

NATIONAL INSTITUTE OF TECHNOLOGY PATNA, PATNA

(Ashok Rajpath Patna-800 005)

End-Sem Examination Dec -2024

Time allotted: 3hrs.

Full Marks: 60

SUBJECT: Engineering Physics

Course code: PH18101/17101

Attempt any five questions. All questions carry equal marks

1. (a) Derive and solve the differential equation of a damped harmonic oscillator. Discuss the conditions under which the oscillations are said to be under damped, overdamped and critically damped. [6+3]
(b) A wave along a string is $y = 0.02\sin(30t - 4.0x)$ m (here, x in metres and t in seconds). Find the speed of the wave. [3]
2. What do you mean by continuity of \vec{E} and \vec{D} across the boundary of two dielectrics in contact? Which component of \vec{E} and \vec{D} is continuous across the boundary of two dielectrics. Derive and prove them by appropriate method. [2+3+7]
3. (a) Write Maxwell's four electromagnetic equations. Derive a wave equation for isotropic linear dielectric medium. [4+4]
(b) If $A = x^2yi + (x-y)k$. Find (i) $\nabla \cdot A$ and (ii) $\nabla \times A$. [4]
4. Explain stimulation emission of radiation. Describe the construction and working of a Ruby laser. Explain the appearance of spikes in the laser output. [4+4+4]
5. Discuss the Planck's quantum hypothesis. State and explain de-Broglie hypothesis. (b) Calculate the velocity and K.E. of an electron of wavelength 1.66×10^{-10} m. [4+4+4]
6. Distinguish between Fresnel and Fraunhofer diffraction (any four points). Describe the Fraunhofer diffraction due to a single slit and discuss the conditions of maximum and minima. [4+4]
(b) A light of wavelength 550nm incident normally on a slit of width $2.2\mu\text{m}$. Determine the angular position of second and third minima. [2+2]



NATIONAL INSTITUTE OF TECHNOLOGY PATNA
DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

End Semester Examination July - Dec 2024

B. Tech-M Tech-DD-PH-MSE 1st semester
Course Code: CS18101

Course Name: Introduction to Computing
Max. Marks: 60
Time: 3 Hours

- Write a program to find all unique pairs in an array that sum up to a given number k. [5 M][CO4][BL3]
Example : Input: Array: [1, 4, 6, 2, 3, 8], k: 7, **Output:** (1, 6), (4, 3)
- Write a C program that swaps two numbers using pointers. The program should take two integers as input, and then swap their values using a function that accepts pointers as parameters. The function should NOT use any arithmetic operator (+, -, *, /) or third variable. [5 M][CO7][BL3]
- Explain the concept of "pointer to pointer to pointer" in C. Write a C program that demonstrates the use of a pointer to a pointer to pointer to store and print the value of an integer using all the cases. [1+4 = 5 M][CO7][BL2]
- Write a C program that demonstrates the usage of all types of operators in C. For each operator, explain its function and provide a simple example. [5 M][CO2][BL1]
- Please go through the program below. List out all possible errors and warning. Fix those errors and warning to make the program work properly. Further, write output of the program assuming you provide your roll number to the program as input. [6M][CO4,CO7][BL3]

```
#include<stdio.h>
int main () {int rollNum;
printf("Enter your roll number"); scanf("%d",&rollNum);
char a[8]; a[8]='\0';
for(int j = 0; j < 7; j++) { *a = rollNum % 10; a++; (*a)++; rollNum = rollNum / 10; }
for(int j = 0; j < 7; j++) { printf("\n%d", a[j]); }
}
```

6. Guess the output of following programs assuming you input your roll number to the program. [2+2 = 4 M][CO2][BL3]

```
#include<stdio.h>
int main(){
unsigned int rollNum;
printf("Enter your roll number");
scanf("%u",&rollNum);
rollNum += (rollNum/100);
rollNum >>= (rollNum%3);
rollNum << (rollNum%3);
printf("%u",rollNum);
}
```

Handwritten calculations:
2452008
2452008 + 24520 = 2476528
2476528 + 1 = 2476529
2476529 - 1 = 2476528
2476528

```
#include<stdio.h>
int main(){ int rollNum;
printf("Enter your roll number");
scanf("%d",&rollNum);
rollNum = rollNum - 2*rollNum;
rollNum = rollNum%10;
printf("%d\n",rollNum);
if(rollNum){printf("1\n");}
rollNum=0;
if(rollNum){printf("n2");}
rollNum=5;
if(rollNum){printf("3\n");}
}
```

