



## HALDIA INSTITUTE OF TECHNOLOGY

(AN AUTONOMOUS INSTITUTION UNDER MAULANA ABUL KALAM AZAD UNIVERSITY OF TECHNOLOGY, WEST BENGAL)

**Paper Code: ES-EE 101**

**Paper Name: Basic Electrical & Electronics Engineering**

*Time Allotted: 3 Hours*

*Full Marks: 70*

*The figures in the margin indicate full marks*

*Candidates are required to give their answers in their own words as far as practicable*

### Group - A

**(Multiple Choice Type Questions)**

**PART - I (Basic Electrical)**

**Choose the correct alternatives from the followings:**

**$7 \times 1 = 7$**

1. (i) Permeability in a magnetic circuit corresponds to ..... in an electric circuit

- a) Resistance      b) Resistivity      c) Conductivity      d) Conductance

(ii) Those magnetic materials are best suited for making armature and transform cores which have ..... permeability and ..... hysteresis loss

- a) High, high      b) Low, high      c) High, low      d) Low, low

(iii) The unit of Flux Density is

- a) Weber/meter<sup>2</sup>      b) Tesla      c) Coulomb      d) Both a and b

(iv) The relative permeability of ferromagnetic material is \_\_\_\_\_

- a) Less than unity      b) Equal than unity      c) Larger than unity      d) Not equal to unity

(v) The power factor of pure inductor is

- a) Unity      b) Zero      c) Lagging      d) Leading

(vi) The phase difference between the following voltage and current waves

$v=311 \sin(100\pi t+30^\circ)$  volts and  $i=17\sin(100\pi t+20^\circ)$  amps is

- a)  $20^\circ$       b)  $50^\circ$       c)  $10^\circ$       d)  $30^\circ$

(vii) A sinusoidal voltage varies from zero to a maximum of 250V. The voltage at instant of  $45^\circ$  of the cycle will be

- a) 152.5V      b) 176.77V      c) 125V      d) 108.25V

### Group - B

**(Short Answer Type Questions)**

**PART - I (Basic Electrical)**

**Attempt any two from the followings:**

**$2 \times 5 = 10$**

2. a) What is co-efficient of coupling between two coils? b) Determine the emf induced in a coil of  $4.19 \times 10^{-4}$  Henry when a current of 5 Amp is reversed in 60 milliseconds.

1+4

3. A circuit takes a current  $i = 50 \sin(314t - \frac{\pi}{3})$  when the supply voltage is  $v = 400\sin 314t$ . Find the impedance, resistance, inductance of the circuit.

1+2+2

4. A Single-Phase transformer has 400 primary and 1000 secondary turns. The net cross sectional area of the core is  $60 \text{ cm}^2$ . The primary winding is connected to a 500 V supply. Find the a) peak value of the core flux density and b) emf induced in the secondary winding.

3+2

### Group - C

**(Long Answer Type Questions)**

**PART - I (Basic Electrical)**

**Attempt any two from the followings:**

**$2 \times 10 = 20$**

5. a) Describe power triangle. b) Two impedances consist of (resistance of 15 ohms and series-connected inductance of 0.04 H) and (resistance of 10 ohms, inductance of 0.1 H and a capacitance of 100  $\mu\text{F}$ , all in series) are connected in series and are connected to a 230 V, 50 Hz A.C source. Find: (i) Current drawn    (ii) Voltage across each impedance  
(iii) Individual power factor.

3+7

6. a) Prove that active power in a general series circuit is  $P = VI\cos\Phi$  watt. b) A 4 kW load takes a current of 20 A from a 240 V ac supply. Calculate the kVA and KVAR of the load.

6+4

7.a) A single-phase 230/110 volt takes an input of 350 VA at no load while working at 230 volt. The core loss is 110 watt. Find the core loss component of no-load current, magnetizing component of no-load current, no-load power factor, core loss resistance and magnetizing reactance. b) A 8 kVA, 440/2000 V, 50 Hz single-phase transformer gave the following test results: No load test: 440 V, 0.8 A, 80 W. Short circuit test: 50 V, 3 A, 20 W. Calculate (i) the magnetizing current and the component corresponding to iron losses at normal voltage and frequency, (ii) the efficiency on full load at unity p.f.

5+5

Group - A  
(Multiple Choice Type Questions)  
PART - II (Basic Electronics)

Choose the correct alternatives from the followings:

8 x 1 = 8

1. (i) If  $\alpha = 0.95$ , then the value of  $\beta$  of the transistor is

- a) 19                    b) 190                    c) 85                    d) 100

(ii) The phase difference between input and output voltages in common emitter arrangement is

- a)  $180^\circ$                     b)  $90^\circ$                     c)  $0^\circ$                     d)  $270^\circ$

(iii) An n-p-n transistor with  $\alpha = 0.96$  and negligible  $I_{CO}$  carries a base current of 0.2 mA in the active region. The emitter current is

- a) 5 mA                    b) 10 mA                    c) 1.5 mA                    d) 25 mA

(iv) A CE amplifier operates at  $I_c$  2.6 mA and has  $R_c = 1\text{ k}\Omega$ . The ac emitter resistance is

