

නව නිර්දේශය / புதிய பாடத்திட்டம் / New Syllabus

ශ්‍රී ලංකා විභාග දෙපාර්තමේන්තුව ශ්‍රී ලංකා විභාග දෙපාර්තමේන්තුව ශ්‍රී ලංකා විභාග දෙපාර්තමේන්තුව ශ්‍රී ලංකා විභාග දෙපාර්තමේන්තුව ශ්‍රී ලංකා විභාග දෙපාර්තමේන්තුව
 திணைக்களம் இலங்கைப் பரீட்சைத் திணைக்களம் இலங்கைப் பரීட்சைத் திணைக்களம் இலங்கைப் பரීட்சைத் திணைக்களம் இலங்கைப் பரීட்சைத் திணைக்களம்
 Department of Examinations, Sri Lanka Department of Examinations, Sri Lanka Department of Examinations, Sri Lanka Department of Examinations, Sri Lanka Department of Examinations, Sri Lanka

NEW

අධ්‍යයන පොදු සහතික පත්‍ර (උසස් පෙළ) විභාගය, 2020
 கல்விப் பொதுத் தராதரப் பத்திர (உயர் தர)ப் பரீட்சை, 2020
 General Certificate of Education (Adv. Level) Examination, 2020

ඉංජිනේරු තාක්ෂණවේදය II
 பொறியியற் தொழினுட்பவியல் II
Engineering Technology II

65 E II

පැය තුනයි
 மூன்று மணித்தியாலம்
Three hours

අමතර කියවීමේ කාලය - මිනිත්තු 10 යි
 மேலதிக வாசிப்பு நேரம் - 10 நிமிடங்கள்
Additional Reading Time - 10 minutes

Use additional reading time to go through the question paper, select the questions you will answer and decide which of them you will prioritise.

Index No. :

Important :

- * This question paper comprises of four parts, A, B, C and D. The total time allotted for all four parts is three hours.
- * Use of non-programmable calculators is allowed.

PART A — Structured Essay :
 (pages 2 - 8)

Answer all the questions on the question paper itself. Write your answers in the space provided for each question. Note that the space provided is sufficient for the answers and that extensive answers are **not** expected.

PARTS B, C and D — Essay :
 (pages 9 - 14)

Essay question paper contains six questions, Answer four questions selecting at least one question from each part. Use the papers supplied for this purpose.

At the end of the time allotted for this paper, tie the four parts A, B, C and D together as a single answer script so that Part A is on top and hand it over to the supervisor.

For Examiners' Use Only

65 - Engineering Technology II		
Part	Question Nos.	Marks Awarded
A	1	
	2	
	3	
	4	
B	5	
	6	
C	7	
	8	
D	9	
	10	
Total		

Total

In numbers	
In words	

Code Number and Signature

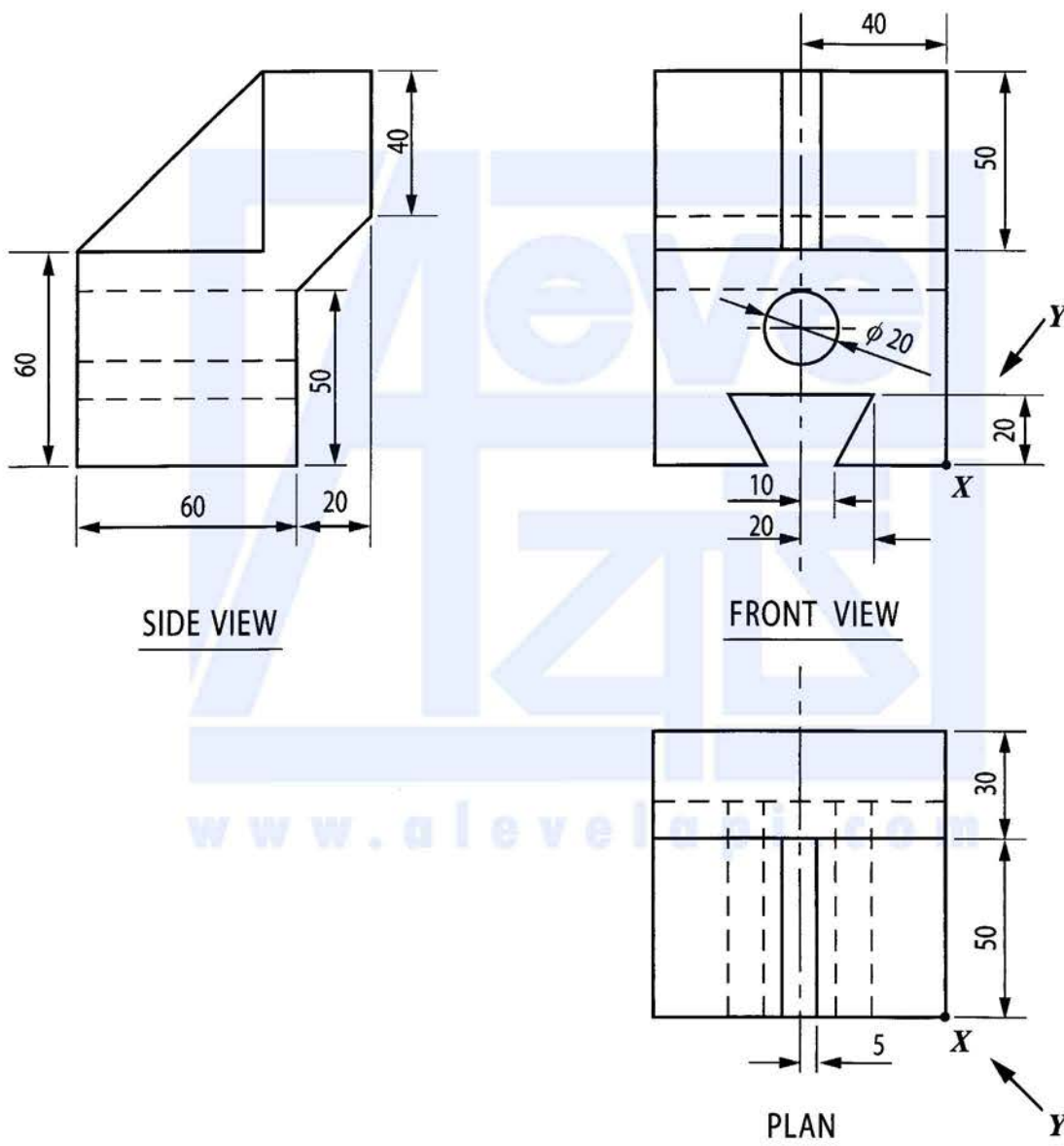
Marking Examiner 1	
Marking Examiner 2	
Marks checked by	
Supervised by	

