TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2079 Bhadra

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

Subject: - Computer Programming (*CT 401*)

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

1. a) Differentiate between system software and application software. Provide relevant examples for each of them. [4]
   b) List the steps involved in solving a problem using a computer. Why do we need an algorithm before writing program code? [2+2]
2. a) Define tokens in C programming language. How are variables declared as constant? Explain with example. [2+2]
   b) Write the output of the following: [6]

```
# include < stdio.h >
int main ( )
{
char str1 [50], str2 [50] = { 'N' , 'E' , 'P' , 'A' , 'L' } ;
scanf ( "% [A-Z]" , str1 ) ;
printf ("%s\n" , str1) ;
printf ("% 0.5 s\n" , str2) ;
printf ("% 5.3 s\n" , str2) ;
printf ("% -0.3 s" , str2) ;
return 0;
}
```

Input string: KATHmanDU

3. How are break and continue statements used to jump out from the loop? Write a program to evaluate the following series until the term value becomes less than 10^{-6}: $\cos(x) = 1 - \frac{x^2}{2!} + \frac{x^4}{4!} - \frac{x^6}{6!} + \frac{x^8}{8!} \ldots\ldots$ [4+6]
4. a) Write a syntax of function declaration, function definition and function call in C programming. Can a main function be called recursively in C? Justify your opinion. [3+1]
   b) Explain the use of recursive function with a suitable example. [4]
5. a) Differentiate between array and string. Explain how to declare and use multi dimensional arrays in C. [3+2]
   b) Write a C program to read a string from the user. Pass the string to a function and sort the alphabets in descending order. For example, if the user entered "exam" then the program should display "xmea". [5]
6. a) What is the meaning of data type used in pointer declaration? Define a function in your program to swap two integers using pass by reference. [1+3]
   b) Write a program to find the frequency of a number in array. Explain the relation of pointer and array using this program. [4]
7. Write the purpose and syntax of fopen () and fclose () function. WAP to create a structure book with its member name price and author. Read 10 records from user write it to a file named "book.dat". Read information from book.dat file, search author name "Gotterfried". If found copy the records to a file "gotterfried.dat" [3+7]
8. What are the data types available in FORTRAN? Write a program in FORTRAN to check a number is palindrome or not. [3+5]
9. Write short notes on: [2×4]
   a) Associativity in C
   b) Entry and exit control loop

TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2079 Baishakh

Exam.	Back		
Level	BE	Full Marks	80
Programme	All (Except BAR and BAS)	Pass Marks	32
Year / Part	I / I	Time	3 hrs.

Subject: - Computer Programming *(CT 401)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
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1. Explain the program development and compilation process in detail. Draw a flowchart to find all possible roots of a quadratic equation. [4+4]
2. Describe fundamental data types in the C programming language. What are relational and logical operators? Explain their precedance, associativity and their uses with example. [3+1+4]
3. Explain how scanf() and printf() are used. Write syntax and use of gets(), getchar(), scanf() and getche(); [4+4]
4. Discuss the difference between while and dowhile structure with examples. Write a program to find the following sum of following series up to n terms. [3+5]

$$\text{sum} = 1 + \frac{x^1}{1!} + \frac{x^2}{2!} + \frac{x^3}{3!} + \frac{x^4}{4!} + \ldots\ldots$$

5. Give the necessary condition for a function to be a recursive. Write a program to generate Fibonacci series up n terms. You need to make a recursive function to generate the each term of Fibonacci series. [3+5]
6. Why do we need array in programming? Write a program to display the addition of two matrix. Your program should include one function named input to enter the values of two matrix, one function named add to perform addition of two matrix and one function named display to show the result obtained after addition of two matrix. [1+7]
7. What is difference between array and structure? Create a structure TIME containing hour, minutes and seconds as its member. Write a program that uses this structure to input start time and stop time. Pass structures to a function by reference that calculates the sum and difference of start and stop time. Display the sum and difference from calling function. [2+6]
8. How is an array related with pointer? Write a program to read a string containing letters, numbers and special characters, transfer only letters contained in it into another string using pointer, finally display the second string containing only alphabets. [2+6]
9. Discuss "a", "r" and "w" modes used in data file operations. Write a program that reads numbers from a file containing series of numbers and separates odd numbers from even numbers and writes them on two separate files. [2+6]
10. How are one dimensional array declared in FORTRAN. Write a program in FORTRAN to read and compute the transpose of any matrix. [2+6]

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TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2078 Bhadra

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

Subject: - Computer Programming *(CT 401)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt All questions.*
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1. a) What is a program? Explain different types of programming language in brief. [1+3]
   b) What is an algorithm? Explain how does algorithm and flowchart helps in computer programming. [1+3]
2. a) Explain Ternary operator in C with an example. Define following terms. [2+2]
   (i) Preprocessor directives (ii) Keywords
   b) Write the output of the following C program. [4]

```
int a,b;
double c = 123.55667788
char str[] = "I enjoy programming";
scanf(" %3d%2d", &a, &b);
printf("a = %5\n b=%-7d",a,b);
printf("\n%10.7s",str);
printf("\n%0.3f",c);
printf("\n%-10.6f",c);
```

   input:123456 789

3. Write the difference between formatted I/O and unformatted I/O functions in C-programming. Write the syntax for following functions. [2+4]
   (i) getche() (ii) getchar() (iii) scanf()
4. a) What do you mean by iteration? Explain the operation of break and continue statement with a suitable example. [1+3]
   b) Write a C program to check whether an entered word is a palindrome or not without using library function. [6]
5. a) What do you mean by a function header? Explain the function parameters and its types. [1+3]
   b) Write a C program to calculate the sum of digits of a given number unless the sum becomes a single digit using recursion. [Hint: 9785 => 29 => 11 => 2] [4]
6. a) What is an array? Why is it necessary in c programming? [1+2]
   b) Write a program which display following pattern. [5]

```
H
HE
HEL
HELL
HELLO
HELL
HEL
HE
H
```

7. Is there any relation between array and pointer? If yes, show the relation between array and pointer with a suitable example. [1+3]

8. What is structure? Write a program to read a structure named "Faculty" having StaffID, Name, Address and ServiceYear as member. Where ServiceYear is another structure having DurationInYear as member. Now display the details of those faculties whose service duration is more than 10 and less than 30 years. [1+7]

9. a) Why do we need file handing? Write different modes of file opening. [1+3]

   b) What is the purpose of fseek and write a program to write the name, roll no, and age of five students into a disk file name "STUDENT.DAT". [6]

10. Describe X format and T format in FORTRAN. Differentiate between unconditional goto and computed goto in FORTRAN. Write a program in FORTRAN to sort elements of a ID array in ascending as well as descending order. [2+2+6]

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TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2078 Kartik

Exam.	Back		
Level	BE	Full Marks	80
Programme	All except BAR	Pass Marks	32
Year / Part	1 / I	Time	3 hrs.

Subject: - Computer Programming *(CT 401)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
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1. a) Discuss the recent software trends. Explain in details about the features that a software should include. [2+2]

   b) List out the general rules for flowcharting. What are the errors that might occur during debugging? [2+2]

2. a) What are pre-processor directives? Explain compilation process with suitable block diagram. [1+3]

   b) Why do we need to analyse the problem before solving it? Define tokens, expression and identifiers. [1+3]

3. a) What is the control statement? Write down the classification of control statements. [1+2]

   b) Write down the syntax of a given function. [4×1]

   (i) printf()
   (ii) scanf()
   (iii)getchar()
   (iv)getch()

4. a) Write the output of following program: [3]

```
int main()
{
char ch='G';
int g=10;
float gravity = 9.81;
printf("%%d%%f\n");
printf("%10d\n", g);
printf("%3c\n", ch);
printf("%.3f\n", gravity);
printf("%-10.1f%d\n", gravity, g);
return 0;
}
```

   b) Define and write syntax of the following: [3×1]

   (i) gets()
   (ii) putchar()
   (iii)scanf()

5. Why do we need loop for programming? Write a program to evaluate the following series. [2+4]

$$cos(x) = 1 - \frac{x^2}{2!} + \frac{x^4}{4!} - \frac{x^6}{6!} \ldots\ldots\ldots + n \text{ terms}$$

6. Why do we need to declare a function? Define formal parameter and actual parameter. [2+2+4]
Evaluate following series using recursive function.

1, 11, 111, 1111, 11111, ... n terms

7. a) Define an array of string with an example. Distinguish between an array and a pointer. [2+2]

   b) Write a C program to insert an element to a desired position to an array using function. The new element to be inserted and desired position should be givne by user. [6]

8. a) Define a void pointer with an appropriate example. [2]

   b) Write a C program that uses pointer to represent two 2-D array of size of m×n and p×q respectively. Find the product of these two matrices if possible otherwise display a message "Calculation cannot be performed" using function. [6]

9. Discuss about nested structure with a suitable example. Create a structure called "student" with data member name, address and id.pass structure to function and sort the information of student on the basis of alphabetical order of "name" and display the result in main() function. [2+6]

10. Write a C program to create a new file named "employee.dat" which consist the information of 10 employees. Employee information includes empName, salary and post. Read the file back to search the word "manager". [6]

11. Explain different format types used in FORTRAN. Mention different data types used in FORTRAN. [3+2]

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TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2076 Chaitra

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

Subject: - Computer Programming *(CT 401)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt <u>All</u> questions.*
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- ✓ *Assume suitable data if necessary.*

1. What are different types of computer software? What do you mean by high level and low level programming languages? A long with the block diagram explain the steps involved during compilation of a source code. [2+2+4]
2. Explain different types of error that usually appears during the programming. Define preprocessing directive and explain its type with example. Write the algorithm and draw the flowchart to find the reverse of given number. [2+2+4]
3. Why are formatted output important in C language? Write a program to print all the roots (Even imaginary roots) of quadratic equation. [3+5]
4. Explain the importance of a switch case statement. Compare switch-case with if-else ladder. Write a program to find sum of numbers from 1 to 100 which are exactly divisible by 5 and not by 3. [2+2+4]
5. How is function declared? Why is function prototype necessary? Write recursive function segment that returns the sum of numbers from 1 to n given by the user. [2+1+5]
6. How can you pass one dimensional array to function and what does name of an array in function call represents? Write a program to find the largest and smallest element of an array using a single function and display the result in calling function. [3+5]
7. Explain how a structure can be defined and structure variables can be declared in C. Write a program that reads name, roll numbers, program and marks obtained in five subjects by students until the user enters 'e' and display the student detail and total marks obtained by each student. [3+5]
8. What is pointer? Discuss its relationship with an array. Write a function program that behaves strcpy() function using pointer as arguement. [1+2+5]
9. Explain different modes in opening file. Write a program to read a string, write it into a file and display the content of a file into a screen. [4+4]
10. Explain different data types available in FORTRAN. Write a program in FORTRAN to check whether a number given by user is palindrome or not. [2+6]

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TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2076 Ashwin

Exam.	Back		
Level	BE	Full Marks	80
Programme	All (Except BAR and BAS)	Pass Marks	32
Year / Part	I / I	Time	3 hrs.

Subject: - Computer Programming *(CT 401)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt <u>All</u> questions.*
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1. a) Define a language processor. Explain the main types of language processor in detail. [2+3]
   b) List the basic step of problem solving using computer. Write an algorithm and draw a flowchart to find the sum of N natural number. [1+4]
2. a) Define formatted and unformatted I/O functions. Write the operations of following functions: [2+3]
   (i) getch()
   (ii) getche()
   (iii)getchar()
   b) What is an expression? Write a program to display the smallest number between three integers entered from user using conditional operator. [1+4]
3. a) Differentiate between while and Do-while looping statement with example. [4]
   b) Write a program to evaluate the following series up n term. Prompt the user to input value of n and x. $f(x) = 1-x^2/2!+x^4/4!-x^6/6!+x^8/8!$---------up to n terms. [6]
4. a) What are the different types of functions available in C? What do you mean by pass by reference and pass by value. [2+3]
   b) What are the similarities and difference between iteration and recursive function? Give suitable example. [5]
5. How do you initialize a 2D array? Explain with an example. Write a program to input two matrices of size m×n and p×q respectively. Pass these matrices to the function to calculate the product matrix. Display the product matrix in the main () function. [2+8]
6. a) What is a structure? When do we use structure? [2+2]
   b) Write a program using pointer to swap the value of two variable where the swapping operation is performed in separate function. [6]
7. a) Why are fgets(), fputs(), fgetc() and fputc() used? [4]
   b) Write a program to display the record in sorted order, sorting is performed in ascending order with respect to name using data files concept. [6]
8. a) Compare Logical IF and Arithmetic If statement in FORTRAN with example. [4]
   b) Write a FORTRAN program to sort 10 integers given from user and display the second largest integer. [6]

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TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2075 Chaitra

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

Subject: - Computer Programming *(CT 401)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
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1. a) What is computer programming and computer software? Explain about types of programming languages and software. [2+2]

   b) What do you mean by compiler? Explain in brief the steps involved during compilation process along with block diagram. [2+4]

2. a) What is expression? What kind of information is represented by expression? [2+2]

   b) What is the purpose of the putchar function? How is it used within a C program? Compare with the getchar function with example. [6]

3. a) Compare nested-if control structure with else-if ladder structure along with flowchart. [4]

   b) Write a program to read a number from user, count the number of even digits contained in it and display whether the resulting count is prime or not. [6]

4. a) Write a program to generate the following output. [6]

```
1 2 3 4 5 4 3 2 1
  1 2 3 4 3 2 1
    1 2 3 2 1
      1 2 1
        1
```

   b) What is a function? What type is the main () function? Explain actual parameter and formal parameter with example. [1+1+2]

5. a) Write a program to read one dimensional array of n elements, pass it to a function for processing so that, the program should display the largest and smallest element of an array from the main function. [6]

   b) How can we initialize 2D array of character data type during compilation? Illustrate with suitable example. [4]

6. a) What is a structure? Explain nested structure with an example. [1+2]

   b) Write a program to define a structure named Person with Name, address, salary as its member. Enter values for five persons. Pass the structure to a function which increases the salary by 15% each. Display the updated information in the main () function. [7]

7. a) Write the output of the following. [6]

address: 65510 address: 65550 address: 65580

```
int a=10,*b, **c;
b=&a;
c=&b;
printf("%d\t%d\n",b,*c);
printf("%d\t%d\n", c, **c);
printf("%d\t%d", *b+5, &c+2);
```

b) What do you mean by Generic pointer, Null pointer and File pointer? [4]

8. a) Explain the FORTRAN structure. What are data types in FORTRAN? [2+2]

b) Write a program to print the Fibonacci series until the term is less than 500. [6]

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01 ; TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2075 Ashwin

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

Subject: - Computer Programming *(CT401)*

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1. a) What is computer program? Discuss in brief about different generation of programming languages. [1+4]
   b) Why is algorithm and flow chart development important in problem solving? Write an algorithm and draw flow chart to test a number entered by user whether it is even or not. [2+3]
2. a) What is the identifier? What are the ways to give value to variable? Explain with example? [1+2+1]
   b) Explain about input and output function available in C with syntax and example of each part. [2+2+2]
3. a) Write algorithm, draw flow chart and program to input a number check it is Armstrong or not. [2+2+2]
   b) What do you mean by selective and repetive statement? Why do we need break and continue statement? [2+2]
4. a) What do you mean by "call by value and call by reference"? Explain it with suitable example. [4]
   b) Can we pass whole array element from the function? Write the program to pass an array to function and sort them. [6]
5. a) Write a program that finds the largest word in a given sentence. [4]
   b) Differentiate between the methods of passing argument to function with example. What are their advantages and disadvantages? [6]
6. What is structure? Why is it necessary? Write a program to add two distances given in feet and inch format using structure. [1+1+6]
7. a) What is null pointer? What will be the output of following program, explain. [1+3]

```
#include<stdio.h>
int main() {
   if( ! NULL )
      printf("C programming is easy");
   else
      printf("C programming is not easy");
   return 0 ;
}
```

   b) Write a program to calculate the length of string without using string handling function. [4]
8. A file name employee.txt stores employee name, employee id and employee salary. Write a program to display the detail of all employees in the order of their salary. [8]
9. Write a program in FORTRAN to read 10 integers from user and short them in ascending [6]

