

Exam.	New Back (2066 & Later Batch)		
Level	BE	Full Marks	80
Programme	All (Except B.Arch)	Pass Marks	32
Year / Part	I / I	Time	3 hrs.

Subject: - Computer Programming (CT401)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt **All** questions.
- ✓ The figures in the margin indicate **Full Marks**.
- ✓ Assume suitable data if necessary.

1. a) Explain different generation of programming languages. [4]
b) Why do we need analysis and design before coding a program? [4]
2. a) What do you mean by precedence and associativity of an operator? Explain with suitable example. [3]
b) What are the differences between formatted and unformatted Input / Output. Give suitable example with sample output for the following: %10i, %3c, %-10.3f and %x. [1+4]
3. a) What are the purpose of the continue statement? Within which control statements can continue statement be included? Compare with the break statement. [1+2+2]
b) Write a program to find the sum of series $S_n = \sum 1/n^2$ up to N term. [5]
4. What is the meaning of function prototyping? Write a program to calculate the sum of the series 1+11+111+.....+up to N terms using recursive function. If N is read as 5, the series is: 1+11+111+1111+11111. [2+6]
5. a) Explain with an example for compile time initialization of 2D array. Describe how compiler manages according to the number of initializers and size of an array given by a user in case of 1D array. [2+3]
b) Write a program to read a word from a main function, pass it into a function that will convert all of its characters into upper case if the first character is in lower case and into lower case if the first character is in upper case. Display the converted string from main function. [5]
6. a) Explain need of structures. How can we create and use a structure within another. [2+3]
b) Explain dot and arrow operators for accessing the members of a structure. [3]
7. a) If Ptr is a pointer to user defined type or basic type, by how many bytes is Ptr incremented when the statement Ptr++ is executed? [2]
b) Write a C program that calls reverse array () to reverse the array and return the array and display the element of reversed array using pointer. [6]
8. List different types of standard I/O used in C. Write a program to write name, roll no and age of five students into a disk file name "STUDENT.DAT". [2+6]
9. a) Explain different types of goto statements in FORTRAN programming with suitable example. Write a program to read n from user and display the sum of following series till n^{th} terms: $1+(1+2)+(1+2+3)+(1+2+3+4)+\dots+n$ [4+4]
b) Explain with suitable example to show how an Impiled Do loop works in FORTRAN. [4]

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1. a) What is mean by compilation? What is mean by interpretation? How do these two processes differ? [4]
- b) Define programming language? What are the features of good computer program? [1+3]
2. a) What are preprocessor directives? Explain constants and variables. [2+2]
- b) Write syntax and example of following statements/functions: [1×4]
 - i) printf
 - ii) getch
 - iii) scanf
 - iv) long
3. What are control statements? Illustrate nested IF statement with its flowchart. Write a program to calculate the series: $1 \times 10 + 3 \times 20 + 6 \times 30 + \dots + \frac{N(N+1)}{2} \times 10N$, where N is an integer term read from the keyboard. [2+2+6]
4. a) Write a program to display Armstrong numbers between the range entered by a user and also display their counts. You must use a function to check for Armstrong numbers and display them from main. [4]
- b) What do you mean by nested function and recursive function? Give an example of recursive function. [2+2]
5. a) Write a C program to read a string and display its reverse. Use user defined function to count number of characters in it and to reverse it. [4]
- b) Write an algorithm to insert a value in an array at a position given by user. [4]
6. a) What is a tag? Must a tag be included in a structure type definition? Must a tag be included in a structure variable declaration? Explain. [1+1+2]
- b) Write a C program that reads several different names and address using structure computer, rearrange the names into alphabetical order and write out alphabetical list. [4]
7. Illustrate with example that "Array is indirectly a pointer". Write program to calculate sum and average of integer numbers between M and N (where value of M and N are read from keyboard) using pointer. [4+4]
8. Write a program to continuously read name, age and salary of a worker and write it into a file until user confirms to end. Then read n from user and display the nth record in the file. Details of worker must be represented by a structure. [7]
9. a) Compare arithmetic and logical if statements in FORTRAN. [7]
- b) Write a FORTRAN program to display nature of roots of a quadratic equation. Calculate and display the roots, if they are real and equal. [8]

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1. a) Categorise programming languages on the basic of their uses and applications. Among them which programming language is C programming? [4]
 b) List and define different steps to solve the problem in computer system. [4]
2. a) Differentiate between declaration and definition. Explain structure of C program with an appropriate example. [4]
 b) Write syntax, example and use of following: [1×4]
 - i) printf()
 - ii) scanf()
 - iii) getch()
 - iv) getche()
3. Write the difference between do and do..... while loop and write the program "to find whether a year is leap or not". [3+7]
4. What is recursive function? How does it work? Find out sum of digit of number until the number becomes one digit number. [891>18>9]. [2+2+4]
5. a) Write a program to read a string and rewrite its characters in alphabetical order. [4]
 b) A multinational company has hired 3 sales persons for marketing/selling its 3 different products in Kathmandu. Each sales person sells each of these products. Write a program to read number of each product sold by all sales-persons. Calculate total sells of each item and the total sells of each sales-person. Use arrays. [6]
6. a) Explain about "Arrays within structures" along with programming example. [4]
 b) Write the program "to understand how structure members are sent to a function". [4]
7. Write down advantages of pointer. Write a program using pointer to swap the value of two variables where the swapping operation is performed in separate function. [2+6]
8. Write a C program to store employee details in a text file. Read data from the text file, sort them in ascending order of salary and store the sorted record to a binary file. Display the details and rank of employee given by the user. [8]
9. a) What do you mean by formatted and unformatted input/output statements in Fortran and also give suitable example which explain the concept of Formatted I/O. [8]
 b) Write the program to convert a binary number to a decimal number using Fortran programming language. [4]

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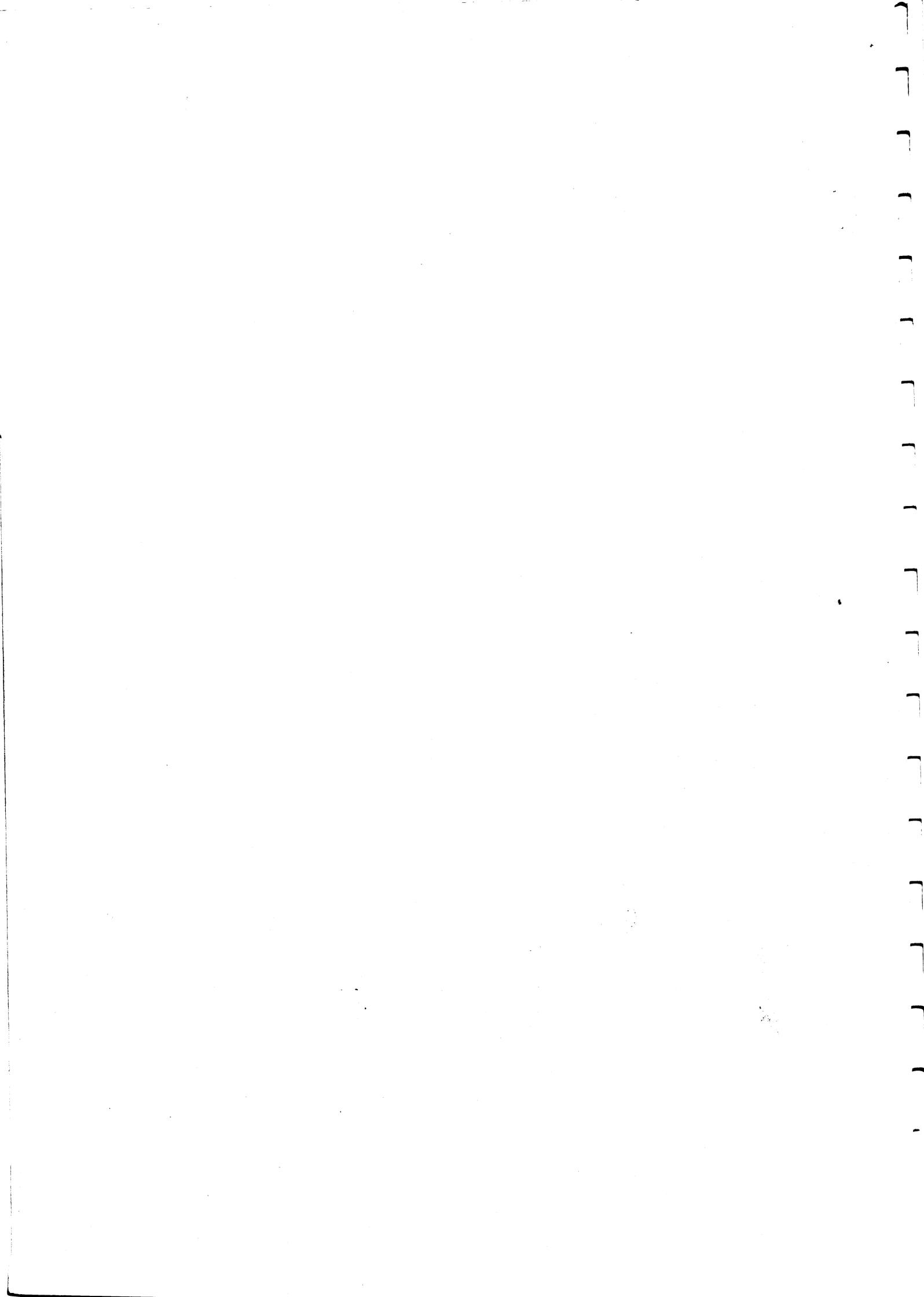
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1. a) ✓ Define software. Explain its types. [3]
b) ✓ What are the steps required to develop a computer program? Explain. [5]
2. a) ✓ What are relational operators and assignment operators? Explain with examples. [3]
b) Rewrite the following program by correcting any syntactical errors, if present. Also show the output of the corrected code. [3+2]

```
#include <stdio.h>
int main ( )
{
    float root, int i = 1;
    do { sum = 2i - 1;
        print ("t%d\n", sum);
        i *= 5/3;
    } while (sum <= 15)
    root = pow (i, 1/2);
    print ("\n%.3f", root);
    return void;
}
```

3. a) ✓ Write a program to read the number until - 1 is encountered. Also count the number of even number and odd numbers entered by the user. [6]
b) Distinguish between break and continue statement with example. [4]
4. a) Explain how function is defined in C? Differentiate call by value and call by reference. [1+2]
b) Write a program using a function that returns the largest number from an array of numbers that is passed to the function. [5]
5. a) How are one dimensional and two dimensional arrays created in C? Explain with examples. [2+2]
b) Write a C program to read two matrices from user, add them and display the result in matrix form. [6]
6. What do you mean by nested structures? Give suitable example. Write a program to read the heights of two students and display the difference between their heights. Use feet and inches as members of a structure to define height. [2+6]
7. a) Compare array and pointer with example. [3]
b) Write a program to read a string from user and use a user defined function to copy the content of the read string into another character array changing lower case letter to upper if any. Use pointer to process the string. [5]
8. Write a program to read the details of book authors and write it to a file, until the user confirms to end. Then read and display the nth record in the file, where n is read from the user. The data for authors must be represented by structures that contain name, nationality and number of books published. [8]
9. a) Explain the FORTRAN structure. What are data types in FORTRAN. [2+2]
b) Write a program in FORTRAN to solve quadratic equation and display roots in proper format. [8]



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INSTITUTE OF ENGINEERING
Examination Control Division
2070 Chitra

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	BE	Full Marks	80
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Year / Part	I / I	Time	3 hrs.

Subject: - Computer Programming I (EG442CT)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
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1. Why do we need programming language? Write down the advantages and disadvantages of high level and low level programming languages. Write an algorithm and flow chart to check whether the given year is a leap year or not. [Hint a year is a leap year if it is divisible by 4 not by 100 and by 400.] [2+3+5]
2. What do you mean by operators? Explain different operators along with their precedence and associativity. Write a program to count the number of vowels in a string you are not allowed to use library functions. [2+2+6]
3. What is a nested if-else statement? Explain it with an example. Write a program to find the largest of the three numbers using a nested if-else statement. [1+2+7]
4. Compare while loop, for loop and do-while loop. Write a program to evaluate the following series until the difference between the two terms is less than 0.001. [3+7]

$$S_n = x + \frac{x^3}{3!} + \frac{x^5}{5!} + \dots$$
5. Explain why we need function in programming. Write a function to check whether a number is prime or not and use the output of that function to print prime numbers from 1 to n entered by the user. [3+7]
6. What is a pointer? Write down the relationship of array and pointer. Write a function that takes string as an argument and return the number of characters in the string. Also return by converting the string to upper case. Don't use library function. [1+2+7]
7. How is nested structure formed? Explain with example. Write a program to perform addition, subtraction, multiplication and division of complex numbers. Make separate functions for each operation. [1+2+7]
8. What are binary and text files? Write a program to write any structure information in a binary file and to read and display it later. Make a menu driven program to read and display information from file. [3+7]



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1. a) What do you mean by software and explain about generation of programming languages. [4]
 b) Define the term "Flowchart". Discuss about different symbols used in Flowchart. [4]
2. a) Find out final value of a, b and c where following expressions are executed sequentially. [4]


```
int a = 2, b = 3, c;
a = (b++) + (++b) + a; 10
c = a > b ? a : b; 3
b = (a++) + (b--) + a; 7
c = c++ * b--; 9
```

 b) What are the difference between formatted and unformatted I/O statements? Describe with proper example. [4]
3. a) Explain importance of break and default statements in switch statements. [3]
 b) Write a C program to display following pattern using unformatted output statements: [7]


```
P
Pu
PuL
PULC
PuLcH
PULCHO
puLcHoW
PULCHOWK
```
4. a) Define "function definition" and write the program to find the sum of two numbers using user-defined functions. [4]
 b) What do you mean by "call by value and call by reference" along with suitable example? [4]
5. Can we pass whole array element from function? Write a program to display only those students information which are passed. Use separate function to check the result of student. The information of students like Name, Roll No, Address and Marks are passed from main functions and pass to functions using array type arguments. [2+8]

6. a) Explain the use of typedef of keyboard in structures. [2]
b) Explain the need of nested structure. Write a C program to convert data in BS to data in AD using structure. Use the data difference of current data. [1+5]
7. a) A pointer variable is used to store address of some other variables, however, we need to specify datatype while declaring a pointer variable. Why? [3]
b) Briefly explain array of pointers. How are array and pointer related? Give example. [5]
8. a) Define opening and closing a file along with suitable examples. [4]
b) Write the program to display the records in sorted order sorting is performed in ascending order with respect to name using data files concept. [4]
9. a) Compare arithmetic and logical if statements in FORTRAN with suitable example. [4]
b) Write a FORTRAN program to read $m \times n$ matrix, transpose it and display both the matrices. [8]

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- ✓ 1. Differentiate between high level and low level. Explain the steps of solving a problem using computer. [4+4]
- ✓ 2. Consider a statement

```
scanf("%s", str);
```

Where str is a string variable

In above statement, why '&' symbol is not used? Can we input string with space in this statement? If not, why? [4]
- ✓ 3. Write a program in C to find all possible roots of a quadratic equation $ax^2+bx+c=0$. [8]
- ✓ 4. Write down significance of `main()` function in C, Differentiate between pass by value and pass by reference arguments. Describe both with meaningful example. [2+6]
- ✓ 5. Explain how array can be passed to functions. Write a program that passes an array to a function and print the largest and smallest element. [2+6]
- ✓ 6. How are structures different from arrays? Create a structure in C to store the name of a batsman, runs scored and no of times the batsman in dismissed. In the program, read the data of five players and display the batting average of the player whose name is entered by the user. Batting average is given by $\text{total runs}/\text{total dismissals}$. [2+6]
- ✓ 7. Write down advantages of pointer. What type of arithmetic operations can be implemented in pointer? Also describe the relationship between array and pointer with appropriate syntax and examples. [2+3+3]
8. Write a program in C, to read the following information for 96 students.
Student Name, Student roll number, Marks obtained(in 100)
Record all data in "ioe.txt" file, and program should print roll number and name of student who have obtained greater than or equal to 40 marks. [8]
9. Rewrite the following source code correcting any error present in it. Also indicate the error corrected in comment. Then write the output of the program. [4+4]

```

//program to convert list of temperatures
//in Centigrade to Fahrenheit
#include stdio.h;
int main()
{
    int i, n=3;
    float celc[n], faren[n];
    for(i=0; i<n; i++)
    {
        print("Celc[%d]=")
        scanf("%d", celc[i]);
    }
    convert(celc, faren, n);
    for(i=0; i<n; i++) print(faren[i]);
    break;
};
void convert(float cel[], float far[], int n)
{
    for(i=0; i<n; i++) cel2far(far[i], cel[i]);
};
cel2far(float f, float c)
{
    f = 9/5*c+32; };

```

10. How are do-loops used in FORTRAN? Explain with example. Compare it with implied do-loop. Write a FORTRAN program to read ten integer numbers, store them in array, arrange them in ascending order and display the sorted list.

11. What is the syntax of two dimensional arrays in FORTRAN? Explain with example.

[4]

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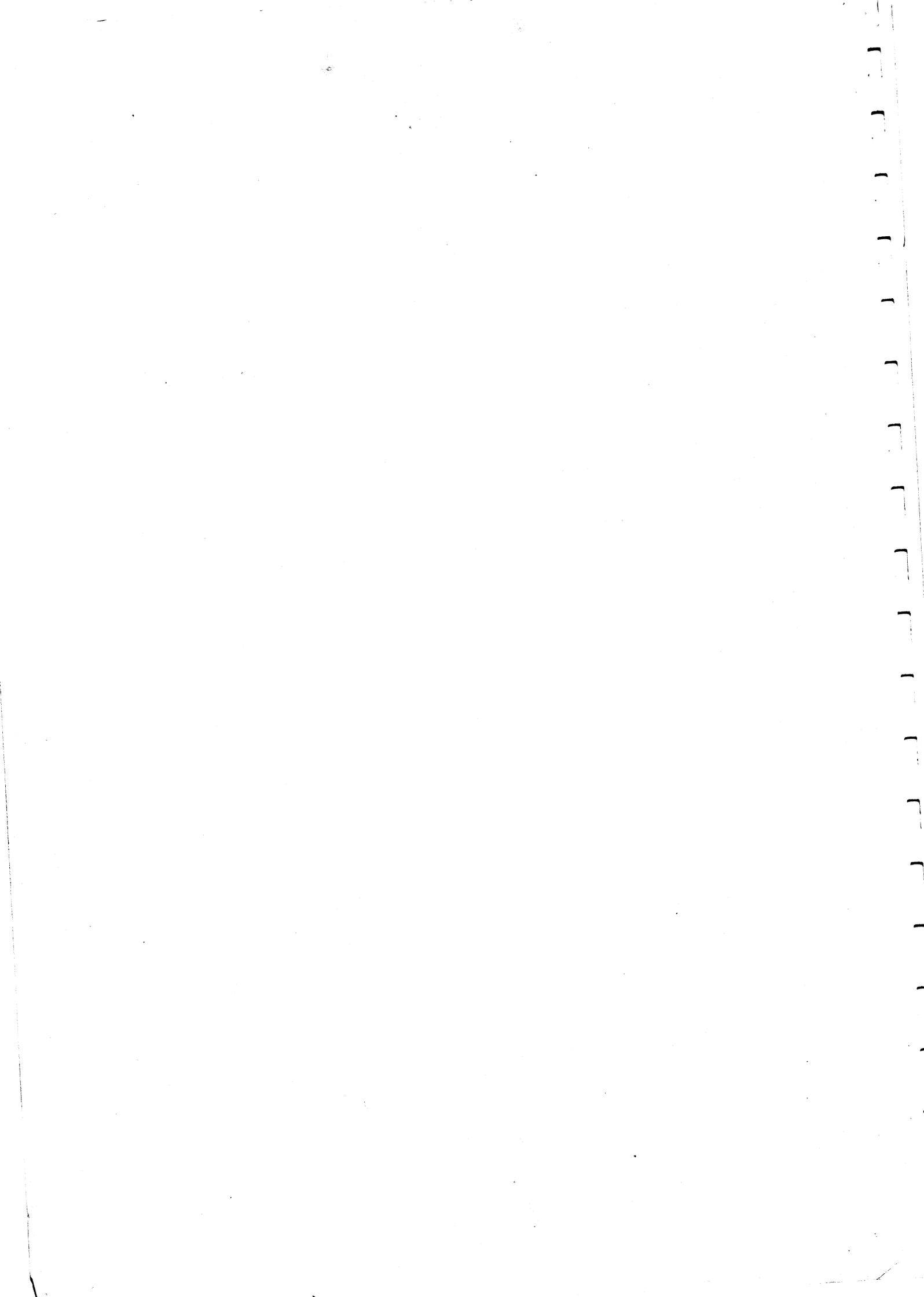
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1. What is high level language? Write different types of high level programming languages with their examples. How compiler is different than assembler programming language? [1+4+3]
2. What is a pseudo code? How is it different from an algorithm? Draw the flowchart to solve the multiplication of two matrices. [1+2+5]
3. Write a hierarchy of operations of the following expression in computer programming C: !EOF || B.Salary + Daily_Allowance > 8000 && eligible_code == 1 || net_pay > 10000. Write different formatted input output used in For Tran programming language. [4+4]
4. Write a program in C to calculate the frequency (F) for different values of capacitances (C), for a certain electrical circuit, with an inductance (L) and resistance (R), the damped natural frequency is given by $F = \sqrt{((1/LC) - (R^2/4C^2))}$. It is required to study the variation of this frequency with capacitance starting from 0.01 to 0.1 in steps of 0.01, and calculation should be done using user defined function. [8]
5. Write a syntax in C- programming with example of the following: "scanf", single statement "do....while", "strcpy", structures with arrays. [4x2]
6. What are the rules that govern the passing of arrays to user defined functions? Compare "user defined function" and "switch" in C- programming language. [3+5]
7. What are the importances of "Pointers" in C programming language? Write the output of the following program. [4+4]

```
# include<stdio.h>
# include<conio.h>
void main()
{   int k; int a[ ] = {1, 2, 3}; int*b[3]; int **c[3];
    int***d[3]; int****e[3]; int*****f[3];
    clrscr();
    for (k = 0;k<3; k++)
        {   b[k] = a + k; c[k] = b + k; d [k] = c + k;
            e [k] = d + k; f [k] = e + k;
        }
    for (k = 0;k<3; k++)
        {   printf ("%3d", *b[k];      printf ("%3d", **c[k];
            printf ("%3d", ***d[k];   printf ("%3d", ****e[k];
            printf ("%3d\n", *****f[k];
        }
}
```

8. Write a program to read name and age of 10 different students as the two members of a structure named "students". Display the name and corresponding age of the students sorted in an alphabetical order. [8]
9. What are the inputs and outputs functions used with data files? Explain, error handling process during reading and writing in a data files. [5+3]
10. Write a program in ForTran to test whether the accepted year is leap year, or not. (Hint: A year is leap year if: the year is divisible by 4, but not by 100 or the year is divisible by 400) [8]



Examination Control Division

2068 Shrawan

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1. Define algorithm. Write an algorithm for finding largest and smallest values from a list. [2+6]
2. Draw a flowchart and algorithm to find roots of a quadratic equation ($ax^2 + bx + c = 0$). Include all three conditions of the determinant. [10]
3. Write a program to read values from user and find sum until user types 0, also display sum and average. [8]
4. Why programmers prefer using user defined functions? What is merits and demerits of using functions in program? Differentiate actual and formal parameters used in functions. [3+2+3]
5. Write a program to take a list of values from user into an array. Pass the list to a function which sorts the values in ascending order. Display the sorted list from main program. [3+5]
6. Write a program to represent complex number by a structure with real and imaginary as members. Take 2 complex numbers as input from user into structure variables. Pass the complex numbers to a function which calculates sum and returns it. Display the sum from another function display(). [10]
7. What is the role of pointers in passing parameters to functions by reference? Give example, how 2 dimensional array can be accessed by a pointer. [4+4]
8. What do you mean by opening a data file? How is this accomplished? Explain fscanf, fprintf, fread, fwrite functions. [1+3+4]
9. Explain the structure of a FORTAN program. Differentiate between arithmetic and logical if statement. [2+2]
10. Write a program in FORTAN to read two matrices from user, find their sum and display the sum. [8]



8. Rewrite program correctly and write output of the given program written in C programming language below:

[8]

```
#include <stdio.h>
#include <conio.h>
#include <string.h>
void main()
{
    char ar1[11] = {'I','o','E',' ','P','U','L','C','H','O','W','K'};
    char ar2[15] = "IoE, Pulchowk";
    char ar3[11] = {{'I'},{'O'},{'E'},
    {' ','P','U','L','C','H','O','W','K'};
    clrscr();
    printf("\nArray 1 = %c\n", ar1);
    printf("\nArray 2 = %c\n", ar2);
    printf("\nArray 1 = %c\n", ar3);
    return 0
}
```

9. Describe the formatted input and output statement in FORTRAN programming language with its syntax.

[4]

10. Write a program in FORTRAN to evaluate the following series:

[8]

$$\text{series} = 1/1^1 + 1/2^2 + 1/3^2 + \dots + 1/n^2$$

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Subject - Computer Programming I

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1. a) What are the demerits of C programming? Flowchart is representation of an algorithm. Justify the statement with suitable example. [2+2]
 b) Draw a flowchart and then write a program to read three sides of a triangle and print area for valid data and to print "Invalid data" if either one side of triangle is greater or equals to the sum of other two sides. [Area = $\sqrt{s(s-a)(s-b)(s-c)}$], where a, b, c are three sides and $s = (a + b + c) / 2$. [4]
2. a) Describe the meaning of precedence and associativity of operators with suitable example. How much memory is required for long integer and its range? [2+4]
 b) Write a program in C to calculate the sum of given series up to the term given by the user. [4]

$$Y = 1/2 - 2/x^2 + 3/x^3 - \dots$$
3. a) Distinguish between call by value and call by reference with example in C. [2]
 b) Write a program in C to find trace and norm of a matrix. Trace is defined as the sum of principal diagonal element; Norm is defined as square root of the sum of the square of all the elements in matrix. [6]
4. a) Classify the variable according to the scope and extent (storage class) with C. [2]
 b) Write a program in C which calculates F, where $F = (a * b^n) / c!$ and n is an integer. For designing above program, use two functions, one calculates factorial and other calculates power of a number. [6]
5. a) Why pointer operator is called indirection operator? Give example. [3]
 b) Write a C program to check whether the given string is palindrome or not. Palindrome should be checked by user defined function. [5]
6. a) What are the differences between malloc () and calloc (). When we use realloc (). [2+1]
 b) Write a C program to read n integer numbers in an array dynamically and create two functions to sort in ascending and descending order and display the result in the main function. [5]
7. a) Discuss how array of strings can be stored in array of pointer variable. [3]
 b) Write a C program to enter the strings until the user enters "end" and display the list of string in alphabetical order using two dimensional array of character using function. [5]

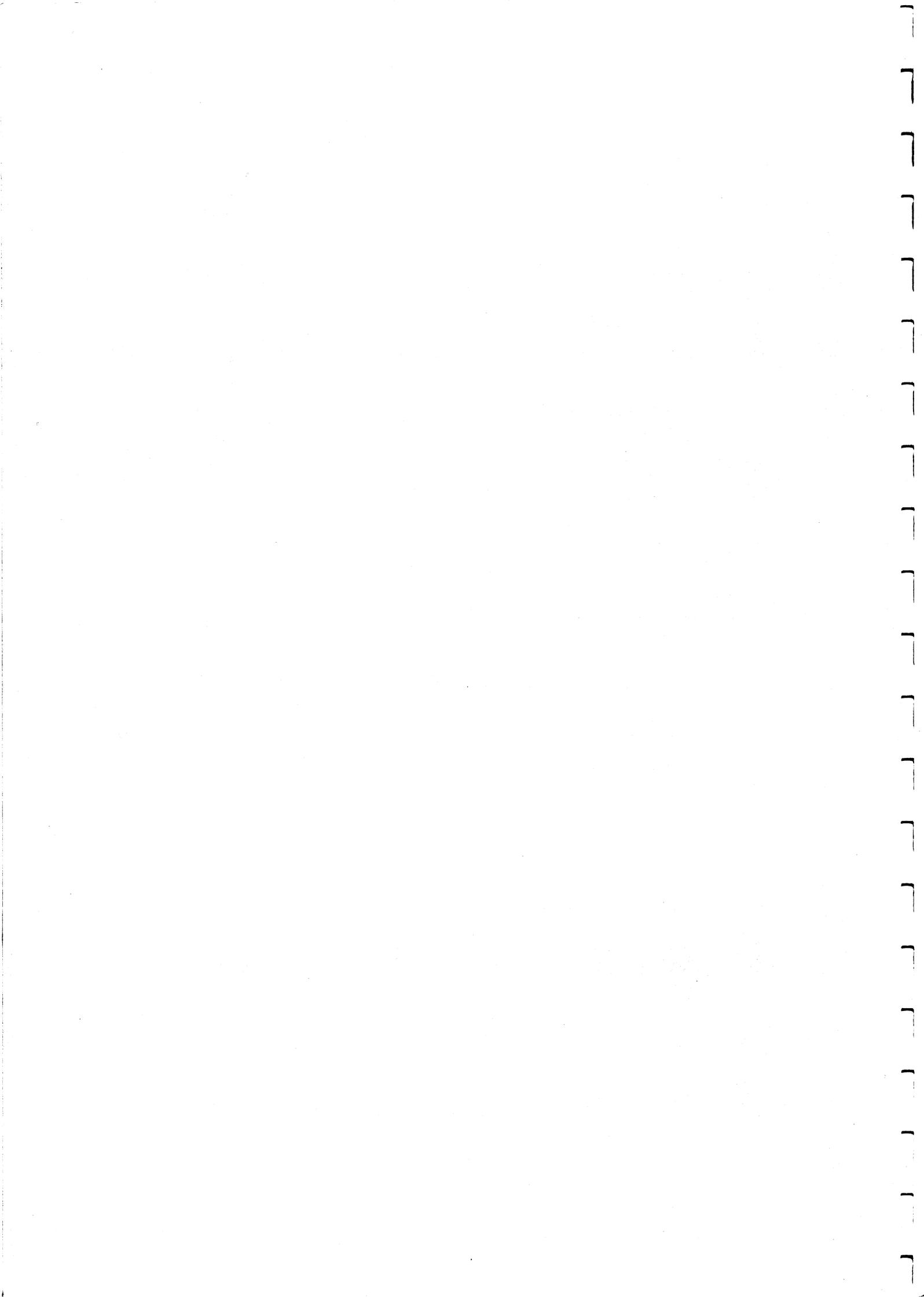
8. a) Explain nested structure in C, with example. [3]
b) Write a C program that illustrates the pointer pointing to the function. [5]
9. a) How can we pass structure variable as a parameter in function. Illustrate with an example. [2]
b) Create a structure Student(Roll, Name, Address, Age) to store 10 different records of students and another structure Marks_Sheet(SN, Subject_Name, Full_Marks, Pass_Marks, Marks_Obtained) within Student to store the records of 5 different subjects. Write a program to enter the records of students and display the records with the percentage each student have scored. [6]
10. a) In which condition unary operator is equivalent to assignment operator. Explain with examples. [2]
b) Write a program in-C to create a file named "subject.txt" that stores subject name, subject code and full marks where subject name and subject codes are strings and full marks is float. Also display all the records stored in the file. Write a program to keep the records of 10 subjects and display all records from the file. [6]

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1. a) Why is C programming most commonly used in simulation? Do you agree that the compiler can produce the executable file directly itself? Elaborate your answer. [2+2]
- b) Write an algorithm and a flowchart to read a five digit number and check whether the number is a palindrome or not. [2+2]
2. a) List different operators with their corresponding associativity in C. Mention the size and range of signed long int and float. [2+1]
- b) Write an interactive program that reads positive numbers until user enters "no" and then sum the numbers divisible by 4 that lie between the range of 10 and 50 and finally display the count and the average value. [5]
3. a) Illustrate the formatted I/O string data. Why don't good programmers prefer goto-statement? Compare switch over else if-ladder. [1+1+1]
- b) Write a program using recursion to compute the sum of the following series: [5]
 $1^2 - 2^2 + 3^2 - 4^2 \dots + (-1)^{n+1} n^2$ without using pow() function. You should read the value of n from the user.
4. a) How does a function optimize resources at the programmer and the machine side? How does a function return value? Illustrate with example. [1+2]
- b) Write a program to read number and call a function till 'yes' is entered by the user. You should count and sum the numbers using static variables in the function and return the average to the main function. [5]
5. a) Compare array with pointer syntactically and physically. [2]
- b) Write a program to compute the determinant of a square matrix of nth order and then check whether the given matrix is singular or not. You need to have two functions as read () and process (). [6]
6. a) Why do we need DMA? Explain the significance of calloc() with example. [1+1]
- b) Write a program that reads positive integer numbers into an array dynamically and pass them to a function where odd numbers are filtered into another array and display the array containing odd numbers in the main function. [6]
7. a) Mention the applications of pointer. Illustrate the invalid and valid pointer arithmetic on both data variable and pointer variable. [1+1]
- b) Write a program that dynamically allocates two different strings and pass them to a function where the second string is compared with the reverse of the first string on the character basis and display the message in the main function. You are not allowed to use the string functions. [6]
8. a) Illustrate the self referential structure and the position pointer. [1+1]
- b) Write a program that illustrates passing function address to other functions directly and using pointer. [6]
9. a) Sketch the bits assignment in a structure if you have 7 bit fields of 5 bits length each. Justify the bytes consumption by above structure with reasoning. [2]
- b) Write a program to compute any two instant memory spaces in a format (Kilobytes: Bytes: Bits) using structure. Build functions to add and subtract given memory spaces where 1KB = 1024 B and 1B=8 bits and display the results in the main function. [6]
10. a) Differentiate Text versus Binary mode of file. [2]
- b) Write a program that first appends the customer records in a binary file and display the number of customer records as well as the contents from the file. The file name should be given by user and display message if it does not exit. [6]



Exam.	New Back (2066 & Later Batch)		
Level	BE	Full Marks	80
Programme	All (Except B.Arch)	Pass Marks	32
Year / Part	I / I	Time	3 hrs.

Subject: - Engineering Mathematics I (SH401)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ All questions carry equal marks.
- ✓ Assume suitable data if necessary.

1. If $y = (\sin^{-1} x)^2$ then show that:

i) $(1-x^2)y_2 - xy_1 - 2 = 0$

ii) $(1-x^2)y_{n+2} - (2n+1)xy_{n+1} - n^2 y_n = 0$

2. State Rolle's Theorem and verify the theorem for $f(x) = \frac{x(x+3)}{e^{x/2}}$; $x \in [-3, 0]$

3. Evaluate: $\lim_{x \rightarrow 0} \left(\frac{\tan x}{x} \right)^{1/x}$

4. Find the asymptotes of the curve: $(a+x)^2(b^2+x^2) = x^2 y^2$

5. Find the pedal equation of the curve $r^2 = a^2 \cos 2\theta$

6. Evaluate $\int_0^{\pi/4} \frac{(\sin x + \cos x)}{(9+16 \sin 2x)} dx$

7. Use Beta Gamma function to evaluate $\int_0^{2a} x^5 \sqrt{2ax - x^2} dx$

8. Evaluate by using the rule of differentiation under the sign of integration.

$$\int_0^{\infty} \frac{e^{-x} \sin bx}{x} dx$$

9. Find the area of one loop of the curve $r = a \sin 3\theta$

OR

Find the volume of the solid formed by the revolution of the cardioid $r = a(1 + \cos \theta)$ about the initial line.

Find center and eccentricity of conic $x^2 + 4xy + y^2 - 2x + 2y - 6 = 0$

OR

Describe and sketch the graph of the equation $r = \frac{10}{3 + 2 \cos \theta}$

10. Find the condition that the line $lx + my + n = 0$ may be a normal to the ellipse

$$\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$$

11. Show that the pair of tangents drawn from the center of a hyperbola are its asymptotes.

12. Solve the differential equation: $\frac{dy}{dx} = \frac{y}{x} + \tan \frac{y}{x}$

13. Solve: $y - 2px + ayp^2 = 0$ where $p = \frac{dy}{dx}$

14. Solve the differential equation: $x \frac{dy}{dx} + y \log y = xye^x$

15. Solve the differential equation: $x^2 \frac{d^2y}{dx^2} + x \frac{dy}{dx} - 4y = x^2$

Exam.	New Back (2066 & later batch)		
Level	BE	Full Marks	80
Programme	All (Except B.Arch)	Pass Marks	32
Year / Part	I / I	Time	3 hrs.

Subject: - Engineering Mathematics I (SH401)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

1. If $y = \log(x + \sqrt{a^2 + x^2})$, then show that $(a^2 + x^2)y_{n+2} + (2n+1)xy_{n+1} + n^2y_n = 0$ [5]

2. State and prove Lagrange's Mean Value theorem. [5]

3. Evaluate: $\lim_{x \rightarrow 0} \prod (\sin x)^{\tan x}$ [5]

4. Find the asymptote of the curve $a^2y^2 + x^2y^2 - a^2x^2 + 2ax^3 - x^4 = 0$ [5]

5. Find the radius of curvature at the origin for the curve $x^3 + y^3 = 3axy$

6. Evaluate $\int_0^a \frac{\sqrt{x}}{\sqrt{x} + \sqrt{a-x}} dx$ [5]

7. Apply differentiation under integral sign to evaluate $\int_0^\infty \frac{e^{-ax} - e^{-bx}}{x} dx$ [5]

8. Using Gamma function show that $\int_0^{\frac{\pi}{4}} \sin^4 x \cos^2 x dx = \frac{3\pi - 4}{192}$ [5]

9. Find the area bounded by the curve $x^2 = 4y$ and the line $x = 4y - 2$

OR

Find the volume of the solid generated by the revolution of the cardioid $r = a(1 - \cos\theta)$ about the initial line.

10. Solve: $\sin x \frac{dy}{dx} + y \cos x = x \sin x$ [5]

11. Solve: $xp^2 - 2yp + ax = 0$ where $p = \frac{dy}{dx}$ [5]

12. Solve: $\frac{d^2y}{dx^2} - 2\frac{dy}{dx} + y = x^2e^{3x}$ [5]

13. Solve: $x^2 \frac{d^2y}{dx^2} - x \frac{dy}{dx} + y = \log x$ [5]

14. Transform the equation $x^2 - 2xy + y^2 + x - 3y = 0$ to axes through the point $(-1, 0)$ parallel to the lines bisecting the angles between the original axes. [5]

15. Find the center, length of axes and the eccentricity of the ellipse $2x^2 + 3y^2 - 4x - 12y + 13 = 0$ [5]

16. Find the length of axes and eccentricity of the conic [5]

$$14x^2 - 4xy + 11y^2 - 44x - 58y + 71 = 0$$

OR

Describe and sketch the conic $r = \frac{12}{2 - 6\cos\theta}$



01 TRIBHUVAN UNIVERSITY
 INSTITUTE OF ENGINEERING
Examination Control Division
 2071 Chaitra

Exam.	Regular		
Level	BE	Full Marks	80
Programme	All (Except B.Arch)	Pass Marks	32
Year / Part	I / I	Time	3 hrs.

Subject: - Engineering Mathematics I (SH401)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ All questions carry equal marks.
- ✓ Assume suitable data if necessary.

1. State Leibniz's theorem on Leibniz derivatives:

If $y = \sin(m \sin^{-1} x)$ then show that

$$(1-x^2)y_{n+2} - (2n+1)xy_{n+1} + (m^2-n^2)y_n = 0$$

2. Assuming the validity of expansion, find the expansion of the function $\frac{e^x}{1+e^x}$ by Maclaurin's theorem.
3. Evaluate $\lim_{x \rightarrow 0} \frac{xe^x - (1+x)\log(1+x)}{x^2}$
4. Find the asymptotes of the curve $y^3 + 2xy^2 + x^2y - y + 1 = 0$
5. Find the radius of curvature of the curve $y = x^2(x-3)$ at the points where the tangent is parallel to x-axis

OR

Find the pedal equation of the curve $r^2 = a^2 \cos 2\theta$

6. Show that $\int_0^a \frac{dx}{x + \sqrt{a^2 - x^2}} = \frac{\pi}{4}$

7. Apply differentiation under integral sign to evaluate $\int_0^{\pi/2} \frac{dx}{(a^2 \sin^2 x + b^2 \cos^2 x)^2}$

8. Use gamma function to prove that $\int_0^1 \frac{dx}{(1-x^6)^{1/6}} = \pi/3$

9. Find the volume or surface area of solid generated by revolving the cycloid $x = a(\theta + \sin\theta)$, $y = a(1 + \cos\theta)$ about its base.

10. If the line $lx+my+n=0$ is normal to the ellipse $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$ then show that

$$\frac{a^2}{l^2} + \frac{b^2}{m^2} = \frac{(a^2 - b^2)^2}{n^2}$$

11. Solve the locus of a point which moves in such a way that the difference of its distance from two fixed points is constant is Hyperbola.

12. Solve the differential equation $x \frac{d^2y}{dx^2} + 2 \frac{dy}{dx} = 6x$

13. Solve $(x^2D^2 + xD + 1)y = \sin(\log x^2)$

14. Solve $y = yp^2 + 2px$ where $p = \frac{dy}{dx}$

15. Solve: $\frac{d^2y}{dx^2} + 3 \frac{dy}{dx} + 2y = e^{2x} \sin x$

16. Describe and sketch the graph of the equation $r = \frac{10}{2 - 3 \sin \theta}$

OR

Show that the conic section represented by the equation

$14x^2 - 4xy + 11y^2 - 44x - 58y + 71 = 0$ is an ellipse. Also find its center, eccentricity, latus rectum and foci

Exam.	New Back (2066 & Later Batch)		
Level	BE	Full Marks	80
Programme	All (Except B.Arch)	Pass Marks	32
Year / Part	I / I	Time	3 hrs.

Subject: - Engineering Mathematics I (SH401)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

1. If $y = \log(x + \sqrt{a^2 + x^2})$, then show that $(a^2 + x^2)y_{n+2} + (2n+1)xy_{n+1} + n^2y_n = 0$ [5]

2. State and prove Logrange's Mean Value theorem. [5]

3. Evaluate: $\lim_{x \rightarrow \pi} (\sin x)^{\tan x}$ [5]

4. Find the asymptote of the curve $a^2y^2 + x^2y^2 - a^2x^2 + 2ax^3 - x^4 = 0$ [5]

5. Find the radius of curvature at the origin for the curve $x^3 + y^3 = 3axy$

6. Evaluate $\int_0^a \frac{\sqrt{x}}{\sqrt{x} + \sqrt{a-x}} dx$ [5]

7. Apply differentiation under integral sign to evaluate $\int_0^\infty \frac{e^{-ax} - e^{-bx}}{x} dx$ [5]

8. Using Gamma function show that $\int_0^{\frac{\pi}{4}} \sin^4 x \cos^2 x dx = \frac{3\pi - 4}{192}$ [5]

9. Find the area bounded by the curve $x^2 = 4y$ and the line $x = 4y - 2$

OR

Find the volume of the solid generated by the revolution of the cardioid $r = a(1 - \cos\theta)$ about the initial line.

