CINEC CAMPUS
Beyond A Graduate

Faculty of Engineering & Technology Department of Civil Engineering BSc. Hons. (Eng.) in Civil Engineering Semester 8 First Sit - Final Examination 2026 Batch: B. Sc. Batch 5	
Module Code: CE 4322	Module Title: Environmental Engineering
Date: 10th August 2026	Duration: 3 hrs
Examiner:	Prof. (Ms) Buddhika Gunawardana

Instructions to Candidates:

- *This is a closed book examination. No reference materials are allowed unless specified.*
- *This paper contains six (06) questions in six (6) pages.*
- ***Answer all questions.***
- *The marks allocated to each question are listed in the column on the far right. The final mark of the question paper will be calculated out of 100.*
- *Use only the provided answer booklet and additional sheets for your answers.*
- *Write clearly and legibly. Use a blue or black pen only.*
- *Write your student number on all sheets.*
- *Start each question on a new page in the answer booklet or answer sheets. Clearly indicate the question number at the top of the page.*
- *If parts of the same question are written discontinuously on non-consecutive sheets, ensure that each part is relevantly labelled with its corresponding question number.*

Q1 A mini hydropower project is proposed to be constructed in the Central Province of Sri Lanka. The proposed location is situated in an area containing environmentally sensitive forest ecosystems and several rural communities. The proposed reservoir will inundate approximately 500 hectares of forest land and require the relocation of 200 families. Due to the scale and potential environmental impacts of the project, an Environmental Impact Assessment (EIA) must be conducted under the National Environmental Act. The Project Approving Agency (PAA), in consultation with the Central Environmental Authority (CEA), has issued the Terms of Reference (TOR) for the EIA study.

i) Explain the purpose of **alternatives analysis** in the EIA process. Mention two (02) examples of the types of alternatives that should be evaluated. [04]

ii) Briefly explain two (02) objectives of public participation during the EIA process. [04]

iii) Recommend one appropriate **mitigation measure** for each of the following impacts associated with the proposed dam project.

a) Deforestation [01]

b) Soil erosion [01]

c) Water quality deterioration [01]

d) Community displacement [01]

iv) Propose two (02) appropriate **environmental monitoring parameters** for each of the following project stages.

a) Construction phase [02]

b) Operational phase [02]

v) As an environmental engineer advising the Project Approving Agency (PAA), would you recommend approval of the project if significant biodiversity impacts remain after all practicable mitigation measures have been implemented? Justify your recommendation. [04]

Total [20]

Q2 A new township consisting of residential areas, commercial activities, a school, and recreational facilities is proposed for development. The proposed developments are expected to generate considerable quantities of municipal solid waste (MSW). If this waste is not properly managed, it may lead to environmental pollution, public health issues, and degradation of the surrounding ecosystem.

i) MSW is composed of different waste streams generated from residential and commercial activities. Explain **biodegradable** (organic) **waste and non-biodegradable waste**, giving one suitable example of each. [04]

ii) Explain the importance of **waste segregation** at the source in the effective management of MSW. [03]

iii) Explain the **Waste Minimization Hierarchy** using a clearly labeled diagram. How does the hierarchy contribute to sustainable MSW management? [04]

iv) Describe the **3R concept (Reduce, Reuse, Recycle)** and its importance for reducing the amount of waste requiring final disposal. [04]

Total [15]

Q3 An industrial zone is proposed in the neighborhood of a rapidly developing urban area. The industries within the zone include a vehicle repair workshop, a chemical laboratory, an electronic equipment assembly plant, and a healthcare facility. These industries are expected to generate different types of hazardous waste, including used oils, waste solvents, laboratory chemicals, batteries, electronic waste, and infectious medical waste. Improper management of these wastes may result in significant risks to human health and the environment.

i) What are the four (04) **main characteristics** that distinguish hazardous waste from ordinary solid waste? Give one suitable example for each characteristic. [04]

ii) Describe why **incineration** is an appropriate treatment method for hazardous waste. [03]

iii) Explain the importance of **air pollution control** devices in a hazardous waste incineration facility. [04]

iv) Recommend one (01) suitable management measure for each of the following hazardous waste types generated within the industrial estate.

a) Used engine oil [01]

b) Waste laboratory chemicals [01]

c) Infectious healthcare waste [01]

d) Electronic waste (E-waste) [01]

Total [15]

Q4 A conventional drinking water treatment facility is proposed to supply potable water to a rapidly growing town in Sri Lanka. The source of raw water is a nearby river. During the rainy season, this river experiences elevated turbidity levels due to increased suspended solids. To ensure the delivery of safe drinking water, the treatment plant will employ conventional processes, including coagulation, flocculation, sedimentation, filtration, and disinfection.

During the planning and design stage, engineers carried out various laboratory analyses to determine the solids concentration of the raw water, optimize the coagulant dose using a Jar Test, and assess the quality of the treated water against the Sri Lanka Drinking Water Standard (SLS 614).

i) Briefly explain two (02) **negative environmental impacts** of excessive suspended solids in natural water bodies. [03]

ii) The following measurements were obtained during laboratory analysis of the raw water.
The initial weight of the filter paper (1.5 µm pore size) was 3.220 g; the final weight of the dried filter paper after filtering a 200 mL water sample was 3.270 g.
After evaporating 20 mL of the filtrate (water sample obtained after filtration) in a Petri dish, the weight of the Petri dish with the dried residue was 48.361 g; and the weight of the empty Petri dish was 48.360 g.
Calculate the concentrations of Total Suspended Solids (**TSS**), Total Dissolved Solids (**TDS**), and Total Solids (**TS**) (as mg/L). [03]

iii) A Jar Test was conducted using Ferric Chloride as the coagulant while maintaining a constant pH. The following results were obtained.