PART A – Structured Essay

Answer **all four** questions on this **question paper itself**.
(Marks allocated for each question is 75.)

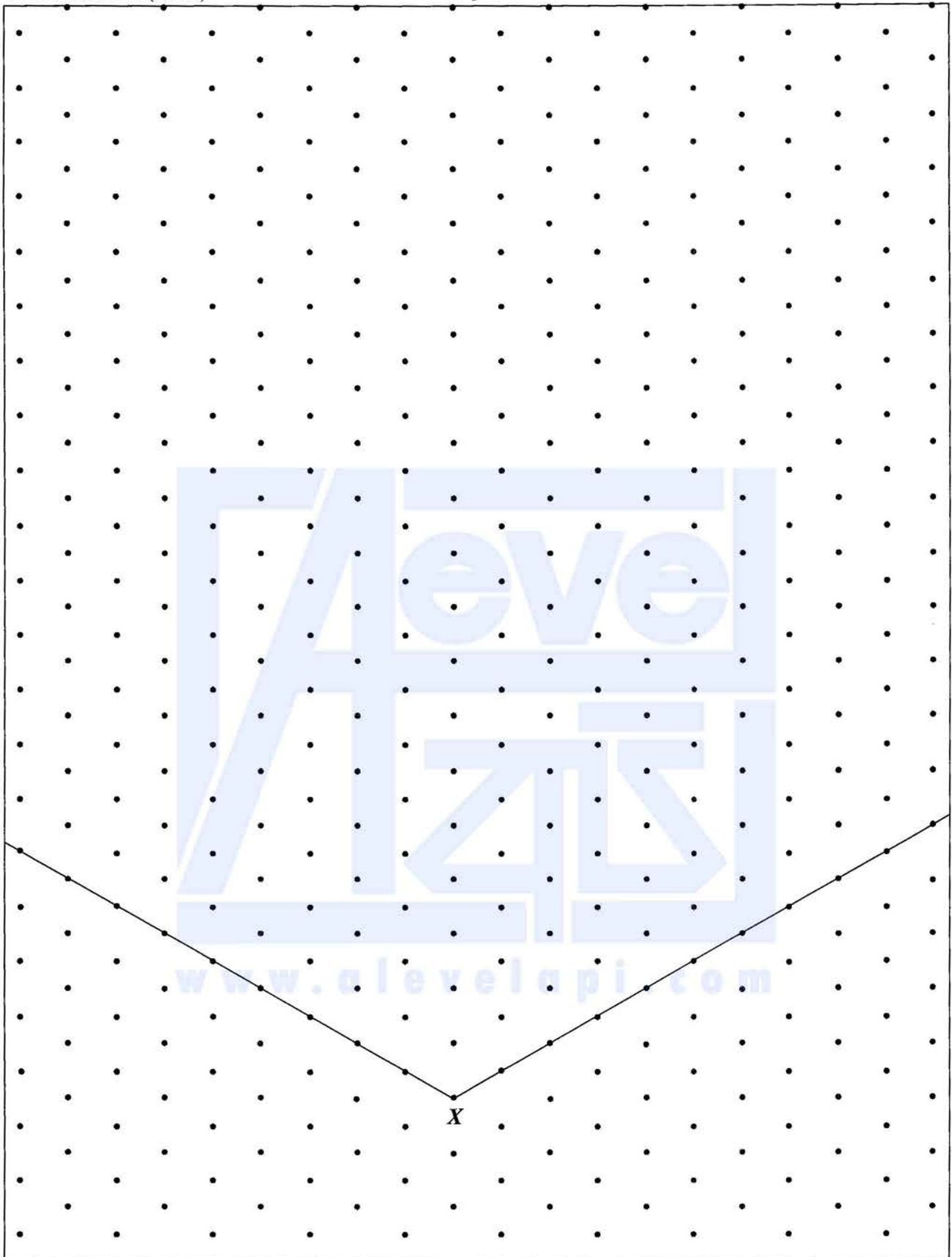
Do not
write
in this
column

1. The front view, side view and plan of a steel machine part drawn using first-angle projection are shown in the figure. This machine part is symmetric about the shown centre line. The drawings given are not to scale. Using free hand, draw the isometric view of the machine part in the dot sheet provided taking the corner shown by X as the origin, looking in the direction shown by the arrow Y. Mark all the given dimensions in the isometric drawing. Make the origin X of the drawing coincide with the origin X shown in the dot sheet. It is not necessary to show hidden lines in the isometric drawing and to use isometric scale. When drawing, consider the distance between two adjacent dots on the dot sheet as 10 mm.