10. Solve: $\sin x \frac{dy}{dx} + y \cos x = x \sin x$ [5]

11. Solve: $xp^2 - 2yp + ax = 0$ where $p = \frac{dy}{dx}$ [5]

12. Solve: $\frac{d^2y}{dx^2} - 2\frac{dy}{dx} + y = x^2e^{3x}$ [5]

13. Solve: $x^2 \frac{d^2y}{dx^2} - x \frac{dy}{dx} + y = \log x$ [5]

14. Transform the equation $x^2 - 2xy + y^2 + x - 3y = 0$ to axes through the point $(-1, 0)$ parallel to the lines bisecting the angles between the original axes. [5]

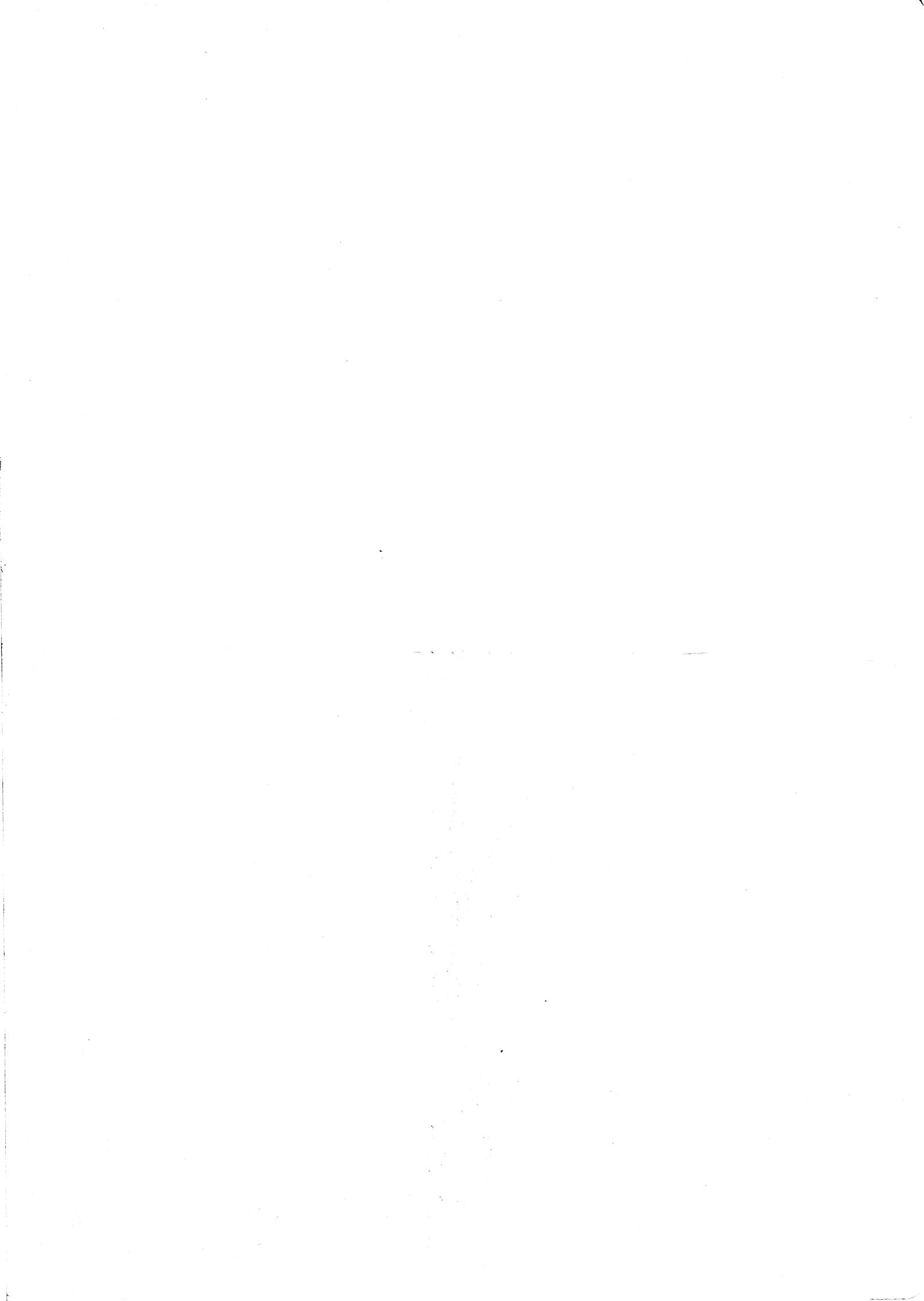
15. Find the center, length of axes and the eccentricity of the ellipse $2x^2 + 3y^2 - 4x - 12y + 13 = 0$ [5]

16. Find the length of axes and eccentricity of the conic [5]

$$14x^2 - 4xy + 11y^2 - 44x - 58y + 71 = 0$$

OR

Describe and sketch the conic $r = \frac{12}{2 - 6\cos\theta}$



2070 Chaitra

Exam.	Regular		
Level	BE	Full Marks	80
Programme	All (Except B.Arch)	Pass Marks	32
Year / Part	I / I	Time	3 hrs.

Subject: - Engineering Mathematics I (SH401)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ All questions carry equal marks.
- ✓ Assume suitable data if necessary.

✓ 1. If $Y = \sin(m \sin^{-1}x)$, then show that $(1-x^2)y_{n+2} - (2n+1)xy_{n+1} + (m^2 - n^2)y_n = 0$

2. Apply Maclaurin's series to find the expansion of $\frac{e^x}{1+e^x}$ as far as the term in x^3

3. Evaluate: $\lim_{x \rightarrow a} \left(2 - \frac{x}{a}\right)^{\tan \frac{\pi x}{2a}}$

4. Find the asymptotes of the curve $x(x-y)^2 - 3(x^2 - y^2) + 8y = 0$

5. Find the pedal equation of the curve $x^{\frac{2}{3}} + y^{\frac{2}{3}} = a^{\frac{2}{3}}$

6. Apply the method of differentiation under integral sign to evaluate $\int_0^{\infty} \frac{\log(1+a^2x^2)}{1+b^2x^2} dx$

7. Show that $\int_0^{\infty} \frac{\log(1+x^2)}{1+x^2} dx = \pi \log 2$

8. Use Gamma function to prove that $\int_0^1 \frac{dx}{(1-x^6)^{\frac{1}{6}}} = \frac{\pi}{3}$

9. Find the area of two loops of the curve $a^2y^2 = a^2x^2 - x^4$

OR

Find the volume of the solid formed by the revolution of the cycloid $x = a(\theta + \sin\theta)$, $y = a(1 - \cos\theta)$ about the tangent at the vertex.

✓ 10. Solve the differential equation $(1+y^2) + (x - e^{\tan^{-1}y}) \frac{dy}{dx} = 0$

✓ 11. Solve: $y - 3px + ayp^2 = 0$

✓ 12. Solve: $(D^2 - 2D + 5)y = e^{2x} \cdot \sin x$

13. A resistance of 100 Ohms, an inductance of 0.5 Henry are connected in series with a battery 20 volts. Find the current in the circuit as a function of time.

14. What does the equation $3x^2 + 3y^2 + 2xy = 2$ becomes when the axes are turned through an angle 45° to the original axes.

15. Show that the locus of a point which moves in such a way that the differences of its distance from two fixed points is constant is a hyperbola.

16. Find the center, length of the axes and eccentricity of the conic $2x^2 + 3y^2 - 4x - 12y + 13 = 0$

OR

Describe and sketch the graph of the polar equation of conic $r = \frac{10 \operatorname{cosec}\theta}{2 \operatorname{cosec}\theta + 3}$

Handwritten notes and diagrams at the bottom of the page, including sketches of conic sections and calculations.

Handwritten notes and diagrams at the bottom right of the page, including a sketch of a hyperbola and calculations.

Exam.	Regular		
Level	BE	Full Marks	80
Programme	All (Except B.Arch)	Pass Marks	32
Year / Part	I / I	Time	3 hrs.

Subject: - Engineering Mathematics I (SH401)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ All questions carry equal marks.
- ✓ Assume suitable data if necessary.

1. If $y = \log(x + \sqrt{a^2 + x^2})$ show that $(a^2 + x^2)y_{n+2} + (2n+1)xy_{n+1} + n^2y_n = 0$
2. State and prove Lagrange's Mean Value theorem.
3. If $\lim_{x \rightarrow 0} \frac{a \sin x - \sin 2x}{\tan^3 x}$ is finite, find the value of a and the limit.
4. Find asymptotes of $(x^2 - y^2)^2 - 2(x^2 + y^2) + x - 1 = 0$
5. Find the radius of curvature at any point (x, y) for the curve $x^{2/3} + y^{2/3} = a^{2/3}$
6. Prove that $\int_0^{\infty} \frac{\sin bx}{x} dx = \frac{\pi}{2} (b > 0)$
7. Use Beta and Gamma function to evaluate $\int_0^{2a} x^5 \sqrt{2ax - x^2} dx$
8. Evaluate $\int_0^{\infty} \frac{e^{-x} \sin bx}{x} dx$ by using the rule of differentiation under the sign of integration.
9. Find the volume of the solid formed by the revolution of the cardioid $r = a(1 + \cos\theta)$ about initial line.

OR

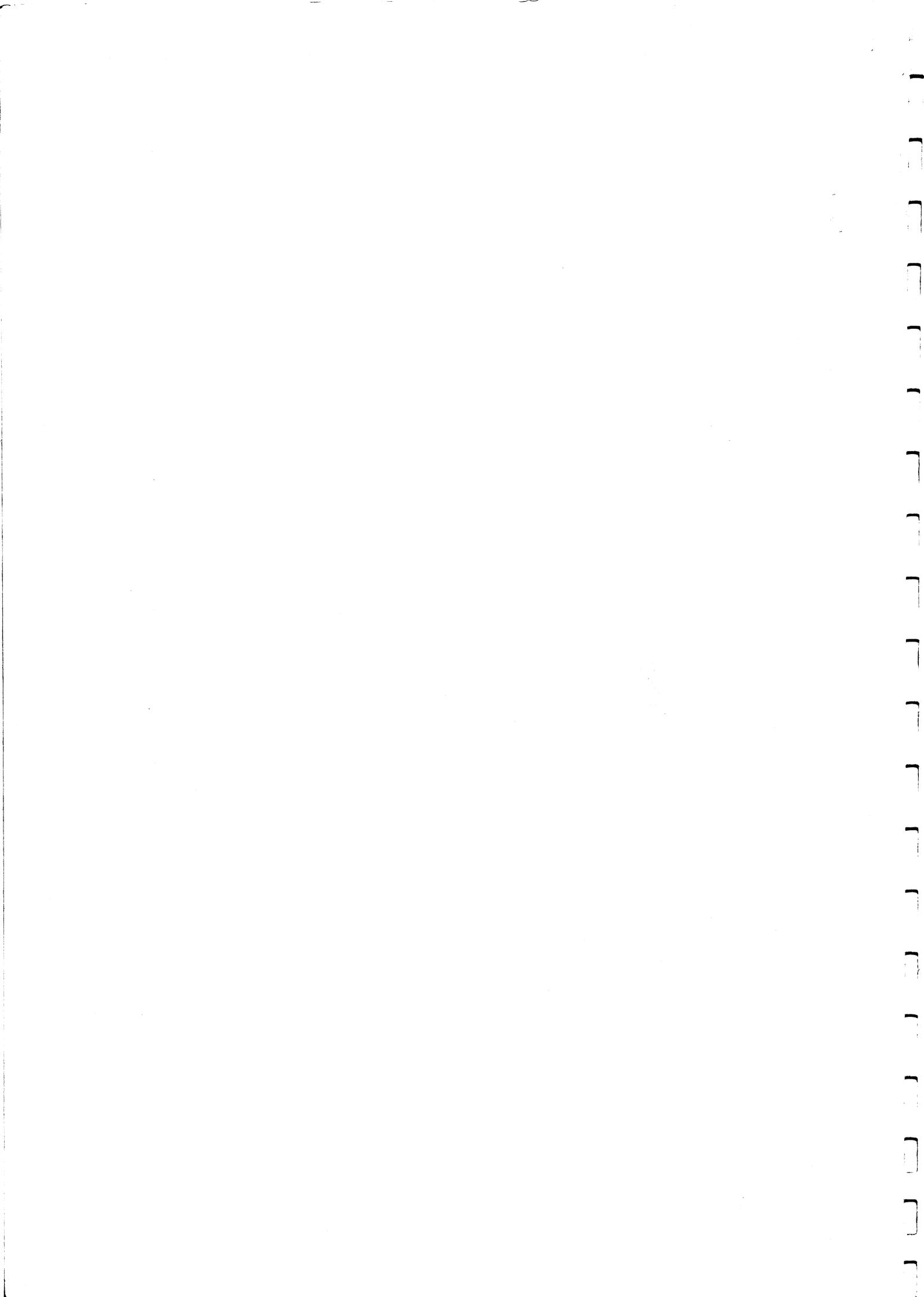
Find the area bounded by the curve $x^2y = a^2(a - y)$ and the x-axes.

10. Solve the differential equation $\frac{dy}{dx} = \frac{y}{x} + \tan \frac{y}{x}$
11. Solve the differential equation $x \frac{dy}{dx} + y \log y = xye^x$
12. Solve the differential equation $\frac{d^2y}{dx^2} + 2 \frac{dy}{dx} = e^x + e^{-x}$
13. Solve $y = px - \sqrt{m^2 + p^2}$ where $p = \frac{dy}{dx}$

OR

A resistance of 100 ohms, an inductance of 0.5 henry are connected in series with a battery of 20 volts. Find the current in the circuit as a function of time.

14. Solve that locus of a point which moves in such a way that the differences of its distance from two fixed points is constant is Hyperbola.
15. Find the equation of ellipse of the form $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$ where $a > b$
16. Describe and sketch the graph of the equation $r = \frac{4 \sec \theta}{2 \sec \theta - 1}$



Exam.	New Back (2066 Batch & Later)		
Level	BE	Full Marks	80
Programme	All (Except B.Arch.)	Pass Marks	32
Year / Part	I / I	Time	3 hrs.

Subject: - Engineering Mathematics I

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ All questions carry equal marks.
- ✓ Assume suitable data if necessary.

1. If $y = \log(x + \sqrt{a^2 + x^2})$, show that $(a^2 + x^2)y_{n+2} + (2n + 1)xy_{n+1} + n^2y_n = 0$.
2. State and prove Lagrange's mean value theorem.

3. Evaluate: $\lim_{x \rightarrow 0} \left(\frac{\tan x}{x} \right)^{1/x}$.

4. Find the asymptotes of the curve $(x^2 - y^2)(x + 2y + 1) + x + y + 1 = 0$.

5. Show that for the ellipse $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$, the radius of curvature at the extremity of the major axis is equal to half of the latus rectum.

6. Evaluate: $\int_0^{\pi/2} \frac{dx}{1 + \sqrt{\tan x}}$.

7. Use Gamma function to prove that $\int_0^1 \frac{dx}{(1-x^6)^{1/6}} = \frac{\pi}{3}$.

8. Using method of differentiation under integral sign, evaluate: $\int_0^{\infty} \frac{e^{-x} \sin bx}{x} dx$.

9. Find the area bounded by the cardioid, $r = a(1 + \cos\theta)$.

OR

Find the volume of the solid formed by revolving the cycloid $x = a(\theta + \sin\theta)$, $y = a(1 + \cos\theta)$ about its base.

10. Find the angle through which the axes must be turned so that the equation $ax^2 + 2hxy + by^2 = 0$ may become an equation having no term involving xy .

11. Obtain the equation of an ellipse in the standard form.

12. Find the centre of the conic $3x^2 + 8xy - 3y^2 - 40x - 20y + 50 = 0$.

13. Solve the differential equation $(x + y + 1) \frac{dy}{dx} = 1$.

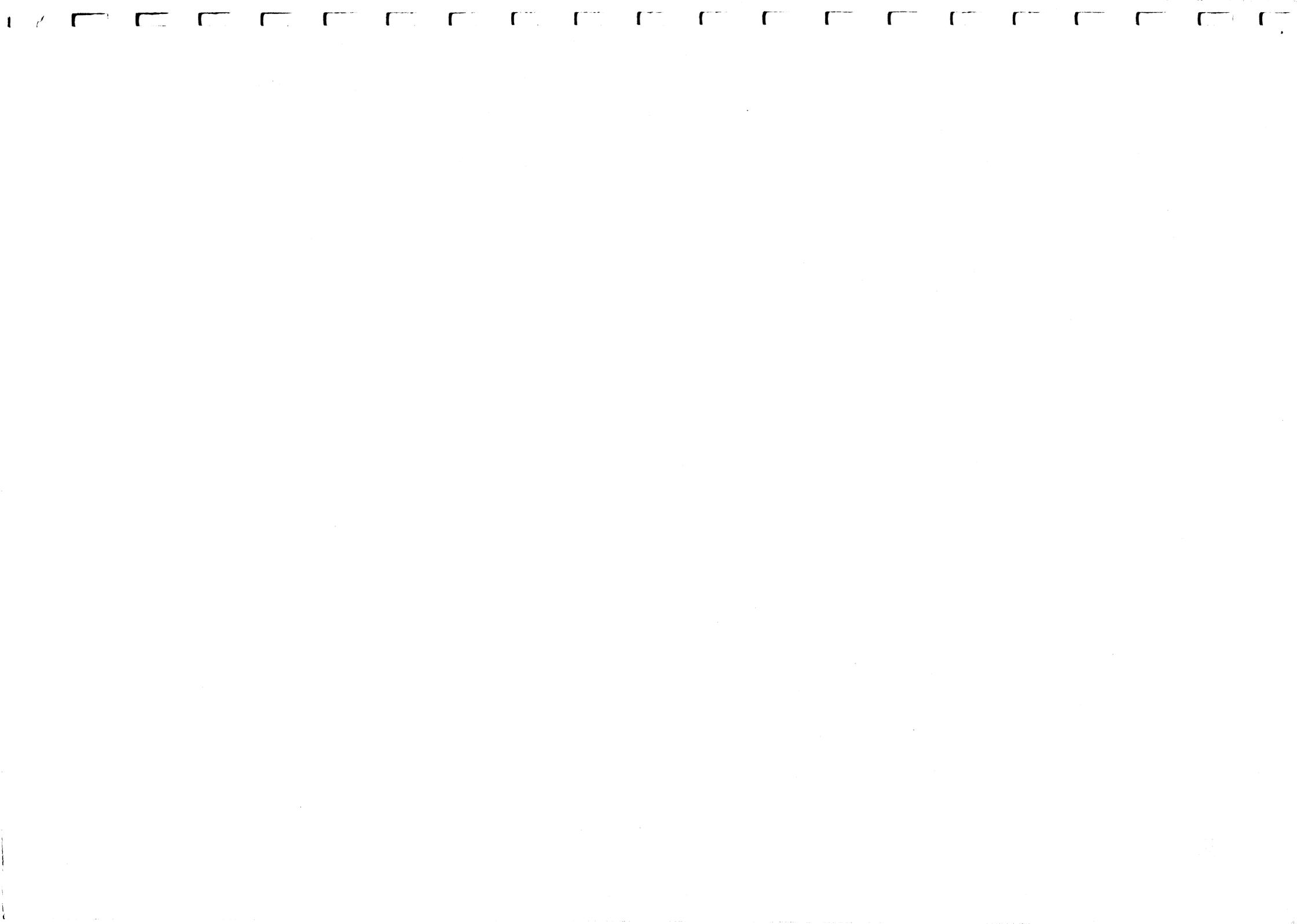
14. Find the general solution of the differential equation: $p^3 - 4xyp + 3y^2 = 0$.

15. Find the general solution of the differential equation: $(D^2 + 2D + 1)y = e^x \cos x$.

16. Newton's law of cooling states that "The temperature of an object changes at a rate proportional to the difference of temperatures between the object and its surroundings". Supposing water at a temperature 100°C cools to 80°C in 10 minutes, in a room maintained at 30°C , find when the temperature of water will become 40°C .

OR

Solve: $x^2 \frac{d^2y}{dx^2} - 4x \frac{dy}{dx} + 6y = x$



Exam. Level	Regular / Back		
	BE	Full Marks	80
Programme	All (Except B.Arch.)	Pass Marks	32
Year / Part	I / I	Time	3 hrs.

Subject: - Engineering Mathematics I

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ All questions carry equal marks.
- ✓ Assume suitable data if necessary.

1. If $y = a \cos(\log x) + b \sin(\log x)$. Prove that $x^2 \cdot y_{n+2} + (2n+1)x \cdot y_{n+1} + (n^2 + 1)y_n = 0$.
2. State and prove Rolle's theorem.

3. Determine the values of a, b, c, so that $\lim_{x \rightarrow 0} \frac{(a + b \cos x)x - c \cdot \sin x}{x^5} = 1$.

4. Find the asymptotes of the curve $(x + y)^2(x + 2y + 2) = x + 9y - 2$.

5. If e_1 and e_2 be the radii of curvature at the ends of a focal chord of the parabola $y^2 = 4ax$, prove that $e_1^{-2/3} + e_2^{-2/3} = (2a)^{-2/3}$.

6. Prove that $\int_0^{\pi} \frac{x \tan x}{\sec x + \cos x} dx = \frac{\pi^2}{4}$.

7. Apply the method of differentiation under integral sign to prove:

$$\int_0^{\pi/2} \frac{dx}{(a^2 \sin^2 x + b^2 \cos^2 x)^2} = \frac{\pi(a^2 + b^2)}{4a^3b^3}$$

8. Use Gamma function to prove that $\int_0^1 \frac{dx}{(1-x^6)^{1/6}} = \frac{\pi}{3}$.

9. Find the area bounded by the curve $x^2y = a^2(a-y)$ and the x axis.

OR

Find the volume of the solid formed by revolving the cycloid $x = a(\theta + \sin\theta)$, $y = a(1 + \cos\theta)$ about its base.

10. Solve the differential equation: $(1 + y^2) + (x - e^{\tan^{-1}y}) \frac{dy}{dx} = 0$.

11. Solve: $xy^2(p^2 + 2) = 2py^3 + x^3$

12. solve: $(D^2 - 2D + 5)y = e^{2x} \cdot \sin x$

13. Solve the differential equation: $x^2 \frac{d^2y}{dx^2} + 4x \frac{dy}{dx} + 2y = e^x$

14. What does the equation $3x^2 + 3y^2 + 2xy = 2$ becomes when the axes are turned through an angle 45° to the original axis.

OR

Describe and Sketch the graph of the conic $r = \frac{10 \cos e\theta}{2 \cos e\theta + 3}$.

15. Derive the equation of Ellipse in the standard form.

16. Find the equation of tangents to the hyperbola $3x^2 - 4y^2 = 12$ which are perpendicular to the line $x - y + 2 = 0$. Also find the point of contact.

Exam.	Regular/Back		
Level	BE	Full Marks	80
Programme	All (Except B.Arch.)	Pass Marks	32
Year / Part	I / I	Time	3 hrs.

Subject: - Engineering Mathematics I

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

1. If $y = e^{a \tan^{-1} x}$, prove that $(1 + x^2)y_{n+2} + (2nx + 2x - a)y_{n+1} + n(n + 1)y_n = 0$. 5

2. State and prove Lagrange's mean value theorem.

3. Evaluate $\lim_{x \rightarrow 0} \left(\frac{\sin x}{x} \right)^{\frac{1}{x}}$

4. Find the asymptotes of the curve $(x + y)^2(x + 2y + z) = x + 9y - 2$.

5. Find the radius of curvature of the curve $r = a(1 - \cos\theta)$.

6. Apply the method of differentiation under integral sign to evaluate $\int_0^{\infty} \frac{\tan^{-1}(ax)}{x(1+x^2)} dx$.

7. Prove that $\int_0^{\pi/2} \frac{\sin^2 x dx}{\sin x + \cos x} = \frac{1}{\sqrt{2}} \log(\sqrt{2} + 1)$.

8. Use Gamma function to prove $\int_0^{\pi/6} \cos^4 3\theta \sin^2 6\theta = \frac{5\pi}{192}$. 5

9. Find, by method of integration, the area of the loop of the curve $ay^2 = x^2(a - x)$.

10. Solve the differential equation $(1 + x^2) \frac{dy}{dx} + y = e^{\tan^{-1} x}$. 5

11. Solve $y = yp^2 + 2px$, where $p = dy/dx$. 5

12. Solve $(D^2 - 3D + 2)y = x^2 + x$. 5

13. Newton's law of cooling states that the temperature of an object changes at a rate proportional to the difference of temperature between the object and its surroundings. Supposing water at 100°C cools to 80°C in 10 minutes, in a room temperature of 30°C, find when the temperature of water will become 40°C?

OR

Solve the differential equation $x^2 \frac{d^2 y}{dx^2} - x \frac{dy}{dx} + y = \log x$.

14. Find the condition that the line $lx + my + n = 0$ may be the tangent to the ellipse $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$. 5

15. Derive the equation of a hyperbola in standard form. 5

16. Find the centre, length of axes and eccentricity of the conic $2x^2 + 3y^2 - 4x - 12y + 13 = 0$.

OR

Identify and sketch the conic $r = \frac{10}{3 + 2 \cos \theta}$.

Exam.	Regular / Back		
Level	BE	Full Marks	80
Programme	All (Except B.Arch.)	Pass Marks	32
Year / Part	I / I	Time	3 hrs.

Subject: - Mathematics I

- ✓ Candidates are required to give their answers in their own words as far as practicable.
 ✓ Attempt All questions.
 ✓ The figures in the margin indicate Full Marks.
 ✓ Assume suitable data if necessary.
- ✓ Find the angle of intersection of the pair of curves $r^n = a^n \cos n\theta$ and $r^n = a^n \sin n\theta$. [5]
- OR
- If $y = a \cos(\log x) + b \sin(\log x)$. Prove that $x^2 y_{n+2} + (2n+1)x y_{n+1} + (x^2 + 1)y_n = 0$
- ✓ State Rolle's theorem and verify it for the function $f(x) = x(x+3)e^{-(x/2)}$, $x \in [-3, 0]$ [5]
3. Evaluate: $\lim_{x \rightarrow 0} \frac{(1+x)^{1/x} - e}{x}$ [1+4]
- ✓ 4. A cone is circumscribed to a sphere of radius r . Show that when the volume of the cone is least its altitude is $4r$ and its semivertical angle is $\sin^{-1}(1/3)$. [5]
- ✓ 5. Find the asymptotes of the curve $(x+y)^2(x+2y+2) = x+9y-2$. [5]
- OR
- Find the radius of curvature at any point (x, y) for the curve $x^{2/3} + y^{2/3} = a^{2/3}$.
6. Integrate any three [10]
- a) $\int \frac{x.e^x}{(1+x)^2} .dx$ b) $\int_0^1 \frac{\log(1+x)}{1+x^2} .dx$
- c) $\int_{-\infty}^{\infty} \frac{e^x}{1+e^{2x}} .dx$ d) $\int_0^{\pi/2} \frac{\sqrt{\cot x}}{1+\sqrt{\cot x}} .dx$
7. Evaluate $\int_1^4 x^3 dx$ by the method of summation. [5]
8. Obtain reduction formula for $\int \cot^n x dx$ and hence integrate $\int \cot^7 x dx$. [3]
- OR
- Using Gamma function show that $\int_0^{\infty} e^{-x^4} .x^2 dx \times \int_0^{\infty} e^{-x^4} .dx = \frac{\pi}{8\sqrt{2}}$
9. Find the area bounded by the cardioid $r = a(1 + \cos\theta)$ [5]
- OR
- Find the volume of the solid formed by revolving the cycloid $x = a(\theta + \sin\theta)$, $y = a(1 + \cos\theta)$ about its base.
10. Solve any three of the following differential equations. [15]
- a) $x dy - y dx = \sqrt{x^2 + y^2} .dx$ b) $x \frac{dy}{dx} + y \log y = xy.e^x$
- c) $y - 2px + ap^2.y = 0$ d) $(D^2 - 3D + 2)y = e^x$
11. If the axes be turned through an angle $\tan\theta = 2$. What does the equation $4xy - 3x^2 = a^2$ becomes? [5]
12. Find the equation of an ellipse in the standard form. [5]
13. If e_1 and e_2 are the eccentricities of the hyperbola, and it conjugate respectively. Then prove that $\frac{1}{e_1^2} + \frac{1}{e_2^2} = 1$. [5]

Exam.	Regular/Back		
	Level	BE	Full Marks
Programme	All (Except B.Arch.)	Pass Marks	32
Year / Part	I / I	Time	3 hrs.

Subject: - Mathematics I

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

1. Find the angle between the curves $r = a \sin 2\theta$, $r = a \cos 2\theta$. [5]

OR

If $y = (x^2 - 1)^n$, prove that $(x^2 - 1)y_{n+2} + 2xy_{n+1} - n(n+1)y_n = 0$.

2. State and prove Lagrange's mean value theorem. [5]

3. Evaluate: $\lim_{x \rightarrow 0} (\cot x)^{\frac{1}{\log x}}$ [5]

4. Find the surface of the right circular cylinder of greatest surface which can be inscribed in a sphere of radius r . [5]

5. Find the asymptotes of the curve $(x^2 - y^2)(x + 2y + 1) + x + y + 1 = 0$. [5]

OR

Show that the radius of curvature for the curve $r^m = a^m \cos m\theta$ is $\frac{a^m}{(m+1)r^{m-1}}$.

6. Integrate any three: [10]

a) $\int \frac{\cos x dx}{(1 + \sin x)(2 + \sin x)}$

b) $\int_0^{\pi/4} \frac{\sin 2\theta d\theta}{\sin^4 \theta + \cos^4 \theta}$

c) $\int_0^{\pi/2} \frac{\sqrt{\cot x} dx}{1 + \sqrt{\cot x}}$

d) $\int_{-1}^2 \frac{dx}{x^3}$

7. Evaluate $\int_0^1 \sqrt{x} dx$ by the method of summation. [5]

8. Obtain a reduction formula for $\int \sec^n x dx$ and hence find $\int \sec^6 x dx$. [5]

OR

Evaluate $\int_0^1 \frac{dx}{(1-x^6)^{1/6}}$

9. Find the area of a loop of the curve $a^2 y^2 = a^2 x^2 - x^4$. [5]

OR

Find the volume of the solid generated by revolving the astroid $x^{\frac{2}{3}} + y^{\frac{2}{3}} = a^{\frac{2}{3}}$ about the axis of x .

10. Solve any three of the following differential equations. [15]

a) $(3y - 7x + 7)dx + (7y - 3x + 3)dy = 0$

b) $\cos x dy = y(\sin x - y)dx$

c) $p^2 - py + x = 0$; where $p = \frac{dy}{dx}$

d) $(D^2 - 3D + 2)y = x^2 + x$

11. Find the changed form of the equation $3x^2 + 3y^2 + 2xy = 2$ when the axes are turned through 45° the origin remaining fixed. [5]

12. The line $x + y = 0$ is a directrix of an ellipse, the point $(2,2)$ is the corresponding focus. If the eccentricity be $1/3$, find the equation of the other directrix. [5]

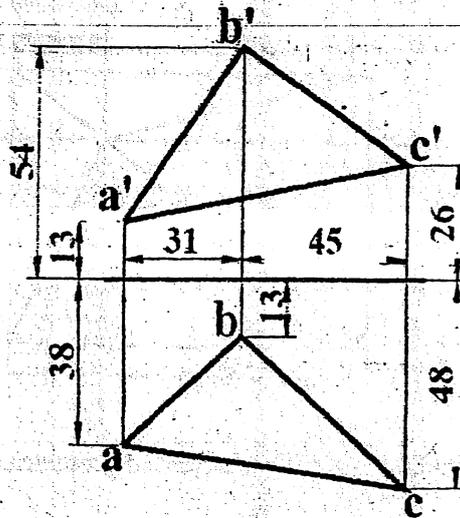
13. Find the equation of the hyperbola in the standard form [5]

Exam.	New Back (2066 & Later Batch)		
Level	BE	Full Marks	40
Programme	All (Except B. Arch)	Pass Marks	16
Year / Part	I / I	Time	3 hrs.

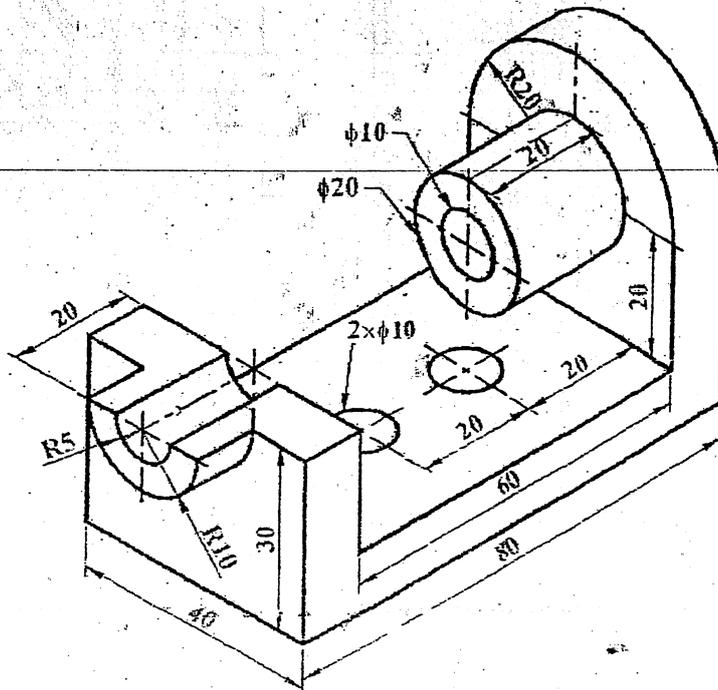
Subject: - Engineering Drawing I (ME401)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

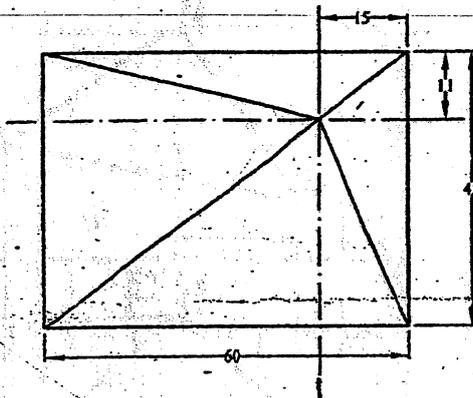
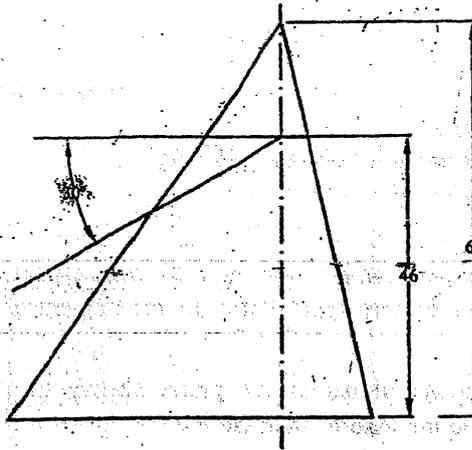
1. Draw two circles with radii 15 mm and 20 mm respectively with their centers lying on a horizontal line and 60 mm apart. Draw an arc tangent of radius 40 mm outside to both the circles. [3]
2. Reproduce the given views of the plane shown in figure below. Determine its true perimeter and true inclination with the HP. [5]



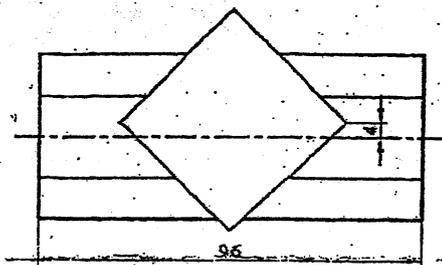
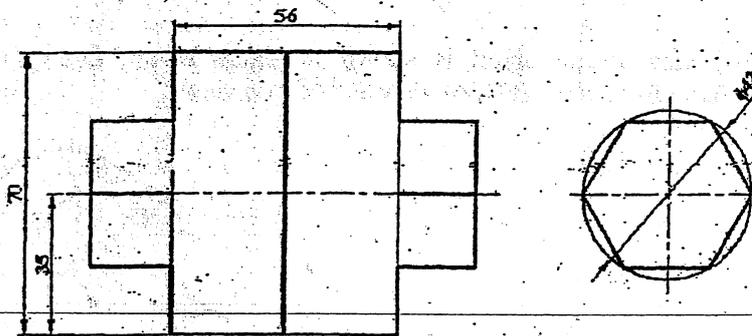
3. Pictorial view of an object is shown in figure below. Draw (with dimension) its (a) sectional front view, (b) side view and (c) top view. [15]



4. Complete the given orthographic views of geometrical solid cut by plane shown in figure below and develop the complete surfaces. [10]



5. Draw the lines of intersection of the surfaces of geometrical solids shown in figure below: [5]

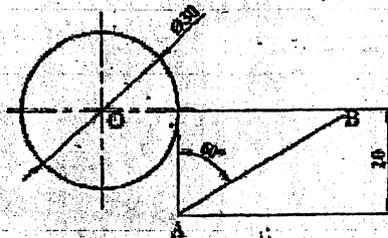


Exam.	New Back (2066 & Later Batch)		
Level	BE	Full Marks	40
Programme	All (Except B.Arch)	Pass Marks	16
Year / Part	I / I	Time	3 hrs.

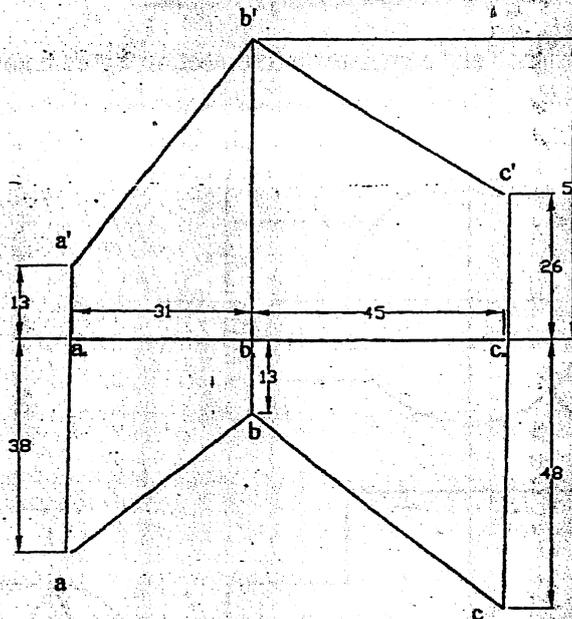
Subject: - Engineering Drawing I (ME401)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

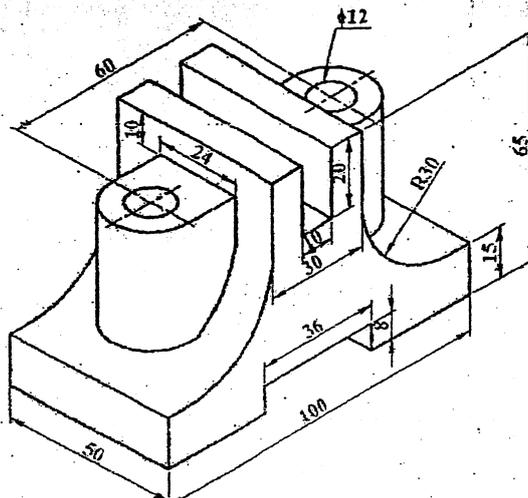
1. Figure below shows a straight line and a circle. Draw an arc of radius 18 mm tangent to both the given line and circle and outside to the given circle. [3]



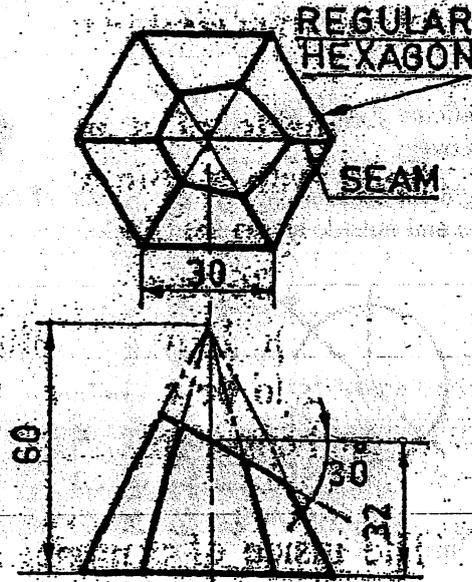
2. Find the true angle between line AB and BC. [5]



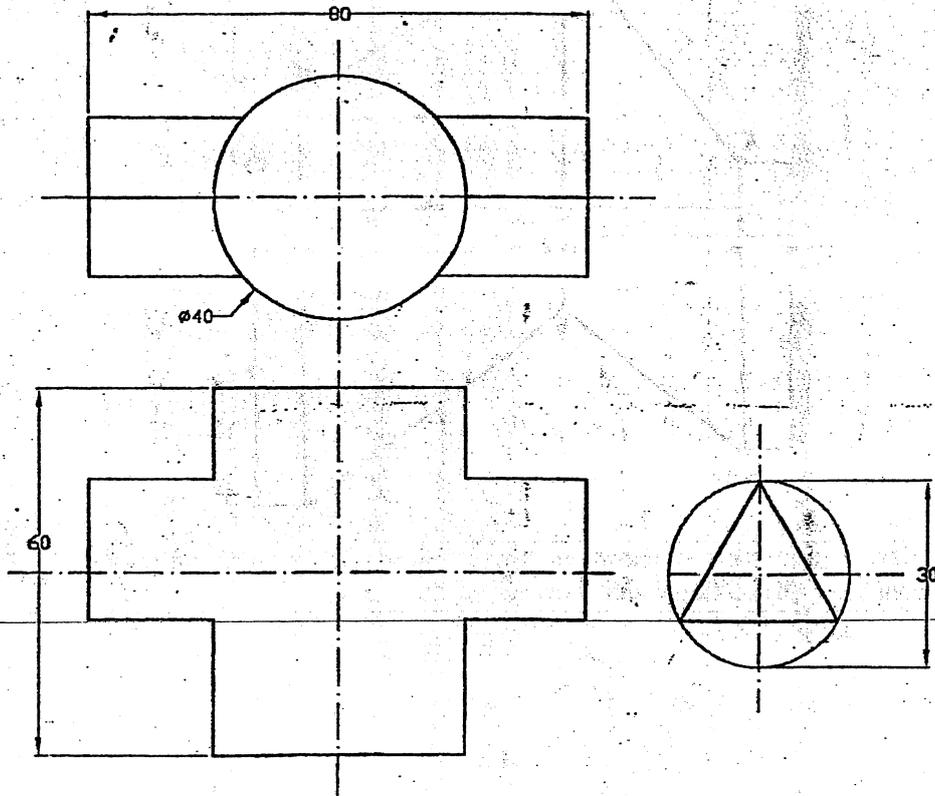
3. Pictorial view of an object is shown in figure below. Draw (with dimension) its (a) sectional front view, (b) sectional side view and (c) top view. [15]



4. Draw a complete orthographic drawing of a solid cut by a plane as shown in figure below. Find the true shape of the section. Then develop lateral surface of the solid. [12]



5. Draw the given views assigned and complete the intersection figure below. [5]

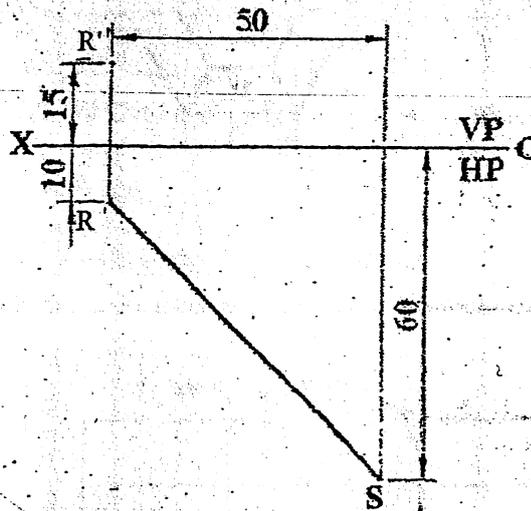


Exam.	Regular		
Level	BE	Full Marks	40
Programme	All (Except B.Arch)	Pass Marks	16
Year / Part	1 / I	Time	3 hrs.

