute the area included in the irregular boundary using a preferred method.

Chainage from A (m)	0	110	220	330	440	550	660	770
Offset (m)	20	32.5	35.0	30.7	39.6	28.7	25.7	20



(05 marks)

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EXAMINATION PAPER

Module Code	:	**4MA014**
Module Title	:	**Engine and Chassis design**
Academic Year	:	**Semester 2/2024**
Date	:	**22nd April 2024**
Examiners	:	**Yohan Silva**
Time Allowed	:	**3 Hours**

INSTRUCTIONS TO CANDIDATES

- This is a closed book examination. The paper consists of 4 questions in 6 pages.
- You Should Answer **All 4 questions**. Each question carries equal marks.
- Answers should be written in the answer booklet provided Additional papers can be obtained and should be attached.
- Show all stages of your work.

MATERIALS REQUIRED

- Answer Booklet.
- You may use a Scientific calculator. This must not be programmable and may be inspected during the examination.

Attempt all questions.

Question 01

a) Using annotated sketches explain the operation of spark ignition four stroke engine. Clearly identifying Piston motion, valve action and processes inside combustion chamber for each stroke.

(10 marks)

b) For an internal combustion engine sketch and annotate the "ideal" and "real" PV diagram.
(5 marks)

c) Figure 1 below shows an electronic fuel injection system. State the names and purposes of components 3, 5, 8, 12, and 17.

(10 marks)

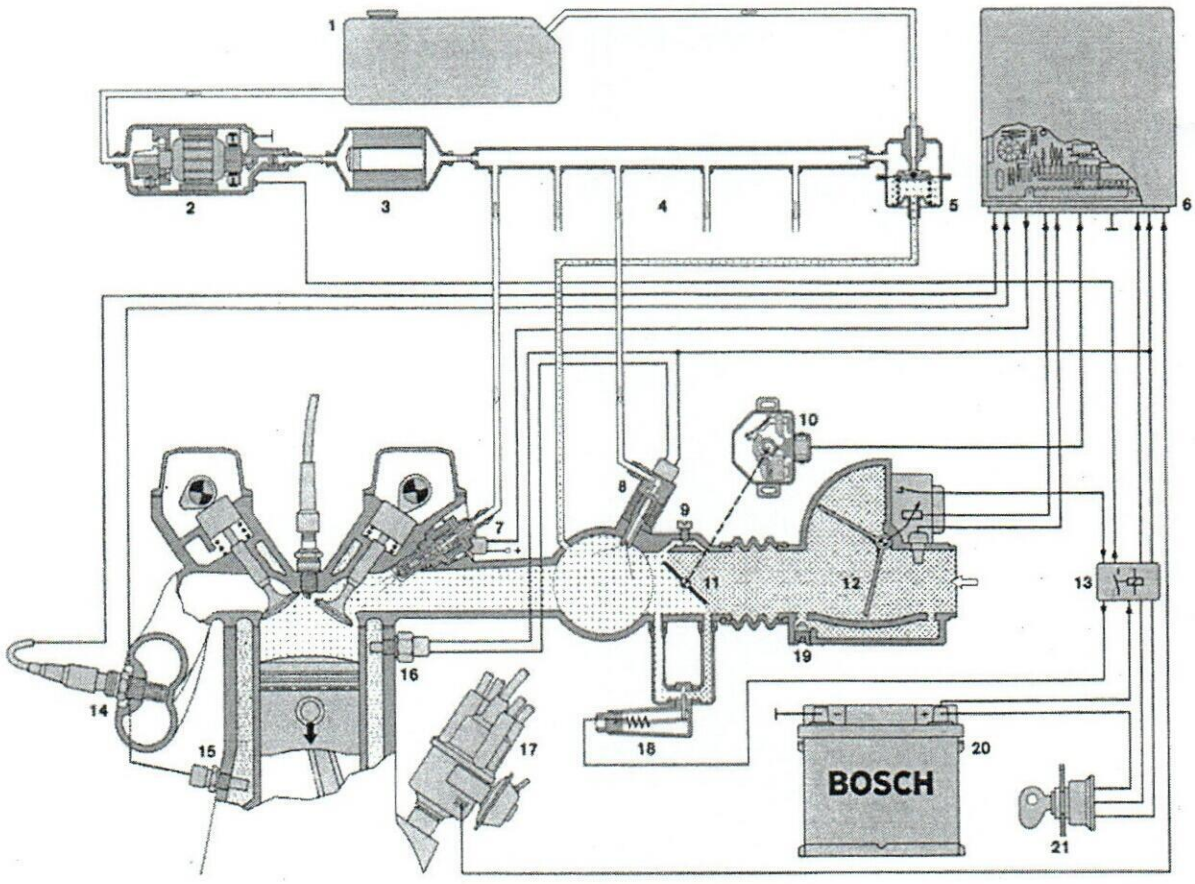


Figure 1.

(Total: 25 marks)

Question 02

For the Lamborghini Luxury Sport car shown below

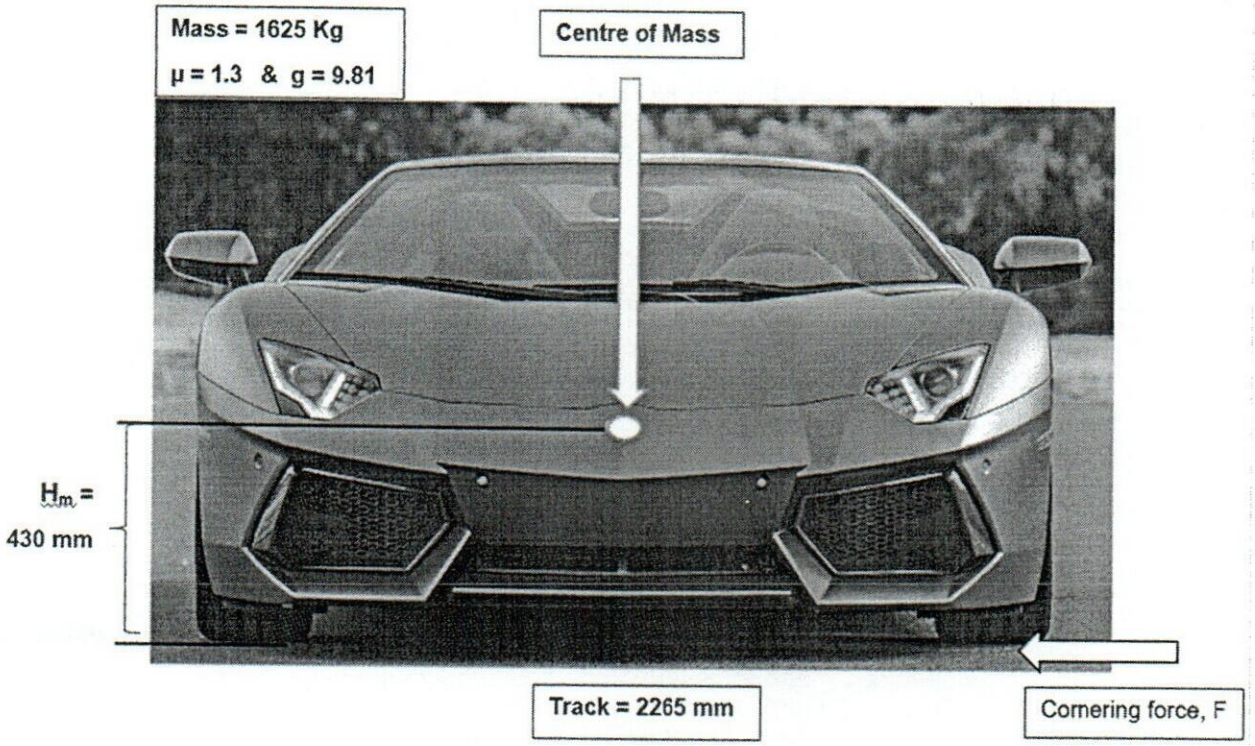


Figure 2

The driver is going to fill the fuel tank up to 75 litres. The fuel density is 847 kg/m^3. Filling up the tank cause reduction of centre of mass from 430 mm to 395 mm. Considering all information to calculate:

(i) Value of combined cornering force. **(5 marks)**

(ii) The maximum lateral weight transfers in total. **(10 marks)**

(iii) Calculate the maximum velocity in km/hr that the car can travel before the wheels slide when the corner radius is 65 m. **(10marks)**

(Total: 25 marks)

Question 3

a) What are the functions of a clutch?. (2 marks)

b) State **two advantages** of diaphragm spring clutch and **two advantages** of coil spring clutch. (4 marks)

c) Figure 2 below shows an exploded view of a diaphragm spring clutch. Name components A,B,C,D,E, F and G.

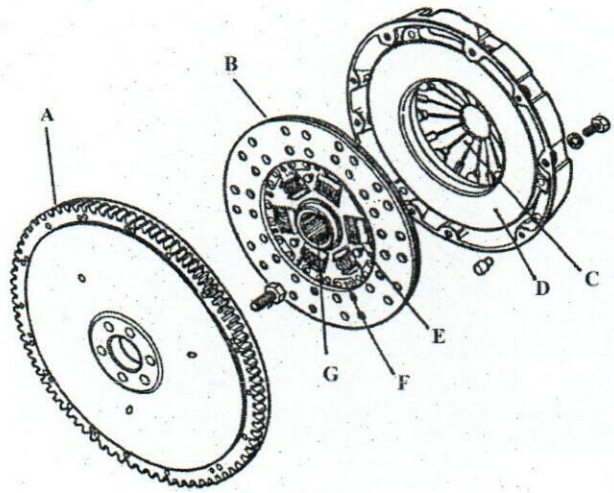


figure 3

(7 marks)

d) State the function of the 'cooling system' of an internal combustion engine.

(2 marks)

e) With an aid of a block diagram explain the oil flow sequence of an engine lubrication system.

(5 marks)

f) What are the functions of an engine lubrication system?

(2 marks)

g) In the drive train what is the significant for a differential? Use sketches to annotate your answer as needed.

(3 marks)

(Total: 25 marks)

Question 4

a) Explain the difference between independent suspension system and rigid axle (Solid axle) suspension system. Use sketches to annotate your answer as needed.

(4 marks)

b) Define "wheel track" and "wheel base" use sketches for your explanation.

(3 marks)

c) State the name and purpose / function of component labeled 'X' in the figure 3 below.

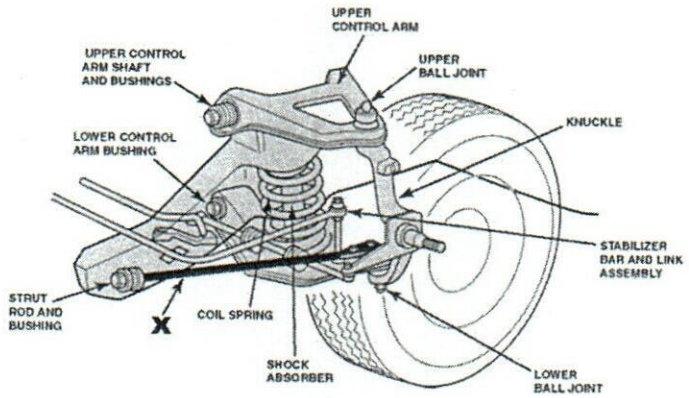


Figure 4.

(4 marks)

d) From the figure 4 below, list the load carrying ball joints and non-load carrying (friction) ball joints.

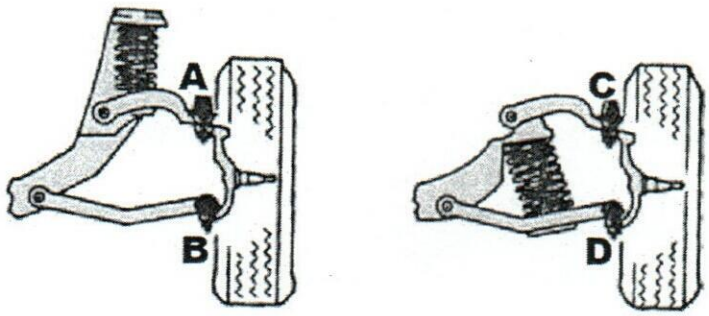


Figure 5.

(4 marks)

e) Figure 5 below shows a cut way diagram of a typical double tube shock absorber. Referring to the diagram below explain the function of the shock absorber during rebound (Extension) and jounce (Compression).

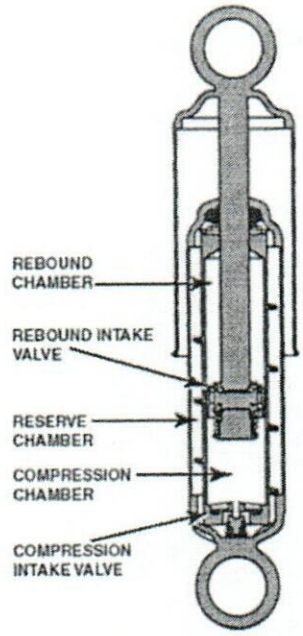


Figure 6.

(10 marks)

(Total: 25 marks)

-The end-

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FACULTY OF ENGINEERING & TECHNOLOGY

IN-CLASS TEST 02

Module Code	:	**4MM028**
Module Title	:	**Engineering Mathematics II**
Date	:	**April 2024**
Examiner	:	**Ms. Hiruni Wickramasinghe**
Time Allowed	:	**3 Hours**

INSTRUCTIONS TO CANDIDATES

- This is a **closed book** examination.
- **Attempt all questions**. Your responses should be recorded on the answer booklet attached.
- You should write legibly in black or blue ink.
- You may use a scientific calculator. This must not be programmable and may be inspected during the examination.
- **Additional Information is provided on page 4 and 5.**
- You may not leave the examination room during the first hour or last 30 minutes of the exam.
- An announcement will be made when there are 30 minutes of the exam time left.

1.

I. The Partial discharge, V, between the plates of a capacitor C charged by a steady voltage E through a resistor R is given by the equation

$$CR\frac{dv}{dt} + V = E$$

a) Solve the equation for V given that at t=0, V =0. **(20 marks)**

b) Calculate V, correct to 3 significant figures, when E =25V, C =20×10^{-6}F, R=$200\times10^{3}\Omega$ and t = 3.0 s. **(10 marks)**

II. Consider the following second order differential equation,

$$2\frac{d^2y}{dx^2} + 5\frac{dy}{dx} - 3y = 0$$

a) Determine the particular solution when x=0.y=4 and $\frac{dy}{dx} = 9$ **(30 marks)**

b) Use the Laplace transform method to solve the above second order differential equation $[y(0) = 4, y'(0) = 9]$ **(30 marks)**

c) What can you say about the solution, Comparing the Part a and b. **(10 marks)**

2.