Handwritten calculations:
2452008 - 4904016 = 2452008
2452008 % 10 = 8
8 - 16 = -8
-8 % 10 = 2
2 * 5 = 10
10 % 10 = 0
Output: 1, 2, 3

7. Write a C program to take input your full name char by char and store it in a one dimensional array. Further, store content of your 1-D array in a 2 D array of size 10x10 **evenly**. If length of your name is not a perfect square, append 'X' char to make it a perfect square. For example, if the 2D array is of size 5x5 and your name is **Girish Kumar**, it should look as matrix below. Further make the program print the content of 2-D array in 2-D layout. Usage of any library function apart from printf and scanf is not allowed. [10 M][CO4][BL3]

| | | | | | |
|---|---|---|---|--|--|
| G | I | R | I | | |
| S | H | | K | | |
| U | M | A | R | | |
| X | X | X | X | | |
| | | | | | |
| | | | | | |

OR

Describe the characteristics, scope, lifetime, and default values of the following storage classes. Write a C program to demonstrate the use of each storage class, showing how the value of a variable changes based on its storage class. Explain what a **void pointer** is and why it is used in C programming. Write a simple program to demonstrate the use of a void pointer to store and print the value of an integer, float and character variable. [3+3+2+2=10 M][CO2,CO4,CO7][BL3]

8. Will the following code snippets compile, if so what will be the output. Explain your answer in all cases. Assume that all necessary header files are already included. You should consider your Roll Number for the input to variable rollNum. [2x10 = 20 M]

2452008

a. [CO6][BL3]

```
void function() {
    int x = 5;
    x++;
    printf("%d", x);
}

int main() {
    unsigned int rollNum;
    printf("Enter your roll number");
    scanf("%u", &rollNum); 2452008
    int x = 0; ⑧
    int y = rollNum%10? rollNum%10:3; ⑧
    for (int i = 0; i < y; i++) {
        function(); ⑧
    }
    return 0;
}
```

y = 8

b. [CO2][BL3]

```
int main()
{
    unsigned int rollNum;
    printf("Enter your roll number");
    scanf("%u", &rollNum); 2452008
    int y = rollNum%10? rollNum%10:3;
    int x = 5;
    printf("x < 1: %d\n", x < 1);
    printf("y > 1: %d\n", y > 1);
    return 0;
}
```

y = 8, x = 5

②

④

c. [CO4][BL3]

```
int main() {
    char a[] = {'a', 'b', 'c', '\0', 'd', 'e', '\0'};
    printf("%s", a);
}
```

abc de

d. [CO3][BL3]

```
int main()
{
    unsigned int rollNum;
    printf("Enter your roll number");
    scanf("%u", &rollNum); 2452008
    int y = rollNum%10? rollNum%10:5;
    int sum = 0;
    for (int i = 1; i <= y; i++)
```

```
{
    sum += i * i; sum = sum + i * i = 6
    }
    printf("Sum of squares: %d\n", sum);
    return 0;
}
```

e. [CO2][BL3]

```
int main()
{
    unsigned int rollNum;
    printf("Enter your roll number");
    scanf("%u", &rollNum); 2452008
    int y = rollNum%10? rollNum%10:7;
    int x = 3;
    printf("x == y: %d\n", x == y);
    printf("x < y && y > 5: %d\n", x < y && y > 5);
    printf("x & y: %d\n", x & y);
    return 0;
}
```

x = 3
y = 8

f. [CO2][BL3]

```
int main()
{
    unsigned int rollNum;
    printf("Enter your roll number");
    scanf("%u", &rollNum); 2452008
    int x = 0;
    int b = rollNum%10? rollNum%10:8;
    int a = 5;
    int result = a++ + ++b;
    printf("a = %d, b = %d, result = %d\n", a, b, result); return 0;
}
```

g. [CO2][BL3]

```
int main() {
    unsigned int rollNum;
    printf("Enter your roll number");
    scanf("%u", &rollNum); 2452008
    int a = rollNum%10? rollNum%10:5;
    int b = 10;
    printf("a == b: %d\n", a == b);
    printf("a != b: %d\n", a != b);
    printf("a < b: %d\n", a < b);
    printf("a > b: %d\n", a > b);
    return 0;
}
```

a = 8
b = 10

h. [CO2][BL3]

```
int main() {
    unsigned int rollNum;
    printf("Enter your roll number");
    scanf("%u", &rollNum); 2452008
    int a = rollNum%2? rollNum%2:1;
    int b = 0;
    printf("a && b: %d\n", a && b);
    printf("a || b: %d\n", a || b);
    printf("!a: %d\n", !a);
    return 0;
}
```