(75 marks)

[see page three]



For use of the examiners

Marks

Drawing straight lines (54 Marks)

Drawing curves and centre lines (04 Marks)

Marking of straight line dimensions according to the standard (13 Marks)

Marking dimensions of curves according to the standard (04 Marks)

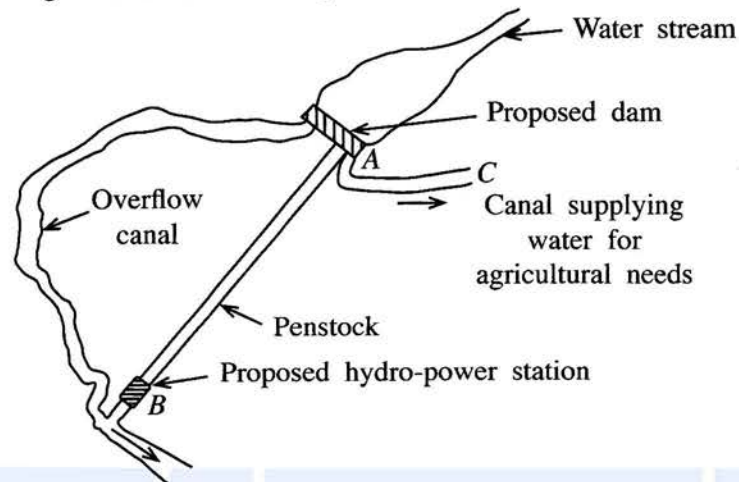
Q. 1

75

[see page four]

Do not
write
in this
column

2. It has been proposed to construct a dam across a water stream at place A and construct a hydro-power plant at B as shown in the figure. By this project, it is expected to generate hydro electricity to feed the national electricity grid system and supply water for the agricultural needs of the area through the canal shown by C.



- (a) (i) For planning the project comprehensively and in full detail, it is required to prepare a plan of the site. What is the type of surveying that should be used for this?

(05 marks)

- (ii) If the scale used for drawing the survey plan is 100 m to 1 cm, indicate this scale as a ratio.

(05 marks)

- (iii) A measuring tape cannot be used to measure the slope distance between the dam and the power station, for calculating the length of the penstock. Name a survey instrument that can be used for this.

(05 marks)

- (b) (i) It has been proposed to test the concrete mixtures used for constructing the above dam on site to decide the suitability for use.

- (1) What is this test?

(05 marks)

- (2) Which property of concrete is measured here?

(05 marks)

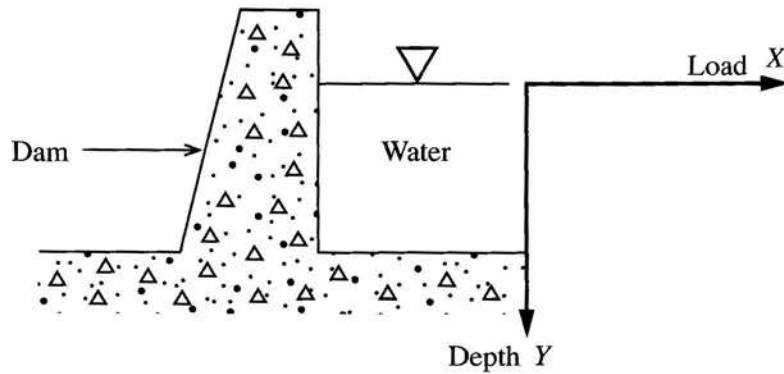
- (ii) What are the machinery used for the following activities in constructing the dam, which is a large scale civil engineering project?

Activity	Machinery
Transporting concrete	
Pouring concrete mixture to the correct place	

(10 marks)

[see page five

- (iii) The figure shows a cross-section of the above dam A. Draw on the X-Y plane, the variation of the load, imposed by water on the dam, with the depth.



(05 marks)

- (c) The water supplied by the canal C is proposed to be supplied as drinking water to a community area. However, this water cannot be supplied directly as drinking water and it is required to subject to a purification process.

- (i) Write a property that may **not** be present in water flowing in the canal but relevant for the quality of drinking water.

(05 marks)

- (ii) Name a purification method to obtain the property mentioned in (c)(i).

(05 marks)

- (d) (i) The water head of the proposed hydro-electric power station is 70 m. What is the type of turbine that is most suitable for the power station?

(05 marks)

- (ii) The voltage generated by the power station is 6.6 kV. In order to connect this to the national electric power transmission system, what is the type of transformer that should be used?

(05 marks)

- (e) (i) If the flow rate of water through the penstock of the power station is $0.5 \text{ m}^3 \text{ s}^{-1}$, water head 70 m and the efficiency of the turbine 85%, how much would be the electricity generating capacity in kW?

(Consider the density of water as 1000 kg m^{-3} and acceleration due to gravity as 10 m s^{-2} .)

(10 marks)

- (ii) The power station runs 10 hours per day for 300 days in a year. How much is the amount of electrical energy generated by the power station in a year in kWh?