I. Use **Euler's method** to obtain a numerical solution of the differential equation

$$\frac{dy}{dx} = 1 + x - y$$

Given the initial conditions that at x =1, y=2, for the range x =1(0.2)2. Draw the graph of the solution in this range. **(30 marks)**

II. Let $\frac{dy}{dx} = 2x - y$, y (0) =k

a) If y (0.1) = 1.82 using the improved Euler (Euler-Cauchy) method with a step size of h = 0.1 then find the value of k. **(20 marks)**

b) Apply the improved Euler method to find y (0.2). (Consider the step size in a)) **(15 marks)**

c) Solve the above differential equation using integrating factor method. **(20 marks)**

d) Hence, find the percentage error with improved Euler method for x= 0.2

(15 marks)

3. $$f(x)\begin{cases}+2 & when \quad -\pi < x < 0 \\ -2 & when \quad 0 < x < \pi\end{cases}$$

a) Sketch a graph of f (x) in the interval $(-2\pi, 2\pi)$. **(20 marks)**

b) Find the fourier series representation of f(x) **(50 marks)**

c) Deduce a series for $\frac{\pi}{4}$ at the point where $x = \frac{\pi}{2}$ **(30 marks)**

$$\left[\frac{\pi}{4} = 1 - \frac{1}{3} + \frac{1}{5} - \frac{1}{7} + \cdots\right]$$

Additional Information

Table1.1 Elementary standard Laplace transforms

	Function $f(t)$	Laplace transforms $\mathcal{L}\{f(t)\}=\int_0^\infty e^{-st} f(t)\,dt$
(i)	1	$\frac{1}{s}$
(ii)	k	$\frac{k}{s}$
(iii)	e^{at}	$\frac{1}{s-a}$
(iv)	$\sin at$	$\frac{a}{s^2+a^2}$
(v)	$\cos at$	$\frac{s}{s^2+a^2}$
(vi)	t	$\frac{1}{s^2}$
(vii)	t^2	$\frac{2!}{s^3}$
(viii)	$t^n\ (n=1,2,3,\ldots)$	$\frac{n!}{s^{n+1}}$
(ix)	$\cosh at$	$\frac{s}{s^2-a^2}$
(x)	$\sinh at$	$\frac{a}{s^2-a^2}$

Table1.2 Laplace transforms of the form $e^{at}f(t)$

Function $e^{at} f(t)$ (a is a real constant)	Laplace transform $\mathcal{L}\{e^{at} f(t)\}$
(i) $e^{at}t^n$	$\frac{n!}{(s-a)^{n+1}}$
(ii) $e^{at}\sin\omega t$	$\frac{\omega}{(s-a)^2+\omega^2}$
(iii) $e^{at}\cos\omega t$	$\frac{s-a}{(s-a)^2+\omega^2}$
(iv) $e^{at}\sinh\omega t$	$\frac{\omega}{(s-a)^2-\omega^2}$
(v) $e^{at}\cosh\omega t$	$\frac{s-a}{(s-a)^2-\omega^2}$

Laplace Transform of the derivatives

$$L\left\{\frac{dy}{dx}\right\} = sL\{y\} - y(0)$$

$$L\left\{\frac{d^2y}{dx^2}\right\} = s^2L\{y\} - sy(0) - y'(0)$$

Euler's method Equation

$$y_1 = y_0 + \mathrm{h}\, f(x_0, y_0)$$

Improved Euler's method Equation

$$y_1 = y_0 + \frac{1}{2}h[f(x_0, y_0) + f(x_0 + h, y_0 + hf(x_0, y_0))]$$

Fourier series corresponding to f (x).

$f(x) = a_0 + \sum_{n=1}^{\infty}(a_n cosnx + b_n sinnx)$ where the range $-\pi$ to π

$$a_0 = \frac{1}{2\pi}\int_{-\pi}^{\pi} f(x)dx$$

$$a_n = \frac{1}{\pi}\int_{-\pi}^{\pi} f(x)cosnx\, dx$$

$$b_n = \frac{1}{\pi}\int_{-\pi}^{\pi} f(x)sinnx\, dx$$

n= (1,2, 3.....)

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FACULTY OF ENGINEERING & TECHNOLOGY

IN-CLASS TEST 02

Module Code	:	**3MM003**
Module Title	:	**Foundation mathematics I**
Date	:	**April 2024**
Examiner	:	**Ms. Hiruni Wickramasinghe**
Time Allowed	:	**2 Hours**

INSTRUCTIONS TO CANDIDATES

- This is a closed book examination
- You may use a scientific calculator. This must not be programmable and may be inspected during the examination.
- This question paper consists of **four** questions.
- Answer **all four** questions.
- Show all stages of your work, with diagrams where appropriate.
- Write legibly in blue or black ink.

1.

a) Prove the following identities

I. $\tan x \sin x + \cos x = \sec x$

II. $\frac{\cos\theta}{1+\sin\theta} + \frac{1+\sin\theta}{\cos\theta} = 2\sec\theta$

III. $\frac{\tan\alpha+\cot\alpha}{\tan\alpha} = \csc^2\alpha$

(50 Marks)

b) Suppose that sin A = 3/5 and that cos B = 5 /13, where A and B are acute angles. find sin(A+B) and cos(A−B)

(25 Marks)

c) Using expansion of Tan (A-B), Show clearly that $\tan 15^0 = 2 - \sqrt{3}$

(25 Marks)

2. Prove the following identities

a) $\cos 2\alpha = \frac{1-\tan^2\alpha}{1+\tan^2\alpha}$ **(10 Marks)**

b) $\sin 3x = 3\sin x.\cos^2 x - \sin^3 x$ **(15 Marks)**

c) $\frac{\sin^2\theta+4\sin\theta+3}{\cos^2\theta} = \frac{3+\sin\theta}{1-\sin\theta}$ **(15Marks)**

d) $\frac{\cos(4t)-\cos(2t)}{\sin(4t)+\sin(2t)} = -\tan t$ **(15Marks)**

e) $\sin\frac{x}{2}\sin\frac{7x}{2} + \sin\frac{3x}{2}\sin\frac{11x}{2} = \sin 2x \sin 5x$ **(25 Marks)**

f) $\cos(36^0 - A)\cos(36^0 + A) + \cos(54^0 + A)\cos(54^0 - A) = \cos 2A$

(20 Marks)

1.

a) Prove the following identities

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e) $\sin\frac{x}{2}\sin\frac{7x}{2} + \sin\frac{3x}{2}\sin\frac{11x}{2} = \sin 2x \sin 5x$ **(25 Marks)**

f) $\cos(36^0 - A)\cos(36^0 + A) + \cos(54^0 + A)\cos(54^0 - A) = \cos 2A$

(20 Marks)

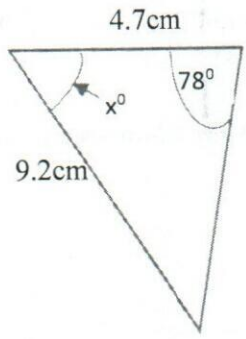
3.

a) If A+B+C=180°, then prove the identities given below

I. $sin2A - \sin 2B + sin2C = 4\, cosA.sinB.\cos C$ **(20 Marks)**

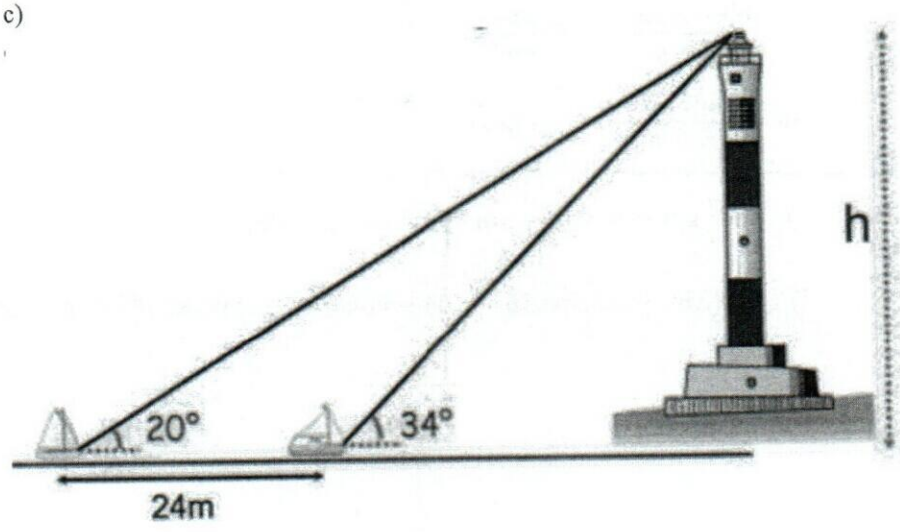
II. $sin^2A + sin^2B - sin^2C = 2sinA.sinB.cosC$ **(25 Marks)**

b) Find the Value of the angle "x"



(20 Marks)

c)



Two small boats are 24m apart.

The angle of elevation of the boats to the top of a light house are 20^0 and 34^0 respectively. Calculate the height of the light house. **(20 Marks)**

Additional Information

$$\sin(A+B) = \sin A \cos B + \cos A \sin B$$

$$\sin(A-B) = \sin A \cos B - \cos A \sin B$$

$$\cos(A+B) = \cos A \cos B - \sin A \sin B$$

$$\cos(A-B) = \cos A \cos B + \sin A \sin B$$

$$\tan(A+B) = \frac{\tan A + \tan B}{1 - \tan A \tan B}$$

$$\tan(A-B) = \frac{\tan A - \tan B}{1 + \tan A \tan B}$$

$$\sin 2A = 2 \sin A \cos A \qquad \cos 2A = \cos^2 A - \sin^2 A \qquad \tan 2A = \frac{2 \tan A}{1 - \tan^2 A}$$

$$\sin A + \sin B = 2 \sin\left(\frac{A+B}{2}\right) \cos\left(\frac{A-B}{2}\right)$$

$$\sin A - \sin B = 2 \cos\left(\frac{A+B}{2}\right) \sin\left(\frac{A-B}{2}\right)$$

$$\cos A + \cos B = 2 \cos\left(\frac{A+B}{2}\right) \cos\left(\frac{A-B}{2}\right)$$

$$\cos A - \cos B = -2 \sin\left(\frac{A+B}{2}\right) \sin\left(\frac{A-B}{2}\right)$$

$$\cos A = \frac{b^2 + c^2 - a^2}{2bc}$$

$$\cos^2\theta + \sin^2\theta = 1$$

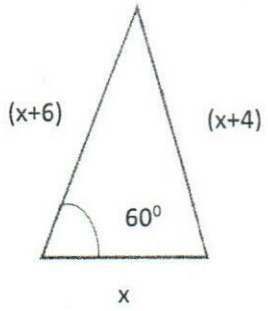
$$1 + \tan^2\theta = \sec^2\theta$$

$$\cot^2\theta + 1 = \csc^2\theta$$

In radians	In degrees
If $\sin\theta = \sin\alpha$, then $\theta = n\pi + (-1)^n \alpha$	If $\sin\theta = \sin\alpha$, then $\theta = 180n + (-1)^n \alpha$
If $\cos\theta = \cos\alpha$, then $\theta = 2n\pi \pm \alpha$	If $\cos\theta = \cos\alpha$, then $\theta = 360n \pm \alpha$
If $\tan\theta = \tan\alpha$, then $\theta = n\pi + \alpha$	If $\tan\theta = \tan\alpha$, then $\theta = 180n + \alpha$

[In each case, n is an integer.]

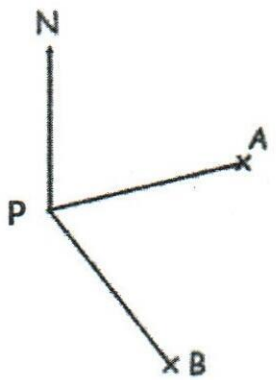
d) Find the value of "x"



(15 Marks)

4.

a)



Two ships, A and B, leave a port P at 11.00. A travel on a bearing of 80^0 from north at a speed 25km/h and B travel on a bearing of 152^0 from north at a speed 20km/h. Work out the distance between A and B at 14.00. **(25 Marks)**

b) Find Solutions for following trigonometric equation

I. $3\sin^2 3x - 7\cos 3x = 5 \quad 0 \leq x < 180°$ **(25 Marks)**

II. $2\sin\theta = 5\cos\theta \quad 0 \leq° \theta < 360°$ **(20 Marks)**

c) Sketch the functions $y = Sin3x, y = 1 + Sinx$ & $y = cos\ (x - 90°)$ in the region $0 \leq x \leq 2\pi$. The sketches must include the coordinates of all the points where each of the graphs meets the two axes.

(30 Marks)

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FACULTY OF SCIENCE & ENGINEERING
SCHOOL OF MATHEMATICS AND COMPUTER SCIENCE

EXAMINATION PAPER

BSc (Hons) CN
Sem 2.

Module Code	:	**6CC004**
Module Title	:	**NETWORK SECURITY**
Date	:	**Sem 2**
Examiners	:	**DR GREGORY EPIPHANIOU**
Time Allowed	:	**2 Hours**
Date	:	**16th February 2020**

INSTRUCTIONS TO CANDIDATES

- This is a Closed book examination.
- You Should Attempt 4 Questions in Total.
- Each answer to be written in a separate answer Sheets.

MATERIALS REQUIRED

- 1 six page answer booklet(s), use a separate Sheets for each question.
- You may use a scientific calculator. This must not be programmable and may be inspected during the examination.

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Question 1 **25 marks**

a) Briefly describe rootkit(s) and discuss their key functionalities and measures against them. 10 marks

b) Briefly differentiate Kernel vs User Space in a Linux System. 8 marks

c) **setuid** (short for "set user ID upon execution") is a Unix access rights flag that allow users to run an executable with the permissions of the executable's owner and to change behaviour in directories. Discuss weaknesses of running a program with **setuid root**. 7 marks

Question 2 **25 marks**

a) IPSecurity (IPSec) is a framework that provides security services at the IP layer by enabling a system to select required security protocols, determine the algorithm(s) to use for the service(s), and put in place any cryptographic keys required to provide the requested services. Critically discuss the two different modes of operation in which IPSec can operate 10 marks

b) Briefly describe a VPN and three reasons that Why do organizations use VPNs? 8 marks

a) Briefly describe SSL Record Protocol. 7 marks

Question 3 **25 marks**

a) The rise in popularity of Internet of Things (IoT) connected devices leading to rise in IoT app development which comes with its fair share of concerns and security challenges. Due to the huge competition among manufacturers to be the first mover who gets the latest device in the hands of consumers, they are lagging behind considering the security issues associated with data access & management as well as with that of the IoT devices themselves. Critically discuss security challenges associated with IoT adoption. 10 marks

b) A WSN can be broadly described as a cluster of networked nodes with the ability to sense data around its periphery and control the surrounding environment. Briefly describe three security threats associated with WSN. 8 marks

c) Wi-Fi Protected Access (WPA) is a security standard for users of computing devices equipped with wireless internet connections, or Wi-Fi. Briefly discuss security ramifications associated with WEP. 7 marks

Question 4 **25 Marks**

a) Bring your own device (BYOD) is a phrase used to describe the process in which employees bring their own computing devices such as tablets, laptops and smartphones to the workplace and connect them on the secure corporate network. Critically discuss security risks associated with BYOD adoption — 10 marks

b) A hash function is any function that can be used to map data of arbitrary size onto data of a fixed size. Briefly explain the importance of hashing function in cryptography. — 8 marks

c) Kerberos is a network authentication protocol which is designed to provide strong authentication for client/server applications by using secret-key cryptography with a aid of proper labelled diagram briefly explain the Kerberos operation. — 7 marks

Question 5 **25 marks**

a) Firewalls are a fundamental element if any Information Technology infrastructure. Briefly explain why Secure Firewall Protection is Vital for Business. — 10 marks

b) Discuss the key difference between stateful and stateless IP packet filtering. — 8 marks

c) With references to IPTables operation, explain what the command below does: — 7 marks
iptables -A INPUT –p tcp –m state –state NEW –m tcp –dport 22 –j ACCEPT

Question 6 **25 marks**

a) Critically discuss best practices for converged network security. — 10 marks

b) Briefly describe three detection mechanism used in intruder detection system (IDS). — 8 marks

c) With an aid of a diagram briefly describe the Distributed IDS. — 7 marks

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Question 7 **25 marks**

a) Voice over IP (VoIP) is the the technology for delivering voice communications over IP-based networks such as the Internet or other packet-switched networks. Briefly explain on problematic areas due to security on VoIP. 8 marks

b) Session Initiation Protocol (SIP) is an application-layer signalling protocol mainly responsible for initiating, maintaining and terminating a VoIP call under unicast or multicast transmissions. Briefly describe SIP Diggest Authentication and its operation using a suitable diagram. 10 marks

c) Briefly explain on any security threat related to SIP with the aid of a diagram. 7 marks

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Student Number .....

BSc (Hons) CN – Sem 1

FACULTY OF SCIENCE & ENGINEERING
SCHOOL OF ENGINEERING, COMPUTING AND MATHEMATICAL SCIENCES

EXAMINATION PAPER

Module Code	:	5CS031
Module Title	:	Network Security
Date	:	31st July 2023
Examiners	:	Dr C Mbarushimana / Mr. Nimesh Polwaththage
Time Allowed	:	02 hrs

INSTRUCTIONS TO CANDIDATES

- This is a Closed book examination.
- Answer all the questions

MATERIALS REQURIED

- You should write legibly in black or blue ink

Question :1

A flaw or weakness in a system's design, implementation, or operation and management that could be exploited to violate the system's security policy is a(n) _____.

- countermeasure
- vulnerability
- adversary
- risk

Question :2

A(n) _____ is an attempt to learn or make use of information from the system that does not affect system resources.

