

3rd Semester - 2025.

MATHEMATICS-I

BS-101 (New)

Full Mark : 60 SCTE/NGL/R-2025-I

Pass Mark : 24

Time : 3 Hours

(Attempt all questions)

A. Choose the correct answer.

(1 x 7 = 7)

1. The value of $\cos(-\theta)$ is

- a) $-\cos \theta$ b) $\cos \theta$ c) $-\sin \theta$ d) $\sin \theta$

2. $\lim_{x \rightarrow 0} \frac{\sin x}{x} =$

- a) 0 b) 1 c) -1 d) 2

3. A function 'f' is said to be an even function if $f(-x) =$ ____.

- a) $-f(x)$ b) x c) $-x$ d) $f(x)$

4. $\frac{d}{dx}(\sqrt{x}) =$

- a) $\frac{1}{2\sqrt{x}}$ b) $-\frac{1}{2\sqrt{x}}$ c) $\frac{1}{\sqrt{x}}$ d) $-\frac{1}{\sqrt{x}}$

5. If n is any rational number, then $(\cos \theta + i \sin \theta)^n =$

- a) $\cos n\theta + i \sin n\theta$ b) $\cos n\theta - i \sin n\theta$
c) $\sin n\theta + i \cos n\theta$ d) $\sin n\theta - i \cos n\theta$

6. $\sqrt{-2}\sqrt{-3} =$

- a) $\sqrt{6}$ b) $-\sqrt{6}$ c) $i\sqrt{6}$ d) $-i\sqrt{6}$

7. The value of 5P_2 is

- a) 5 b) 10 c) 15 d) 20

B. Answer the following questions:

(2 X 7 = 14)

1. Define one radian. Give the relationship between radian and degree measure.

2. Define a function. Examine whether the relation

$R = \{(2,2), (2,4), (3,3), (4,4)\}$ is a function or not?

3. Evaluate $\lim_{x \rightarrow -1} \left(\frac{x^2 - 1}{x^2 + 3x + 2} \right)$.

4. Differentiate $y = \log(\tan x)$ with respect to x .

5. Find the modulus of $(2 + 5i) + 3(i + 1) - (1 + 5i)$.
6. Convert $-1 + i$ into Polar form.
7. Evaluate ${}^nC_{17}$ if ${}^nC_9 = {}^nC_8$.

C. Answer the following questions:

(3 X 9 = 27)

1. Prove that $2\sin^2\left(\frac{3\pi}{4}\right) + 2\cos^2\left(\frac{\pi}{4}\right) + \sec^2\left(\frac{\pi}{3}\right) = 6$.
2. Prove that $\frac{1+\sin 2A-\cos 2A}{1+\sin 2A+\cos 2A} = \tan A$.
3. Find the derivative of $y = \sin x$ by definition.
4. Evaluate $\lim_{\theta \rightarrow 0} \frac{\operatorname{Cosec} \theta - \cot \theta}{\theta}$.
5. Find $\frac{dy}{dx}$ if $y = \cos^{-1}\left(\frac{1-x^2}{1+x^2}\right)$.
6. Evaluate $\lim_{x \rightarrow 0} (1 + 3x)^{\frac{2}{x}}$.
7. Resolve $\frac{x^2}{(x^2+1)(x^2+4)}$ into partial fractions.
8. Find the 5th term in the expansion of $(x^2 + 2y)^8$.
9. Find the number of permutations of the letters of the word ALLAHABAD.

D. Answer the following questions:

(4 X 3 = 12)

1. a) Prove that $\sin 10^\circ \sin 30^\circ \sin 50^\circ \sin 70^\circ = \frac{1}{16}$.

OR

- b) Prove that $\frac{\sin(A-B)}{\cos A \cos B} + \frac{\sin(B-C)}{\cos B \cos C} + \frac{\sin(C-A)}{\cos C \cos A} = 0$.

2. a) Find $\frac{dy}{dx}$ if $y = (\sin x)^x + x^{\sin x}$.

OR

- b) Evaluate $\lim_{x \rightarrow 0} \frac{x \log(x+1)}{1 - \cos x}$.