(05 marks)

Q.2

75

[see page six]

3. It is required to transport raw materials from the ground floor to the second floor of a factory as shown in figure (1) below. The finished materials processed on the second floor are again brought down to the ground floor. An elevator that can be used for this purpose has to travel up and down many times during a day to perform such activity. The figure (2) shows the schematic arrangement of the mechanism used in the proposed elevator system. A drive system which is operated by an electric motor is proposed to be connected to pulley Y.

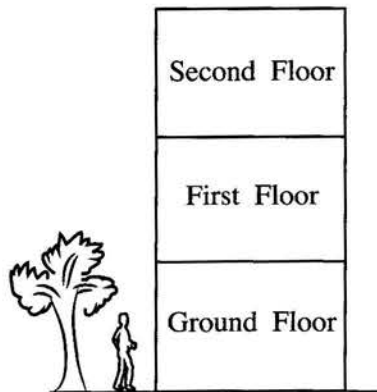


figure (1)

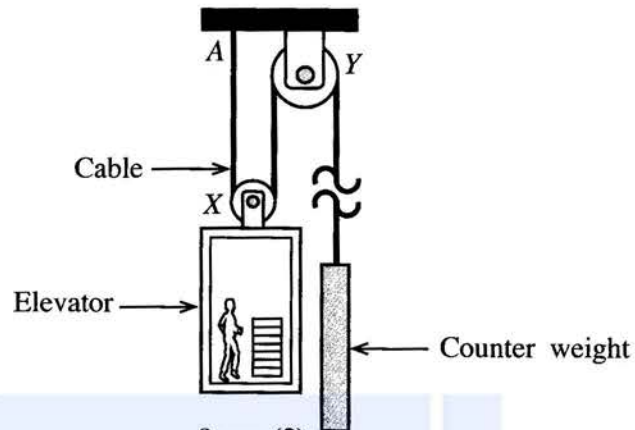


figure (2)

(Consider the acceleration due to gravity as 10 m s^{-2} for the calculations.)

- (a) (i) State a benefit of using a counter weight in this elevator.

(05 marks)

- (ii) The cable has been made with a number of wire strands with small cross-sectional area. State **two** reasons for this.

(1)

(2)

(10 marks)

- (iii) The mass of the counter weight is 100 kg and the mass of the elevator is 200 kg . When the elevator is moving at a constant velocity while carrying the maximum mass of 500 kg that can be carried, how much will be the tensile force in Newton (N) in cable section A? Neglect the mass of the cable and bearing frictional forces.

(15 marks)

- (iv) Under the situation referred to in (a)(iii) above, when the elevator is moving up at its maximum velocity of 0.4 m s^{-1} , calculate the power delivered by the motor in kW.

(15 marks)

- (v) The power of the required motor has been estimated to be 50% more than the calculated power in (a)(iv) above. State a reason for this.

(05 marks)

[see page seven]

- (b) Three light emitting diodes (D_0 , D_1 and D_2) (LED) are used to indicate the floor that is being passed by the elevator. Floors are identified using a sensor system which gives three signals S_0 , S_1 and S_2 .

When the elevator is in ground floor ($S_0=1$, $S_1=0$, $S_2=0$), only D_0 LED is ON, when in first floor ($S_0=0$, $S_1=1$, $S_2=0$) D_0 and D_1 are ON and when in the second floor all ($S_0=0$, $S_1=0$, $S_2=1$) D_0 , D_1 and D_2 are ON and under any other conditions, all the LEDs should be OFF.

- (i) Construct the truth table in relation to the above LED operation.

S_0	S_1	S_2	D_0	D_1	D_2

(15 marks)

- (ii) Derive the Boolean expression in relation to D_0 LED operation.

(05 marks)

- (iii) Design the logic circuit in relation to D_0 LED operation.

(05 marks)

Q.3

75

4. Rani who was working as an experienced quality controller in a garment factory, was hoping to have her own manufacturing business someday. Having procured machinery required she started a business for manufacturing and selling face masks used for health and safety according to an international standard and resigned from her usual job. By this time she had only a very small amount of money as her personal savings. Later on several friends also joined to work in her business.

Answer the following questions based on the above case.

- (a) (i) State **two** factors leading to identify Rani as an entrepreneur according to the definitions of entrepreneurship.

(1)

(2)

(05 × 2 = 10 marks)

- (ii) State **two** aspects that should be considered in performing a competitive analysis for the face masks market.

(1)

(2)

(05 × 2 = 10 marks)

[see page eight

Do not
write
in this
column

- (iii) Name **two** types of institutions which provide financial facilities for small scale entrepreneurs like Rani for starting up businesses.

(1)

(2)

(05 × 2 = 10 marks)

- (iv) State a business risk which is likely to be faced by Rani and propose an action that can be taken to control the risk.

Risk :

Action :

(05 × 2 = 10 marks)

- (v) If face masks are manufactured in large quantities mention an organised selling method that can be employed.

.....

(05 marks)

- (b) (i) State a reason for the high demand for face masks that are manufactured according to a standard.

.....

(05 marks)

- (ii) State a method that can be used for checking, in a single setting, whether several dimensions of manufactured face masks are within specified tolerance limits.

.....

(05 marks)

- (iii) Mention a hazard and a risk to the health of the workers, caused by dust producing materials used in apparel factories and state one technological method that can be used to control the hazard when designing factories.

Hazard :

Risk :

Action :

(05 × 3 = 15 marks)

- (iv) Write down an aim of the government in initiating apparel factories in Sri Lanka.

.....