- a)  $10\Omega$                     b)  $100\Omega$                     c)  $0.1\Omega$                     d)  $1\Omega$

(v) An n-channel JFET gives a saturation voltage  $V_{Dsat} = 4$  V for  $V_{GS} = -1$  V. Another n-channel JFET gives  $V_{Dsat} = 6.5$  V for the same  $V_{GS}$ . The ratio of the pinch off voltages of the two JFET is

- a) 5:1                    b) 3:5                    c) 2:3                    d) 1:5

(vi) The Slew rate of an ideal OPAMP is

- a) Zero                    b) Infinite                    c)  $1\text{V}/\mu\text{s}$                     d) None of these

(vii) Find the CMRR uses of the following data  $A_d = 1250$  and  $A_c = 10$ .

- a) 125                    b) 120                    c) 145                    d) 132

(viii) If the input to an integrator is square wave, the output is

- b) a)sine                    b) square                    c) triangular                    d) saw-tooth

Group - B  
(Short Answer Type Questions)  
PART - II (Basic Electronics)

Attempt any one from the followings:

1 x 5 = 5

2. What are  $\alpha$  and  $\beta$  of the transistor? Deduce the relationship between them.

3+2

3. An OPAMP inverting amplifier has an input resistor of  $10\text{k}\Omega$  and a feedback resistor  $50\text{k}\Omega$ . If the input voltage is 0.5V, find the output voltage and the input current.

2.5+2.5

Group - C

(Long Answer Type Questions)  
PART - II (Basic Electronics)

Attempt any two from the followings:

2 x 10 = 20

4.(a) Why a FET is known as unipolar device? (b) What are the advantages of FET over BJT?

(c) A transistor is operating in CE configuration. A  $560\Omega$  resistor is joined between the collector and the power supply and a voltage drop of 0.6V occurs across it. If  $\alpha = 0.97$ , calculate the base current.

2+3+5

5. (a) Write down the differences between inverting and non-inverting amplifier. (b) Explain the adder circuit using OPAMP as an inverting mode.

3+7

6. (a) Explain the three JFET's parameters and deduce the relationship among them. (b) Write down the differences between BJT and JFET

5+5



## HALDIA INSTITUTE OF TECHNOLOGY

(AN AUTONOMOUS INSTITUTION UNDER MAULANA ABUL KALAM AZAD UNIVERSITY OF TECHNOLOGY, WEST BENGAL)

**Paper Code: ES-CS 101**

**Paper Name: Computer Programming for Problem Solving**

*Time Allotted: 3 Hours*

*Full Marks: 70*

*The figures in the margin indicate full marks*

*Candidates are required to give their answers in their own words as far as practicable*

### Group - A

#### (Multiple Choice Type Questions)

**Choose the correct alternatives from the followings:**

**15 x 1 = 15**

1. (i) int \*x, a[10];

x=a;

Here x stores

a) Contents of array a      b) cell numbers of array a      c) Sum of all elements of array a      d) None

(ii) Which format specifier is used to print the values of string?

a) %ls      b) %s      c) %x      d) %d

(iii) What is the output of the C statement?

```
int main()
{ int a=0;
a = 5< 2 ? 4 : 3;
printf("%d",a);
return 0;
}
```

a) 4      b) 3      c) 5      d) 2

(iv) What is the output of the program?

```
int main()
{ int a = 25%10;
printf("%d", a);
return 0;
}
```

a) 2.5      b) 2      c) 5      d) Compiler error

(v) In C, return is a \_\_\_\_\_

a) Identifier      b) Keyword      c) Function      d) Constant

(vi) What is an example of iteration in C?

a) if-else      b) return      c) for      d) All of these

(vii) Which symbol is used as a statement terminator in C?

a) !      b) #      c) \*      d) ;

(viii) Size of int a[20] will be

a) 20      b) 40      c) 60      d) None of these

(ix) The operator + in a+ =4 means

a)  $a=a+4$       b)  $a+4=a$       c)  $a=4$       d)  $a=4+4$

(x) Which of the following symbol is used to denote a pre-processor statement?  
a) !      b) #      c) :      d) ()

(xi) A declaration float a, b; occupies \_\_\_\_\_ of memory  
a) 1 byte      b) 4 bytes      c) 8 bytes      d) 16 bytes

(xii) What will be the output of the following code snippet?

```
int main()
{ int a = 3;
  int res = a++ + ++a + a++ + ++a;
  printf("%d", res);
  return 0;
}
```

a) 12      b) 24      c) 18      d) 20

(xiii) Which searching algorithm is used on a sorted array?  
a) Linear Search      b) Binary Search      c) Quick Sort      d) Both (a) and (b)