3. a) Simply $\frac{(\cos 3\theta + i \sin 3\theta)^2 (\cos 5\theta + i \sin 5\theta)^{-3}}{(\cos 4\theta + i \sin 4\theta)^{-5} (\cos 2\theta + i \sin 2\theta)^4}$ using De Moivre's theorem.

OR

- b) Expand $\left(\frac{2x^2}{3} - \frac{3}{x^2}\right)^6$ using Binomial Theorem.

APPLIED CHEMISTRY

BS-105 (New)

Full Mark : 60 SCTE/NGL/R-2025-I

Pass Mark : 24

Time : 3 Hours

A. Objective Questions:

(1x 9 =9)

- The shape of an s-orbital is-
 - Circular
 - Dumbbell
 - Spherical
 - Double dumbbell
- In the Zeolite process of water softening, the Ca^{2+} and Mg^{2+} ions are exchanged for-
 - Na^+
 - Cl^-
 - SO_4^{2-}
 - K^+
- The permanent hardness of water is caused by _____ of Calcium and Magnesium.
 - Chlorides and Sulphates
 - Bicarbonates
 - Oxides
 - Carbonates and Hydroxides
- The first step in metallurgy that involves the removal of undesired foreign impurities i.e., gangue from the ore is called-
 - Reduction
 - Calcination
 - Concentration
 - Refining of metal
- Which of the following is a ferrous alloy?
 - Steel
 - Bronze
 - Brass
 - Magnalium
- The primary phase having continuous character in a composite is-
 - Dispersed phase
 - Reinforcement
 - Interphase
 - Matrix phase
- The rate at which the viscosity of an oil changes with temperature is called-
 - Oiliness
 - Coke number
 - Viscosity index
 - Saponification number
- Which of the following is assigned an anti-knock value of 100?
 - n-Heptane
 - Propane
 - 1-methylnaphthalene
 - iso-Octane

9. Oxidation corrosion is caused by the direct attack of-
- | | |
|-----------------|-----------------|
| a. Water Vapour | c. Liquid metal |
| b. Chlorine gas | d. Oxygen gas |

B. Answer the following questions in brief.

(2 x 6 =12)

1. Define: a. Molarity b. Solute
2. Define: a. Scales b. Sludges
3. State the purpose of alloying.
4. Give the constituent-based application of Portland cement.
5. State the functions of a lubricant.
6. Briefly explain the application of redox reaction in a fuel cell.

C. Answer the following:

(3 x 8 =24)

1. Explain Rutherford's model of an atom.
2. a. State Aufbau's principle.
b. Give the electronic configuration of Cu and N.
3. Explain the formation of ionic bond in NaCl molecule.
4. Explain the lime soda process of water softening.
5. Calculate the total hardness and temporary hardness of a water sample containing—
 $\text{Mg}(\text{HCO}_3)_2 = 73 \text{ mg/L}$; $\text{Ca}(\text{HCO}_3)_2 = 162 \text{ mg/L}$
 $\text{MgCl}_2 = 95 \text{ mg/L}$; $\text{CaSO}_4 = 136 \text{ mg/L}$
6. Give the preparation and application of nylon-6 and nylon-6,6.
7. Describe the proximate analysis of coal.
8. Explain the H_2 liberation mechanism of electrochemical corrosion.

D. Long answer questions:

(5 X 3 =15)

1. Describe the extraction of iron from haematite using blast furnace with the help of a diagram.

Or

Explain the extraction of aluminum from bauxite ore along with chemical reactions.

2. a. Define calorific value.

b. Calculate the gross and net calorific value of coal having the following composition: Carbon=80%, Hydrogen=10%, Sulphur=2%, Nitrogen=1%, Oxygen=3% and ash=4%.

3. a. State Faraday's Second Law of electrolysis.

b. An electric current is passed through three cells in series containing solutions of CuSO_4 , AgNO_3 and KI , respectively. What weights of Silver and Iodine will be liberated while 1.25g of Copper is being deposited?