(05 marks)

Q.4

75

* *

[see page nine]

නව නිර්දේශය/புதிய பாடத்திட்டம்/New Syllabus

ශ්‍රී ලංකා විභාග දෙපාර්තමේන්තුව ශ්‍රී ලංකා විභාග දෙපාර්තමේන්තුව ශ්‍රී ලංකා විභාග දෙපාර්තමේන්තුව ශ්‍රී ලංකා විභාග දෙපාර්තමේන්තුව ශ්‍රී ලංකා විභාග දෙපාර්තමේන්තුව
 இலங்கைப் பரீட்சைத் திணைக்களம் இலங்கைப் பரීட்சைத் திணைக்களம் இலங்கைப் பரීட்சைத் திணைக்களம் இலங்கைப் பரීட்சைத் திணைக்களம் இலங்கைப் பரීட்சைத் திணைக்களம்
 Department of Examinations, Sri Lanka

NEW

අධ්‍යයන පොදු සහතික පත්‍ර (උසස් පෙළ) විභාගය, 2020
 கல்விப் பொதுத் தராதரப் பத்திர (உயர் தர)ப் பரீட்சை, 2020
 General Certificate of Education (Adv. Level) Examination, 2020

ඉංජිනේරු තාක්ෂණවේදය II
 பொறியியற் தொழினுட்பவியல் II
Engineering Technology II

65 E II

Instructions:

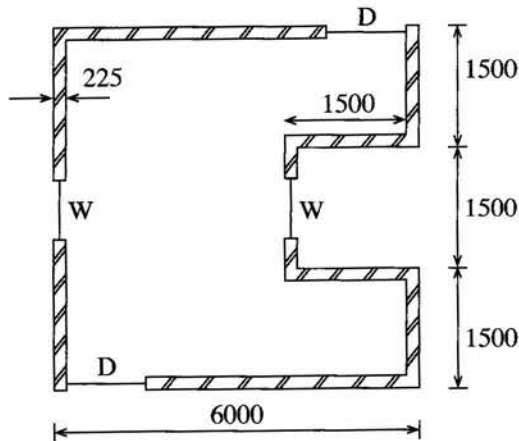
- * Answer **four** questions only selecting at least **one** question each from parts **B, C and D**.
- * Marks allocated for each question is **100**.

Part B - Essay (Civil Technology)

5. It is proposed to construct a 40 storied high-rise apartment building in an urban area adjacent to a main road. It is expected to use light-weight construction material as much as possible.
- (a) (i) Name **two** light-weight materials that can be used for the doors and windows in this building instead of wood. (10 marks)
- (ii) Explain how the cost of the structure can be reduced by using light weight materials of this building, stating technological reasons. (10 marks)
- (iii) Name the most important environmental load to be considered in designing the structure of this type of high-rise buildings and explain how that load affects the building structure. (10 marks)
- (b) (i) Draw a figure of a wooden door frame and name the main parts of it. (10 marks)
- (ii) Name the timber joint used in a door frame and draw a three dimensional figure showing its parts clearly. (10 marks)
- (iii) Describe the process of maintaining geometrical accuracy in making the timber joint mentioned in (b)(ii) above, stating the specific tools used for applying the measurements and marking out. (10 marks)
- (c) Approval has been obtained from the Urban Development Authority for constructing this building.
- (i) Explain the reason for constructing this building without obstructing the 'standard light plane'. (05 marks)
- (ii) This building is situated on the same level plane as the main road, and waste water of it has to be connected to the public sewer system using manholes. State **two** instances where manholes should be used related to the disposal system of the building. (10 marks)
- (d) Domestic waste of this building is proposed to be managed by collection after separation.
- (i) Explain the importance of not mixing solid and water-borne waste types together, generated in this building using **three** scientific reasons. (15 marks)
- (ii) Explain separately one damage to the environment and one community health problem caused by releasing untreated wastes to the environment. (10 marks)

[see page ten]

6. Plan of a simple building is shown in the figure below. (Figure is not to scale)



Dimension	Value (mm)
Height of brick walls	3000
D-Door	1000 × 2200
Diameter of circular window-W	800

(a) Answer the following questions according to SLS 573. Prepare measurement sheets, abstract sheets and bill-of-quantity (BOQ) formats when necessary.

- Calculate the centreline distance for the 225 mm thick brick walls. (05 marks)
- Take off quantities of the brick wall. (05 marks)
- Take off quantities for the deductions for D and W openings in the brick wall. (10 marks)
- Parts of several measurement sheets used to take off quantities by a Quantity Surveyor for the concrete slab of a building is given below. Transfer the quantities in these measurement sheets to an abstract sheet. (10 marks)

9.00	125 mm concrete slab of the building	3.00	Deductions
7.50	roof	1.50	space for the stairway
0.13		0.13	
		2/	
		1.50	Additions
		1.00	Sun shade
		0.13	above D1-doors

- Using the abstract sheet prepared in (iv) above, insert the quantities of the concrete slab into the bill-of-quantity. (05 marks)
- (b) Using the data given below calculate the net unit rate per square meter for painting a plastered brick wall with one prime coat and two coats of emulsion paint.
- One litre of Prime coat is Rs. 800 and 50 m² of wall can be painted with it.
 - One litre of Emulsion paint is Rs. 1000 and 25 m² of wall can be painted with it.
 - A gang with a painter and a helper paints 150 m² of the wall per day.
 - All wastes are included in the above values.
 - It is not needed to add the cost of water, scaffolding and brushes to the unit rate as they are included in the preliminary bill.
 - Daily wage of a painter is Rs. 2000.
 - Daily wage of a helper is Rs. 1500.
- (15 marks)
- (c) Explain the use of levelling process to take measurements with one instrument station for preparing longitudinal section of a road segment of horizontal length 40 m with a rise. For this, consider the interval between two points for taking measurements as 10 m. Descriptions about instruments to be used, field process, the method of taking readings, the way of recording readings, calculation process and drawing the longitudinal section should be included in the answer. (30 marks)