Jar No.	1	2	3	4	5	6
Ferric Chloride Dose (mg/L)	0	20	40	60	90	120
Final Turbidity (NTU)	270.0	105.0	25.0	1.8	15.0	45.0

a) Briefly explain the Jar test procedure, including specific details about the mixing speed at each step. [03]

b) Determine the optimum Ferric Chloride dose based on the Jar Test results. Justify your answer using a suitable graph. [03]

c) Explain the reasons for the increase in turbidity observed with the increase in Ferric Chloride dose. [03]

iv) The treated water produced using the optimum Ferric Chloride dose was analyzed and compared with selected requirements of the Sri Lanka Drinking Water Standard (SLS 614).

Water Quality Parameter	**Measured Value**	**SLS 614 Requirement**
pH	7.3	6.5–8.5
Turbidity (NTU)	1.8	≤ 2.0
Total Dissolved Solids (mg/L)	46	≤ 500
Fluoride (mg/L)	1.3	≤ 1.0
Nitrate (mg/L) as Total Nitrate	18	≤ 50

a) Compare the measured water quality with the Sri Lanka Drinking Water Standard (SLS 614) and determine whether the treated water complies with the selected drinking water quality requirements. [03]

b) Apart from the parameters listed above, recommend two (02) **additional water quality parameters** that should be tested before supplying the treated water for public consumption. Briefly justify your answer. [02]

Total [20]

Q5 A newly developed rural housing scheme consisting of 25 houses is located in an area where a centralized sewer network is not available. The site has moderately permeable soil. The local authority has recommended an on-site wastewater treatment system for each house to protect human health and the surrounding environment.

i) Briefly distinguish between **separate and combined** wastewater collection systems. [02]

ii) Explain the primary functions of a **septic tank** and the role of anaerobic bacteria in the treatment process. [03]

iii) Using a clearly labeled diagram, briefly describe how wastewater separates into **scum, effluent, and sludge** inside a septic tank. [03]

iv) Recommend one (01) **suitable effluent disposal method** for this housing scheme. Justify your recommendation based on engineering and environmental considerations. [02]

Total [10]

Q6 Municipal wastewater treatment in Sri Lanka faces critical infrastructure deficits. The country relies overwhelmingly on localized, on-site containment systems like septic tanks and soakage pits, while centralized piped sewerage infrastructure remains strictly limited to major urban centers like Colombo. Rapid urbanization and population growth necessitate the immediate development of centralized wastewater treatment infrastructure to comply with stringent statutory discharge limits and safeguard the nation's water resources.

i) Compare municipal **water treatment** with **wastewater treatment**. Differentiate the two processes by analyzing their raw water sources, treatment objectives, quality parameters, and standard unit operations. [04]

ii) Draw a detailed process flow diagram for a **conventional municipal wastewater treatment plant**. On your diagram, clearly demarcate the boundaries of the **preliminary, primary, secondary and sludge treatment systems**, ensuring all major unit operations and processes are chronologically labeled. [05]

iii) A clean, mechanically raked vertical bar screen is installed in an approach channel. The screen consists of 15 parallel bars, each with a width of 8 mm and a clear spacing of 10 mm. The upstream approach velocity is 0.85 m/s at a water depth of 450 mm. Assuming a discharge coefficient (C) of 0.7 for the clean screen, determine:

a) The flow velocity through the screen openings (m/s). [03]

b) The downstream water depth (mm) immediately after the screen. [03]

iv) State four (04) distinct engineering configurations or process variants used in secondary biological wastewater treatment to achieve carbonaceous organic removal. [02]

v) State three (03) primary sequential stages involved in **municipal sludge treatment**. Provide one specific engineering unit operation or technology example for each stage. [03]

Total [20]

Supplementary Information:

Head loss across bar screens h_L:

$$h_L = \frac{1}{C}\left(\frac{V^2 - v^2}{2g}\right)$$

Where;

- V: Velocity of water through the bar openings (m/s)
- v: Approach velocity in the upstream channel (m/s)
- g: Acceleration due to gravity (9.81 m/s²)
- C is the discharge coefficient (typically 0.7 for a clean screen and down to 0.6 or lower as the screen gets clogged).

End of the Question Paper

CINEC CAMPUS
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Faculty of Engineering & Technology Department of Civil Engineering BSc. Hons. (Eng.) in Civil Engineering Semester 8 First Sit - Final Examination 2026 Batch: 5	
Module Code: CE 4321	**Module Title: Construction Engineering and Management**
Date: 05/08/2026	**Duration: 3 hours**
Examiner 1:	**Mr. Kushan Hirimuthugodage**

Instructions to Candidates:

- *This is an open book examination.*
- *This paper consists of two parts and 13 pages. Answer all questions from Part A and Part B.*
- *Use the Same booklet to answer Part A.*
- *Suggested time period for Part A is 80 minutes and Part B is 100 minutes.*
- *The marks allocated to each question are listed in the column on the far right. Final mark of the question paper will be calculated out of 100.*
- *Use only the provided answer booklet, additional sheets, and graph papers for your answers.*
- *Write clearly and legibly. Use a blue or black pen only.*
- *Write your student number on all sheets.*
- *Start each question on a new page in the answer booklet, answer sheets. Clearly indicate the question number at the top of the page.*
- *If parts of the same question are written discontinuously in non-consecutive sheets, ensure that each part is relevantly labelled with its corresponding question number.*