02 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2074 Ashwin

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

Subject: - Computer Programming *(CT401)*

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1. What are computer programs and computer programming? Explain the steps that are required to build a computer program for solving a certain problem. [2+6]

2. Explain with an example the role that precedence and associativity play in the execution of an expression. Rewrite the following program by correcting any errors, if present and also write down the output of the corrected code. [4+4]

```
Define MAX '5'
int main ( )
{
  int case[MAX]={2,3,5,4,10},i,sum=0;
  for(i=0,i<MAX,i+=1)
  {
    printf("Case %d = %3.2d\n",i,case[i]);
    sum +=* case+i;
  };
  average = sum/MAX;
  printf("%06.2f",average);
  return 1;
}
```

3. a) Compare if-else-if ladder and switch construct with example and flowchart. [5]

   b) Write a program in C to generate following pattern using unformatted input/output functions only. [5]

```
        N
      e e e
    p p p p p
  a a a a a a a
L L L L L L L L L
```

4. Write a program in C to find out whether the n^{th} term of the Fibonacci series is a prime number or not. Read the value of n from the user and display the result in the main function. Use separate user-defined functions to generate the n^{th} Fibonacci term and to check whether a number is prime or not. [8]

5. a) How two dimensional arrays are created in C programming? Write a program to read square matrix of size N×N and find sum of both diagonals. [2+4]

   b) Write a program in C to check whether a given string is palindrome or not using user defined function. [4]

6. What are the advantages of using pointer in C programming? Write a program in C to find second largest elements from an array containing N elements using concept of pointer. [2+4]

7. Explain structures and nested structures? Create a structure to hold any complex number x+iy. Write a program that uses the structure to read two complex numbers and display a third complex number which is the multiplication of the entered complex numbers. [3+5]

8. a) What are different input/output functions used with data files in C? Explain with syntax and examples. [4]

   b) Write a program in C to read integers from user until user says "no". After reading the data write all the odd numbers to a file name odd.txt and all the even number to file named even.txt. [4]

9. When can we use recursive functions? Why do we need control statements in computer programs? Differentiate between do...while and for statements. [2+2+2]

10. What are the characteristics of FORTRAN Programming? Write a program in FORTRAN to calculate the value of π by evaluating the following formula for the first 25 terms. [8]

$$\pi = 4\left(1-\frac{1}{3}+\frac{1}{5}-\frac{1}{7}+\frac{1}{9}-\cdots\right)$$

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01 TRIBHUVAN UNIVERSITY
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2074 Chaitra

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Subject: - Computer Programming *(CT401)*

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1. a) What is a programming language? What is the difference between source code and object code. [2+2]
   b) What is debugging and testing? What are the step that need to be followed for developing the application software. [2+2]
2. a) What is the difference between variable declaration and variable definition? Explain with example. [4]
   b) What do you mean by macro expansion and file inclusion in C? Explain with example. [4]
3. What are functions used for formatted and unformatted output? Write down its syntax. Write down the output of printf() function for the following sections of statements. [4+4]

```
float a = 5.7891;
int b = 6789;
printf("a=%4f and b=%-7d from first line", a,b);
printf("a=%-7.2f and b=%07d from second line", a,b);
printf("a=%.2f and b=%2d from third line", a,b);
```

4. a) Explain about while loop with its syntax and flowchat. [4]
   b) Write a program to convert a decimal number into binary number. [6]
5. a) Can a function return an array to the calling function? Explain with example. [4]
   b) Write a program to read a mxn matrix of integers and to find the largest elements of each row. Store the largest elements of the row in a one-dimensional array of m integers before displaying them. [6]
6. a) How does a structure differ from an array? What are the different ways to access structure member? [4]
   b) Create a structure named student that has name, roll and marks as members. Assume appropriate types and size of members. Use this structure to read and display records of 10 students. Crete two functions: One is to read information of students and other to display the information. [6]
7. a) Define following term: [5]
   i) int*p;
   ii) int p(char*a)
   iii) int(*p(char*a))
   iv) int *p(void)
   v) int*(*p[10])char a)
   b) Write the advantages of using pointer in C- programming. [3]
8. Write a program to copy to copy content of one file source.txt to another destination.txt. [8]
9. a) Explain the FORTRAN structure. What are different types on FORTAN? [2+3]
   b) Write a FORTRAN program to read N number to find second largest number among

02 TRIBHUVAN UNIVERSITY
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2073 Chaitra

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1. Explain the generations of programming language. Distinguish between High level and Low level programming language. [3+3]
2. What is an algorithm and how it differs from pseudo-code? Develop algorithm and draw flowchart to find the largest of N numbers. [2+3+3]
3. a) What are identifiers? List the rules to define valid C identifiers. [2+3]
   b) What is operator? Describe the conditional operator in C with syntax and example. [2+3]
4. What are the differences between global and local function, variables and data types, & (Ampersand) operator and * operators used in c-programming language? Explain with example. [4+4]
5. a) Differentiate between pass by value and pass by reference. [3]
   b) Explain the significance of user defined functions with example. [5]
6. a) Write a program to read a string and check whether it consists of Alphabet or not. Use user defined function to accomplish the task. [5]
   b) Explain how 2D array is passed to a function. Write a C program to display largest and smallest elements of a 2D array. [5]
7. What is nested structure? Write a program in C to read name, age and salary of 10 different employees as the three members of a structure named as "employee". Sort this data in salary basis using user defined function and display sorted data from main function. [2+8]
8. Write a program in C-programming language to compute the cosine series. (hints: $\cos(x) = 1-x^2/2!+x^4/4!-x^6/6!+$.....up to n terms) [6]
9. Write a program to open file named INVENTORY and store in it for maximum 10000 data of ITEM_NAME, NUMBER, PRICE, QUANTITY. Extend the program to read this data from the above given filename and display the inventory table with the value of each item. [6]
10. a) Compare unconditional goto and computed goto in FORTRAN with syntax. [3]
    b) Write a program in FORTRAN to read an array containing N elements, sort this data in ascending order and display the result. [5]

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05 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2073 Shrawan

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) What do you mean by Programming Language? Explain about the evolution of programming languages. [1+3]
   b) What are the advantages of a Flowchart-design? Write down the guidelines to be followed to draw a flowchart. [2+2]
2. a) What is the purpose of the semicolon that appears at the end of most assignment statement in C? Explain the program compilation, linking and loading process with example. [2+4]
   b) Discuss the types of errors in programming. How do you debug a C-program? [2+4]
3. a) Explain relational and logical operators. [4]
   b) Write a C program to display following pattern without using formatted input/output statements. [4]

```
Programming
rogrammin
ogrammi
gramm
ram
a
```

4. a) Why do we need control statements? Compare switch and if-else-if ladder with example. [4]
   b) Write a C program to display all characters between a given ranges. [6]
5. a) What are the advantages of using functions? Differentiate between Library functions and User-defined functions with suitable example. [5]
   b) Write a program to check whether a given number is Armstrong number or not using recursive function. [5]
6. a) Write a C program to read two strings in main and compare them using userdefined function. Display appropriate message from main. [4]
   b) What are overflow and underflow errors in context of array? Write a program to add corresponding elements of two arrays. The results should form a new array. [2+4]
7. a) Why should we prefer structure over array? Explain nested structure with example. [2+4]
   b) Write a program to read name and roll number of 48 students from user and store them in file. If the file already contains data, your program should add new data at the end of the file. [6]
8. a) What is the structure of FORTRAN program? [5]
   b) Write a FORTRAN program to read n numbers and display largest number among them. [5]

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05 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2072 Chaitra

Exam.	Regular		
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) What is a flow chart? Use the various commonly used flow chart symbols. How does a flow chart help computer programming? [2+2+2]
   b) What is a program? Briefly describe types of computer software. [2+2]
2. a) What is an operator, datatype, constant and variable? Define. [6]
   b) Define and write syntax of the following: [4]
      i) gets()
      ii) putchar()
      iii) scanf()
      iv) strlen()
3. a) How is the switch statement used in decision making? Explain with a suitable example. [4]
   b) Write a program to check whether a given integer is a triangular number or not. [6]

   (Any number is a triangular number if the sum of natural number from 1 to any number i is exactly equal to that number. For e.g 1,3,6,10,15 etc are triangular number as, 1+2=3, 1+2+3=6, 1+2+3+4=10, 1+2+3+4+5=15)
4. a) Briefly explain the passing by value and passing by reference in function with example. [6]
   b) Write a program to calculate sum of digits of a given 5-digits number entered by the user using recursive function. [4]
5. What is a string? Write a program to read a 3*3 square matrix, find minimum integer value of a matrix, replace the diagonal elements by the minimum element and display it using pointer. [2+8]
6. a) What is the principal difference between a structure and an array? [2]
   b) Write a program to read structure "college" having name, estDate and location where estDate is an another structure having day, month and year as members. Display the records of 10 colleges. [8]
7. a) What is a data file in C? What are the modes in file handling? Explain briefly. [1+3]
   b) Write a program to read the information of a file named "data.txt" and write its contents to another file "record.txt". [6]
8. a) Compare DO and implied DO statement in FORTRAN. [3]
   b) Write a FORTRAN program to add and subtract two matrices and display the results in matrix form. [7]

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05 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2072 Kartik

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 $Sn = \sum 1/n^2$ 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 compilier 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)+.....n [4+4]
   b) Explain with suitable example to show how an Impiled Do loop works in FORTRAN. [4]

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05 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2071 Shawan