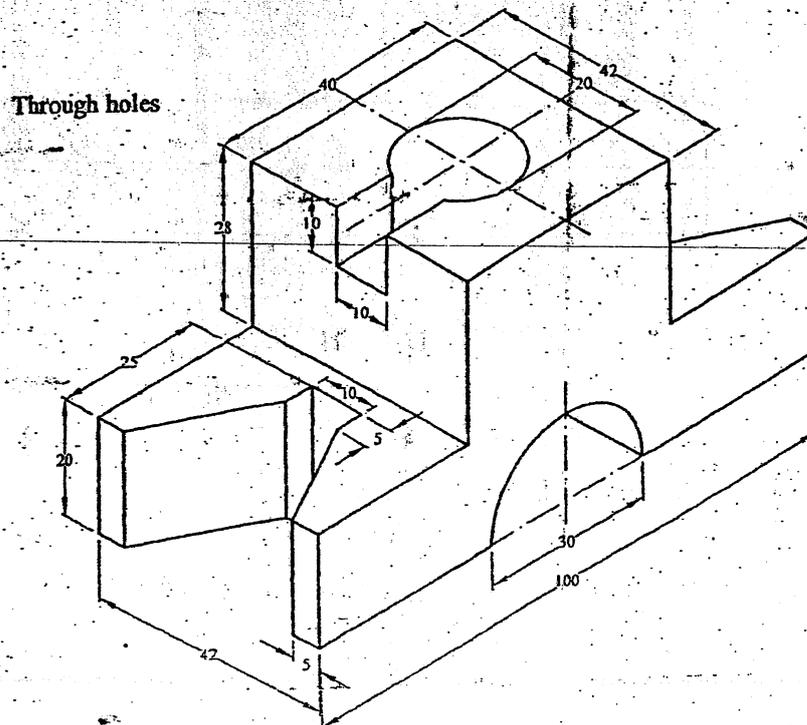
Subject: - Engineering Drawing I (ME401)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

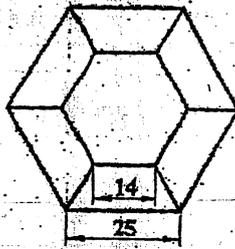
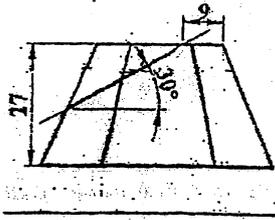
1. Construct an ellipse having a major axis 80 mm and minor axis 60 mm. [3]
2. Top view of a straight line RS and the front view of its end R are shown in figure below. Complete its projection if it is inclined at 30° to the HP. Also determine its true length and true inclination with the VP. [5]



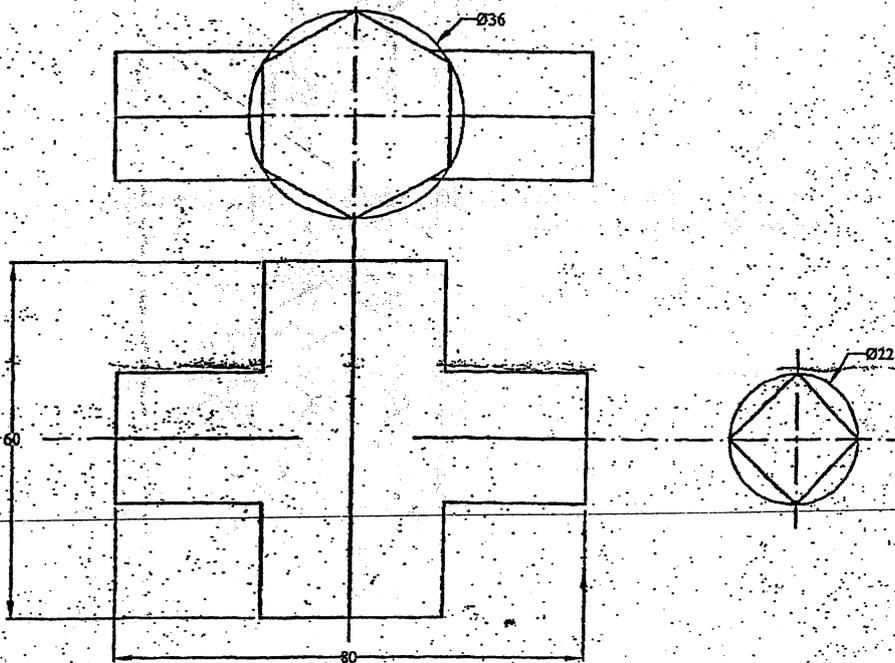
3. Draw orthographic projections with full sectional front view, top view and side view of the given object shown in figure below. [15]



4. Draw a complete orthographic drawing of a solid cut by a plane as shown in figure below. Find the true shape of the section. Then develop the surface of the solid. [12]



5. Draw the given views assigned and complete the intersection for figure below. [5]

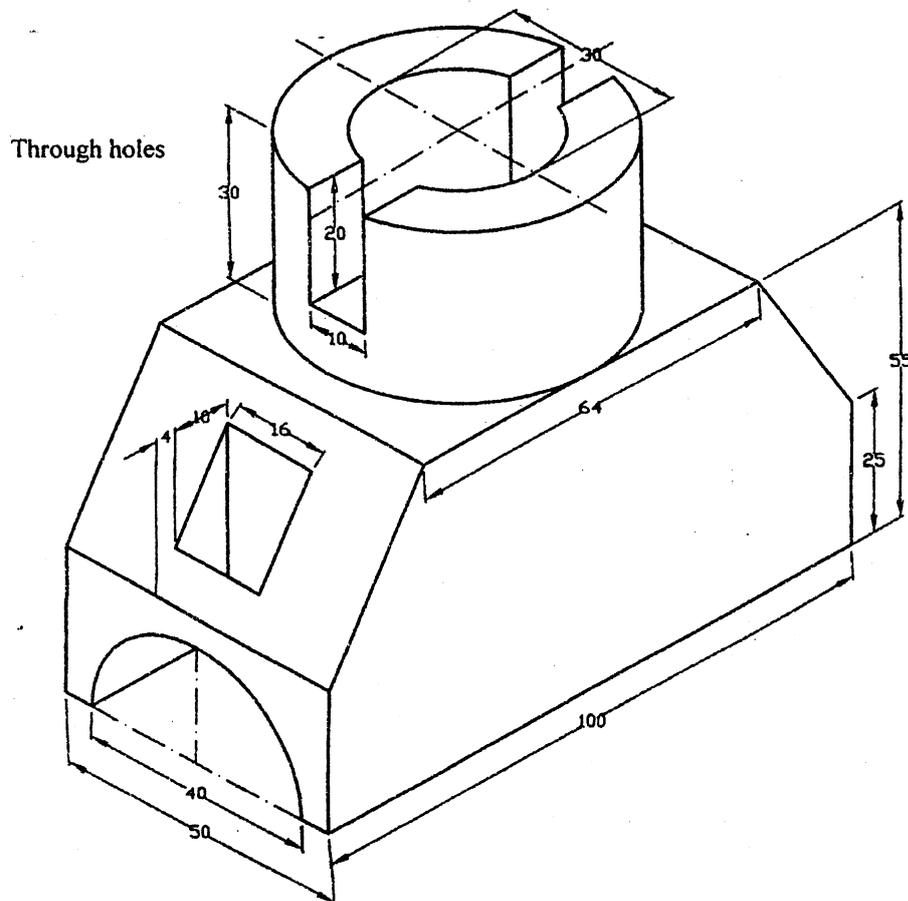


Exam.	Regular		
Level	BE	Full Marks	40
Programme	All (Except B.Arch)	Pass Marks	16
Year / Part	I / I	Time	3 hrs.

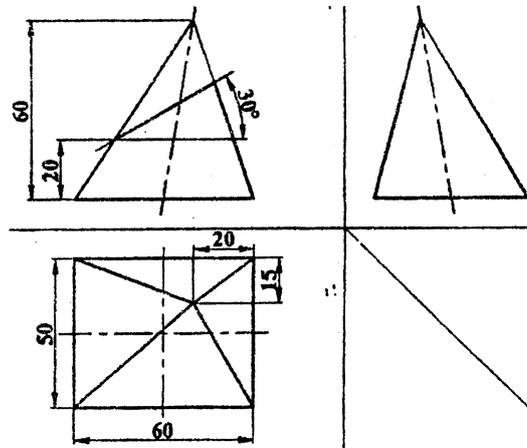
Subject: - Engineering Drawing I (ME401)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

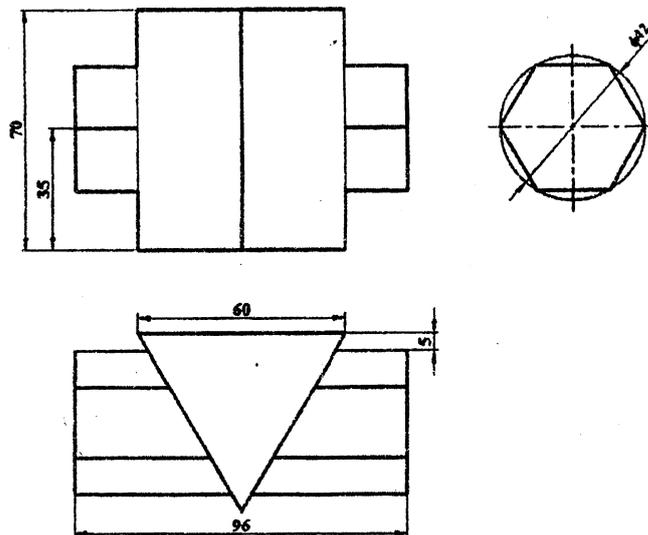
1. Draw an involute of circle having diameter of 40 mm. [3]
2. A regular pentagonal plane ABCDE of 20 mm side has its edge BC resting on the HP. Its plane is perpendicular to the HP and inclined to the VP at 45°. Draw its projections when its corner nearer to the VP is 18 mm in front of the VP. [5]
3. Draw orthographic projections with full sectional front view, top view and side view of the given isometric drawing in figure below. [15]



4. Draw a complete orthographic drawing of a solid cut by a plane as shown in figure below. Find the true shape of the section. Then develop the surface of the solid. [12]



5. Draw the lines of intersection of the surfaces of geometrical solids shown in figure below. [5]

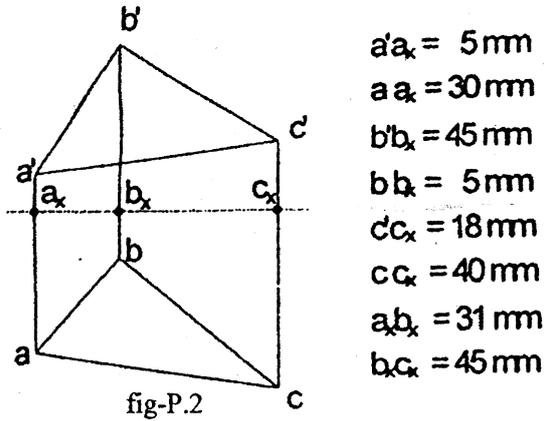


Exam.	Regular		
Level	BE	Full Marks	40
Programme	All (Except B.Arch)	Pass Marks	16
Year / Part	I / I	Time	3 hrs.

Subject: - Engineering Drawing I (ME401)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

1. Draw one turn of a helix of pitch 60 mm on a cylinder of diameter of 40 mm [4]
2. Reproduce the given views of the plane and find out its indination with HP and the true shape of the plane. Refer figure P.2 [6]



3. Pictorial view of an object is shown in figure P.3. Draw its (a) Sectional front view (b) Side view from the left and (c) Top view. Also dimension the views. [14]

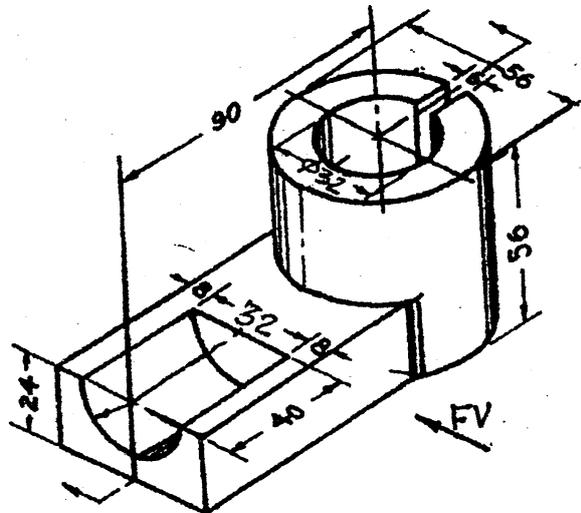


fig-P.3

4. A square base pyramid is cut by an inclined cutting plane p_x and horizontal plane p_4 as shown in figure p.4. Draw the lateral surface development of the lower portion of solid. [10]

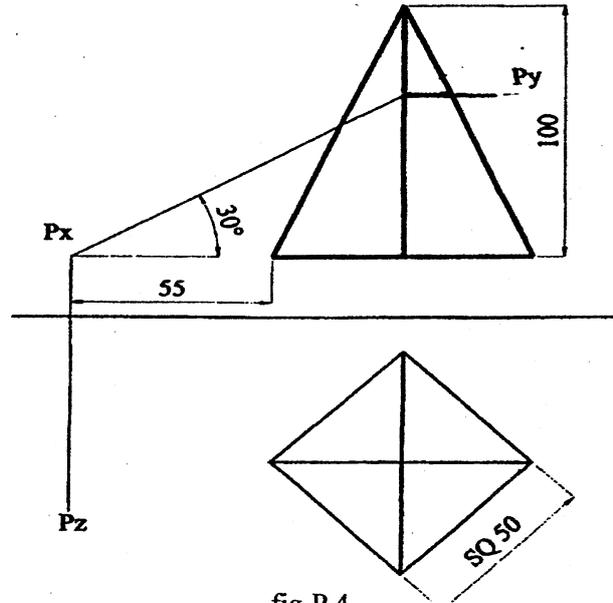


fig-P.4

5. Draw lines of intersection of the surfaces of geometrical solids as shown in figure P.5 [6]

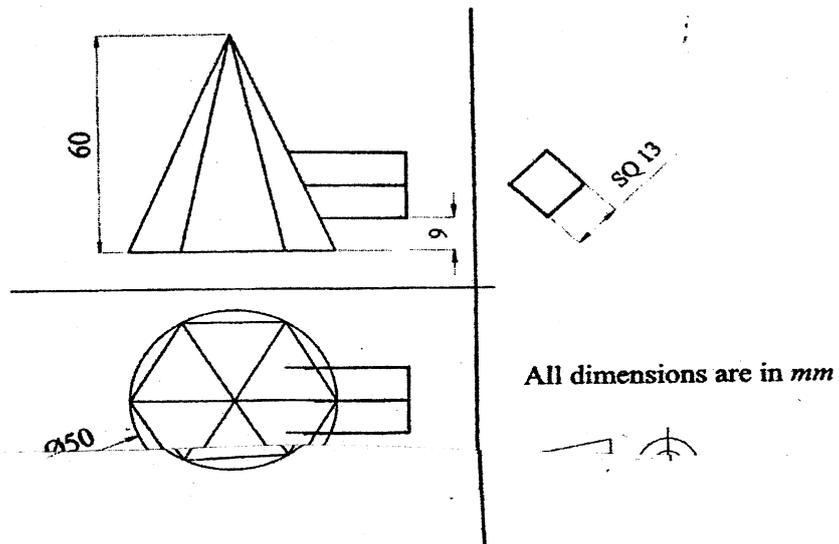


fig-P.5

Exam.	Regular		
Level	BE	Full Marks	40
Programme	All (Except B.Arch.)	Pass Marks	16
Year / Part	I / I	Time	3 hrs.

Subject: - Engineering Drawing I

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Necessary figures are attached herewith.
- ✓ Assume suitable data if necessary.

1. Draw a cycloid with the diameter of the generating circle as 50mm. [4]
2. A line AB, 90mm long is inclined at 45° to H.P. and its top view makes an angle of 60° with V.P. The end A is in the H.P. and 12mm in front of V.P. Draw its front view and find its true inclination with V.P. [6]
3. Draw orthographic projections with Full Sectional Front View, Side View and Top View of pictorial drawing as shown in Figure P.3. [14]

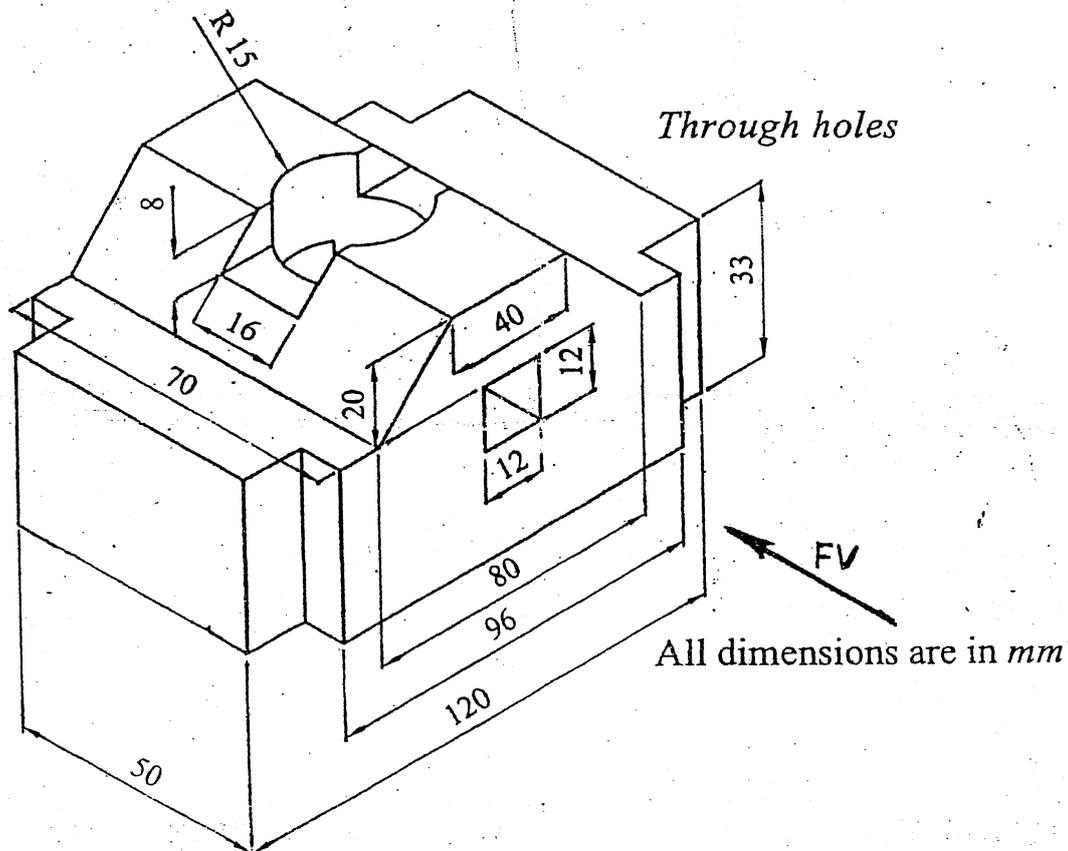


Figure P.3.

4. Make a complete orthographic drawing of the solid pyramid cut by a plane as shown in Figure P.4. Find the true shape of the section and construct development of the solid below the cutting plane. [10]

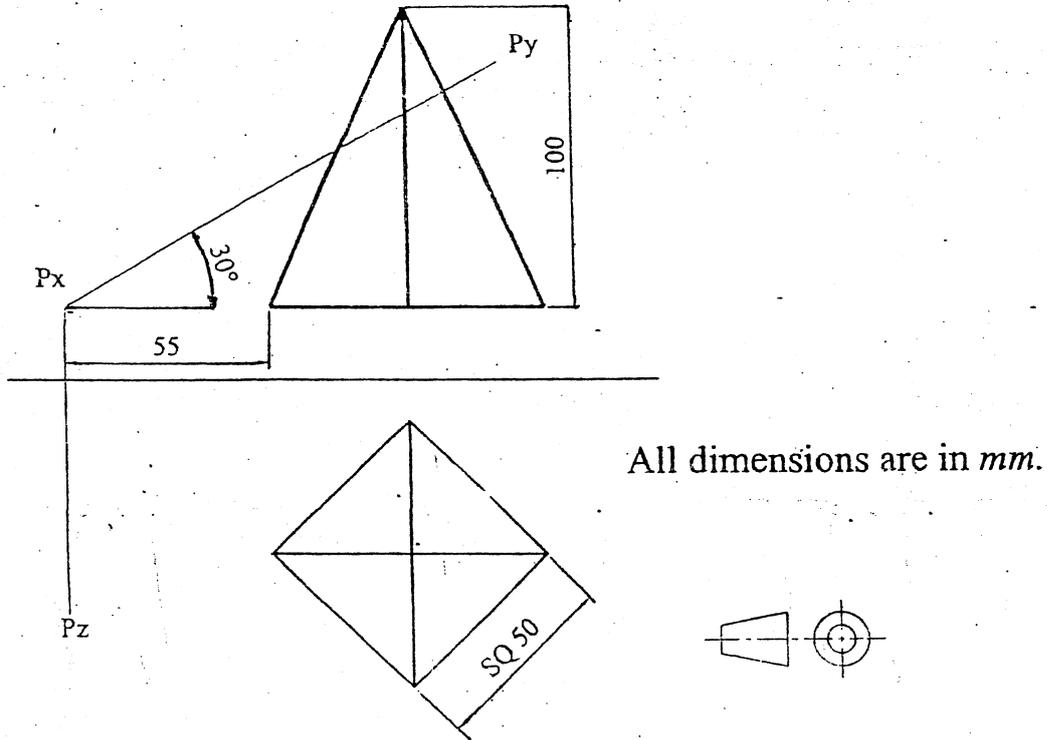


Figure P.4

5. Draw the given figure as shown in Figure P.5 and complete the intersections. [6]

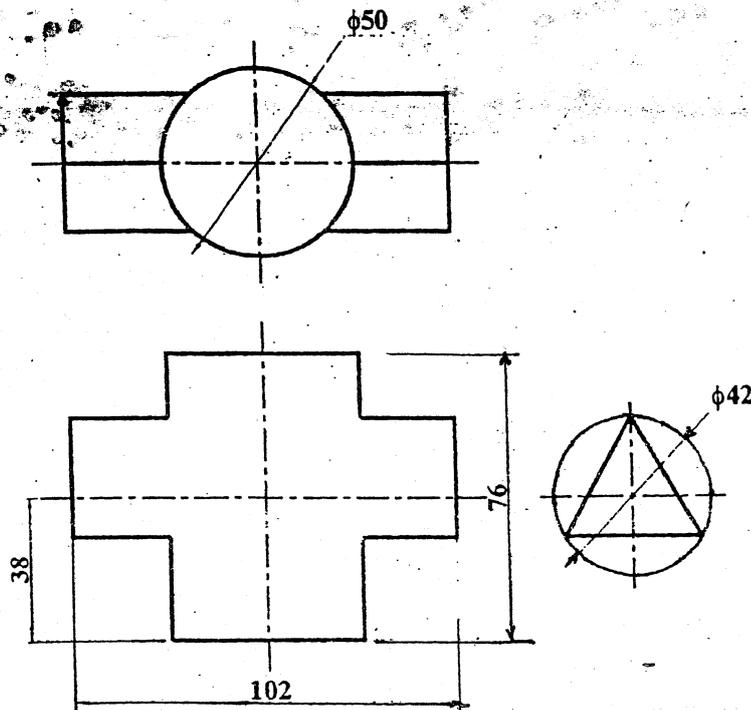


Figure P.5

Exam.	Back		
Level	BE	Full Marks	40
Programme	BCE, B.Agr.	Pass Marks	16
Year / Part	I / I	Time	3 hrs.

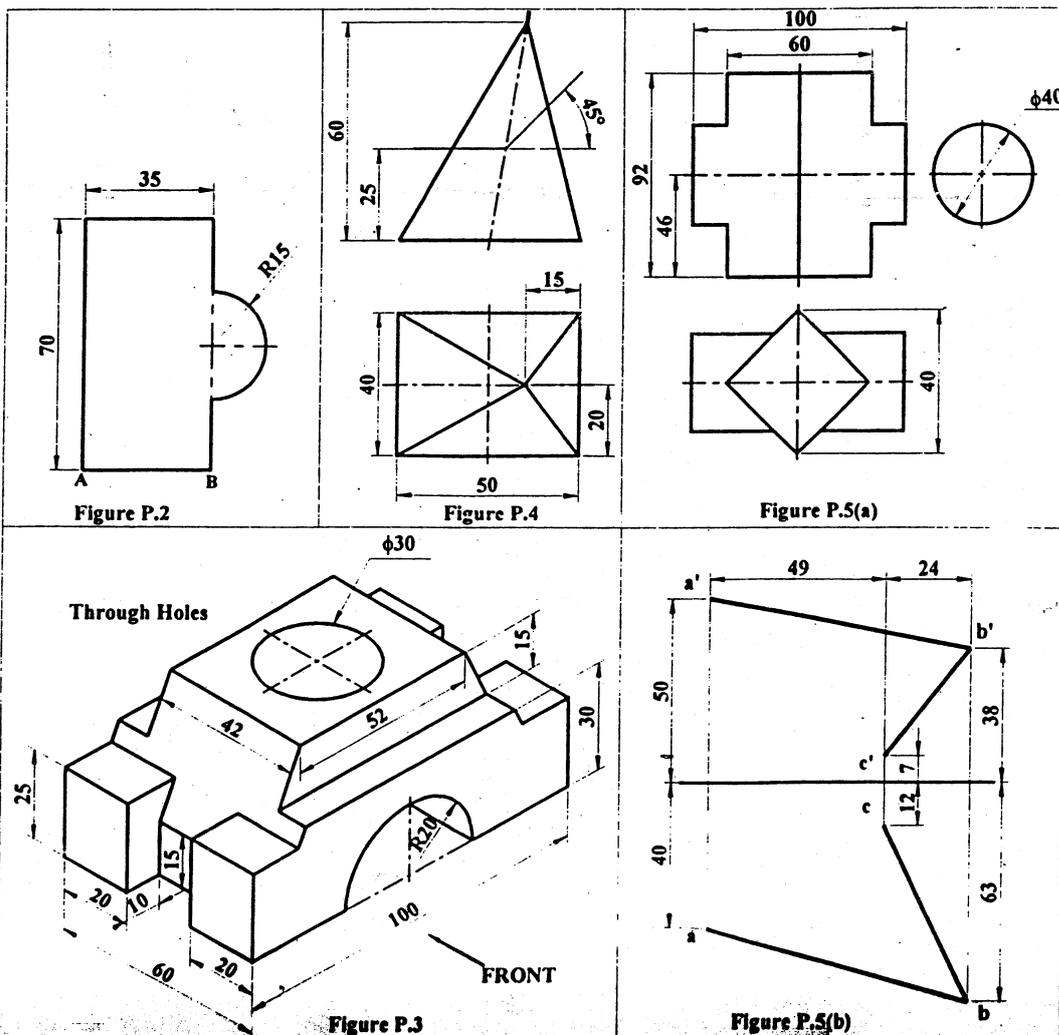
Subject: - Engineering Drawing I

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt **All** questions.
- ✓ The figures in the margin indicate **Full Marks**.
- ✓ Necessary figures are attached herewith.
- ✓ Assume suitable data if necessary.

1. Draw an involute of a rectangle 30 mm × 20 mm. [3]
2. A thin sheet of shape as shown in *Figure P.2* is resting on its side AB on the HP such that it is perpendicular to the VP and inclined to the HP at 45°. Draw its projections when the corner nearest to the VP is 20 mm in front of the VP. [5]
3. Pictorial view of an object is shown in *Figure P.3*. Draw the sectional front view, top view and side view for the object and dimension it. [8+4+4]
4. Draw a complete orthographic drawing of a pyramid cut by two planes (horizontal plane and plane inclined to HP at 45° and perpendicular to VP) as shown in *Figure P.4*. Find the true shape of the section. Then develop the surfaces of the solid. [4+4+8]

OR

- (a) Draw the lines of intersection of the surfaces of geometrical solids shown in *Figure P.5(a)*. [10]
- (b) Top views and front views of line AB and BC are shown in *Figure P.5(b)*. Determine true angle between two line AB and BC. [6]



Exam.	Regular / Back		
	Level	BE	Full-Marks
Programme	BEL, BEX, BCT, BME, BIE	Pass Marks	16
Year / Part	I/I	Time	3 hrs.

Subject: - Engineering Drawing I

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

1. Draw a parabola with double ordinate 100mm and axis length 80mm. [3]
2. The front view of a 75mm long line measures 55mm. The line is parallel to the HP and one of its ends is in the VP and 25mm above the HP. Draw the projections of the line and determine its inclination with the VP. [3]
3. Pictorial view of an object is shown in Figure P.3. Draw (with dimension) its (a) sectional front view, (b) side view and (c) top view. [16]

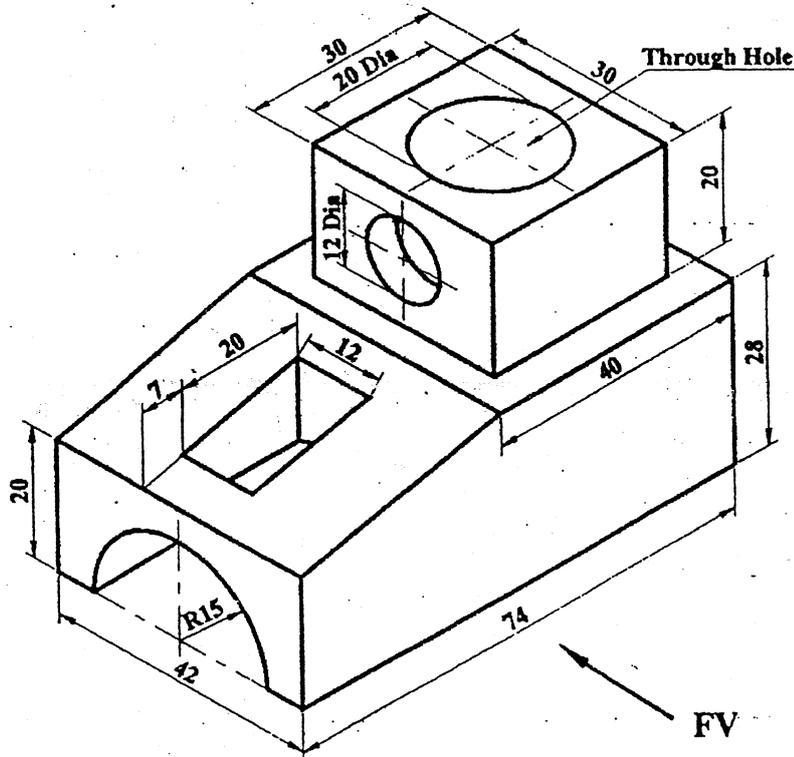


Figure P.3

4. Draw a complete orthographic drawing of a solid cut by a plane as shown in Figure P.4. Find the true shape of the section. The develop the lateral surface of the solid. [12]

5. Draw the lines of intersection of the surfaces of geometrical solids shown in Figure P.5.

[6]

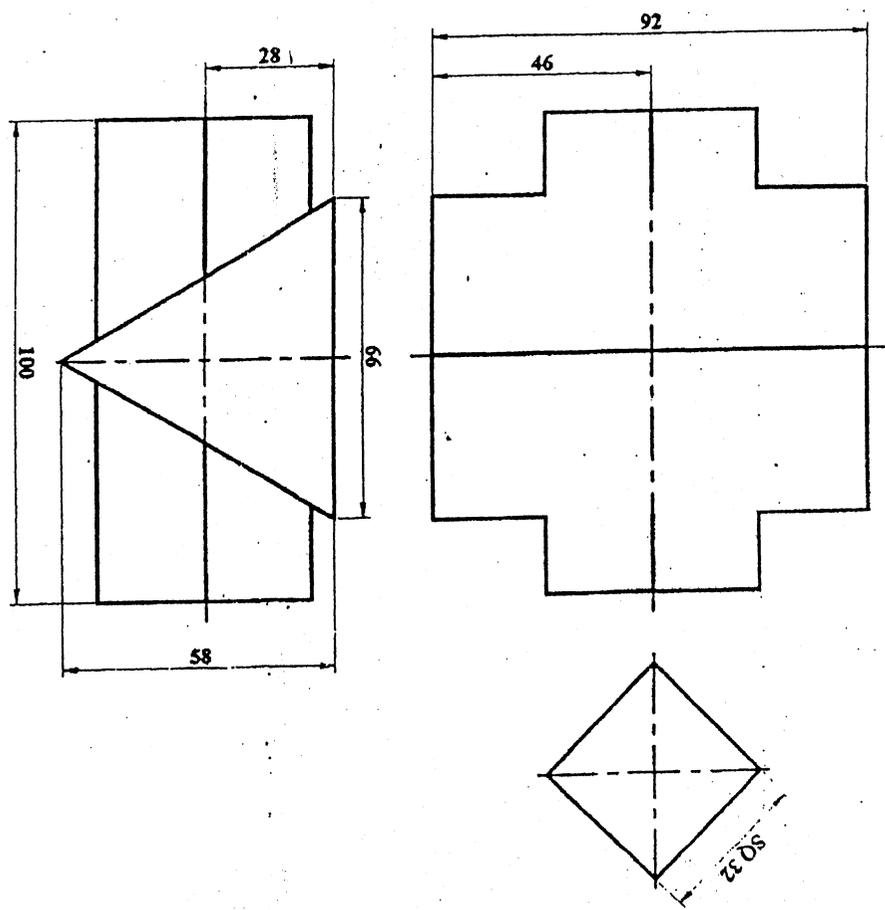


Figure P.5

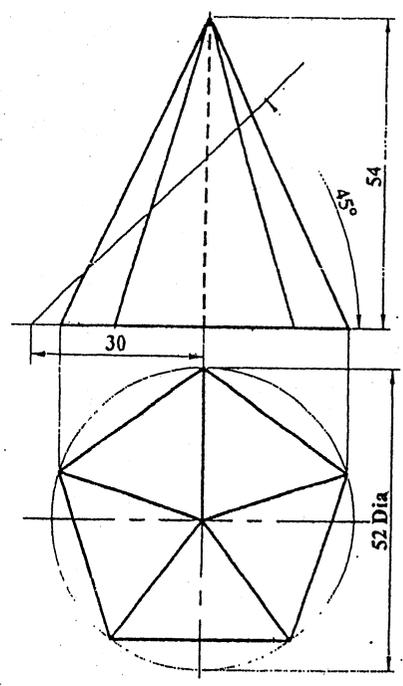


Figure P.4

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Exam.	Back		
Level	BE	Full Marks	40
Programme	BEL, BEX, BCT, BME, BIE	Pass Marks	16
Year / Part	I / I	Time	3 hrs.

Subject: - Engineering Drawing I

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

1. Draw an involute of circle having diameter of 50mm. [4]
2. A line 65mm long has its one end 15mm above the horizontal plane and 20mm in front of the vertical plane. The other end is 35mm above the horizontal plane and 60mm in front of the vertical plane. Draw the projections of the line and determine its inclination with both the planes. [6]
3. Pictorial view of an object is shown in figure 1. Draw (with dimension) its sectional front view, side view and top view. [12]

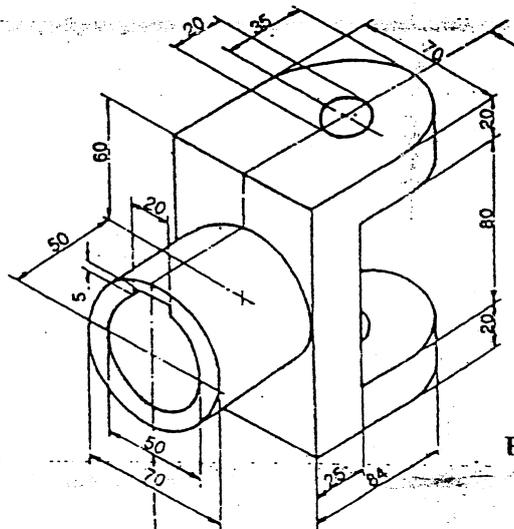


Figure 1

4. Draw a complete orthographic drawing of a hexagonal prism cut by a plane as shown in figure 2. Find the true shape of the section and develop the surfaces of the solid. [12]
5. Draw the lines of intersections of the surfaces of geometrical solids shown in figure 3. [6]

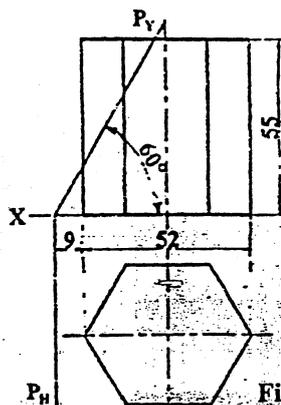


Figure 2

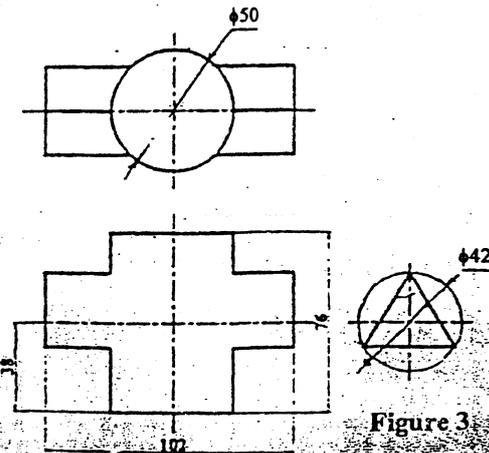
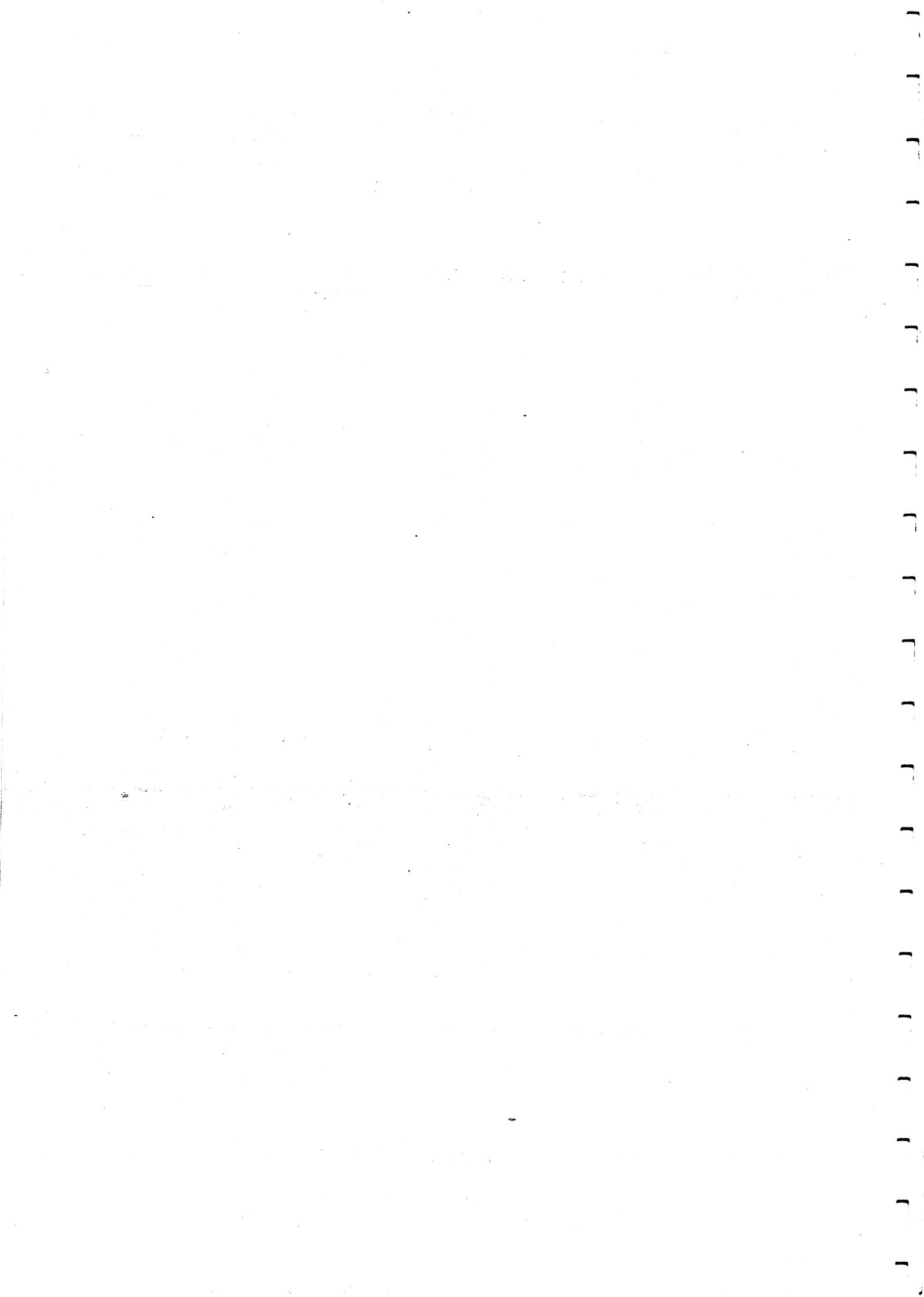


Figure 3



Exam. Level	Regular / Back		
	BE	Full Marks	40
Programme	BCE, B.Agr.	Pass Marks	16
Year / Part	I / I	Time	3 hrs.

Subject: - Engineering Drawing I

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

1. Draw a regular pentagon on a circumscribing circle of 60mm diameter. [4]
2. A line AB 80mm long is inclined at 30° to the H.P. The plan of the line is inclined at 50° to the V.P. Draw the projections of the line when end A is 10mm above H.P. and 20mm in front of V.P. [5]
3. Pictorial view of an object is shown in Figure 1. Draw its (a) Sectional front view (b) Side view and (c) Top view. Also dimension the views. [4+4+4]

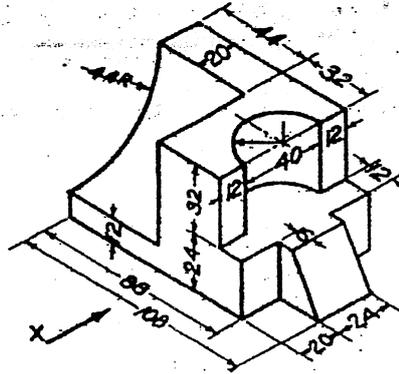


Figure 1

4. Draw a complete orthographic drawing of a solid cut by a plane as shown in Figure P.4. Find the true shape of the section. The develop the lateral surface of the solid. [12]

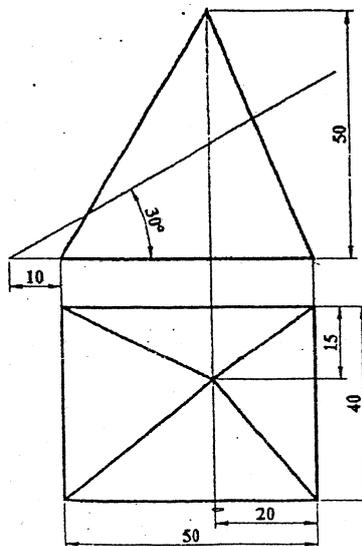


Figure P.4

5. Draw the lines of intersection of the surfaces of geometrical solids shown in Figure P.5.

[7]

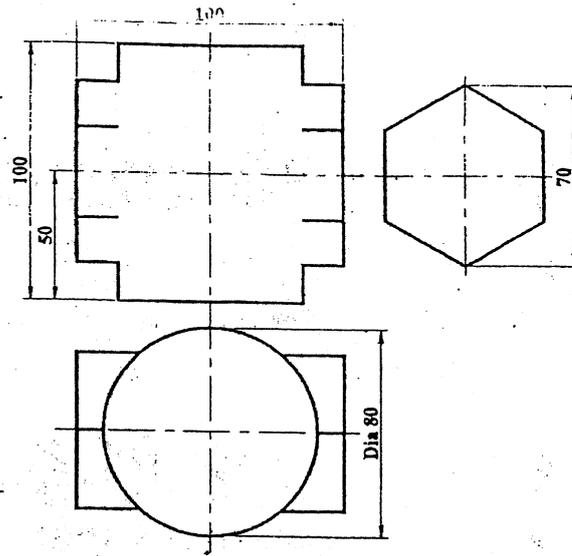


Figure P.5

Exam. Level	Regular/Back		
	BE	Full Marks	40
Programme	BEL, BEX, BCT, BME, BIE	Pass Marks	16
Year / Part	I / I	Time	3 hrs.