Part A

1. If Actual Cost (AC) is greater than your Earned Value (EV), what does this mean
    1. The project is under the budget
    2. The project is over the budget
    3. The project is ahead of schedule
    4. The project is behind schedule
    5. Not enough data

2. What is the ISO standard for management systems of Occupational Health and Safety (OHS)?
    1. ISO 45001
    2. ISO 27001
    3. ISO 18001
    4. ISO 9001
    5. ISO 9000

3. A worker is working at height where the height of the anchorage point of the safety belt to the floor level is 19ft. Take height of the worker as 6 feet and safety factor as 2.5 feet and maximum deceleration distance as 3 feet. With a full safety harness belt what is the maximum length of the lanyard that he can use
    1. 6.5ft
    2. 7.0ft
    3. 7.5ft
    4. 8.0ft
    5. Not enough data

4. Which of the following statements are FALSE regarding construction machines?
    a) Forklift can lift one or few workers
    b) Asphalt paving machine provides minor compaction before it is compacted by a roller
    c) From a tunnel boring machine a specific excavation profile can be achieved
        1. a only
        2. b only
        3. c only
        4. a and b only
        5. b and c only

5. Which of the following statements are TRUE about productivity?
    a) The main objective of work study is to improve productivity of workers, machines and materials
    b) Work Measurement helps to find the best method of performing by eliminating wastages
    c) Method Study is used to find the time required to carry out the operation at a defined level of activity
        1. a only
        2. a and b only
        3. a and c only
        4. b and c only
        5. All

6. Planned budget is a snapshot of.....
        1. Life Cycle Costing
        2. Internal Rate of Return (IRR)
        3. Earned Value (EV)
        4. Benefit Cost Ratio (BCR)
        5. Cost Baseline

7. When you use MS Project to allocate Resources for the project what is the frequency that you use?
    a) Specify people and equipment for the project
    b) Define working times for resources
    c) Assign people and equipment to tasks
    d) Specify the booking types for resources
        1. a ⟹ b⟹c ⟹d
        2. a ⟹ d⟹b ⟹c
        3. a ⟹ b⟹d ⟹c
        4. a ⟹ d⟹c ⟹b
        5. a ⟹ c⟹d ⟹c

8. In a construction site, a sub-contractor has been given task to finish a job within 10 weeks as ordered by the immediate supervisor. But the project manager asks him to deliver the job within 7 weeks. Which of the Fayol's principles of management is lagging at that site?
        1. Equity
        2. Scalar Chain
        3. Order
        4. Unity of Command
        5. Authority

9. Which of the following business organizations will protect the owner's assets in the event of business fault or accident?
    a) Limited Liability
    b) Sole Proprietorship
    c) Partnership
        1. a only
        2. a and b only
        3. a and c only
        4. b and c only
        5. All

10. Repairing an assembly line in a toy factory is a;
    a) Project
    b) Process
    c) Operation
        1. a only
        2. b only
        3. c only
        4. a and b only
        5. b and c only

11. In which of the following project management process group you make the tenders
        1. Initiating
        2. Planning
        3. Executing
        4. Programming
        5. Closing

12. Which of the following statements are TRUE about earth moving machines?
    a) A Scraper is generally carried out on a downward gradient to take full advantage of gravity
    b) If the mould board can be tilted in the horizontal and vertical planes in a Dozer, then the machine is called an angle dozer
    c) Front Shovel the bucket faces way from the machine

        1. a only
        2. a and b only
        3. a and c only
        4. b and c only
        5. All

13. Which of the following is NOT correct about compaction equipment?
    1. Power Rammer is used to compact soil in narrow trenches
    2. Sheep's foot roller is an example for kneading compactor
    3. Tandem rollers are made with ballastable wheels which can increase the weight of the roller
    4. Vibratory rollers can be used in cohesive soils
    5. Tandem roller is an example for a static weight compactor

14. Which of the following are benefits of CIDA registration scheme?
    a) Client organizations can select the right contractor
    b) It motivates the contract for self-development
    c) It prevents contractors from undertaking projects beyond their capabilities
        1. a and b
        2. a and c
        3. b and c
        4. a only
        5. All

15. You are managing a project and when your client tells you that an external problem happened, and now you have to meet an earlier deadline. Your supervisor heard that in a situation like this, you can use schedule compression by either crashing or fast tracking the schedule, but he's not sure which is which. What do you tell him?
    1. Crashing the project adds risk, while fast-tracking adds cost
    2. When you crash a project, it always shortens the total duration of the project
    3. Crashing the project adds cost, while fast-tracking adds risk
    4. When you fast-track a project, it always shortens the total duration of the project
    5. Both crashing and fast tracking will not work with scenario

16. You are a newly appointed engineer for a construction project. From the first day you have been given lot of responsibilities, without telling the procedures to fellow. Because of this you are very stressed and now you are thinking of leaving the company. what is the Feyol's Management Theory that your company should follow to retain you
    1. Unity of command
    2. Unity of direction
    3. Scalar chain
    4. Order
    5. Stability of tenure personnel

17. Which of the following does NOT affect the productivity in construction
    1. Industry under invests in digitization and innovation
    2. Increasing project and site complexities
    3. Bespoke or suboptimal owner requirements
    4. Using proper project management and execution basics
    5. Contractual structures and incentives are misaligned