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) 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) pintf( )
      ii) scanf( )
      iii) getche( )
      iv) getch( )
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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05 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: - 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) 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: $1\times10+3\times20+6\times30+.....+\frac{N(N+1)}{2}\times10N$, 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 n^{th} 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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05 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
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: - 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) 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;
c = a > b ? a:b;
b = (a++) + (b--) +a;
c = c++*b--;
```

   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*n matrix, transpose it and display both the matrices. [8]

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05 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2070 Ashad

Exam.	New Back (2068 & 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) 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 n^{th} record in the file, where n is read from the user. The data for authors must be represented by structures that contain name, nationally 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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12/20

22 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2070 Chitra

Exam.	Old Back (2065 & Earlier Batch)		
Level	BE	Full Marks	80
Programme	BEL, BEX, BCT	Pass Marks	32
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.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Assume suitable data if necessary.*

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]

$$S_n = x + \frac{x^3}{3!} + \frac{x^5}{5!} + \cdots$$

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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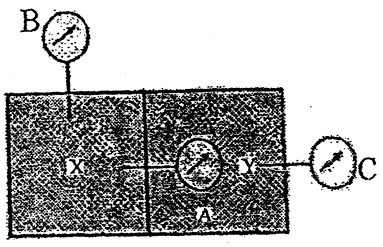
TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2079 Bhadra

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

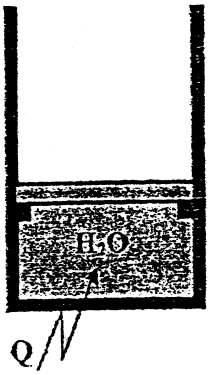
Subject: - Fundamental of Thermodynamics and Heat Transfer (*ME 402*)

- ✓ 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.*
- ✓ *For air take Cp = 1005J/kgk and Cv = 718 J/kgk.*

1. How will you find out whether a given variable is a thermodynamic property? How are those properties classified? Give examples. [4]
2. Define transient energy with its salient features. Differentiate between molecular potential energy and macroscopic potential energy of a system. [4]
3. Show how saturation curve is formed on P-v diagram by sketching constant temperature process lines. Sketch saturation curve and show all important points, lines and regions. [4]
4. State first law of thermodynamics for a power cycle and a refrigeration cycle. Write down general mass and energy conservation equations for a control volume and reduce them for a steady state process. [2+4]
5. Define entropy. State and explain second law of thermodynamics for an isolated system. [1+5]
6. Derive an expression for compression ratio for an internal combustion engine in terms of cylinder dimensions. Also explain how the thermal efficiency of an air standard otto cycle can be increased with respect to the cylinder dimensions. [6]
7. Derive expressions for overall heat transfer coefficients for a composite cylinder consisting of two layers and subjected to convection medium on outside of the composite cylinder only. [6]
8. A large chamber is separated into two compartments which are maintained at different pressure, as shown in figure below. Pressure gauge A reads 200kPa and pressure gauge B reads 120 kPa. If the barometric pressure is 100 kPa, determine the absolute pressure existing in the compartments and reading of gauge C. [6]



9. Water (1 kg) at 0.2 MPa is initially enclosed within a volume of 0.1 m^3 and the piston rest on stops as shown in figure below. The piston will move when the pressure is 1 MPa. A total heat transfer of 2500 kJ is added to the water. Determine the total work done and draw the P-V and T-V diagram. [8]



10. Air at 100 kPa and 130°C enters an adiabatic diffuser at a rate of 1.5 kg/s and leaves at a pressure of 150 kPa. The velocity of the air is decreased from 250 m/s to 50 m/s as it passes through the diffuser. Determine the exit temperature of the air and exit area of the diffuser. [8]

11. A cold storage is to be maintained at -5°C while the surroundings are at 40°C. The heat leakage from the surroundings into the cold storage is estimated to be 1.35 kW per degree temperature difference. The actual COP of the refrigeration plant is 75% of an ideal plant working between the same temperatures. Find the power required to drive the plant. [8]

12. A steam power plant works on Rankine cycle that operates between boiler pressure of 1.6 MPa and condenser pressure of 600 kPa. Steam leaves the boiler as saturated vapor. The mass flow rate of the steam is 40 kg/s. Determine: [8]

    a) the pump work and turbine work of the cycle, in kW,
    b) the heat transferred to boiler
    c) the efficiency of the cycle
    d) the efficiency of Carnot cycle working between same temperature limit

13. A hot room wall has made of 40 cm of brick on the outside, 12 cm of plastic foam and finally 2 cm of the fire clay on the inside. The inside and outside temperatures are 590°C and 220°C respectively. If inside and outside heat transfer coefficients are 56 W/m^2K and 6 W/m^2K and thermal conductivities of brick, foam and fire clay are 0.98 W/mK, 0.02 W/mK and 0.09 W/mK respectively. Determine: [6]

    a) rate of heat loss from the hot room if the total wall area is 100 m^2 and
    b) the temperature at the interface

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TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2079 Baishakh

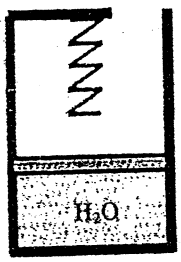
Exam.	Back		
Level	BE	Full Marks	80
Programme	BCE, BME, BGE	Pass Marks	32
Year / Part	I / I	Time	3 hrs.

Subject: - Fundamental of Thermodynamics and Heat Transfer *(ME 402)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt <u>All</u> questions.*
- ✓ *The figures in the margin indicate <u>Full Marks</u>.*
- ✓ ***Take C_p = 1005 J/kgK, C_v = 718 J/kgK, R = 287 J/kgK, γ = 1.4.***
- ✓ *Assume suitable data if necessary.*

1. Define the following terms: thermodynamic property, thermodynamic equilibrium, thermodynamic state and thermodynamic process. [4]
2. Define polytropic process. Sketch polytropic process with n = 0, n = 1, n = 1.4 and n = ∞ on a common P-V diagram. Derive an expression for work transfer for an isobaric process. [4]
3. Define: dryness fraction, degree of superheat, saturation temperature and saturated liquid. [4]
4. Write the general mass and energy equation for a control volume operating under unsteady state condition. Derive mass and energy conservation equations for a gas filling process in a gas station. [6]
5. Define isentropic process. Derive an expression for isentropic relation for an ideal gas. [6]
6. Briefly explain the working principle of diesel cycle using P-v and T-s diagram. [6]
7. Derive an expression for overall heat transfer coefficient for a composite wall consisting of two layers subjected to convection medium on both sides. [6]
8. A vertical piston cylinder device contains a gas at a pressure of 100 kPa. The piston has a mass of 15 kg and a diameter of 10 cm. Pressure of the gas is to be increased by placing some weights on the piston. Determine the local atmospheric pressure and the mass of the weight that will double the pressure of the gas inside the cylinder. [6]
9. A piston cylinder arrangement shown in figure below contains water initially at P_1 = 100 kPa, x_1 = 0.9 and V_1 = 0.01 m^3. When the system is heated, it encounters a linear spring (k = 100 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
   a) the final temperature and
   b) the total work transfer
   c) Also sketch the process on P-v diagram

   [8]



10. An adiabatic diffuser has air entering at 100 kPa, 300 K with a velocity of 220 m/s. The inlet cross sectional area of the diffuser is 100 mm^2. At the exit, the area is 860 mm^2 and velocity is 20 m/s. Determine the exit temperature and pressure of the air. [8]

11. An air conditioning unit with a power input of 2 kW has a COP of 3 while working as a cooling unit in summer and 4 while working as heating unit in winter. It maintains a hall at 22°C year round, which exchanges heat at a rate of 0.85 kW per degree temperature difference with the surroundings. Determine the maximum and minimum outside temperature for which the units is sufficient. [8]

12. The minimum temperature a Brayton cycle is 400 K which is one fourth of its maximum temperature. If the pressure ratio is 9, determine: [8]
    a) the net work per kg of air and
    b) the thermal efficiency of the cycle.

13. A pipe (k = 30 W/mK) with inner and outer diameter of 2 cm and 4 cm respectively is covered with 2 cm layer of insulation (k = 0.2 W/mK). If the inside and outside surface of the combination are at 450°C and 50°C respectively, determine the heat loss from the unit length of the pipe. Also determine the pipe insulation interface temperature. [6]

***

Table 1: Properties of Saturated Water – Pressure Table

P	T	v_l	v_{lg}	v_g	u_l	u_{lg}	u_g	h_l	h_{lg}	h_g
kPa	°C	m³/kg	m³/kg	m³/kg	kJ/kg	kJ/kg	kJ/kg	kJ/kg	kJ/kg	kJ/kg
90	96.713	0.001041	1.8688	1.8698	405.11	2097.1	2502.2	405.20	2265.3	2670.5
100	99.632	0.001043	1.6933	1.6943	417.41	2088.3	2505.7	417.51	2257.6	2675.1
125	105.99	0.001048	1.3742	1.3752	444.25	2068.2	2513.2	444.38	2240.7	2685.0
150	111.38	0.001053	1.1584	1.1595	467.02	2052.4	2519.4	467.18	2226.0	2693.2
175	116.07	0.001058	1.0027	1.0038	486.89	2039.8	2524.7	487.08	2213.3	2700.4
200	120.24	0.001060	0.8848	0.8859	504.59	2024.8	2529.4	504.80	2201.7	2706.5
225	124.01	0.001064	0.7923	0.7934	520.59	2012.9	2533.5	520.83	2191.2	2712.0
250	127.44	0.001067	0.7177	0.7188	535.22	2001.9	2537.1	535.49	2181.3	2716.8

Table 2: Properties of Superheated Steam

P	T	v	u	h	s
kPa	°C	m³/kg	kJ/kg	kJ/kg	kJ/kg.K
100	(99.63)	(1.6943)	(2505.7)	(2675.1)	(7.3589)
	100	1.6961	2506.3	2675.9	7.3609
	150	1.9364	2582.4	2776.1	7.6129
	200	2.1723	2657.6	2874.8	7.8335
	250	2.4061	2733.3	2973.9	8.0325
	300	2.6388	2810.1	3073.9	8.2154
	350	2.8709	2888.3	3175.1	8.3846
	400	3.1027	2968.1	3277.8	8.5421
	450	3.3342	3049.5	3382.3	8.6927
	500	3.5655	3131.6	3488.2	8.8342
	550	3.7968	3216.1	3595.8	8.9690
	600	4.0279	3302.3	3705.0	9.0979
	650	4.2590	3390.2	3816.1	9.2216
	700	4.4900	3479.8	3928.8	9.3405
	750	4.7210	3571.3	4043.4	9.4553
	800	4.9519	3664.5	4159.7	9.5662

P	T	v	u	h	s
kPa	°C	m³/kg	kJ/kg	kJ/kg	kJ/kg.K
200	(120.24)	(0.8859)	(2529.4)	(2706.5)	(7.1272)
	150	0.9597	2576.7	2768.6	7.2793
	200	1.0803	2653.9	2870.0	7.5059
	250	1.1988	2730.8	2970.5	7.7078
	300	1.3162	2808.2	3071.4	7.8920
	350	1.4328	2886.5	3173.1	8.0628
	400	1.5490	2966.0	3276.0	8.2228
	450	1.6648	3046.9	3380.3	8.3737
	500	1.7804	3129.1	3486.2	8.5169
	550	1.8959	3213.0	3593.8	8.6535
	600	2.0130	3301.7	3704.3	8.7773
	650	2.1287	3389.7	3815.4	8.9011
	700	2.2443	3479.4	3928.3	9.0201
	750	2.3599	3570.9	4042.9	9.1350
	800	2.4755	3664.1	4159.2	9.2460
	850	2.5910	3759.1	4277.3	9.3536

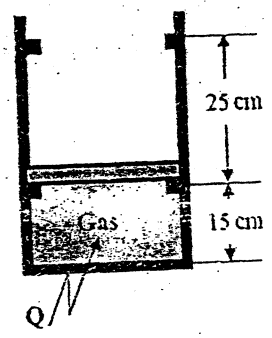
TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2078 Bharda

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 *(ME 402)*

- ✓ 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 a thermodynamic property and thermodynamic state. List two important features of a thermodynamic property. [4]
2. Define work transfer and heat transfer with examples. Also derive a mathematical expression of displacement work for an ideal gas undergoing an adiabatic process. [4]
3. Explain how saturation curve is formed on T-V diagram. [4]
4. Define unsteady state work applications. Derive general mass and energy conservation equations for an open system undergoing a process in which a fluid is being supplied into a piston cylinder device through a valve. [6]
5. Define refrigerator and its COP. Explain how first law and second law of thermodynamics can be applied to analyze the performance of the refrigerator. [6]
6. Derive an expression of thermal efficiency of an ideal Rankine cycle. Sketch P-V and T-S diagrams of the cycle. [6]
7. Define thermal resistance. Write the expression of thermal resistance for plane wall, hollow cylinder and convective layer. Differentiate between free and forced convection with examples. [6]
8. A piston cylinder arrangement as shown in figure below contains gas initially at $P_1=P_{atm}=100kPa$ and $T_1= 20°C$. The cross sectional area of the piston is 0.01 m^2 and has a mass of 50kg and is initially resting on the bottom stops. Heat is added to the system until it touches the upper stops. [6]
   a) Sketch the process on P-V and T-V diagrams.
   b) Determine the total work transfer.



9. A rigid container with a volume of 0.2 m^3 is initially filled with steam at 200kPa, 200°C. It is cooled to 100°C. [8]

   a) At what temperature and pressure 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?
   d) Sketch the process on P-V and T-V diagrams.

   [Refer attached table for the properties of steam]

10. Air enters the turbine at 1MPa and 327°C with a velocity of 100m/s and exits at 100 kPa and 27°C with low velocity. Heat loss from the turbine surface is 1200kJ/min and power output of the turbine is 240kW. For an inlet area of turbine 800cm^2, determine the velocity and volumetric flow rate of air at turbine exit. [Take R = 287 J/kgK and C_p=1005 J/kgK] [8]

11. Air enters a gas turbine at 1MPa and 1500K and exists at 100kPa. If its isentropic efficiency is 80%, determine the turbine exit temperature. (Take r = 1.4 and C_p = 1005 J/kgK) [8]

12. An ideal Otto cycle has a compression ratio of 8. At the beginning of the compression process, air is at pressure 95kPa and temperature 27°C, and 750 kJ/kg of heat is transferred to air during the heat addition process. Determine:

    (i) pressure and temperature at the end of the heat addition process,
    (ii) the net work output per kg of air and
    (iii)the thermal efficiency of the cycle. [Take R=287J/kgK and Cv = 718 J/kgK] [8]

13. The walls of furnace 4m×3m are constructed from a inner fire brick (k=0.4 W/mK) wall 30cm thick, a layer of ceramic blanket insulation (k = 0.2 W/mK) 10cm thick and steel protective layer (k = 50 W/mK) 4 mm thick. The inside temperature of the fire brick layer was measured as 500°C and the temperature of the outside of the insulation as 50°C. Determine:

    a) The rate of heat loss through the wall.
    b) The temperature at the interface between fire brick layer and insulation layer, and
    c) The temperature at the outside surface of the steel layer. [6]