Subject: - Engineering Drawing I

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

1. Draw a regular pentagon on a circumscribing circle of 60mm diameter. [5]
2. A straight line AB 55mm long makes an angle of 30° to the H.P. and 45° to the V.P. the end A is 12mm in front of V.P. and 15mm above H.P. Draw the projections of the line AB. [5]
3. Pictorial view of an object is shown in fig-1. Make a complete orthographic drawing and dimension it. [14]

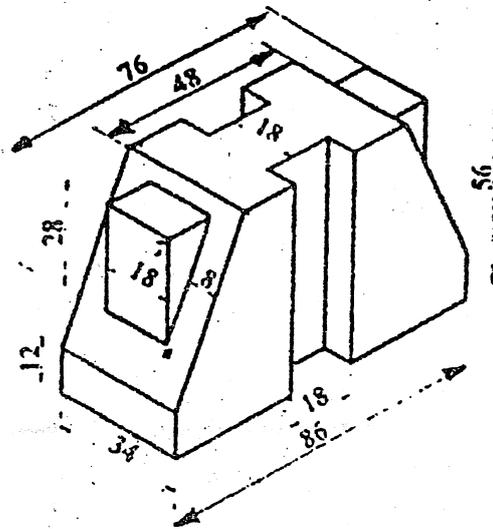


Fig-1

4. A right circular cone is cut as shown in fig-2. Develop its lateral surface. [16]

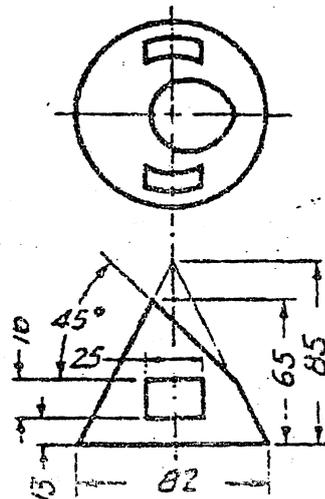


Fig-2

OR

OR

- a) Draw the given view of assigned form and complete the intersection. Refer fig-3. [10]

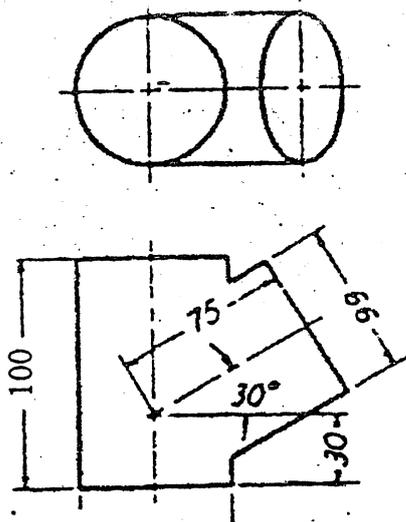


Fig-3

- b) A square lamina ABCD of 25mm side is perpendicular to V.P. and inclined to H.P. at 45° . It rests on its side BC in HP. Draw its projections when corner C is 12mm in front of the V.P. [6]

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Exam.	New Back (2066 & Later Batch)		
Level	BE	Full Marks	80
Programme	BEL, BEX, BCT, BIE, B.Agric.	Pass Marks	32
Year / Part	I / I	Time	3 hrs.

Subject: - Engineering Physics (SH402)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ All questions carry equal marks.
- ✓ Assume suitable data if necessary.

1. Differentiate between bar pendulum and torsional pendulum. Using a torsional pendulum, derive a relation for modulus of rigidity of the metallic wire.

OR

Compare the damped and forced LCR oscillation. Derive the differential equation of forced em-oscillation and compare it with driven mechanical oscillation

2. Show that in a bar pendulum, minimum time period is achieved if radius of gyration is equal to the distance of point of suspension or point of oscillation from center of gravity.
3. Write some features of acoustically good auditorium. Derive Sabine's formula.
4. Two thin converging lenses of focal lengths 3 cm and 4 cm respectively are placed coaxially in air separated by a distance of 2 cm. An object is placed at 4 cm in front of first lens. Locate the positions of the principal points and final image.
5. What is polarization? Derive the relation for plane, elliptical and circular polarized light.

OR

What are the coherent sources of light? How such sources develop in lab? Show that the square of diameters of the n^{th} dark ring by the reflected light of Newton's ring is directly proportional to the natural number.

6. Define acceptance angle and numerical aperture. In an optical fiber, show that Numerical Aperture (NA) = $\mu_{\text{core}} \sqrt{2\Delta}$, symbols have their usual meanings.
7. In a Fraunhofer Single slit diffraction, a convex lens of focal length 20 cm is placed just after a slit of width 0.6 mm. If a plane wave of wavelength 6000\AA falls on slit normally, calculate the separation between the second minima on either side of central maximum.
8. Calculate the minimum no of lines per cm in a 2.5 cm wide grating which will just resolve the sodium lines 5890\AA and 5896\AA in second order spectrum.
9. A thin ring made of plastic of radius R is uniformly charged with linear charge density λ . Calculate the electric field intensity at any point at an axial distance y from the center. If electron is constrained to be in axial line of the same ring, show that the motion of electron is SHM.

OR

Discuss the behavior of dielectrics in a parallel plate capacitor. Based on Gauss law of electrostatic in dielectric, show that $\vec{D} = \epsilon_0 \vec{E} + \vec{P}$, where symbols have their usual meaning.

10. The potential in a region between $x = 0\text{m}$ and $x = 6\text{m}$ is $V = a + bx^2$ where $a = 10$ and $b = -7\text{V/m}$. Determine (i) the potentials at $x = 0\text{m}$, 3m and 6m and (ii) the magnitude and direction of electric fields at $x = 0\text{m}$, 3m and 6m .
11. What are the current density and mobility? Explain the atomic view of the resistivity and show that $\rho = \{m/ne^2\tau\}$, where symbols have their usual meanings.
12. Give general method of calculating capacitance of a capacitor. Use the method to calculate the capacitance of a spherical capacitor.
13. A toroid has number of turns 1250, internal radius 52 mm, external radius 95 mm and thickness of the ring 13 mm, calculate the inductance.

OR

A solenoid having an inductance of $6.3 \mu\text{H}$ is connected in series with a $1.2 \text{ k}\Omega$ resistance. If a 14 V battery is connected across the pair, how long will it take for the current through the resistor to reach 80% of its final value?

14. Explain Hall effect. What results you can draw from Hall experiment? Obtain an expression for the Hall voltage in a current carrying specimen placed in a magnetic field.
15. State Maxwell equation in integral form. Convert them into differential form. Explain each of these equations.
16. A free particle is confined in a box of width L . Using Schrodinger wave equation find an expression for energy eigen value.

Exam.	New Back (2066 & Later Batch)		
Level	BE	Full Marks	80
Programme	BEL, BEX, BCT, BIE, B.Agr.	Pass Marks	32
Year / Part	1 / 1	Time	3 hrs.

Subject: - Engineering Physics (SH402)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ All questions carry equal marks.
- ✓ Assume suitable data if necessary.

1. Derive a relation to find the moment of inertia of a rigid body about an axis passing through its center of gravity using the torsional pendulum.

OR

What is resonance? Formulate the differential equation of forced electromagnetic oscillation. Then determine the expression for resonant frequency.

2. A string has a linear density of 625 gm/m and is stretched with a tension 50N. A wave, whose frequency and amplitude are 160Hz and 10mm respectively, is travelling along the string. At what average rate is the wave transporting energy along the string?
3. Why is it important to study the reverberation time, before the construction of a Cinema Hall? Derive a relation for reverberation time based on absorption coefficient, volume and surface area of the hall.
4. What happens to the energy when waves perfectly cancel to each other in interference? Derive the relations for thin film interference by reflected light.

OR

Show that the diameters of the Newton's rings when two surfaces of radii R1 and R2 are placed in contact are related by the relation $(1/R_1) - (1/R_2) = (4n\lambda/d^2)_n$, where n is the integer number of the fringes.

5. A grating with 250 grooves/mm is used with an incandescent light source. Assume the visible spectrum to range in wavelength from 400 to 700 nm. In how many orders can one see the entire visible spectrum?
6. Define the polarization of light. Write its importance in different optical instruments. Derive the relation for the thickness of quarter wave plate and half wave plate.
7. Two thin converging lenses of focal length 3cm and 4cm respectively are placed coaxially in air and separated by distance of 2cm. An object is placed 4cm in front of the first lens. Find the position of the nature of the image and its lateral magnification.
8. A glass-clad fiber is made with a core glass of refractive index 1.55 and the cladding is doped to give a fractional index difference of 5.5×10^{-4} . Determine (i) Cladding index (ii) the critical internal reflection angle (iii) the external critical acceptance angle and (iv) numerical aperture (NA).
9. A particle of charge -q and mass m is placed midway between two equal positive charges q_0 of separation d. If the negative charge -q is displaced in perpendicular direction to the line joining them and released. Show that the particle describes a SHM with a period.

$$T = \sqrt{\frac{\epsilon_0 m \pi^3 d^3}{qq_0}}$$

OR

Calculate electric field at any point is axial distance due to a dipole and a quadrapole. What conclusion you can draw from your results.

10. Charges are uniformly distributed throughout the volume of an infinitely large cylinder of radius 'a'. Show that the electric field at a distance 'r' from the cylinder axis $r < a$ is given by $E = \frac{\rho r}{2\epsilon_0}$ where ρ is the volume charge density.
11. A cylindrical capacitor has radii a and b. Show that half the stored electric potential energy lies within a cylinder whose radius is $r = \sqrt{ab}$.
12. Explain Hall Effect. Derive a relation for Hall resistance. From this relation explain the meaning of quantization of Hall resistance.
13. The current density in a cylindrical wire of radius $R = 2$ mm and uniform cross-sectional area is given by $J = 2 \times 10^5 \text{ Am}^2$. What is the current through the outer portion of the wire between radial distances $R/2$ and R ?
14. Explain the phenomenon of "self-induction". Find an expression for the self-induction of a toroid having N numbers of turns, radius r and carrying current i.

OR

- State Ampere's law. Find the expressions for magnetic field outside and inside the long straight wire by using this law.
15. Write down the Maxwell's equations for non-conducting medium. Find the equation of propagation of plane electromagnetic wave for E-field and B-field for such medium. Show that electromagnetic wave travels with velocity less than velocity of light in such medium.
16. Derive Schrodinger time independent wave equation. A particle is moving in one dimensional potential well of infinite height and width 'a'. Find the expression for energy of the particle.

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BEL, BEX, BCT, BIE, B.Agri.	Pass Marks	32
Year / Part	I / I	Time	3 hrs.

Subject: - Engineering Physics (SH402)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ All questions carry equal marks.
- ✓ Assume suitable data if necessary.

1. Distinguish between free and forced vibrations. Write the differential equation of forced oscillation. Determine the amplitude of oscillation for forced oscillation and hence explain sharpness of the resonance.

OR

Define simple harmonic motion. Show the average kinetic energy is half of the total energy of a particle executing simple harmonic motion.

2. A $2\mu\text{F}$ capacitor is charged upto 50V. The battery is disconnected and 50mH coil is connected across the capacitor so that LC oscillation to occur. Calculate the maximum value of the current in the circuit.
3. The elastic limit of steel forming a piece of wire is equal to 2.70×10^8 Pa. What is the maximum speed at which transverse wave pulses can propagate along this wire without exceeding this stress? (density of steel = $7.89 \times 10^3 \text{ kg/m}^3$)
4. What are Newton's rings? How can you use these rings to determine the refractive index of a given liquid?

OR

Discuss the phenomenon of Fraunhofer diffraction at a single slit. Show that the relative intensities of the successive maxima are $1 : \frac{4}{9\pi^2} : \frac{4}{25\pi^2} : \dots$

5. Light of wavelength 6000 Å falls normally on a thin wedge shaped film of refractive index 1.4, forming fringes that are 2 mm apart. Find the angle of the wedge.
6. If the plane of vibration of the incident beam makes an angle of 30° with the optic axis, compare the intensities of extraordinary and ordinary light.
7. Show that the diameter of circle of least confusion depends on the diameter of lens aperture and dispersive power of the material of the lens but is independent of the focal length of the lens.
8. An optical fiber has a numerical aperture of 0.22 and core refractive index 1.62. Determine the acceptance angle for the fiber in a liquid which has a refractive index of 1.25. Also, determine the fractional refractive index change.

9. Prove that electric field due to a short dipole at axial point is twice that at equatorial point.
10. A capacitor of capacitance C is discharging through a resistor of resistance R . After how many time constants is the stored energy $1/8$ of its initial value?
11. Give a general method to calculate electric field and potential due to continuous charge distribution. Using your method, calculate electric field at an equatorial distance y due to a long charged rod having linear charge density λ .
12. Consider a circular coil of radius R carrying current I . Find the magnetic field at any point on the axis of the loop at a distance z from the center of the loop. Show that the circular current carrying coil behaves as a magnetic dipole for large distance.
13. In a Hall Effect experiment, a current of 3.2A lengthwise in a conductor 1.2 cm wide, 4.0 cm long and $9.5\mu\text{m}$ thick produces a transverse Hall voltage (across the width) of $40\mu\text{V}$ when a magnetic field of 1.4T is passed perpendicularly through the thin conductor. From this data, find (a) the drift velocity of the charge carriers and (b) the number density of charge carriers.
14. Derive an expression for growth and decay of current in LR circuit. Explain inductive time constant by sketching graph between current and time for both cases.

OR

Derive expressions for inductance of a Solenoid and Toroid. Then show that inductance is the property of the coil.

15. Write and explain Ampere's law in magnetism. How Maxwell modified it. Based on this modified equation, explain the term displacement current. Prove displacement current is equal to conduction current.
16. Explain Schrodinger's wave equation. Derive time independent Schrodinger wave equation. Use this equation to find energy for a particle in a box of infinite square well potential.

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BEL, BEX, BCT, BIE, B.Agric.	Pass Marks	32
Year / Part	I / I	Time	3 hrs.

Subject: - Engineering Physics (SH402)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt **All** questions.
- ✓ **All** questions carry equal marks.
- ✓ Assume suitable data if necessary.

1. Point out the similarities and dissimilarities between the oscillations of bar pendulum and torsional pendulum. Show that the radius of gyration is equal to distance from center of suspension to center of gravity of compound pendulum, when time period is minimum.
2. Derive a differential equation for LC Oscillation. Show that the maximum value of electric and magnetic energies stored in LC circuit is equal.

OR

Prove that if a transverse wave is travelling along a string, then the slope at any point of the string is numerically equal to the ratio of the particle speed to the wave speed at that point.

3. The time of reverberation of an empty hall is 1.5 sec with 500 audiences present in the hall; the reverberation time falls to 1.4 sec. Find the no. of persons present in the hall if the reverberation time falls down to 1.32 sec.
4. Show that the intensity of the first subsidiary maxima of Fraunhofer's diffraction at a single slit is 4.5% of that of principal maxima.

OR

What is double diffraction? Explain how Nicol prism can be used as polarizer and analyzer?

5. In a Newton's ring experiment, the radius of curvature of the lens is 5cm and the lens diameter is 20mm. (a) How many bright rings are produced? Assume that $\lambda=589\text{nm}$ (b) How many bright rings would be produced if the arrangement were immersed in water ($\mu=1.33$)?
6. A diffraction grating 3cm wide produces the second order at 33° with light of wavelength 600nm. What is the total number of lines on the grating.
7. What is population inversion? Explain why laser action cannot occur without population inversion between atomic levels?
8. What are cardinal points of an optical system? Determine the equivalent focal length of a combination of two thin lenses separated by a finite distance.
9. A ring has a charge q uniformly distributed in it. Derive an expression for the electric field at any point on the axial line of the ring. Extend your result to find the potential.

OR

Write an expression for electric field at any point in the axial line of a charged ring. Using this equation, calculate the electric field at any point in the axial line of a charged disk.

10. What is the magnitude of the electric field at the point (3,2) m if the electric potential is given by $V = 2x + 5xy + 3y^2$ volts. What acceleration does an electron experiences in the x-direction.
11. Derive an equation $\vec{J} = \sigma \vec{E}$. Explain why resistivity of a conductor increases with increasing temperature plot a graph between R_θ (Resistance at any temperature θ) and temperature. Based on the graph, explain what are superconductor? How they differ from perfect conductor? Describe the characteristics of superconductor.
12. Derive an expression for energy stored in magnetic field. Show that the energy stored per unit volume is directly proportional to the square of the magnetic flux density. Compare this result with electric energy density.

OR

What is self induction? Define inductance of a coil. Show by calculation inductance of a coil depends on the permeability of a medium and the geometry of the coil.

13. A long circuit coil consisting of 50 turns with diameter 1.2m carries a current of 10Amp. (a) Find the magnetic field at a point along the axis 90cm from the center. (b) At what distance from the center, along the axis, the field is 1/8 greater as at the center.
14. Describe the principal and working of Cyclotron. Show that the time taken by the ion in a Dee to travel a semicircle is exactly same whatever be its radius and velocity.
15. Write Maxwell's equations in free space and dielectric medium. With the help of Maxwell's equations, Derive charge conservation theorem.
16. A beam of electrons having energy of each 3eV is incident on a potential barrier of height 4eV. If the width of the barrier is 20\AA , calculate the transmission coefficient of the beam through the barrier.

2069 Ashad

Exam.	New Back (2066 & Later Batch)		
Level	BE	Full Marks	80
Programme	BEL, BEX, BCT, BIE, B.Agric.	Pass Marks	32
Year / Part	I / I	Time	3 hrs.

Subject: - Engineering Physics (SH 402)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ All questions carry equal marks.
- ✓ Assume suitable data if necessary.

1. Obtain an expression for the time period of a compound pendulum and show that its time period is unaffected by the fixing of a small additional mass to it at its centre of suspension.

OR

What is electromagnetic oscillation? Derive differential equation of damped LCR oscillation and find its frequency.

2. A particle is moving with simple harmonic motion in a straight line. If it has a speed v_1 when the displacement is x_1 and speed v_2 when the displacement is x_2 then show that the

amplitude of the motion is, $a = \left[\frac{v_2^2 x_1^2 - v_1^2 x_2^2}{v_2^2 - v_1^2} \right]^{\frac{1}{2}}$.

3. In the progressive wave, show that the potential energy and kinetic energy of every particle will change with time but the average K.E. per unit volume and P.E. per unit volume remains constant.
4. Two coherent sources having constant phase δ but different amplitudes A_1 and A_2 superimpose, prove that the intensity of superimposed beam is $I = A_1^2 + A_2^2 + 2A_1 A_2 \cos \delta$.

OR

Explain the phenomenon of double refraction. Describe the construction and action of Nicol prism.

5. White light is incident on a soap film at an angle $\sin^{-1}\left(\frac{4}{5}\right)$ and the reflected light on examination by a spectrometer shows dark bands. The consecutive dark bands correspond to wavelength 6.1×10^{-5} cm and 6.0×10^{-5} cm. If $\mu = 1.33$ for the film, calculate its thickness.
6. Light of wavelength 600nm is incident normally on a slit of width 0.1mm. Calculate the intensity at $\theta = 0.2^\circ$.
7. Two lenses of focal lengths 8cm and 4cm are placed at a certain distance apart. Calculate the position of principal points if they form an achromatic combination.

8. An optical fiber has a NA of 0.2 and a cladding refractive index of 1.59. Determine acceptance angle for the fiber in water which has a refractive index of 1.33.
9. A ring has a charge q uniformly distributed in it. Find the expression for the electric field at any point on the axial line of the ring. Locate the point at which the field is maximum.

OR

Prove that electric field due to a short dipole at axial point is twice that at equatorial point.

10. A particle of charge $-q$ and a mass m is placed midway between two equal positive charges q_0 of separation d . If the negative charge $-q$ is displaced in perpendicular direction to the line joining them and released, show that the particle describes a SHM with

$$\text{a period } T = \left[\frac{\epsilon_0 m \pi^3 d^3}{q q_0} \right]^{\frac{1}{2}}$$

11. A cylindrical capacitor has radii a and b . Show that half the stored electric potential energy lies within a cylinder of radius $r = \sqrt{ab}$.
12. A flat silver strip of width 1.5cm and thickness 1.5mm carries a current of 150A. a magnetic field of 2.0 Tesla is applied perpendicular to the flat face of the strip. The emf developed across the width of strip is measured to be $17.9\mu\text{V}$. Estimate the number density of free electrons in the metal.
13. A straight wire segment of length l carries current I . Show that the magnetic field B produced by that segment at a distance y from it along a perpendicular bisector is $B = (\mu_0 / 2\pi y) [l / (l^2 + 4y^2)]$.
14. Find the inductance of a toroid having N number of turns and radius R .

OR

Show that the energy per unit volume in electric field and magnetic field are proportional to the square of their fields.

15. State and explain Maxwell's equations. Derive the continuity equation: $\nabla \cdot \vec{J} = -\frac{\partial \rho}{\partial t}$.
16. Determine the total energy of a particle using Schrodinger equation, when the potential energy has value $V=0$ for $0 < x < a$, and $V=\alpha$ for $x \leq 0$ and $x \geq a$.

Exam.	Regular		
Level	BE	Full Marks	80
Programme	All	Pass Marks	32
Year / Part	I / I	Time	3 hrs.

Subject: - Engineering Physics (SH 402)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ All questions carry equal marks.
- ✓ Assume suitable data if necessary.

1. Differentiate between linear and angular harmonic motion. Show that the motion of torsion pendulum is angular harmonic motion. Also find its time period.

OR

Derive the differential equation of the forced oscillation of LCR circuit with an AC source and find the expression for the current amplitude. Hence explain the condition of current resonance in such circuit.

2. A 750g block oscillates on the end of a spring whose force constant, $k=56\text{N/m}$. The mass moves in a fluid which offers a resistive force $F = -bv$, where $b = 0.162\text{Ns/m}$. What is the period of the oscillation?
3. A room has dimensions $6\text{m} \times 4\text{m} \times 5\text{m}$. Find:
- i) Mean free path of sound wave in the room
 - ii) The number of reflections made persecond by the sound wave with the walls of the room. (Take velocity of sound in air = 350ms^{-1}).
4. Define interference. Show that interference in thin film due to reflected and transmitted lights are complementary.

OR

What are Newton's rings? How can you determine the refractive index of given liquid using Newton's rings experiment?

5. Explain the dispersive and resolving power of a diffraction grating. Derive expressions and develop a relation between them.
6. A 200mm long tube containing 48cm^3 of sugar solution produces an optical rotation of 11° when placed on a saccharimeter. If the specific rotation of sugar solution is 66° , calculate the quantity of sugar contained in the tube in the form of solution.
7. Prove that the condition for achromatism for the combination of two lenses of focal length f_1 and f_2 having dispersive power ω_1 and ω_2 placed at a separate distance x is $(\omega_1/f_1) + (\omega_2/f_2) = (x/f_1 f_2) (\omega_1 + \omega_2)$.
8. Differentiate between spontaneous and stimulated emission of radiation. Explain the construction and working of He-Ne laser with a suitable energy level diagram.
9. Derive an expression for the electric field at a point P at a distance X from a circular plastic disc of radius a along its central axis. Does this expression for E reduces to an expected result for $x \gg a$?

10. A capacitor of capacitance 'C' is discharged through a resistor of resistance 'R'. After how many time constants is the energy stored becomes one fourth of initial value?

11. Calculate the electric field due to a uniformly charged rod of length l at a point along its long axis at a distance 'a' from its nearest end.

12. Explain the principle and working of cyclotron. Show that the time spent by the particle in a Dee is independent of its speed and radius of its circular path.

OR

Use Biot-Savart Law to calculate magnetic field on the axial line of a current carrying circular loop. Explain how the coil behaves for a large distance point.

13. A copper strip $150\mu\text{m}$ thick is placed in a magnetic field of strength 0.65T perpendicular to the plane of the strip and current of 23Amp is set up in the strip. Calculate: (i) the Hall voltage (ii) Hall coefficient and (iii) Hall mobility, if the number of electrons per unit volume is $8.5 \times 10^{28}/\text{m}^3$ and resistivity is $1.72 \times 10^{-8} \text{ Ohm-m}$.

14. A parallel plate capacitor with circular plates of 10cm radius is charged producing uniform displacement current of magnitude $20\text{A}/\text{m}^2$. Calculate (i) dE/dt in the region (ii) Displacement current density and (iii) Induced magnetic field.

15. Obtain an expression for energy transfer rate by electromagnetic wave. From your result show that $I \propto E_{\text{rms}}^2$. Where I is the intensity em wave and E_{rms} is root mean square value of electric field.

16. Derive the schrodinger time independent wave equation. Also what do you mean by a potential barrier?

2067 Ashadh

Exam.	Regular/Back		
	Level	BE	Full Marks
Programme	BEL, BEX, BCT, BIE, B.Agr.	Pass Marks	32
Year / Part	I / I	Time	3 hrs.

Subject: - Engineering Physics

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ All questions carry equal marks.
- ✓ Assume suitable data if necessary.

1. Show that there are four collinear points within compound pendulum having same time period. Give their physical significance.

OR

Derive the differential equation of damped harmonic oscillation in LCR circuit. Solving the equation find the damped frequency of the oscillation and explain its significance.

2. A uniform circular disk whose radius R is 12.6cm is suspended as a physical pendulum from a point on its rim. (a) What is its period? (b) At what radial distance $r < R$. Is there a pivot point that gives the same period?
3. Define absorption coefficient of sound. Derive a relation between reverberation time and absorption coefficient for acoustically good hall.
4. Explain how interference fringes are formed by a thin wedge shaped film, when examined by normally reflected light. How will you estimate the difference of film thickness between two points?

OR

Show that the intensity of second order maxima of Fraunhofer's single slit diffraction is

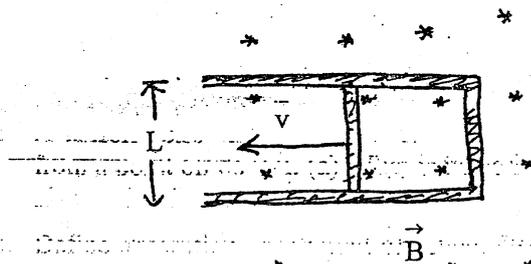
$$\frac{2}{5\pi} \text{ times the intensity of central maxima.}$$

5. In Newton's ring arrangement a source emitting two wavelengths $6 \times 10^{-7} \text{m}$ and $5.9 \times 10^{-7} \text{m}$ is used. It is found that n^{th} dark ring due to one wavelength coincides with $(n + 1)^{\text{th}}$ dark ring due to other. Find the diameter of the n^{th} dark ring if radius of curvature of lens is 0.9m.
6. Calculate the thickness of quarter wave plate for light of wavelength 5893\AA . Given refractive indices of ordinary and extraordinary ray are 1.544 and 1.553 respectively.
7. Define acceptance angle of an optical fiber. Derive the relation for Numerical Aperture (NA) of the optical fiber. Also write down its significance.
8. Two thin converging lenses of focal lengths 0.2m and 0.3m are placed coaxially 0.10m apart in air. An object is located 0.6m in front of the lens of smaller focal length. Find the position of the two principal points and that of image.
9. Derive an expression for the electric potential at any point on the axis of the uniformly charged disk. Extend your result to calculate electric field.

OR

Derive an expression for the electric field at any point on the axis of the short linear quadrupole.

10. A copper slab of thickness b is inserted into a parallel plate capacitor exactly half way between the plates. If the separation of the plate is d and the area of each plate is A , show that the change in capacitance is equal to $\frac{\epsilon_0 Ab}{(d-b)d}$.
11. What is the drift speed of the conduction electrons in a copper wire (molecular mass = 63.54 g/mol, density 8.96 g/cm³) with radius 900 μ m when it has a uniform current 17mA flowing in the wire?
12. A long straight wire of radius R carries a uniformly distributed current I . Calculate magnetic fields at any points inside and outside the wire.
13. The conducting rod shown in figure has length L and is being pulled along horizontal, frictionless conducting rails at a constant velocity \vec{v} . The rails are connected at one end with a metal strip. A uniform magnetic field \vec{B} , directed out of the page, fills the region in which the rod moves. Derive an expression for the rate of thermal energy being generated in the rod.



14. A coil has an inductance of 53 mH and a resistance of 0.35 Ω . If a 12V emf is applied across the coil, how much energy is stored in the magnetic field after the current has built up to its equilibrium value? After how many time constants will half this equilibrium be stored in the magnetic field?

OR

In a certain cyclotron a proton moves in a circle of radius 0.5m. The magnitude of the magnetic field is 1.20T. What is the oscillator frequency? What is the kinetic energy of the proton in eV?

15. Define poynting vector. Prove that $\vec{S} = \frac{1}{\mu_0} (\vec{E} \times \vec{B})$, where the symbols have their usual meanings.

16. An electron is trapped in an one dimensional infinite potential well of width 'a' such that

$$V = \infty \text{ for } 0 \leq x \text{ and } x \geq a$$

$$V = 0 \text{ for } 0 < x < a$$

Using boundary condition, prove that the total energy of the system is

$$E = \frac{\pi^2 n^2 \hbar^2}{2ma^2}$$

Where symbols carry their usual meanings.

Examination Control Division

2067 Ashwin

Exam.	New Back (2066 Batch)		
Level	BE	Full Marks	80
Programme	BEL, BEX, BCT, BIE, B.Agr.	Pass Marks	32
Year / Part	I / I	Time	3 hrs.

Subject: - Engineering Physics

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt *All* questions.
- ✓ *All* questions carry equal marks.
- ✓ Assume suitable data if necessary.

1. Define forced oscillation. Show that the total energy of the damped oscillation decreases with increasing time.

OR

Derive a differential equation for LC oscillation. Solve the equation and show that the maximum value of electric and magnetic energies stored in L.C. circuit are equal.

2. A meter stick swings about pivot point at one end, at distance 'h' from the stick's center of mass. Calculate the period of oscillation using parallel axis theorem.

3. Give an account of bad acoustic properties of a hall. Derive the expression for reverberation time in a good acoustics of a hall.

4. What are coherent sources? Describe a method for determining the refractive index of transparent liquid film using the interference phenomenon.

OR

Describe the construction of Nicol Prism. Explain how it can be used as polarizer and analyzer.

5. A diffraction grating is used at normal incidence. In such arrangement a green line ($\lambda = 5400\text{\AA}$) of certain order is superimposed on the violet line ($\lambda = 4050\text{\AA}$) of the next order. If the angle of diffraction is 30° , how many lines are there in 1 centimeter?

6. A light source emits light of two wavelengths 4300\AA and 5100\AA . The source is used in a double slit experiment. The distance between the sources and the screen is 1.5m and the distance between the slits is 0.025mm. Calculate the separation between the third order bright fringes due to these two wavelengths.

7. A thin convex and thin concave lens, each of focal length 50cm, are coaxially situated and separated by 10cm. Find the position and nature of the final image formed of an object placed 20cm from the convex lens.

8. What is population inversion? Explain the lasing action of a gas laser with necessary energy level diagram.

9. Consider a circular plastic disk of radius R that has a positive surface charge of uniform density on its upper surface. Find the electric field at any point at a distance x from the centre of the disk along its central axis.

OR

✓ Define electric quadrupole. Calculate the electric potential of linear quadrupole of separation $2a$ at an axial distance r from its centre.

10. As a parallel plate capacitor with circular plates 20cm in diameter is being charged, the current density of the displacement current in the region between the plates is uniform and has a magnitude of 20A/m^2 . Calculate the magnitude of magnetic field (B) at a distance $r = 50\text{mm}$ from the axis of symmetry of this region. Also calculate $\frac{dE}{dt}$ in this region.

11. Assuming that each atom of copper contributes one free electrons, calculate the drift velocity of free electrons in copper conductor of cross sectional area 10^{-4}m^2 carrying a current of 200A. Given:

Atomic weight of copper = 63.5 g/mol

Density of copper = $8.94 \times 10^3 \text{kg/m}^3$

Charge of an electron = $1.6 \times 10^{-19} \text{C}$

✓ 12. State Ampere's law. Use this law to find magnetic field that a current produces inside and outside a long straight wire of circular cross section.

OR

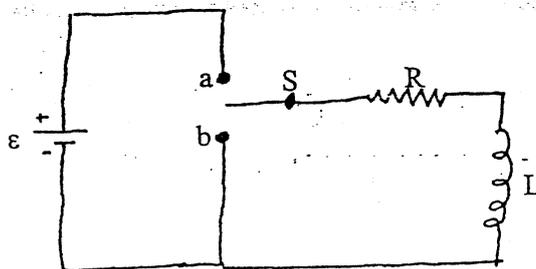
Derive an expression for energy stored in an inductor. Show that the magnetic energy density is directly proportional to the square of the magnetic flux density. How can you compare electric energy density with this result?

✓ 13. A cyclotron which has the dees of radius 42cm and magnetic field of flux density 0.5 weber/ m^2 is employed to accelerate protons. If the final velocity of the proton is $2.02 \times 10^7 \text{m/sec}$, calculate the charge to mass ratio for the proton and the frequency of the alternating potential between the dees.

✓ 14. In the given figure, when switch S is closed on a, the current rises and approaches a limiting value $\frac{\epsilon}{R}$.

a) Find the current through the inductor as a function of time.

b) When the switch is closed on b, the current reduces to zero. Find the rate of decay of current through the inductor.



✓ 15. State Maxwell equations in integral form. Convert them into differential form. Explain each of these equations.

16. Discuss the significance of the wave function and deduce the time independent Schrodinger equation.

Exam	Regular		
Level	B.E.	Full Marks	80
Programme	All	Pass Marks	32
Year / Part	I / I	Time	3 hrs

Subject: Physics

Attempt ALL questions. Each question carries equal mark.

1. Define physical pendulum show that point of Suspension and point of oscillation are interchangeable.

OR

Define damped harmonic oscillator; find time period and frequency for under damping oscillation.

2. Define interference. Show that interference in thin film due to reflected and transmitted light are complementary.

OR

What is double refraction? Obtain the mathematical relation for linearly, circularly and elliptically polarized light.

3. Define diffraction. Derive the intensity distribution pattern of single slit due to diffraction.

4. What is the importance of laser? Discuss the laser action of He-Ne laser with labeled diagram.

5. The maximum Pressure Variation that the ear can tolerate in loud Sound is about 20 N/m^2 . If normal atmospheric pressure is about 10^5 Pascal what is the corresponding maximum displacement for sound wave in air of frequency 1000Hz. (density of air 1.3 kg/m^3 and velocity of sound in air is 343 m/sec).

6. Two thin converging lenses of focal length 20 cm and 40 cm respectively are placed Coaxially 10 cm apart. An object is located at a distance 48 cm from the first lens. Find (a) Position of image (b) Position of principal point and (c) position of focal points.

7. Light is incident normally on a grating 0.5 cm wide having 2500 lines? Find the angle of diffraction for the principal maxima of two sodium line in first order spectrum. ($\lambda_1 = 5890 \text{ \AA}$, $\lambda_2 = 5896 \text{ \AA}$). Are the two lines resolved?

8. A circuit has $L = 10 \text{ mH}$ and $C = 1 \mu\text{F}$, How much resistance must be inserted in the circuit to reduce the (undamped) resonance frequency by 0.01%?

9. Design an electric- quadrupole. Derive the electric field intensity at point on the axial line of the quadrupole.

OR

Derive an expression for the potential at any point due to an electric dipole.

10. An air filled parallel plates Capacitor has a Capacitance of 1.3 pF. The separation of the plates is doubled and wax is inserted between them. The new Capacitance is 2.6 pF. Find the dielectric constant of the wax.

11. Define resistivity. Discuss Atomic view of resistivity and show that $\sigma = m/ne^2\tau$. Where symbols carry to their usual meaning.
12. What is the magnitude of magnetic field needed to be accelerated in the cyclotron? ($m_d = 3.34 \times 10^{-27} \text{ kg}$)
13. State & explain Hall Effect. Derive an expression for Hall coefficient for an Electron.
14. A circular loop of wire 10 cm in radius carries a current 100 Amp. What is the energy density at the center of the loop?
15. Prove that the speed of electromagnetic wave is equal to velocity of light in free space.
16. Derive an expression for one dimensional time independent Schrodinger wave equation.

OR

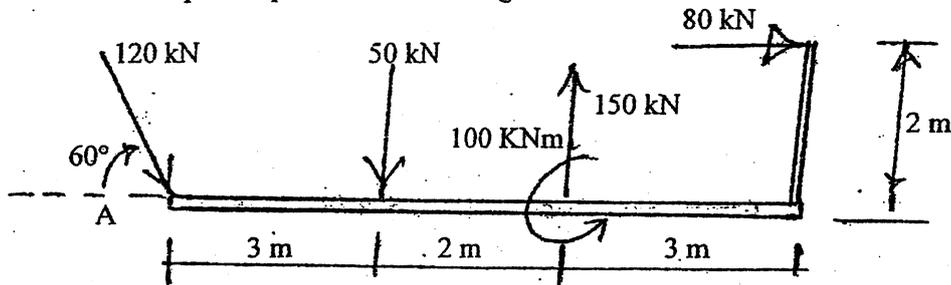
Define tunneling effect and derive the expression for transmission coefficient for a barrier of width a and potential of height V_0 .

Exam.	New Back (2066 & Later Batch)		
Level	BE	Full Marks	80
Programme	BEL, BEX, BCT, BIE, B. Agri., B.Arch.	Pass Marks	32
Year / Part	I / I	Time	3 hrs.

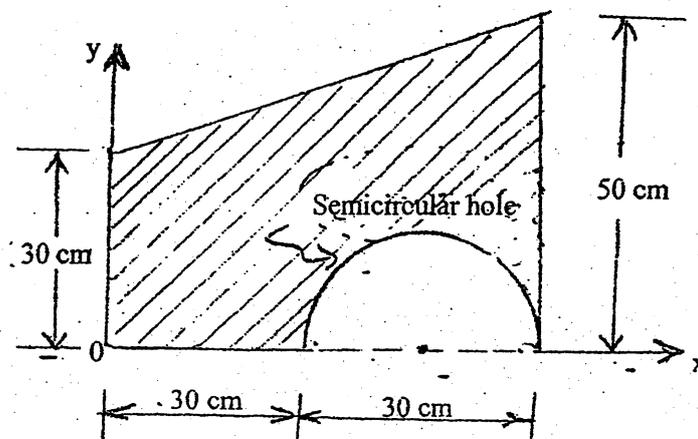
Subject: - Applied Mechanics (CE401)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

1. Explain the physical meaning of equilibrium and its application in structural engineering. [4]
2. a) Differentiate between rigid body and deformable body. Also explain the free body diagram. [2+2]
- b) Determine the magnitude, direction and position of the resultant of the system of forces with respect to point A shown in figure below. [12]



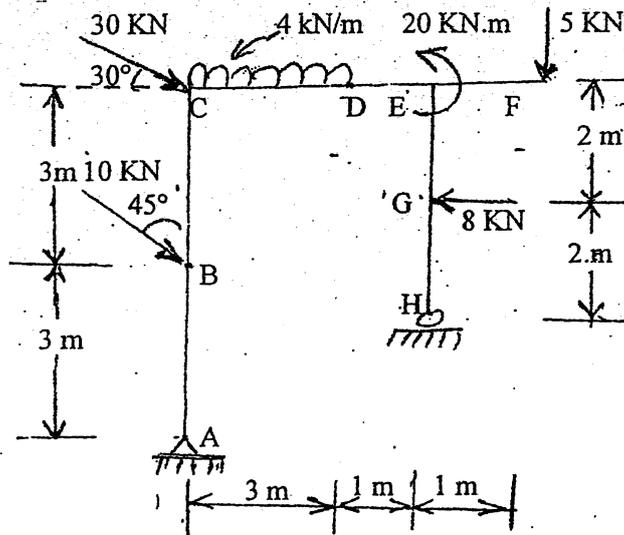
3. State and prove the parallel axis theorem for moment of inertia. Determine the moment of inertia of the given composite area as shown in figure below about its centroidal X-X axis. [4+8]



4. Define friction force and explain condition of tipping and sliding of a block. [1+3]

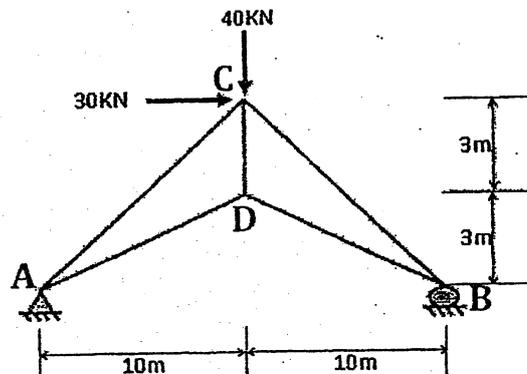
5. Draw AFD, SFD and BMD of the given frame loaded as shown in figure below. Indicate also the salient features if any.

[14]



6. Write down the ideal assumption of truss. Calculate the force developed in all members of the truss loaded as shown in figure by using suitable methods.

[2+8]



7. What do you mean by dependent motion of particles? Illustrate it with suitable example.

A particle starting from origin is subjected to acceleration such that $a_x = -2 \text{ m/sec}^2$ and $a_y = -5 \text{ m/sec}^2$. The initial velocity is 60 m/sec directed at a slope of 30° w.r.t. horizontal. Compute the radius of curvature at the end of 3 sec. Also determine its position at the end of 3 sec.

[3+7]

8. Show that, "rate of change of angular momentum about a point is equal to moment of the force about the same point." The resultant external force acting on a 5 kg particle in space is $\vec{F} = (12t \hat{i} - 24t^2 \hat{j} + 40t^3 \hat{k}) \text{ N}$, where t is seconds. The particle is initially at rest at origin. Determine the x component of acceleration, velocity and position at the instant of 5 sec.

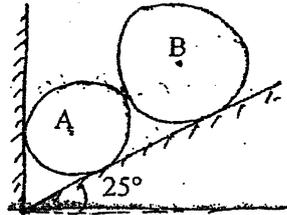
[4+6]

Exam.	New Back (2066 & Later Batch)		
Level	BE	Full Marks	80
Programme	BEL, BEX, BCT, BIE, B.Agr, B.Arch	Pass Marks	32
Year / Part	I / I	Time	3 hrs.