18. Which one of the following is NOT an advantage of an orientation program?
    1. It helps to understand about the organization
    2. Feels welcome
    3. Can get an idea about what is expected in work and behavior
    4. Gives technical knowledge on what to do
    5. It helps to start the socialization process

Use this for Question No. 20 and 21

Activity	Duration(Weeks)	Predecessor
Start	0	None
A	4	Start
B	3	A
C	4	A
D	2	B and C
E	3	C
F	1	D
G	4	D and E
H	3	F and G
I	2	H

19. What is the critical path in the activity list?
    1. Start-A-C-E-G-H-I
    2. Start-A-C-D-F-H-I
    3. Start-A-B-D-G-H-I
    4. Start-A-B-D-F-H-I
    5. None of the above

20. What is the float for activity "F" in the activity list?
    1. 0
    2. 3
    3. 4
    4. 5
    5. 6

21. What is the role of Adjudicator in construction
    1. Evaluate tenders submitted by the bidders
    2. Recruit new workers for the company
    3. Resolve disputes between contractor and the client
    4. Prepare tenders for bidding
    5. Evaluate performance of the staff

22. In general, a steel building can be built in 20 weeks, but rain could stretch the project out to 21 weeks. However, if the forecast is correct, warm, sunny weather might bring the duration down to just 16 weeks. Using Program Evaluation Review Technique (PERT) what is the estimated duration of the project
    1. 18.5 weeks
    2. 19.5 Weeks
    3. 20 Weeks
    4. 20.5 Weeks
    5. Not enough data

23. Estimated cycle time of an excavator which is going to be used in a bulk excavation project is calculated as 3 minutes. The capacity of the bucket which is going to be used is $0.6m^3$ and the efficiency of the machine and the operator is estimated as 80%. Calculate the hourly production of the machine?
    1. $8.60m^3$
    2. $8.80m^3$
    3. $9.00m^3$
    4. $9.60m^3$
    5. $9.80m^3$

24. If the natural soil which is going to be excavated in Question 23 is having a compaction factor of 1.3 and the excavator is working for 4 hours, how many 3 cube truck loads you need to transport the soil
    1. 6
    2. 7
    3. 17
    4. 18
    5. Not Enough Data

25. Key Performance Indicators (KPI) Can be used to improve;
    a) Quality in Construction
    b) Productivity in Construction
    c) Time efficiency in construction
        1. a only
        2. a and b only
        3. a and c only
        4. b and c only
        5. All

26. When you go to the job for the first time you find that your company is having different departments for different functions such as Engineering, Procurement, Finance, Human Resources. You have a project manager who is handling your project also. You need to report to the Project Manager at site and also to the Engineering manager at head office. The organization structure at your company is highly likely;
    1. Flat Organization
    2. Matrix Organization
    3. Functional Organization
    4. Divisional Organization
    5. Not enough data

27. Which of the following is TRUE about Activity Sampling?
    a) This technique provides rapid and effective means of studying the pattern of almost any type of activity
    b) The process of collecting information about machine or human activities by making a large number of instantaneous observations of the subject
    c) The degree of confidence and accuracy in the result can be varied
        1. a only
        2. a and b only
        3. a and c only
        4. b and c only
        5. All

28. Which of the following Techniques that you can use to Manage Quality?
    a) 5S
    b) Three MU's
    c) Standardization
        1. a only
        2. a and b only
        3. a and c only
        4. b and c only
        5. All

29. You are doing the Vendor Bid Analysis. Which Process Are you in?
    1. Determining Budget
    2. Controlling Costs
    3. Estimating Costs
    4. Cost Baselining
    5. Cost Evaluation

30. Which of the following is a Direct Cost of an accident
    1. Replacement cost
    2. Administrative cost
    3. Insurance cost
    4. Loss of productivity
    5. Property damage

31. Which of the following is FALSE about a Functional Organization?
    1. Work is performed more efficiently since each manager is responsible for a single function
    2. The employees are accountable to more than one boss
    3. Delay in decision-making
    4. Divides a firm's operations based on specialties and there's an individual in charge of a particular function
    5. There's a total specialization of work

32. What do you mean by "Halo Effect" in performance appraisal
    1. The tendency for an impression created in one area to influence opinion in another area
    2. Evaluate employee performance by summarizing individual ratings into a single representative score
    3. Being more merciful for someone
    4. Biasness based on personal interest
    5. Evaluate based on recent performance

33. Which of the following is NOT correct about transporting equipment?
    1. Crawler Carriers can be used in environmental sensitive sites
    2. Belt conveyors can be used to easily transport material on a different route
    3. By using conveyors materials can be safely transport without damaging
    4. Equipment Transporters are used to transport material for long distances
    5. Crawler carriers can travel on uneven, steep and wet terrains

34. Which of the following is TRUE about Near Miss?
    a) It is also known as Near Hit
    b) It is an accident result in injury or damage
    c) A Near Miss today can be tomorrow's accident
        1. a only
        2. b only
        3. c only
        4. a and b only
        5. a and c only

35. Which of the following statements are TRUE about soil compaction?
    a) In the case of large lift thickness, bridging may occur at the top of lifts
    b) When the soil starts to crack, it means you need some more roller passes
    c) At site you use 75% of the ideal maximum lift thickness provided by the machine manufacturer

        1. a only
        2. b only
        3. c only
        4. a and b only
        5. b and c only

