

Full Marks: 70

Times: 3 Hours

The figures in the margin indicate full marks.
Candidates are requested to write their answers in their own words as far as practicable.

GROUP-A
[OBJECTIVE TYPE QUESTIONS]



Answer *all* questions

5x2=10

1. Through what angle must a 0.20 MeV photon be scattered by a free electron so that it loses 10% of its energy? 2
2. If the speed of a non-relativistic particle is changed by 1%, calculate the change in de Broglie wavelength. 2
3. Show that $\vec{\nabla} \times \vec{\nabla} \phi = 0$. 2
4. What is the physical significance of $\vec{\nabla} \cdot \vec{B} = 0$. 2
5. Show that $\vec{\nabla} \phi$ is a vector perpendicular to the surface $\phi(x, y, z) = c$ where c is a constant. 2

GROUP-B
[LONG ANSWER TYPE QUESTIONS]

$\oint \vec{B} \cdot d\vec{s} = 0$
 $\oint (\vec{v} \cdot \vec{B}) d\vec{s}$
 $4 \times 15 = 60$

Answer any *four* questions

6. i) Derive the differential equation for the simple harmonic motion from energy consideration. 3
 ii) Three simple harmonic motions of the same frequency act on a particle simultaneously in the same direction. Their amplitudes are 1.0, 1.5 and 2.0 cm respectively. The phase angle of the second with respect to the first is 60° and that of the third with respect to the second is 30° . Obtain the resultant amplitude and phase angle relative to the first. 3
 iii) Write the differential equation for the damped oscillations of a body and solve it. Give the conditions for over damped, critically damped and under damped motions. 6
 iv) A particle executing SHM has velocities u_1 and u_2 when it is at distances x_1 and x_2 respectively from the mean position. Show that the time-period of the motion is given by $T = 2\pi \sqrt{\frac{x_2^2 - x_1^2}{u_1^2 - u_2^2}}$ 3
7. i) Write down the one-dimensional wave equation. Find a general solution of it. 1+4
 ii) Show that EM wave is transverse in nature. 6
 iii) Define Poynting vector. Calculate the Poynting vector of an EM wave with electric vector $\vec{E} = E_0 \sin(kz - \omega t)\hat{j}$ 1+3
8. i) Prove that the Coulomb force is conservative. 4
 ii) Calculate the line integral of the function $\vec{v} = x^2\hat{x} + 2yz\hat{y} + y^2\hat{z}$ from the origin to the point (1, 1, 1) along the prescribed path: $(0, 0, 0) \rightarrow (1, 0, 0) \rightarrow (1, 1, 0) \rightarrow (1, 1, 1)$. 4
 iii) If $\phi(x, y, z) = xy^2 + yz^3$ be a scalar function, find out the component of $\vec{\nabla} \phi$ at the point (2, -1, 1) in the direction of the vector $\hat{i} - 2\hat{j} + 2\hat{k}$. 4
 iv) Give geometrical interpretation of $\vec{A} \cdot (\vec{B} \times \vec{C})$, where \vec{A} , \vec{B} and \vec{C} are three non-zero vectors. 3
9. i) Show that $[f(x), \hat{p}_x] = i\hbar \frac{df}{dx}$? 3
 ii) Find the constant B which makes e^{-ax^2} an eigenfunction of the operator $\frac{d^2}{dx^2} - Bx^2$. What is the corresponding eigenvalue? 3+1
 iii) Show that the wave functions given by $\psi_n(x) = \sqrt{2/L} \sin(n\pi x/L)$ are orthonormal. 4
 iv) What are the properties of well-behaved wave-function? Which of the following wave-functions is well-behaved and why? (i) $\psi(x) = Ae^{x^2}$, (ii) $\psi(x) = Ae^{-x^2}$ 2+2