a = 1
b = 0

i. [CO2][BL3]

```
int main() {
    unsigned int rollNum;
    printf("Enter your roll number");
    scanf("%u", &rollNum); 2452008
    int b = rollNum%10? rollNum%10:3;
    int a = 5;
    printf("a & b: %d\n", a & b); // Bitwise AND
    printf("a | b: %d\n", a | b); // Bitwise OR
    printf("a ^ b: %d\n", a ^ b); // Bitwise XOR
    return 0;
}
```

a = 5
b = 8

j. [CO3][BL3]

```
int main() {
    int a;
    int result = scanf("%d", &a);
    if (result == 1) {
        printf("Input successful! You entered: %d\n", a);
    } else {
        printf("Input failed.\n");
    }
    return 0;
}
```

5

National Institute of Technology Patna

Department of Mathematics

END-SEM-EXAMINATION: December, 2024

Course Name: **Engineering Mathematics**

Course Code: MA14102, MA18101

Program: B.Tech (CSE III), MSE

Full Marks: 60

Duration: 3 Hrs.

ANSWER ALL QUESTIONS

- ✓ 1. For the function f defined by

$$f(x, y) = \begin{cases} xy \frac{x^2 - y^2}{x^2 + y^2}, & \text{for } (x, y) \neq (0, 0) \\ 0, & \text{for } (x, y) = (0, 0) \end{cases}$$

Verify whether $f_{yx}(0, 0) = f_{xy}(0, 0)$.

[6M]

2. If $u = \tan^{-1} \left\{ \frac{x^2 + y^2}{\sqrt{x} + \sqrt{y}} \right\}$, then show that

$$x \frac{\partial u}{\partial x} + y \frac{\partial u}{\partial y} = \frac{3}{4} \sin 2u.$$

[6M]

3. By the method of variation of parameter solve

$$\frac{d^2 y}{dx^2} - 6 \frac{dy}{dx} + 9y = \frac{e^{3x}}{x^2}.$$

[6M]

- ✓ 4. Solve $(1 + y^2)dx + (x - \tan^{-1} y)dy = 0$.

[6M]

- ✓ 5. Solve $\frac{dy}{dx} = \frac{y^2}{1 - xy}$.

[6M]

6. Find the values of λ for which the equations

$$3x + y - \lambda z = 0; 4x - 2y - 3z = 0; 2\lambda x + 4y + \lambda z = 0$$

has a non trivial solution. Obtain the most general solutions in each case.

[6M]

7. Show that the non-singular matrix

✓

$$A = \begin{pmatrix} 7 & 2 & -2 \\ -6 & -1 & 2 \\ 6 & 2 & -1 \end{pmatrix}$$

satisfy the equation $-A^3 + 5A^2 - 7A + 3I_3 = 0$ & hence find A^{-1} .

[6M]

8. Find the null-space of

$$A = \begin{pmatrix} 1 & -1 & 0 \\ -1 & 1 & 2 \\ 2 & -2 & 0 \end{pmatrix}$$

and hence find nullity of A .

[6M]

9. Find the non-singular matrix P such that $P^{-1}AP$ is diagonal, where

$$A = \begin{pmatrix} 2 & 2 & 1 \\ 1 & 3 & 1 \\ 1 & 2 & 2 \end{pmatrix}.$$

[6M]

10. Find the basis and dimension of the subspace

$$S = \left\{ (x, y, z) \in \mathbb{R}^3 \mid x - 2y + 3z = 0, 2x + y - z = 0 \right\}.$$

[6M]

*****ALL THE BEST*****



Department of Electronics and Communication Engineering, NIT Patna
End Semester Examination
Elements of Electronics Engineering (EC17101/ EC18101)
B.Tech, (EC), Semester –I

Max Marks: 60

Time: 3:00 Hrs.

Note: All questions carry equal marks. Any missing data may be assumed suitably.