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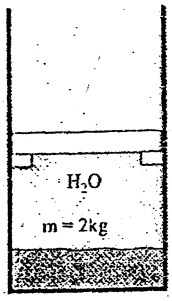
TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2078 Kartik

Exam.	Back		
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 *(ME 402)*

- ✓ 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.*
- ✓ *Take C_p=1005J/kgK, R=287J/kgK, γ=1.4 for air.*

1. Explain how you would find out whether a given variable is a thermodynamic property or not. Also differentiate between state function and path function with examples. [4]
2. Define Polytropic process and polytropic index. Find the value of polytropic index for isochoric reduction. [2+2]
3. Define the following terms: [4×1]
   a) Saturation pressure
   b) Superheated vapor
   c) Critical point
   d) Degree of super heat
4. Explain first law of thermodynamics for a control mass undergoing cyclic process. Write down statements of first law for power cycle and refrigeration cycle. [6]
5. Explain second law of thermodynamics for a control mass with necessary derivations. [6]
6. Explain the working principle of Vapour compression Refrigeration cycle with corresponding processes on P-h and T-S diagram. [6]
7. Derive an expression for radial steady state heat transfer through a composite cylinder with two different materials with a convective layer on the inside only. [6]
8. At the inlet and exhaust of a turbine the absolute steam pressure are 5000kPa and 5.0 cm of Hg, respectively. Barometric pressure is 76cm of Hg. Calculate the gauge pressure for the entering steam and the vacuum gauge pressure for the exhaust steam. [Take ρ_{Hg}=13600kg/m^3 and g = 9.81m/s^2] [6]
9. A piston cylinder device shown in figure below contains 2kg of water with an initial temperature and volume of 80°C and 0.05m^3. It requires a pressure of 400kPa to lift the piston from the stops. The system is heated until its temperature reaches 250°C. Sketch the process on P-V diagram and determine the total work transfer. [8]



10. Air at 90kPa, 27°C and 220m/s enters a diffuser at a rate of 4 kg/s and leaves at 42°C. The exit area of the diffuser is 450cm^2. The air is estimated to lose heat at a rate of 25kJ/s during this process. Determine:

    a) the inlet area of the diffuser
    b) the exit velocity and
    c) the exit pressure of the air. [8]

11. An air conditioning unit having a COP 65% of the theoretical maximum maintains a house at a temperature of 17°C by cooling it against the surrounding temperature. The house gains energy at a rate of 0.6kW per degree temperature difference. For a maximum work input of 1.8kW, determine the maximum surrounding temperature for which it provides sufficient cooling. [8]

12. The following data relate to an air standard Diesel cycle. The pressure and temperature at the end of suction stroke are 100kPa and 30°C respectively. Maximum temperature during the cycle is 1800°C and compression ratio is 16. Determine:

    a) the percentage of stroke at which cut-off takes place
    b) the temperature at the end of expansion stroke, and
    c) thermal efficiency. [8]

13. A 100mm diameter pipe carrying steam is covered by a layer of insulation (k=0.06W/mK) having a thickness of 50mm. The heat transfer coefficient between the outer surface of insulation and the ambient air is 20W/m^{2}K. Determine the required thickness of another insulating layer (k=0.1 W/mK) that must be added to reduce the heat transfer by 40% assuming that the heat transfer coefficient remains the same. [6]

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TRIBHUVAN UNIVERSITY
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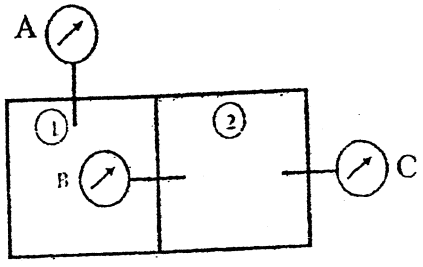
Examination Control Division
2076 Chaitra

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 *(ME 402)*

- ✓ 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 equality of temperature. [4]
2. Derive a general expression for the displacement work transfer for a piston cylinder device. Also reduce it for an ideal gas undergoing isothermal process. [4]
3. Define quality and write why it is necessary. Derive an expression for specific volume of a two phase mixture in terms of quality. [4]
4. Write the general mass and energy equation for a control volume operating under unsteady state condition. Derive the mass conservation and energy conservation equation for a process in which gas is supplied to piston cylinder device through a valve and it can produce some work by displacing the piston. [6]
5. Define an isentropic process. Also derive isentropic relations for an ideal gas. [6]
6. Sketch an ideal Otto cycle on P-V and T-S diagrams. Also derive an expression for its efficiency in terms of compression ratio. [6]
7. Derive an expression for steady state heat transfer through a composite cylinder consisting of three layers. [6]
8. Three pressure gauges are connected to a container consisting of two compartments as shown in figure below. If the local barometer reads 760mm of Hg and pressure gauges A and B read 250kPa and 150kPa respectively, determine the absolute pressure in each compartment and reading of pressure gauge C. [Take ρ=13600 kg/m^3 and g=9.81m/s^2]. [6]



9. A closed rigid container of volume 0.5m^3 is placed on a plate. Initially the container holds two phase mixture of saturated liquid water and saturated water vapor at initial pressure P_1=100 kPa with a quality of 50%. After heating, the pressure in the container is P_2=150 kPa. Draw the P-V and T-V diagrams of the heating process and determine:
   a) the temperature at each state.
   b) the mass of the vapor present at each state. [8]

   [Refer the attached table for properties of water]

10. An adiabatic diffuser has air entering at 100kPa, 300K with a velocity of 200m/s. The inlet cross sectional area of the diffuser is 100mm^2. At the exit, the area is 860 mm^2 and velocity is 20m/s. Determine the exit temperature and pressure of the air. [Take c_p=1005 J/kgK, R=287 J/kgK] [8]

11. 2 kg of water at 100°C is mixed with 4kg of water at 20°C in an isolated system. Calculate the neat change in entropy due to the mixing process. [Take specific heat of water, c=4.18 kJ/K] [8]

12. Air is used as the working fluid in a simple ideal Brayton cycle that has a pressure ratio of 12, a compressor inlet temperature of 300K, and a turbine inlet temperature of 1000K. Determine the required mass flow rate of air for a net power output of 90MW. Also calculate thermal efficiency of the cycle. [Take c_p=1005 J/kgK, R=287 J/kgK, γ=1.4] [8]

13. An exterior wall of a house consists of 10cm of common brick (K=0.8W/mK) followed by a 4cm layer of gypsum plaster K=0.5 W/mK). What thickness of rock wool insulation (k=0.065 W/mK) should be added to reduce the heat transfer though the wall by 50%? [6]

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Properties of Saturated Water-Pressure Table

P kPa	T °C	v_f m^3/kg	v_{fg} m^3/kg	v_g m^3/kg	u_f kJ/kg	u_{fg} kJ/kg	u_g kJ/kg	h_f kJ/kg	h_{fg} kJ/kg	h_g kJ/kg	s_f kJ/kg.K	s_{fg} kJ/kg.K	s_g kJ/kg.K
100	99.632	0.001043	1.6933	1.6943	417.41	2088.3	2505.7	417.51	2257.6	2675.1	1.3027	6.0562	7.3589
101.32	100.00	0.001043	1.6727	1.6737	418.96	2087.1	2506.1	419.06	2256.6	2675.7	1.3069	6.0476	7.3545
125	105.99	0.001048	1.3742	1.3752	444.25	2068.9	2513.2	444.38	2240.7	2685.1	1.3741	5.9100	7.2841
150	111.38	0.001053	1.1584	1.1595	467.02	2052.4	2519.4	467.18	2226.2	2693.4	1.4338	5.7894	7.2232
175	116.07	0.001057	1.0027	1.0038	486.89	2037.8	2524.7	487.08	2213.3	2700.4	1.4851	5.6866	7.1717
200	120.24	0.001060	0.8848	0.8859	504.59	2024.8	2529.4	504.80	2201.7	2706.5	1.5304	5.5968	7.1272

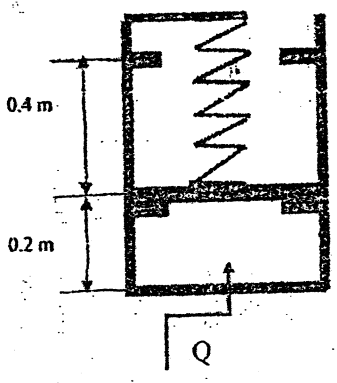
TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2076 Ashwin

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

Subject: - Fundamental of Thermodynamics and Heat Transfer *(ME 402)*

- ✓ 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.*
- ✓ *Steam tables are attached herewith.*
- ✓ *Assume suitable data if necessary.*

1. Differentiate between the microscopic and macroscopic view point in thermodynamic with examples. [4]
2. Differentiate between the stored energy and transient energy with examples. [4]
3. Define pure substance. Explain how saturation curve is formed on T-v diagram. [6]
4. Write down general energy equation for a heat exchanger, condenser, compressor, evaporator and throttling valve. [6]
5. Derive an expression for control mass formulation of second law of thermodynamics. [7]
6. Sketch the cycle on P-v and T-s diagrams for an ideal Diesel cycle and derive an expression for its efficiency in terms of compression ratio and cut-off ratio. [6]
7. Differentiate between steady state and unsteady state heat transfer. Derive an expression for steady state heat transfer through a composite cylinder consisting of two different materials. [6]
8. A piston cylinder arrangement with two set of stops is restrained by a linear spring (k=12 kN/m) as shown in figure below. The initial pressure of the gas is 500 kPa and the pressure required to lift the piston is 1000 kPa. Cross sectional area of the piston is 0.05 m^2. Heat is supplied to the gas until its pressure reaches 6000 kPa. Sketch the process on P-V diagram and determine the total work transfer. [8]



9. A closed rigid container with a volume of 0.2 m^3, initially contains a mixture of saturated liquid water and saturated water vapour at a pressure of 100 kPa with a quality of 40%. Heat is added to the system until its pressure reaches 200 kPa. sketch the process on P-v and T-v diagram and determine,
   a) The temperature at each state.
   b) The mass of vapour present at each state.
   c) If the heating is continued, determine the pressure at which the container holds only saturated vapour. [7]

10. Steam enters a nozzle operating at steady state with $P_1 = 10$ bar, $T_1 = 400°C$ and velocity of 10 m/s. The steam flows through the horizontal adiabatic nozzle. At the exit, $P_2 = 1.5$ bar and the velocity of 1075 m/s. The mass flow rate is 2 kg/s. Determine the exit area of the nozzle. [6]

11. 4kg of water at 25°C is mixed with 1 kg of ice at 0°C in an isolated system. Calculate the change entropy due to mixing process. [Take latent heat of ice L = 336 kj/kg, specific heat of water C = 4.18 kj/kg.k]. [6]

12. An ideal Brayton cycle has a pressure ratio of 12. The pressure and temperature at the compressor inlet are 100 kPa and 27°C respectively. The maximum temperature during the cycle 1200°C. If the mass flow rate is 8 kg/s, determine the power output and efficiency of the cycle. [Take Cp = 1.005 kj/kg.k, $\gamma = 1.4$] [7]

13. A square plate heater (10 cm × 10 cm) is inserted between two slabs having the same cross sectional areas. The left slab is 100 mm thick (k = 50 W/mK) and the right slab is 50 mm thick (k = 0.25 W/mK). The heat transfer coefficients for left and right slab outer surface are 250 W/m2K and 50 W/m2K respectively. The ambient air temperature is 25°C. If the rating of the heater is 1 kW, determine,
    a) Temperature at the heater surface
    b) Outer surface temperature of each slab [7]

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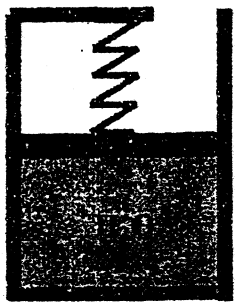
TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2075 Chaitra

Exam.	Regular / Back		
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 *(ME 402)*

- ✓ 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**.*
- ✓ ***Steam tables are attached herewith.***
- ✓ *Assume suitable data if necessary.*

1. State and explain zeroth law of thermodynamics. Write down its application. [4]
2. Derive an expression for displacement of work transfer. [5]
3. Define the term saturation curve for two phase mixture, Quality and moisture content. [6]
4. Derive general energy conservation equation for control volume. [6]
5. Define reversible and irreversible process with reference to entropy. [3]
6. Sketch otto cycle on P-v and T-s diagram. Derive expression for its efficiency to relate to compression ratio. [6]
7. Explain mode of heat transfer with their types and specific differences with them. [6]
8. During operation of a lift, it can be subjected to a maximum gauge pressure of 500 kPa. If it is designed to lift a mass upto 900 kg, what should be diameter of piston-cylinder? [6]
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 m^3, as shown in figure below. If the piston is at the bottom, the system pressure is 300 kPa. The system now cools until the pressure reaches 1000 kPa. Sketch the process on P-v diagram and determine [8]
   a) the mass of H_2O
   b) the final temperature and volume, and
   c) the total work transfer



10. Air expands through an adiabatic turbine from 1100 kPa, 1000 K to 100 kPa, 100 K. The inlet velocity is 10 m/s and exit velocity is 100 m/s. The power output of turbine is 3600 kW. Determine mass flow rate of air and inlet and exit areas. [Take r = 287 J/KgK, C_p = 1005 J/KgK] [8]
11. Steam enters into a turbine at 2 MPa, 400°C with a velocity 200 m/sec and saturated vapour exits from turbine at 100 kPa with velocity 80 m/s. The power output of turbine is 800 kW, when mass flow rate is 1.5 kg/sec. Turbine rejects heat to surrounding at 300K. Determine rate at which entropy is generated within the turbine. [8]
    {h_1 = 3247.5 kJ/kg, s_1 = 7.1269 kJ/kg}
12. An air standard diesel cycle has a compression ratio of 22 and expansion ratio of 11. Determine its cut off ratio and the efficiency. [6]
13. A hollow cylinder with inner and outer diameter of 8 cm and 12 cm respectively has an inner surface temperature of 200°C and the outer surface temperature of 50°C. If the thermal conductivity of the cylinder material is 60 W/mK, determine heat transfer from the unit length of the pipe. Also determine the temperature at the surface at a radial distance of 5 cm from the axis of the cylinder. [8]

Saturated Water Table

P = 800 kPa

T °C	$\hat{v}$ m³/kg	$\hat{u}$ kJ/kg	$\hat{h}$ kJ/kg	$\hat{s}$ kJ/kg K
sat	0.24043	2576.8	2759.1	6.6627
200	0.26080	2630.6	2839.2	6.8158
250	0.29314	2715.5	2950.0	7.0384
300	0.32411	2797.1	3056.4	7.2327
350	0.35439	2878.2	3161.7	7.4088
400	0.38426	2959.7	3267.1	7.5715
500	0.44331	3125.9	3480.6	7.8672
600	0.50184	3297.9	3699.4	8.1332
700	0.56007	3476.2	3924.3	8.3770
800	0.61813	3661.1	4155.7	8.6033
900	0.67610	3852.8	4393.6	8.8153
1000	0.73401	4051.0	4638.2	9.0153
1100	0.79188	4255.6	4889.1	9.2049
1200	0.84974	4466.1	5145.8	9.3854
1300	0.90758	4681.8	5407.9	9.5575

P = 1 MPa

T °C	$\hat{v}$ m³/kg	$\hat{u}$ kJ/kg	$\hat{h}$ kJ/kg	$\hat{s}$ kJ/kg K
sat	0.19444	2583.6	2778.1	6.5864
200	0.20596	2621.9	2827.9	6.6939
250	0.23268	2709.9	2942.6	6.9246
300	0.25794	2793.2	3051.2	7.1228
350	0.28247	2875.2	3157.7	7.3010
400	0.30659	2957.3	3263.9	7.4650
500	0.35411	3124.3	3478.4	7.7621
600	0.40109	3296.8	3697.9	8.0289
700	0.44779	3475.4	3923.1	8.2731
800	0.49432	3660.5	4154.8	8.4996
900	0.54075	3852.2	4392.9	8.7118
1000	0.58712	4050.5	4637.6	8.9119
1100	0.63345	4255.1	4888.5	9.1016
1200	0.67977	4465.6	5145.4	9.2821
1300	0.72608	4681.3	5407.4	9.4542

P = 2 MPa

T °C	$\hat{v}$ m³/kg	$\hat{u}$ kJ/kg	$\hat{h}$ kJ/kg	$\hat{s}$ kJ/kg K