36. When selecting a new project manager for a construction project you should NOT consider this;
        1. Gender
        2. Knowledge
        3. Skills
        4. Abilities
        5. Previous experience in similar projects

37. Which is NOT an advantage of having a proper organization structure?
    1. Better communication
    2. Provides accountability
    3. Better employee performance
    4. Set organization priorities
    5. Conflict in decision making authority

38. You are a project manager for a construction project and you work with your own work force of the company. But for electrical and plumbing works you do not have competent skill workers on the company. Because of that you are going to hire some subcontractors for that specific job. This is called;
    1. Outsourcing
    2. Referrals
    3. Walk ins
    4. Head Hunting
    5. Offshoring

39. You are managing a project that has a To-complete performance index (TCPI) of 0.98 What is the BEST course of action?
    1. You're under budget, so you can manage costs with lenience
    2. Manage costs aggressively
    3. Create a new schedule
    4. Create a new budget
    5. Not Enough Data

40. Which of the following is TRUE about a Matrix Organization?
    a) There's more than one line of reporting managers
    b) The employees are accountable to only one boss
    c) Provides a practical way of integrating the firm's objectives with operations

    1. a only
    2. b only
    3. c only
    4. a and b only
    5. a and c only

(1.25x40=50 Marks)

Part B

1. JKH is a construction company engaged in land reclamation projects. They decided to buy an JCB machine for their project for Rs. 15,000,000.00. They were able to negotiate with a leasing company to fund 75% of the amount of the machine with an annual interest rate of 8% which is fixed for all 5years. The interest is equally calculated to the capital on every year for the lease period of 5 years.

   In addition to all these JKH needs to pay Rs. 400,000.00 as a heavy vehicle tax for the government every year for all 5 years. They also arranged an insurance with a premium of Rs. 200,000.00 per year for all 5 years.

   JKH is expecting to sell the machine after 5 years with a salvage value of Rs. 5,000,000.00 and the company accountant is using Sum of Digits method to calculate the depreciation for the machine. The fuel consumption of the machine is 5l/hr and the lubricant consumption is 0.25l/hr. Assume that these consumptions and the tyres unchanged for the all 5years. The machine is expected to work an average of 6 hours per day for 300 days in a year for all 5 years.

   (Additional data: fuel price Rs.400.00/per liter, Lubricant price Rs.800.00/per liter, repair cost Rs. 500.00/per hr, operator wages Rs. 700.00/per hr. Assume all these prices will not change for all 5 years)

   Help the newly appointed Project manager to find the following for the 3rd year of machine operations;

   I. Machine Fixed cost
      a) Depreciation
      b) IIT
   II. Machine variable cost
      a) Operator Wages
      b) Fuel
      c) Lubricant and Filter
      d) Repair and Maintenance
      e) Tyre
   III. Total Owning and Operating Cost

2. As a job rotation you have been asked to work as a Procurement Manager for a period of one year. Once you start working with the procurement team you found that the productivity of the department is very low. The procurement team is using conventional methods and there is no transparency in purchasing. Based on the knowledge that you gained during the university, describe what are the methods that you can use to improve productivity at your new department. (Discuss **three** methods with **examples**)

3. You are a newly appointed project manager multi story construction project. When you start work, you realized that there are issues with the quality management process of the site. There are lot of wastages and miss use of machineries. You are planning to introduce continuous quality improvements to the site using **Kaizen approaches**.
   Discuss **Three** techniques that you can use with **examples**

4. You are the project responsible PM for a project which has a budget of Rs.34,000 ,000.00 and a time duration of 12months. At the end of 3 months your actual completion is 40% and as your plan it has to be 45%. By that time, you have spent Rs.19,200,000.00 of your budget.

   i. Calculate; BAC, PV, AC, EV, SV, CV, SPI, CPI, TCPI, EAC, ETC, VAC
   ii. Based on Your answers explain the position of the project

5. "Urban Build Ltd." has been awarded a contract to construct a large commercial office building in the city. As the first step the company is planning to start pilling works for the project. You are the newly appointed safety officer for the company. The company needs to submit their safety plan for the client before starting the project. Therefore, you need to identify **Two safety hazards** that can happen at each the following stages of the site progress and the **safety measures** that you can take to avoid them
   i. Site clearing
   ii. Pile boring and drilling
   iii. Pile concreting
   iv. Pile Hacking

(10x5=50 Marks)

CINEC CAMPUS
Beyond A Graduate

Faculty of Engineering & Technology

Department of Civil Engineering

Bachelor of Science Honours in Engineering

Year 1 Semester 1 Re sit Examination 2026

Module Code	:	**CE1313**
Module Title	:	**Properties of Materials**
Date/Time	:	**17th July 2026/ 09.00 am – 12.00 noon**
Examiner	:	**P.W Gavithra Udayakumara**
Time Allowed	:	**Three hours only**

INSTRUCTIONS TO CANDIDATES

- This is a **closed book** examination.
- "Section A" consists of 10 Multiple Choice Questions. You should attempt **ALL** questions.
- Section B consists of 4 questions. You should attempt all 4 questions.
- Show all stages of your work.
- This paper contains 09 pages.

MATERIALS REQURIED

- Answer Booklet.
- You may use a scientific calculator. This must not be programmable and may be inspected during the examination.
- Extra answer papers (if required)
- Equations are mentioned at the 9th page

Student Number .....