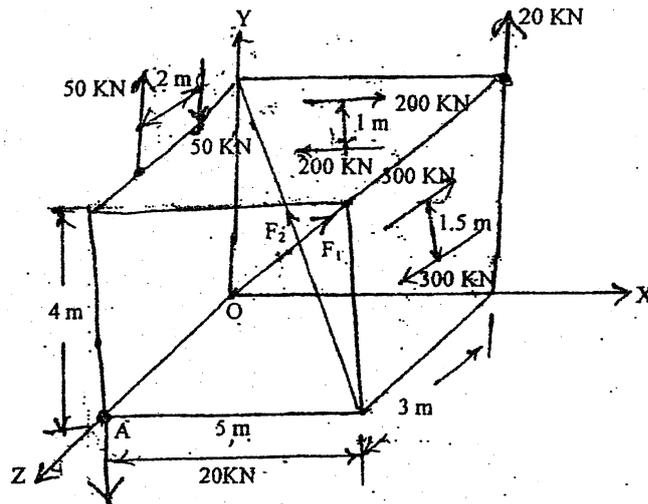
Subject: - Applied Mechanics (CE401)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

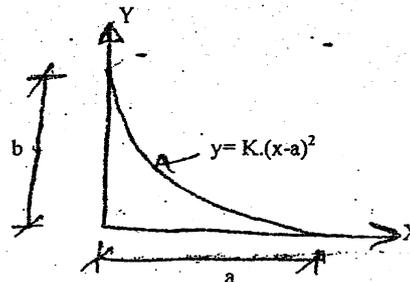
1. Why it is necessary to assume a solid body as a perfectly rigid in the Engineering study. [3]
2. What is free body diagram? The cylinder A and B rest in an inclined surface which makes an angle of 25° with horizontal as shown in figure below. Determine reaction at contact points. Take: [2+6]
 - Weight of cylinder A (W_A) = 100 N
 - Weight of cylinder B (W_B) = 200 N
 - Diameter of cylinder A (r_A) = 60 mm
 - Diameter of cylinder B (r_B) = 90 mm



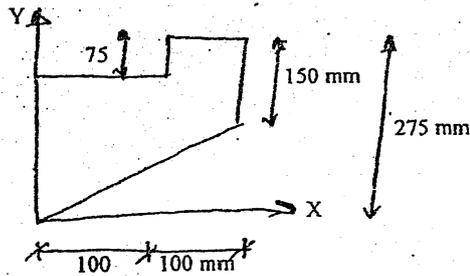
3. Find the resultant of force couple system at point 'A' as shown in figure below. Take $F_1 = 100$ KN, $F_2 = 300$ KN. Define a couple and show that couple is a free vector. [8+3]



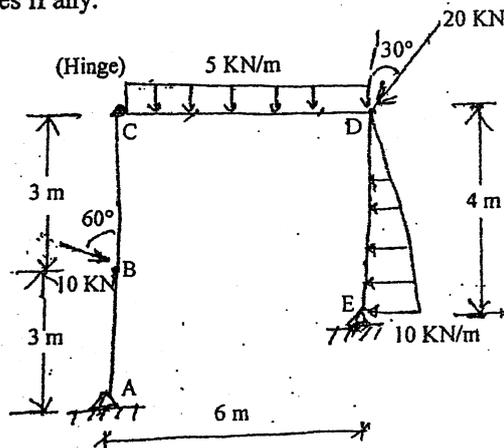
4. Determine by direct integration method, the centroid of the area shown in figure below: [5]



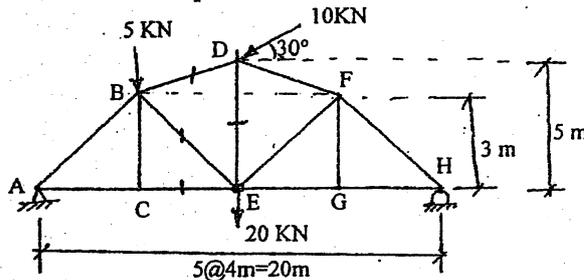
5. Calculate the moment of inertia of the composite area about Y-axis. [6]



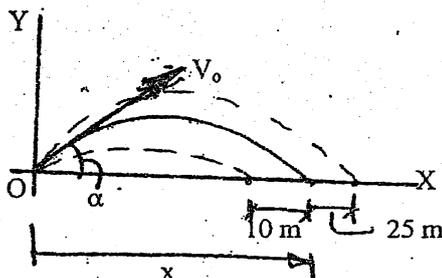
6. State laws of dry friction. How can we assume the condition of overturning and sliding of a block? Explain with suitable example. [2+3]
7. Draw axial force shear force and bending moment diagram for the given frame. Also indicate salient features if any. [14]



8. Find the member forces in CE, BE, BD and DE for the given truss. Define stability and determinacy of structures with examples. [5+3]



9. A projectile is aimed at a marked on the horizontal plan through the point of projection and falls 10 shorts when the angle of projection is 15° while overshoots the mark by 25 m when the inclination is 40° . Calculate the distance of the target and required angle of projection, if the velocity remains constant. Neglecting air resistance. Define dependent motion of particle with example. [8+2]



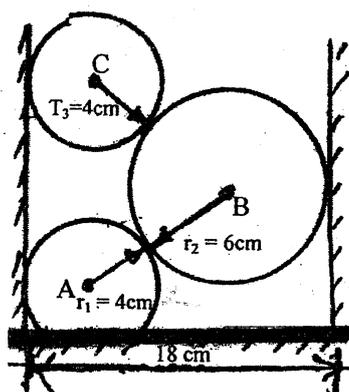
10. Define the dynamic equilibrium. Determine the velocity and acceleration of the particle, if it moves along a curved path defined by $r = 5\theta$ and $\theta = t^2/3$, where r is in meters and t is in seconds. Given that the instant angle is $\theta = \pi/2$. [2+8]

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BEL, BEX, BCT, BIE B.Agri, B.Arch	Pass Marks	32
Year / Part	I / I	Time	3 hrs.

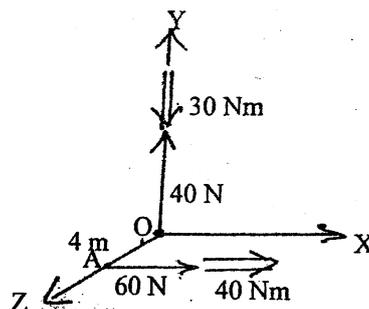
Subject: - Applied Mechanics (CE401)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt **All** questions.
- ✓ The figures in the margin indicate **Full Marks**.
- ✓ Assume suitable data if necessary.

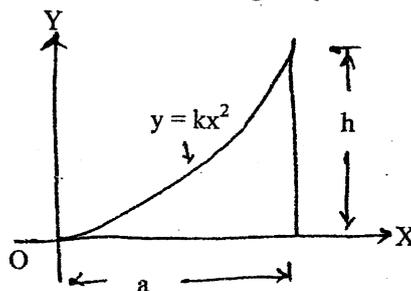
1. Describe the scope and importance of applied mechanics in engineering study. Define free body diagram with examples. [2+2]
2. Determine the reactions at the contact points, if three cylinders are piled in a rectangular ditch as shown in figure. Given that the weight of the cylinders are: $W_A = 2 \text{ KN}$ [8]
 $W_B = 5 \text{ KN}$
 $W_C = 3 \text{ KN}$



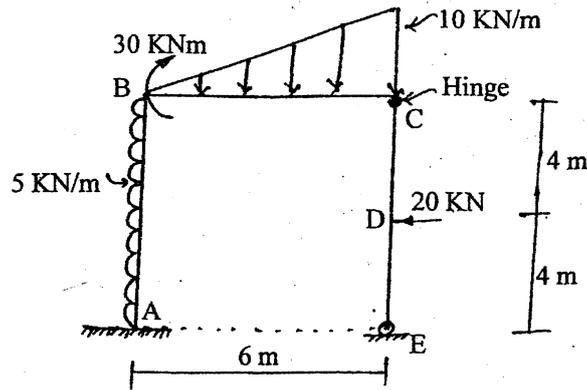
3. How can you reduce a force into a force and couple? Obtain the resultant of the two pairs of wrench shown in the figure. Indicate its line of action. [3+8]



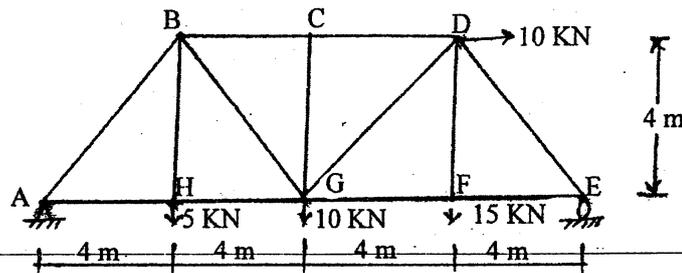
4. Determine centroid of the given plane figure. State and prove parallel axes theorem for moment of inertia. Define centroid and center of gravity. [7+3+2]



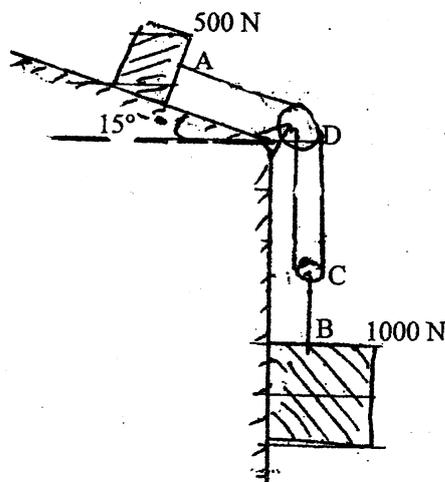
5. Define the angle of friction and also write the laws of static friction. [4]
6. Draw axial force, shear force and bending moment diagram for the loaded frame as shown in figure below. Also indicate the salient features if any. [13]



7. Determine the total degree of internal, external indeterminacy of given truss. Also determine the member forces in members BC, BG, HG and GD. [2+6]



8. The acceleration of a particle is given by a relation $a = v^3$. It is known that at time $t = 0$, position is -2m and velocity is 2m/sec . Find the displacement, position, velocity and acceleration at instant of $\frac{1}{2}$ sec. What do you mean by projectile and obtain the equations for projectile motion. [7+3]
9. What do you mean by impulse momentum principle? Two blocks A and B having respective weights 500 N and 1000 N start from rest. The pulley is frictionless and also practically mass less. The kinetic coefficient of friction between the block A and the inclined surface is 0.35 . Determine the acceleration of each block and tension in the cord. [2+8]

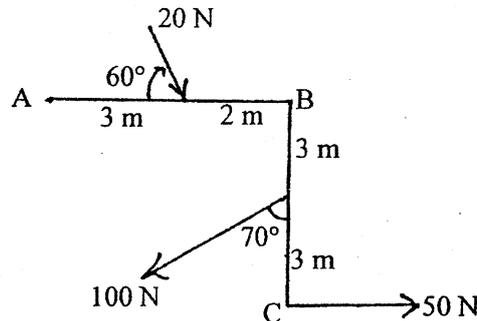


Exam.	New Back (2066 & Later Batch)		
Level	BE	Full Marks	80
Programme	BEL, BEX, BCT, BIE, B.Agric, B.Arch	Pass Marks	32
Year / Part	I / I	Time	3 hrs.

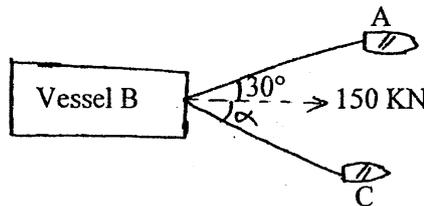
Subject: - Applied Mechanics (CE401)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

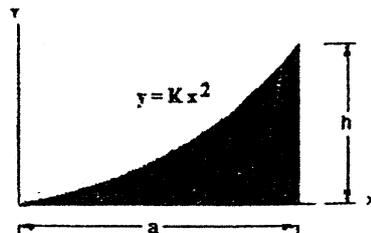
1. Describe the scope of applied mechanics in engineering. [3] 2
2. What is the physical meaning of equilibrium and why it is important in structure? How can we draw good Free Body Diagram? Explain with suitable examples. [4+4] 6
3. Determine magnitude, direction and line of action of the resultant of forces acting in the system shown in figure below. [8]



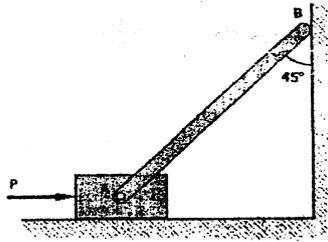
4. A commercial vessel is being pulled into harbour for unloading by two tugboats as shown in figure knowing the vessel requires 150 kN along its axis to move it steadily. Compute the tensions in rope AB and BC when $\alpha = 40^\circ$. [4]



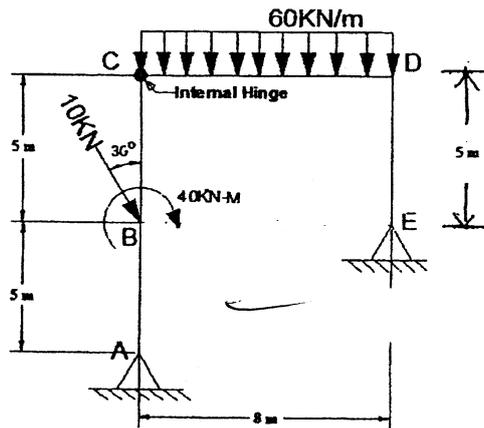
5. State and prove parallel axis theorem. Also determine the centroidal X and Y coordinate of the hatched area. [3+8]



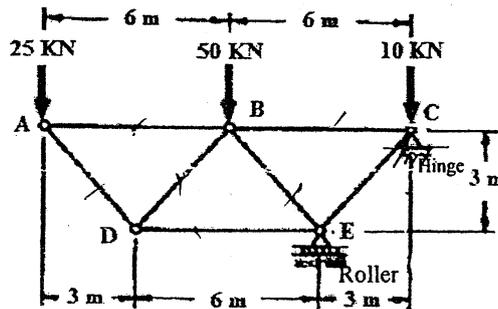
6. A uniform bar AB, weighing 424 N, is fastened by a frictionless pin to a block weighing 200 N as shown in figure. At the vertical wall, $\mu = 0.268$ while under the block, $\mu = 0.20$. Determine the force P needed to start motion to the right. [5]



7. Draw the Axial Force, Shear force and Bending Moment diagram of the given frame. Also show the salient features if any. [13]



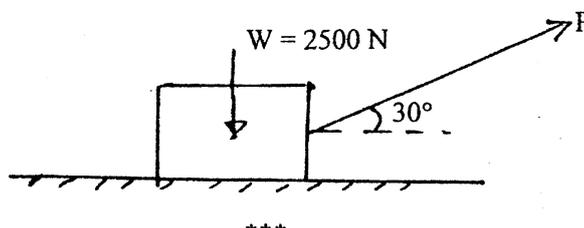
8. Determine the member forces for given truss loaded as shown in figure below. [8]



9. The motion of a vibrating particle is defined by the equations $x = 100 \sin \pi t$ and $y = 25 \cos 2\pi t$ where x and y are expressed in mm and t in sec. [10]

- Determine the velocity and acceleration when $t = 1$ sec
- Find the nature of path of the particle

10. Determine the magnitude of force P required to give the block an acceleration of 10 m/s^2 . Coefficient of friction between the block and the floor is 0.25. [10]



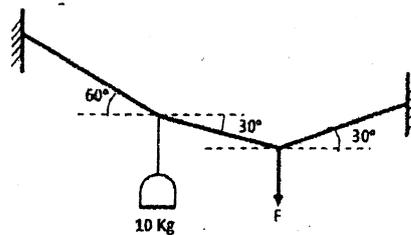
Exam.	Old Back (2065 & Earlier Batch)		
Level	BE	Full Marks	80
Programme	BEL, BEX, BCT	Pass Marks	32
Year / Part	1/1	Time	3 hrs.

Subject: - Applied Mechanics (EG439CE)

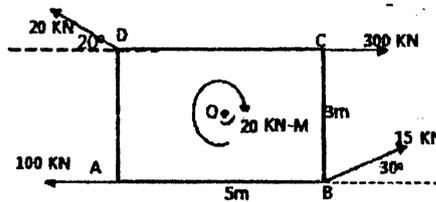
- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt any **Five** questions.
- ✓ The figures in the margin indicate **Full Marks**.
- ✓ Assume suitable data if necessary.

1. (a.) Describe the Free Body Diagram and its importance in analysis of structure. (3)

(b.) Determine the force in each cable and the force F needed to hold the 10Kg lamp in the position shown in figure below. (5)

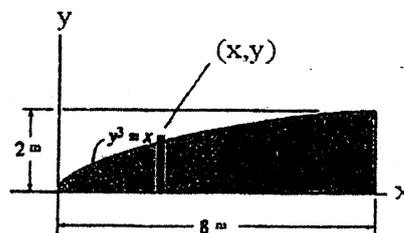


(c.) Determine the magnitude and direction of the resultant force in the given force system (8)



2. (a.) Define the Moment of Inertia, Polar Moment of Inertia and Radius of Gyration. (6)

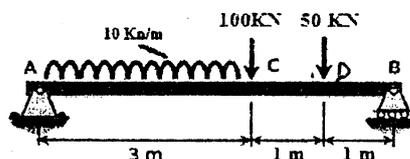
(b.) Determine the Moment of Inertia of following enclosed (hatched) area with the curves $y^3 = x$. Use suitable method. (10)



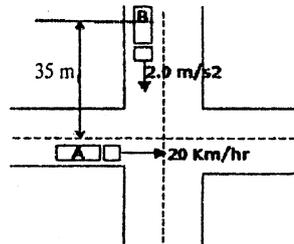
3. (a.) Define the limiting friction, coefficient of friction and angle of friction. (3)

(b.) Write down the ideal assumptions of Truss. (3)

(c.) Draw the **Axial Force, Shear Force and Bending Moment diagram** of the given beam. Also show the salient features, if any. (10)



4. (a.) Auto mobile 'A' is travelling east at the constant speed of 20 Km/hr. As automobile 'A' crosses the intersection shown, automobile 'B' starts from rest 35m North of a intersection and moves south with a constant acceleration of 2m/s^2 . Determine the position, velocity, and acceleration of 'B' relative to 'A'; 10 sec after 'A' crosses the intersection. (10)



- (b.) Derive the expression for the tangential and normal components of the acceleration. (6)

5. (a.) Describe the translational, rotational and general plane motion of rigid body? Illustrate with suitable examples. (8)

- (b.) Describe the impulsive motion and eccentric impact for the rigid body with suitable expression. (8)

6. Write short notes on: (any four)

[4×4]

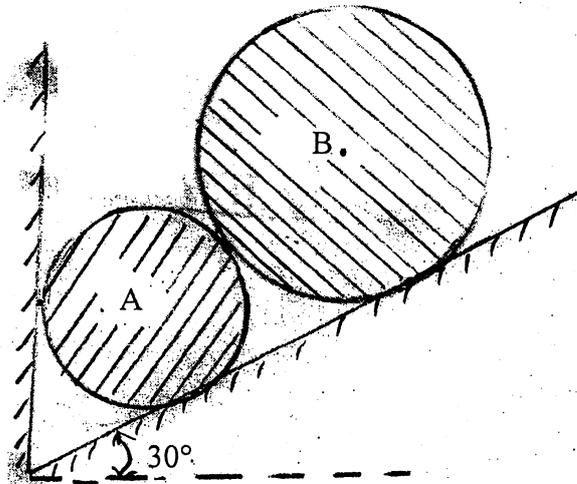
- Force analysis for rigid bodies and their equations of motion
- Conservative and non-conservative systems
- Projectile motion with examples and applications
- Distribution and centre of pressures on submerged surfaces with examples
- Determinate and indeterminate frames

Exam.	Old Back (2065 & Earlier Batch)		
Level	BE	Full Marks	80
Programme	BCE, B.Agric.	Pass Marks	32
Year / Part	I/I	Time	3 hrs.

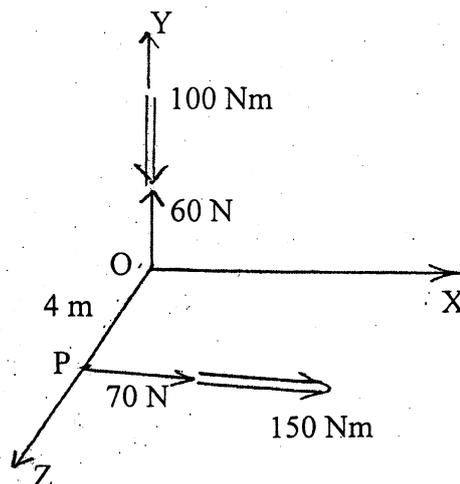
Subject: - Applied Mechanics I (Statics) (EG441CE)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt any **Five** questions.
- ✓ The figures in the margin indicate **Full Marks**.
- ✓ Assume suitable data if necessary.

1. a) Define Free Body Diagram with examples. Why it is necessary to assume a solid body as "Perfectly Rigid" for the study of statics? Define also the equation of statics equilibrium. [2+3+3]
- b) Two smooth rollers are supported by an inclined plane and a vertical wall as shown in figure below. Find the reaction at all contact points using the following information:
 $W_A = 100 \text{ N}$, $Y_A = 10 \text{ cm}$ $W_B = 140 \text{ N}$, $Y_B = 14 \text{ cm}$. [8]

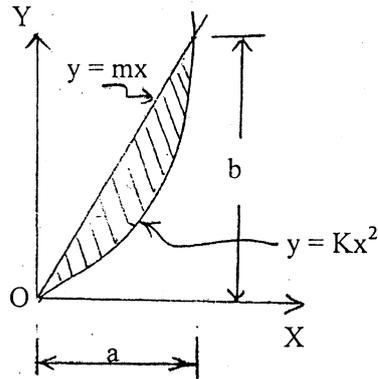


2. a) Define dot and cross product of two vectors. Define also the scalar triple product and show that "scalar triple product represents the volume of the parallelepiped." [2+4]
- b) Two wrenches are shown in figure below, determine the equivalent wrench and also indicate its line of action. [10]

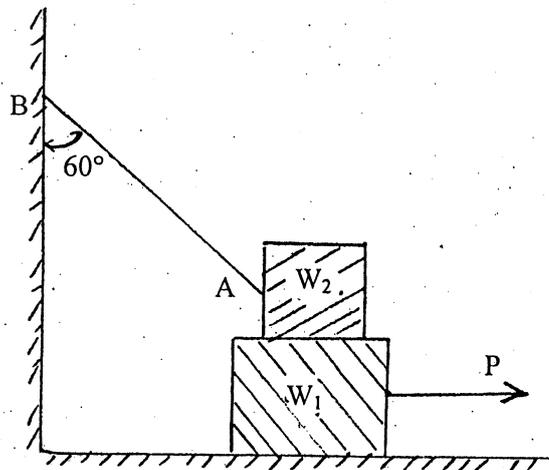


3. a) Define the terms: Centroid, Center of gravity and axis of symmetry. State and prove the parallel axis theorem for moment of inertia. [3+4]

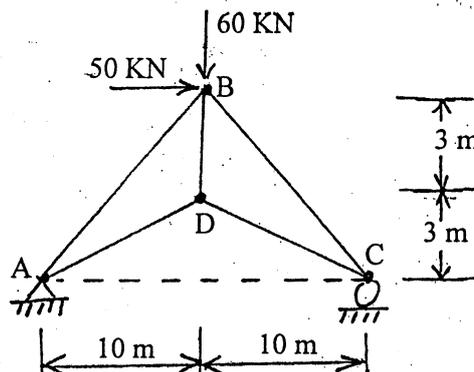
- b) Locate the centroid of the shaded area as shown in figure below by the method of integration. [9]



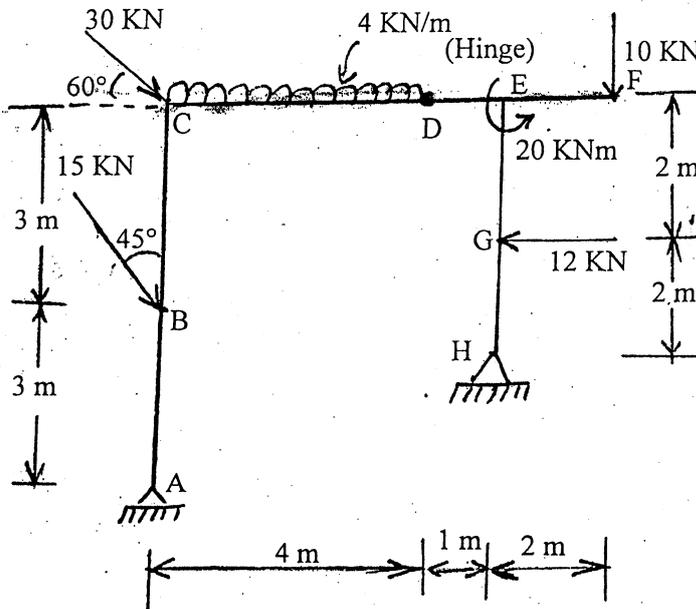
4. a) Obtain the expression for total pressure by the liquid on an inclined immersed surface. [6]
 b) How can we assure the condition of sliding and overturning of a block? Explain with suitable example. A block of weight $W_1 = 800$ N rests on a horizontal surface and supports on top of it another block of weight $W_2 = 500$ N as shown in figure below. The block W_2 is attached to a vertical wall by the inclined string AB. Find the magnitude of the horizontal force P, applied to the lower block as shown, that will be necessary to cause just sliding. The coefficient of static friction for all contact surfaces is 0.4. [3+7]



5. a) Define plane and space structures with examples. How can we check the determinacy and stability of the structures (ie beam, frame and truss)? Explain with suitable examples. [2+6]
 b) Calculate the force developed in all the members of the truss loaded as shown in figure below. [8]



6. a) Obtain the relationship between load, shear force and bending moment for a beam section loaded with intensity of load w . [4]
- b) Draw AFD, SFD and BMD of the given frame loaded as shown in figure below. Indicate also the salient features if any. [12]



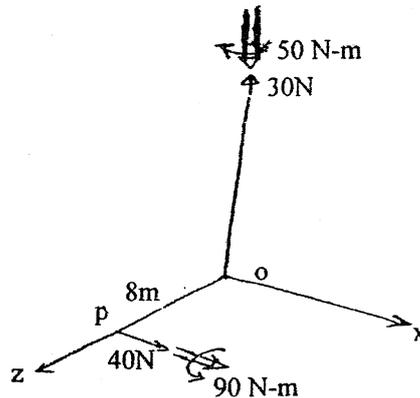
Examination Control Division
2069 Chaitra

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BEL, BEX, BCT, BIE, B.Agr. B.Arch.	Pass Marks	32
Year / Part	I / I	Time	3 hrs.

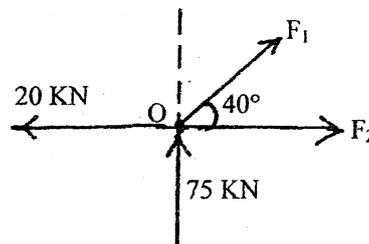
Subject: - Applied Mechanics (CE401)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

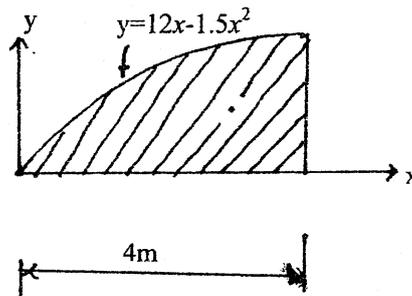
1. Describe briefly the concept of particle, rigid body and deformable body. [3]
2. Describe Free Body Diagram and physical meaning of equilibrium. Also describe the importance of Free Body Diagram and equilibrium in structural analysis. [2+2+2+2]
3. Replace the two wrenches as shown in figure by a single equivalent wrench and determine (a) the resultant force, (b) indicate it's line of action. [8]



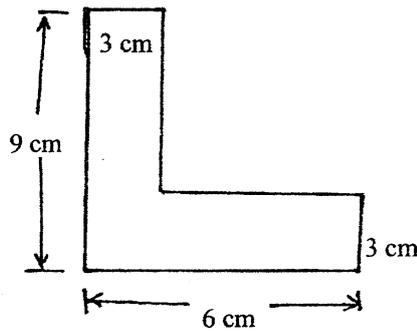
4. Determine the value of F_1 and F_2 if the forces shown in figure below are in equilibrium. [4]



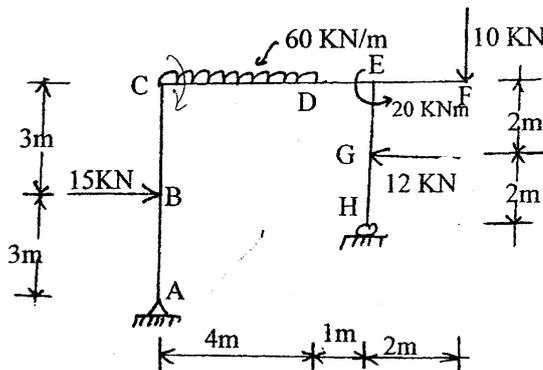
5. Determine centroidal x coordinate of the shaded area shown in figure below. [4]



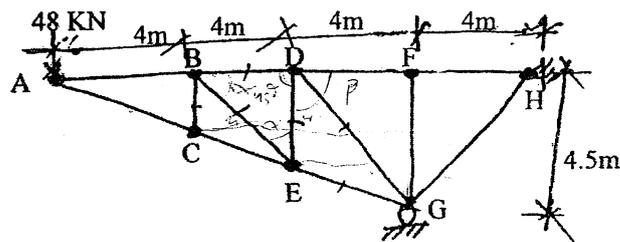
6. Determine radius of gyration (r_x) of the angle section shown in figure below about centroidal x -axis. [8]



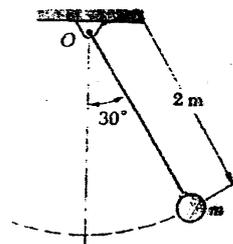
7. Illustrate impending motion state of friction and demonstrate the change in frictional force for different motion stages using relevant figure. [4]
8. Draw AFD, SFD and BMD of the given frame loaded as shown in figure below. Indicate the salient feature if any. [14]



9. Compute the force developed in the member BC, BD, BE, DE, DG and EG of the given truss loaded as shown in figure. [7]



10. Define uniformly rectilinear motion and uniformly accelerated rectilinear motion. A projectile is fired with an initial velocity of 244m/s at a target B located 610m above the level of gun A and at a horizontal distance of 3658m. Neglecting air resistance, determine the value of the firing angle. [2+8]
11. Define the linear momentum and angular momentum. Find the velocity and acceleration of the bob in the given position. The bob of a 2m pendulum describes an arc of a circle in a vertical plane. Tension in the cord is 2.5 times the weight of the bob for the position shown. [2+8]



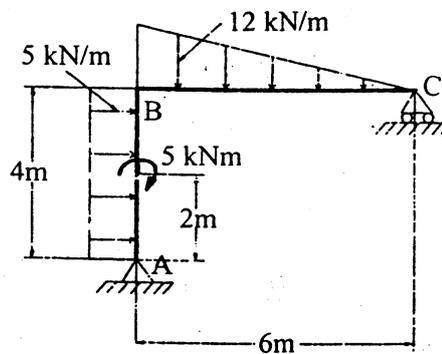
Exam.	Regular / Back		
	Level	BE	Full Marks
Programme	BEL, BEX, BCT, BIE, B.Agric., B.Arch.	Pass Marks	32
Year / Part	I / I	Time	3 hrs.

Subject: - Applied Mechanics

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt any Five questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

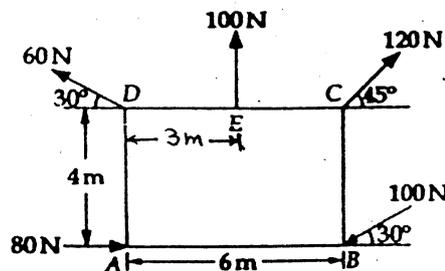
1. a) Derive the relationship between load, shear force and bending moment. [4]

b) Draw axial force, shear force and bending moment diagram for the given loaded frame as shown in figure below. [12]



2. a) What is the equilibrium of a body? Write the conditions of equilibrium of a particle. [4]

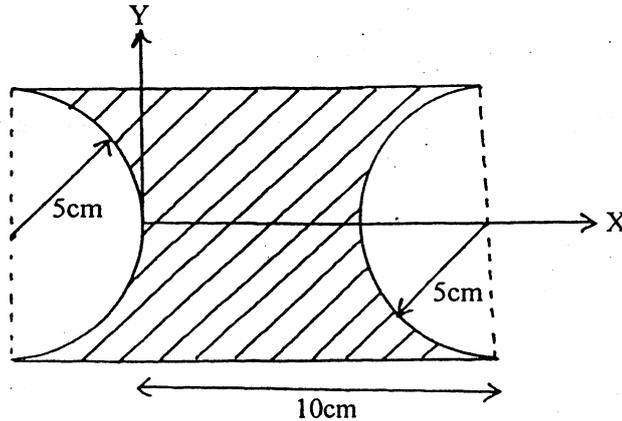
b) A plate of size 6m × 4m is acted upon by a set of forces in its plane as shown in figure below. Determine the magnitude, direction and position of resultant force. [12]



3. a) Determine the centroid of right angle triangle by method of integration. [6]

- b) Find the moment of inertia and radius of gyration about X-Y axis of the figure shown below.

[10]

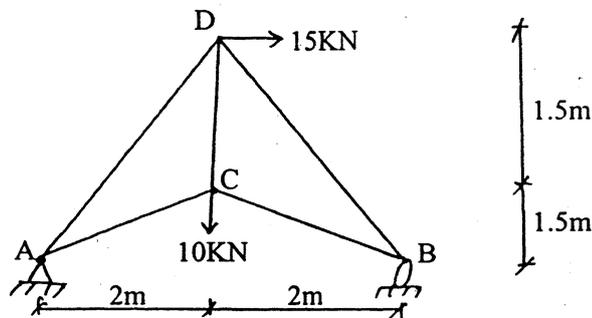


8

4. a) What is the angle of friction? Explain about tipping and sliding of block?
 b) Determine the support reactions and forces in all member in the given pin jointed truss as shown in figure below.

4 [6]

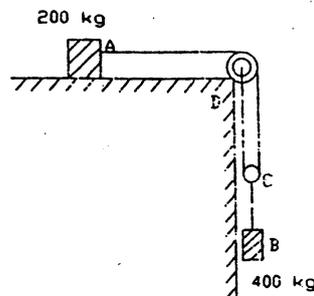
[10]



5. a) What is the linear momentum? Explain about rate of change of it.
 b) Two blocks shown in figure below start from rest. The horizontal plane and the pulleys are frictionless, and the pulley is assumed to be of negligible mass. Determine the acceleration of each block and the tension in each rod.

[4]

[12]



6. a) Mention the types of support on structures and support reactions with its free body diagram.
 b) For a particular body moving rectilinearly, $a = -10x^{-2}$, where a is the acceleration in m/sec^2 and x is in meter units. It is known that when $t = 2$ sec, $x = 8m$ and $v = 3m/sec$.
 - Determine its acceleration when $t = 3$ sec.

[6]

[10]

Examination Control Division

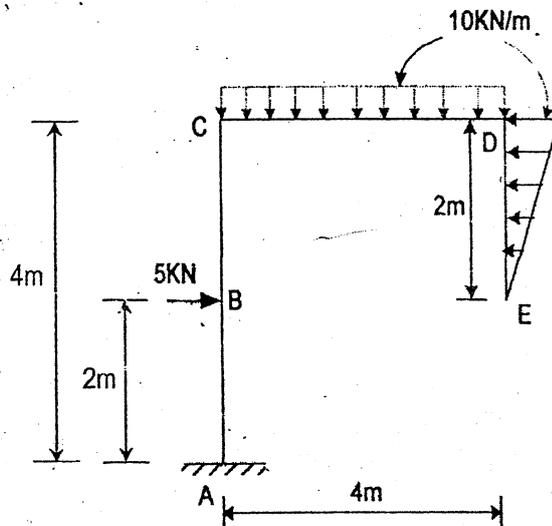
2068 Shrawan

Exam.	New Back (2066 Batch & Later)		
Level	BE	Full Marks	80
Programme	BEL, BEX, BCT, BIE, B.Agr., B.Arch.	Pass Marks	32
Year / Part	I / I	Time	3 hrs.

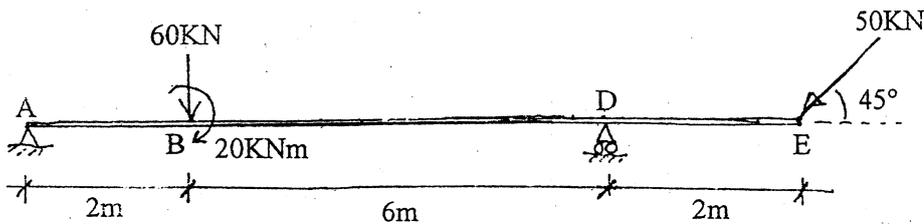
Subject: - Applied Mechanics

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt any **Five** questions.
- ✓ The figures in the margin indicate **Full Marks**.
- ✓ Assume suitable data if necessary.

1. a) What are the fundamental concepts and principles of Newtonian mechanics? [4]
- b) Draw bending moment diagram, shear force diagram and axial force diagram for the given figure below. And also indicate the salient points if any. [12]

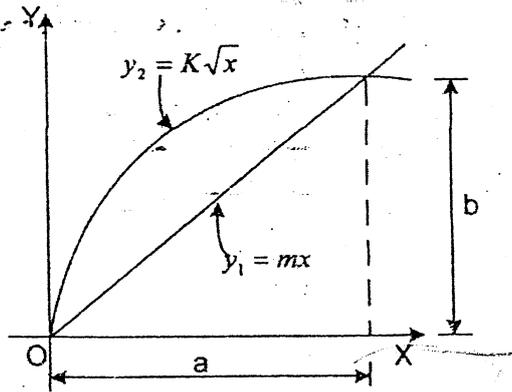


2. a) Explain principles of transmissibility and its limitations. [6]
- b) Determine force couple system about point 'A' for the given system of forces as shown in figure below. [10]

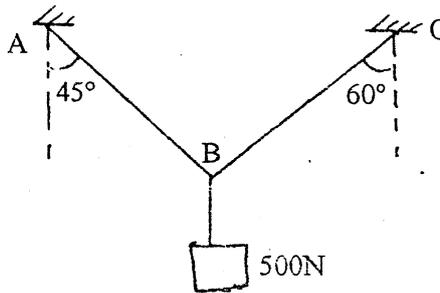


3. a) Explain the characteristics of friction with sketch. [4] 3

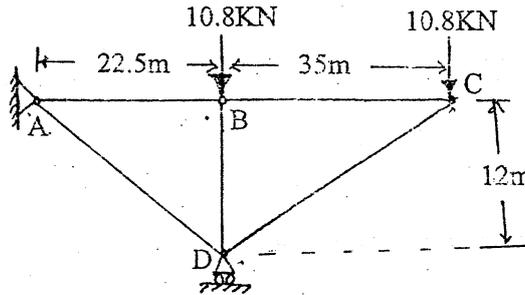
b) Determine the moment of inertia of the common area as shown in figure below about x and y axis. [12] 50



4. a) Determine the forces in cables AB and AC as shown in figure below. [5] 4



b) Determine the forces in all members of the truss shown in figure below. [11] 9



5. a) The position of particle which moves along a straight line is defined by the relation $x = t^3/3 - 6t^2 - 15t$. Where x is in meter and t is in seconds. Determine: [8]

- i) The time at which velocity will be zero
- ii) The position and distance travelled by the particle at that time
- iii) The acceleration of the particle at that time

b) Define dynamic equilibrium. Also state equation of motion for rectilinear and curvilinear motion of particle. [8]

6. a) How the motion of a particle is found when the acceleration is a given function of time? [6] 3

b) A particle projected at an angle of θ to horizontal axis with an initial velocity of 61m/sec hits a target located at 600 meter below the horizontal axis and having the inclined slope of $3/4$ downward from the axis of to the target. Find the projected angle θ and the maximum height achieved by particle from the target. [10] 8

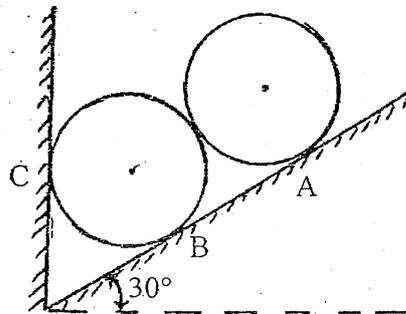
2068 Chaitra

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BEL, BEX, BCT, BIE, B.Agri, B.Arch	Pass Marks	32
Year / Part	I / I	Time	3 hrs.