sat	0.09963	2600.3	2709.5	6.3408
225	0.10377	2628.3	2835.8	6.4146
250	0.11144	2679.6	2902.5	6.5452
300	0.12547	2772.6	3023.5	6.7663
350	0.13857	2859.8	3137.0	6.9562
400	0.15120	2945.2	3247.6	7.1270
500	0.17568	3116.2	3467.6	7.4316
600	0.19960	3290.0	3690.1	7.7023
700	0.22323	3471.0	3917.5	7.9487
800	0.24668	3657.9	4150.4	8.1765
900	0.27004	3849.3	4388.4	8.3895
1000	0.29333	4047.9	4634.6	8.5900
1100	0.31659	4252.7	4885.9	8.7800
1200	0.33984	4463.2	5142.9	8.9606
1300	0.36306	4679.0	5405.1	9.1333

P = 4 MPa

T °C	$\hat{v}$ m³/kg	$\hat{u}$ kJ/kg	$\hat{h}$ kJ/kg	$\hat{s}$ kJ/kg K
sat	0.04978	2602.3	2801.4	6.0700
275	0.05457	2667.9	2886.2	6.2284
300	0.05884	2725.3	2960.7	6.3614
350	0.06645	2826.6	3092.4	6.5820
400	0.07341	2919.9	3213.5	6.7659
450	0.08003	3010.1	3330.2	6.9362
500	0.08643	3099.5	3445.2	7.0900
600	0.09885	3279.1	3674.4	7.3638
700	0.11095	3462.1	3905.9	7.6198
800	0.12287	3650.1	4141.6	7.8502
900	0.13469	3843.6	4382.3	8.0647
1000	0.14645	4042.9	4628.7	8.2661
1100	0.15817	4248.0	4880.6	8.4566
1200	0.16987	4458.6	5138.1	8.6376
1300	0.18156	4674.3	5400.5	8.8090

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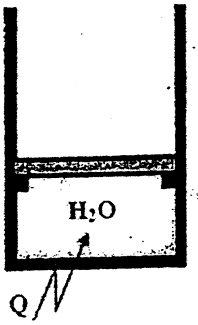
Exam.	Back		
Level	BE	Full Marks	80
Programme	BCE, BME, BGE	Pass Marks	32
Year / Part	I / I	Time	3 hrs.

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. Define thermodynamic property. Explain intensive and extensive property with examples. [4]
2. Define polytropic process. Sketch polytropic processes with n = 0, 1, γ and ∞ on a common P-V diagram. Derive and enprossion for work transfer for a polytropic process. [4]
3. Derive an expression for the specific volume of a two phase mixture in term of quality. Which takes more energy to vaporize 1 kg of saturated liquid water at 100°C or 120°C? Why? [4]
4. Define a cyclic process. Derive first law of thermodynamics for a control mass undergoing a cyclic process. Also write down the statements for a power cycle and refrigeration cycle. [6]
5. Define heat engine, heat pump and refrigerator. Explain how first and second law are applied to determine performance of heat engine. [6]
6. Explain the working principle of a Brayton cycle. Sketch the cycle on p-v and T-s diagrams and explain the variation of its efficiency with pressure ratio. [6]
7. Derive the overall heat transfer coefficient for composite for plane wall consisting of two layers with convection on both sides. [6]
8. A piston-cylinder device contains 0.05 m^3 of a gas initially at 200 kPa. At this state, a linear spring that has a spring constant of 150 kN/m is touching the piston but exerting no force on it. Now heat is transferred to the gas, causing the piston to rise and to compress the spring until the volume inside the cylinder doubles. If the cross-sectional area of the piston is 0.25 m^2, determine: [6]
   i) The final pressure inside the cylinder
   ii) The total work done by the gas
9. A piston cylinder device shown in figure below contain 2 kg of H_2O with an initial temperature and volume of 80°C and 0.05 m^3 respectively. It requires a pressure of 400 kPa to lift the piston from the stops. The system is heated until its temperature reaches 250°C. Sketch the process on P-v and T-v diagrams and determine the total work transfer. [8]



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 diameters to inlet and exhaust pipes. [8]
[Take R = 287 J/kgK and c_p = 1005 J/kgK]

11. Five kg of water at 30°C is mixed with 1 Kg of ice at 0°C. Assuming the process of mixing is adiabatic, find the change in entropy. Latent heat of ice = 336kJ/kg, C_p for water = 4.2kJ/kgK. [8]

12. In a Rankine cycle stream leaves the boiler and enters the turbine at 4Mpa, 400°C. The condenser pressure is 10 kPa. Determine the cycle efficiency. [8]

13. A steel pipe having an outer diagram of 4 cm is maintained at a temperature of 80°C in a room where the ambient temperature is 25°C. The emissivity of the surface is 0.8 and the convection heat transfer coefficient between the surface and air is 10 W/m^2K. Determine the total heat loss from the unit length of the pipe. [Take $\sigma = 5.67\times10^{-8}$ w/m^2k^4] [6]

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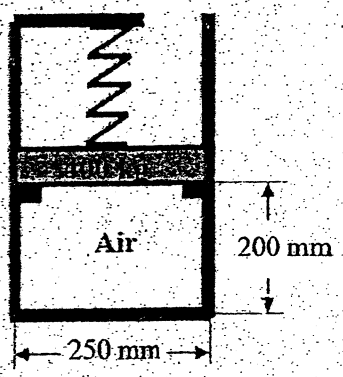
Exam.	Regular		
Level	BE	Full Marks	80
Programme	BCE, BME, BGE	Pass Marks	32
Year / Part	I / I	Time	3 hrs.

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

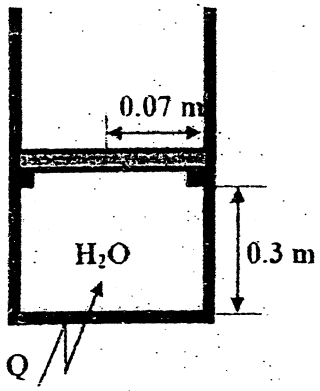
- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ ***Necessary tables are attached herewith.***
- ✓ *Assume suitable data if necessary.*

1. State and explain Zeroth law of thermodynamics. Also write down its application. [4]
2. Compare heat and work with suitable examples. Prove that work is a path function. [4]
3. Define pure substance. Explain why quality is necessary to define the state of a two phase mixture. [4]
4. Differentiate between steady state work applications and steady state flow applications. Write down the function of turbine and nozzel. Derive governing equations for them when they operate under steady state condition. [6]
5. State second law of thermodynamics for an isolated system and define entropy generation. Differentiate between reversible and irreversible processes with reference to entropy. [6]
6. Explain the working of simple vapor compression refrigeration cycle with corresponding process in P-h and T-s diagram. [6]
7. Derive an expression for steady state heat transfer through a composite cylinder consisting three different materials. [6]
8. Air (0.01 kg) is contained in a piston cylinder device restrained by a linear spring (k = 500 kN/m) as shown in figure below. Spring initially touches the piston but exerts no force on it. Determine the temperature at which piston leaves the stops when heat is supplied to the system. [Take R = 287J/kg. K, P_{atm} = 100 kPa and g = 9.81 m/s^2] [6]

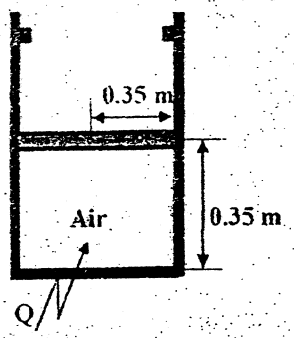


9. A piston cylinder device shown in figure below contains water initially at a pressure of 125 kPa with a quality of 50%. Heat is added to the system until it reaches to a final temperature of 800°C. It takes a pressure of 600 kPa to lift the piston from the stops. Sketch the process on P-V and T-V diagrams and determine: [8]

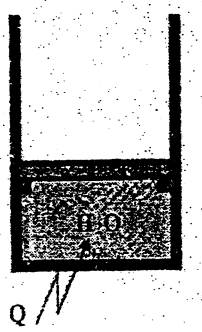
   i) The mass of H_2O in the system and
   ii) The total work transfer



10. A piston cylinder device shown in figure below contains 3.06 kg of air initially at a temperature of 34°C. Heat is supplied to the system until it reached to a final temperature of 950°C and a final pressure of 5 MPa. Sketch the process on P-V and T-V diagrams and determine the total work transfer and total heat transfer. [Take R = 287J/kgK and c_v = 718J/kgK] [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. Sketch the process on p-V and T-V diagrams and determine the total entropy generation during the process. [8]



P.T.O

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 of air during the cycle is 2000 kJ/kg. Determine: [8]

    i) The pressure and temperature at the end of each process of he cycle
    ii) The thermal efficiency
    iii) The mean effective pressure

    [Take R = 287 J/kg.k and c_v = 718 J/kg.k]

13. A gas turbine blade is modeled as a flat plate. The thermal conductivity of the blade materials is 15W/mK and its thickness is 1.5mm. 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 2500W/m^2K and 1500 W/m^2K 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]

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Table 1: Properties of SATURATED WATER – Pressure Table

P	T	v_f	v_{fg}	v_g	u_f	u_{fg}	u_g	h_f	h_{fg}	h_g	s_f	s_{fg}	s_g
kPa	°C	m^3/kg	m^3/kg	m^3/kg	kJ/kg	kJ/kg	kJ/kg	kJ/kg	kJ/kg	kJ/kg	kJ/kg.K	kJ/kg.K	kJ/kg.K
90	96.713	0.001041	1.8688	1.8698	405.11	2097.1	2502.2	405.20	2265.3	2670.5	1.2696	6.1247	7.3943
100	99.632	0.001043	1.6933	1.6943	417.41	2088.3	2505.7	417.51	2257.6	2675.1	1.3027	6.0562	7.3589
101.32	100.00	0.001043	1.6727	1.6737	418.96	2087.1	2506.1	419.06	2256.6	2675.7	1.3069	6.0476	7.3545
125	105.99	0.001048	1.3742	1.3752	444.25	2068.9	2513.2	444.38	2240.7	2685.1	1.3741	5.9100	7.2841
150	111.38	0.001053	1.1584	1.1595	467.02	2052.4	2519.4	467.18	2226.2	2693.4	1.4338	5.7894	7.2232
400	143.64	0.001084	0.4614	0.4625	604.47	1949.0	2553.5	604.91	2133.6	2738.5	1.7770	5.1191	6.8961
425	145.84	0.001086	0.4357	0.4368	613.91	1941.7	2555.6	614.37	2126.9	2741.3	1.7996	5.0762	6.8758
450	147.94	0.001088	0.4129	0.4140	622.93	1934.7	2557.6	623.42	2120.5	2743.9	1.8211	5.0356	6.8567
475	149.94	0.001090	0.3923	0.3934	631.56	1927.8	2559.4	632.07	2114.2	2746.3	1.8415	4.9971	6.8386
500	151.87	0.001093	0.3738	0.3749	639.84	1921.4	2561.2	640.38	2108.2	2748.6	1.8610	4.9604	6.8214
550	155.49	0.001097	0.3415	0.3426	655.48	1908.9	2564.4	656.08	2096.8	2752.9	1.8977	4.8917	6.7894
600	158.86	0.001101	0.3115	0.3156	670.05	1897.3	2567.3	670.71	2086.0	2756.7	1.9315	4.8286	6.7601
650	162.02	0.001104	0.2915	0.2926	683.71	1886.2	2569.9	684.42	2075.8	2760.2	1.9631	4.7699	6.7330
700	164.98	0.001108	0.2717	0.2728	696.58	1875.8	2572.4	697.35	2066.0	2763.3	1.9925	4.7154	6.7079

Table 2: Properties of Superheated Steam

P	T	v	u	h	s
kPa	°C	m^3/kg	kJ/kg	kJ/kg	kJ/kg.K
400	(143.64)	(0.4625)	(2553.5)	(2738.5)	(6.8961)
	150	0.4708	2564.4	2752.8	6.9300
	200	0.5342	2646.4	2860.1	7.1699
	250	0.5951	2725.6	2963.6	7.3779
	300	0.6538	2804.4	3066.3	7.5654
	350	0.7139	2883.8	3169.4	7.7378
	400	0.7726	2964.3	3273.3	7.8982
	450	0.8311	3046.0	3378.5	8.0489
	500	0.8894	3129.3	3485.0	8.1914
	550	0.9475	3214.1	3593.1	8.3268
	600	1.0056	3300.5	3702.7	8.4561
	650	1.0636	3388.6	3814.1	8.5801
	700	1.1215	3478.5	3927.1	8.6993
	750	1.1791	3570.1	4041.8	8.8143
	800	1.2373	3663.4	4158.3	8.9254
	850	1.2951	3758.4	4276.5	9.0331

P	T	v	u	h	s
kPa	°C	m^3/kg	kJ/kg	kJ/kg	kJ/kg.K
600	(158.86)	(0.3156)	(2567.3)	(2756.7)	(6.7601)
	200	0.3520	2638.5	2849.7	6.9658
	250	0.3938	2720.3	2956.6	7.1806
	300	0.4344	2800.5	3061.2	7.3716
	350	0.4742	2880.9	3165.4	7.5459
	400	0.5137	2961.9	3270.2	7.7076
	450	0.5529	3044.1	3375.9	7.8591
	500	0.5920	3127.7	3482.9	8.0022
	550	0.6309	3212.7	3591.2	8.1380
	600	0.6697	3299.3	3701.2	8.2676
	650	0.7085	3387.6	3812.7	8.3918
	700	0.7472	3477.6	3925.9	8.5112
	750	0.7859	3569.2	4040.8	8.6264
	800	0.8246	3662.7	4157.4	8.7376
	850	0.8632	3757.8	4275.7	8.8453

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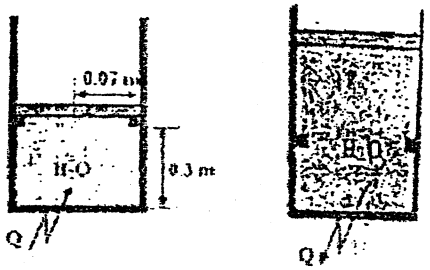
Exam.	Back		
Level	BE	Full Marks	80
Programme	BCE, BME, BGE	Pass Marks	32
Year / Part	I / I	Time	3 hrs.

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 and tables are attached herewith.***
- ✓ *Assume suitable data if necessary.*

1. Define thermodynamic equilibrium. Explain reversible and irreversible processes with reference nature of intermediate states. [4]
2. Define internal energy, potential energy, kinetic energy and total energy of a thermodynamic system. Also differentiate between microscopic potential energy and macroscopic potential energy. [4]
3. Define saturation pressure, saturation temperature and critical point. Write down the effect of pressure on
   a) Specific volume of a saturated liquid (V_f)
   b) Specific volume of a saturated vapor (V_g)
   c) Change in specific volume due to evaporation (V_{fg}) [4]
4. State and explain conservation of energy for a control volume. [6]
5. Differentiate between thermal and mechanical irreversibilities. Explain why most of the real processes are irreversible. Also explain how they can be assumed to be reversible. [6]
6. Explain with the help of neat diagrams the various processes of any Rankine cycle and derive an expression for its efficiency. [6]
7. Derive an expression with appropriate diagram for conduction heat transfer through a composite cylinder tube consisting of three layers of different materials. [6]
8. A piston cylinder has a diameter of 0.1 m. With an outside atmospheric pressure of 100 kPa, determine the piston mass that will create an inside pressure of 500 kPa. What would be the new pressure if the piston mass is halves. [Take $g = 9.81\ m/s^2$] [6]
9. Steam is contained in a closed rigid container. Initially, the pressure and temperature of the steam are 1500 kPa and 250°C, respectively. The temperature drops as a result of heat transfer to the surroundings. Determine the pressure at which condensation first occurs and the fraction of the total mass that gas been condensed when the temperature reaches 100°C. What percentage of the volume is occupied by saturated liquid at the final state? [8]
10. A piston cylinder devices shown in figure below contains water initially at 105°C with quality 10%. Heat is added to the system until it becomes saturated vapor. It takes pressure of 1000 kPa to lift the piston from the stops. Sketch the P-v, T-v diagram and determine: [8]
    a) The mass of water in system
    b) The total work transfer

c) The total heat transfer *[Refer the attached table for properties of water]*



11. 2 kg water at 100°C is mixed with 4 kg of water at 20°C in an isolated system. Calculate the net change in entropy due to the mixing process. [Take specific heat of water c = 4.18 kJ/K] [8]

12. An ideal Brayton cycle has pressure ratio of 10. The temperature of air at compressor and turbine inlets are 300K and 1200K respectively. Determine its thermal efficiency and mass flow rate of air required to produce net power output of 80MW. [Take Cp = 1005 J/Kg.K, γ = 1.4] [8]

13. A 200 mm diameter 50 m long pipe carrying steam is covered with 40 mm thick of high temperature insulation (k = 0.1 W/m) and 30 mm thick of low temperature insulation (k = 0.05 W/m). The inner and outer surfaces of the insulating layer are at 400°C and 40°C respectively. Determine:

    a) The rate of heat loss from the pipe,
    b) The temperature at the interface of two insulating layer. [6]

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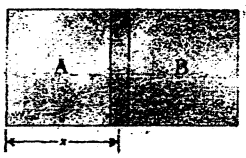
Exam.	Regular		
Level	BE	Full Marks	80
Programme	BCE, BME, BGE	Pass Marks	32
Year / Part	I / I	Time	3 hrs.

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

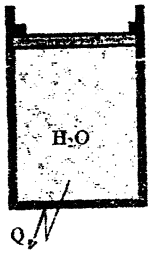
- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ ***Necessary tables are attached herewith.***
- ✓ *Assume suitable data if necessary.*

1. Define macroscopic and microscopic viewpoint as applied to the study of thermodynamics. Also list their features. [4]
2. Define stored energy and transient energy. Also list their features. [4]
3. Define quality. Explain why it is necessary to define the state of two phase mixture. Also derive an expression for specific volume of a two-phase mixture. [4]
4. Differentiate between steady state and unsteady state control volume. Derive mass and energy conservation equation for a process in which gas is being supplied to a rigid cylinder. [6]
5. Write down the similarities and differences between heat pump and refrigerator. Explain how first and second laws can be applied to analyze the performance of a heat pump. [6]
6. Sketch ideal Vapour compression refrigeration cycle and explain the processes on P-h and t-s diagram. Also write an expression for theoretical COP of the cycle used as heat pump. [6]