(xiv) How many times value of 'i' will be checked in the following C code?

```
#include<stdio.h>
```

```
int main()
{ int i = 2;
  while(i>=1)
  { i++;
  }
  return 0;
}
```

a) Compiler Error      b) 2      c) Infinite      d) 1

(xv) What is the output of the C statement?

```
int main()
{ int a=0;
  a = 4 + 4/2*5 + 20;
  printf("%d", a); return 0;
}
```

a) 40      b) 4      c) 34      d) 54

**Group - B**  
**(Short Answer Type Questions)**

**Attempt any three from the followings:**

2. a) Find errors in the program and write the correct code.

```
#include (stdio.h)
#include (conic.H)
int main();
{ float a, b, c
  a = 3;
  b = 4;
  c = a + b;
  printf("The value of c is %d", C);
  return 0;
}
```

**$3 \times 5 = 15$**

- b) Explain types of error with appropriate example. 2+3
3. a) Write an algorithm to convert centimeters into meters and centimeters.  
E.g. - 127 meters into 1meter and 27 centimeter
- b) Draw a flowchart to determine whether a triangle is acute, obtuse or right-angled. 2+3
4. Write a program that takes a single digit integer and display it into equivalent Roman numeral. 5
5. a. What is recursion? Explain with an example  
b. Explain ternary operator with appropriate example. 3+2
6. Using structure, write a program to create two complex numbers, add them and display their result. 5

**Group – C**  
**(Long Answer Type Questions)**

**Attempt any four from the followings:** 4 x 10 = 40

7. a) Write a program where user will input a word and following pattern will emerge  
E.g. – User has entered “BENGAL”  
B  
BE  
BEN  
BENG  
BENGA  
BENGAL
- b) What is a pointer and how it differs from other variables? Mention advantages and disadvantages of pointers. 6+(2+2)
8. a) Explain the logic behind linear search and binary search.  
b) Create an array and implement binary search on it. 3+7
9. a) Find errors in the code and write the correct code if any errors exist.
- ```
#include <studio.h>
viod main()
{ int mass, vel;
printf("Enter mass and vel\n");
scanf("%f %f", &mass, &vel);
clrscr();
ke==1/2mass*vel*vel;
printf("Kinetic Energy=%d",ke);
getch();
}
```
- b) Write the use of the following functions
- i. strlwr()
  - ii. strcpy()
  - iii. isalpha()
  - iv. isdigit()
- c) What is structure and union? How a structure differs from a union? 3+4+3
10. a) Write a program to find maximum of three numbers using if-else.  
b) Find maximum of three numbers using ternary operator.  
c) What are the disadvantages of switch case? 5+3+2
11. a) Write a program to calculate  $1+1/2+1/3+\dots+1/n$   
b) Write a program to calculate  $0+1+1+2+3+5+8+13+\dots+n$  5+5
12. Write a program to calculate Simple or Compound interest based on users' choice. 10



## HALDIA INSTITUTE OF TECHNOLOGY

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Paper Code: HM-HU 101  
Paper Name: English Language and Technical Communication

Time Allotted: 3 Hours

Full Marks: 70

The figures in the margin indicate full marks

Candidates are required to give their answers in their own words as far as practicable

### Group - A

#### (Multiple Choice Type Questions)

Choose the correct alternatives from the followings:

$15 \times 1 = 15$

1. (i) \_\_\_\_\_ creates shortened words from longer words but does not change the class or meaning of the word.  
a) Compounding      b) Back-formation      c) Clipping      d) Blending
  
- (ii) \_\_\_\_\_ is a communication which contains the decision of the meeting.  
a) Amendment      b) Resolution      c) Debate      d) Minutes.
  
- (iii) . ----- refers to the amount of space that individuals naturally maintain between each other.  
a) Chronemics      b) Gestures      c) Proxemics      d) None of these.
  
- (iv) Mom had to intervene when my sister and I started to argue over the remote. The prefix ‘inter-‘ in the word intervene means \_\_\_\_\_.  
a) Into      b) Between      c) Above      d) Over
  
- (v) ..... refers to mental disturbances  
a) Coherence      b) Notion      c) Distraction      d) Psychological noise
  
- (vi) List of items to be discussed and decided in a meeting is called as \_\_\_\_\_.  
a) Resolution      b) Minutes      c) Invoice      d) Agenda
  
- (vii) The phrases “a far cry,” “catch a falling knife” and “dream comes true” are all examples of  
a) ageism      b) clichés      c) redundancy      d) jargon
  
- (viii) Type of reduction that may result in a noun being used as a verb.  
a) blending      b) backformation      c) compounding      d) coinage
  
- (ix) Joining of two separate WORDS to produce a single form (toothpaste, bedroom, sweetheart, blackboard, friendly-looking) is known as –  
a) Compounding      b) blending      c) borrowing      d) clipping
  
- (x) The word PIN is an example of  
a) abbreviation      b) acronym      c) initialism      d) backformation
  
- (xi) Smog and brunch are examples of

- a) blending      b) Clipping      c) Borrowing      d) Compounding

(xii) Those bright yellow football boots really ..... (Use a suitable phrasal verb)  
a) stand up      b) stand down      c) stand in      d) stand out

(xiii) While conversing with an individual we shake hands and do look them in eyes. This act of looking at the person we are engaged in the conversation is called?

- a) Verbal      b) Kinesics      c) Prosody      d) Oculistics

(xiv) Technical writing demands \_\_\_\_\_ use of language.  
a) figurative      b) poetic      c) factual      d) dramatic

(xv) What is the antonym of the word – FRAUDULENT?