- passive attack
- inside attack
- active attack
- outside attack

Question :3

A(n) _____ is an action, device, procedure, or technique that reduces a threat, a vulnerability, or an attack by eliminating or preventing it, by minimizing the harm it can cause, or by discovering and reporting it so that correct action can be taken.

- attack
- adversary
- countermeasure
- protocol

Question :4

The assurance that data received are exactly as sent by an authorized entity is _____.

- data integrity
- data confidentiality
- authentication
- access control

Question :5

An assault on system security that derives from an intelligent act that is a deliberate attempt to evade security services and violate the security policy of a system is a(n) _____.

- asset
- risk
- vulnerability
- attack

Question :6

Masquerade, falsification, and repudiation are threat actions that cause _____ threat consequences.

- deception
- disruption
- unauthorized disclosure
- usurpation

Question :7

The original message or data that is fed into the algorithm is _____.

- encryption algorithm
- plaintext
- secret key
- decryption algorithm

Question :8

The most important symmetric algorithms, all of which are block ciphers, are the DES, triple DES, and the _____.

- SHA
- AES
- RSA
- DSS

Question :9

If the only form of attack that could be made on an encryption algorithm is brute-force, then the way to counter such attacks would be to _____ .

- use more keys
- use shorter keys
- use longer keys
- use less keys

Question :10

_____ is a procedure that allows communicating parties to verify that received or stored messages are authentic.

- Cryptanalysis
- Decryption
- Collision resistance
- Message authentication

Question :11

The purpose of a _____ is to produce a "fingerprint" of a file, message, or other block of data.

- secret key
- digital signature
- hash function
- keystream

Question :12

A _____ is created by using a secure hash function to generate a hash value for a message and then encrypting the hash code with a private key.

- digital signature
- keystream
- secret key
- one way hash function

Question :13

Like the MAC, a hash function also takes a secret key as input.

- True
- False

Question :14

Digital signatures and key management are the two most important applications of _____ encryption

- private-key
- public-key
- preimage resistant
- advanced

Question :15

Presenting or generating authentication information that corroborates the binding between the entity and the identifier is the _____.

- identification step
- verification step
- authentication step
- corroboration step

Question :16

The _____ strategy is when users are told the importance of using hard to guess passwords and provided with guidelines for selecting strong passwords.

- reactive password checking
- proactive password checking
- user education
- computer-generated password

Question :17

A _____ is when an adversary attempts to achieve user authentication without access to the remote host or to the intervening communications path.

- client attack
- host attack
- eavesdropping attack
- Trojan horse attack

Question :18

A _____ strategy is one in which the system periodically runs its own password cracker to find guessable passwords.

- user education
- proactive password checking
- reactive password checking
- computer-generated password

Question :19

An individual's signature is not unique enough to use in biometric applications.

- True
- False

Question :20

_____ implements a security policy that specifies who or what may have access to each specific system resource and the type of access that is permitted in each instance.

- Audit control
- Resource control
- Access control
- System control

Question :21

_____ is verification that the credentials of a user or other system entity are valid.

- Adequacy
- Authentication
- Authorization
- Audit

Question :22

_____ controls access based on comparing security labels with security clearances.

- MAC
- DAC
- RBAC
- MBAC

Question :23

A _____ is an entity capable of accessing objects

- group
- object
- subject
- owner

Question :24

The final permission bit in Unix is the _____ bit.

- superuser
- kernel
- sticky
- set user

Question :25

_____ is based on the roles the users assume in a system rather than the user's identity.

- DAC
- RBAC
- URAC
- MAC

Question :26

Any program that is owned by, and SetUID to, the "superuser" potentially grants unrestricted access to the system to any user executing that program.

- True
- False

Question :27

A _____ is a security event that constitutes a security incident in which an intruder gains access to a system without having authorization to do so.

- intrusion detection
- IDS
- criminal enterprise
- security intrusion

Question :28

A _____ monitors the characteristics of a single host and the events occurring within that host for suspicious activity.

- host-based IDS
- security intrusion
- intrusion detection
- network-based IDS

Question :29

_____ involves an attempt to define a set of rules or attack patterns that can be used to decide if a given behavior is that of an intruder

- Profile based detection
- Signature detection
- Anomaly detection
- Threshold detection

Question :30

A(n) _____ is inserted into a network segment so that the traffic that it is monitoring must pass through the sensor.

- passive sensor
- analysis sensor
- inline sensor
- LAN sensor

Question :31

A (n) _____ is a hacker with minimal technical skill who primarily uses existing attack toolkits.

- Master
- Apprentice
- Activist
- Journeyman

Question :32

The _____ is the ID component that analyzes the data collected by the sensor for signs of unauthorized or undesired activity or for events that might be of interest to the security administrator.

- data source
- operator
- sensor
- analyzer

Question :33

_____ involves the collection of data relating to the behavior of legitimate users over a period of time.

- Profile based detection
- Signature detection
- Anomaly detection
- Threshold detection

Question :34

Typically the systems in the _____ require or foster external connectivity such as a corporate Web site, an e-mail server, or a DNS server.

- DMZ
- IP protocol field
- VPN
- boundary firewall

Question :35

_____ scans for attack signatures in the context of a traffic stream rather than individual packets.

- Pattern matching
- Protocol anomaly
- Stateful matching
- Traffic anomaly

Question :36

A _____ consists of a set of computers that interconnect by means of a relatively unsecure network and makes use of encryption and special protocols to provide security

- proxy
- VPN
- UTM
- stateful inspection firewall

Question :37

A packet filtering firewall is typically configured to filter packets going in both directions.

- True
- False

Question :38

A _____ attack is a bot attack on a computer system or network that causes a loss of service to users.

- spam
- phishing
- DDoS
- sniff

Question :39

In order to accelerate the introduction of strong security into WLANs the Wi-Fi Alliance promulgated _____, a set of security mechanisms that eliminates most 802.11 security issues, as a Wi-Fi standard.

- WPA
- WEP
- RSN
- MAC

Question :40

_____ is the recommended technique for wireless network security.

- Using encryption
- Using anti-virus and anti-spyware software
- Turning off identifier broadcasting
- All of the above

Question :41

The smallest building block of a wireless LAN is a _____.

- BSS
- ESS
- CCMP
- WPA

Question :42

_____ defines a number of content formats, which standardize representations for the support of multimedia e-mail.

- MEM
- MIME
- MSC
- DKIM

Question :43

ESP supports two modes of use: transport and _____.

- padding
- tunnel
- payload
- sequence

Question :44

IPsec can assure that _____.

- a router advertisement comes from an authorized router
- a routing update is not forged
- a redirect message comes from the router to which the initial packet was sent
- all of the above

Question :45

_____ is a list that contains the combinations of cryptographic algorithms supported by the client.

- Compression method
- Session ID
- CipherSuite
- None of the above

Question :46

A Trojan horse is an apparently useful program containing hidden code that, when invoked, performs some harmful function.

- True
- False

Question :47

Unsolicited bulk e-mail is referred to as _____.

- propagating
- spam
- crimeware
- phishing

Question :48

_____ will integrate with the operating system of a host computer and monitor program behavior in real time for malicious actions.

- Fingerprint-based scanners
- Behavior-blocking software
- Heuristic scanners
- Generic decryption technology

Question :49

_____ attacks are vulnerabilities involving the inclusion of script code in the HTML content of a Web page displayed by a user's browser.

- PHP file inclusion
- Mail injection
- Code injection
- Cross-site scripting

Question :50

The _____ is what the virus "does".

- infection mechanism
- trigger
- payload
- logic bomb

----------End of the Examination----------

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Student Number .....

Sem2

FACULTY OF SCIENCE & ENGINEERING
SCHOOL OF COMPUTING AND MATHEMATICS

Resit EXAMINATION PAPER

Module Code	:	6CS010
Module Title	:	Digital Forensics
Date	:	21st May 2023
Examiners	:	Dr C Mbarushimana / Mr. Nimesh Pollwaththage
Time Allowed	:	1.5 hrs

INSTRUCTIONS TO CANDIDATES

- This is a Closed book examination.
- You Should Attempt 3 Questions in Total

MATERIALS REQURIED

- Answer booklet.
- You may use a scientific calculator. This must not be programmable, and may be inspected during the examination.
- You should write legibly in black or blue ink

Question 1:

Explain the the four ACPO principles of computer based electronic evidence. Illustrate your answer with examples. ***20 marks***

Question 2:

The figure below shows the first sector of a MBR disk.

```
Offset(d) 00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15

00000000  33 C0 8E D0 BC 00 7C 8E C0 8E D8 BE 00 7C BF 00  3ÀŽÐ¼.|ŽÀŽØ¾.|¿.
00000016  06 B9 00 02 FC F3 A4 50 68 1C 06 CB FB B9 04 00  .¹..üó¤Ph..Ëû¹..
00000032  BD BE 07 80 7E 00 00 7C 0B 0F 85 0E 01 83 C5 10  ½¾.€~..|.....ƒÅ.
00000048  E2 F1 CD 18 88 56 00 55 C6 46 11 05 C6 46 10 00  âñÍ.ˆV.UÆF..ÆF..
00000064  B4 41 BB AA 55 CD 13 5D 72 0F 81 FB 55 AA 75 09  ´A»ªUÍ.]r..ûUªu.
00000080  F7 C1 01 00 74 03 FE 46 10 66 60 80 7E 10 00 74  ÷Á..t.þF.f`€~..t
00000096  26 66 68 00 00 00 00 66 FF 76 08 68 00 00 68 00  &fh....fÿv.h..h.
00000112  7C 68 01 00 68 10 00 B4 42 8A 56 00 8B F4 CD 13  |h..h..´BŠV.‹ôÍ.
00000128  9F 83 C4 10 9E EB 14 B8 01 02 BB 00 7C 8A 56 00  ŸƒÄ.žë.¸..».|ŠV.
00000144  8A 76 01 8A 4E 02 8A 6E 03 CD 13 66 61 73 1C FE  Šv.ŠN.Šn.Í.fas.þ
00000160  4E 11 75 0C 80 7E 00 80 0F 84 8A 00 B2 80 EB 94  N.u.€~.€.„Š.²€ë„
00000176  55 32 E4 8A 56 00 CD 13 5D EB 9E 81 3E FE 7D 55  U2äŠV.Í.]ëž.>þ}U
00000192  AA 75 6E FF 76 00 E8 8D 00 75 17 FA B0 D1 E6 64  ªunÿv.è..u.ú°Ñæd
00000208  E8 83 00 B0 DF E6 60 E8 7C 00 B0 FF E6 64 E8 75  èƒ.°ßæ`è|.°ÿædèu
00000224  00 FB B8 00 BB CD 1A 66 23 C0 75 3B 66 81 FB 54  .û¸.»Í.f#Àu;f.ûT
00000240  43 50 41 75 32 81 F9 02 01 72 2C 66 68 07 BB 00  CPAu2.ù..r,fh.».
00000256  00 66 68 00 02 00 00 66 68 08 00 00 00 66 53 66  .fh....fh....fSf
00000272  53 66 55 66 68 00 00 00 00 66 68 00 7C 00 00 66  SfUfh....fh.|..f
00000288  61 68 00 00 07 CD 1A 5A 32 F6 EA 00 7C 00 00 CD  ah...Í.Z2öê.|..Í
00000304  18 A0 B7 07 EB 08 A0 B6 07 EB 03 A0 B5 07 32 E4  . ·.ë. ¶.ë. µ.2ä
00000320  05 00 07 8B F0 AC 3C 00 74 09 BB 07 00 B4 0E CD  ...‹ð¬<.t.»..´.Í
00000336  10 EB F2 F4 EB FD 2B C9 E4 64 EB 00 24 02 E0 F8  .ëòôëý+Éädë.$.àø
00000352  24 02 C3 49 6E 76 61 6C 69 64 20 70 61 72 74 69  $.ÃInvalid parti
00000368  74 69 6F 6E 20 74 61 62 6C 65 00 45 72 72 6F 72  tion table.Error
00000384  20 6C 6F 61 64 69 6E 67 20 6F 70 65 72 61 74 69   loading operati
00000400  6E 67 20 73 79 73 74 65 6D 00 4D 69 73 73 69 6E  ng system.Missin
00000416  67 20 6F 70 65 72 61 74 69 6E 67 20 73 79 73 74  g operating syst
00000432  65 6D 00 00 00 63 7B 9A BD 00 9F EC 00 00 80 20  em...c{š¼.Ÿì..€
00000448  21 00 07 FE FF FF 00 08 00 00 00 30 62 03 00 FE  !..þÿÿ.....0b..þ
00000464  FF FF 0C FE FF FF 00 38 62 03 00 20 03 00 00 FE  ÿÿ.þÿÿ.8b.. ...þ
00000480  FF FF 07 FE FF FF 00 58 65 03 00 20 03 00 00 FE  ÿÿ.þÿÿ.Xe.. ...þ
00000496  FF FF 0F FE FF FF 00 78 68 03 00 80 57 00 55 AA  ÿÿ.þÿÿ.xh..€W.Uª
```

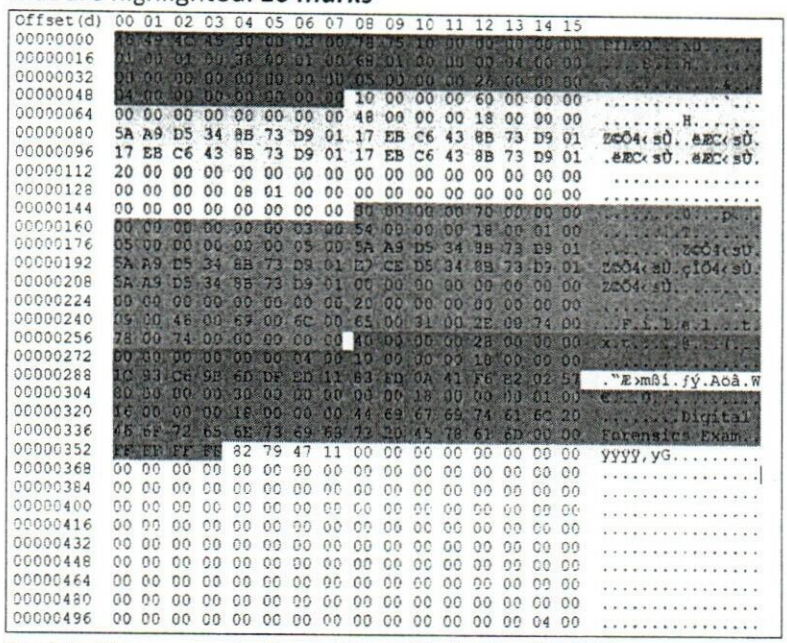
a. What information does this sector contain? ***5 marks***
b. How many active partitions does the disk have and how many partitions in total? Explain your answer. ***5 marks***
c. What is the starting sector in LBA of the first partition? ***5 marks***
d. What is the size in MBs of the 3rd partition? ***5 marks***

Question 3:

NTFS is the most common file system used in Windows today.

a. With regards to NTFS, discuss the role of the Master File Table (MFT) ***5 marks***

b. The figure below shows a portion of an NTFS file record, explain the significance of the areas that are highlighted. ***10 marks***