[see page eleven

- (d) From a theodolite set up at the foot of a mountain the angle of elevation measured to the top end of the ranging pole kept at the top of the mountain was 40° . The slant distance from the theodolite to the top end of the ranging pole along the line of sight was 20 m. Consider the height of the instrument as 1.5 m, the height of the ranging pole as 1.0 m and the reduced level of the point situated at the foot of the mountain as 800 m (relative to the mean sea level).

Show the given measurements on a sketch and calculate the reduced level of the point where the ranging pole was kept.

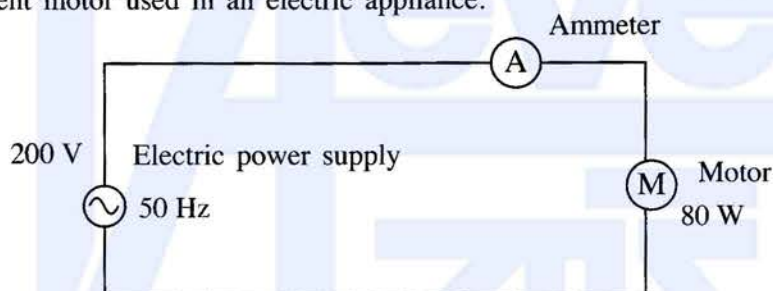
Use the following trigonometric values for the calculation.

$$\sin 40^\circ = 0.64 \quad \cos 40^\circ = 0.77 \quad \tan 40^\circ = 0.84$$

(20 marks)

Part C - Essay (Electrical and Electronic Technology)

7. (a) (i) Explain the difference between renewable and non-renewable sources of energy. (05 marks)
- (ii) State **two** renewable energy conversion methods seen in Sri Lanka and explain **two** factors that negatively affect their use. (20 marks)
- (b) (i) In relation to an electric motor, show active power, apparent power, reactive power and power factor using a power triangle. (10 marks)
- (ii) The circuit shown below was designed to calculate the power factor of a single-phase alternating current motor used in an electric appliance.



When the electric power supply was 200 V, the ammeter reading was seen as 0.5 A. Assume that the power loss in the ammeter is zero.

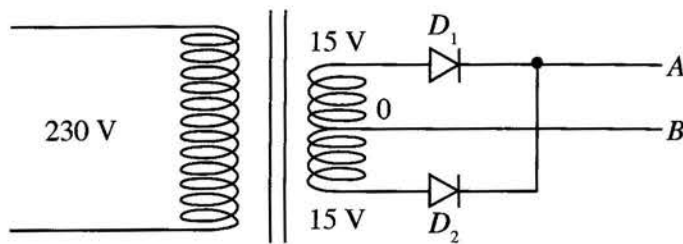
- (I) Calculate the apparent power drawn by the motor. (10 marks)
- (II) How much is the active power of the motor? (10 marks)
- (III) Calculate the power factor of the motor. (10 marks)
- (IV) Calculate the reactive power drawn by the motor. (10 marks)
- (c) In a household electrical installation, it is compulsory to install an earth electrode and to connect the earth wire of the circuits. Explain the way in which personal protection is provided by this arrangement. (10 marks)
- (d) A consumer purchased a new electric oven rated 2.3 kW, 230 V and 50 Hz. This electric oven did not have a plug installed. Therefore, the consumer connected a 5 A plug to it and plugged to the 5 A socket outlet in the kitchen. After that,
- the consumer turned "ON" the electric oven to bake a cake, and set its timer to 45 minutes.
 - having ensured that the oven is in operation, the consumer left the place.
 - when returned after 30 minutes, it was observed that the electric oven has ceased to operate.
 - when investigated, it was observed that the 6 A miniature circuit breaker at the distribution board related to the socket outlet used for the electric oven has switched to the "OFF" position.
 - when further investigated, consumer observed that, even though the miniature circuit breaker was switched to the "ON" position, it did not stay in the "ON" position.

Explain the reasons for above observations.

(15 marks)

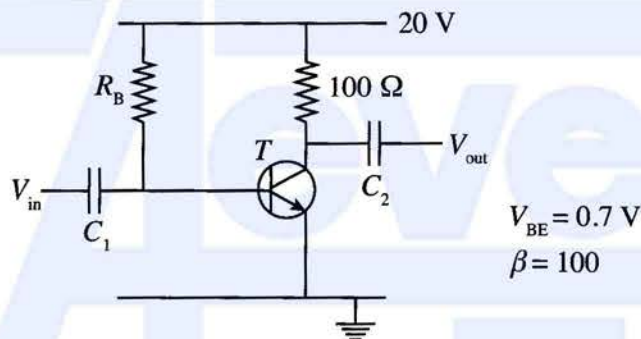
[see page twelve]

8. (a) The figure shows a part of a power supply circuit.