- a) Candid      b) Direct      c) Forthright      d) Genuine

### Group – B

#### (Short Answer Type Questions)

**Attempt any three from the followings:**

**$3 \times 5 = 15$**

2. The 'Mehrabian formula' (7%/38%/55%) describes how a person expresses himself through verbal and non-verbal cues. Explain how these percentages are divided in the process of communication.
3. Discuss the concepts of word formation – Blending and Clipping, and provide suitable examples of the same.
4. What are the advantages and disadvantages of oral communication?
5. Mention the golden rules of telephone etiquette.
6. What is the difference between a solicited and unsolicited cover letter?

### Group – C

#### (Long Answer Type Questions)

**Attempt any four from the following:**

**$4 \times 10 = 40$**

7. What do you understand by grapevine? Explain various types of grapevine communication.
8. Write an application in response to the following advertisement in The Times of India. Enclose an appropriate CV. *Wanted fresh graduates for Cascade Software. Applicants should be willing to travel to all parts of India. Preference will be given to candidates with good communication skills.*
9. What are the barriers to effective communication? How can these barriers be overcome?
10. Explain K O P PA C T.
11. Write an essay on “Brain Drain”.
12. Does technology provide for a better life, or is it a bane? Discuss.



## HALDIA INSTITUTE OF TECHNOLOGY

(AN AUTONOMOUS INSTITUTION UNDER MAULANA ABUL KALAM AZAD UNIVERSITY OF TECHNOLOGY, WEST BENGAL)

**Paper Code: BS-CH 101**

**Paper Name: Chemistry-I**

*Time Allotted: 3 Hours*

*Full Marks: 70*

*The figures in the margin indicate full marks*

*Candidates are required to give their answers in their own words as far as practicable*

### Group - A

#### (Multiple Choice Type Questions)

**Choose the correct alternatives from the followings:**

**15 x 1 = 15**

1. (i) What is the spin-only magnetic moment in BM for  $[\text{CoF}_6]^{3-}$

- a) 2.8      b) 4.9      c) 0      d) 3.5

(ii) If unit of reaction rate constant for a specific chemical reaction is  $(\text{Concentration})^{-1} \text{ time}^{-1}$  then order of that reaction

- a) 0      b) 1      c) 2      d) 3

(iii) Entropy change of an irreversible process can be denoted as

- a)  $\Delta S < 0$       b)  $\Delta S = 0$       c)  $\Delta S \geq 0$       d)  $\Delta S > 0$

(iv) Joule Thomson coefficient  $\mu_{JT}$  is expressed as:

- a)  $\left(\frac{dT}{dP}\right)_H$       b)  $-\frac{1}{C_p} \left(\frac{dT}{dP}\right)_H$       c)  $+\frac{1}{C_p} \left(\frac{dT}{dP}\right)_H$       d)  $-\frac{1}{C_v} \left(\frac{dT}{dP}\right)_H$

(v) Caustic embrittlement in boiler cause due excess use of

- a) sodium phosphate as softening reagents      b) sodium carbonate as softening reagents  
c) sulphuric acid      d) hydrochloric acid

(vi) For asthma and lungs related issue the specific drug is

- a) Aspirin      b) Paracetamol      c) Ibuprofen      d) Salbutamol

(vii) Which of the following is true for a galvanic cell?

- a) The cell potential is always negative      b)  $\Delta G$  for the cell reaction is positive  
c) The products are less stable than the reactants      d) The cell potential is always positive

(viii) According to molecular orbital theory, which of the following will not be a viable molecule?

- a)  $\text{H}_2^{2-}$       b)  $\text{H}_2^-$       c)  $\text{He}_2^{2+}$       d)  $\text{He}_2^+$

(ix) Which one of the following will show only one  ${}^1\text{H-NMR}$  signal?

- a) Neopentane      b) Pentane      c) Isobutane      d) None

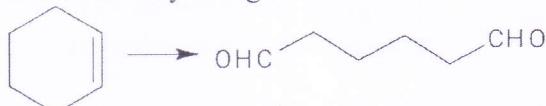
(x) Disproportionation reaction is observed during

- a) aldol condensation      b) Cannizaro reaction      c) Wittig reaction      d) Michael addition

- (xii) Ziegler-Natta catalyst is used during

  - a) Aldol condensation                      b) Addition polymerization
  - c) Condensation polymerization        d) Wittig reaction

- (xiii) The following transformation can be done by using-



- a) Cold and dilute  $\text{KMnO}_4$   
b) Hot and conc.  $\text{KMnO}_4$   
c) Ozone followed by water  
d) Ozone followed by zinc and water

- (xiv) The actual expression of Hamiltonian operator is

$$\text{a) } -\frac{8\Pi^2m}{h^2}\nabla^2 + V \quad \text{b) } \frac{8\Pi^2m}{h^2}\nabla^2 + V \quad \text{c) } -\frac{h^2}{8\Pi^2m}\nabla^2 + V \quad \text{d) } \frac{h^2}{8\Pi^2m}\nabla^2 - V$$