10. (i) State Planck's hypothesis for blackbody radiation and derive and draw the nature of the energy density vs. frequency curve. 5
- (ii) Starting from de Broglie hypothesis show that the group velocity associated with a particle is same as particle velocity. 4
- (iii) Calculate the de Broglie wavelength of proton at temperature $T = 300\text{ K}$ (1.454) 3
- (iv) State and explain Heisenberg's uncertainty principle. Justify that an atomic nucleus cannot harbor a free electron. 3
11. (i) Starting from Faraday's law of electromagnetic induction show that $\vec{\nabla} \times \vec{E} = -\frac{\partial \vec{B}}{\partial t}$ 5
- (ii) A particle of mass m is confined in a force free region in one dimension between two rigid walls situated at $x = 0$ and $x = L$. Find the eigenfunctions and eigenvalues of the Hamiltonian. 5
- (iii) Evaluate de Broglie wavelength of an electron having kinetic energy equal to its rest mass energy. Find the % of error involved if the non-relativistic calculation is done. 5

JALPAIGURI GOVERNMENT ENGINEERING COLLEGE
[A GOVERNMENT AUTONOMOUS COLLEGE]
JGEC/B.TECH/CE/EE/ME/CSE/ECE/IT/HM-HU201/2022-23
2023
ENGLISH

Full Marks: 70

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GROUP-A
[OBJECTIVE TYPE QUESTIONS]

cut

Answer **all** questions

5x2=10

Point out and correct the errors in the following sentences.

1. One of the most widely spread bad habit is the use of tobacco. 2
2. He was not blind from birth. 2
3. Krishna is the taller boy in the class. 2
4. The man is a social animal 2
5. The principal threatened to inform to his father about his misdeeds. 2

GROUP-B
[LONG ANSWER TYPE QUESTIONS]

Answer any **four** questions

4x15=60

6. ~~Write~~ Write an essay in 250 words arguing 'Is Engineering hard?' 10

b) Fill in the blanks with appropriate prepositions: 5

- i) The truth of the matter finally dawned _____ Tina.
- ii) The employees called _____ the strike.
- iii) The flight will take _____ any minute now.
- iv) The neighbour asked us to turn _____ the music.
- v) Call _____ the surgeon immediately; the patient needs her.

Date

7. a) You are the Sales representative of your company. Write a letter to the business manager of ABC ENTERPRISES introducing one of your new products/services. Be sure to give the important details about the product. 10

b) Form meaningful sentences with each word in the pair of homophones given below: 5

- i) coral/choral ii) brake/break iii) bury/berry iv) cache/cash v) coughers/coffers

8. a) You have completed your post-graduation recently and wish to start applying for various Ph.D. programmes. In about 250 words, draft your statement of purpose. 10

b) Put the right alternative in the right place: 5

- i) He has the _____ of keeping regular hour. (custom, habit)
- ii) The building was _____ to the ground. (raised, razed)
- iii) The Irish _____ settled in Canada. (immigrants, emigrants)
- iv) The Third World War is _____. (eminent, imminent)
- v) Guru Nanak Dev led a _____ life. (godly, godlike)

9. a) You have completed your graduation recently. Apply for the post of Junior Engineer in an institution of your choice. Invent necessary details. **CV ?** 10

b) Rewrite the following sentences according to the instructions given: 5

- i) They haven't stamped the letter. (End:.... Stamped)
- ii) Don't walk on the grass. (use: keep off)
- iii) You have nothing to complain of. (End with: ... complain)
- iv) He has refused to help me. (Rewrite using said)
- v) This apple is bigger than any other that I have ever seen. (Begin: I have never...)

10. a) You have been given the responsibility of writing a product launch email on behalf of your institution to promote a new product for a targeted set of customers. Mention the details about the new product. Invent necessary details. 10

b) Fill in the blanks with the appropriate form of the verb: 5

My guide told me if I wanted to meet these people I would have to walk two miles. We finally _____ (reach) a village where I _____ (meet) a lady whose age I _____ (can) not immediately make out. My translator _____ (find) it difficult to interpret the lady's words because her dialect _____ (be) quite different.

11. a) Write an essay in 250 words on the Importance of perfecting Communication Skills. 10
- b) Insert articles where necessary: 5
- i) Tiger is native of Asia.
 - ii) Moon shone through night.
 - iii) Priest was old Brahmin.
 - iv) Man cannot survive without water.
 - v) Sun rises in east.