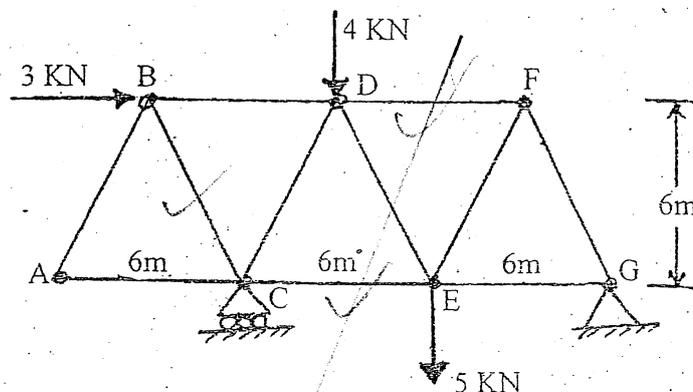
Subject: - Applied Mechanics (CE401)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

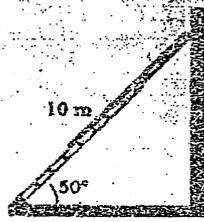
1. What are the fundamental principles of mechanics? Explain briefly. [3]
2. Two identical rollers each of weight $W = 500\text{N}$ are supported by an inclined plane and a vertical wall as shown figure below. Draw the free body diagram of each roller separately. Assuming smooth surfaces, find the reactions induced at the points of support A, B and C. [8]



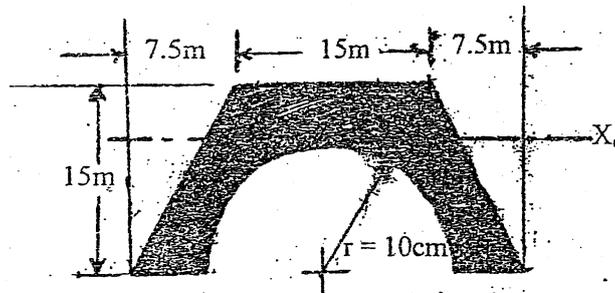
3. Use the method of sections to compute the force in bars BC, DF and CE of the Warren truss loaded as shown in figure below. [8]



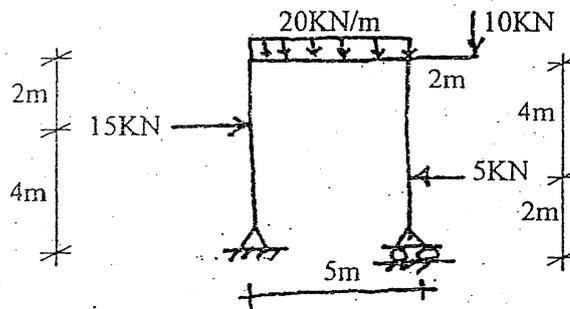
4. A 10m ladder is leaning against a smooth vertical wall and the floor with the friction coefficient 0.4. Determine the normal reactions and the friction force at the top and bottom of the ladder. [4]



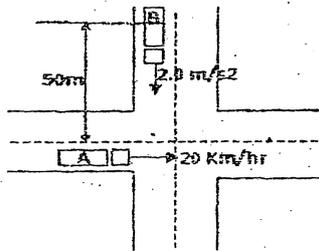
5. Determine the moment of inertia of the shaded area shown in figure below about its centroidal X_0 axis. [12]



6. What are statically determinate and indeterminate structures? Draw axial force, shear and bending moment diagrams of the frame loaded as shown in figure below. [3+10]



7. Define the uniformly rectilinear and uniformly accelerated rectilinear motion. Automobile 'A' is travelling east at the constant speed of 20 Km/hr. As automobile 'A' crosses the intersection shown, automobile 'B' starts rest 35m North of a intersection and moves South with a constant acceleration of 2 m/s^2 . Determine the position, velocity and acceleration of 'B' relative to 'A'; 10 sec after 'A' crosses the intersection. [2+8]



8. A particle projected at an angle of 20° with the horizontal axis with an initial velocity of 50m/sec. hits the target located at 'h' meter below the horizontal axis having the inclined

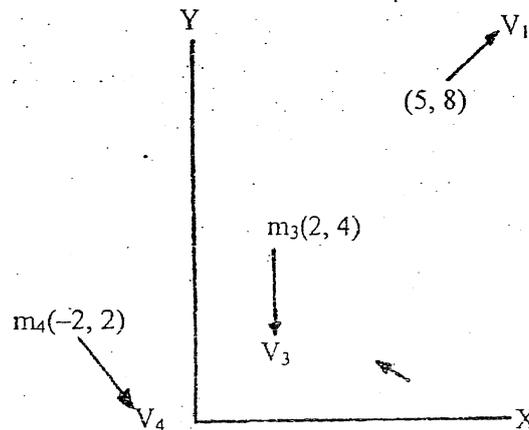
slope of $\frac{3}{4}$ downward from the axis of the target. Determine the sloping distance covered by the projectile and the maximum height achieved by the projectile from the target. [12]

OR

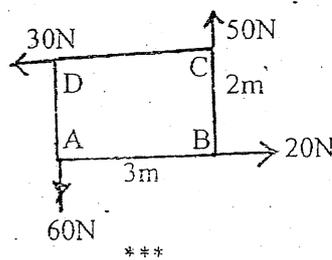
In Figure below is shown a system of particles at time t moving in the xy plane. The following data apply:

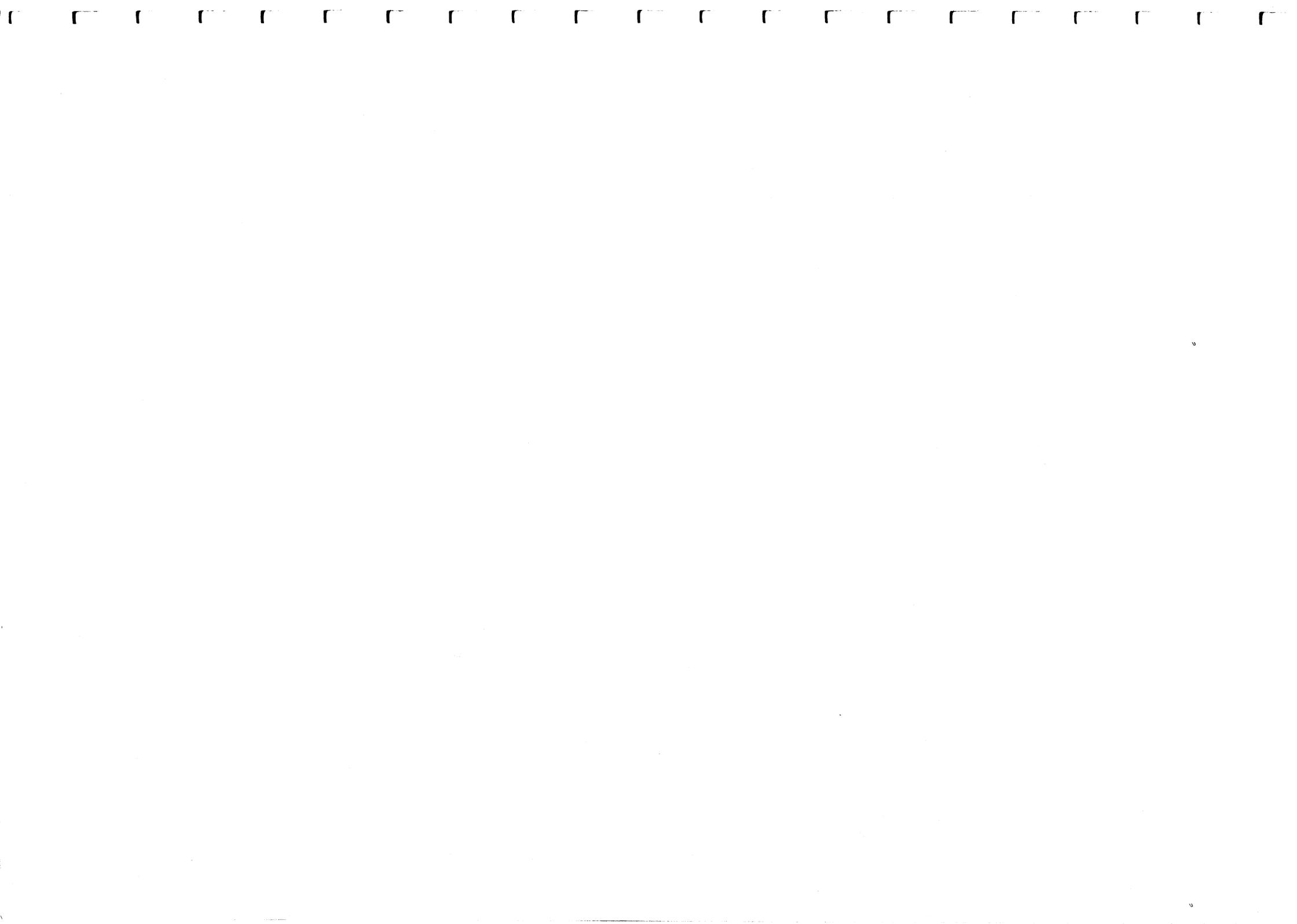
$$\begin{aligned} m_1 &= 0.5 \text{ kg} & V_1 &= 1.5i + 1.5j \text{ m/s} \\ m_2 &= 0.35 \text{ kg} & V_2 &= -1.3i + 1j \\ m_3 &= 1 \text{ kg} & V_3 &= -1.3i \\ m_4 &= 0.75 \text{ kg} & V_4 &= 1i - 1.3j \end{aligned}$$

- What is the total linear momentum of the system?
- What is the linear momentum of the center of mass?
- What is the total moment of momentum of the system about the origin and about point $(2,6)$? [4+4+4]



- Define moment and couple. Determine magnitude direction and position of the resultant force of the forces acting on a rectangular plate shown in figure below. [2+8]



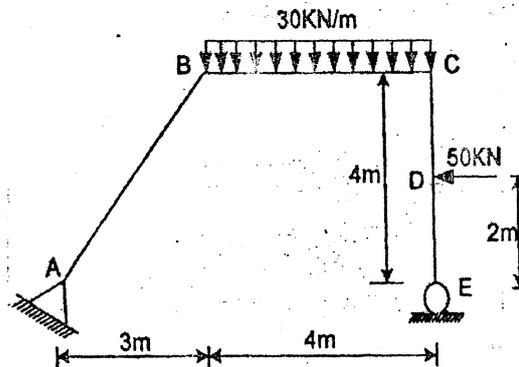


Exam.	Regular/Back		
Level	BE	Full Marks	80
Programme	BEL, BEX, BCT, BIE, B.Agric., B.Arch.	Pass Marks	32
Year / Part	I / I	Time	3 hrs.

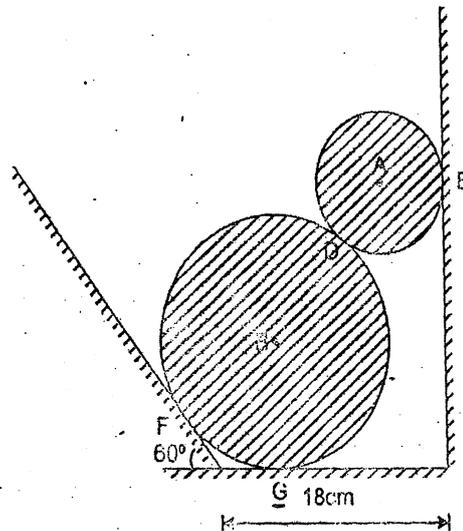
Subject: - Applied Mechanics

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt any Five questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

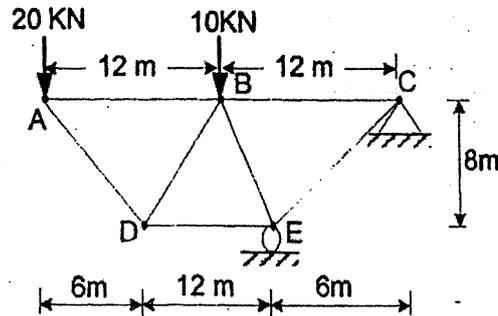
1. a) Define rigid and deformable body. Explain principles of free body diagram and static equilibrium while solving problems in statics? Support your answer with examples. [4]
- b) Draw bending moment, shear force and axial force diagrams for the given figure. And also give ordinates of the salient points, if any. [12]



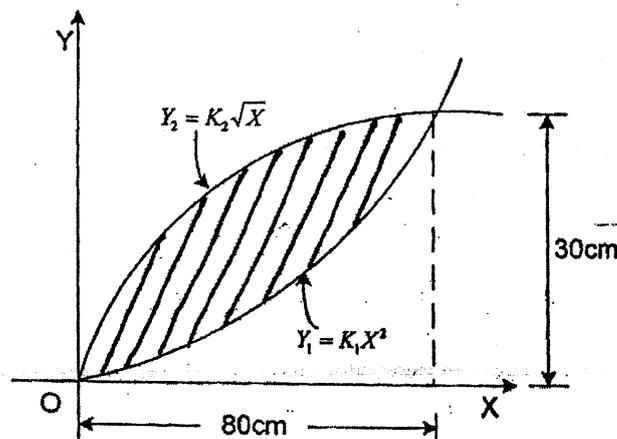
2. a) Two cylinders A and B rest in a channel as shown in figure below. 'A' has a diameter of 10cm and weight 20kg. 'B' has 18cm diameter and weight 50kg. The channel is 18cm wide at the bottom with one side vertical and other side at 120° as shown. Determine the reactions at four contact points. [11]



- b) State and prove the parallel axis theorem for moment of inertia. [5]
3. a) Calculate the member forces of the given truss shown in figure below. [10]



- b) Define discrete and continuum structure. Also discuss about stability, indeterminacy, and determinacy of structures with suitable examples. [6]
4. a) Define limiting friction and impending motion. Justify why coefficient of static friction is greater than coefficient of kinetic friction. [5]
- b) Determine the moment of inertia and radius of gyration of the common area as shown in figure below about x and y axis. [11]



5. a) The acceleration of a particle is directly proportional to the time (t). At time (t) = 0, the velocity of the particle is $v = 16$ m/sec. Knowing that velocity (v) = 15 m/sec position (x) = 20m and time (t) = 1 sec, determine the velocity, the position and total distance travelled when time (t) = 7 sec. [8]
- b) A particle is projected at an angle of 30° to horizontal axis with an initial velocity of 61m/sec hit the target located at 'h' meter below the horizontal axis and having the inclined slope of $\frac{3}{4}$ downward from the axis of the target. Find the sloping distance covered by the projectile and the maximum height achieved by particle from the target. [8]
6. a) Define angular momentum and also prove that rate of change of angular momentum is equal to the moment of the force acting on that particle about the same point. [6]
- b) The motion of a particle is defined by the position vector $(r) = 3t^2i + 4t^3j + 5t^4k$ where r is in meter and t is in second. Find the normal and tangential component of acceleration and the principal radius of curvature at the instant when $t = 4$ secs. [10]

Exam. Level	Regular / Back			
	BE	Full Marks	80	
Programme	BEL, BEX, BCT	Pass Marks	32	
Year / Part	I / I	Time	3 hrs.	

Subject: - Applied Mechanics

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt any Five questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

1. a) Define free body diagram with a suitable example. Also mention the points to be considered while drawing free body diagram. [4]
- b) Draw bending moment, shear force and axial force diagrams for the given Figure 1. And also indicate the salient points. [12]

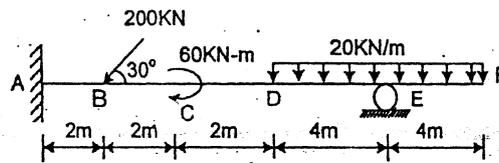


Figure 1

2. a) Two identical rollers, each of weight (W) = 100N, are supported by an inclined plane and vertical wall as shown in Figure 2. Find the reaction at the contact points. Assume all surfaces to be smooth. [8]

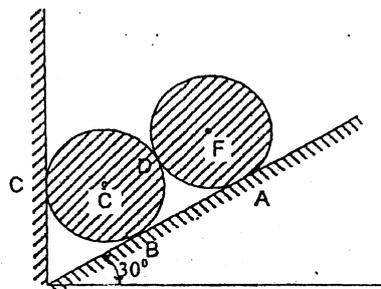


Figure 2

- b) Determine the forces in the truss shown in Figure 3 which carries a horizontal load of 50 kN. [8]

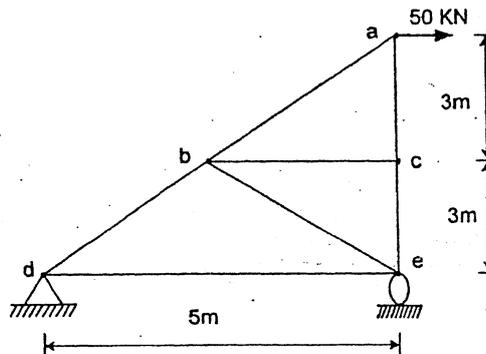


Figure 3

3. a) Prove that centre of pressure is always below the centroid of plane surface submerged in the liquid. [6]
- b) Determine the moment of inertia and radius of gyration of the given area as shown in Figure 4 about centroidal axis. [10]

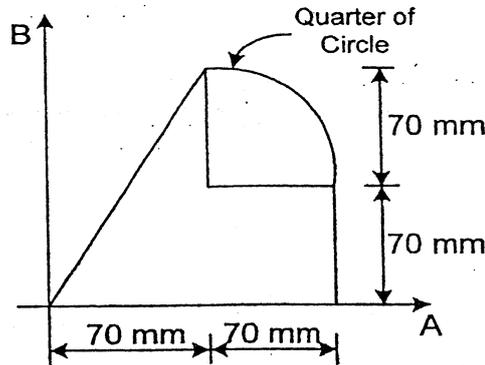


Figure 4

4. a) The acceleration of the particle is directly proportional to the time (t). At $t = 0$, the velocity of the particle (v) = 16m/sec. Knowing that velocity (v) = 15m/sec and that $x = 20$ m when $t = 1$ sec, determine the velocity, the position and the total distance travelled when $t = 7$ sec. [8]
- b) An aeroplane used to drop water on bushfire is flying horizontally in a straight line at 315 km/hr at an altitude of 80m. Determine the distance (d) at which the pilot should release water so that it will hit the point whereat fire starts. [8]
5. a) A 30 kg block is dropped from a height of 2m onto the 10 kg pan on the top of a spring scale. Assuming the impact to be perfectly plastic, determine the maximum deflection of the pan. The constant of spring (K) = 20 KN/m. [10]
- b) What is meant by kinetic energy of a particle? Show that the kinetic energy of a particle also represents the capacity to do work. [6]
6. a) Describe general plane motion briefly with suitable figure. [4]
- b) A 20 gm bullet 'B' is fired with a horizontal velocity of 450 m/sec into the side of a 10 kg square panel suspended from a hinge as 'A' as shown in Figure 5. Knowing that the panel is initially at rest, determine (i) angular velocity of the panel immediately after the bullet becomes embedded, (ii) the impulsive reaction at 'A', assuming that the bullet becomes embedded in 0.6 mins. [12]

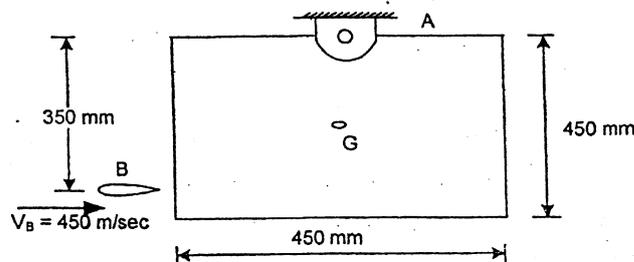


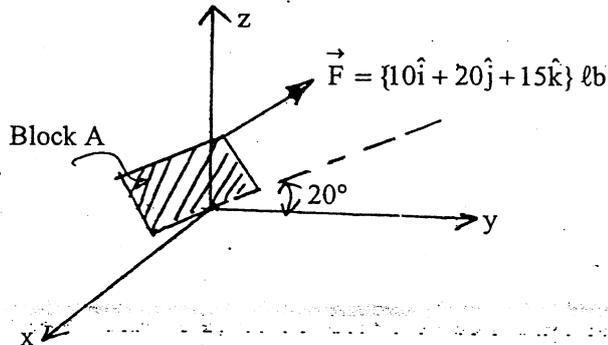
Figure 5

Exam. Level	BE	Back Full Marks	80
Programme	BEL, BEX, BCT	Pass Marks	32
Year / Part	I/I	Time	3 hrs.

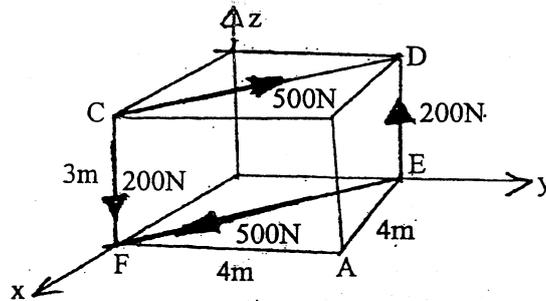
Subject: - Applied Mechanics

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt any **Five** questions.
- ✓ The figures in the margin indicate **Full Marks**.
- ✓ Assume suitable data if necessary.

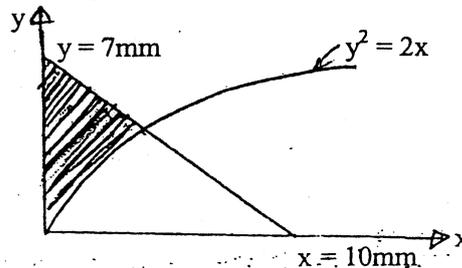
1. a) A block A is constrained to move along a 20° incline in the yz plane. How far does the block have to move if the force F is to do 10 ft-lb work? [6]



- b) What is the moment of the forces shown about point A and about a point P having a position vector $\vec{r}_p = \{10\hat{i} + 7\hat{j} + 15\hat{k}\}m$. [10]

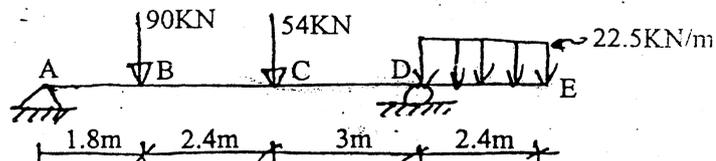


2. a) What are the co-ordinates of the centroid of the shaded area? The parabola is given as $y^2 = 2x$ with y and x in millimeters. [10]

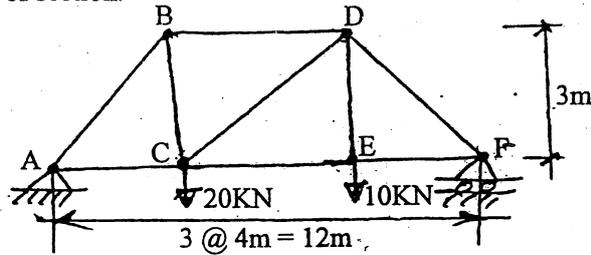


- b) State and prove the parallel axis theorem. [6]

3. a) Draw the shear force and bending moment diagrams for the beam loaded as shown. Find the value of shear force where the value of bending moment is maximum sagging. [10]

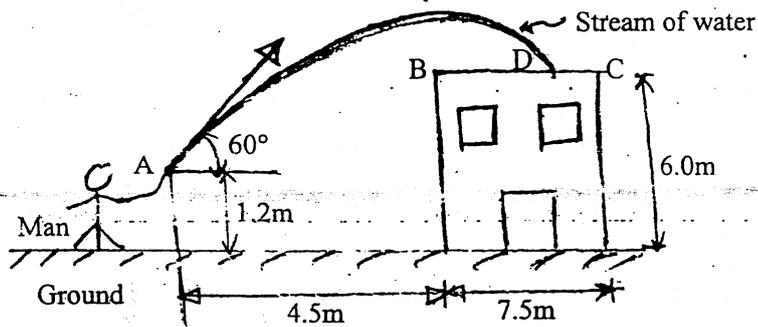


- b) Determine the number forces in members BD, CD and CE for the truss as shown using method of section. [6]

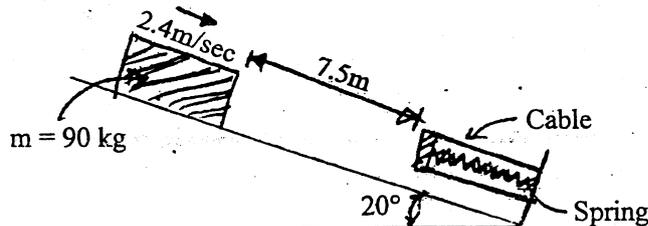


4. a) The acceleration of a particle is defined by the relation $a = -Kx^{-2}$. The particle starts with no initial velocity at $x = 800\text{mm}$, and it is observed that its velocity is 6 m/sec when $x = 500\text{mm}$. Determine (i) the value of K (ii) the velocity of the particle when $x = 250\text{mm}$. [8]

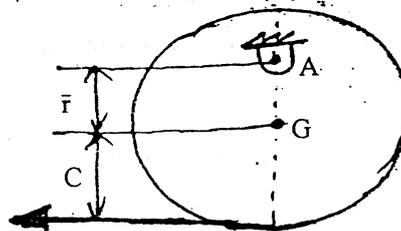
- b) A nozzle at A discharges water with an initial velocity of 12 m/sec at an angle of 60° with the horizontal. Determine where the stream of water strikes the roof. Check that the stream will clear the edge of the roof. [8]



5. a) A spring is used to stop 90 kg package which is moving from a 20° incline. The spring has a constant of $K = 22\text{ KN/m}$ and is held by cables so that it is initially compressed 150mm . Knowing that the velocity of package is 2.4 m/sec when it is 7.5m from spring and neglecting friction. Determine the maximum additional deformation of the spring in bringing the package to rest. [10]



- b) State and explain the principle of conservation of energy. [6]
6. a) General plane motion of a rigid body can be considered as the sum of translational and rotational motion. Justify the expression with examples. [6]
- b) A uniform disk of radius $C = 160\text{mm}$ and mass $m = 6\text{ kg}$ hangs freely from a pin support at A. A force P of magnitude 20N is applied as shown to the chord wrapped around the disk. Determine (i) the distance \bar{r} for which the horizontal component of the reaction at A is zero, (ii) the corresponding angular acceleration of the disk. [10]



Where
 $C =$ radius of
the disk

Exam.	Regular/Back		
	Level	BE	Full Marks
Programme	BEL, BEX, BCT	Pass Marks	32
Year / Part	I / I	Time	3 hrs.

Subject: - Applied Mechanics

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt any **Five** questions.
- ✓ The figures in the margin indicate **Full Marks**.
- ✓ Assume suitable data if necessary.

1. a) State the Varignon's theorem and also prove that a couple is a free vector. [4]
 b) Draw bending moment diagram, shear force diagram and axial force diagram for the frame shown in Figure No. 1. [12]

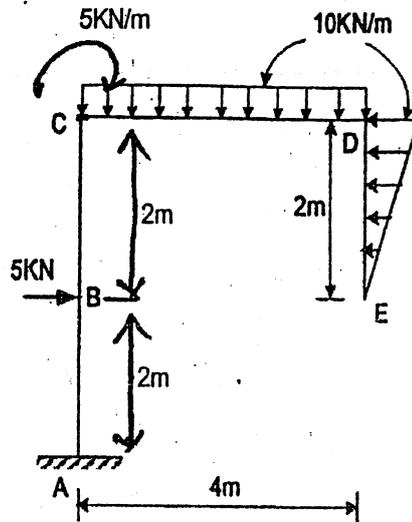


Figure no.1

2. a) Find the magnitude and direction of the resultant forces and moment of the following system about the point 'O' as shown in Figure No. 2. [8]

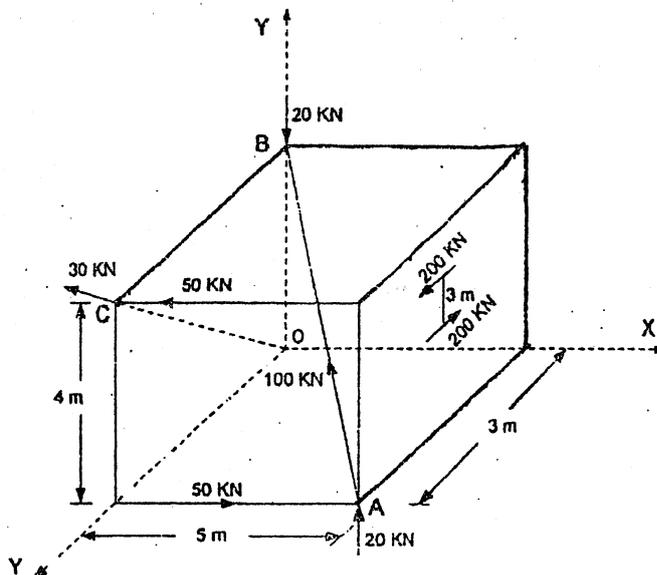
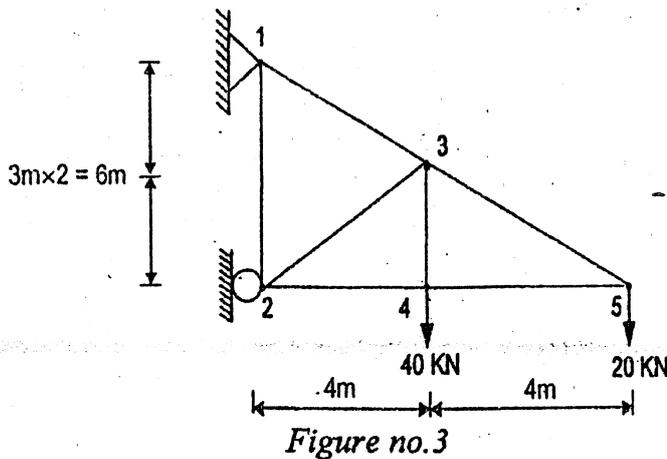


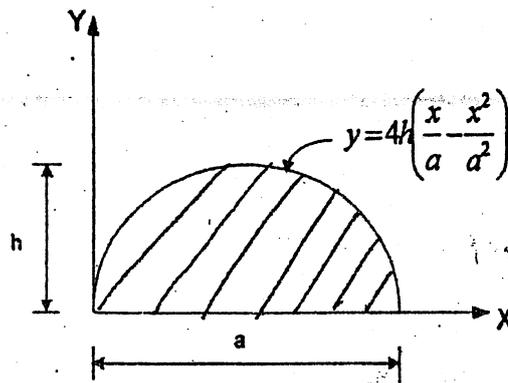
Figure no.2

b) Determine the member forces in the pin jointed truss shown in Figure No. 3. [8]



3. a) Prove that centre of pressure is always below the centroid of vertical plane surface submerged in the liquid. [6]

b) Determine the moment of inertia and radius of gyration of the shaded area as shown in Figure No. 4 about X and Y axes. [10]



4. a) A ball is thrown vertically upward from the 12-m level in an elevator shaft with an initial velocity of 18 m/sec. At the same instant an open-platform elevator passes the 5-m level, moving upward with a constant velocity of 2 m/sec. Determine (i) when and where ball will hit the elevator, (ii) the relative velocity of ball with respect to the elevator when ball hits the elevator. [8]

b) The rectangular component of acceleration for particle are $a_x = 3t$ and $a_y = 10t$, where, a is in m/sec^2 . If the particle starts from rest at the origin, find the radius of curvature of the path at the instant of 2 sec. [8]

5. a) The balls 'A' and 'B' having same masses are coming from opposite direction forming an oblique central impact along horizontal plane surface (line of impact along x-axis). The velocities and direction of balls are 40 m/sec, 60° and 30 m/sec, 30° to x-axis respectively. Assuming $e = 0.9$, determine the magnitude and direction of the velocity of each ball after the impact. [10]

b) Show that the rate of change of angular momentum of the particle about any point is equal to the sum of the moments about the same points of the forces acting on the particle. [6]

6. a) State D'Alembert's Principle; also derive the equation of angular momentum of a rigid body in plane motion. [4]

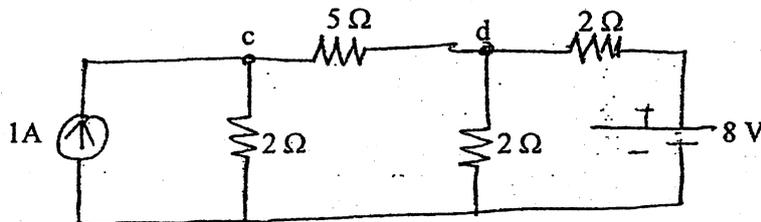
b) A sphere of radius 'r' and mass 'm' is released with no initial velocity on the incline surface and rolls down without slipping. Determine (i) the minimum value of the coefficient of static friction compatible with the rolling motion, (ii) the velocity of the mass center of the sphere after the sphere has rolled 4m, (iii) the velocity of mass centre if the sphere were to move 4m down a frictionless 30° incline. [12]

Exam.	New Back (2066 & Later Batch)		
Level	BE	Full Marks	80
Programme	BEL, BEX, BCT, BIE, B.Agric.	Pass Marks	32
Year / Part	I / I	Time	3 hrs.

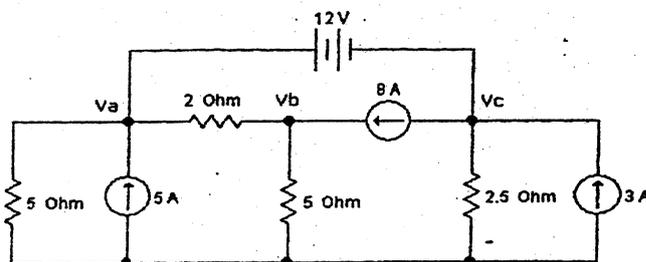
Subject: - Basic Electrical Engineering (EE401)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

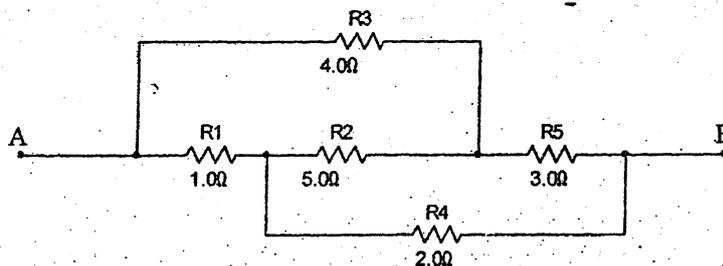
1. a) Explain ideal current and voltage sources. [4]
- b) Define temperature coefficient of resistance. The resistance of a certain length of wire is 4.6Ω at 20°C and 5.88Ω at 80°C . Determine (a) The temperature coefficient of resistance of the wire at 0° (b) The resistance of the wire at 60°C . [8]
- c) State and explain Superposition theorem with an appropriate example. [4]
2. a) Find out the current through 5 ohm resistor connected across the terminal c and d in the network shown below using the Venin's theorem. [8]



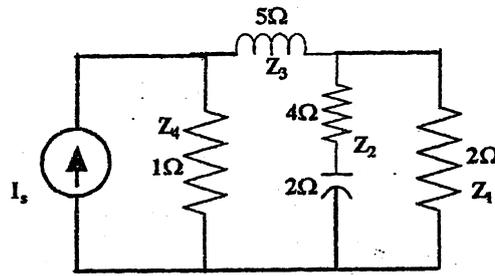
- b) Use Nodal Analysis Method to determine the V_a , V_b and V_c and calculate current through 2.5Ω . [8]



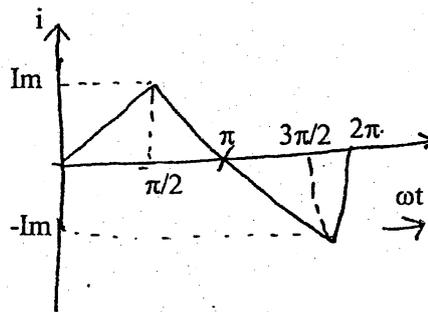
3. a) Find the resistance between the terminals A and B in the circuit segment below. [4]



- b) Three capacitors A, B and C have capacitances 10, 50 and 25 μF respectively. Calculate: [6]
- Charge on each when connected in parallel to a 250 V supply
 - Total capacitance and
 - p.d. across each when connected in series
- c) State Maximum Power Transfer Theorem and also prove "maximum power will be dissipated when $R_{\text{internal}} = R_L$ " [6]
4. a) Derive the expression for electrical current in a pure inductive circuit when input power is $V_m \sin \omega t$. Draw the wave form of voltage and current and phasor diagram of the circuit. Show analytically and graphically that it does not consume real power. [6]
- b) In the given circuit, find the current through the inductor, what is the equivalent impedance? [6]



- c) Find the peak factor and form factor of the triangular wave shown in figure below. [4]



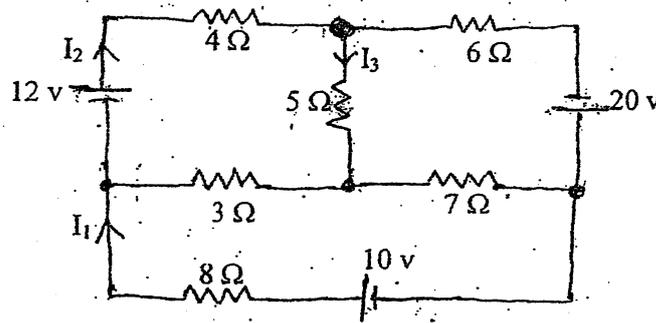
5. a) Explain the importance of power factor in an ac circuit, with suitable example. How power factor can be improved? [4]
- b) A three phase star connected system with line voltage 400 V is connected to three loads: $25 \angle 0^\circ$, $11 \angle -20^\circ$ and $15 \angle 10^\circ$ (also connected in star). Find the line to line current, total power and current in the neutral of the system. [8]
- c) Define phase sequence and explain its significance in three phase system. [4]

Exam.	New Back (2066 & Later Batch)		
Level	BE	Full Marks	80
Programme	BEL, BEX, BCT, BIE, B.Agric.	Pass Marks	32
Year / Part	I / I	Time	3 hrs.

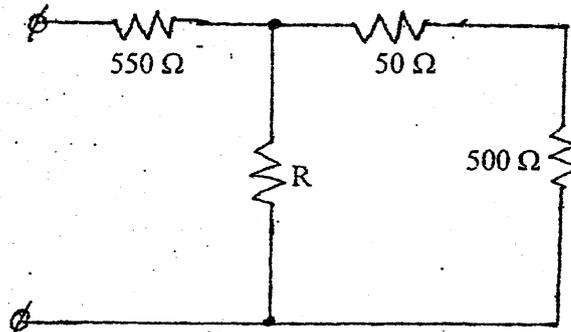
Subject: - Basic Electrical Engineering (EE401)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt any Five questions.
- ✓ All questions carry equal marks.
- ✓ Assume suitable data if necessary.

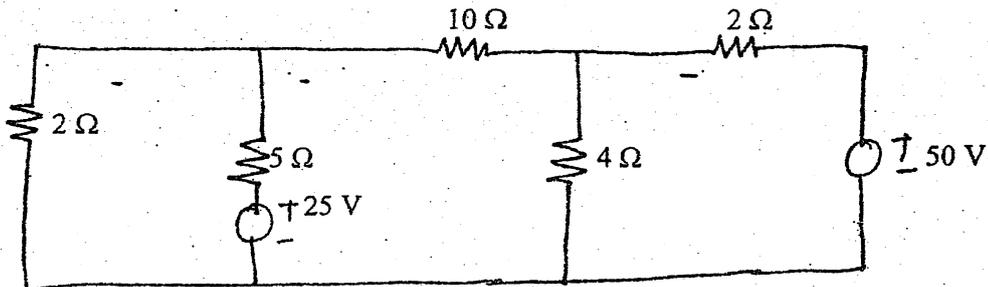
1. a) What is the difference between the potential difference and electromotive force? [4]
 b) Find I_1 , I_2 and I_3 in the circuit shown in the figure using Kirchhoff's law. [6]



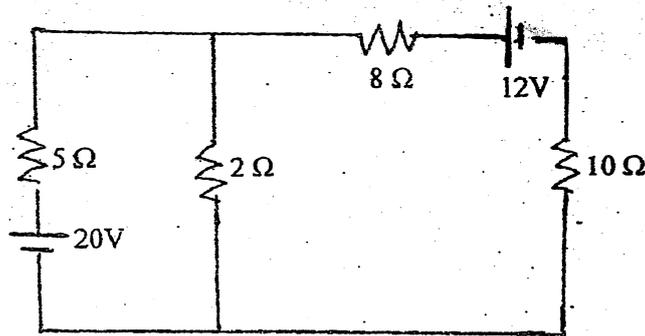
- c) What is the value of the unknown resistor 'R' in figure below, if the voltage drop across 500Ω resistor is 2.5 volts? [6]



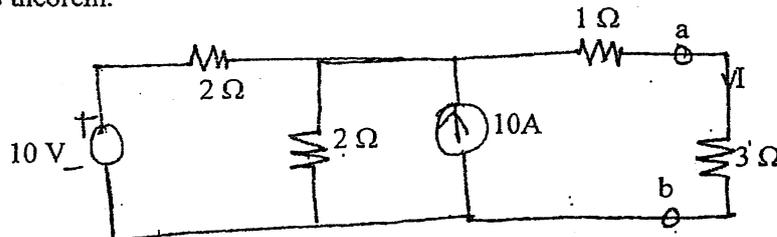
2. a) Use the node voltage method (nodal) to find the current flowing through 10Ω resistor in the network shown figure below. [8]



- b) For the circuit shown in figure below, calculate the current in the 10 ohm using Thevenin's theorem.



3. a) Determine power dissipated in 3Ω resistor in the circuit shown in figure below using Norton's theorem. [8]



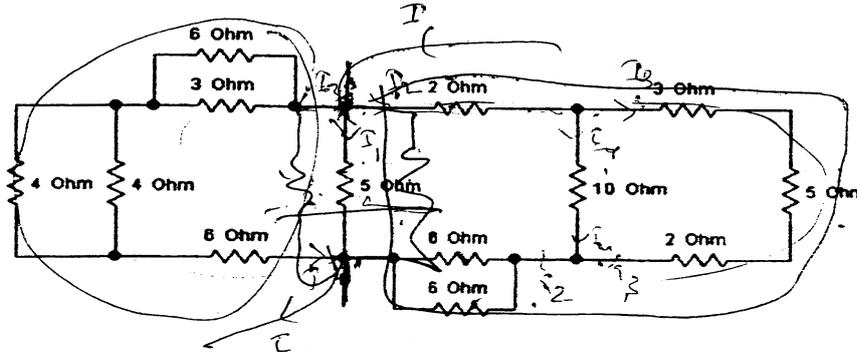
- b) An inductor is to be made with copper wire wound on a circular iron core having mean length of 40 cm with cross-sectional area of 50 sq mm. If the required value of inductance is 500 mH, calculate the number of turns required given that relative permeability of the core is 1500. [8]
4. a) A 415 V, 3 phase, 50 HZ induction motor takes 50 KW power from supply mains at 0.72 power factor lagging. A bank of capacitors is connected in delta across the line to improve the overall power factor. Calculate the capacitance per phase in order to raise the power factor to 0.9 lagging. [8]
- b) Three loads $(31+j59)\Omega$, $(30-j40)\Omega$ and $(80+j60)\Omega$ are connected in delta to a 3 phase, 200 V supply. Find the phase currents, line currents and total power absorbed. [8]
5. a) Define cycle, Time period, angular velocity, frequency, average and rms value of an alternating quantity. [6]
- b) A series circuit consists of resistance equal to 4Ω and inductance of 0.01 H. The applied voltage is $283 \sin(300t + 90^\circ)V$. Calculate the following: [10]
- Power factor
 - Expression for $i(t)$
 - The power dissipated in the circuit
 - Voltage drop across each elements
 - Draw a phasor diagram

Exam.	New Back (2066 & Later Batch)		
Level	BE	Full Marks	80
Programme	BEL, BEX, BCT, BIE, B. Agri.	Pass Marks	32
Year / Part	I / I	Time	3 hrs.

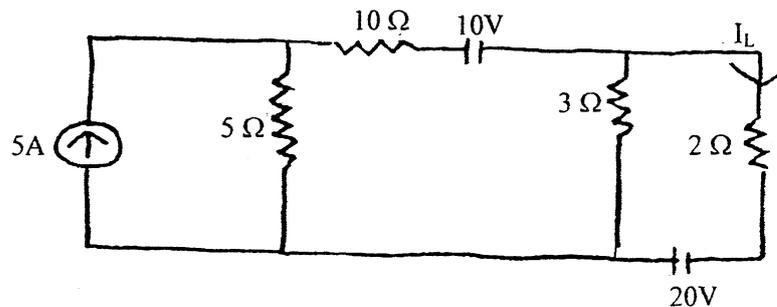
Subject: - Basic Electrical Engineering (EE401)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt **All** questions.
- ✓ The figures in the margin indicate **Full Marks**.
- ✓ Assume suitable data if necessary.

1. a) What is the factor responsible for the deviation of the practical sources from their ideal behavior? Explain the effect of this factor on the terminal characteristics of the voltage source. [6]
- b) Write down the steps to calculate Norton's equivalent resistance in the circuit with a suitable example. [4]
- c) A conductor material has a free electron density of 10^{24} electrons per m^3 . When a voltage is applied a constant drift velocity of 1.5×10^{-2} m/s is attained by the electrons. If the cross sectional area of the material is 1 cm^2 , calculate the magnitude of the current. [6]
2. a) Explain with neat diagram and write the equations for Delta-Star Conversion and for Star-Delta Conversion. [4]
- b) Find the equivalent resistance across the terminals A and B, R_{AB} . [6]

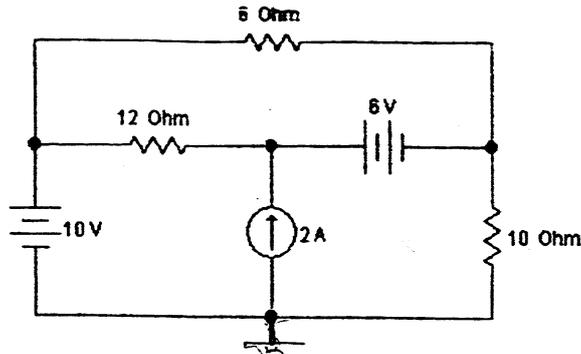


- c) "Thevenin's theorem and Norton's theorem are dual of each other". Justify the statement with suitable example. [6]
3. a) Use Superposition theorem to find the current I_L through 2Ω resistors in figure below. [8]

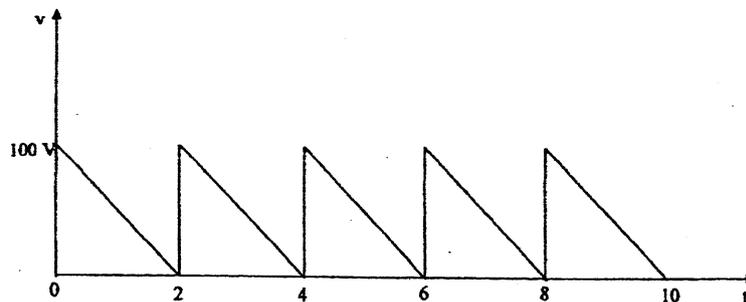


OR

Find the current passing through $10\ \Omega$ resistor using loop current method.