- (xv) The ionization isomer of  $[\text{Cr}(\text{H}_2\text{O})_4\text{Cl}(\text{NO}_2)]\text{Cl}$  is-

- a)  $[\text{Cr}(\text{H}_2\text{O})_4(\text{O}_2\text{N})]\text{Cl}_2$       b)  $[\text{Cr}(\text{H}_2\text{O})_4\text{Cl}_2]\text{NO}_2$   
 c)  $[\text{Cr}(\text{H}_2\text{O})_4\text{Cl}(\text{ONO})]\text{Cl}$       d)  $[\text{Cr}(\text{H}_2\text{O})_4\text{Cl}_2(\text{NO}_2)]\text{H}_2\text{O}$

### Group – B

### **(Short Answer Type Questions)**

**Attempt any three from the followings:**

$$3 \times 5 = 15$$

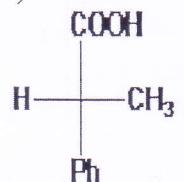
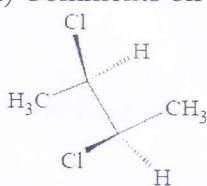
- 2.i)  $[\text{Ni}(\text{H}_2\text{O})_6]^{2+}$  (aq.) is green in color whereas  $[\text{Ni}(\text{H}_2\text{O})_4(\text{en})]^{2+}$  (aq.) is blue in color. Explain  
ii) What is the role of salt bridges in electrochemical cells?

3. i) Prove that for one mole ideal gas  $C_p - C_v = R$ . ii) Prove that for ideal gas in adiabatic reversible process  $PV^\gamma = \text{Constant}$ . 3+2

4. Draw the MO diagram of  $O_2$  and explain why it sticks to a magnet bar? ii) Explain why the bond angle of Ammonia is  $107^\circ$  where as in water is  $105^\circ$ ? 3+2

5. i) What is Markonikoff rule explain with example.  
ii)

- a) Comments on optical activity of following      b) Find R/S of the following



3+2

6. i) Write the differences between thermoplastic and thermosetting polymer. ii)  $[Ti(H_2O)_6]^{3+}$  is purple color but  $[Zn(H_2O)_6]^{2+}$  is colorless - Why? 3+2

Group - C

(Long Answer Type Questions)

- Attempt any four from the followings:  $4 \times 10 = 40$
7. i) How will you account the splitting of  $t_{2g}$  and  $e_g$  for  $d^4$  system in strong field and weak field ligands? Calculate their CFSE values of these cases. 5  
ii) How do you prepare a) Aspirin from phenol and b) Paracetamol from nitrobenzene? 2+3
8. i) What is eigen function and eigen value? What are significance of  $\psi$  and  $\psi^2$ ? ii) The uncertainty in momentum of a particle is  $3.5 \times 10^{-2} \text{ kg m s}^{-1}$ . Find the uncertainty of position? iii) How many number radial and angular nodes are there in 3d orbital? 3+4+3
9. i) What do you mean by parallel reaction? Give an example of a parallel reaction. 2  
ii) A first order reaction has a specific reaction rate  $10^{-3} \text{ sec}^{-1}$ . How much time will it take for 10 g the reactant to reduce to 2.5 g? 3  
iii) Write down the Arrhenius equation regarding reaction rate constant and temperature and mention the significance of the symbol used. What is the slope when  $\ln k$  is plotted against  $\frac{1}{T}$ ? Explain graphically. 5
10. i) How many mgs of  $\text{MgCl}_2$  dissolved in water per litre gives 200 ppm hardness? 3  
ii) Write a short note on sacrificial anode. 3  
iii) What is the emf of hydrogen electrode at pH 10 and NTP? 4
11. i) Give a brief idea about a) Aldol condensation b) Intramolecular Cannizaro reaction c) Wittig reaction 6  
ii) Suggest probable ways to carry out the following transformations. (any two) 2+2  
a) Propan-2-one to 2-methylpropene  
b) Ethanal to butane-1,3-diol  
c) Benzaldehyde to cinnamaldehyde
12. i) Define bathochromic and hypsochromic shifts. 2  
ii) Why does 1,3-butadiene possess higher  $\lambda_{\max}$  value than that of ethane? 3  
iii) What is chemical shift? Explain why  $^{13}\text{C}$  is NMR active while  $^{12}\text{C}$  is not. 2+2  
iv) What is finger print region range in IR spectra? 1



## HALDIA INSTITUTE OF TECHNOLOGY

(AN AUTONOMOUS INSTITUTION UNDER MAULANA ABUL KALAM AZAD UNIVERSITY OF TECHNOLOGY, WEST BENGAL)

**Paper Code: BS-PH 101**

**Paper Name: Physics - I**

*Time Allotted: 3 Hours*

*Full Marks: 70*

*The figures in the margin indicate full marks*

*Candidates are required to give their answers in their own words as far as practicable*

### Group – A

#### (Multiple Choice Type Questions)

**Choose the correct alternatives from the followings:**

**$15 \times 1 = 15$**

1. (i) A vector field with a vanishing curl is called as \_\_\_\_\_  
a) Irrotational      b) Solenoidal      c) Rotational      d) Cycloidal
  