SECTION A

1. An engineering team is designing ultra-small transistor patterns for a new microprocessor chip. They need a method where nanoscale features are created by carving larger material using external tools. Which nanomaterial fabrication approach should they select?

   a) Self-assembly of atoms into nanostructures
   b) Chemical vapor deposition using gaseous precursors
   c) Photolithography using masks and photo-sensitive coatings
   d) Growth of nanowires atom-by-atom
   e) Bottom-up synthesis of carbon nanotube

2. An engineering team is working on designing a critical component for an aircraft that will be subjected to cyclic loading during its operational life. The team is concerned about the potential for fatigue failure and is exploring various materials and design strategies to mitigate this risk. What is the significance of conducting fatigue testing during the design phase of the component?

   a) To determine the hardness of the material
   b) To identify the yield strength of the material
   c) To assess the material's response to cyclic loading and predict fatigue life
   d) To measure the material's thermal conductivity
   e) To determine the Ultimate Tensile Strength and Yield Strength of the material

3. A company wants to develop a flexible, lightweight electronic display. The material must be extremely thin and must have excellent electrical conductivity. Which nanomaterial is the best choice?

   a) Bulk graphite
   b) Graphene, because of its excellent electrical mobility and transparency
   c) Diamond, because it is an electrical insulator
   d) Multi-walled carbon nanotubes only, because graphene cannot conduct electricity
   e) Silicon wafer, because it is the thinnest possible semiconductor

4. Radioactive materials are using for various purposes. A γ-ray source is delivered with 10mCi of radio-cobalt, half-life 3 months and is due for renewal when the activity has fallen to 1.5mCi. How often will renewal be necessary?
   a) 4.3 months
   b) 8.2 months
   c) 7.4 months
   d) 5.6 months
   e) 9.5 months

5. Copper (Cu) has an FCC structure with a lattice parameter of **3.61 Å**. The atomic weight of Cu is **63.5 g/mol**. Calculate the density of Cu.

   a) 7.85 g/cm³
   b) 8.96 g/cm³
   c) 9.50 g/cm³
   d) 8.20 g/cm³
   e) 7.20 g/cm³

6. Which of the following is true for crystalline materials compared to amorphous materials?
   a) Crystalline materials lack long-range order
   b) Amorphous materials have repeating atomic arrangement
   c) Crystalline materials exhibit sharp melting points
   d) Amorphous materials have well-defined planes
   e) Crystalline materials are always transparent

7. A photovoltaic cell (solar cell) is designed to convert sunlight into electrical energy. It relies on a p-n junction to generate a voltage when exposed to light. The cell is made using a semiconductor material doped to create p-type and n-type regions. Which of the following statements best explains the role of extrinsic semiconductors in the functioning of a photovoltaic cell?
   a) Intrinsic semiconductors are used exclusively because they generate electrons and holes equally.
   b) Extrinsic semiconductors form the p-n junction, which separates charge carriers created by light absorption.
   c) The p-type material absorbs photons, while the n-type material blocks recombination of charge carriers.
   d) Extrinsic semiconductors are unnecessary because sunlight itself provides all required carriers.

8. A mild steel specimen is subjected to a tensile test. The test is stopped after significant plastic deformation and the specimen is unloaded. When reloaded, the yield strength is found to be higher than before. What phenomenon explains this behavior?

   a) Necking
   b) Strain Hardening
   c) Ductile-Brittle Transition
   d) Toughness Increase
   e) Elastic Recovery

9. An engineering team is designing bridge structure. The team is designing a bridge that needs to withstand heavy loads and potential earthquakes. Which type of failure, ductile or brittle, is more desirable for this application, and why?
   a) Ductile failure because it allows for deformation and energy absorption before complete failure, which is crucial for withstanding dynamic loads.
   b) Brittle failure because it provides early warning signs through visible deformations, allowing for timely maintenance.
   c) Ductile failure because it results in sudden, catastrophic failure, reducing the chances of progressive collapse.
   d) Brittle failure because it ensures better load distribution across the structure

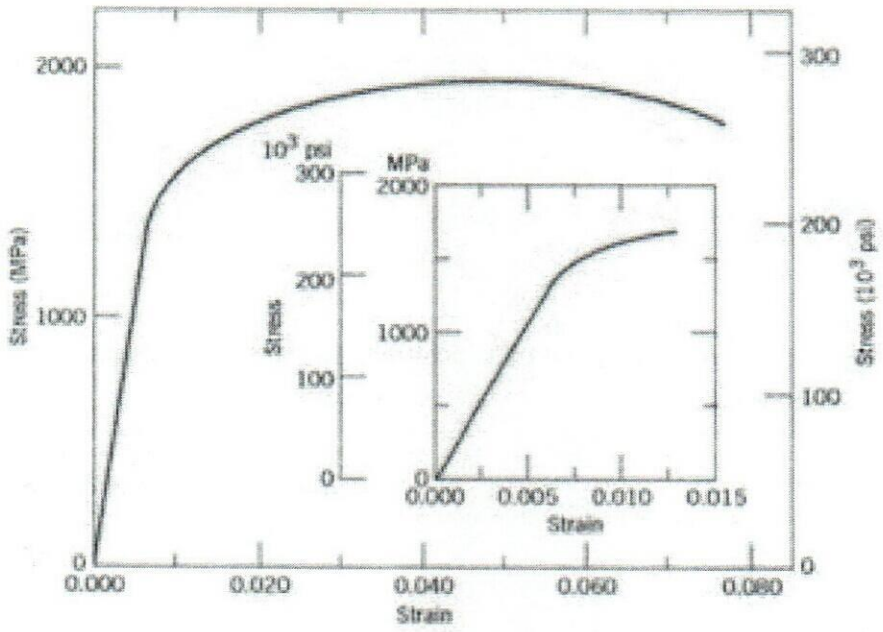
10. A mobile phone manufacturing company wants to design a battery management circuit using silicon as the semiconductor base. The engineers must decide whether to use intrinsic silicon or doped extrinsic silicon for effective conduction at room temperature. The design requires a material with higher conductivity and reliable performance under varying temperatures.
    Which of the following statements best explains why extrinsic silicon (doped) would be preferred over intrinsic silicon in this application?