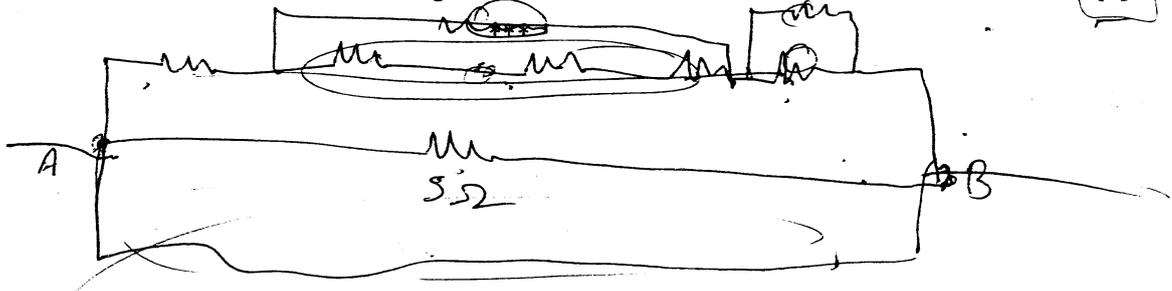


- b) Calculate the inductance that must be connected in parallel with a $100\ \text{mH}$ inductor to give a total inductance of $70\ \text{mH}$. Assume no mutual inductance between the two. [4]
- c) Two impedances $(3-4j)$ and $(8+6j)$ are connected in parallel across an ac voltage source. If the total current drawn from the source is $25\ \text{A}$, find the total active power consumed by the impedances. [4]
4. a) Find the average value, rms value of the voltage waveform given below. [8]



40

- b) An Industrial load consists of the following: [8]
- i) A load of $200\ \text{KVA}$ @ 0.8 power factor lagging
 - ii) A load of $50\ \text{KW}$ @ unity power factor
 - iii) A load of $48\ \text{KW}$ @ 0.6 power factor leading
- Calculate the total KW, Total KVAR, Total KVA and the overall power factor.
5. a) A $100\ \text{KW}$ load at 0.8 lagging power factor is being supplied by a $220\ \text{V}$, $50\ \text{Hz}$ source. Calculate the reactive power drawn from the source. If a capacitor connected parallel to the load improves its power factor to 0.9 . Find the capacitance of the capacitor. Also calculate the current drawn from the source before and after connecting the capacitor. [8]
- b) With the help of necessary Phasor diagram and circuit diagram, explain the two wattmeter method of Active Power Measurement in Three Phase AC system? What is the variation of wattmeter readings with load Power Factor? [8]

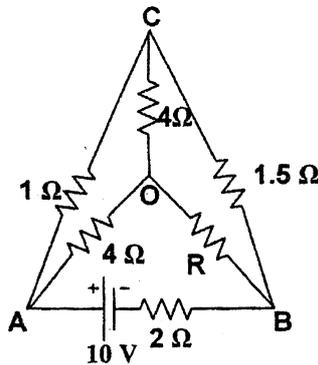


Exam.	Regular		
Level	BE	Full Marks	80
Programme	BEL, BEX, BCT, BIE, B.Agr.	Pass Marks	32
Year / Part	I / I	Time	3 hrs.

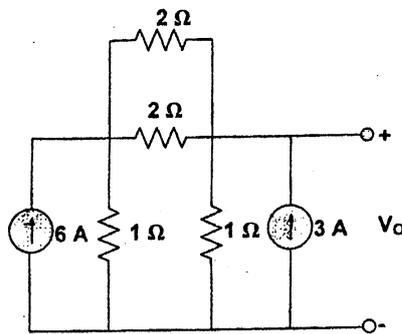
Subject: - Basic Electrical Engineering (EE401)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

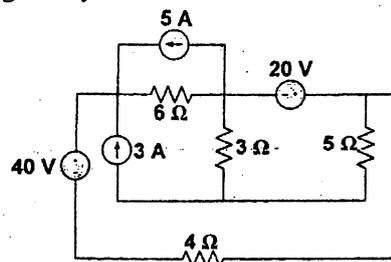
1. a) What do you understand by terms 'resistance' and 'resistivity'? On what factors the resistance offered by a conductor depends? [4]
- b) Two resistors made of different materials having temperature coefficients of resistance $\alpha_1 = 0.004/^\circ\text{C}$ and $\alpha_2 = 0.005/^\circ\text{C}$ are connected in parallel and consume equal power at 15°C . What is the rate of power consumed in resistance R_2 to that in R_1 at 70°C ? [6]
- c) Calculate the value of unknown resistance R in the circuit shown below and the current flowing through it when the current in the branch OC is zero. [6]



2. a) Calculate the output voltage, V_o for the circuit shown in figure below using Kirchoff's laws. [5]

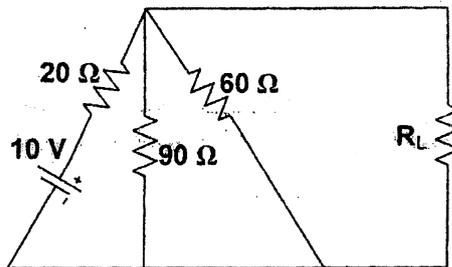


- b) Determine the power dissipated by 5Ω resistor in the circuit shown in figure below by applying nodal voltage analysis. [6]

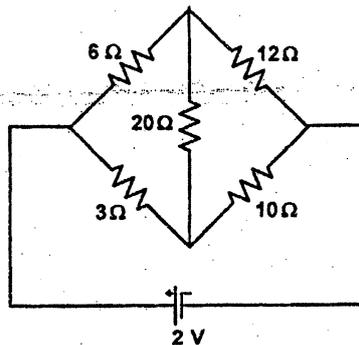


- c) State and explain superposition Theorem with an appropriate example. [5]

3. a) For the circuit shown in figure below, what will be the value of R_L to get the maximum power? What is the maximum power delivered to the load? [8]



- b) Determine the current in 20Ω resistor of the network shown in figure below using Star Delta Transformation [4]



- c) State the definition of the capacitance and from it write an equation for the charge stored in a capacitor. [4]
4. a) Derive the equation for instantaneous current flowing through a pure capacitor when excited by AC sinusoidal voltage $V = V_m \sin \omega t$. Draw the waveform of voltage and current and phasor diagram of the circuit. Show analytically and graphically that it does not consume real power. [4]
- b) A coil takes 1.3 kVA and 1.2 kVAR when connected to a 240 V, 50 Hz sinusoidal supply. Calculate: (i) Power dissipated (ii) Current and (c) Inductance of the coil. [4]
- c) A Circuit consisting of a resistance of 30Ω in series with an inductance of 75mH is connected in parallel with a circuit consisting of a resistance of 20Ω in series with a capacitance of $100\mu\text{F}$, if the parallel combination is connected to a 240V, 50Hz, single-phase supply. Calculate (i) The total current (ii) Power factor (iii) Active and reactive power. Also draw a neat phasor diagram. [8]
5. a) What are the two ways of connecting a 3-phase system? Draw their phasor diagrams and write down the relationship between phase and line voltages and phase and line current for these system. [4]
- b) A 220 V, 3-phase voltage is applied to a balanced delta connected 3-phase load of phase impedance $(15+j20)\Omega$. Calculate: [8]
- The phase voltages
 - The phasor current in each line
 - The power consumed per phase
 - Draw the phasor diagram
 - What is the phasor sum of three line currents? Why does it have this value?
- c) Explain 2-wattmeter method for the measurement of power in a balanced three phase load. [4]

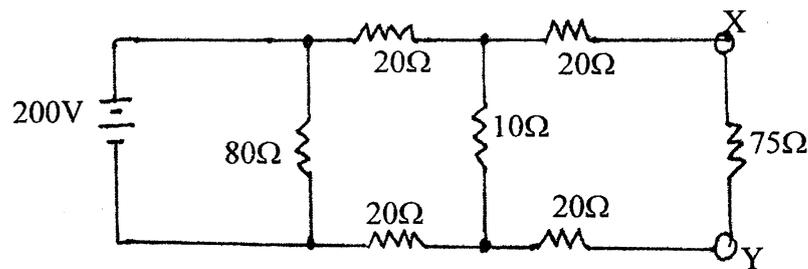
Exam.	Regular		
Level	BE	Full Marks	80
Programme	BEL, BEX, BCT, BIE, B.Agr.	Pass Marks	32
Year / Part	I / I	Time	3 hrs.

Subject: - Basic Electrical Engineering (EE401)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt any **Five** questions.
- ✓ The figures in the margin indicate **Full Marks**.
- ✓ Assume suitable data if necessary.

1. a) Explain the methods for converting practical current source in to practical voltage source. [4]

b) Calculate the power which would be dissipated in a $75\ \Omega$ resistor connected across XY in the network shown below. [4]



c) Find the currents I_1 , I_2 , I_3 using Kirchoff's Law and also find the power output of each voltage source of figure below? [8]

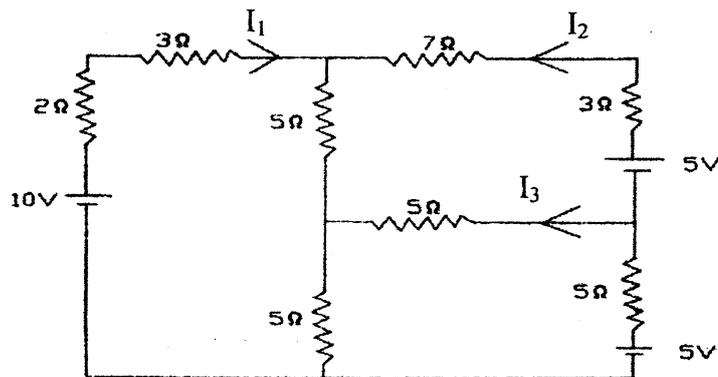
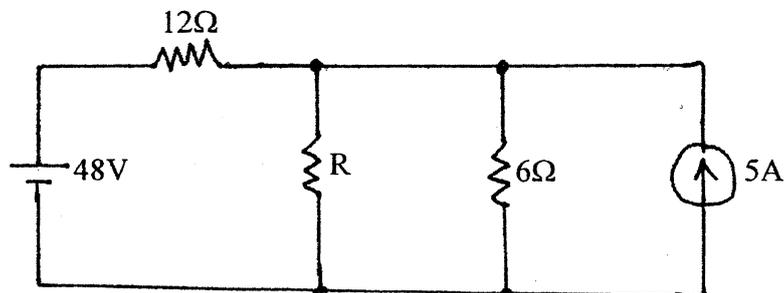
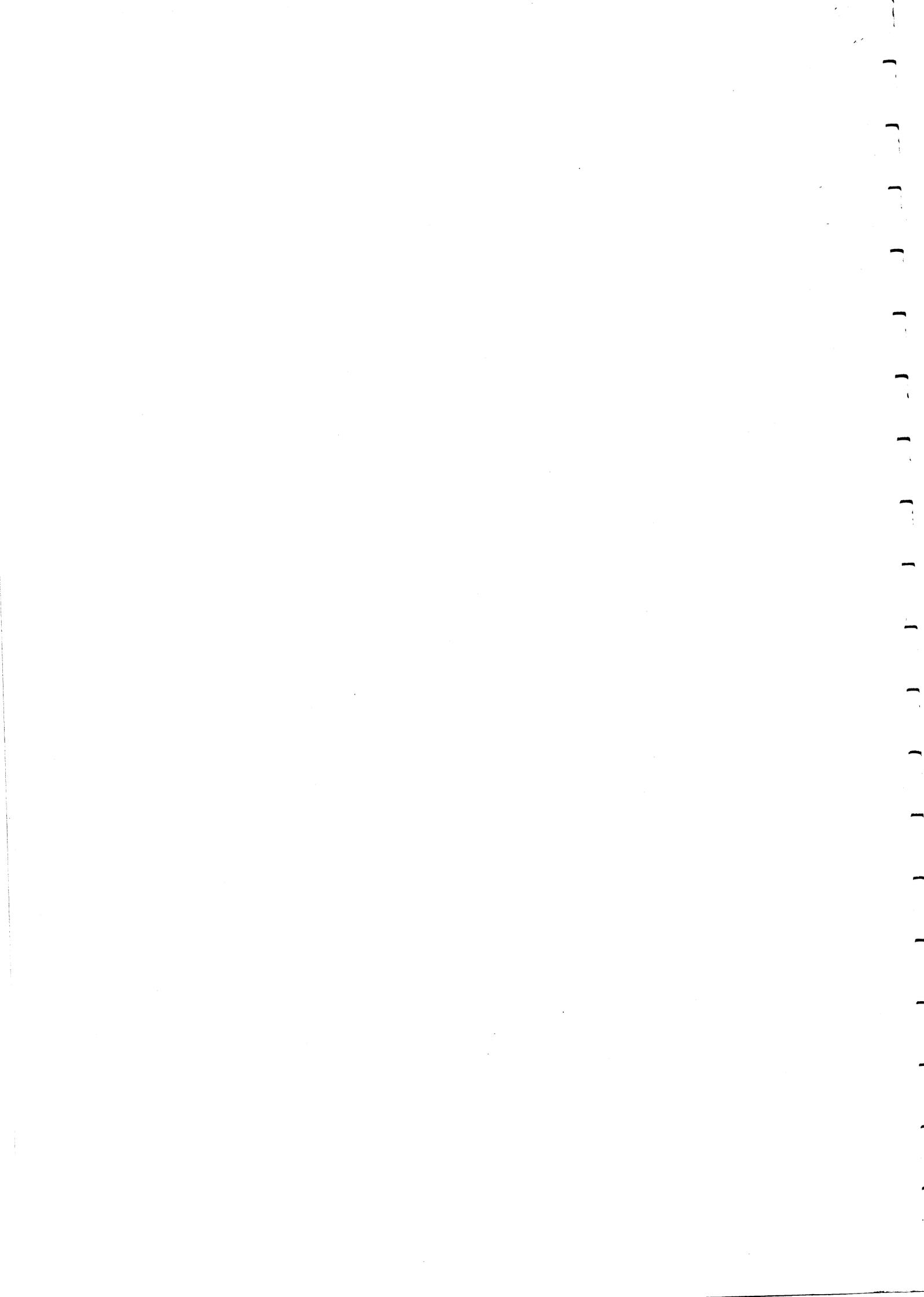


Fig: 1.2

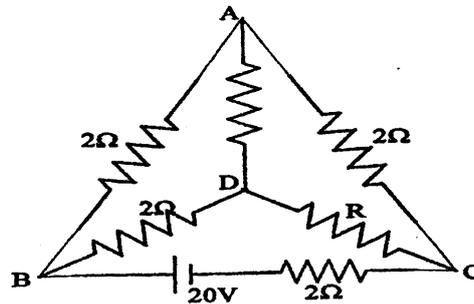
2. a) The resistivity of a metal alloy is $50 \times 10^{-8}\ \Omega\text{-m}$. A sheet of material 15 cm long, 6 cm wide and 0.014 cm thick. Calculate the resistance in the direction: (a) along the length and (b) along the thickness. [4]

b) Use Norton's theorem to calculate the value of R that will absorb maximum power from the circuit shown in the figure below. Also calculate the maximum power drawn by it. [4]





- c) In the network shown below, find the value of resistance R and the current through it when the current through branch DA is zero. [4]



3. a) Find the current through the $10\ \Omega$ resistor using loop-current method? [8]

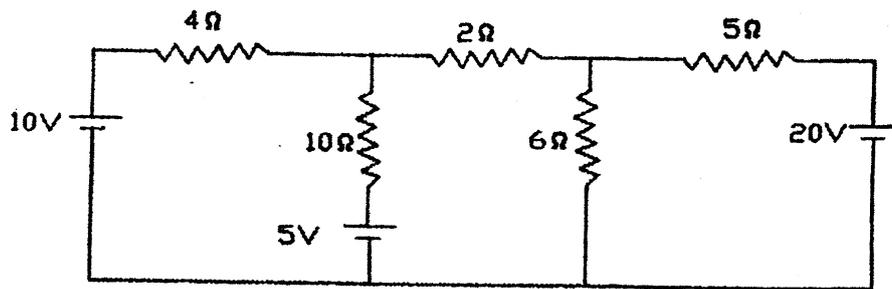
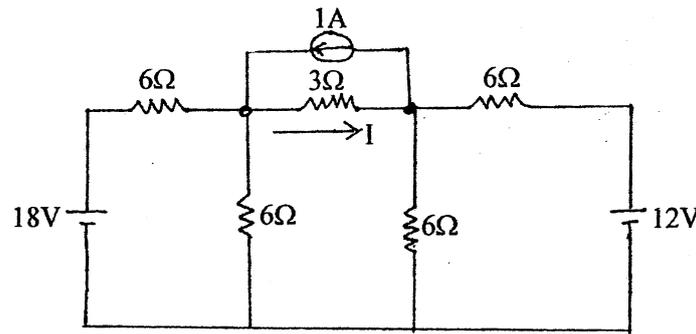


Fig: 3.1

- b) Find the current I in the circuit of figure below by applying nodal voltage method. [8]

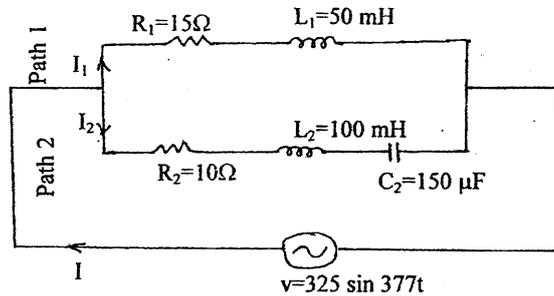


- a) Explain generation of sinusoidal emf with diagram and define angular velocity. [6]
- b) A sinusoidal voltage is applied to three parallel branches yielding branch currents, $i_1 = 14.14 \sin(\omega t - 45^\circ)$, $i_2 = 28.3 \cos(\omega t - 60^\circ)$ and $i_3 = 7.07 \sin(\omega t + 60^\circ)$ (i) Find the complete time expression for the source current (ii) Draw the phasor diagram in terms of effective values. Use the voltage as reference. [6]
- c) Define inductance and derive relation for connection of inductors connected in parallel connection. [4]

5. a) For the parallel circuit shown below, calculate:

[8]

- (i) RMS value for current, power factors and active power of path 1.
- (ii) RMS value of current, power factor and reactive power of path 2.
- (iii) RMS value of current and power factor of the whole circuit.



b) A three phase induction motor takes 50KW at 415V, 50Hz and a power factor of 0.72 lagging. Determine the KVAR rating of capacitor bank to improve the power factor to 0.9 lagging. What capacitance per phase is required if the capacitor bank is connected in star connection? What is the advantage of power factor correction from the source point of view and from the point of view of motor itself?

[6+2]

6. a) In the network shown in figure below, determine:

[8]

- i) Total impedance
- ii) Total current
- iii) The current in each branch
- iv) The overall power factor
- v) Volt amperes, Active Power and Reactive Power

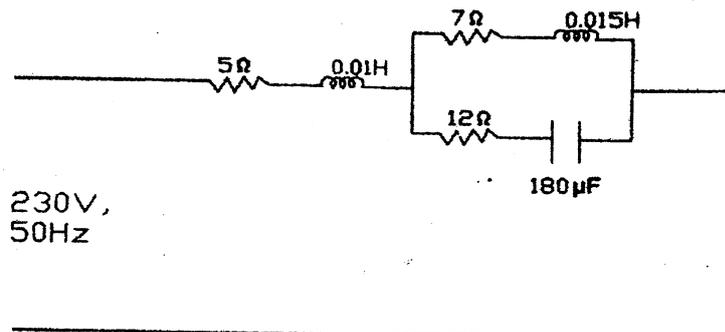


Fig: 5.1

b) In a 3-phase, 4 wire Wye connected system the phase voltage $V_{ph} = 200V$, and its frequency is 60Hz. The load impedance components are $R_1 = 100\Omega$, $R_2 = 100\Omega$, $C_2 = 66.3 \mu F$, $R_3 = 100\Omega$, $L_3 = 159.2mH$. Calculate the three line currents and the neutral current.

[8]

Examination Control Division

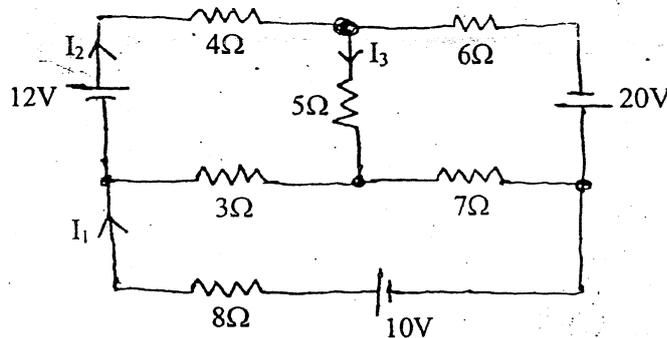
2068 Baishakh

Exam.	Regular / Back		
Level	EE	Full Marks	60
Programme	BEL, BEX, BCT, BIE, B.Agric	Pass Marks	32
Year / Part	I / I	Time	3 hrs.

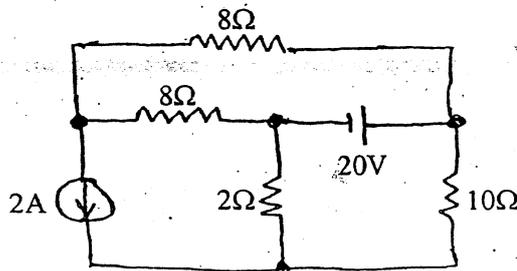
Subject: - Basic Electrical Engineering

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt any **Five** questions.
- ✓ The figures in the margin indicate **Full Marks**.
- ✓ Assume suitable data if necessary.

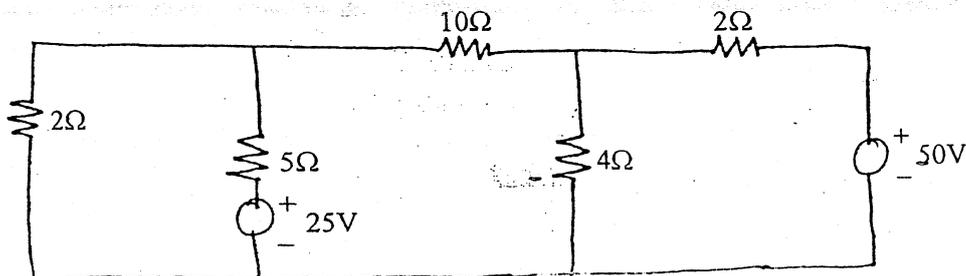
1. a) The temperature rise of a m/c field winding was determined by the measurement of the winding resistance. At 20°C the field resistance was 150Ω . After running the m/c for 6 hours at full load, the resistance was 175Ω . The temperature coefficient of resistance of the copper winding is $4.3 \times 10^{-3}/\text{k}^{\circ}\text{C}$. Determine the temperature rise of the m/c. [6]
- b) Find I_1 , I_2 , and I_3 , in the circuit shown in the figure using Kirchoff's law. [10]



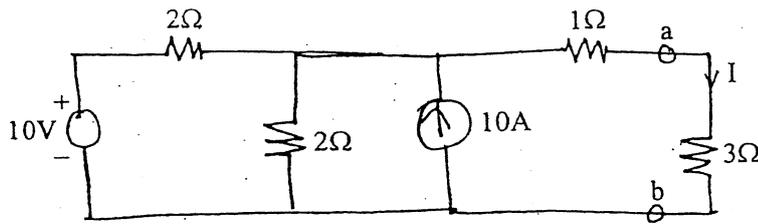
2. a) Use Superposition theorem to find the current flowing through the 10Ω resistor shown in the figure. [8]



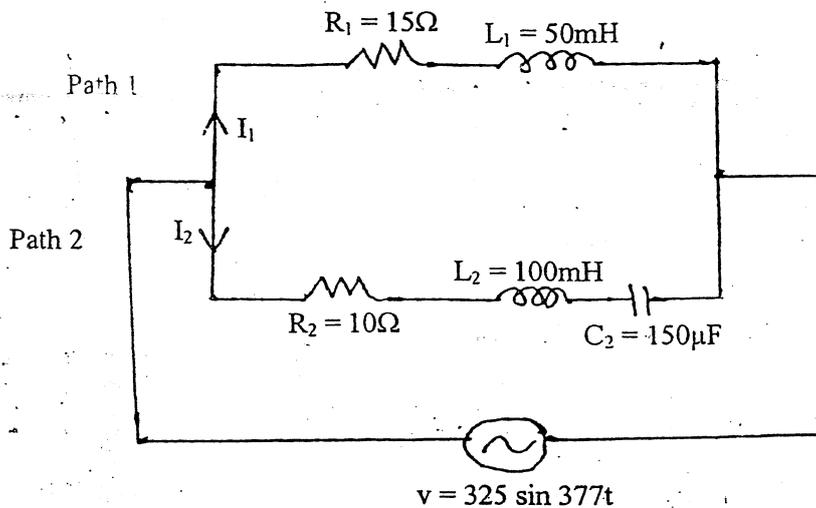
- b) State Thevenin's theorem and give the procedure for Thevenizing a circuit. Explain the major advantages offered by use of this theorem. [8]
3. a) Use the node voltage method (Nodal) to find the current flowing through 10Ω resistor in the network shown below. [8]



- b) Determine the power dissipated in 3Ω resistor in the circuit shown below using Norton's theo.em. [8]



4. a) An rms voltage of $100\angle 0^\circ$ is applied to the series combination of \bar{Z}_1 and \bar{Z}_2 where $\bar{Z}_1 = 20\angle 30^\circ$. The effective voltage drop across \bar{Z}_2 is known to be $40\angle -30^\circ$ V. Find the reactive component of \bar{Z}_2 . [8]
- b) For the parallel circuit shown below, calculate: [8]
- RMS value of current, power factor, active and reactive power of path 1
 - RMS value of current, power factor, active and reactive power of path 2
 - RMS value of current, power factor, active and reactive power of the whole circuit



5. a) Define cycle, Time period, angular velocity, frequency, average and rms value of an alternating quantity. [6]
- b) A series circuit consists of resistance equal to 4Ω and inductance of 0.01 H. The applied voltage is $283 \sin(300t + 90^\circ)$ V. Calculate the followings: [10]
- Power factor
 - Expression for $i(t)$
 - The power dissipated in the circuit
 - Voltage drop across each elements and
 - Draw a phasor diagram
6. a) A 415V, 3 phase, 50Hz induction motor takes 50kW power from supply mains at 0.72 power factor lagging. Capacitors are connected in delta across the line to improve the overall power factor. Calculate the capacitance per phase in order to raise the power factor to 0.9 lagging. [8]
- b) Three loads $(31 + j59)\Omega$, $(30 - j40)\Omega$ and $(80 + j60)\Omega$ are connected in delta to a 3 phase, 200V supply. Find the phase currents, line currents and total power absorbed. [8]

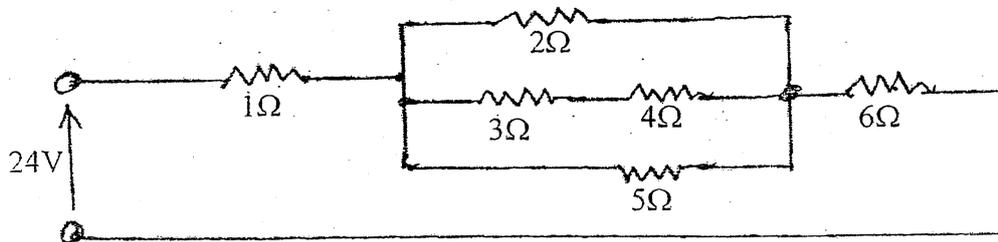
2068 Chaitra

Exam.	Nepal		
Level	BE	Full Marks	80
Programme	BEL, BEX, BCT, BIE, B. Agri.	Pass Marks	32
Year / Part	I / I	Time	3 hrs.

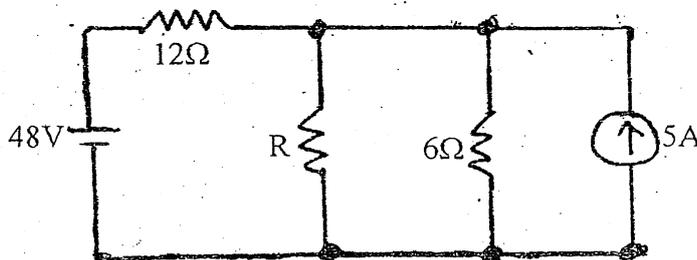
Subject: - Basic Electrical Engineering (EE 401)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt any **Five** questions.
- ✓ The figures in the margin indicate **Full Marks**.
- ✓ Assume suitable data if necessary.

1. a) Explain emf, potential difference and current with a circuit diagram. [4]
- b) The temperature rise of the machine field winding was determined by the measurement of the winding resistance at 20°C the field winding resistance was $160\ \Omega$. After running the machine for some hours at full load the resistance is $185\ \Omega$. If the temperature coefficient of resistance of the copper winding is $4.3 \times 10^{-6}/^{\circ}\text{C}$ at 0°C . Determine the temperature rise of the machine. [6]
- c) Find the equivalent resistance in the figure shown, and power dissipated in the $5\ \Omega$ resistor. [6]



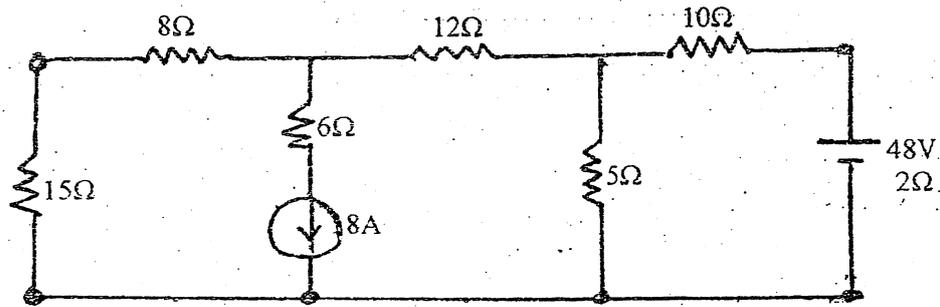
2. a) Calculate the value of R that will absorb maximum power from the circuit (shown in the figure). Also calculate the maximum power drawn by it. [6]



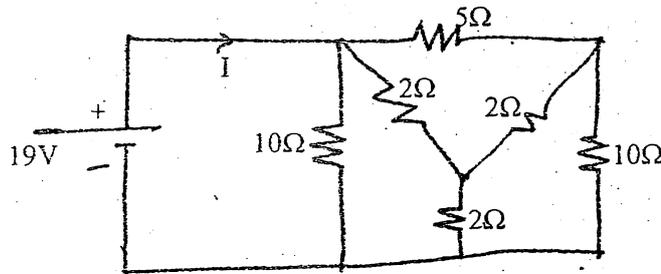
- b) State Norton's description theorem and list the steps for Nortonizing a circuit. Compare the Norton's equivalent circuit to the Thevenin's equivalent circuit. [6]
- c) What is the total cost of using the following at Rs 7 per kallowatt hour? [4]
- i) A $1200\ \text{W}$ toaster for 30 min
 - ii) Six $50\ \text{W}$ bulbs for 4 hours

- iii) A 400 W washing machine for 45 min.
- iv) A 4800 W electric cloths dryer for 20 min.

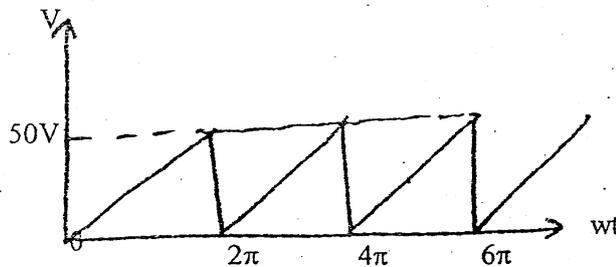
3. a) Use Nodal analysis method to calculate the current through the 15Ω resistor in the figure shown below. [8]



- b) Find the current I as shown in figure below using star - delta transformation. [4]



- c) An air cored coil is 2.5cm long and has an average cross-sectional area of 2cm^2 . Determine the number of turns if the coil has an inductance of $100\ \mu\text{H}$. [4]
4. a) Calculate the average value, rms value, form factor and peak factor of the saw tooth wave as shown in figure below. [6]



- b) What do you mean by reactive power in AC circuit? Explain it by constructing phasor diagram for real power, reactive power and apparent power. [5]
- c) Describe and illustrate the phasor relationship that exist between the voltage that appears across the terminals of a pure capacitor and the current that flows through it in steady state when the capacitor is excited by a sinusoidal source. [5]
5. a) A voltage of $200\angle 0^\circ$ V is applied across impedances in parallel. The value of impedances are $(12 + j16)\Omega$ and $(10 - j20)\Omega$. Determine the KW, KVA and KVAR in each branch and the power factor of the whole circuit. [8]

- b) A delta connected load of $Z_{AB} = 52\angle 45^\circ\Omega$, $Z_{BC} = 52\angle -30^\circ\Omega$ and $Z_{CA} = 10\angle 0^\circ\Omega$ are connected to a 380V, 3 phase ac source. Find the magnitude of the line currents and total power absorbed by loads, when phase sequence is ABC. [8]

6. a) A single phase motor takes a current of 40A at pf 0.7 lagging from a 440V, 50HZ supply. What value must a shunting capacitor have to raise the power factor to 0.9 lagging.

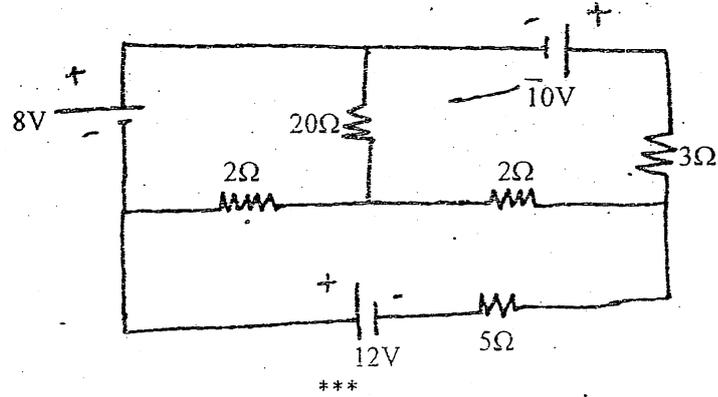
[6]

b) What are the advantages of three phase AC system over single phase ac system?

[4]

c) Determine current in 5Ω resistor by mesh analysis in figure below.

[6]



[8]

[4]

[4]

[6]

[5]

[5]

[8]

[8]

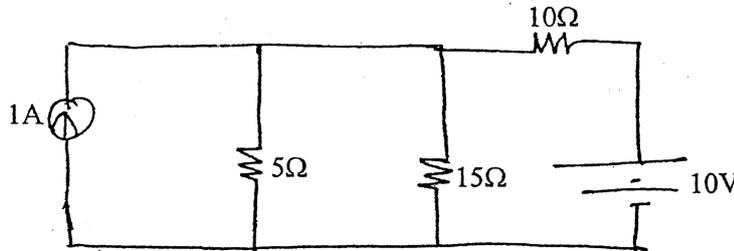


Exam.	Regular/Back		
	Level	BE	Full Marks
Programme	BEL, BEX, BCT, BIE, B.Agric.	Pass Marks	32
Year / Part	I / I	Time	3 hrs.

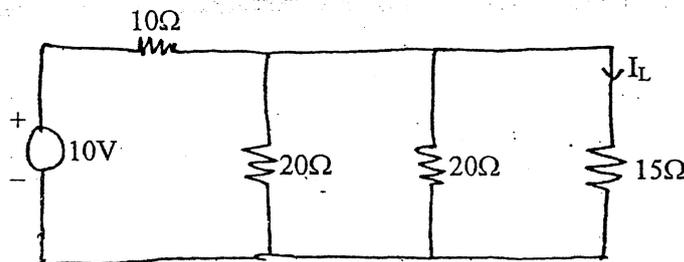
Subject: - Basic Electrical Engineering

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt any **Five** questions.
- ✓ **All** questions carry equal marks.
- ✓ Assume suitable data if necessary.

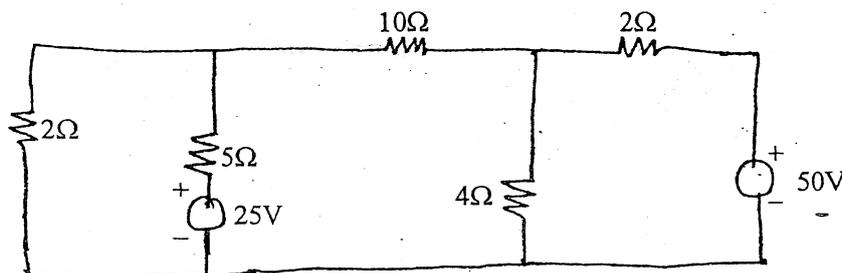
1. a) The temperature rise of the machine field winding was determined by the measurement of the winding resistance. At 20°C the field resistance was 150 ohm. After running the m/c for 6 hours at full load, the resistance was found to be 175 ohm. If the temperature coefficients of resistance of the copper winding is $1.57 \times 10^{-5}/^{\circ}\text{C}$ at 0°C, determine the temperature rise of the machine.
- b) What are ideal and practical voltage and current sources? Explain.
2. a) Calculate the current in the 15Ω resistor in the network shown in figure below using superposition theorem.



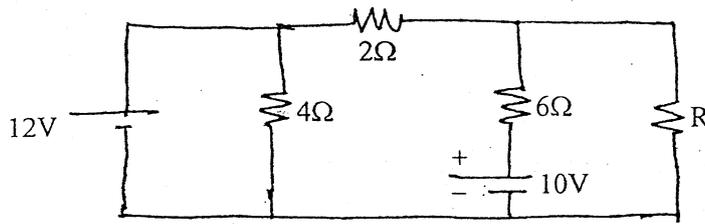
- b) Determine the current I_L through 15Ω resistor in the network by Norton's theorem.



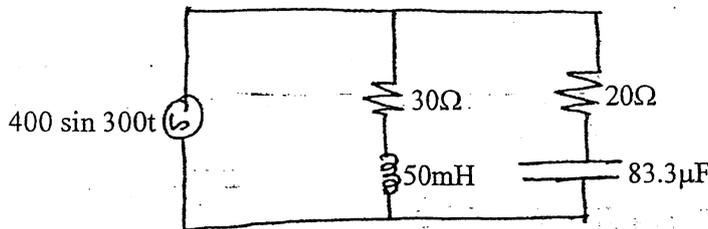
3. a) Use nodal method to find the current through 10Ω resistor for circuit shown below.



- b) Calculate the value of R to receive maximum power and the maximum power received by it for the circuit shown below.



4. a) A series circuit consists of a resistance equal to 4Ω and inductance of 0.01H . The applied voltage is $v = 283 \sin(300t + 90^\circ)$ volts. Find
- The power dissipated in the circuit
 - The expression for $i(t)$
 - Power factor and
 - Draw a phasor diagram
- b) For the circuit below, calculate
- Magnitude and phase angles of current in each of the branches,
 - Active, reactive and apparent power and power factor of the circuit, and
 - Draw the vector diagram indicating branch currents and supply voltage



5. a) Describe the advantages of three phase AC system over single-phase AC system.
- b) Three phase balanced load consists of three similar coils, each of resistance 50Ω and inductance of 0.3H . The supply voltage is 415V , 50Hz . Calculate (i) The line current (ii) The power factor (iii) Total power consumed and (iv) Draw the phasor diagram. Take RxB as phase sequence.
6. a) Define power factor and explain the disadvantages and causes of low power factor?
- b) A single-phase 50Hz motor takes 20A at 0.65 power factor lagging from a 230V sinusoidal supply. Calculate the KVar rating and capacitance to be connected in parallel to raise the power factor to 0.9 lagging. What is the new supply current?

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BCE, BME, BGE	Pass Marks	32
Year / Part	I / I	Time	3 hrs.

Subject: - Engineering Chemistry (SH403)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

1. Derive Henderson equation for buffer solution. What is the pH of resulting mixture obtained by mixing of 100 cc of 0.2 N HCL and 50 cc of 0.5M ammonia solution, K_b for ammonia is 1.8×10^{-4} . [1+4]
2. How can you measure the standard reduction potential of Zn electrode? Hydrogen electrode at 1 atm is connected with Zn electrode in which the emf of the cell is found to be 0.61 V at 25°C. If $[Zn^{++}] = 1.0$ M, calculate H^+ in hydrogen electrode. [2+3]
3. What is heterogeneous catalysis? Giving a suitable example, explain the mechanism of heterogeneous catalysis. Write any two criteria for choosing a catalyst for industrial purpose. [1+3+1]
4. a) What do you mean by CFC? Mention their photolytic reactions in high altitude at stratosphere.
 b) How do the oxides of sulphur and nitrogen make water acidic? [1+2+2]
5. Write major sources of water pollution. How does CO_2 act as pollutant of the atmosphere? Explain. [[2+3]
6. Give an account on chalcogenide glasses and polysulphur nitride. [2.5+2.5]
7. Explain about the biodegradable and non-biodegradable polymers with suitable examples. [2.5×2]
8. Explain giving reasons.
 a) Transition metals and their compounds show paramagnetic behavior. [2.5]
 b) Zinc (II) Compounds are white and diamagnetic while copper (II) Compounds are colored and paramagnetic. [2.5]
9. Transition elements formed colored compounds. Explain this on the basis of d to d transition. [5]
10. Compare the magnetic behavior of the complex entities $[Fe(CN)_6]^{4-}$ and $[FeF_6]^{3-}$ using valence bond theory. [2.5+2.5]
11. a) Write the IUPAC name of the following co-ordination compounds. [2]
 i) $[Cr(NH_3)_6]^{3+}$
 ii) $[Pt(NH_3)_2Cl_2]$
 iii) $Na_3[Cr(C_2O_4)_3]$
 iv) $[Co(NH_3)_4Cl_2]Cl$
 b) What is EAN? How would you explain the stability and magnetic behavior of a complex compound by EAN rule. [3]

12. a) Write the characteristics of a good paint and explain the method of application of paint in galvanized iron.
- b) Mention the types and functions of lubricants with examples. [2+1+2]
13. a) What isomerism is shown by lactic acid? Write its possible isomers. [2]
- b) What do you mean by racemic mixture? Explain chemical resolution of a racemic mixture. [1+2]
14. a) Describe SN^1 reaction mechanism in haloalkane shown stereochemistry.
- b) Why does nucleophile attack the substrate molecule from backside in SN^2 reaction mechanism? [4+1]
15. Discuss E^1 reaction with reference to the dehydrohalogenation of alkyl halide. How does E^1 differs from E^2 reaction. [3+2]
16. What are plastic explosives? Write down the characteristics of explosives. Give the preparation and uses of explosive obtained from toluene. [1+2+2]

01/06

Exam.	Old Back (2065 & Earlier Batch)		
Level	BE	Full Marks	80
Programme	BCE, B.Agric.	Pass Marks	32
Year / Part	I / I	Time	3 hrs.

Subject: - Chemistry (EG403SH)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

Group A

1. a) What are the limitations of Bohr's atomic theory? [4]
b) State and explain Hund's rule of maximum multiplicity. [4]
2. a) Define a buffer solution. Explain the mechanism of a buffer action. [2+3]
b) What is the pH of a buffer solution having 0.20M acetic acid and 0.1M sodium acetate, K_a for acetic acid is 1.8×10^{-5} ? [3]
3. a) How does a galvanic cell differ from an electrolytic cell? [3]
b) Define standard electrode potential. [1]
Calculate the emf of the following cell at 25°C. [4]
 $Zn/Zn^{++} (0.025M) // Cu^{++} (0.1M)/Cu$
 $E^0_{Zn^{++}/Zn} = -0.76V, \quad E^0_{Cu^{++}/Cu} = 0.34V$
4. a) Derive an expression for the work done in an isothermal reversible expansion of an ideal gas. [4]
b) How is C_p of a gas related to C_v ? [4]

OR

[2x4]

Write short notes on

- a) Hess's law of constant heat summation
- b) Calorific value of food and fuel

Group B

5. a) How does Werner's theory explain the structure of coordination compounds? [4]
b) Write the formula of following; [4]
 - i) Triamminechlorocyanonitrocobalt(III)
 - ii) Diamminesilver(I) chloride
 - iii) Potassium hexacyanoferrate(III)
 - iv) Pentaamminechlorocobalt(III) ion

OR

- b. What are complex salts and double salts? [4]
- c. Explain the geometry and magnetic property of $[Fe(CN)_6]^{4-}$ on the basis of valence bond theory. [4]

6. a) Explain the geometry of PCl_5 on the basis of hybridization. [6]
b) Explain the formation of O_2 on the basis of valence bond theory. [2]
7. a) What are transition elements? Briefly discuss any two features of transition elements. [6]
b) Give the uses of silicones. [2]

Group C

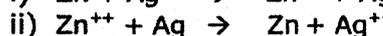
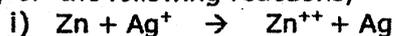
8. Explain SN_1 and SN_2 reaction mechanism briefly. [4+4]
- OR,*
- a) Briefly discuss E_1 reaction mechanism with appropriate example. [4]
b) Show your familiarity with Pinacol Pinacolone rearrangement. [4]
9. a) What are geometrical isomers? [2]
b) Define enantiomers and diastereomers with suitable examples. [3+3]
10. a) Give the preparation and uses of bakelite or Nylon-66. [4]
b) List the uses of explosives. Give the preparation of trinitrotoluene (TNT). [1+3]

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BCE, BME, BGE	Pass Marks	32
Year / Part	I / I	Time	3 hrs.