- (ii) For a particle executing SHM, the phase difference between displacement and velocity is  
a)  $\pi$       b) 0      c)  $\pi/2$       d)  $\pi/4$
  
- (iii) In any damped oscillation the resisting force is proportional to  
a) displacement      b) acceleration      c) velocity      d) position
  
- (iv) The relation between the sharpness (S) and the quality factor (Q) in case of forced vibration is given by  
a)  $Q = 2S$       b)  $Q = 1/S$       c)  $Q = 1/2S$       d)  $Q = S$
  
- (v)  $\omega$  is the natural frequency of an oscillator and b is the damping factor ( $b = \beta / 2m$ ) where  $\beta$  per unit velocity, the quality factor of the oscillator is given by  
a)  $\omega/b$       b)  $\omega/2b$       c)  $2\omega/b$       d)  $b/\omega$
  
- (vi) Expression for maxima in thin film interference for reflected light is:  $2\mu tc \cos r = ?$   
a)  $n\lambda$       b)  $2n\lambda$       c)  $(2n+1)\lambda/2$       d)  $(n+1)\lambda/2$
  
- (vii) The intensity of the principal maximum of the grating spectra having N-slits is proportional to  
a)  $1/N$       b)  $N^2$       c)  $N^3$       d)  $1/N^2$
  
- (viii) Population inversion is achieved due to the presence of \_\_\_\_\_  
a) metastable state      b) ground state      c) excited state      d) donor state
  
- (ix) Circularly polarized light is produced if the amplitudes of the O- and E-rays are equal and there is a phase difference of \_\_\_\_\_  
a)  $\pi$       b)  $\pi/2$       c)  $\pi/4$       d) zero
  
- (x) In Newton's ring experiment interference pattern is produced by division of  
a) Amplitude      b) Wavefront      c) Both of these      d) none of these
  
- (xi) Nicol prism is based on the phenomenon of  
a) refraction      b) reflection      c) birefringence      d) scattering
  
- (xii) The probability of finding a particle in a distance  $dx$  around the point  $x$  is given by  
a)  $\Psi^*$       b)  $\Psi^* \Psi dx$       c)  $\Psi \Psi^*$       d)  $\Psi$
  
- (xiii) Which of the following functions is an Eigen function of the operator  $\frac{d^2}{dx^2}$ ?  
a)  $\Psi = c \ln x$       b)  $\Psi = c x^2$       c)  $\Psi = \frac{c}{x}$       d)  $\Psi = c e^{-mx}$

- (xiv) The fundamental magnetic moment in magnetism is  
a) dipole moment      b) Bohr Magneton      c) Curie constant      d) susceptibility

- (xv) For  $T > 0K$ , the probability of occupancy of an electron at Fermi energy level is  
a) 1/2                  b) 1                  c) 0                  d) 1/3

### Group – B

### (Short Answer Type Questions)

**Attempt any three from the followings:**

$$3 \times 5 = 15$$

2. (i) Show that the total energy of a particle executing simple harmonic oscillation is constant.  
(ii) What is logarithmic decrement?

3. (i) Write down the conditions of sustained interference.

- (ii) Write down the intensity expression for Fraunhofer diffraction from a single slit explaining all terms and plot the pattern.

4. (i) Define Brewster's law in polarization. Hence prove that the angle between the reflected and refracted rays is  $90^\circ$ .  
(ii) Calculate the polarizing angle for light travelling from water of refractive index 1.33 to glass of refractive index 1.53. (1+2)=2

5. Write down the energy and momentum operator for one dimension. Hence show that  $[\hat{x}, \hat{p}] = i\hbar$  2+3

6. Consider a two-particle system each of which can exist in states  $E_1$ ,  $E_2$  and  $E_3$ . What are the possible states if the particles according to (i) MB, (ii) BE (iii) FD statistics? 5

### **Group - C**

### Group C (Long Answer Type Questions)

**Attempt any four from the followings:**

$$4 \times 10 = 40$$

7. (i) What is the physical significance of divergence and curl of a vector field? (ii) If  $\psi(x, y, z) = 3x^2y - y^3z^2$ , find  $\nabla \vec{\psi}$  at the point  $(1, -2, -1)$ . (iii) What is solenoidal vector? Determine the constant 'a' so that the vector  $\vec{A} = (x + 3y)\hat{i} + (y - 2z)\hat{j} + (x + az)\hat{k}$  is solenoidal.