- (a) A particular semiconductor has hole concentration of $10^8/\text{cm}^3$. If intrinsic concentration of charge carriers is $1.7 \times 10^{13}/\text{cm}^3$. Find the electron concentration.
(b) Write down the relationship between the current gain coefficient of CB and CE Bipolar Junction transistor. If the current gain coefficient of CC is 50, find out the value of the remaining two.
- (a) Draw the circuit diagram of the (i) AND (ii) OR gates using Diode. Furthermore, draw the circuit diagram of $y=(A+B)(C+D)$ using Diode.
(b) What do you mean by the pinch off voltage. Explain in terms of transfer and drain characteristics of n-channel JFET.
- Determine I_B , I_C , V_C and V_B for the biasing network shown in following Fig. 2

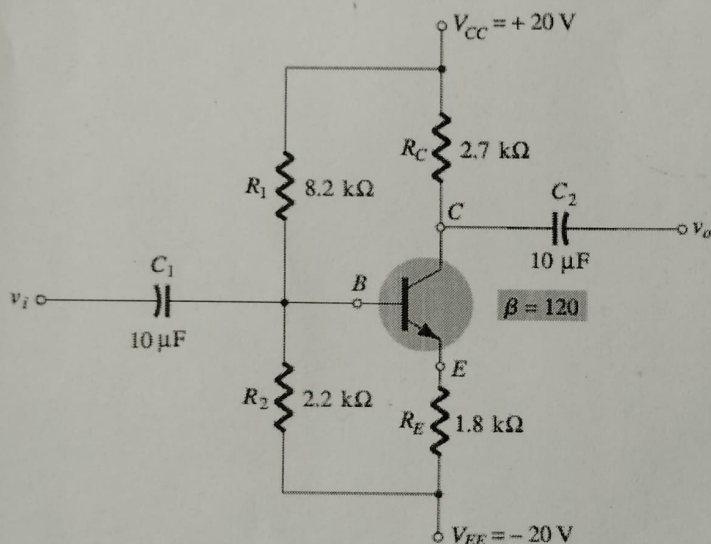


Fig. 2

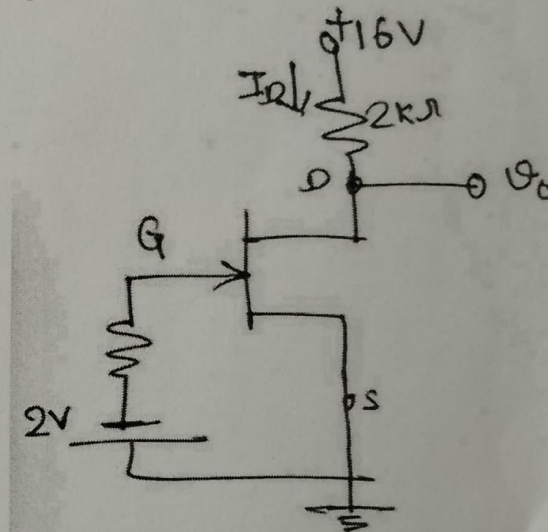


Fig. 3

- (a) For the circuit given below $I_{DSS}=10\text{ mA}$, $V_P=-8\text{ V}$, calculate V_{GS} , I_D and V_{DS} for the following Fig. 3. ✓
(b) Explain the working principle of a Unijunction Transistor (UJT) and describe its key characteristics, including the negative resistance region.
- (a) Reverse saturation current of a diode is $10\mu\text{A}$ at a certain temperature. What will be the new current if temperature is increased by 20°C ?
(b) Draw the output characteristics and transfer characteristics of the (i) p-channel depletion MOSFET (ii) n-channel enhancement MOSFET. Also write the (iii) drain current of both the MOSFET.
- (a) In the circuit shown in Fig 4, assume that the OPAMP is ideal. If the gain (v_o/v_i) is -12, calculate the value of R (in $k\Omega$) ?

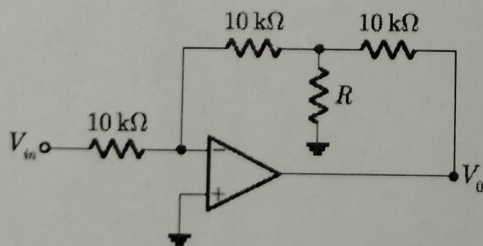


Fig. 4

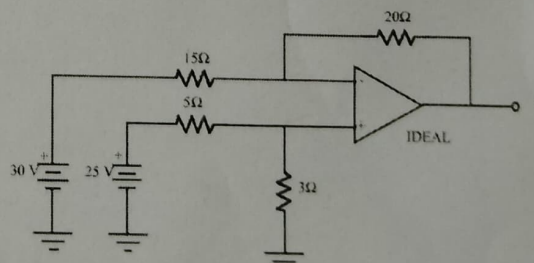


Fig. 5

- (b) For the difference amplifier circuit shown Fig. 5, determine the output voltage at terminal A.