JALPAIGURI GOVERNMENT ENGINEERING COLLEGE
[A GOVERNMENT AUTONOMOUS COLLEGE]
COE/B.TECH./CSE/ECE/IT/ES-CS201/2023-2024
2023
PROGRAMMING FOR PROBLEM SOLVING

Full Marks: 70

Times: 3 Hours

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GROUP-A
[OBJECTIVE TYPE QUESTIONS]

Answer **all** questions

5X2 = 10

1. What is type casting? 2
Which one is the right output?
int main(){
2. int p[3]={22,77,90}; 2
printf("%d", *(a+2));
a) 22 b) 77 c) 90 d) compiler error
3. Convert $(1011100.1101011)_2 = (?)_{16}$ 2
Write the output of the following code
#define PRODUCT(x) x*x
Void main(){
4. int j=5,k; 2
k=PRODUCT(j+1);
printf("%d",k);}
5. Write a C code to print a char value using double pointer. 2

GROUP-B
[LONG ANSWER TYPE QUESTIONS]

Answer any **four** questions

4X15 = 60

6. i) Write a user-friendly Program in C to Print the Reverse of a Number. 5
ii) Write a C program to print the following pattern: 5
A
B B
C C C
D D D D
iii) Explain typecasting with a suitable example. 3+2
Write the output of the below code.
printf("%d",5*2/3);
7. i) Briefly describe the functions of memory unit and discuss its various parts. 3
ii) Write a flowchart to find the sum of all integers ranging 100 to 500 and divisible by both 3 and 7. 4
iii) Write a C program to multiply two matrices and show the resultant matrix. 6
iv) Write down the difference between compiler and interpreter. 2

P.T.O

8. a) What is structure? How does a structure differ from array? 2+2
 b) What is the size of the following union 2+2

```
union abc{
  int a;
  float b;
  char c;
};
```

 If we use structure instead of union for the same program code, what is the size?
 c) Define a structure called customer that will describe 7

```
customer name,
customer id,
Account number,
age
```

 Using customer, declare a variable of customer structure and write a program to read the information of the member variables and display them
9. a) What are the different storage classes? 4
 b) Explain conditional operator with an example 2
 c) Write the output of the following code and explain the output 1+3

```
int main() {
  char *ptr;
  char str[]="abcdefg";
  ptr=str;
  ptr+=5;
  printf("%s",ptr);}
d) Write a program in C to calculate the power of any number using recursion 5
```

10. i) Discuss call by value, call by reference and call by address. 5
 ii) Write a C program to merge two strings and show the resultant string using call by reference. 5
 iii) Write a program in C to find the frequency (number of occurrences) of a character in a string. 5

11. i) Write a C program to print the Fibonacci series up to n^{th} term. 5
 ii) Write a user-friendly Program in C to compute the total number of spaces in a sentence. 5
 iii) Write a user-friendly Program in C to compute the cube of an integer number **using function** 5

12. i) What is pointer? What do you mean by array of pointer? Explain with example. 1+4
 ii) Write down the differences between *malloc()* and *calloc()* functions with example. What is header file? 4+1
 iii) Write a C program to search an element using binary search technique in a descending order sorted array. 5

END

JALPAIGURI GOVERNMENT ENGINEERING COLLEGE
[A GOVERNMENT AUTONOMOUS COLLEGE]
COE/B.TECH.(ME/CE/EE/ECE)/ BS-M201B/2022-23
2023
MATHEMATICS-IIB

Time: 3 Hours

Full Marks: 70

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GROUP-A
[OBJECTIVE TYPE QUESTIONS]

5x2=10

Answer **all** questions

1. Transform the differential equation $xy \cos x^2 dx + 2 \sin x^2 dy = 0$ into an exact differential equation. 2

2. Show that $J_{\frac{1}{2}}(x) = \sqrt{\frac{2}{\pi x}} \sin x$. 2

3. Using Green's theorem, show that $\frac{1}{2} \oint_C (x dy - y dx) = \text{area of the region enclosed by the closed curve } C$. 2

4. Locate and classify (with reason) the singular points of the equation $x(x-1)^3 \frac{d^2 y}{dx^2} + 2(x-1)^3 \frac{dy}{dx} + 3y = 0$ 2