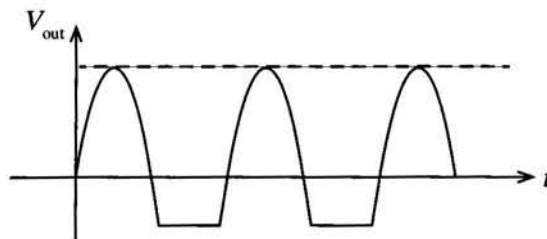


- (i) What is the type of rectification shown in the circuit? (05 marks)
- (ii) Write down the polarities of A and B separately. (05 marks)
- (iii) Draw the waveform of A when diode D_1 is open circuited. (05 marks)
- (iv) Draw the circuit again after modifying the above circuit section for obtaining a 12 V stable voltage using a zenner diode, a resistor and a capacitor. (15 marks)

(b) Consider the transistor amplifier circuit given below.



- (i) Briefly describe an instance in day-to-day life where a transistor is used as an amplifier. (05 marks)
- (ii) State the importance of capacitors C_1 and C_2 in the above circuit. (05 marks)
- (iii) Calculate the following, considering that the collector current (I_{CQ}) at the bias point (Q -point) of the transistor T is 100 mA.
 - (I) Base current (I_{BQ}) (05 marks)
 - (II) Value of resistor R_B (15 marks)
 - (III) The voltage difference (V_{CEQ}) between collector and emitter (10 marks)
- (iv) Draw in the same graph the wave forms of V_{in} and V_{out} when a sinusoidal wave is supplied to the circuit as the main signal. (10 marks)
- (v) When the above circuit is in operation for a long time the output signal (V_{out}) changed as below.

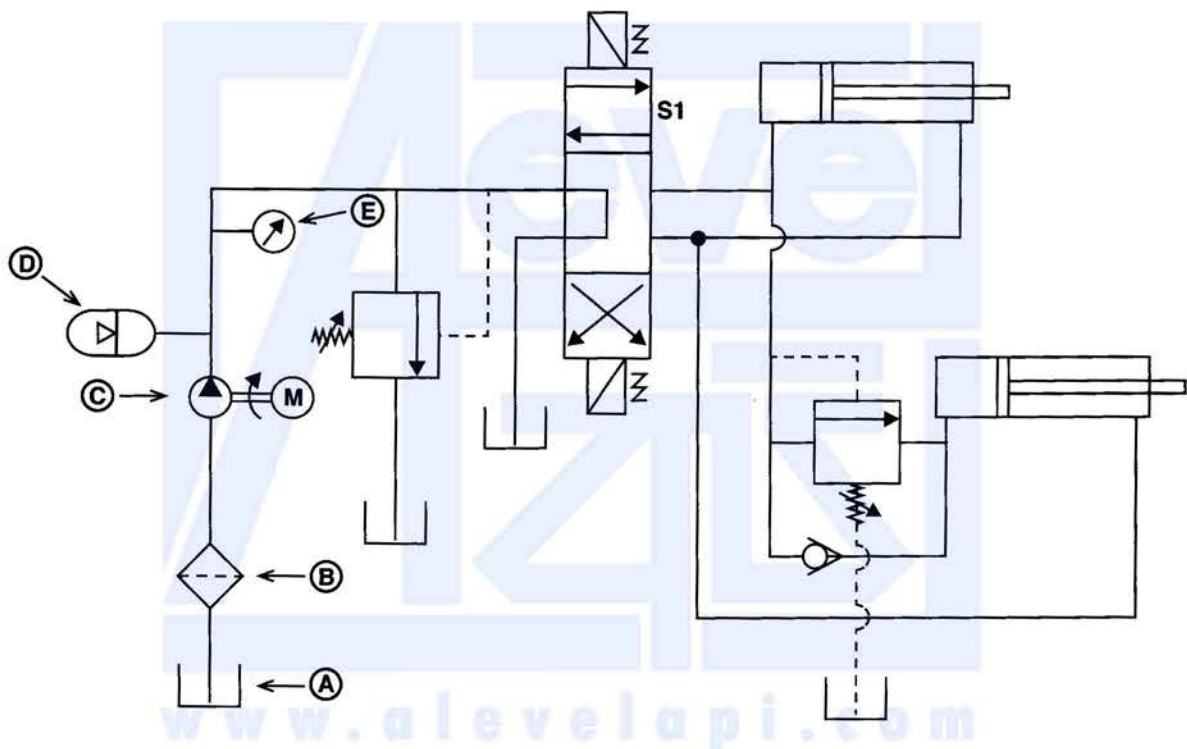


- (I) Explain the reasons for the above observation. (10 marks)
- (II) Draw a circuit diagram to show how the circuit should be changed to prevent the above change. (10 marks)

[see page thirteen]

Part D - Essay (Mechanical Technology)

9. (a) Draw a labelled rough sketch to illustrate the connection of turbo charger and intercooler to the engine. (10 marks)
- (b) Explain, giving technological reasons, how the drop in lubrication oil pressure of an automobile engine, below its recommended value affects its operation. (10 marks)
- (c) It was identified, without removing the spark plugs, in a four cylinder four stroke spark ignition piston engine that one of the spark plugs was not operating.
- Write down **two** observations which could have helped to identify that one spark plug is not working. (10 marks)
 - Describe step by step, a simple method without using testing equipment and not removing the spark plugs to correctly identify the defective spark plug out of the four spark plugs. (30 marks)
- (d) The circuit diagram of a hydraulic power transmission system is shown in the figure below.