Offset(d)	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	
00000000	46	49	4C	45	30	00	03	00	78	75	10	00	00	00	00	00	FILE0...xu......
00000016	01	00	01	00	38	00	01	00	68	01	00	00	00	04	00	00	....8...h.......
00000032	00	00	00	00	00	00	00	00	05	00	00	00	26	00	00	00	............&...
00000048	04	00	00	00	00	00	00	00	10	00	00	00	60	00	00	00	............`...
00000064	00	00	00	00	00	00	00	00	48	00	00	00	18	00	00	00	........H.......
00000080	5A	A9	D5	34	8B	73	D9	01	17	EB	C6	43	8B	73	D9	01	Z©Õ4‹sÙ..ëÆC‹sÙ.
00000096	17	EB	C6	43	8B	73	D9	01	17	EB	C6	43	8B	73	D9	01	.ëÆC‹sÙ..ëÆC‹sÙ.
00000112	20	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	....
00000128	00	00	00	00	08	01	00	00	00	00	00	00	00	00	00	00	....
00000144	00	00	00	00	00	00	00	00	30	00	00	00	70	00	00	00	........0...p...
00000160	00	00	00	00	00	00	03	00	54	00	00	00	18	00	01	00	........T.......
00000176	05	00	00	00	00	00	05	00	5A	A9	D5	34	8B	73	D9	01	........Z©Õ4‹sÙ.
00000192	5A	A9	D5	34	8B	73	D9	01	ED	CE	D5	34	8B	73	D9	01	Z©Õ4‹sÙ.íÎÕ4‹sÙ.
00000208	5A	A9	D5	34	8B	73	D9	01	00	00	00	00	00	00	00	00	Z©Õ4‹sÙ........
00000224	00	00	00	00	00	00	00	00	20	00	00	00	00	00	00	00	....
00000240	09	00	46	00	69	00	6C	00	65	00	31	00	2E	00	74	00	..F.i.l.e.1...t.
00000256	78	00	74	00	00	00	00	00	40	00	00	00	28	00	00	00	x.t.....@...(...
00000272	00	00	00	00	00	00	04	00	10	00	00	00	03	10	00	00	....
00000288	1C	93	C6	9B	6D	DF	ED	11	83	ED	0A	41	F6	E2	02	57	.“Æ›mßí.íý.Aöâ.W
00000304	80	00	00	00	30	00	00	00	00	00	18	00	00	00	01	00	€...0...........
00000320	16	00	00	00	18	00	00	00	44	69	67	69	74	61	6C	20	........Digital
00000336	46	6F	72	65	6E	73	69	63	73	20	45	78	61	6D	00	00	Forensics Exam..
00000352	FF	FF	FF	FF	82	79	47	11	00	00	00	00	00	00	00	00	ÿÿÿÿ‚yG........
00000368	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	....
00000384	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	....
00000400	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	....
00000416	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	....
00000432	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	....
00000448	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	....
00000464	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	....
00000480	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	....
00000496	00	00	00	00	00	00	00	00	00	00	00	00	00	00	04	00	....

c. Explain the concept of a resident file in the NTFS file system. ***5 marks***

Question 4:

Critically discuss digital antiforensics techniques and explain how these techniques may be used to mislead the forensic investigation process. ***20 marks***

Question 5:

Discuss what you could do to find data of interests on a seized hard disk drive. Share examples of tools you could utilise and a relevant investigation methodology. ***20 marks***

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FACULTY OF SCIENCE & ENGINEERING
SCHOOL OF ENGINEERING, COMPUTING AND MATHEMATICAL SCIENCES

EXAMINATION PAPER

Module Code	:	6CS010
Module Title	:	Digital Forensics
Date	:	11th June 2023
Examiners	:	Dr C Mbarushimana / Mr. Nimesh Pollwaththage
Time Allowed	:	1.5 hrs

INSTRUCTIONS TO CANDIDATES

- This is a Closed book examination.
- You Should Attempt 3 Questions in Total

MATERIALS REQURIED

- Answer booklet.
- **You may use a scientific calculator**. This must not be programmable, and may be inspected during the examination.
- You should write legibly in black or blue ink

Question 1:

Explain the the four ACPO principles of computer based electronic evidence. Illustrate your answer with examples. ***20 marks***

Question 2:

The figure below shows the first sector of a MBR disk.

```
Offset(d) 00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15

00000000  33 C0 8E D0 BC 00 7C 8E C0 8E D8 BE 00 7C BF 00  3ÀŽÐ¼.|ŽÀŽØ¾.|¿.
00000016  06 B9 00 02 FC F3 A4 50 68 1C 06 CB FB B9 04 00  .¹..üó¤Ph..Ëû¹..
00000032  BD BE 07 80 7E 00 00 7C 0B 0F 85 0E 01 83 C5 10  ½¾.€~..|.…..ƒÅ.
00000048  E2 F1 CD 18 88 56 00 55 C6 46 11 05 C6 46 10 00  âñÍ.ˆV.UÆF..ÆF..
00000064  B4 41 BB AA 55 CD 13 5D 72 0F 81 FB 55 AA 75 09  ´A»ªUÍ.]r..ûUªu.
00000080  F7 C1 01 00 74 03 FE 46 10 66 60 80 7E 10 00 74  ÷Á..t.þF.f`€~..t
00000096  26 66 68 00 00 00 00 66 FF 76 08 68 00 00 68 00  &fh....fÿv.h..h.
00000112  7C 68 01 00 68 10 00 B4 42 8A 56 00 8B F4 CD 13  |h..h..´BŠV.‹ôÍ.
00000128  9F 83 C4 10 9E EB 14 B8 01 02 BB 00 7C 8A 56 00  ŸƒÄ.žë.¸..».|ŠV.
00000144  8A 76 01 8A 4E 02 8A 6E 03 CD 13 66 61 73 1C FE  Šv.ŠN.Šn.Í.fas.þ
00000160  4E 11 75 0C 80 7E 00 80 0F 84 8A 00 B2 80 EB 84  N.u.€~.€.„Š.²€ë„
00000176  55 32 E4 8A 56 00 CD 13 5D EB 9E 81 3E FE 7D 55  U2äŠV.Í.]ëž.>þ}U
00000192  AA 75 6E FF 76 00 E8 8D 00 75 17 FA B0 D1 E6 64  ªunÿv.è..u.ú°Ñæd
00000208  E8 83 00 B0 DF E6 60 E8 7C 00 B0 FF E6 64 E8 75  èƒ.°ßæ`è|.°ÿædèu
00000224  00 FB B8 00 BB CD 1A 66 23 C0 75 3B 66 81 FB 54  .û¸.»Í.f#Àu;f.ûT
00000240  43 50 41 75 32 81 F9 02 01 72 2C 66 68 07 BB 00  CPAu2.ù..r,fh.».
00000256  00 66 68 00 02 00 00 66 68 08 00 00 00 66 53 66  .fh....fh....fSf
00000272  53 66 55 66 68 00 00 00 00 66 68 00 7C 00 00 66  SfUfh....fh.|..f
00000288  61 68 00 00 07 CD 1A 5A 32 F6 EA 00 7C 00 00 CD  ah...Í.Z2öê.|..Í
00000304  18 A0 B7 07 EB 08 A0 B6 07 EB 03 A0 B5 07 32 E4  . ·.ë. ¶.ë. µ.2ä
00000320  05 00 07 8B F0 AC 3C 00 74 09 BB 07 00 B4 0E CD  ...‹ð¬<.t.»..´.Í
00000336  10 EB F2 F4 EB FD 2B C9 E4 64 EB 00 24 02 E0 F8  .ëòôëý+Éädë.$.àø
00000352  24 02 C3 49 6E 76 61 6C 69 64 20 70 61 72 74 69  $.ÃInvalid parti
00000368  74 69 6F 6E 20 74 61 62 6C 65 00 45 72 72 6F 72  tion table.Error
00000384  20 6C 6F 61 64 69 6E 67 20 6F 70 65 72 61 74 69   loading operati
00000400  6E 67 20 73 79 73 74 65 6D 00 4D 69 73 73 69 6E  ng system.Missin
00000416  67 20 6F 70 65 72 61 74 69 6E 67 20 73 79 73 74  g operating syst
00000432  65 6D 00 00 00 63 7B 9A F9 1D 7B AF 00 00 80 20  em...c{šù.{¯..€
00000448  21 00 07 DF 13 0C 00 08 00 00 00 20 03 00 00 DF  !..ß..... ...ß
00000464  14 0C 07 FE FF FF 00 28 03 00 00 18 FC 00 00 FE  ...þÿÿ.(....ü..þ
00000480  FF FF 07 FE FF FF 00 40 FF 00 00 40 00 00 00 FE  ÿÿ.þÿÿ.@ÿ..@...þ
00000496  FF FF 0F FE FF FF 00 80 FF 00 00 78 80 06 55 AA  ÿÿ.þÿÿ.€ÿ..x€.Uª
```

a. What information does this sector contain? ***5 marks***
b. How many active partitions does the disk have and how many partitions in total? Explain your answer. ***5 marks***
c. What is the starting sector in LBA of the first partition? ***5 marks***
d. What is the size in MBs of the 3rd partition? ***5 marks***

Question 3:

NTFS is the most common file system used in Windows today.

a. With regards to NTFS, discuss the role of the Master File Table (MFT) ***5 marks***
b. What are the main components of a MFT file record? ***10 marks***
c. With the help of a diagram, explain the concept of file slack and its significance in digital forensics. ***5 marks***

Question 4:

Critically discuss digital antiforensics techniques and explain how these techniques may be used to mislead the forensic investigation process. ***20 marks***

Question 5:

a. Using a digital investigation process model of your choice, discuss the importance of adopting such a methodology and the main phases of an investigation. ***14 marks***
b. In the context of data acquisition, explain the differences between disk cloning and disk imaging. ***6 marks***

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FACULTY OF ENGINEERING & TECHNOLOGY

IN-CLASS TEST 01 (Resit)

Module Code :	:	**3MM003**
Module Title	:	**Foundation mathematics I**
Date	:	**28th march 2023**
Examiner	:	**Supun Walpita**
Time Allowed:	:	**2 Hours**

INSTRUCTIONS TO CANDIDATES

- This is a Closed book examination.
- Attempt **ALL** questions. Your responses should be recorded on the answer sheet attached.
- All questions are not equally weighted. Please refer assigned marks for each subparts within the question
- You should write legibly in black or blue ink.
- **Calculators are not allowed**

1)

a. solve following

i. $6\frac{1}{5} + 3\frac{1}{6}$

ii. $\frac{5}{64} \div \frac{7}{8}$

iii. $5\frac{1}{4} \times \frac{2}{9}$

(15 marks)

b. Oder these fractions from smallest to largest

i. 4/7 , 61/100 , 3/5

ii. 23/100 , 4/15, 1/5

(10 marks)

c. 1/9 of the shirts sold at a shop are red. 5/8 of the remainder are white. The rest of the shirts are blue colored. If the shop has 81 blue colored shirts, find the total number of shirts.

(15 marks)

d. Express in decimals

i. $\frac{14}{50}$

ii. $5\frac{1}{6}$

(10 marks)

e. Simplify

$$\frac{\left(\frac{9}{25} - \frac{1}{5}\right)}{\left(\frac{49}{36}\right)^{1/2} \times \left(\frac{8}{27}\right)^{1/3}}$$

(20 marks)

f. If $2^{10x} = 2500$, then find the value of $2^{(x-1)5}$

(25marks)

g. An initial investment becomes Rs 13,000 in 2 years and Rs 18720 in 4 years respectively at a constant compound interest. Find the amount of initial investment

(25 marks)

2)

a. Solve for x in following equations

i. $log_2 64 = x$

ii. $log_6 x = 4$

iii. Given that $log_6 2 = q$ and $log_6 25 = p$, find $log_6 200$ in terms of p & q

iv. $log\,(x+1) + log\,(x-3) = 2\,log\,(x+3)$

(50 marks)

b. According to a study the population (P) of an endangered species of animals obeys the relationship

$$\frac{(125ka^t)}{(k+2a^t)}$$

Whereas k =8, a=10 and t is time in years since the study, find what is the value of t when the population is 400

(30 marks)

c. Perform the following multiplication and simplify

i. (x+5) (x-7)

ii. (2x-1) (x^2+3x+1) **(10 marks)**

3)

a. Solve following expressions for x

i. x^2-6x=27

ii. (x -5)(x -6) =12

iii. x^2 +8x+6=0

iv. x^3+4x^2+x-6=0 **(35 marks)**

b. perform the following division and simplify

i. $\frac{(x^3-64)}{(x-4)}$

ii. $\frac{(x^3+3x^2-18x-40)}{(x-4)}$

(25 marks)

c. Solve following Linear simultaneous equations

i. $4x + y = 13$
$5y+3x = 14$ by Substitution method

ii. $3x + 2y = 14$
$x + 4y = -18$ Eliminating method

(20 marks)

d. Kamal bought two oranges and three apples for Rs.170. Since he only got Rs.100, the salesmen took back one apple and one orange, so that the total price of the fruits equals to the amount possess by Kamal. Find the price of an apple and an orange separately

(20 marks)

4)

a. Sketch $y= x^2-7x+12$ & $y= x+5$ in the same axes of coordinates highlighting all intercepts, critical points and intersection points between two functions.

(35 marks)

b. Sketch the function defined below

$$y = \begin{cases} -9, & x < 0 \\ x^2 - 9, & x \geq 0 \end{cases}$$

(20 marks)

c. Suppose that a square shaped metal plate was processed by heating to a high temperature and removing a part by cutting. As a result of that, length of the one side of the plate has increased by 2cm while length of the other side decreased by 3cm. it was found out that the new area of the rectangular plate is 24 cm^2.Find the area of the plate before it was processed

(35 marks)

Cobra BSc (Hons) Computer Networks (TopUp) Semester - 3

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This exam paper must be submitted with your answer booklet

Student Number .....

FACULTY OF SCIENCE & ENGINEERING
SCHOOL OF COMPUTING AND MATHEMATICS

EXAMINATION PAPER

Module Code	:	6CS029
Module Title	:	Advanced Networks
Date	:	05th March 2023
Examiners	:	Dr Ian Coulson, Dr Consolee Mbarushimana.
Time Allowed	:	2 hours

INSTRUCTIONS TO CANDIDATES

- This is a Closed book examination.
- Number of Questions to be attempted: Three complete questions from the Six on the paper
- All questions are equally weighted (unless otherwise stated)
- Answer to q1 part e) should be written on the exam paper on the last sheet and the **question paper submitted with your answer sheet.**
- Your responses should be recorded on the answer sheet attached.

MATERIALS REQURIED

- 1 six page answer booklet.
- You should write legibly in black or blue ink
- Check your work carefully for inaccurate spelling, punctuation and grammar

1.

a. What is meant by the term Minimum Spanning Tree? (6 marks)
b. Why is Kruskal's algorithm known as a greedy algorithm? (6 Marks)

c. In the graph in figure 1 of a network use Kruskal's algorithm to determine an MST for this network and state its length. Show the order in which you select and reject edges.
(36 marks)

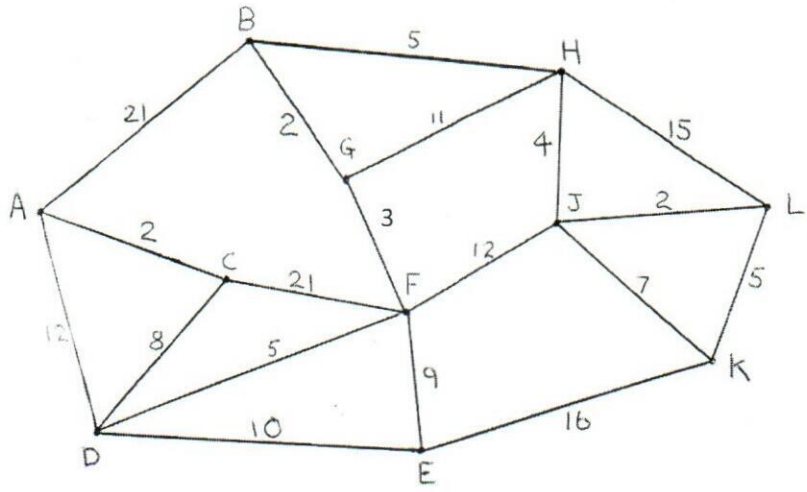


Figure 1 – Graph of a network

d. Sketch the defined MST for the graph in Figure 1.

(6 marks)

e. The network in Figure 2 shows the defined weights between nodes. Use Dijkstra's Algorithm to find the route with the lowest cost from A to L.
You should illustrate your method on the attached sheet at the back of the question paper and submit this with your answer booklet. Note marks will only be awarded if you have illustrated Dijkstra's method.

(46 marks)

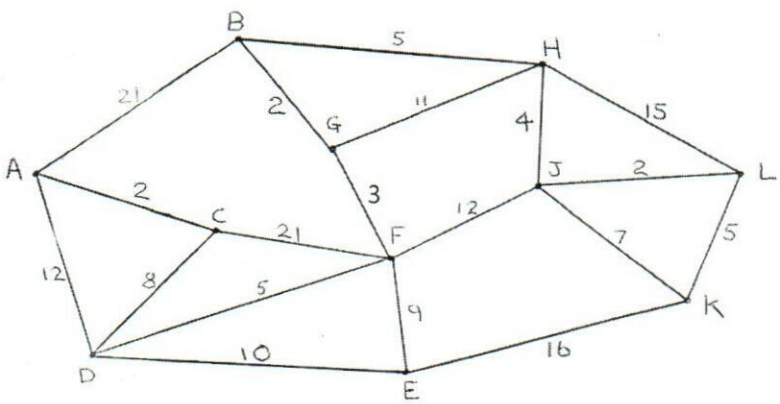


Figure 2 – Graph of a network

2.

a. Discuss with the aid of diagrams the process of a workstation obtaining an IP address through DHCP. (40 Marks)

b. Describe the domain name system and the processes involved to resolve a web address to its respective IP address. You may include diagrams to aid with this.