7. Differentiate between free and forced convection with examples. Write down the expressions for thermal resistance for a plane wall, a hollow cylinder and convective layer of fluid. [6]
8. The device shown in figure below has a free moving piston between the two chambers. The initial total volumes of A and B are equal with $vA = 100\ m^3/kg$ and $vB = 50\ m^3/kg$. If the piston is moved so that x is one-fourth of the entire length, determine the final specific volumes of chambers A and B. [6]



$V_{tot} = 1m^3$

9. A piston cyclinder arrangement shown in figure below contains 1 kg of water initially at a pressure of 1 MPa and a temperature of 500°C. The water is cooled until it is completely converted into saturated liquid. It requires a pressure of 400 kPa to support the piston. Sketch the process on P-v and T-v diagrams and determine the total work transfer. (Refer the attached table for the properties of water) [8]



10. Steam at 0.4 MPa and 200°C enters into an adiabatic nozzle with a velocity of 50 m/s and leaves the nozzle at 0.1 MPa and with a velocity of 75 m/s. Determine [8]

a) The exit temperature of the steam.
b) The ratio of inlet diameter to the exit diameter. (Refer the attached table for the properties of steam)

11. Work output of an ideal engine is 4 times the heat rejected by it. Determine its efficiency. If the sink temperature increases by 300°C, its efficiency reduces to 60%. Determine its source and sink temperatures. [8]

12. An air standard Otto cycle has a compression ratio of 10. At the beginning of the compression stroke, the pressure and temperature are 100 kPa and 20°C respectively. The peak temperature during the cycle is 2000 K. Determine,

a) The pressure and temperature at the end of each process of the cycle
b) The thermal efficiency (Take Cv = 718 J/kgk, $\gamma = 1.4$) [8]

13. A thick walled tube of stainless steel (k = 19 W/m°C) with 2 cm inside diameter and 4 cm outer diameter is covered with a 3 cm layer of asbestos insulation (k = 0.2 W/m°C). If the inside and outside wall temperature of the pipe is maintained at 600°C and 100°C. Calculate the heat loss per meter of length. Also calculate the tube-insulation interface temperature. [6]

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04 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2073 Shrawan

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 tables are attached herewith.***
- ✓ *Assume suitable data if necessary.*

1. Define thermodynamic property. Differentiate between state function and path function with examples. [4]
2. Define total energy. Differentiate between stored energy and transient energy with examples. [4]
3. Define quality and write why it is necessary. Sketch saturation curve on P-V diagram and also show constant quality lines. [4]
4. Differentiate between steady state work application and unsteady state flow applications. Derive mass conservation and energy conservation equations for a process in which gas contained in a rigid cylinder is being consumed during cooking. [6]
5. Define Entropy. Derive an expression for change in Entropy for reversible heat transfer and reversible work transfer process. [6]
6. Differentiate between gas and vapor cycles. Sketch P-V and T-S diagrams and layout for Brayton and Rankine cycle. [6]
7. Write down expressions for thermal resistance for a plane wall and a convective fluid layer. Use them to derive overall heat transfer coefficient for a plane subjected convection on both sides. [6]
8. An oxygen cylinder having a volume of 10 m^3 initially contains 5 kg of oxygen. Determine the specific volume of oxygen in the cylinder initially. During certain process 3 kg of oxygen is consumed. Determine the final specific volume of oxygen in the cylinder. Also sketch the amount of oxygen that has been consumed versus the specific volume of the remaining in the cylinder. [6]
9. A piston cylinder device shown in **Figure P.9** contains 2 kg of water initially at a pressure of 500 kPa with a quality of 20 %. The water is heated until it becomes a saturated vapor. The volume of the system when the piston is at the upper stops is 0.4 m^3. Sketch the process on P-v and T-v diagrams and determine: [8]
   (a) the final pressure, and
   (b) the total work transfer. [*Refer the attached tables for the properties of steam*]

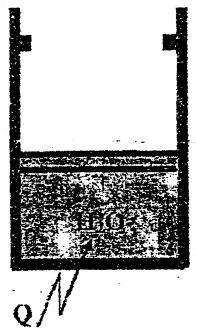

Figure P.9

10. Air enters a nozzle steadily at 300 kPa, 127^0C and with a velocity of 40 m/s and leaves at 100 kPa and with a velocity of 300 m/s. The heat loss from the nozzle surface is 20 kJ/kg of the air. The inlet area of the nozzle is 100 cm^2. Determine: [8]
    (a) the exit temperature of the air, and
    (b) the exit area of the nozzle. [Take $R = 287\ J/kgK$ and $c_P = 1005\ J/kgK$]

11. A carnot engine operates between two reservoirs at temperature TL and TH. The work output of the engine is 0.6 times the heat rejected. The difference in temperature between the sources and the sink is 200°C. Calculate the thermal efficiency, source temperature and the sink temperature. [8]

12. An ideal gas turbine cycle has a pressure ratio of 10. The minimum and maximum temperatures are 300 K and 1500 K respectively. Determine: [8]
    i) The net work per kg of air
    ii) The thermal efficiency of the cycle and
    iii) Compare both of these for a cycle with ideal compressor and turbine.

    [Take γ = 1.4 and cp = 1005 J/kg.k]

13. A steel pipe having an outside diameter of 2 cm is to be covered with two layers of insulation, 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]

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Properties of SATURATED WATER – Pressure Table

P	T	v_f	v_{fg}	v_g	u_f	u_{fg}	u_g	h_f	h_{fg}	h_g	s_f	s_{fg}	s_g
kPa	°C	m^3/kg	m^3/kg	m^3/kg	kJ/kg	kJ/kg	kJ/kg	kJ/kg	kJ/kg	kJ/kg	kJ/kg.K	kJ/kg.K	kJ/kg.K
400	143.64	0.001084	0.4614	0.4625	604.47	1949.0	2553.5	604.91	2133.6	2738.5	1.7770	5.1191	6.8961
[illegible]													
600	158.86	0.001101	0.3145	0.3156	670.05	1897.3	2567.3	670.71	2086.0	2756.7	1.9315	4.8286	6.7601
650	162.02	0.001104	0.2915	0.2926	683.71	1886.2	2569.9	684.42	2075.8	2760.2	1.9631	4.7699	6.7330
700	164.98	0.001108	0.2717	0.2728	696.58	1875.8	2572.4	697.35	2066.0	2763.3	1.9925	4.7154	6.7079
750	167.79	0.001111	0.2544	0.2555	708.76	1865.8	2574.6	709.59	2056.6	2766.2	2.0203	4.6642	6.6845
800	170.44	0.001115	0.2393	0.2404	720.33	1856.3	2576.6	721.23	2047.7	2768.9	2.0464	4.6161	6.6625
[illegible]													

04 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2072 Chaitra

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 <u>All</u> questions.*
- ✓ *The figures in the margin indicate <u>Full Marks</u>.*
- ✓ ***<u>Necessary tables are attached herewith.</u>***
- ✓ *Assume suitable data if necessary.*

1. Sketch P-V, T-V and P-T diagrams for an ideal gas undergoing [4]
   i) Constant volume cooling process
   ii) Constant temperature heat rejection process
2. Differentiate between heat transfer and work transfer. Derive the mathematical expression for work transfer for an isobaric process. [4]
3. Define pure substance. State two property rules and give examples. [4]
4. Write down general mass conservation and energy conservation equations for a control volume. Also reduce them for a control volume operating under unsteady state condition. [6]
5. Define refrigerator and its COP. Explain how first law and second law of thermodynamics can be applied to analyze the performance of the refrigerator. [2+4]
6. Differentiate between power cycle and refrigeration cycle. Sketch P-V and T-S diagram for ideal otto and ideal diesel cycles. Also write down the expressions for their efficiencies. [6]
7. Write down the expression for thermal resistance for a hollow cylinder and connective fluid layer. Use them to derive overall heat transfer coefficient for a hallow cylinder subjected to convection of both sides. [6]

8. A piston–cylinder device shown in **Figure P.8** contains 0.05 m^3 of a gas initially at 200 kPa. At this state, a linear spring that has a spring constant of 150 kN/m is touching the piston but exerting no force on it. Now heat is transferred to the gas, causing the piston to rise and to compress the spring until the volume inside the cylinder triples. If the cross-sectional area of the piston is 0.25 m^2, determine the final pressure inside the cylinder. [6]

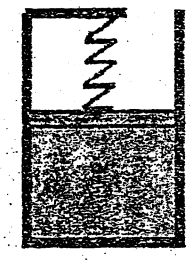

Figure P.8

9. A rigid container with a volume of 0.170 m^3 is initially filled with steam at 200 kPa, 300^{0}C. It is cooled to 90^{0}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? [*Refer the attached tables for the properties of steam*]

10. Nitrogen ($5\ kg$) is contained in a piston cylinder device shown in **Figure P.10** initially at a pressure of 800 kPa and a temperature of 127^0C. There is a heat transfer to the system until the temperature reaches to 527^0C . It takes a pressure of 1500 kPa to lift the piston. Sketch the process on $P-V$ and $T-V$ diagrams and determine the total work and heat transfer in the process. [Take $R = 297\ J/kgK$ and $c_v = 743 J/kgK$] [8]

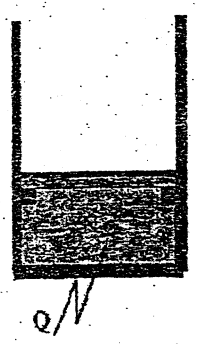

Figure P.10

11. A heat pump having a COP of 5 maintains a building at a temperature of 24°C by supplying heat at a rate of 72000 KJ/h when the surrounding is at 0°C. The heat pump runs 12 hrs in a day and the electricity costs Rs 10/Kwh. [8]

a) Determine the actual and minimum theoretical cost per day.
b) Compare the actual operating cost with the cost of direct electric resistance heating.

12. The pressure and temperature at the end of suction stroke are 100 kPa and 27°C respectively. Maximum temperature during the cycle is 1600°C and the compression ratio is 16. Determine: [8]

i) The percentage of stroke at which cut-off takes place
ii) The temperature at the end of the expansion stroke and
iii) The thermal efficiency [Take $\gamma = 1.4$ and R = 287 J/kg.K]

13. The heat flux at the surface of an electrical heater is 3500 W/m^2. The heater surface temperature is 120°C when it is cooled by air at 50°C. What is the average convective heat transfer coefficient? What will be the heater temperature be if the power is reduced so that heat flux is 2500 W/m^2? [6]

***

Table 1: Properties of SATURATED WATER – Temperature Table

T °C	P kPa	v_f m³/kg	v_{fg} m³/kg	v_g m³/kg	u_f kJ/kg	u_{fg} kJ/kg	u_g kJ/kg	h_f kJ/kg	h_{fg} kJ/kg	h_g kJ/kg	s_f kJ/kg.K	s_{fg} kJ/kg.K	s_g kJ/kg.K
105	120.79	0.001047	1.4190	1.4200	440.05	2072.1	2512.1	440.18	2243.4	2683.6	1.3630	5.9326	7.2956
110	143.24	0.001052	1.2095	1.2106	461.19	2056.7	2517.9	461.34	2230.0	2691.3	1.4186	5.8200	7.2386
115	169.02	0.001056	1.0359	1.0370	482.36	2041.1	2523.5	482.54	2216.3	2698.8	1.4735	5.7098	7.1833

Table 2: Properties of Superheated Steam

P kPa	T °C	v m³/kg	u kJ/kg	h kJ/kg	s kJ/kg.K
200	(120.24)	(0.8859)	(2529.4)	(2706.5)	(7.1272)
	150	0.9597	2576.7	2768.6	7.2793
	200	1.0803	2653.9	2870.0	7.5059
	250	1.1988	2730.8	2970.5	7.7078
	300	1.3162	2808.2	3071.4	7.8920
	350	1.4325	2886.7	3173.3	8.0624
	400	1.5493	2966.6	3276.4	8.2216
	450	1.6655	3047.9	3381.0	8.3711
	500	1.7814	3130.8	3487.1	8.5133
	550	1.8971	3215.4	3594.9	8.6483
	600	2.0130	3301.7	3704.3	8.7773
	650	2.1287	3389.7	3815.4	8.9011
	700	2.2443	3479.4	3928.3	9.0201
	750	2.3599	3570.9	4042.9	9.1350
	800	2.4755	3664.1	4159.2	9.2460
	850	2.5910	3759.1	4277.3	9.3536

04 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2072 Kartik

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: - 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. Explain different types of thermodynamic systems with examples. [4]
2. Differentiate between heat transfer and work transfer. Derive the mathematical expression for work transfer for an ideal gas undergoing isothermal process. [4]
3. Define quality and moisture content. Derive an expression for specific volume of a two phase mixture in terms of quality. [4]
4. Differentiate between steady state work applications and steady state flow applications with examples. Also write the functions and governing equations for an adiabatic turbine and adiabatic nozzle. [6]
5. Define heat engine and heat pump. Explain how first law and second law of thermodynamics can be applied to analyze the performance of a heat pump. [6]
6. Sketch an ideal otto cycle on P-v and T-s diagram. Derive the expression for compression ratio interms of cylinder dimension. [6]
7. Derive an expression for overall heat transfer coefficient for a hollow cylinder subjected to convection medium on both sides. [6]
8. Three pressure gauges are connected to a container consisting of two compartments as shown in figure below. If the local barometer reads 760 mm of Hg and pressure gauges A and B read 250 kPa and 150 kPa respectively. Determine the absolute pressure in each compartment and reading of pressure gauge C. [Take ρ_{Hg} = 13600 kg/m^3 and g = 9.81 m/s^2] [6]

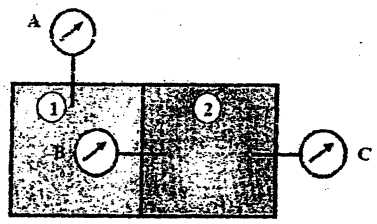

Figure P1

9. A rigid vessel having a volume of 0.4 m^3 contains 2.0 kg of liquid water and water vapor mixture in equilibrium at a pressure of 250 kPa. Calculate: [8]
   i) The volume and mass of liquid
   ii) The volume and mass of vapour
   iii) Temperature
   iv) Enthalpy
   v) If it is heated until its pressure reached to 350 kPa, what will be its quality?

[Refer the attached table for properties of water]

10. Air enters a compressor operating at steady state at 100 kPa, 300 K and leaves at 1000 kPa, 400 K. The volumetric flow rate of air at the exit is 1.5 m^3/min. The work consumed by the compressor is 250 kJ per kg of air. Neglecting the effects of potential and kinetic energy, determine the heat transfer rate, in kW. [Take R = 287 J/kgK and C_p = 1005 J/kgK] [8]

11. A heat pump heats a house in the winter and then reverses to cool it in the summer. The room temperature should be 22°C in the winter and 26°C in the summer. Heat transfer through the walls and ceilings is estimated to be 3000 kJ/h per degree temperature difference between the inside and outside. [8]

    i) Determine the power required to run it in the winter which when the outside temperature decrease to 0°C.
    ii) If the unit is run by the same power as calculate in (i) throughout the year, determine the maximum outside summer temperature for which the house can be maintained at 26°C

12. Air enters the compressor of an ideal Brayton cycle at 100 kPa, 290 K with a volumetric flow rate of 4 m^3/s. The pressure ratio for cycle is 10 and the maximum temperature during the cycle is 1500 K. Determine: [8]

    i) The thermal efficiency of the cycle
    ii) The fraction of work output that is consumed by the compressor and
    iii) The net power output

    [Take Cp = 1005 J/kg.K, γ = 1.4]

13. A 2 m long steel plate (k = 50 W/mK) is well insulated on its sides, while its left section is maintained at 120°C and the right section is exposed to ambient air at 40°C. Under steady state conditions, a thermocouple inserted at the middle of the plate gives a temperature of 100°C. Determine the value of convection heat transfer coefficient for convection heat transfer between the right section of the plate and air. [6]