    a) Intrinsic silicon has a very high conductivity at room temperature, making it unsuitable for controlled conduction.
    b) Doping increases the forbidden energy gap, reducing the chances of unwanted conduction.
    c) Extrinsic silicon introduces donor or acceptor impurities, increasing the number of charge carriers significantly.
    d) Intrinsic silicon contains both electrons and holes in equal numbers, leading to unstable device performance.
    e) Doping decreases mobility of carriers, which directly increases conductivity.

SECTION B

Question 01

A steel alloy specimen having a rectangular cross section of dimensions 38mm * 6.4mm has the stress-strain behavior as shown in below graph. If the specimen is subjected to a tensile force of 110,000N , write your answers by referring values of below graph



Section B, Q1 Figure 01

a) Determine the elastic and plastic strain values

b) If the original length is 610mm, what will be its final length after above load is applied and then released?

c). Briefly explain the term "Poison's ratio"

d) A cylindrical steel bar using for concrete subjects to tensile stress along the long axis which is having the diameter of 12 mm. Determine the magnitude of the load required to produce 3 $*10^{-3}$ mm change in the diameter if the deformation is entirely elastic. Poisson's ratio is 0.4 and modulus of elasticity of steel is 69 GPa

Electrical properties of materials play a vital role in deciding the Engineering applications of those. Based on that answer the below questions.

e) Define the two types of semiconductor with the aid of diagrams

a) List three engineering applications of semiconductors

For intrinsic silicon, the room-temperature electrical conductivity is $8 \times 10^{-4}\ \Omega^{-1}m^{-1}$. The electron and hole mobilities are, 0.24 and 0.064 m^2/Vs respectively. Compute the electron and hole concentration

Question 02

00018

Composites can be defined as a material consisted with customized properties to meet the prevailing requirement of the various engineering disciplines. Cost effectiveness, improved stiffness and oxidation resistance are among those improved characteristics. Assume you have been allocated for research and development team in manufacturing continuous and aligned glass - fiber reinforced plastic with optimized mechanical properties. As per the obtained results, the composite consists of 35% glass- fibers and the remaining portion with plastic matrix. The elastic moduli of glass fiber and plastic are 160GPa and 30GPa. Respective tensile strengths are 4600MPa and 400MPa. If the composite subjected to a load of 64,000N parallel to the fibers and having the cross sectional area of 1000mm2, answer the following questions.

a) Briefly explain how "rule of mixture" theory can be used to ensure the applicability of new product with the aid of graph. (Upper bound and lower bound graphs can be assumed by yourself)
b) The modulus of elasticity of this composite in the longitudinal direction.
c) The fiber-matrix load ratio.
d) Strain experienced by the matrix.
e) Name 3 types of polymer matrix composites and mention 2 applications for each of those.

Question 03

A renewable energy company wants to increase the storage capacity and efficiency of their next-generation Li-ion batteries for electric vehicles. They are currently using conventional graphite anodes, but the engineers are exploring the possibility of using nanotechnology to improve performance.

b) Explain the advantages of nanoscale materials over bulk materials.
c) Evaluate how silicon nanowires or carbon-based nanomaterials such as graphene or carbon nanotubes can be used in Li-ion batteries.
d) Evaluate the fabrication approaches (top-down / bottom-up) that could be used to produce these nanomaterials.

Crystal structure plays a vital role in determining the mechanical properties of a material.

e) Discuss how atomic arrangement and coordination number influence strength and ductility.
f) Compare FCC, BCC, and HCP in terms of slip systems and deformation behavior

Question 04

Strain hardening defines as a scenario where a ductile metal becomes harder and stronger when it deforms plastically. This process also called as "Cold Working". Based on the strain hardening process, comment on the below process. (The respective graphs are shown in the next page)

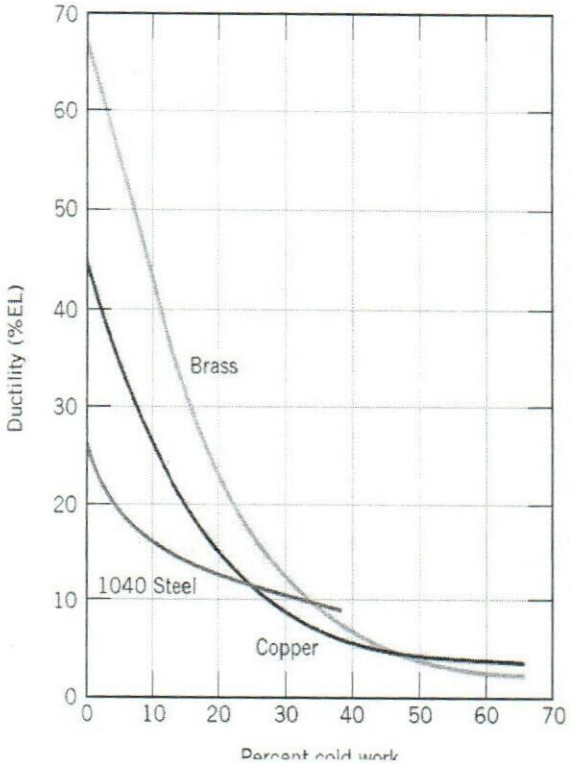
a) A Cylindrical rod of brass originally 20.4 mm in diameter is to be cold worked by drawing, the circular cross section will be maintained during deformation. A cold worked yield strength in excess of 380 MPa and a ductility of at least 15% EL are desired. Furthermore, the final diameter must be 15.2mm. Explain how this may be accomplished.