5. Show that the function $f(z) = \bar{z}$ is continuous at $z = 0$ but not differentiable there. 2

GROUP-B
[LONG ANSWER TYPE QUESTIONS]

5x12=60

Answer any **five** questions

6. i) Solve: $xy dx + (2x^2 + 3y^2 - 12) dy = 0$ 4

ii) Solve: $\frac{dy}{dx} + y = y^3 (\cos x - \sin x)$ 4

iii) Find the general solution and the singular solution of the differential equation 2+2

$$y = x \frac{dy}{dx} + \sqrt{49 \left(\frac{dy}{dx} \right)^2 + 25}$$

4

7. i) Solve: $\frac{d^2 y}{dx^2} - 5 \frac{dy}{dx} + 6y = (xe^x)^3$. 4

ii) Solve by the method of variations of parameters: $\frac{d^2 y}{dx^2} + a^2 y = x \cos ax, a \neq 0$. 4

iii) Solve: $x^2 \frac{d^2 y}{dx^2} - x \frac{dy}{dx} + 4y = x \sin(\log x)$. 4

8. i) Find the power series solution of the equation $(1+x^2) \frac{d^2 y}{dx^2} + x \frac{dy}{dx} - xy = 0$ in powers of x . 6

ii) Use Rodrigue's formula to evaluate $P_0(x), P_1(x), P_2(x), P_3(x)$. Hence express $f(x) = 4x^3 + 6x^2 + 7x + 2$ in terms of Legendre's polynomials. 2+2

iii) Write the solution of the equation $x^2 \frac{d^2 y}{dx^2} + x \frac{dy}{dx} + (k^2 x^2 - n^2)y = 0$ by reducing it to Bessel's equation. 2

9. i) Evaluate $\iint_R \frac{\sqrt{a^2b^2 - b^2x^2 - a^2y^2}}{\sqrt{a^2b^2 + b^2x^2 + a^2y^2}} dx dy$ where R is the positive quadrant of the ellipse $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$. 6

ii) Evaluate $\iint_R xy(x+y) dx dy$ where R is the region enclosed by the curves $y = x, y = x^2$. 6

10. i) State Green's theorem. Use Green's theorem to evaluate 1+5

$\int_C [(3x - 8x^2)dx + (4y - 6xy)dy]$ where C is the boundary of the region bounded by $x = 0, y = 0$ & $x + y = 1$. (-1)

ii) State Stoke's theorem. Evaluate $\int_C \vec{F} \cdot d\vec{r}$ by Stoke's theorem, where 1+5

$\vec{F} = y^2\vec{i} + x^2\vec{j} - (x+z)\vec{k}$ and C is the boundary of the triangle with vertices at $(0,0,0), (1,0,0), (1,1,1)$.

11. i) Prove that the function $f(z)$ defined by $f(z) = \begin{cases} \frac{(z)^2}{z}, z \neq 0 \\ 0, z = 0 \end{cases}$ 3+3

is not differentiable at the origin though Cauchy-Riemann equations are satisfied at that point.

ii) Show that the function $u(x, y) = e^x(x \cos y - y \sin y)$ is harmonic and find a function $v(x, y)$ such that $f(z) = u + iv$ is analytic. Then express $f(z) = u + iv$ as a function of z . 2+2+2

12. i) State Laurent's theorem. Expand the function $f(z) = \frac{z^2-1}{z^2+5z+6}$ as a Laurent's series in the region $2 < |z| < 3$. 2+4

ii) Evaluate $\int_{\Gamma} z^2 dz$ where Γ is the boundary of the triangle with vertices $0, 1+i, -1+i$ and traversed in the clockwise sense. 6

13. Find the bilinear transformation which maps the points $z = 1, i, -1$ into the points $w = i, 0, -1$ respectively. 3

ii) Use Cauchy's integral formula to evaluate $\iint_C \frac{e^z}{z^2+4} dz$ where C is the positively oriented circle $|z - i| = 2$. 3

iii) Evaluate $\int_0^{2\pi} \frac{\cos 2\theta}{5+4 \cos \theta} d\theta$, using Cauchy's residue theorem. 6