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Properties of SATURATED WATER – Pressure Table

P^* kPa	T °C	v_f m^3/kg	v_{fg} m^3/kg	v_g m^3/kg	u_f kJ/kg	u_{fg} kJ/kg	u_g kJ/kg	h_f kJ/kg	h_{fg} kJ/kg	h_g kJ/kg	s_f kJ/kg.K	s_{fg} kJ/kg.K	s_g kJ/kg.K
25	64.980	0.001020	6.2038	6.2048	271.97	2190.3	2462.3	271.99	2345.4	2617.4	0.8933	6.9365	7.8298
30	69.114	0.001022	5.2288	5.2298	289.27	2178.4	2467.7	289.30	2335.3	2624.6	0.9441	6.8231	7.7672
35	72.700	0.001024	4.5252	4.5262	304.28	2168.0	2472.3	304.32	2326.4	2630.7	0.9878	6.7266	7.7144
40	75.877	0.001026	3.9930	3.9940	317.59	2158.8	2476.4	317.64	2318.5	2636.1	1.0261	6.6427	7.6688
45	78.736	0.001028	3.5759	3.5769	329.58	2150.4	2480.0	329.62	2311.3	2640.9	1.0603	6.5684	7.6287
50	81.339	0.001030	3.2398	3.2408	340.49	2142.8	2483.3	340.54	2304.8	2645.3	1.0912	6.5016	7.5928
60	85.949	0.001033	2.7314	2.7324	359.84	2129.2	2489.0	359.90	2293.1	2653.0	1.1454	6.3856	7.5310
70	89.956	0.001036	2.3644	2.3654	376.68	2117.3	2494.0	376.75	2282.9	2659.6	1.1920	6.2869	7.4789
80	93.511	0.001038	2.0866	2.0876	391.63	2106.7	2498.3	391.71	2273.6	2665.3	1.2330	6.2009	7.4339
90	96.713	0.001041	1.8688	1.8698	405.11	2097.1	2502.2	405.20	2265.3	2670.5	1.2696	6.1247	7.3943
100	99.632	0.001043	1.6933	1.6943	417.41	2088.3	2505.7	417.51	2257.6	2675.1	1.3027	6.0562	7.3589
101.32	100.00	0.001043	1.6727	1.6737	418.96	2087.1	2506.1	419.06	2256.6	2675.7	1.3069	6.0476	7.3545
125	105.99	0.001048	1.3742	1.3752	444.25	2068.9	2513.2	444.38	2240.7	2685.1	1.3741	5.9100	7.2841
150	111.38	0.001053	1.1584	1.1595	467.02	2052.4	2519.4	467.18	2226.2	2693.4	1.4338	5.7894	7.2232
175	116.07	0.001057	1.0027	1.0038	486.89	2037.8	2524.7	487.08	2213.3	2700.4	1.4851	5.6866	7.1717
200	120.24	0.001060	0.8848	0.8859	504.59	2024.8	2529.4	504.80	2201.7	2706.5	1.5304	5.5968	7.1272
225	124.01	0.001064	0.7923	0.7934	520.59	2012.9	2533.5	520.83	2191.2	2712.0	1.5708	5.5172	7.0880
250	127.44	0.001067	0.7177	0.7188	535.22	2001.9	2537.1	535.49	2181.3	2716.8	1.6075	5.4454	7.0529
275	130.61	0.001070	0.6565	0.6574	548.73	1991.8	2540.5	549.02	2172.3	2721.3	1.6411	5.3800	7.0211
300	133.56	0.001073	0.6048	0.6059	561.29	1982.2	2543.5	561.61	2163.7	2725.3	1.6721	5.3200	6.9921
325	136.31	0.001076	0.5609	0.5620	573.04	1973.3	2546.3	573.39	2155.6	2729.0	1.7009	5.2645	6.9654
350	138.89	0.001079	0.5232	0.5243	584.10	1964.8	2548.9	584.48	2147.9	2732.4	1.7278	5.2129	6.9407
375	141.33	0.001081	0.4903	0.4914	594.56	1956.7	2551.3	594.96	2140.6	2735.6	1.7531	5.1646	6.9177

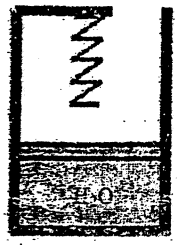
04 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2071 Chaitra

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)*

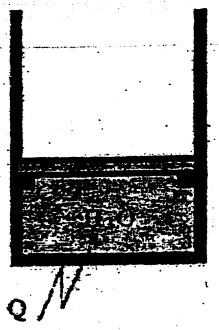
- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ ***Necessary tables are attached herewith.***
- ✓ *Assume suitable data if necessary.*

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 vopor 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 guage pressure for the entering steam and the vacuum gauge pressure for the exhaust steam. (ρ_{Hg} = 13600 kg/m^3 and g = 9.81 m/s^2) [6]
9. A piston cylinder arrangement shown in figure below contains water initially at P_1 = 100 kPa, x_1 = 0.8 and V_1 = 0.01 m^3. When the system is heated, it encounters a linear spring (k = 100 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 Cp = 1005 J/kg, k and R = 287 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]

    i) Determine the thermal efficiency of the cycle
    ii) Determine the power output from the turbine and
    iii) What fraction of the turbine power output is required to drive the compressor? [Take $C_p = 1005$ J/kg.k, $\gamma = 1.4$]

13. A 40 m long steel pipe (k = 50 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 W/mK) and the layer next to it is 20 mm thick magnesia (k = 0.1 W/mK). The heat transfer coefficients for the inside and outside surfaces are 240 W/m^{2}K and 10 W/m^{2}K respectively. If the temperature of the steam inside the pipe is 400°C and the ambient air temperature is 25°C. Determine: [6]

    i) The inside overall heat transfer coefficient U_i,
    ii) The outside overall heat transfer coefficient U_o,
    iii) The heat transfer rate using U_i, and
    iv) The heat transfer rate using U_o

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34 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division

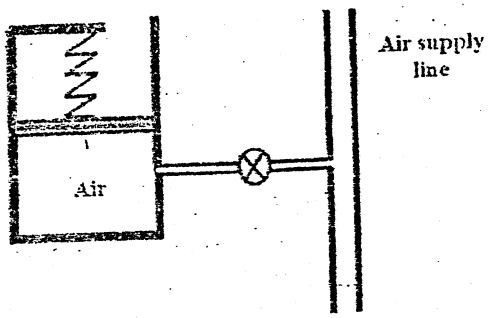
2071 Bhadra

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

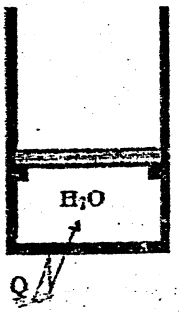
Subject: - Fundamental of Thermodynamics and Heat Transfer *(ME452)*

- ✓ 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 atmospheric pressure, gauge pressure and absolute pressure. Also write down the relationship between them. [4]
2. Differentiate between heat transfer and work transfer. [4]
3. Explain saturation curve of two-phase mixture on T-V diagram. [4]
4. Write down general mass conservation and energy conservation equations for a control volume. Also reduce them for a control volume operating under unsteady state condition. [6]
5. Define entropy. Derive expressions for changes in entropy for reversible heat transfer and reversible work transfer processes. [6]
6. Sketch an ideal Brayton cycle on P-v and T-s diagrams. Also derive an expression for its efficiency in terms of pressure ratio. [6]
7. Derive for thermal resistance of composite wall using electric analogy. [6]
8. A 15 kg piston in a cylinder with diameter of 0.15 m is loaded with a linear spring and the outside atmospheric pressure of 100 kPa, as shown in figure below. The spring exerts no force on the piston when it is at the lower position of the cylinder and for the state shown, the pressure is 300 kPa with volume of 0.02 m^3. The valve is opened to let some air in, causing the piston to rise 5 cm. Find the new pressure. [Take g = 9.81 m/s^2] [6]



9. A piston cylinder device shown in figure below contains 2 kg of H_2O with an initial temperature and volume of 80°C and 0.05 m^3 respectively. It requires a pressure of 400 kPa to lift the piston from the stops. The system is heated until its temperature reaches 250°C. Sketch the process on P-v and T-v diagrams and determine the total work transfer. [Refer attached table for the properties of steam] [8]



10. Air expands through an adiabatic turbine from 1000 kPa, 1000 K to 100 kPa, 400 K. The inlet velocity is 10 m/s whereas exit velocity is 100 m/s. The power output of the turbine is 3600 kW. Determine the mass flow rate of air and the inlet and exit diameters. [Take R = 287 J/kgK and C_p = 1005 J/kgK]. [8]

11. An air conditioning unit with a power input of 1.5 kW. It has a COP of 3 while working as a cooling unit in summer and 4 while working as heating unit in winter. It maintains a hall at 22°C year around, which exchanges heat at a rate of 0.8 kW per degree temperature difference with the surroundings. Determine the maximum and the minimum outside temperature for which this unit is sufficient. [8]

12. A Rankine cycle has a boiler working at a pressure of 2 MPa. The maximum and minimum temperatures during the cycle are 400°C and 50°C respectively. Determine the efficiency of the cycle and compare it with that of the Carnot cycle operating between the same temperature limits. [Refer attached table for the properties of steam] [8]

13. A 2.5 cm thick plate (k = 50 W/mK) 50 cm by 75 cm is maintained at 300°C. Heat is lost from the plate surface by convection and radiation to the ambient air at 20°C. If the emissivity of the surface is 0.9 and the convection heat transfer coefficient is 20 W/m^2K, determine the inside plate temperature. [$\sigma = 5.67 \times 10^{-8}$ W/m^2K^4] [6]

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34 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division

2071 Magh

Exam.	New Back (2068 & Later Batch)		
Level	BE	Ful. Marks	80
Programme	BEL, BEX, BCT, BIE, B.Agri.	Pass Marks	32
Year / Part	I / II	Time	3 hrs.

Subject: - Fundamental of Thermodynamics and Heat Transfer *(ME452)*

- ✓ 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. Mention the characteristics of thermodynamics properties. Differentiate between intensive property and extensive property of thermodynamics with examples. [4]
2. Derive mathematical expression of displacement work and simplify it for a bolytropic process. [4]
3. Define the following terms: critical point, quality, enthalpy, specific heat of an ideal gas at constant volume. [4]
4. Explain the first law of thermodynamics for a control mass undergoing a cyclic process. [6]
5. Define entropy. Derive detail mathematical expression for entropy relations of an ideal gas. [6]
6. Compare spark ignition and compression ignition engine. Sketch P-V and T-S diagrams for them. [6]
7. Define thermal resistance. Write down expression for thermal resistances for a plane wall, cylindrical layer and convective layer of a fluid. [4]
8. A cylinder encloses a gas with a piston as shown in Figure P.2. The area of piston is 0.01 m^2. Take the atmospheric pressure to be 0.101 MPa and the local gravitational acceleration as 9.81 m/s^2. If the weight of the piston is 490.50 N, what is the gas pressure? Will the gas pressure change if the gas volume beneath the piston is double? [6]

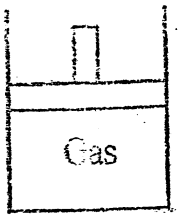

Figure P.2

9. A rigid container with a volume of 0.170 m^3 is initially filled with steam at 1500 kPa, 200°C. It is cooled to 100°C. Determine [8]
   a) Total mass of the system
   b) Final pressure
   c) Mass fraction of the 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. Nitrogen (3.10 kg) in the piston - cylinder device shown in Figure P.3 has an initial pressure of 0.2 MPa and temperature of 70°C. Energy is added until the piston just reaches the upper stops where the total volume is 4.015 m^3. It takes a pressure of 0.4 MPa to move the piston. Calculate the total work done and heat transfer. [R = 297 J/kg.K, C_V = 743 J/kg.K] [8]

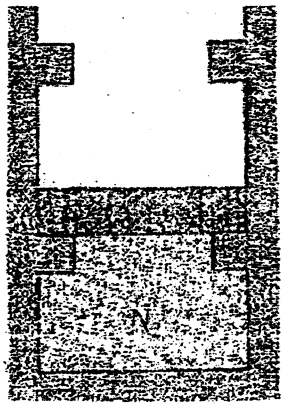

Figure P.3

11. An adiabatic steam turbine has an isentropic efficiency of 70% and operates between 2 MPa and 0.175 MPa. The inlet temperature is 400°C. What mass flow rate is required for the turbine output of 1750 kW? Excessive wear of the turbine may occur if the moisture content exceeds 2 percent. Does it occur in this case? [8]

12. An ideal gas turbine has a net power output 100 kW. The working medium is air. The minimum and maximum temperatures of the cycle are 30°C and 750°C respectively. If the turbine outlet temperature is 300°C, determine [8]

    a) Compressor pressure ratio
    b) Compressor work
    c) Mass flow rate of air
    d) Thermal efficiency

    [Take C_p = 1005 J/KgK and γ = 1.4]

13. A standard cast iron pipe inner diameter 50 mm and 2.5 mm thick is insulated with 85 percent magnesium insulation, K = 0.02 W/m°C. Temperature at the interface between the pipe and the insulation is 300°C. The allowable heat loss through the pipe is 600 W/m length of pipe and for the safety; the temperature of the outside surface of insulation must not exceed 100°C. Determine [8]

    a) Minimum thickness of insulation required and
    b) The temperature of inside surface of the pipe assuming its thermal conductivity 20 W/m°C.

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04 : TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2071 Shawan

Exam.	New Back (2066 & Later Batch)		
Level	BE	Full Marks	80
Programme	BCE, BME, BGE	Pass Marks	32
Year / Part	4 / 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 <u>All</u> questions.*
- ✓ *The figures in the margin indicate <u>Full Marks</u>.*
- ✓ *<u>Necessary figures are attached herewith.</u>*
- ✓ *Assume suitable data if necessary.*

1. Differentiate between the microscopic and macroscopic view point in thermodynamics with example. [4]
2. Define energy and power. Differentiate between stored and transient energy with examples. [4]
3. Define moisture content and critical point. Derive an expression for specific volume of a two phase (liquid and vapor) mixture in terms of quality. [4]
4. Differentiate between steady state work application and steady state flow application. Write down mass and energy conservation equation of steady state process. Reduce them for a nozzle and a condenser. [6]
5. Explain entropy. Derive the relations for entropy for an ideal gas and an incompressible substance. [6]
6. Sketch Rankine cycle on P-v and T-s diagram using dry saturated stream and obtain an expression for the Rankine cycle efficiency. [6]
7. Define thermal resistance. Derive an expression for heat transfer through composite plane wall of three different layers of different materials using electric analogues approach. [6]
8. A piston cylinder arrangement shown in figure below has cross sectional area of 0.01m2 and a piston mass of 80 kg. If the atmospheric pressure is 1 bar, what should be the gas pressure to lift the piston? If 50 kg mass is added above the piston, what would be the new pressure? [6]

10. A perfect gas flows through a nozzel where it expands in a reversible adiabatic manner. The inlet conditions are 22 bar, 500°C and 38m/s at the exit the pressure is 2 bar. Determine the exit velocity and exit area if the flow rate is 4 kg/s. Take R=190 J/Kg K and $\Upsilon = 1.35$. [8]

11. A house is to be maintained at 25°C in summer as well as winter. For this purpose, it is proposed to use a reversible device as a refrigerator in summer and a heat pump in winter. The ambient temperature is 40°c in summer and 3°c in winter. The energy losses as heat from the roof and the walls are estimated as 5 kw per degree Celsius temperature between the room and the ambient conditions. Calculate the power required to operate the device in summer and winter. [8]

12. At the beginning of a compression stoke of an air standard Diesel cycle having a compression ratio of 16 the temperature is 300 K and the pressure is 1000 kpa, if the cut off ratio for the cycle is 2 Determine: [8]

    a) The pressure and temperature at the end of each process of the cycle.

    b) The thermal efficiency and

    c) The mean effective pressure

    [Take R =287 J/kg.k and $\Upsilon = 1.4$]

13. A gas turbine blade is modeled as a flat plate. the thermal conductivity of the blade material is 15W/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 upper and lower surfaces of the blade are 2500 W/m^2K and 1500 W/m^2K respectively. Under steady state conditions, the temperature at upper surface of the blade is measured as 850°C, determine the temperature of the coolant air. [6]

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TABLE 1 Properties of SATURATED WATER – Pressure Table

P kPa	T °C	v_f m^3/kg	v_{fg} m^3/kg	v_g m^3/kg	u_f kJ/kg	u_{fg} kJ/kg	u_g kJ/kg
900	175.39	0.001121	0.2138	0.2149	741.92	1838.3	2580.2
950	177.70	0.001124	0.2030	0.2041	752.03	1829.8	2581.8
1000	179.92	0.001127	0.1933	0.1944	761.75	1821.6	2583.3