(40 Marks)

c. Explain the Reflection and Amplification attack as it relates to the DNS system, and feel free to use diagrams to help illustrate your explanation.

(20 Marks)

3.

a. Discuss the structure using illustrations of the different classes of IPV6 addresses. Your discussion should mention their scope and range of values.

40marks)

b. What is meant by the term IPV6 tunnelling, use a sketch to illustrate this.

(40 marks)

c. List four benefits and two drawbacks of IPv6.

(20 marks)

d. Give an account using diagrams of EU-64 which is used to generate the 64 bit interface ID.

(30 marks)

3.

a. Why is QoS an important consideration in designing a network? What are the parameters used to evaluate QoS?

(35 marks)

b. Discuss VLAN implementation as a virtualization technology and their benefits

(30 marks)

c. Using diagrams, explain the difference between a traditional network and Software Defined Network (SDN). What are the main planes of a typical SDN architecture?

(35 Marks)

4.

a. With the aid of a diagram, explain how collisions are avoided in CSMA/CA wireless LAN

(40 marks)

b. What are the differences between the following types of wireless channel impairments: path loss, multipath propagation and interference from other sources?

(40 Marks)

c. Describe the different steps involved in WLAN deployment planning.

(20marks)

5.

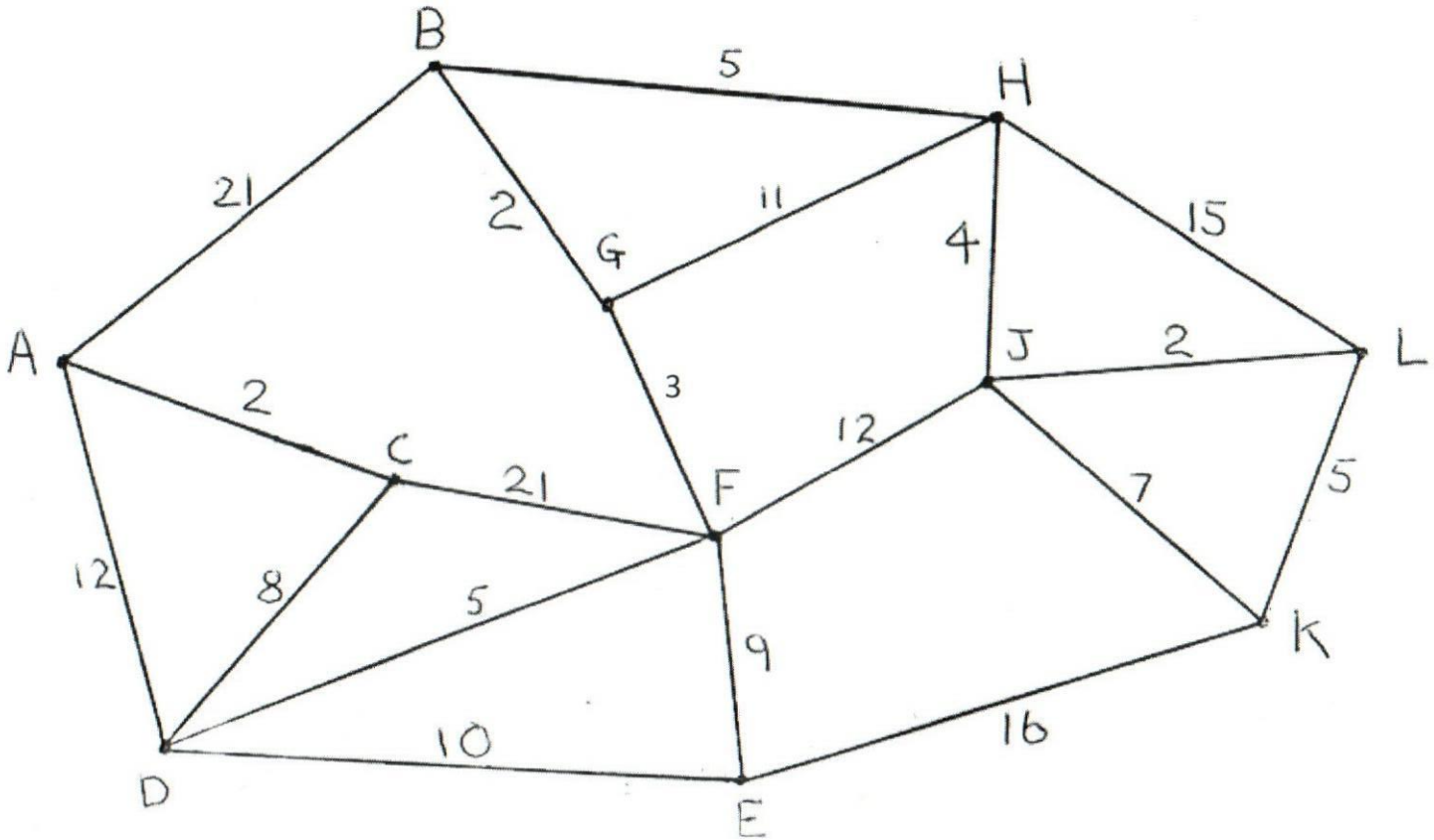
a. In the context of Computing Networks, what is a "Directory Service" and its main functions?

(30 marks)

b. Describe and explain in detail, with diagrams, the structure and functions of "Windows Active Directory".

(70 marks)

Student Number .....**You should document the method by using labels on this sheet, which must be submitted with your answer booklet, also Illustrate your path on the diagram.**



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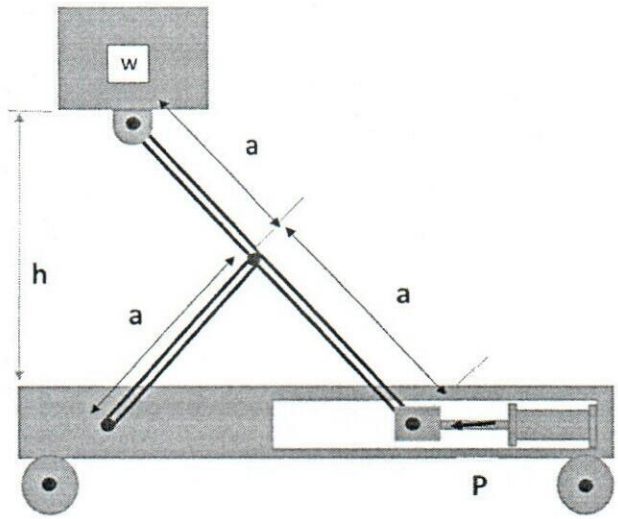
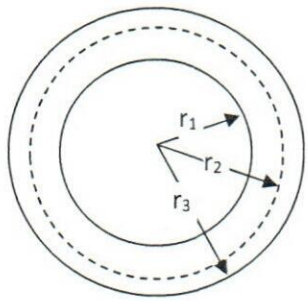
SCHOOL OF ENGINEERING

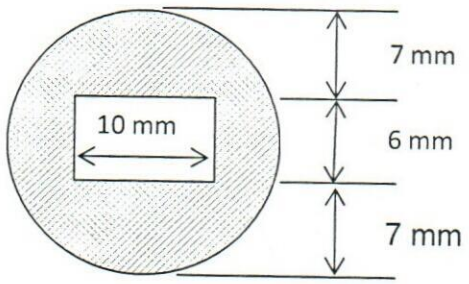
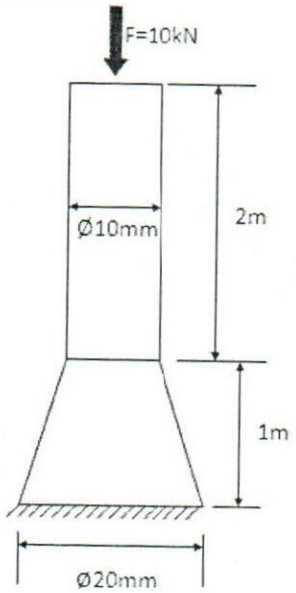
EXAMINATION PAPER

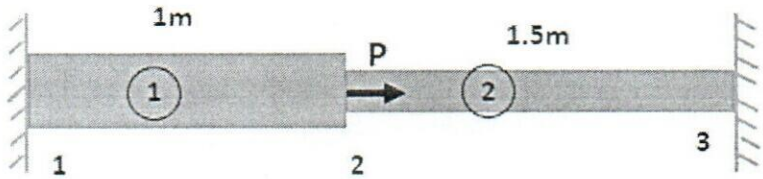
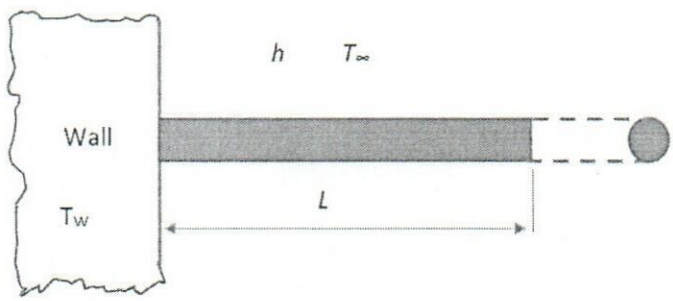
Module Code	:	6MA016
Module Title	:	Structural Mechanics & Stress Analysis
Date	:	20th February 2023
Module Leader	:	Mr. Ishan Virantha
Time Allowed	:	3 Hours

INSTRUCTIONS TO CANDIDATES

- This is a closed book examination.
- A scientific calculator can be used in this exam. This must not be programmable.
- **Four questions** should be attempted out of five questions.
- Answers to each question to start on a separate page.
- All questions are equally weighted.
- Any data which is not given should be assumed and clearly mentioned.

Q1		A movable hydraulic lift is used to elevate the weight of **W** as shown in the Figure Q1. Using the principle of virtual work obtain an expression for force **P** exerted by the hydraulic cylinder when the load **W** at height **h**.  **Figure Q1**	100%
Q2		An engineer proposed that a cylindrical vessel, which is subjected to an internal pressure of 50 MPa, can be reinforced by shrinking on an outer cylindrical liner as shown in Figure Q2. When the material's maximum tensile strength is 100 MPa, help the engineer to calculate the required shrinkage (the difference between the outside radius of the inner cylinder and the inside radius of the outer cylinder); and justify the proposed designs. (Material Young's Modulus is 205000 MPa)  r_1=50 mm r_2=70 mm r_3=80 mm **Figure Q2**	100%

Q3	a	The cross-section of a steel strut is shown in Figure Q3a. The material's Young's modulus is E = 205 GPa, the strut length L=1.5 m, both ends of the strut are pinned. Calculate the Euler buckling load, slenderness ratio and stress in the section under the buckling load.  **Figure Q3a**	50%
	b	The column shown in the Figure Q3b consist with two parts, cylindrical and conical part. The cylindrical part material's elastic modulus is 150Gpa and the conical part material's elastic modulus is 200Gpa. Calculate the total strain energy stored in the column structure.  **Figure Q3b**	50%

Q4		The bar structure below contains two components and three nodes, with P=3kN force applied at node 2, and nodes 1 and 3 fixed. Find the followings. I. Find the displacement at node 2. II. Find Stress in each bar. (A_1=10000mm^2, A_2=5000mm^2, E_1=100 GPa, E_2=150GPa)  **Figure Q4**	100%
Q5		An Aluminum pin of 1mm diameter 50 mm in length is used to enhance the heat transfer from a surfaced walled at 300 °C as shown in the Figure Q5.  **Figure Q5** The governing differential equation and the boundary conditions are given by $$k\frac{d^2T}{dx^2} = \frac{Ph}{A_c}(T - T_\infty)$$ $$T(0) = T_w = 300°C$$ $$\frac{dT}{dx}(L) = 0 \quad \text{(insulated tip)}$$	

		where k = coefficient of thermal conductivity, P = perimeter, A_c = cross-sectional area, h = convective heat transfer coefficient, T_w = wall temperature, T_∞ = ambient temperature. Let k= 200 W/m/°C for aluminum, h=20W/m^2 °C and T_∞=30°C. Using the Galerkin's weighted residuals approach to obtain an expression for the temperature distribution in the pin.	100%

Data Sheet

Torsion

$$\frac{\tau}{r} = \frac{T}{J} = \frac{G\theta}{L} \qquad P = \frac{2\pi NT}{60} \qquad J = \frac{\pi d^4}{32} \qquad T = Frn$$

Thin Shells

Cylinder $\sigma_C = \frac{Pd}{2t}$ $\sigma_L = \frac{Pd}{4t}$ Vol Strain = 2 × Hoop Strain + Axial Strain

Sphere $\sigma = \frac{Pd}{4t}$ Vol Strain = 3 × Hoop strain

$$\varepsilon = \frac{\sigma_x}{E} - \upsilon\frac{\sigma_y}{E} - \upsilon\frac{\sigma_z}{E} \qquad \Delta V = \frac{V \times P}{K}$$

Principal Stresses

$$\sigma_\theta = \sigma_x \cos^2\theta + \sigma_y \sin^2\theta + \tau \sin 2\theta \qquad \tau_\theta = \frac{1}{2}(\sigma_y - \sigma_x)\sin 2\theta + \tau\cos 2\theta$$

$$\sigma_1, \sigma_2 = \frac{1}{2}(\sigma_y + \sigma_x) \pm \frac{1}{2}\sqrt{(\sigma_y - \sigma_x)^2 + 4\tau^2} \quad \text{or} \quad (\sigma_x - \sigma)(\sigma_y - \sigma) = \tau^2$$

$$\tan\theta = \frac{(\sigma - \sigma_y)}{\tau} \qquad \tau_{max} = \pm\frac{1}{2}\sqrt{(\sigma_y - \sigma_x)^2 + 4\tau^2} \quad \text{or} \quad \pm\frac{(\sigma_1 - \sigma_2)}{2}$$

Strain energy

$$u = \frac{1}{2}\sigma_x \varepsilon_x \qquad U = \frac{P^2 L}{2AE}$$

Bar element stiffness

$$K = \frac{EA}{L}\begin{bmatrix} 1 & -1 \\ -1 & 1 \end{bmatrix}$$

$$k = \frac{AE}{L}\begin{bmatrix} C^2 & CS & -C^2 & -CS \\ CS & S^2 & -CS & -S^2 \\ -C^2 & -SC & C^2 & CS \\ -CS & -S^2 & CS & S^2 \end{bmatrix}$$

Thick-walled Cylinders

$$\sigma_r = \frac{a^2 p_i - b^2 p_o}{b^2 - a^2} - \frac{(p_i - p_o)a^2 b^2}{r^2\left(b^2 - a^2\right)}$$

$$\sigma_t = \frac{a^2 p_i - b^2 p_o}{b^2 - a^2} + \frac{(p_i - p_o)a^2 b^2}{r^2\left(b^2 - a^2\right)}$$

Radial Deformation

$$u = \frac{1-\mu}{E}\frac{a^2 p_i - b^2 p_0}{b^2 - a^2} r + \frac{1+\mu}{E}\frac{a^2 b^2 (p_i - p_o)}{\left(b^2 - a^2\right) r}$$

Shrink-fit Interface Pressure in Cylinders

$$\frac{bp}{E}\left(\frac{b^2 + c^2}{c^2 - b^2} + \mu\right) + \frac{bp}{E}\left(\frac{a^2 + b^2}{b^2 - a^2} - \mu\right) = \delta$$

or

$$p = \frac{E\delta}{b}\frac{\left(b^2 - a^2\right)\left(c^2 - b^2\right)}{2b^2\left(c^2 - a^2\right)}$$

Buckling

$$P_E = \frac{n\pi^2 EI}{L^2} \qquad P_R = \frac{\sigma_C A}{1+\frac{a}{n}\left(\frac{l}{k}\right)^2} \qquad I = Ak^2$$

Biaxial Plane Stress

$$\varepsilon_x = \frac{\sigma_x}{E} - \nu\frac{\sigma_y}{E}$$

$$\varepsilon_y = \frac{\sigma_y}{E} - \nu\frac{\sigma_x}{E}$$

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This exam paper must be submitted with your answer booklet

Student Number .....