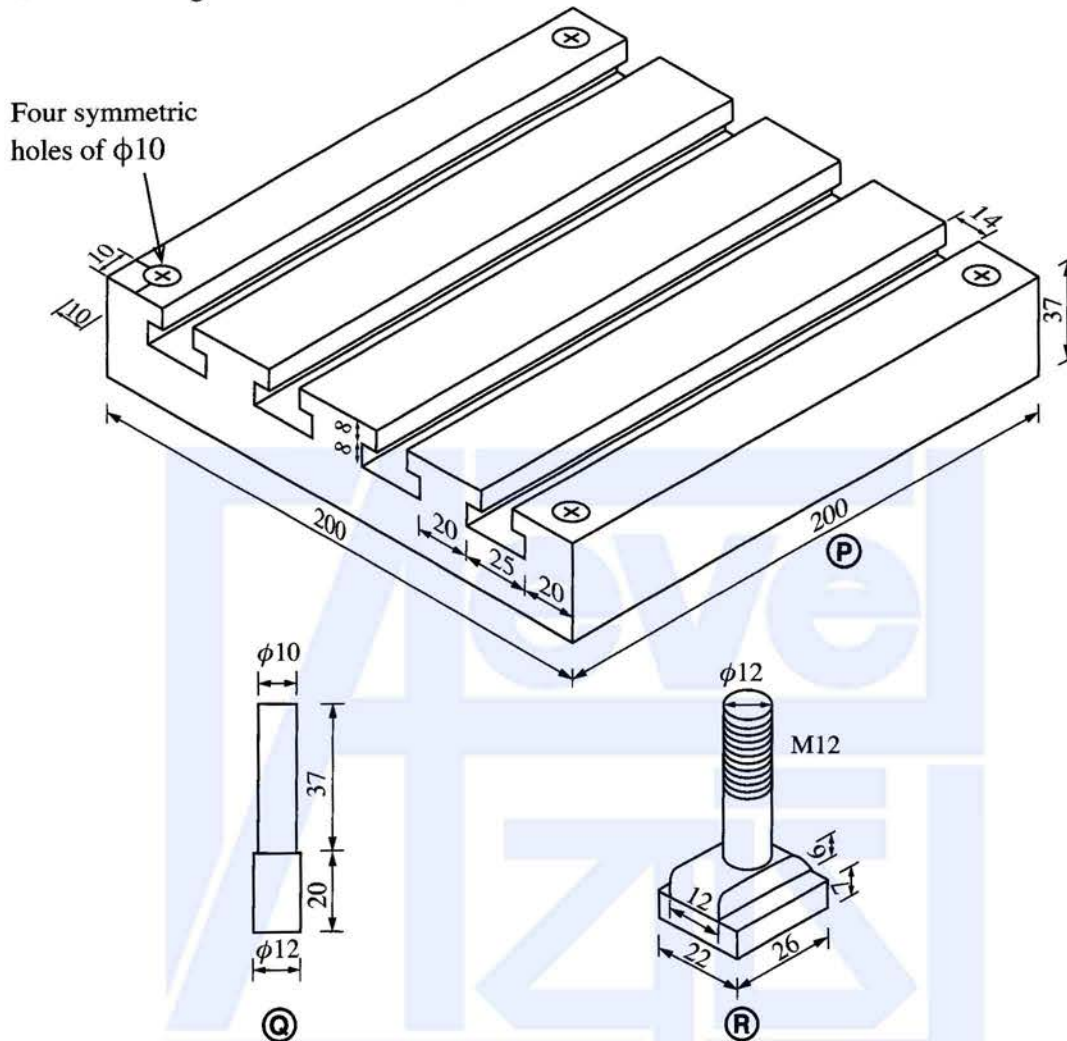


State the components shown by the above symbols from ① to ⑤ and briefly explain the functions performed by each of the component. (15 marks)

- (e) (i) Sketch the circuit diagram of a vapour compression refrigerator and name the main components and mark the direction of refrigerant flow. (10 marks)
- (ii) State **three** technical methodologies used in refrigerators for increasing the efficiency of heat transfer between refrigerant and the freezing compartment and explain how the efficiency is increased by them. (15 marks)

[see page fourteen

10. A fixture that can be used for mounting a given workpiece on a machine is shown in the figure. This fixture includes part (P), four (4) pins that are shown as (Q) and four (4) T-bolts that are shown as (R). Part (R) is purchased from the market. All dimensions given are in millimetres.



- (a) A 200 mm × 200 mm × 37 mm finished mild steel part has been supplied for manufacturing part **Ⓟ**. In order to completely finish Part **Ⓟ**, T-slots and circular holes parallel to each other have to be produced.
- (i) Describe step by step the method of producing the T-slots in minimum number of passes using only one machine by stating instruments, machines, equipment and tools with their sizes where necessary. (25 marks)
 - (ii) Describe step by step the method of producing the circular holes by stating the instruments, machine, equipment and tools. (25 marks)
- (b) (i) State the most suitable machine for producing part **Ⓠ**. (05 marks)
- (ii) A 12.5 mm diameter 240 mm length mild steel rod is supplied. When producing four parts of Part **Ⓠ**, calculate the maximum finishing allowance for a face. Consider the width of parting of tool as 2 mm. (10 marks)
- (iii) Describe step by step the method of producing part **Ⓠ** using the machine mentioned in above (b)(i) by stating instruments, machines, equipment and tools with their sizes where necessary. (25 marks)
- (c) State the **two** methodologies that are used for manufacturing part **Ⓡ** in mass scale. (10 marks)

* * *