(Atomic weight of Copper=63.5, Silver=107.8, Iodine=126.9)

Or

a. Define electrolytes and non-electrolytes.

b. Explain the application of electrolysis in electroplating.

APPLIED PHYSICS I

BS-103 (New)

Full Mark : 60 SCTE/NGL/R-2025-I

Pass Mark : 24

Time : 3 Hours

I. CHOOSE THE CORRECT ANSWER: (1X9=9)

- Which of the following unit is a derived unit?
(a) Meter (b) kilogram (c) Newton (d) second
- A wheel rotates one full circle. Its angular displacement is
(a) π radians (b) 2π radians (c) $\pi/2$ radians (d) $\pi/4$ radians
- The force of attraction between two masses is
(a) Directly proportional to the product of the masses
(b) Directly proportional to the sum of the masses
(c) Inversely proportional to the product of the masses
(d) Inversely proportional to the sum of the masses.
- The SI unit of work is
(a) Watts (b) Joules (c) erg (d) calorie
- When a body is falling freely under gravity
(a) Its kinetic energy increases and potential energy decreases
(b) Its potential energy increases and kinetic energy decreases.
(c) Both kinetic energy and potential energy remains constant
(d) Both kinetic energy and potential energy increases.
- In the absence of an external torque which of the following quantity is conserved?
(a) Mass (b) energy
(c) linear momentum (d) angular momentum
- The dimensional formula of stress is same as that of
(a) force (b) pressure (c) power (d) work
- A force of 10 N acts on a surface area of 2 m^2 . The value of pressure Exerted on the surface is
(a) 1 pa (b) 10 pa (c) 5 pa (d) 10 pa

9. The relationship between coefficient of linear expansion, α and coefficient of cubical expansion, γ is
(a) $\alpha=2\gamma$ (b) $\alpha=\gamma/2$ (c) $\alpha=\gamma/3$ (d) $\alpha=\gamma^2$ (2x14=28)

II. Answer the following questions:

1. Define fundamental and derived units.
2. Write the significant figures of the following:
(a) 2500 (b) 6.02×10^{-19}
3. In an experiment, the observed values were found to be 1.02, 1.03, 1.01, 1.02, 1.05. calculate the absolute errors of each observations

OR

Derive the dimensional formula of power.

4. State the parallelogram law of vector addition.
5. State the law of conservation of linear momentum.
6. Briefly explain with diagram the reason for bending of cyclist in a curved road.
7. Briefly explain why a gun recoils when fired.
8. A wheel of radius 0.5 m rotates at an angular velocity of 4 rad/s. calculate its linear velocity.
9. Derive the relationship between the acceleration due to gravity, 'g' and universal gravitational constant, 'G'.
10. Two objects of masses 2 kg and 4 kg are separated by a distance of 1 m. calculate the gravitational force of attraction between them.

OR

If the value of acceleration due to gravity is 9.8 m/s^2 on earth's surface. Calculate its value at a height of 1600 km above the earth's surface (radius of earth=6400 km)

11. Write the laws of limiting friction.
12. State the theorem of parallel axes.
13. A force of 5 N is applied at a distance of 2 m from the axis of rotation. Calculate the torque.

OR

Calculate the moment of inertia of an object of mass 4 kg and radius of gyration of 0.5 m.

14. Define specific heat of a substance.

III. Answer the following questions:

(3x5=15)

1. Prove that the total mechanical energy of a freely falling object is conserved.
2. A force of 10 N acts on a body, displacing it by 6 m in 3 seconds. Calculate the power.

OR

An engine pumps 400 kg of water to a height of 10 m in 20 seconds. Calculate the power of the engine, assuming $g=10 \text{ m/s}^2$.

3. Explain the conservation of angular momentum. Give one example of conservation of angular momentum. (2+1=3)
4. Explain with proper illustrations the working of Fortin's barometer.
5. Derive the relationship between coefficient of linear expansion and coefficient of surface expansion of solids.