FACULTY OF SCIENCE & ENGINEERING
SCHOOL OF COMPUTING AND MATHEMATICS

EXAMINATION PAPER

Module Code	:	6CS029
Module Title	:	Advanced Networks
Date	:	tbc
Examiners	:	Dr Ian Coulson, Dr Consolee Mbarushimana, Mr. Nimesh Pollwaththage
Time Allowed	:	2 hours

INSTRUCTIONS TO CANDIDATES

- This is a Closed book examination.
- Number of Questions to be attempted: Three complete questions from the Six on the paper
- All questions are equally weighted (unless otherwise stated)
- Answer to q1 part e) should be written on the exam paper on the last sheet and the **question paper submitted with your answer sheet.**
- Your responses should be recorded on the answer sheet attached.

MATERIALS REQURIED

- 1 six page answer booklet.
- You should write legibly in black or blue ink
- Check your work carefully for inaccurate spelling, punctuation and grammar

1.

a. What is meant by the term Minimum Spanning Tree? (6 marks)

b. Why is Kruskal's algorithm known as a greedy algorithm? (6 Marks)

c. In the graph in figure 1 of a network use Kruskal's algorithm to determine an MST for this network and state its length. Show the order in which you select and reject edges. (36 marks)

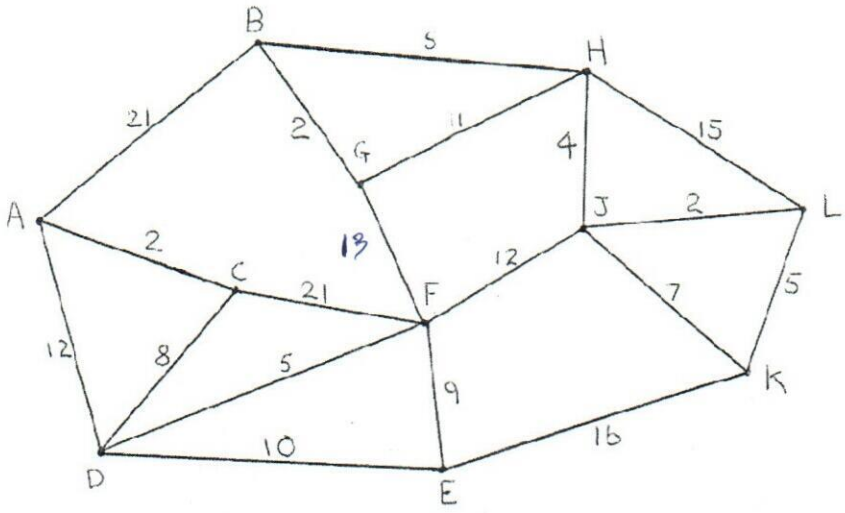


Figure 1 – Graph of a network

d. Sketch the defined MST for the graph in Figure 1.

(6 marks)

e. The network in Figure 2 shows the defined weights between nodes. Use Dijkstra's Algorithm to find the route with the lowest cost from A to L.
You should illustrate your method on the attached sheet at the back of the question paper and submit this with your answer booklet. Note marks will only be awarded if you have illustrated Dijkstra's method.

(46 marks)

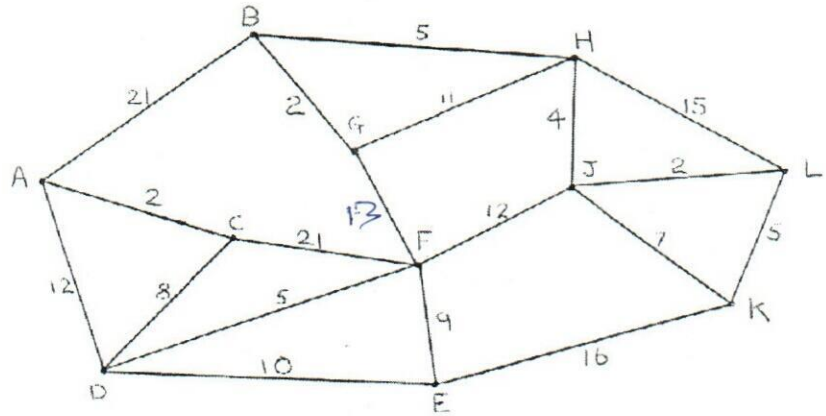


Figure 2 – Graph of a network

2.

a. Discuss with the aid of diagrams the process of a workstation obtaining an IP address through DHCP.

(55 Marks)

b. Describe the domain name system and the processes involved to resolve a web address to its respective IP address. You may include diagrams to aid with this.

(45 Marks)

3. Multicasting is a widely used technology in networks. Give an account of the following features:

a. Addressing, both IP and MAC. (50 marks)
b. Multicast routing protocols (50 marks)

4.

a. Why is QoS an important consideration in designing a network? What are the parameters used to evaluate QoS?

(35 marks)

b. Discuss VLAN implementation as a virtualization technology and their benefits

(30 marks)

c. Using diagrams, explain the difference between a traditional network and Software Defined Network (SDN). What are the main planes of a typical SDN architecture?

(35 Marks)

5.

a. With the aid of a diagram, explain how collisions are avoided in CSMA/CA wireless LANs

(50 marks)

b. Explain how mobility is achieved inside an enterprise wireless network.

(50 marks)

6.

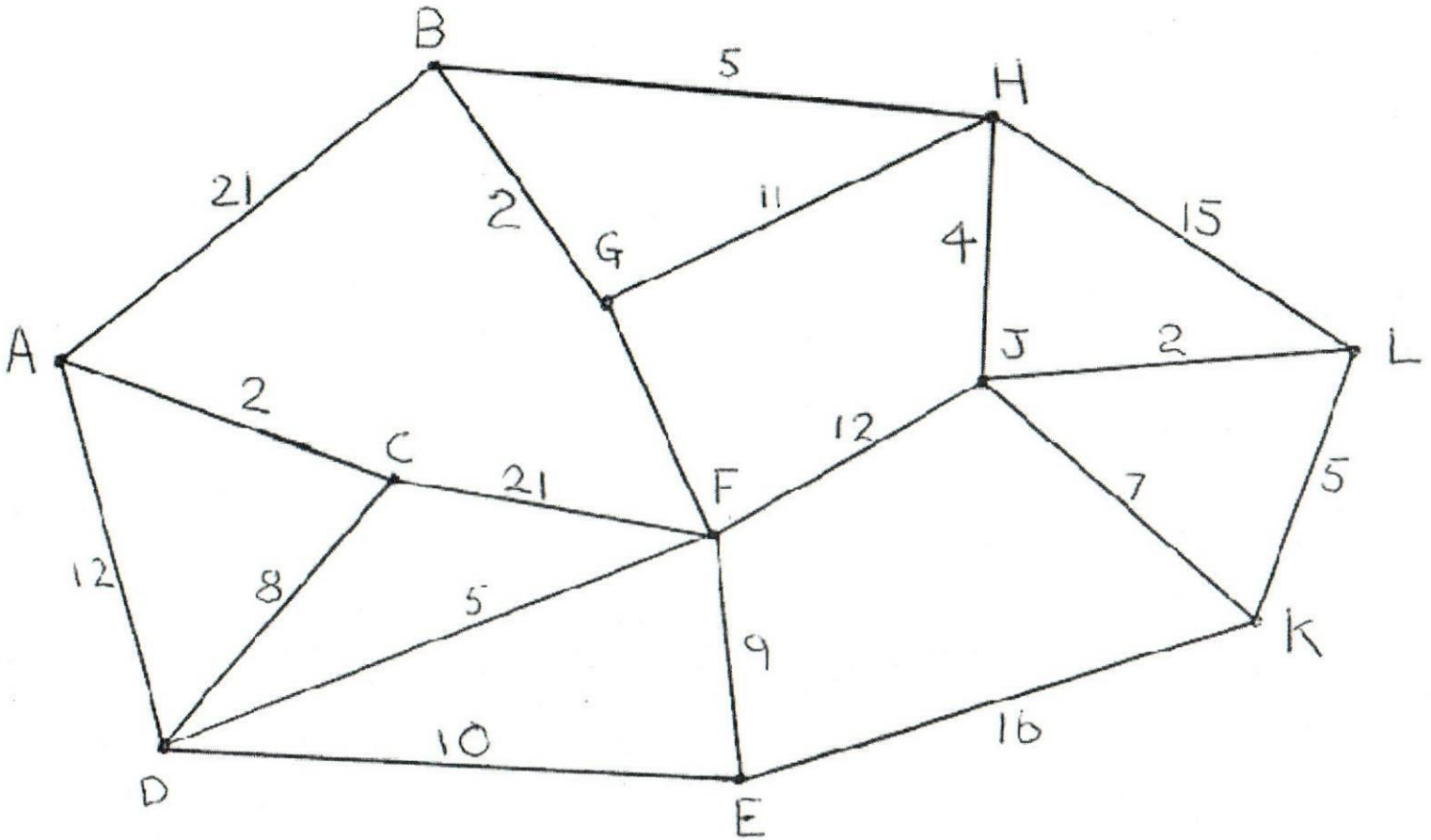
a. In the context of Computing Networks, what is a "Directory Service" and its main functions?

(30 marks)

b. Describe and explain in detail, with diagrams, the structure and functions of "Windows Active Directory".

(70 marks)

Student Number .....You should document the method by using labels on this sheet, which must be submitted with your answer booklet, also Illustrate your path on the diagram.



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Student Number .....

FACULTY OF SCIENCE & ENGINEERING
SCHOOL OF COMPUTING AND MATHEMATICS

EXAMINATION PAPER

Module Code	:	6CS010
Module Title	:	Digital Forensics
Date	:	23/10/2022
Examiners	:	Dr C Mbarushimana
Time Allowed	:	1 hr

INSTRUCTIONS TO CANDIDATES

- This is a Closed book examination.
- You Should Attempt 3 Questions in Total

MATERIALS REQURIED

- Answer booklet.
- You may use a scientific calculator. This must not be programmable, and may be inspected during the examination.
- You should write legibly in black or blue ink

Question 1:

Explain the the four ACPO principles of computer based electronic evidence. Illustrate your answer with examples. ***20 marks***

Question 2:

The figure below shows the first sector of a MBR disk.

```
Offset(d) 00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15

00000000  33 C0 8E D0 BC 00 7C 8E C0 8E D8 BE 00 7C BF 00  3ÀŽÐ¼.|ŽÀŽØ¾.|¿.
00000016  06 B9 00 02 FC F3 A4 50 68 1C 06 CB FB B9 04 00  .¹..üó¤Ph..Ëû¹..
00000032  BD BE 07 80 7E 00 00 7C 0B 0F 85 0E 01 83 C5 10  ½¾.€~..|.…..ƒÅ.
00000048  E2 F1 CD 18 88 56 00 55 C6 46 11 05 C6 46 10 00  âñÍ.ˆV.UÆF..ÆF..
00000064  B4 41 BB AA 55 CD 13 5D 72 0F 81 FB 55 AA 75 09  ´A»ªUÍ.]r..ûUªu.
00000080  F7 C1 01 00 74 03 FE 46 10 66 60 80 7E 10 00 74  ÷Á..t.þF.f`€~..t
00000096  26 66 68 00 00 00 00 66 FF 76 08 68 00 00 68 00  &fh....fÿv.h..h.
00000112  7C 68 01 00 68 10 00 B4 42 8A 56 00 8B F4 CD 13  |h..h..´BŠV.‹ôÍ.
00000128  9F 83 C4 10 9E EB 14 B8 01 02 BB 00 7C 8A 56 00  ŸƒÄ.žë.¸..».|ŠV.
00000144  8A 76 01 8A 4E 02 8A 6E 03 CD 13 66 61 73 1C FE  Šv.ŠN.Šn.Í.fas.þ
00000160  4E 11 75 0C 80 7E 00 80 0F 84 8A 00 B2 80 EB 84  N.u.€~.€.„Š.²€ë„
00000176  55 32 E4 8A 56 00 CD 13 5D EB 9E 81 3E FE 7D 55  U2äŠV.Í.]ëž.>þ}U
00000192  AA 75 6E FF 76 00 E8 8D 00 75 17 FA B0 D1 E6 64  ªunÿv.è..u.ú°Ñæd
00000208  E8 83 00 B0 DF E6 60 E8 7C 00 B0 FF E6 64 E8 75  èƒ.°ßæ`è|.°ÿædèu
00000224  00 FB B8 00 BB CD 1A 66 23 C0 75 3B 66 81 FB 54  .û¸.»Í.f#Àu;f.ûT
00000240  43 50 41 75 32 81 F9 02 01 72 2C 66 68 07 BB 00  CPAu2.ù..r,fh.».
00000256  00 66 68 00 02 00 00 66 68 08 00 00 00 66 53 66  .fh....fh....fSf
00000272  53 66 55 66 68 00 00 00 00 66 68 00 7C 00 00 66  SfUfh....fh.|..f
00000288  61 68 00 00 07 CD 1A 5A 32 F6 EA 00 7C 00 00 CD  ah...Í.Z2öê.|..Í
00000304  18 A0 B7 07 EB 08 A0 B6 07 EB 03 A0 B5 07 32 E4  . ·.ë. ¶.ë. µ.2ä
00000320  05 00 07 8B F0 AC 3C 00 74 09 BB 07 00 B4 0E CD  ...‹ð¬<.t.»..´.Í
00000336  10 EB F2 F4 EB FD 2B C9 E4 64 EB 00 24 02 E0 F8  .ëòôëý+Éädë.$.àø
00000352  24 02 C3 49 6E 76 61 6C 69 64 20 70 61 72 74 69  $.ÃInvalid parti
00000368  74 69 6F 6E 20 74 61 62 6C 65 00 45 72 72 6F 72  tion table.Error
00000384  20 6C 6F 61 64 69 6E 67 20 6F 70 65 72 61 74 69   loading operati
00000400  6E 67 20 73 79 73 74 65 6D 00 4D 69 73 73 69 6E  ng system.Missin
00000416  67 20 6F 70 65 72 61 74 69 6E 67 20 73 79 73 74  g operating syst
00000432  65 6D 00 00 00 63 7B 9A F9 1D 7B AF 00 00 80 20  em...c{šù.{¯..€
00000448  21 00 07 DF 13 0C 00 08 00 00 00 20 03 00 00 DF  !..ß....... ...ß
00000464  14 0C 07 FE FF FF 00 28 03 00 00 18 FC 00 00 FE  ...þÿÿ.(....ü..þ
00000480  FF FF 07 FE FF FF 00 40 FF 00 00 40 00 00 00 FE  ÿÿ.þÿÿ.@ÿ..@...þ
00000496  FF FF 0F FE FF FF 00 80 FF 00 00 78 80 06 55 AA  ÿÿ.þÿÿ.€ÿ..x€.Uª
```

a. What information does this sector contain? ***5 marks***
b. How many active partitions does the disk have and how many partitions in total? Explain your answer. ***5 marks***
c. What is the starting sector in LBA of the first partition? ***5 marks***
d. What is the size in MBs of the 3rd partition? ***5 marks***

Question 3:

NTFS is the most common file system used in Windows today.

a. With regards to NTFS, discuss the role of the Master File Table (MFT) ***5 marks***
b. What are the main components of a MFT file record? ***10 marks***
c. With the help of a diagram, explain the concept of file slack and its significance in digital forensics. ***5 marks***

Question 4:

Critically discuss digital antiforensics techniques and explain how these techniques may be used to mislead the forensic investigation process. ***20 marks***

Question 5:

a. Using a digital investigation process model of your choice, discuss the importance of adopting such a methodology and the main phases of an investigation. ***14 marks***
b. In the context of data acquisition, explain the differences between disk cloning and disk imaging. ***6 marks***

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School of Architecture and Built Environment