Subject: - Engineering Chemistry (SH403)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

1. Define a galvanic cell. What are functions of salt bridge in a galvanic cell?
 Predict the feasibility of the following reactions,



Given, $E^{\circ}_{\text{Zn}^{++}/\text{Zn}} = -0.76\text{V}$, $E^{\circ}_{\text{Ag}^+/\text{Ag}} = 0.80\text{V}$ [1+1+3]

2. What is a buffer solution? Discuss the mechanism of buffer action with suitable examples. [1+4]
3. What is meant by catalysis? Point out its importance. Discuss intermediate compound formation theory of catalysis. [1+1+3]
4. a) Point out the sources of radioactive substances responsible for environmental pollution. Give their adverse effects and protective measures. [2.5]
 b) Briefly discuss any two sources of organic and inorganic substances responsible for water pollution. Point out their possible remedies. [2.5]
5. a) How do exhausts of internal combustion engine pollute air? Give the possible remedies. [3]
 b) What is the photochemistry behind ozone layer depletion? [2]
6. a) What are Chalcogenide glasses? Give their uses. [2.5]
 b) Give the preparation and applications of silicone rubbers. [2.5]
7. a) Give the preparation and applications of polystyrene and polyurethanes. [4]
 b) What are the advantages of conducting polymers? [1]
8. Why do transition elements form complexes? List the industrial application of 3d transition elements in engineering. [3+2]
9. Explain the following features of transition elements with reference to 3d transition series; [2.5+2.5]
 a) Variable oxidation state
 b) Formation of colored compounds
10. Differentiate between complex salts and double salts. How does Werner's theory explain the bonding in complex salts? [1+4]

11. a) Write the IUPAC name of following; [2]
- i) $K_2 [Hg I_4]$
 - ii) $K_4 [Fe(CN)_6]$
 - iii) $[Co (NH_3)_5 Cl]^{2+}$
 - iv) $Li[AlH_4]$
- b) How does valence bond theory explain the formation of $[Ni(NH_3)_6]^{2+}$? Predict its magnetic behaviour. [3]
12. What are primary explosives, low explosives and plastic explosives? Give the preparation and applications 2,4,6-Trinitrotoluene (TNT). [3+2]
13. a) Show your familiarity with liquid, semi solid and solid lubricants giving examples. [3]
- b) Discuss any two types of paints showing their applications in engineering works. [2]
14. a) What are geometrical isomers? Give an example. [2]
- b) Show your familiarity with diastereomerism. [2]
- c) Draw the structure of 2-Chlorobutane specifying *R* and *S* configuration. [1]
15. Discuss the unimolecular nucleophilic substitution reaction mechanism in alkyl halide showing the stereochemistry. [5]
16. What is meant by elimination reaction? Discuss E1 and E2 reaction mechanism. [1+4]

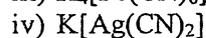
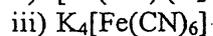
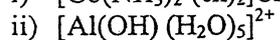
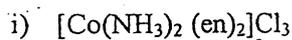
Exam. Level	Regular / Back		
	BE	Full Marks	80
Programme	BCE, BME	Pass Marks	32
Year / Part	I / I	Time	3 Hrs.

Subject: - Engineering Chemistry

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

1. What is galvanic cell? Write electrode reaction, net cell reaction, -EMF of the cell and cell notation of given electrode couple and also predict the spontaneity of the cell reaction. [1+4]
 $E^\circ \text{Zn/Zn}^{++} = 0.76\text{V}$, $E^\circ \text{Ag}^+/\text{Ag} = 0.80\text{V}$
 $[\text{Zn}^{++}] = 0.01\text{M}$, $[\text{Ag}^+] = 0.1\text{M}$
2. How does an acidic buffer solution reserve its PH value on the addition of strong acid or strong base? 100ml of 0.2M CH_3COONa is mixed with 200ml of 0.3M CH_3COOH , which is 2.1% ionised in dilute solution. Find out the PH of the resulting solution. [2.5+2.5]
3. Write the adsorption theory to describe the mechanism of heterogeneous catalysis with a suitable example. How does a promoter enhance the catalytic action? List any two criteria of catalysed reactions applicable for the industries. [3+1+1]
4. Write short notes on:(any two) [2.5+2.5]
 - a) Green house effect
 - b) Formation and depletion of ozone layer
 - c) Acid rain
5. List out four major pollutants of air, their adverse effects on human health and also write their possible remedies. [1+2+2]
6. Write the method of preparation and two important uses of each of polyurethane and diamine epoxy resin. [2.5+2.5]
7. What is biodegradable polymer? Describe the contribution of carbon fibre reinforced polymer and chalcogenide glass in engineering. [1+4]
8. a) What are transition elements? Which of the 3d series elements is not a transition element and why? [1+2]
 b) Explain why compounds of V^{+5} are colourless but those of V^{+3} are colourful. [2]
9. a) Explain the cause of origin of paramagnetism in transition elements. [3]
 b) Explain why are transition elements good for alloy formation. [2]
10. a) What is meant by effective atomic number of metal ion in the complex salt? What information does it convey? [2]
 b) Explain the formation of $[\text{Ni}(\text{CO})_4]^\circ$ complex on the basis of VBT. Also predict its geometry and magnetism with reason. [3]
11. a) Write the basic assumptions of Werner's theory of co-ordination compounds. [3]

b) Write the IUPAC names of the following co-ordination compounds. [2]



12. What is plastic explosive? How do you prepare dynamite and gun cotton? [1+2+2]

13. a) What is paint? Write characteristics of a good paint and explain the method of application of paint in galvanised iron. [0.5+1+1]

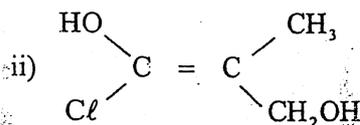
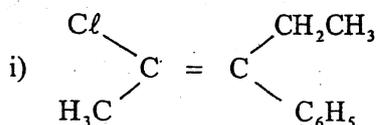
b) What is lubricant? Give an example of emulsion and solid lubricant. Mention their specific functions. [0.5+1+1]

14. a) Distinguish between enantiomers and diastereomers. Write all possible stereoisomers of a compound that contain two asymmetric carbon atoms but cannot exist in meso forms. [4]

b) Write the cis and trans isomers of butenedioic acid. [1]

15. a) What is resolution? Explain the method of chemical resolution of a racemate. [3]

b) Determine E or Z configuration in the following molecules: [2]



16. What is a nucleophilic substitution reaction? Briefly explain SN^2 and SN^1 paths of such reaction in haloalkane. Mention the factors governing these paths. [1+2+2]

Exam.	Regular/Back		
	Level	BE	Full Marks
Programme	BCE, BME	Pass Marks	32
Year / Part	I / I	Time	3 hrs.

Subject: - Engineering Chemistry

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

1. How does electrode potential originate? Define standard electrode potential? Write the cell notation, and cell reaction for Zn-Cu cell. [2+1+2]
2. What is buffer solution? Calculate the pH of resulting solution when 0.005 mole of KOH is added to 200 ml of 0.1N acetic acid solution. ($pK_a = 4.74$). [1+4]
3. What is meant by homogeneous catalysis? Describe the intermediate compound formation theory of catalysis with a suitable example. List the criteria for choosing a catalyst for industrial application. [1+3+1]
4. a) What are chlorofluorocarbons? Give their photolytic reactions in the upper atmosphere. [3]
b) Why oxides of sulphur and nitrogen are assumed as air pollutants? [2]
5. Point out four major pollutants of water, their adverse effect on human health and also mention their possible remedies. [2+1+2]
6. Describe the preparation and uses of polyphosphazines and polymeric sulphur (PS)_n. [5]
7. What are double and complex salts? Write the formulae of the following co-ordination compounds. [2+3]
 - a) Dibromotetraaquo chromium (III) chloride
 - b) Potassium hexacyanocobaltate (II)
 - c) Tetrabromocuparate (II)
 - d) Tetraamminedichlorocobalt (III)
 - e) Hexacyanoferrate (III) ion
 - f) Sodium trioxalato aluminate (III)
8. a) What are principal and auxiliary valencies of the metal ion in the complex compound? Illustrate them in $[\text{Co}(\text{NH}_3)_6]\text{Cl}_3$. [2]
b) Show your familiarity with electronic interpretation of complexes. [3]
9. Explain the followings: [3+2]
 - a) Transition elements are good in forming complexes
 - b) Show your acquaintance with application of 3-d transition elements.
10. What are transition elements? Explain the following features of transition elements; [1+2+2]
 - a) Variable oxidation state
 - b) Magnetic properties

11. Define explosives? Give the preparation, properties and uses of trinitrotoluene (TNT).
What are plastic explosives? [1+3+1]
12. Define lubricants and mention their functions. Name different types of liquid lubricants with examples. Show your familiarity with types of paint. [2+1+2]
13. a) What are geometrical isomers? Draw the structure of 2-Chloro-3-methylpent-2-ene and specify Z and E configuration. [1+1]
b) Illustrate enantiomerism with an example. Mention a typical organic molecule which exhibits distereomerism. [1+2]
14. Describe the mechanism involved in the reaction between a tertiary alkyl halide and aqueous caustic potash. How does S_N2 reaction differ from S_N1 in its stereochemistry? [4+1]
15. a) Write the mechanism of bimolecular elimination reaction. [2]
b) Mention the effect of nucleophile, substrate and solvent on nucleophilic substitution reaction mechanisms. [3]
16. What are bio-degradable and nonbiodegradable polymers? Mention the uses of epoxy resin and fibre reinforced polymer. [2+3]

Exam:	Regular / Back		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	I / I	Time	3 hrs.

Subject: - Chemistry

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

Group A

1. a) - A cricket ball of mass 250g is moving with $\frac{1}{1000}$ th of the velocity of light. Calculate the wavelength of that ball. Also explain whether this cricket ball acts as a particle or wave and why? (Planck's constant = 6.6×10^{-34} JS) [3]
- b) Explain Sommerfield model of atom. How does this model introduced the concept of sub-shell? [3]
- c) State Paulie's exclusion principle. How does this principle limit only two electrons in an orbital with their spin opposite? [2]
2. a) Derive Ostwald's dilution law and write its limitations. [4]
- b) Calculate the pH of the resulting buffer, when 400 ml of 0.2M acetic acid is mixed with 500 ml of 0.3M sodium acetate. ($K_a = 1.8 \times 10^{-5}$) [4]
3. a) Define normal hydrogen electrode. How it is used for the construction of electrochemical series. [4]
- b) Calculate the EMF of the following cell at 15°C. [4]

$\text{Cu} / \text{Cu}^{++} (0.1\text{M}) // \text{Ag}^+ (0.2\text{M}) / \text{Ag}$
 $E^\circ \text{Cu}^{++} / \text{Cu} = 0.34\text{V}$
 $E^\circ \text{Ag} / \text{Ag}^+ = -0.80\text{V}$
4. What do you mean by Molar heat capacities at constant volume and constant pressure? Calculate the enthalpy change for the synthesis of urea [3+5]

$\text{C(S)} + 2\text{H}_2(\text{g}) + \frac{1}{2}\text{O}_2(\text{g}) + \text{N}_2(\text{g}) \rightarrow \text{CO(NH}_2)_2(\text{S}) \quad \Delta\text{H} = ?$

from the following thermochemical equations.

 - a) $\text{C(S)} + \text{O}_2(\text{g}) \rightarrow \text{CO}_2(\text{g}) \quad \Delta\text{H} = -394 \text{ kJ}$
 - b) $\text{H}_2(\text{g}) + \frac{1}{2}\text{O}_2(\text{g}) \rightarrow \text{H}_2\text{O}(\ell) \quad \Delta\text{H} = -286 \text{ kJ}$
 - c) $\text{CO(NH}_2)_2(\text{S)} + \frac{3}{2}\text{O}_2(\text{g}) \rightarrow \text{CO}_2(\text{g}) + 2\text{H}_2\text{O}(\ell) + \text{N}_2(\text{g}) \quad \Delta\text{H} = -632 \text{ kJ}$

OR

Write short notes on (any two):

[4+4]

- a) Electrochemical theory of corrosion
- b) Bomb calorimeter
- c) Hess law of constant heat summation

Exam	Back		
Level	BE	Full Marks	80
Programme	BCE, B.Agr.	Pass Marks	32
Year / Part	I / I	Time	3 hrs.

Subject: - Chemistry

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

1. a) Write the value of four quantum numbers for the last electron of sodium. [2]
b) Derive Schrodinger wave equation and mention its implication. [5+1]
2. a) What is pH scale? Write its limitation. [3+1]
b) 400CC of 0.2M CH₃COOH is mixed with 100CC of semimolar NaOH solution. Calculate the pH of the mixture. [K_a of CH₃COOH = 1.8×10⁻⁵] [4]
3. a) What is standard hydrogen electrode? Give the cell notation of Cu electrode with it. [3+1]
b) The EMF of the combination of given electrode [4]
i) AgCl + e⁻ → Ag + Cl⁻ E = -0.2V
ii) Cu → Cu⁺⁺ + 2e⁻ E = +0.34V
is 0.09. Calculate the concentration of Cu⁺⁺ ion in electrode b, where a is in standard condition.
4. Derive the equation which shows that how the heat of reaction depends upon the temperature. Calculate the heat of formation of glucose if enthalpy of combustion of glucose is -2808 KJ, amount of heat evolved by the burning of 1 mole of charcoal is 394 KJ and heat of formation of water is -286 KJ. [4+4]

OR

Write short notes on: [4+4]

- a) Bomb calorimeter
- b) 1st law of thermodynamic
5. a) Give the chemical formula for the following compounds. [2]
i) Diammine silver (I) iodide
ii) Pentammine monochlorocobalt (III) Chloride
iii) Hexaqua iron (III) chloride
iv) Potassium tetraiodo mercurate (II)
- b) Give the postulates of Werner's theory of complexes and mention the key point to distinct primary and secondary valencies to central metal atom/ion in a complex with example. [4+2]

OR

- a) Give the postulates of valence bond theory of complexes. [4]
- b) Predict the geometry and magnetic character of [Ni(CN)₄]²⁻ and [Ni(CO)₄]⁰ according to the same theory. [4]

6. a) What are hybrid orbitals? Explain the geometry of NH_3 and PCl_5 on the basis of hybridization. [1+5]
b) What are silicones? Give the four main properties of silicones. [2]
7. a) Write down the characteristics of transition metal. [2]
b) Explain the characteristics of 3d transition metals with reference to (i) variable oxidation state (ii) complex formation. [6]
8. a) In which aspect the aqueous hydrolysis of methyl bromide differs from aqueous hydrolysis t-butyl bromide. [4+4]

OR

- a) Explain E_1 and E_2 mechanism with suitable examples. [3+2]
b) Why rearrangement reaction differs from addition one. [2+1]
9. a) What is the minimum requirement for an organic molecule to represent cis and trans isomerism? Explain it with suitable example. [2]
b) Explain diastereomers, enantiomers and meso compound with suitable examples. [6]
10. a) How you will obtain [3]
i) Butanol and
ii) Pentanol from propyl magnesium bromide and benzoic acid from toluene
b) Give the chemistry of TNT. [2]
c) Terylene and Telfon are different polymer, explain it. Give the preparation and property of nylon 66. [1+2]

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BCE, BME, BGE	Pass Marks	32
Year / Part	I / I	Time	3 hrs.

Subject: - Fundamentals of Thermodynamics and Heat Transfer (ME402)

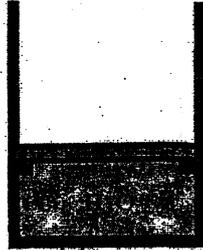
- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt **All** questions.
- ✓ The figures in the margin indicate **Full Marks**.
- ✓ **Necessary tables are attached herewith.**
- ✓ Assume suitable data if necessary.

1. State and explain zeroth law of thermodynamics. Write down its application. [4]
2. Differentiate between stored energy and transient energy with examples. [4]
3. Define saturation pressure and saturation temperature. Explain why quality is necessary for a liquid vapor mixture. [4]
4. Derive general mass conservation and energy conservation equations for a control volume. [6]
5. Define entropy and isentropic process. Derive detail mathematical expression for entropy relation for an ideal gas in terms of pressure and temperature. [6]
6. Sketch the Rankines cycle on p-v and T-s diagrams and derive an expression for its efficiency. [6]
7. Derive the expression for overall heat transfer coefficient for composite plane wall consisting of two layers and subjected convective medium on both sides. [6]
8. At the inlet and exhaust of a turbine the absolute steam pressure are 6000 kPa and 4.0 cm of Hg, respectively. Barometric pressure is 75 cm of Hg. Calculate the gauge pressure for the entering steam and the vacuum gauge pressure for the exhaust steam. ($\rho_{\text{Hg}} = 13600 \text{ kg/m}^3$ and $g = 9.81 \text{ m/s}^2$) [6]
9. A piston cylinder arrangement shown in figure below contains water initially at $P_1 = 100 \text{ kPa}$, $x_1 = 0.8$ and $V_1 = 0.01 \text{ m}^3$. When the system is heated, it encounters a linear spring ($k = 100 \text{ kN/m}$). At this state volume is 0.015 m^3 . The heating continues till its pressure is 200 kPa. If the diameter of the piston is 0.15 m, determine: [8]
 - a) The final temperature and
 - b) The total work transfer



10. Air enters into a turbine at 2 MPa, 400°C and with a velocity of 200 m/s and exits from the turbine at 100 kPa and 100°C with a velocity of 80 m/s. The power output of the turbine is 800 kW when the mass flow rate of air is 4.5 kg/s. Determine the rate of heat loss from the turbine surface, inlet and exit diameters. [Take $C_p = 1005 \text{ J/kg}$, k and $R = 287 \text{ J/kg.h}$] [8]

11. A piston cylinder device shown in figure below contains 1.5 kg of water initially at 100 kPa with 10% of quality. The mass of the piston is such that a pressure of 400 kPa is required to lift the piston. Heat is added to the system from a source at 500°C until its temperature reaches 400°C. Determine the total entropy generation during the process. [8]



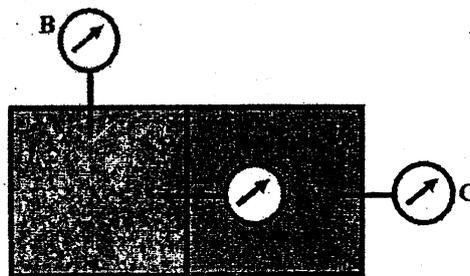
12. A power plant operating on an ideal Brayton cycle delivers a power output of 80 MW. The minimum and maximum temperatures during cycle are 300 K and 1500 K respectively. The pressure at the inlet and exit are 100 kPa and 1400 kPa respectively: [8]
- Determine the thermal efficiency of the cycle
 - Determine the power output from the turbine and
 - What fraction of the turbine power output is required to drive the compressor? [Take $C_p = 1005 \text{ J/kg}\cdot\text{K}$, $\gamma = 1.4$]
13. A 40 m long steel pipe ($k = 50 \text{ W/mK}$) having an inside diameter 80 mm and outside diameter 120 mm is covered with two layers of insulation. The layer in contact with pipe is 30 mm thick asbestos ($k = 0.15 \text{ W/mK}$) and the layer next to it is 20 mm thick magnesia ($k = 0.1 \text{ W/mK}$). The heat transfer coefficients for the inside and outside surfaces are $240 \text{ W/m}^2\text{K}$ and $10 \text{ W/m}^2\text{K}$ respectively. If the temperature of the steam inside the pipe is 400°C and the ambient air temperature is 25°C. Determine: [6]
- The inside overall heat transfer coefficient U_i ,
 - The outside overall heat transfer coefficient U_o ,
 - The heat transfer rate using U_i and
 - The heat transfer rate using U_o .

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BCE, BME, BGE	Pass Marks	32
Year / Part	I / I	Time	3 hrs.

Subject: - Fundamental of Thermodynamics and Heat Transfer (ME402)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Necessary tables are attached herewith.
- ✓ Assume suitable data if necessary.

1. Explain the difference between path function and point function with example. [4]
2. Define heat transfer and work transfer. Also mention similarities and differences between heat and work. [4]
3. Define pure substance. Explain why property tables and charts are necessary. [4]
4. Differential between steady state and unsteady state analysis. Write down general mass conservation and energy conservation equation for a steady state process and reduce them for an adiabatic turbine. [6]
5. Define isentropic process. Derive isentropic relations for an ideal gas and an incompressible substance. [6]
6. Sketch the cycle on P-v and T-s diagrams and derive an expression for its efficiency in terms of compression ratio and cut-off ratio. [6]
7. Derive expressions for inside and outside overall heat transfer co-efficient for a hollow cylinder subjected to convection medium on both sides. [6]
8. A large chamber is separated into two compartments which are maintained different pressures as shown in figure below. Pressure gauge A reads 200 kPa and pressure gauge B reads 150 kPa. If the atmospheric pressure is 100 kPa, determine the absolute pressure existing in the compartments and the reading of gauge C. [6]



9. A rigid container with a volume of 0.170 m^3 is initially filled with steam at 200 kPa, 300°C . It is cooled to 90°C . [8]
 - a) At what temperature does a phase change start to occur?
 - b) What is the final pressure?
 - c) What mass fraction of the water is liquid in the final state?
 Also sketch the process on P-v and T-v diagrams. [Refer the attached table for properties of steam]

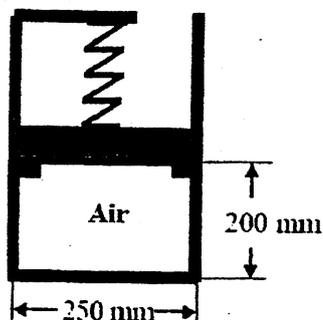
10. Air flows at a rate of 1.2 kg/s through a compressor, entering at 100 kPa, 25°C, with a velocity of 60 m/s and leaving at 500 kPa, 150°C, with a velocity of 120 m/s. Heat lost by the compressor to the surrounding is estimated to be 20 kJ/kg. Calculate the power required to drive the compressor and diameter of inlet and exhaust pipes. [Take $R = 287$ J/kgK and $c_p = 1005$ J/kgK] [8]
11. An air condition unit having COP 50% of the theoretical maximum maintains a house at a temperature of 20°C by cooling it against the surrounding temperature. The house gains Energy at a rate of 0.8 KW per degree temperature difference. For a maximum work input of 1.8 Kw, determine the maximum surrounding temperature for which it provides sufficient cooling. [8]
12. The compression ratio of an air standard Otto cycle is 8. At the beginning of the compression process, the pressure and temperature of air are 100 kPa and 20°C respectively. The heat added per kg air during the cycle is 2000 kJ/kg. Determine the pressure and temperature at the end of each process of the cycle, the thermal efficiency and the mean effective pressure. [Take $R = 287$ J/kg.k and $\gamma = 1.4$] [8]
13. A steel pipe having an outside diameter of 2 cm is to be covered with two layers of insulations, each having a thickness of 1 cm. The average conductivity of one material is 5 times that of the other. Assuming that the inner and outer surface temperature of the composite insulation are fixed, calculate by what percentage the heat transfer will be reduced when the better insulating material is nearer to the pipe than it is away from the pipe. [6]

Exam.	New Back (2066 & Later Batch)		
Level	BE	Full Marks	80
Programme	BCE, BME, BGE	Pass Marks	32
Year / Part	I / I	Time	3 hrs.

Subject: - Fundamental of Thermodynamics and Heat Transfer (ME402)

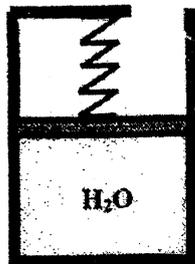
- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Necessary figures are attached herewith.
- ✓ Assume suitable data if necessary.

1. State and explain equality of temperature. Also state zeroth law of thermodynamics. [4]
2. Derive an expression for work transfer for any process on a piston cylinder device. Reduce it to get the expression for work transfer during a polytropic process. [4]
3. Define pure substance. State and explain "state postulate". [4]
4. Differentiate between steady state work applications and steady state flow applications. Write down the functions of a thermal turbine and nozzle. Also derive governing equations for them when they operate under steady state condition. [6]
5. State the entropy change statement for a control volume and derive an expression for its entropy generation. [6]
6. Sketch an ideal Otto cycle on P-v and T-s diagrams. Also derive an expression for its efficiency in terms compression ratio. [6]
7. Derive the expression for overall heat transfer coefficient for a composite plane wall consisting of two layers and subjected to convective medium on both sides. [6]
8. Air (0.01 kg) is contained in a piston cylinder device restrained by a linear spring ($k = 500 \text{ kN/m}$) as shown in figure below. Spring initially touches the piston but exerts no forces on it. Heat is added to the system until the piston is displaced upward by 80 mm. Determine: [6]
 - a) The temperature at which piston leaves the stops and
 - b) The final pressure. [Take $R = 287 \text{ J/kg. K}$, $p_{\text{atm}} = 100 \text{ kPa}$ and $g = 9.81 \text{ m/s}^2$]



9. A piston cylinder device with a linear spring initially contains water at a pressure of 4 Mpa and 500°C with the initial volume being 0.1 m³, as in figure below. The system now cools until the pressure reaches 1000 kpa. If the piston is at the bottom, the system pressure is 300 kpa. Sketch the process on P-v diagram and determine the mass of H₂O, the final temperature and volume and the total work transfer. [Refer the attached table for properties of steam]

[8]



10. Air flows at rate of 1.2 kg/s through a compressor, entering at 100 kpa, 25°C, with a velocity of 60 m/s and leaving at 500 kpa, 150°C, with a velocity of 120 m/s. Heat lost by the compressor to the surrounding is estimated to be 20 kJ/kg. Calculate the power required to drive the compressor and diameters of inlet and exhaust pipes. [Take $R = 287 \text{ J/kgK}$ and $c_p = 1005 \text{ J/kgK}$].
11. A rigid vessel consists of 0.4 kg of hydrogen initially at 200 kpa and 27°C. Heat is transferred to the system from a reservoir at 600 K until its temperature reaches 450 K. Determine the heat transfer, the change in entropy of hydrogen and the amount of entropy produced. [Take $c_v = 10.183 \text{ J/kgK}$].
12. An ideal gas turbine cycle produces 15 MW of power output. The properties of air at the compression inlet are 100 kpa and 17°C. The pressure ratio for cycle is 15 and the heat added per kg of air per cycle is 900 KJ/kg. Determine: (a) Efficiency of cycle (b) The maximum temperature during the cycle and (c) Mass flow rate of air. [Take $\delta = 1.4$ and $c_p = 1005 \text{ J/Kg.k}$]
13. A furnace wall 300 mm thick is made up of an inner layer of fire brick ($k = 1 \text{ W/mK}$) covered with a layer of insulation ($k = 0.2 \text{ W/mK}$). The inner surface of the wall is at 1300°C and the outer surface is at 30°C. Under steady state condition, temperature at the interface is measured to be 1100°C. Determine:
- Heat loss per unit area of the wall and
 - The thickness of each layer

[8]

[8]

[8]

[6]

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BCE, BME, BGE	Pass Marks	32
Year / Part	I / I	Time	3 hrs.

Subject: - Fundamental of Thermodynamics and Heat Transfer (ME402)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Necessary tables are attached herewith.
- ✓ Assume suitable data if necessary.

1. Write features of a thermodynamic property. Also differentiate between state function and path function with examples. [4]
2. Differentiate between heat and work. [4]
3. Define compressed liquid, degree of superheat, moisture content and saturated vapor. [4]
4. Define cyclic process State and explain first law of thermodynamics for a control mass undergoing a cyclic process. [6]
5. Explain the directional feature of the natural process with any one example. State the second of thermodynamics for an isolated system. Also explain the entropy generation. [6]
6. Sketch P-v and T-s diagram for a Brayton cycle. Also derive an expression for its efficiency in terms of pressure ratio. [6]
7. Derive expressions for inside overall heat transfer coefficient and outside overall heat transfer coefficient for a hollow tube subjected to convection medium on its both inner and outer surface. [6]
8. The Piston of a vertical Piston cylinder device containing as gas has a Mass of 50 kg and cross sectional area of 0.02m^2 , [6]
 - i) Determine the pressure inside the cylinder.
 - ii) During some process heat is lost by the gas to the surroundings and it's volume decreases to $\frac{3}{4}$ th of the initial volume, determine it's final pressure. [Take $P_{\text{atm}} = 100 \text{ KPa}$ and $g = 9.81 \text{ M/s}^2$]
9. A piston cylinder device shown in figure P.9 contains 0.2 Kg of a mixture of saturated liquid water and saturated water vapor at a temperature of 50°C and a volume of 0.03m^3 . The mass of the piston resting on the stops is 50 Kg and the cross sectional area of the piston is 12.2625 cm^2 . The atmospheric pressure is 100 kPa. Heat is transferred until it becomes saturated vapor. Sketch the process on P-v and T-v diagrams and determine: [8]
 - i) The final pressure, and
 - ii) The total work transfer. [Take $g = 9.8 \text{ ms}^{-2}$] [Refer attached table for the properties of steam]

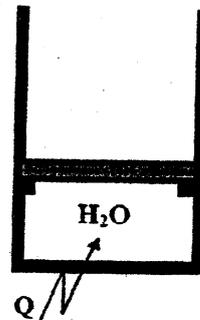


Figure P. 9

10. Air flows at a rate of 1.2 kg/s through a turbine entering at 500 kpa, 150°C; with a velocity of 120 m/s and leaving at 100 kpa, 25°C; with velocity of 60 m/s. Heat lost by the turbine to the surrounding is found to be 20 kJ/kg. Calculate the power developed by the turbine and diameter of inlet and exhaust pipes. [Take $R = 287 \text{ J/kg.k}$, and $C_p = 100 \text{ SJ/kg.k}$]

[8]

11. A heat Pump having COP of 5 maintains a building at a temperature of 24°C by supplying heat at a rate of 72000KJ/h, when the surroundings is at 0°C. The heat Pumps run 12 hours in a day and the electricity costs Rs 10/Kwh.

[8]

i) Determine the actual and minimum theoretical cost per day.

ii) Compare the actual operating cost with the cost of direct electric resistance heating.

12. Steam at 2 MPa, 350°C is expanded in a steam turbine working on a Rankine cycle to 8 kPa. Determine the net work per kg of steam and the cycle efficiency assuming ideal processes. What will be the difference in efficiency if pump work is neglected? [Refer attached table for the properties of steam]

[8]

13. A gas turbine blade is modeled as a flat plate. The thermal conductivity of the blade material is 15 W/mk and its thickness is 1.5 mm. The upper surface of the blade is exposed to hot gases at 1000°C and the lower surface is cooled by air bled of the compressor. The heat transfer coefficients at the upper and lower surfaces of the blade are 2500 W/m²k and 1500 W/m²k respectively. Under steady state conditions, the temperature, at the upper surface of the blade is measured as 850°C; determine the temperature of the coolant air.

[6]

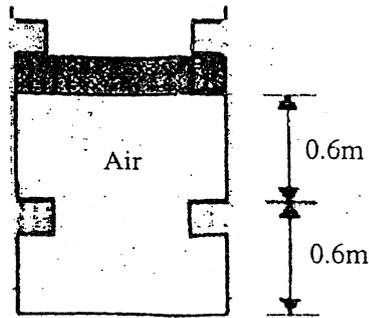
Exam.	Regular / Back		
	Level	BE	Full Marks
Program	BCE, BME	Pass Marks	32
Year / Part	I/I	Time	3 hrs.

Subject: - Fundamentals of Thermodynamics and Heat Transfer

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Necessary tables are attached herewith.
- ✓ Assume suitable data if necessary.

1. State and explain three types of thermodynamic system. [4]
2. Define thermodynamic process. Derive the expression for work done during polytropic process. [4]
3. Define compressed liquid line, saturation temperature and quality. Derive the relation $v = v_1 + xv_{1g}$ for the two phase mixture. [4]
4. Derive the general expression for conservation of energy for control volume. Modify it for turbine and nozzle. [8]
5. Derive the relations for entropy for ideal gases. Also show the equivalence of Clausius and Kelvin's statement. [6]
6. Describe the working principle of Rankine cycle with the help of P-v and T-s diagram. [5]
7. Derive an expression for heat transfer through a mild steel pipe with a layer of insulation on the outside. Take temperature of fluid in the pipe as t_{fluid} , temperature of air as t_{air} and length of the pipe as L. ($t_{fluid} > t_{air}$). [6]
8. In a quasiequilibrium process in a closed system, a gas expands from a volume of $0.15m^3$ and a pressure of 120 kPa to a volume of $0.25m^3$ in such a manner that $P(V + 0.030) = \text{constant}$, where V is in m^3 . Calculate the work. [6]
9. A $1.8 m^3$ rigid tank contains steam at $220^\circ C$. One third of the volume is in the liquid phase and the rest is in the vapor form. Determine: [8]
 - a) The pressure of the steam
 - b) The quality of the saturated mixture; and
 - c) The specific volume
10. Air is contained in a vertical cylinder fitted with a frictionless piston and a set of stops as shown in figure below. The cross sectional area of the piston is $0.05m^2$. At initial condition, piston is in upper stops with pressure and temperature inside the cylinder as 0.3 MPa and $731^\circ C$ respectively. Air is cooled as a result of heat transfer to the surroundings. The piston starts to move down at pressure 0.21 MPa. The cooling process continues until the temperature reaches $70^\circ C$. [6]
 - a) Draw p-v diagram for the process
 - b) Find the temperature of the air inside the cylinder when the piston reaches the lower stops.
 - c) Calculate the heat transfer during the process. (For air $R = 287J/kgK$, $C_p = 1004J/kgK$, $C_v = 717 J/kgK$).

6
[6]



11. Steam enters an adiabatic turbine at 10MPa and 510°C. Exit condition are 0.06MPa and quality of 96%. Determine the isentropic efficiency and actual work for a mass flow rate of 10Kg/sec. [Refer the attached table for properties of steam.] [8]
12. An exterior wall of a house may be approximated by a 10cm layer of common brick [$K = 0.7 \text{ W/m}^\circ\text{C}$] followed by a layer of 3.8cm of cement plaster. [$K = 0.48 \text{ W/m}^\circ\text{C}$]. What thickness of loosely packed rock wool insulation [$K = 0.005 \text{ W/m}^\circ\text{C}$] should be added to reduce the heat loss (or gain) through the wall by 80%. [8]
13. The compression ratio in an air standard Otto cycle is 3. At the beginning of the compression stroke, the pressure is 0.1 MPa and the temperature is 15°C. The heat transfer to the air per cycle is 1800KJ/KG of air. Determine: [7]
- The pressure and temperature at the end of each process of the cycle
 - The thermal efficiency
 - The mean effective pressure. [$R = 287 \text{ J/KgK}$, $C_v = 718 \text{ J/kgK}$]

Exam.	Regular/Back		
	Level	BE	Full Marks
Programme	BCE, BME	Pass Marks	32
Year / Part	I / I	Time	3 hrs.

Subject: - Fundamental of Thermodynamics & Heat Transfer

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt **All** questions.
- ✓ The figures in the margin indicate **Full Marks**.
- ✓ **Necessary tables are attached herewith.**
 assume suitable data if necessary.

1. Define thermodynamic property and thermodynamic state. List two important features of a thermodynamic property. [4]
2. Define total energy of a system. Also differentiate between stored energy and transient energy with examples. [4]
3. Define pure substance. Derive an expression for specific volume of a two phase mixture in terms of quality. [4]
4. Write down general steady state energy equation. Reduce it for an adiabatic turbine, an adiabatic diffuser and throttling valve. Also mention relevant assumptions for each device. [6]
5. Define heat pump and COP. Explain how performance of reversible and irreversible heat pump can be evaluated by applying first law and second law of thermodynamics. [6]
6. Define air standard analysis. Also list the assumptions of an air standard analysis. [4]
7. Derive an expression for overall heat transfer coefficient for composite plane wall consisting of two layers with convection on both sides. [6]
8. Air ($m = 0.1$ kg) is contained in piston/cylinder assembly as shown in *Figure P.8*. Initially, the piston rests on the stops and is in contact with the spring, which is in its unstretched position. The spring constant is 100 kN/m. The piston weighs 30 kN and atmospheric pressure is 101 kPa. The air is initially at 300 K and 200 kPa. Heat transfer occurs until the air temperature reaches the surrounding temperature, 700 K. Find the final pressure and volume. [Take $R = 287$ J/kg K] [6]

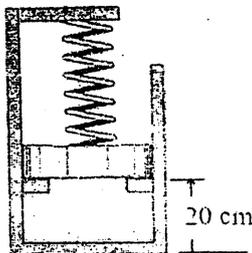


Figure P.8

9. A closed, rigid container of volume 0.5 m^3 is placed on a hot plate. Initially, the container holds two phase mixture of saturated liquid water and saturated water vapor at $T_1 = 100^\circ\text{C}$ with a quality of 0.2. After heating, the temperature in the container is $T_2 = 150^\circ\text{C}$. Indicate the initial and final states on P-v and T-v diagrams, and determine
- the pressure at each state.
 - the mass of the vapor present at each state, in kg.
 - If the heating continued, determine the temperature, when the container holds only saturated vapor. [Refer attached table for the properties of steam]
- [8]
10. Carbon monoxide (2 kg), contained in the piston-cylinder device as shown in Figure P.10, is initially at a pressure of 1.0 MPa and a temperature of 50°C . Energy is added until the final temperature is 500°C and the pressure is 2.0 MPa. A pressure of 2.0 MPa is required to lift the frictionless piston from the stops. Show the process on P-V and T-V diagrams and determine the total work transfer and total heat transfer. [Take $R = 297 \text{ J/kg K}$, $C_V = 743 \text{ J/kg K}$]
- [8]

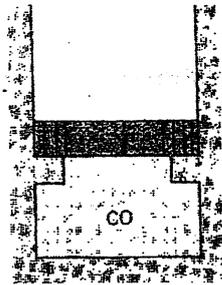


Figure P.10

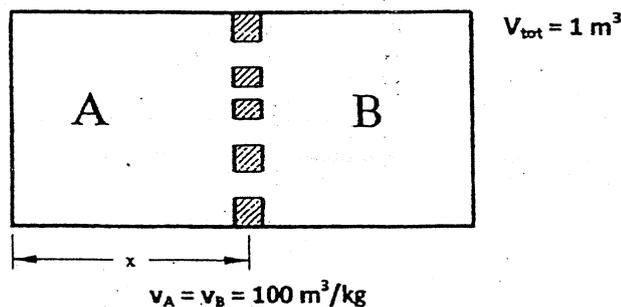
11. Steam enters the nozzle at 1 MPa, 300°C , with a velocity of 30 m/s. The pressure of the steam at the nozzle exit is 0.3 MPa. Determine the exit velocity of the steam from the nozzle, assuming a reversible and adiabatic steady flow process. [Refer attached table for the properties of steam]
- [8]
12. Calculate the efficiency and specific work output of a simple gas turbine working on the Brayton cycle. The maximum and minimum temperatures of the cycle are 1000 K and 288 K respectively, the pressure ratio is 6. [Take $\gamma = 1.4$, $C_p = 1005 \text{ J/kg K}$]
- [10]
13. A 2 m long, 0.3 cm diameter electrical wire extends across a room at 15°C . Heat is generated in the wire as a result of resistance heating, and the surface temperature of the wire is measured to be 152°C in steady operation. Also, the voltage drop and electric current through the wire are measured to be 60 V and 1.5 A, respectively. Disregarding any heat transfer by radiation, determine the convection heat transfer coefficient for heat transfer between the outer surface of the wire and the air in the room.
- [6]

Exam.	New Back (2066 Batch)		
	Level	BE	Full Marks
Programme	BCE, BME	Pass Marks	32
Year / Part	I/I	Time	3 hrs.

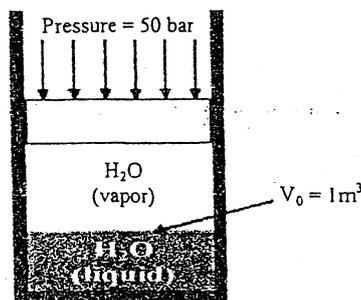
Subject: - Fundamental of Thermodynamics and Heat Transfer

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Necessary tables are attached herewith.
- ✓ Assume suitable data if necessary.

1. Define thermodynamic system. Also differentiate between different types of thermodynamic system with examples. [6]
2. Define work transfer. Derive an expression for work transfer for a polytropic process. [4]
3. Define saturation temperature, saturated vapor, critical point and moisture content. [4]
4. Explain first law of thermodynamics for a control mass with reference to conservation principles. [6]
5. Derive expressions for change in entropy for an ideal gas incompressible substance. [7]
6. Sketch components of Rankine cycle. Also sketch Rankine cycle on P-v and T-s diagram and write an expression for its efficiency. [6]
7. Define convection heat transfer. Differentiate between free and forced convection. [4]
8. The device as shown in figure below has a piston with holes positioned between the two chambers. If the piston is moved so that x is one fourth of the entire length, determine the final mass of air in the chamber A and B. [4]



9. A piston cylinder system as shown in figure below with an initial volume of 1 m^3 is surrounded by a constant pressure of 50 bar. Initially there is a liquid vapor mixture of water with quality 0.32 inside the cylinder. This water is cooled to 110°C . Determine work and heat transfer for the process. [8]



10. A gas undergoes a thermodynamic cycle consisting of three processes:

Process 1-2: compression with $PV = \text{constant}$, from $P_1 = 100\text{kPa}$, $V_1 = 1.6\text{m}^3$ to $V_2 = 0.2\text{m}^3$

Process 2-3: constant pressure to $V_3 = V_1$

Process 3-1: constant volume $U_1 - U_3 = -3549\text{kJ}$.

There are no significant changes in kinetic and potential energy. Sketch the cycle on P-V and T-V diagrams and determine the work transfer and heat for process 2-3, in kJ. Determine its net work and confirm whether it is a power cycle or a refrigeration cycle? [8]

11. Steam enters an adiabatic turbine at 6MPa, 800°C, and 80m/s and leaves at 100kPa and 140m/s. If the power output of the turbine is 8MW, determine the mass flow rate of the steam flowing through turbine assuming isentropic process. [7]

12. An oil engine works on the ideal constant pressure cycle. The overall compression ratio is 11:1 and constant pressure energy addition ceases at 10% of the stroke. The pressure and temperature at the commencement of compression are 0.96 bar and 18°C, respectively. Determine [8]

a) The thermal efficiency of cycle

b) The work done of cycle

13. A house has 2000m² wall area that consists of 1cm of plaster plates ($k = 1.2\text{W/mK}$), 6cm insulation with ($k = 0.04\text{W/mK}$) and outside brick layer 10cm thick, 200m² windows with two 2mm thick glass ($k = 0.95\text{W/mK}$) panes separated by 2cm air ($k = 0.015\text{W/mK}$) gap. Assume no inside convective layer but an outside at 35°C. Find the thermal resistance of the walls and the windows both per square meter. Find the total heat transfer rate to inside. [8]