8. (i) What is resonance? Establish the condition of amplitude of resonance and explain the sharpness of resonance (ii) A series circuit is formed using an inductor ( $L$ ), a capacitor ( $C$ ), and a resistance ( $R$ ) driven by a sinusoidal voltage. Obtain the differential equation describing the charge on the capacitor as function of time. Identify the natural frequency of the circuit. (2+3+1)+4

9. (i) Find out the expression for intensity pattern for single slit diffraction. Find out the maxima and minima condition. (ii) What is missing order in case of double slit diffraction? (iii) In a double slit experiment if the slit width is 2 mm and the separation between the slits is 4 mm, then find the missing orders. (4+3)+1+2

10. (i) Define Heisenberg's Uncertainty Relation.  
(ii) Show that the maximum Compton shift is twice the Compton wavelength.  
(iii) Find out the energy Eigen functions and energy Eigen values for a particle in one dimensional potential box with rigid walls and side L characterized by  $V(x) = 0$ , for  $0 < x < L$  and  $V(x) = \infty$ , otherwise. 3+2+5

11. (i) Write down Plank's distribution law in black-body radiation and hence find out Wein's and Rayleigh-Jean's distribution law.  
(ii) Show graphically how the energy density versus wavelength plot of black body radiations is changed if the temperature is increased.  
(iii) An X-ray photon is found to have its wavelength doubled on being scattered through  $90^\circ$ . Find the wavelength and energy of the incident photon.  $(1+2+2)+2+3$

12. (i) Distinguish between diamagnetic, paramagnetic and ferromagnetic materials. Give example for each. (ii) What is a dielectric constant? What is meant by polarization of dielectric?

- (iii) Explain why the introduction of a dielectric slab between the plates of a capacitor changes its capacitance?

$$6+(1+1)+2$$

# HALDIA INSTITUTE OF TECHNOLOGY

(AN AUTONOMOUS INSTITUTION UNDER MAULANA ABUL KALAM AZAD UNIVERSITY OF TECHNOLOGY, WEST BENGAL)

# PAPER CODE: BS-M 101

## Paper Name: MATHEMATICS-I

*Time Allotted: 3 Hours*

Full Marks: 70

*The figures in the margin indicate full marks*

*Candidates are required to give their answers in their own words as far as practicable*

### Group - A

### **(Multiple Choice Type Questions)**

**Multiple Choice**  
Choose the correct alternatives from the followings:

$$15 \times 1 = 15$$

1. (i) The system of linear equation  $x + 2y + 3z = 1, 2x + 4y + 6z = 3, x + y + z = 1$  has  
 a) Unique solution    b) Many solution    c) No solution    d) None of these

(ii) Which of the following function obey the Rolle's theorem in  $[0, \pi]$   
 a)  $x$     b)  $\sin x$     c)  $\cos x$     d)  $\tan x$

(iii) The inverse of the matrix  $\begin{pmatrix} 2 & 3 \\ 4 & 6 \end{pmatrix}$  is  
 a)  $\begin{pmatrix} 2 & -3 \\ 4 & 6 \end{pmatrix}$     b)  $\begin{pmatrix} 1 & 2 \\ -3/2 & 3 \end{pmatrix}$     c) does not exist    d)  $\begin{pmatrix} -2 & 4 \\ -3 & 6 \end{pmatrix}$

(iv) The  $n^{th}$  order differentiation of  $y = (ax + b)^m, a, b \in \mathbb{R}, m \in \mathbb{Z}^+$ , where  $m = n$ , is  
 a)  $\frac{m!}{(m-n)!} a^n (ax + b)^{m-n}$     b)  $n!$     c)  $0$     d) None

(v)  $\int_0^{\frac{\pi}{2}} \cos^6 x dx =$   
 a)  $\frac{7\pi}{32}$     b)  $\frac{5\pi}{32}$     c)  $\frac{\pi}{32}$     d)  $\frac{3\pi}{16}$

(vi) The function  $f(x, y) = \begin{cases} x^2 + 2y; & (x, y) \neq (1, 2) \\ 12; & (x, y) = (1, 2) \end{cases}$  is  
 a) continuous everywhere    b) nowhere continuous    c) not continuous only at  $(1, 2)$     d) Nor

(vii) The series which converges but does not converge absolutely is called  
 a) absolute convergent    b) convergent    c) conditional convergent    d) None

(viii) The  $p$ -series  $\sum \frac{1}{n^p}$  converges when  
 a)  $p > 1$     b)  $p < 1$     c)  $p = 1$     d)  $p < -1$

(ix) The value of  $\int_0^{\infty} e^{-x} x^{\frac{3}{2}} dx$  is  
 a)  $\frac{5}{8}\sqrt{\pi}$     b)  $\frac{3}{4}\sqrt{\pi}$     c)  $\frac{1}{2}\sqrt{\pi}$     d)  $\frac{1}{4}\sqrt{\pi}$

(x) The improper integral  $\int_a^b \frac{dx}{(x-a)^n}$  is convergent if  
 a)  $n < 1$     b)  $n = 1$     c)  $n > 1$     d) none of these

(xi) If  $x = r \cos \theta$  and  $y = r \sin \theta$ , then  $\frac{\partial(x,y)}{\partial(r,\theta)} =$

- a)  $r \cos \theta \sin \theta$       b)  $r$       c)  $-r$       d)  $\frac{1}{r}$

- (xii) If  $f(x, y)$  is a homogeneous function of degree  $\frac{1}{2}$  then  $x^2 f_{xx} + 2xy f_{xy} + y^2 f_{yy} = kf(x, y)$   
 a)  $\frac{1}{2}$       b)  $\frac{1}{3}$       c)  $-\frac{1}{4}$       d)  $\frac{1}{4}$