IV. Answer the following questions

(4x2=8)

1. Define cohesive and adhesive forces. A liquid rises to a height of 5 cm in a capillary tube. If the surface tension of the liquid is 0.075 N/m and the angle of contact is 0° . Calculate the radius of the capillary tube. (density of liquid = 1000 kg/m^3 , $g=10 \text{ m/s}^2$) (2+2=4)
2. Name the three modes of transmission of heat. Convert 50° F to Celsius and Kelvin scales. (1+3=4)

OR

Define heat. A metal rod of length 2 m at 20° C expands to 2.004 m when heated to 100° C . Calculate the coefficient of linear expansion. (1+3=4)

COMMUNICATION SKILLS IN ENGLISH

HS 101

Full Marks : 60 SCTE/NGL/R-2025-I

Pass Mark : 24

Time : 3 Hours

I) Multiple choice questions (1×6=6)

- 1) The process by which the sender converts their ideas into a message is
 - a. encoding
 - b. decoding
 - c. channel
 - d. receiving
- 2) A manager briefing the team on updated emergency evacuation procedures is ____ communication.
 - a. upward
 - b. horizontal
 - c. downward
 - d. diagonal
- 3) How does poor feedback act as a communication barrier?
 - a. It clarifies misunderstandings
 - b. It prevents effective listening
 - c. It leads to lack of understanding and confusion
 - d. It makes the communication more interactive
- 4) Arriving at a meeting on time is an example oftype of communication.
 - a. Verbal
 - b. chronemics
 - c. written
 - d. formal
- 5) Soft skill can be defined as
 - a. Specific technical abilities related to a particular job
 - b. Non-technical interpersonal and personal attributes
 - c. Computer programming skills
 - d. Academic qualifications and degrees
- 6) The reading technique that encourages active engagement and ensures a high degree of understanding and remembrance is
 - a. ERRQ
 - b. SQR3
 - c. EQRR
 - d. SR3Q

II. Answer the following questions as directed. (1×9=9)

1. Choose the correct word to complete the sentence:
The teacher gave a clear _____ (*instruct / instruction*) before the test.
2. Give the meaning of the administrative term “agenda.”
3. Give a one-word substitution for “*a person who takes care of students in a hostel.*”

4. Choose the correct meaning of the idiom "*Strike while the iron is hot.*"
 - (a) Wait for the right time to rest
 - (b) Act quickly when the opportunity comes
 - (c) Stop working when you are tired
 - (d) Think twice before taking any step
5. Fill in the blank with the correct homophones:
 I don't know _____ to bring a jacket or not. The _____ looks unpredictable today. (*weather/whether*)
6. Identify which part of speech is the underlined word:
 They run every morning to stay fit.
7. Change the following sentence into Passive Voice:
They completed the project.
8. Fill in the correct tense form (Simple Past Tense):
 They _____ (*come*) late to class yesterday.
9. Combine the following sentences using "because":
He was tired. He went to bed early.

III. Answer the following questions

1. Define Frame of Reference. 1
2. Highlight two most important life skills required for engineering students. 2
3. Briefly discuss the importance of grammar in technical writing. 2
4. Skimming and scanning are two important rapid reading techniques. How do these techniques help in identifying important information in the texts? 3
5. Why is the art of Clarity and Simplification of words needed for effective communication? 3
6. Enunciate briefly on three essential components in the process of communication. 3
7. Explain 'Adaptability' and 'Self-awareness' as important soft skills for understanding the importance of cross-cultural communication. 3

8. Elaborate on the importance of communication in technical education. 3
9. Explain 'Comprehension of Technical Text'. How is it different from general text? 4
10. Mention two specific life skills and explain how you would use it to try to resolve a conflict between two groups. 4
11. Why are visuals like tables, charts, diagrams and symbols used while taking notes? 4
12. Mention some common problems encountered by email users. Provide appropriate points to substantiate your answer. (2+2=4)

IV. Punctuate the text by using correct punctuation marks wherever required and make it a correct paragraph. (2)

consider those examples again the bit in the horses mouth the rudder in the ship the spark that starts a forest fire, and a poison that is injected into the life stream the principle underlying each of these illustrations is the same the tongue is a small part of the body but it is able to cause inestimable damage that might never be undone

V. Reply to this advertisement with a covering letter and a resume (7)

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