Final EXAMINATION PAPER

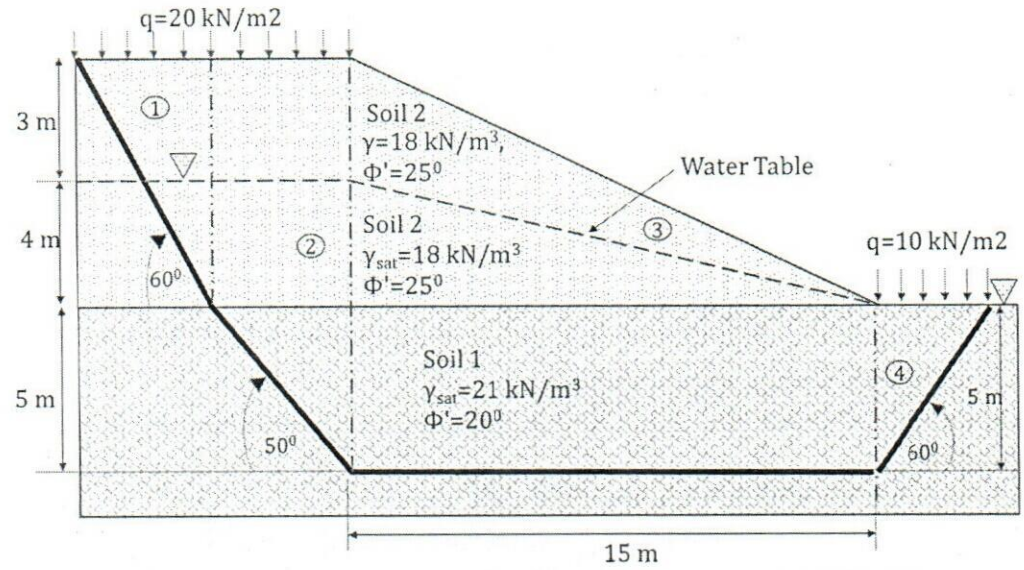
Module Code	:	**6CV014**
Module Title	:	**International Geotechnical Design**
Date	:	**06th November 2022**
Examiner	:	**Mr. Viraj Madushanka**
Time Allowed	:	**3 Hours**

INSTRUCTIONS TO CANDIDATES

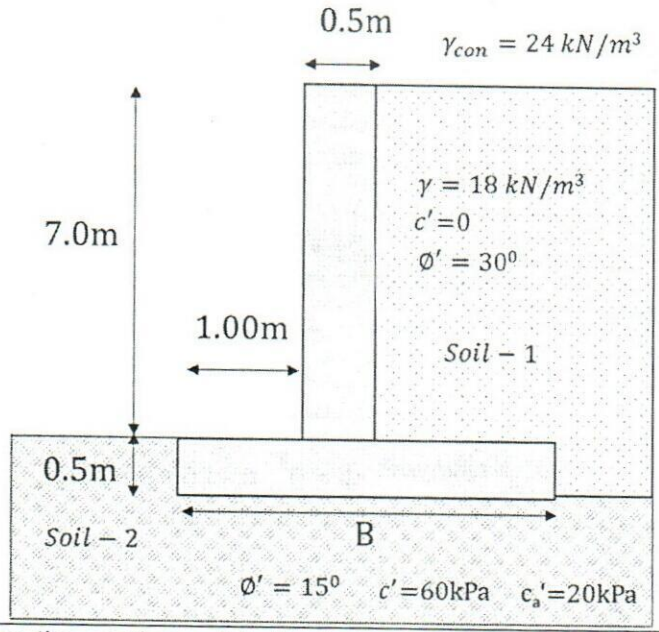
- This is an open-book examination.
- Attempt **ALL** questions. Your responses should be recorded on the answer booklet attached.
- You should write legibly in black or blue ink.
- Check your work carefully for inaccurate spelling, punctuation and grammar.
- You may not leave the examination room during the first hour or last 30 minutes of the exam.
- An announcement will be made when there are 30 minutes of the exam time left.
- All questions are not equally weighted. Please refer assigned marks for each subpart within the question

MATERIALS REQUIRED

- 12 page answer booklets.
- Any literature is allowed
- You may use a scientific calculator.

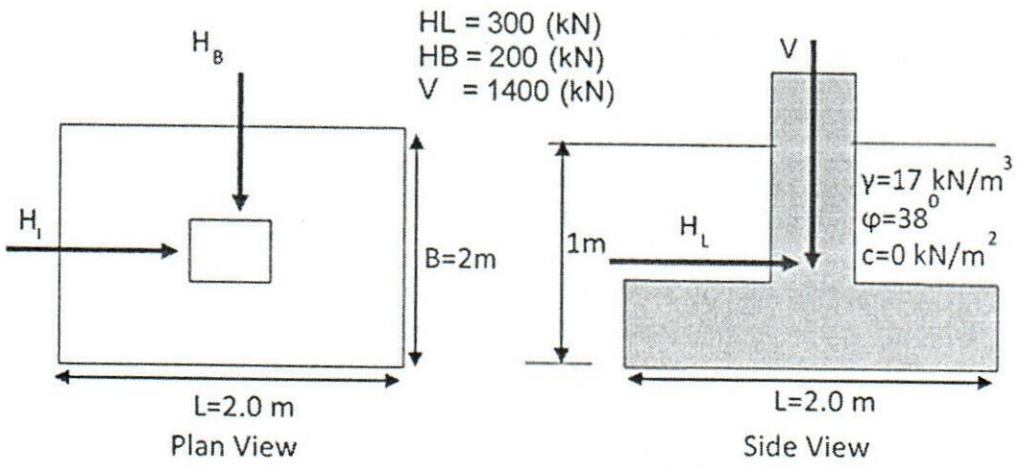
1	(a)	Describe the stages of deformation of the slopes under the influence of seismic loading	15%
	(b)	Use Janbu's method to determine the factor of safety of the slope shown below. Assume d=8.6m and l = 29.0 m and use 0.78 as a factor of safety for the first iterative and one iterative is sufficient for the calculation. The failure line is shown by a bolded line. 	85%
2	(a)	Some of the vertical cuts have been stable for a long period. Examine the reason with the necessary calculations.	20%
	(b)	The cantilever retaining wall shown below has a uniform stem thickness. Existing soil is shown as soil 2 and backfill soil is shown as soil 1. Estimate : i) Width of the base B that is safe for sliding (fos=1.5) and overturning (fos=2.0)	80%

ii) Check the factor of safety of the base against bearing capacity considering the ultimate bearing capacity of soil-2 is 440 kPa

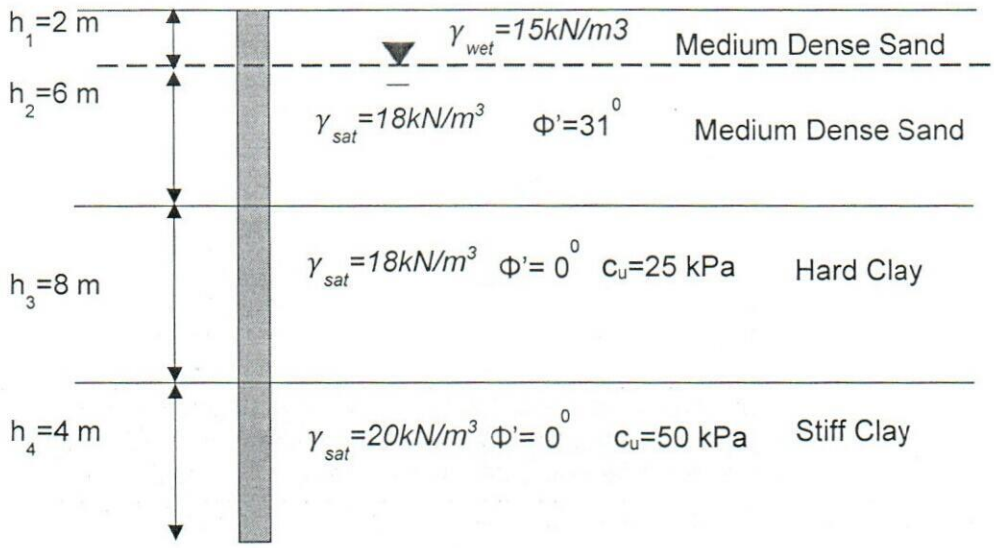


3 (a) Compare the settlement behaviour of elastic foundation and rigid foundation placed on sandy soil and elastic material. 20%

(b) Using Hansen Method, estimate the ultimate carrying capacity of the footing shown below. Further, estimate the allowable bearing capacity against the factor of safety 3 60%



(c) The estimated settlement under vertical stress for the arrangement shown in 4 (b) is 45 mm. As a design engineer, would you recommend placing the foundation on the ground shown above? Justify your answer with the reasons. Suggest a method to reduce the settlement up to 25mm 20%

4	(a)	There is a proposal to construct a four-story apartment complex and a fifty-story star-class hotel in the recently reclaimed port city-Colombo. Suggest suitable foundation types for each structure with the reasons	20%
	(b)	A 1000 mm diameter, 20 m long bored piles are installed as a group through the sub-surface shown in the following figure. The ground water table is present at 2 m below the ground surface and unit weights and the strength properties of the different layers are also given in the same figure. Determine the Net ultimate bearing capacity of the pile. (Consider $c_a = c_u$) 	80%

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Faculty of Science and Engineering

EXAMINATION PAPER

Module Code	**4MA007**
Module Title	**Engineering Mathematics**
Date of Examination:	**26th May 2022**
Examiner:	Ms.B.S Wijerathne
Examiner(s) Room:	06
Time Allowed:	3 Hours
Number of Questions to be attempted:	Attempt **ALL** questions

Marks awarded for each question are stated at the end of each question

Materials Required:

One eight-page answer book.

Additional information is provided on page 4.

Instructions to Students:

- Mobile phones are not permitted in the exam.
- Approved calculator only.
- You should write legibly in black or blue ink.
- Check your work carefully for inaccurate spelling, punctuation and grammar.
- You may not leave the examination room during the first hour or last 30 minutes of the exam.
- An announcement will be made when there are 30 minutes of the exam time left

A1. Solve the following system of equations **using Cramer's Rule**. (You should show all the steps in your calculations)

$$2x - 4y + z = 8$$

$$4x + 2y - 3z = -4$$

$$x + y + 2z = 1$$

(14 marks)

A2. The rate at which a body cools is given by $\theta = 250e^{-0.05t}$ where the excess of temperature of a body above its surroundings at time t minutes is $\theta^0 C$.(Give your answers to the nearest integer)

i) Determine the temperature after 25 minutes.

ii) Determine the time when the temperature is $195^0 C$

(8 marks)

A3. An alternating voltage of 240V, 50Hz is connected across an impedance of $(40 + j\,120)\Omega$. Determine the resistance and the inductance.

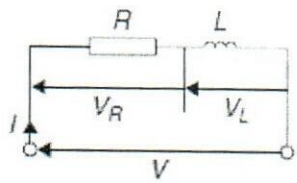


Figure 1

(5 marks)

A4. Find the magnitude of the forces acting upon joints 1,2 and 3 (J1,J2 and J3) for the following system (figure 2 on page 3)

i) By resolving forces into vertical and horizontal components

ii) Without resolving the forces (using the force diagram)

Find the answers correct to 2 decimal places

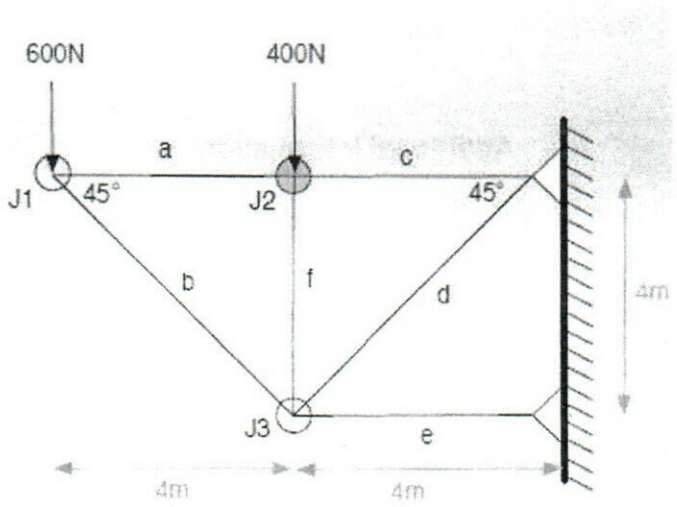


Figure 2

(30 marks)

A5. Determine the coordinates of the maximum and minimum values of the following graph.

$$y = x^3 - 3x + 5$$

(11 marks)

A6. Solve the following first order differential equations.

i) $(xy + x)\frac{dy}{dx} = xy + y$

ii) $5\frac{dy}{dx} + 2x = 3$ given that $y = \frac{7}{5}$ when $x = 2$.

iii) $\frac{dy}{dx} = 4cosx - 2x$

(16 marks)

A7. A differential equation relating the difference in tension ,T pulley contact angle θ and coefficient of friction μ, is given by $\frac{dT}{d\theta} = \mu T$.When $\theta = 0, T = 150\ N\ and\ \mu = 0.3$ as slipping starts.

i) Determine the tension at the point of slipping when $\theta = 2\ radians$.
ii) Determine the value of θ when T=300 N.

(16 marks)

END OF THE EXAMINATION

Additional Information

I. Inverse of a matrix

For matrix A, $A^{-1} = \frac{adj(A)}{|A|}$

II. Standard Derivatives

$f(x)$	$f'(x)$
x^n	nx^{n-1}
$\sin ax$	$a\cos ax$
$\cos ax$	$-a\sin ax$
e^{ax}	ae^{ax}

III. Standard Integrals

$f(x)$	$\int f(x)dx$
x_n	$\frac{x^{n+1}}{n+1}$, for $x \neq -1$
e^x	e^x
e^{ax}	$\frac{1}{a}e^{ax}$
$\frac{1}{x}$	$\ln x$
$\sin ax$	$-\frac{1}{a}\cos ax$
$\cos ax$	$\frac{1}{a}\sin ax$

IV.

Rules of differentiation	$\frac{d}{dx}(uv) = u\frac{dv}{dx} + v\frac{du}{dx}$ $\frac{d}{dx}\left(\frac{u}{v}\right) = \frac{v\frac{du}{dx} - u\frac{dv}{dx}}{v^2}$ $\frac{dy}{dx} = \frac{dy}{du}\frac{du}{dx}$
Integration by parts equation	$\int u\frac{dv}{dx}dx = uv - \int v\frac{du}{dx}dx$

V.

$\boldsymbol{Z = R + jX}$,

Where,

$Z = Impedence$

$R = Resistance$

$X = Reactance$

$\boldsymbol{X = X_L - X_C}$

Where,

$X_L(inductive\ reactance) = 2\pi fL\ ohms$

$X_C(capacitive\ reactance) = \frac{1}{2\pi fC}\ ohms$

$where, f = frequency$

$L = inductance$

$C = capacitance$

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00019

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DEPARTMENT OF INFORMATION TECHNOLOGY

BSc (Hons) Business Information Systems
6CI002

SKILLS DEMONSTRATION
IS Acquisition & Development Method

General Instructions to Candidate

- This paper consists of Seven (07) questions in on Three (03) pages.
- 100 Points for 30% of module grade.
- Answer all questions.

Date: 2020.02.09 Time: 02 hr

STUDENT ID – CINEC: ..... UoW : .....

Short Answer

Each short answer question is worth 10 points (40 points)

1. Select and analyse the critical features of a waterfall type software development methodology, giving an example of the type of project is may be suitable for.

2. Select and analyse the critical features of an agile type software development methodology, giving an example of the type of project is may be suitable for.

3. What is the purpose of an Invitation to Tender?

4. How can Cloud Computing help businesses meet their business requirements? What are the drawbacks to Cloud Computing?

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DEPARTMENT OF INFORMATION TECHNOLOGY

BSc (Hons) Business Information Systems
6CI002

Essay Questions

Answer the questions below in a short, two-page essay. (20 points each, 40 points total)

5. Discuss the difference between Functional and Non-Functional Requirements, giving two properly written examples of each. Then, analyses the difference between a User-Level Requirement and a System requirement, giving two properly written examples of each.

6. How can a business strategy help focus the activities of an organisation – what key benefits do organisations gain from a well-defined business strategy?

Analysis of a Case

7. Examine this case study. Identify the functional and non-functional requirements, indicating user requirements (customer) and system requirements (staff). Then, determine which software development methodology you believe would guide this project to success, and why you believe this to be the case. Support your answer using information you have gained in this module to date. **(20 points)**

Very Fyne Hairdresser

Very Fyne Hair Dresser (VFHD) is looking to develop an app that can give customers the ability to book and change appointments online, connecting to a joint database with the company website.