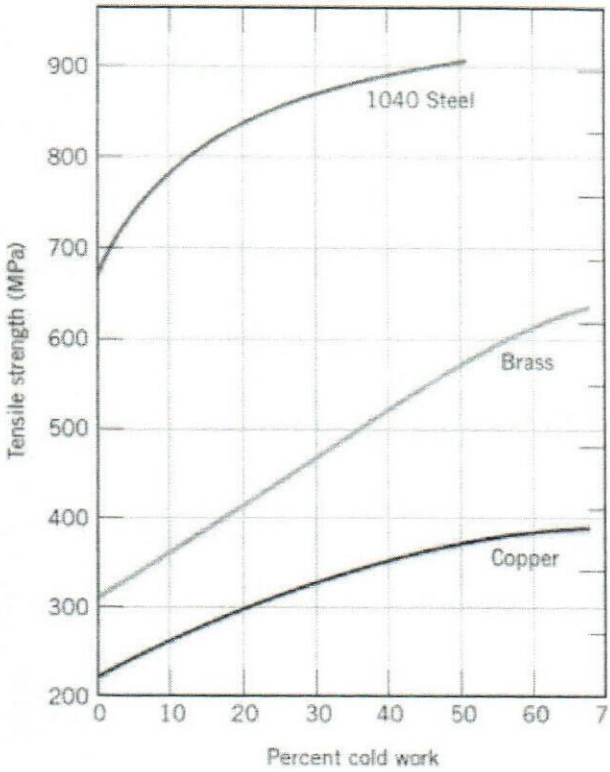
b) Perform a brief comparison between the advantages and disadvantages of "Hot working" and "Cold Working" methods.

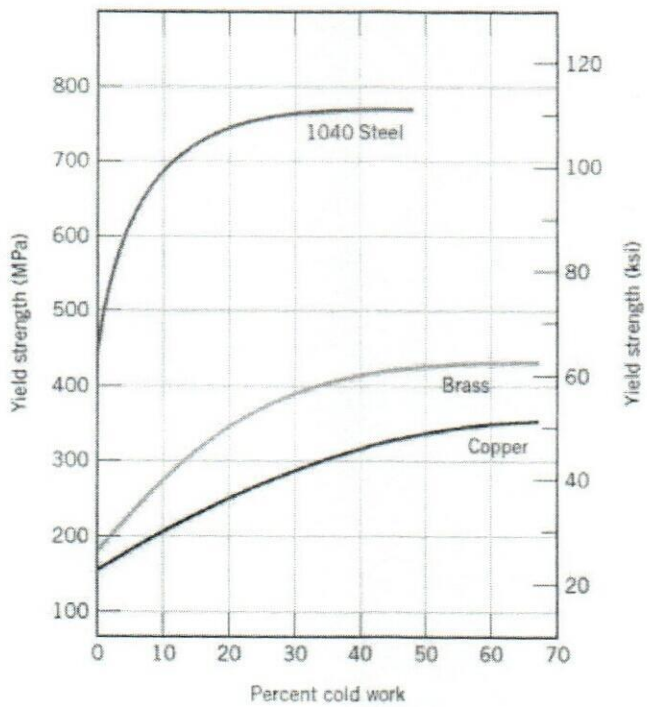
c) Briefly explain the advantages of forming metals by extrusion as opposed to the rolling method

-End of Questions-

Additional Information







$\sigma = E\epsilon$

$\epsilon_A = \{(A_0 - A_f)/ A_{0\}} * 100\%$

$MOR = (3PL) / (2bd^2)$

$\%CW = \{(A_0 - A_d)/A_0)\} * 100\%$

$\sigma_c = {}_{\{}2E\gamma_s / \pi a\}^{1/2}$

$N(S_a)^m = C$

$P_{LM} = T [C + \log (tr)]$

$I = AneV_d$

$\sigma = n|e|\mu_e + p|e|\mu_h$

$E_c(u) = E_m V_m + E_p V_p$

$E_c(l) = E_m E_p / (E_m V_p + E_p V_m)$

$F_c = F_m + F_f$

$\sigma_c A_c = \sigma_m A_m + \sigma_f A_f$

$\sigma_c = \sigma_m V_m + \sigma_f V_f$

$\sigma_c/\epsilon_c = (\sigma_m/\epsilon_m) V_m + (\sigma_f/\epsilon_f) V_f$

$E_c = E_m V_m + E_f V_f$

$E_c = E_m (1-V_f) + E_f V_f$

$I = I_0 e^{-\lambda t}$

$I = I_0 e^{-\mu x}$

$K_c = Y\sigma_c \sqrt{\pi a}$

APF = volume of atoms in the unit cell/ Total Volume of atoms in a unit cell