- (xiii) The value of  $b$  for which  $\vec{A} = (bx^2y + yz)\hat{i} + (xy^2 - xz^2)\hat{j} + (2xyz - 2x^2y^2)\hat{k}$  is solenoidal is  
 a) -2      b) 2      c) 4      d) -4

(xiv) A vector  $\vec{A}$  is irrotational if

- a)  $\vec{\nabla} \cdot (\vec{\nabla} \times \vec{A}) = 0$       b)  $\vec{\nabla} \times \vec{A} = \vec{0}$       c)  $\vec{A} = 0$       d)  $\vec{\nabla} \cdot \vec{A} = 0$

- (xv) The value of  $\nabla^2 \left( \frac{1}{r} \right)$  is  
 a) 1      b) -1      c) 0      d) 10

### Group - B

#### (Short Answer Type Questions)

Attempt any three from the followings:

**3 x 5 = 15**

2. Expand the polynomial  $f(x) = x^3 - 2x^2 + 3x + 5$  in a series of positive integral powers of  $(x - 2)$ .  
5

3. State the comparison test for the convergence of an infinite series. Test the convergence of the series  

$$\frac{6}{1 \cdot 3 \cdot 5} + \frac{8}{3 \cdot 5 \cdot 7} + \frac{10}{5 \cdot 7 \cdot 9} + \dots$$
  
5

4. Find the surface area of the paraboloid generated by revolving the curve  $y = x^2$  included between  $x = 0$  and  $x = \frac{6}{5}$  about y-axis.  
5

5. Examine the convergence of the improper integral  $\int_0^\infty \frac{dx}{(1+x)\sqrt{x}}$  and evaluate if possible.  
5

6. When a vector is called an irrotational vector? Prove that  $\vec{A} = (6xy + z^3)\hat{i} + (3x^2 - z)\hat{j} + (3xz^2 - y)\hat{k}$  is irrotational.  
1+4

### Group - C

#### (Long Answer Type Questions)

Attempt any four from the followings:

**4 x 10 = 40**

7. (a) Find the value of  $\lambda$  and  $\mu$  for which  $x + y + z = 3, 2x - y + 3z = 4, 5x - y + \lambda z = \mu$  have  
 (i) Unique solution,      (ii) No solution      (iii) Many solutions.

(b) State Cayley-Hamilton theorem and verify the same for the matrix  $A = \begin{bmatrix} 1 & 2 \\ 2 & -1 \end{bmatrix}$ . Hence find  $A^{-1}$  (if possible).  
5+5

8. (i) Is the matrix  $A = \begin{bmatrix} 1 & 6 & 1 \\ 1 & 2 & 0 \\ 0 & 0 & 3 \end{bmatrix}$  diagonalizable? If yes, diagonalize  $A$ .

(ii) Evaluate  $I = \int_0^\infty x^4 e^{-x^4} dx$   
7+3

9. (a) Is Rolle's theorem applicable to the function  $f(x) = (x - p)^m (x - q)^n, x \in [p, q]$  where  $m, n$  are positive integers? If so, find the constant  $c$  of Rolle's theorem, where  $c$  has its usual meaning.

(b) If  $f(x) = \sin^{-1} x$ ,  $0 < a < b < 1$ , use Lagrange's mean value theorem to prove that  $\frac{b-a}{\sqrt{1-a^2}} < \sin^{-1} b - \sin^{-1} a < \frac{b-a}{\sqrt{1-b^2}}$

5+5

10.(a) State the D'Alembert's Ratio test for convergence of an infinite series. Test the convergence of the series  $1 + \frac{x}{2} + \frac{x^2}{5} + \frac{x^3}{10} + \dots$

(b) State Leibnitz's test for the convergence of an alternating series and apply it to examine the convergence of  $1 - \frac{1}{2^2} + \frac{1}{3^2} - \frac{1}{4^2} + \dots$

5+5

11. (i) Expanding the determinant by Laplace's method in terms of minors of second order formed from the first and the fourth row, prove that

$$\begin{vmatrix} 0 & a & b & c \\ -a & 0 & d & e \\ -b & -d & 0 & f \\ -c & -e & -f & 0 \end{vmatrix} = (af - be + cd)^2.$$

(ii) Find the rank and nullity of the matrix  $A = \begin{bmatrix} 1 & 1 & 3 & 1 \\ 2 & 1 & 5 & 4 \\ 1 & 2 & 4 & -1 \end{bmatrix}$ .

5+5

12. (a) Evaluate by Green's theorem in the plane  $\oint_{\Gamma} (x^2 dx + xy dy)$ , where  $\Gamma$  is the square in the  $xy$ -plane given by  $x = 0, y = 0, x = a, y = a$  ( $a > 0$ ) described in the positive sense.

(b) Show that  $\vec{A} = (6xy + z^3)\hat{i} + (3x^2 - z)\hat{j} + (3xz^2 - y)\hat{k}$  is irrotational. Find the scalar function  $\varphi$ , such that  $\vec{A} = \vec{\nabla}\varphi$ .

5+5