Customers will be able to select the day, the time, and the duration of appointments by selecting options that calculate the length of time each service takes.

Each service is performed by a qualified technician. Customers can select which technician they prefer for the services they want. Once an appointment is booked, another person cannot book the same person at the same time on the same day.

Customers can use the app to get a discount if they have been given a discount code. They can pay on the app in advance, after they have a services total.

VFHD would like this ready in about three months. They recognize that their staff will need access to the website to look at and if necessary, modify appointments (for example, in case of sickness, or a customer request). It is anticipated that three tablet computers, as well as three cell phones, will be

adequate for staff to maintain this database, and test it occasionally. They will need internet access and will need to contract hosting services as well. It is anticipated that training will be necessary, and that ongoing system support will be required.

----------End of Paper----------

EXAMINATION
UNIVERSITY OF WOLVERHAMPTON
07 SEP 2017
CINEC

12

Short Questions

Student number	
Student name	

Every question is worth 1 mark.

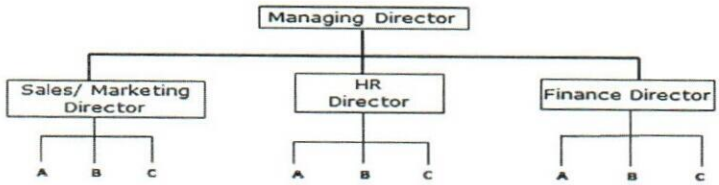
1. A business run by just one person would be referred to as being run by a what?
   - A chairman/chairwoman
   - A loner
   - A sole trader
   - A one-man band

2. The aim of most businesses is to make what?
   - Jobs for the staff
   - A profit
   - Shares
   - Information

3. S.M.E. stands for....
   - Small to Medium-sized Enterprise
   - Strategic Management Enterprise
   - System Management Enterprise
   - Strategic Monetary Enterprise

4. What is the main reason for organising a business into departments?
   - Legal requirements
   - Computing
   - Efficiency
   - Analysis

5. Formal communication in a business flows in what direction?:
   Your answer:
   - Down through the organisation from senior management to operational staff
   - Upwards from operational staff to senior management
   - Both 1 and 2 answers



6. The organisation chart above shows people in what sort of organisation?
   - Matrix
   - Structured
   - Hierarchical
   - Organisational

7. The sales function involves selling goods or services to.....?
   - Purchasing
   - Customers
   - Suppliers
   - Warehouse

8. Purchasing involves buying goods or services from...?
   - Warehouse
   - Customers
   - Suppliers
   - Sales

9. When a customer buys an item, what sort of order would this generate?
   - A purchase order
   - A sales order
   - A reorder
   - A repeat order

10. When a company needs to replenish its stocks, what sort of order does it need to send to the supplier?
   - A purchase order
   - A sales order
   - A reorder
   - A repeat order

11. The Management Triangle Structure hierarchy from top to bottom can be described as:

12

- Tactical - Operational - Strategic
- Strategic - Tactical - Operational
- Strategic - Operational –Tactical
- Strategic – Tactical - Departmental

12. The Strategic level of Management considers business issues that are:
    - Medium term
    - Short term
    - Long term
    - Immediate

13 Which of the following methodology models is procedural?
    - RAD
    - UML
    - Waterfall
    - Database

14. What diagram shows data flowing through a system?
    - SDLC
    - DFD
    - Use Case Diagram
    - ERD

15. What is the missing word? Analysis/Design/……?/ Maintenance
    - Support
    - Implementation
    - Feasibility
    - Usability

16. Generic Software used to solve a problem or perform a business task is called...
    - Bespoke
    - Operating system software
    - Applications Software
    - Configuration software

17. ERP is:
    - Enterprise Region Planning
    - Electronic Resource Planning
    - Electronic Regional Planning

- Enterprise Resource Planning

18. Selecting items off a warehouse shelf for a specific order is called what?

- Choosing
- Assembling
- Picking
- Lifting

19. Buying new stock in to a business is triggered when what lower limit is reached on the stock record?

- The buying target
- The selling target
- The reorder limit
- The request limit

20. What defines the users' needs for the new system you are working on for them?

- Feasibility
- Inputs
- Requirements
- User requests

21. What does GIGO stand for?

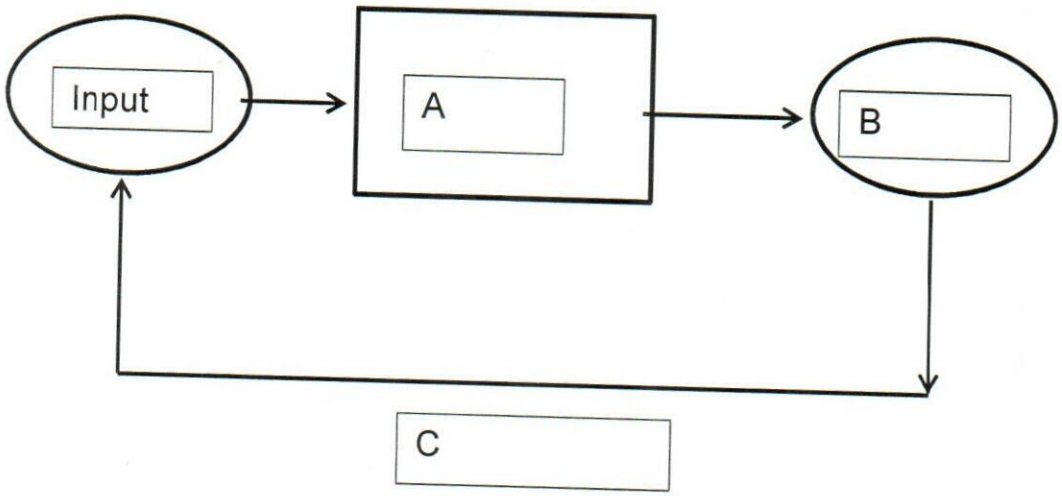
- Great input, great output
- General information generates orders
- Garbage in generates output
- Garbage in, garbage out

22. Metadata is data about?

- Metals
- Data
- Approximations
- Customers

23. In the diagram below, A is what?

- Output
- Control
- Process
- Feedback



24. In the diagram above, B is what?
    - Output
    - Control
    - Process
    - Feedback

25. Disintermediation involves what....?
    - Selling from business to business
    - Increasing the number of links in a sales chain
    - Reducing the number of links in a sales chain
    - Selling via an intermediary

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DEPARTMENT OF INFORMATION TECHNOLOGY

UNIVERSITY OF WOLVERHAMPTON 00026

BSc (Hons) Computer Networks (TopUp) — Sem 1.
5CC003

TIME CONSTRAINT ASSESSMENT (TCA)
IT Security

General Instructions to Candidate

- This paper consists of Fifty MCQ questions on Fourteen (14) pages.
- Each question contains four answers of which there is only one single best answer.
- Underline the correct answer for each question in question paper itself.
- Equal marks offered for each question
- Use a pen to mark the final answer

Date: 2020.02.02 Pass mark: 40% Time: 02 Hours

STUDENT ID – CINEC: …….. UoW : …….

Question 1
The assurance that data received are exactly as sent by an authorized entity is _____.

- data integrity
- data confidentiality
- authentication
- access control

Question 2
The most important symmetric algorithms, all of which are block ciphers, are the DES, triple DES, and the _____.

- AES
- SHA
- RSA
- DSS

Question 3

The Caesar Cypher is a form of:

- Public Key Encryption
- Symmetric Encryption
- Asymmetric Encryption
- Private Key Encryption

Question 4

In public key encryption, if Chris has Ian's public key

- Ian can be sure that any message he receives from Chris can only have come from Chris
- Ian can encrypt a message safe in the knowledge that only Chris can read it
- Chris can encrypt a message that only Brian can decipher
- Chris can be sure that any message he receives from Ian can only have come from Ian

Question 5

The purpose of a _____ is to produce a "fingerprint" of a file, message, or other block of data.

- secret key
- digital signature
- hash function
- keystream

Question 6

A _____ is created by using a secure hash function to generate a hash value for a message and then encrypting the hash code with a private key.

- digital signature
- keystream
- secret key
- one way hash function

Question 7

Digital signatures and key management are the two most important applications of _____ encryption

- private-key
- public-key
- preimage resistant
- advanced

Question 8

A _____ protects against an attack in which one party generates a message for another party to sign.

- data authenticator
- strong hash function
- digital signature
- weak hash function

Question 9

The advantage of a stream cipher is that you can reuse keys.

- True
- False

Question 10

_____ is a human-based attack in which an attacker pretends to be someone he is not.

- Spoofing
- Phishing
- Impersonation
- Whaling

Question 11

Biometric authentication is becoming an increasing reality in many applications, and each one of the techniques produces a biometric profile. Which of the following statements best describes the features of biometric authentication

- The biometric profile for both the imposter and correct user follow a normal distribution curve
- The decision threshold set in the area of curve overlap will determine the ratio of false imposter authentication to correct imposter identification
- The greater the curve overlap the greater the difficulty in correctly authenticating authorized users
- All of the above are true

Question 12

To counter threats to remote user authentication, systems generally rely on some form of _____ protocol.

- eavesdropping
- challenge-response
- Trojan horse
- denial-of-service

Question 13

A _____ is when an adversary attempts to achieve user authentication without access to the remote host or to the intervening communications path.

- client attack
- host attack
- eavesdropping attack
- Trojan horse attack

Question 14

A _____ strategy is one in which the system periodically runs its own password cracker to find guessable passwords.

- user education
- proactive password checking
- reactive password checking
- computer-generated password

Question 15

_____ controls access based on comparing security labels with security clearances.

- MAC
- DAC
- RBAC
- MBAC

Question 16

_____ is based on the roles the users assume in a system rather than the user's identity.

- DAC
- RBAC
- URAC
- MAC

Question 17

_____ implements a security policy that specifies who or what may have access to each specific system resource and the type of access that is permitted in each instance

- Authentication
- Accounting
- Access Control
- Authorization

Question 18

The _____ component deals with the management and control of the ways entities are granted access to resources.

- resource management
- access management
- policy management
- privilege management

Question 19

A _____ monitors network traffic for particular network segments or devices and analyzes network, transport, and application protocols to identify suspicious activity.

- host-based IDS
- security intrusion
- network-based IDS
- intrusion detection

Question 20

A _____ monitors the characteristics of a single host and the events occurring within that host for suspicious activity.

- host-based IDS
- security intrusion
- network-based IDS
- intrusion detection

Question 21

The _____ is responsible for determining if an intrusion has occurred

- analyzer
- host
- sensor
- user interface

Question 22

_____ involves an attempt to define a set of rules or attack patterns that can be used to decide if a given behavior is that of an intruder

- Profile based detection
- Signature detection
- Anomaly detection
- Threshold detection

Question 23

_____ involves the collection of data relating to the behavior of legitimate users over a period of time.

- Profile based detection
- Signature detection
- Anomaly detection
- Threshold detection

Question 24

A _____ gateway sets up two TCP connections, one between itself and a TCP user on an inner host and one between itself and a TCP user on an outside host.

- packet filtering
- stateful inspection
- circuit-level
- application-level

Question 25

Typically the systems in the _____ require or foster external connectivity such as a corporate Web site, an e-mail server, or a DNS server.

- DMZ
- IP protocol field
- VPN
- boundary firewall

Question 26

_____ scans for attack signatures in the context of a traffic stream rather than individual packets.

- Pattern matching
- Protocol anomaly
- Stateful matching
- Traffic anomaly

Question 27

The wireless environment lends itself to a _____ attack because it is so easy for the attacker to direct multiple wireless messages at the target.

- DoS
- man-in-the-middle
- identity theft
- network injection

Question 28

An example of a(n) _____ attack is one in which bogus reconfiguration commands are used to affect routers and switches to degrade network performance.

- identity theft
- ad hoc network
- man-in-the-middle
- network injection

Question 29

In order to accelerate the introduction of strong security into WLANs the Wi-Fi Alliance promulgated _____, a set of security mechanisms that eliminates most 802.11 security issues, as a Wi-Fi standard.

- WPA
- WEP
- RSN
- MAC

Question 30

_____ is the recommended technique for wireless network security.

- Using encryption
- Using anti-virus and anti-spyware software
- Turning off identifier broadcasting
- All of the above

Question 31

A security company wants to identify and learn about current and new attack methodologies. Which of the following is the BEST choice to meet this objective?

- Pen test
- IDS
- Honeypot
- Firewall logs

Question 32

_____ is a human or software-based attack in which the goal is to pretend to be someone else for the purpose of concealing their identity.

- Phishing
- Spoofing
- Impersonation
- Whaling

Question 33

The _____ function consists of encrypted content of any type and encrypted-content encryption keys for one or more recipients

- clear-signed data
- signed data
- enveloped data
- signed and enveloped data

Question 34

_____ is a list that contains the combinations of cryptographic algorithms supported by the client.

- Compression method
- Session ID
- CipherSuite
- None of the above

Question 35

Search engines support HTTPS.

- True
- False

Question 36

Which of the following network tools includes sniffing capabilities?

- IDS
- WAP
- VPN
- NAC

Question 37

The security technology that evaluates IP packet traffic patterns in order to identify attacks against a system is known as

- An Intrusion Prevention System
- Stateful Packet Filtering
- Static Packet Filtering
- Deep Packet Inspection

Question 38

The most common variant of injecting malicious script content into pages returned to users by the targeted sites is the _____ vulnerability.

- XSS reflection
- chroot jail
- PHP file inclusion
- atomic bomb

Question 39

_____ attacks are those where the injected script is permanently stored on the target servers, such as in a database, in a message forum, visitor log, comment field, etc. The victim then retrieves the malicious script from the server when it requests the stored information

- Reflected XSS Attacks
- Stored XSS Attacks
- SQL Injection
- PHP file inclusion

Question 40

_____ attacks are those where the injected script is reflected off the web server, such as in an error message, search result, or any other response that includes some or all of the input sent to the server as part of the request.

- Reflected XSS Attacks
- Stored XSS Attacks
- SQL Injection
- PHP file inclusion

Question 41

_____ attacks are vulnerabilities involving the inclusion of script code in the HTML content of a Web page displayed by a user's browser.

- PHP file inclusion
- Mail injection
- Code injection
- Cross-site scripting

Question 42

Malicious code inserted in place of a query to get to the database information is known as?

- PHP remote code injection
- mail injection
- SQL injection
- command injection

Question 43

Management is concerned about malicious activity on your network and wants to implement a security control that will detect unusual traffic on the network. Which of the following is the BEST choice to meet this goal?

- Network firewall
- Signature-based IDS
- Anomaly-based IDS
- Honeypot

Question 44

_____ will integrate with the operating system of a host computer and monitor program behavior in real time for malicious actions.

- Fingerprint-based scanners
- Behavior-blocking software
- Heuristic scanners
- Generic decryption technology

Question 45

A _____ is a set of programs installed on a system to maintain covert access to that system with administrator (root) privileges while hiding evidence of its presence.

- virus
- rootkit
- worm
- sniffer

Question 46

A virus that attaches to an executable program can do anything that the program is permitted to do.

- True
- False

Question 47

Opening a port on your computer in order to exploit your system is something that _____ would do.

- A virus
- A buffer overflow
- Spyware
- A social engineer

Question 48

A HIDS reported a vulnerability on a system using an assigned vulnerability identification number. After researching the number on the vendor's web site, you identify the recommended solution and begin applying it. What type of HIDS is in use?

- Network-based
- Signature-based
- Heuristic-based
- Anomaly-based

Question 49

Social Engineering is often described as art of obtaining confidential information by manipulating and/or deceiving people. An organisation can stop such attacks by

- each user having a different password for each and every confidential action they take on their network
- channelling all requests for information through a central department
- It is almost impossible to defend against 100%.
- Use of appropriate software to screen requests

Question 50

The typical order of phases of a worm and a virus in their lifetime, are.

- Propagation phase, dormant phase, execution phase, triggering phase
- Triggering phase, dormant phase, propagation phase, execution phase
- Phishing phase, dormant phase, propagation phase, triggering phase
- Dormant phase, propagation phase, triggering phase, execution phase