1100	184.10	0.001133	0.1764	0.1775	780.14	1805.9	2586.0
1200	188.00	0.001138	0.1622	0.1633	797.31	1791.1	2588.4

TABLE 2 Properties of SUPERHEATED STEAM

P kPa	T °C	v m^3/kg	u kJ/kg	H kJ/kg	s kJ/kg.K
4000	(250.39)	(0.04977)	(2601.5)	(2800.6)	(6.0689)
	300	0.05882	2724.4	2959.7	6.3598
	350	0.06644	2826.1	3091.8	6.5811
	400	0.07340	2919.8	3213.4	6.7688
	450	0.08002	3010.3	3330.4	6.9364

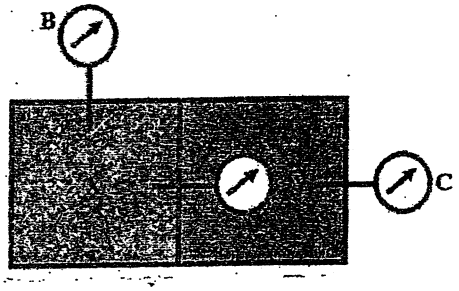
04 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2070 Chaitra

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 stream 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 stream]

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 again 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 Υ = 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 materials is nearer to the pipe than it is away from the pipe. [6]

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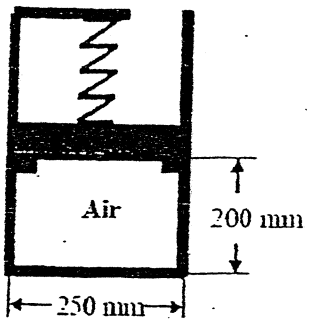
04 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2070 Ashad

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.

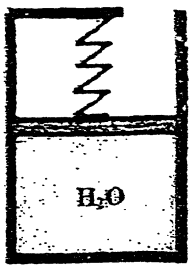
Subject: - Fundamental of Thermodynamics and Heat Transfer *(ME402)*

- ✓ 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 modium on both sides. [6]
8. Air (0.01 kg) is contained in a piston cylinder device restrained by a linear spring ($k = 500$ *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 J/kg. K, p_{atm} = 100 kPa and g = 9.81 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 m^3, 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 H_2O, 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 = 287J/kgK and c_p = 1005 J/kgK]. [8]

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 J/kgK]. [8]

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 δ = 1.4 and c_p = 1005 J/Kg.k] [8]

13. A furnace wall 300 mm thick is made up of an inner layer of fire brick (k = 1 W/mK) covered with a layer of insulation (k = 0.2 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: [6]

    a) Heat loss per unit area of the wall and
    b) The thickness of each layer

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TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2079 Bhadra

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

Subject: - Engineering Mathematics I (*SH 401*)

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

1. State Leibnitz's theorem. If $y = a\cos(\log x) + b\sin(\log x)$ then show that $x^2y_{n+2} + (2n+1)xy_{n+1}x + (n^2+1)y_n = 0$.
2. Apply Maclaurin's series to find the expansion of $e^x \sec x$ as far as the term in x^3.
3. State L'Hopital's rule. Using it evaluate $\lim_{x\to 0}\left(\frac{\sin x}{x}\right)^{\frac{1}{x^2}}$
4. Find the asymptotes of the curve
   $(x+y)^2(x+2y+2) = x + 9y - 2$
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. Integrate: $\int_0^{\frac{\pi}{2}} \frac{\cos x dx}{(1+\sin x)(2+\sin x)}$
7. Apply the rule of differentiation under integral sign to evaluate: $\int_0^\infty \frac{e^{-ax}\sin x}{x}dx$ and hence deduce that $\int_0^\infty \frac{\sin x}{x}dx = \frac{\pi}{2}$
8. Define Beta and Gamma functions. Evaluate: $\int_0^a x^4\sqrt{a^2-x^2}\,dx$
9. Show that the area of the astroid $x^{2/3}-y^{2/3}=a^{2/3}$ is $\frac{3\pi a^2}{8}$

   OR

   Find the volume of the solid of revolution of the cardoid $r = a(1+\cos\theta)$ about the initial line.
10. Solve: $x\frac{dy}{dx}+2y = x^2\log x$
11. Solve: $y = yp^2 + 2px$ where $p = \frac{dy}{dx}$
12. Solve: $\frac{d^2y}{dx^2}+3\frac{dy}{dx}+2y = e^{2x}\sin x$
13. Solve: $x\frac{d^2y}{dx^2}-2\frac{dy}{dx}+2\frac{y}{x}=\frac{1}{x^2}$
14. Derive the standard equation of an ellipse.
15. Through what angle should the axes be rotated to reduce the equation $3x^2+2xy+3y^2-\sqrt{2}x=0$ in to one with the xy term missing?
16. Find the center, length of the axes and eccentricity of the conic
    $9x^2+4xy+6y^2-22x-16y+9=0$

    OR

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

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TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2079 Baishakh

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

Subject: - Engineering Mathematics I *(SH 401)*

- ✓ 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. State Leibnitz's theorem. If $y = \log(x + \sqrt{a^2 + x^2})$ then using the theorem show that $(a^2 + x^2)y_2 + xy_1 = 0$ and hence show that $(a^2 + x^2)y_{n+2} + (2n + 1)xy_{n+1} + n^2y_n = 0$. [1+4]
2. Assuming the validity of expansion, find the expansion of: log(secx) by using Maclaurin's theorem. [5]
3. What do you mean by indeterminate form? State various forms of indeterminacy. Evaluate $\lim_{x \to 0}\left(\frac{\sin x}{x}\right)^{\frac{1}{x^2}}$. [5]
4. Define asymptotes and its types. Find the asymptotes of the curve $x^3 + 4x^2y + 5xy^2 + 2y^3 + 2x^2 + 4xy + 2y^2 - x - 9y + 1 = 0$. [1+4]
5. Find the pedal equation of the curve of $r^m = a^m \cos m\theta$. [5]
6. Show that $\int_0^{\pi/2} \frac{x}{\sin x + \cos x} dx = \frac{\pi}{2\sqrt{2}} \log(\sqrt{2} + 1)$. [5]
7. Evaluate, by using the rule of differentiation under the sign of integration: $\int_0^{\pi} \frac{\log(1 + a\cos x)}{\cos x} dx$. [5]
8. Define Beta and Gamma function and use these to evaluate $\int_0^1 \frac{dx}{(1 - x^6)^{1/6}}$. [5]
9. Find the area included between an arc of cycloid $x = a(\theta - \sin\theta)$, $y = a(1 - \cos\theta)$ and its base.

   OR

   Find the volume of the solid formed by revolution of the cardoid $r = a(1 + \cos\theta)$ about the initial base. [5]
10. Solve the differential equation $\frac{dy}{dx} + \frac{x}{1 - x^2} y = x\sqrt{y}$. [5]
11. State Clairatut's equation, find the general and singular solution of $y = px + p - p^2$. [5]
12. Find the particular integral and hence solve the differential equation $y'' - 2y' + 5y = e^{2x} \sin x$. [5]
13. Solve the differential equation $x^2 \frac{d^2y}{dx^2} - x\frac{dy}{dx} + 2y = x \log x$. [5]
14. Through what angle should the axes be rotated to reduce the equation $3x^2 + 2xy + 3y^2 - \sqrt{2}x = 0$ into one with the xy term missing? Also obtain the transformed equation. [2+3]
15. Deduce the standard equation of the hyperbola. [5]
16. Describe and sketch the graph of the equation $r = \frac{10}{2 - 3\sin\theta}$

    OR

    Find the centre, length of axes and eccentricity of the conic $3x^2 + 8xy - 3y^2 - 40x - 20y + 50 = 0$. [5]

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TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2078 Bhadra

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

Subject: - Engineering Mathematics I *(SH 401)*

- ✓ 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 $y=(x^2-1)^n$, then prove that: $(x^2-1)y_{n+2}+2xy_{n+1}-n(n+1)y_n=0$ [5]
2. Assuming the validity of expansion, expand log(1+x) by using Maclaurin's theorem. [5]
3. Give an example of indeterminate from. Evaluate: $\lim_{x\to 0}(\cot x)^{\frac{1}{\log x}}$ [5]
4. Find the asymptote of the curve: $(x^2-y^2)^2-2(x^2+y^2)+x-1=0$ [5]
5. Find the radius of curvature for the curve $r^m=a^m\cos m\theta$. [5]

   OR

   Find the pedal equation of the following curves $y^2=4a(x+a)$. [5]
6. Evaluate: $\int_0^1 \frac{\log(1+x)}{(1+x^2)}dx$ [5]
7. Evaluate by using the rule of differentiation under the sign of integration: $\int_0^\infty \frac{log(1+a^2x^2)}{1+b^2x^2}dx$ [5]
8. Define Gamma function. Use it to prove: $\int_0^{\pi/8}\cos^3 4x\,dx=\frac{1}{6}$ [5]
9. Find the area of a loop of the curve : $a^2y^2=a^2x^2-x^4$ [5]

   OR

   Prove that the volume and surface area of a sphere of radius 'a' is $\frac{4}{3}\pi a^3$ and $4\pi a^2$ respectively. [5]
10. Solve: $\frac{dy}{dx}+\frac{y}{x}\log y=\frac{y}{x^2}(\log y)^2$ [5]
11. Find the general solution of the differential equation $y=(1+p)x+ap^2$. [5]
12. Solve: $(D^2+3D+2)y=e^{2x}\sin x$ [5]
13. Solve: $(x^2D^2-2)y=x^2+\frac{1}{x}$

    OR

    A certain culture of bacteria grows at rate proportional to its size. If the size doubles in 4 days, find the time required for the culture to increase to 10 times to its original size. [5]
14. Through what angle must the axes be rotated to remove the term containing xy in $11x^2+4xy+14y^2=5$. [5]
15. Prove that: $2x^2+3y^2-4x-12y+13=0$ represents equation of ellipse. Find its center, length of axes, eccentricity, and direct ices of ellipse. [5]
16. Show that the line $x\cos\alpha + y\sin\alpha = p$ will be a tangent to the hyperbola $\frac{x^2}{a^2}-\frac{y^2}{b^2}=1$ if $a^2\cos^2\alpha-b^2\sin^2\alpha=p^2$ [5]

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TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2076 Chaitra

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

Subject: - Engineering mathematics I *(SH 401)*

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

1. If $y=a\cos(\log x) + b \sin(\log x)$ prove that:
   (i) $x^2y_2+xy_1+y=0$
   (ii) $x^2y_{n+2}+(2n+1)xy_{n+1}+(n^2+1)y_n=0$
2. State and prove Lagrange's mean value theorem.
3. State L' Hospital's Rule and hence evaluate $\lim_{x \to 0}(\cot x)^{\sin 2x}$
4. Find the asymptote of $(x+y)^2(x+2y+2) = x+9y-2$
5. Find the radius of curvature of the curve $r = a(1 - \cos\theta)$.

   Or,

   Find the pedal equation of $y^2=4a(x+a)$
6. Evaluate $\int_0^{\pi/2} \frac{x \sin x \cos x}{\cos^4 x + \sin^4 x} dx$
7. Using the rule of differentiation under the integral sign, evaluate $\int_0^{\infty} \frac{\log(1+a^2x^2)}{1+b^2x^2} dx$
8. Obtain the reduction formula for $\int_0^{\pi/2} \cos^n x dx$ and hence evaluate $\int_0^{\pi/2} \cos^{10} x dx$.
9. Obtain the area of a loop of the curve $y^2(a^2+x^2)=x^2(a^2-x^2)$

   Or,

   Find the volume of the solid formed by the revolution of the cycloid $x=a(\theta+\sin\theta)$
10. Solve the differential equation: $\frac{dy}{dx} = \frac{y}{x} + \tan\frac{y}{x}$
11. Find the general solution of $y=Px+x^4p^2$
12. Solve $(D^2-2D+5)y = e^{2x}\sin x$
13. Solve $x^2\frac{d^2y}{dx^2} - 2x\frac{dy}{dx} - 4y = x^4$

    Or,

    A radio active material has an initial mass 100mg. After two years, it is left to 75mg. Find the amount of the material at any time t.
14. What does the equation $3x^2+3y^2+2xy=2$ become when the axes are turned through an angle 45° with the original axes.
15. Obtain the equation of hyperbola in standard form.
16. Find the center for the conic $3x^2+8xy-3y^2-40x-20y+50=0$.

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TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2076 Ashwin

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

Subject: - Engineering Mathematics I *(SH 401)*

- ✓ 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 $y=\sin(m\sin^{-1}x)$, show that $(1-x^2)y_{n+2}-(2n+1)xy_{n+1}+(m^2-n^2)y_n=0$, where suffices of y denote the respective order of derivatives of y. [5]
2. State Lagrange's mean value theorem. Verify it for the function $y=\sin x$ on $\left[-\frac{\pi}{2},\frac{\pi}{2}\right]$. Is this theorem valid for the function $y=\tan x$ on $[0,\pi]$? [1+3+1]
3. Evaluate $\lim_{x\to 0}\left(\frac{\tan x}{x}\right)^{1/x}$ [5]
4. Find the asymptotes of the curve $(x+y)^2(x+2y+2)=x+9y-2$. [5]
5. Find the pedal equation of the curve $y^2=4a(x+a)$. [5]
6. Evaluate, if possible $\int_0^\infty \ell n\, x\,dx$. [5]
7. Apply differentiation under integral sign to evaluate $\int_0^\infty \frac{e^{-ax}\sin x}{x}dx$ and then show that $\int_0^\infty \frac{\sin x}{x}dx=\frac{\pi}{2}$. [4+1]
8. Define Beta and Gamma function and use it to show that, $\int_0^{\pi/6}\cos^4 3\theta\sin^2 6\theta\ d\theta=\frac{5\pi}{192}$. [5]
9. Find the volume of the solid formed by the revolution of the cardioid r = a(1 + cos θ) about the initial line. [5]
10. Solve the differential equation $\frac{dy}{dx}+y\cot x=2\cos x$. [5]
11. If p stands for $\frac{dy}{dx}$, then solve the differential equation $y - 2px + ayp^2 = 0$. [5]
12. Solve the differential equation $(D^2-2D+5)y=e^{2x}\sin x$. [5]
13. Solve the differential equation $(x^2D^2+xD+1)y=\sin(\log x^2)$ [5]
14. Define ellipse and obtain the equation of ellipse in standard form. [5]
15. Prove that the locus of a point which moves in such a way that the difference of its distances from the point (5, 0) and (-5, 0) is 2 is a hyperbola. [5]
16. Describe and sketch the graph of the conic $r=\frac{10}{3+2\sin\theta}$ [5]

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TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2075 Chaitra

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

Subject: - Engineering Mathematics I *(SH 401)*

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

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

2. Assuming the validity of expansion, find the expansion of $\log(1+e^x)$ by using Machlaurin's Theorem.

3. Evaluate: $\lim_{x\to 0} \left(\frac{\sin x}{x}\right)^{\frac{y}{x}}$

4. Find the asymptotes of the curve:
$$y^2 = \frac{(a-x)^2}{a^2+x^2}x^2$$

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 major axis is equal to half of the latus rectum.

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

7. Evaluate by using the rule of differentiation under the sign of integration
$$\int_0^{\pi} \frac{\log(1+a\cos x)}{\cos x}dx$$

8. Prove that: $\int_0^{\infty} \sqrt{y}e^{-y^2}dy \times \int_0^{\infty} \frac{e^{-y^2}}{\sqrt{y}}dy = \frac{\Pi}{2\sqrt{2}}$

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

10. Solve the differential equation:
$$\frac{dy}{dx} + \frac{1}{x}\sin 2y = x^3\cos^2 y$$

11. If p denotes $\frac{dy}{dx}$, then solve $p^3 - 4xyp + 8y^2 = 0.$

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

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

14. Derive the standard equation of an ellipse.

15. Find the condition that the line xcosα + ysinα = p to touch hyperbola $\frac{x^2}{a^2} - \frac{y^2}{b^2} = 1$ and also find point of contact.

16. Find the centre, length of axes and eccentricity of conic $9x^2 + 4xy + 6y^2 - 22x - 16y + 9 = 0.$

OR

Describe and sketch the graph of polar equation: $r = \frac{4}{\quad}$

02 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2075 Ashwin

Exam.	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 *(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. State Leibnitz's theorem. If $y^{\frac{1}{m}}+y^{\frac{-1}{m}}=2x$, show that $(x^2-1)y_2+xy_1-m^2y=0$ and hence prove that $(x^2-1)y_{n+2}+(2n+1)xy_{n+1}+(n^2-m^2)y_n=0.$ [2+3]
2. State Roller's theorem. Does the theorem hold when the function is not continuous at the end points? Justify your answer. Verify the theorem for $f(x)=x^2-4x+3$ on [1,3]. [5]
3. State L-Hospital's theorem and evaluate $\lim_{x\to 0}\left(\frac{\sin x}{x}\right)^{\frac{1}{x^2}}$ [5]
4. Find the asymptotes of curve $4x^3-3xy^2-y^3+2x^2-xy-y^2-1=0$ [5]
5. Find the pedal equation of the curve $y^2=4c(x+c)$ [5]
6. Show that $\int_0^{\frac{\pi}{2}}\frac{\sin^2 x}{\sin x+\cos x}dx=\frac{1}{\sqrt{2}}\log(\sqrt{2}+1)$ [5]
7. Evaluate, by using differentiation under the sign of integration [5]

   $\int_0^{\infty}\frac{\log(1+a^2x^2)}{1+b^2x^2}dx$
8. Define Beta-Gamma function and use it to evaluate $\int_0^{\frac{\pi}{6}}\cos^4 3\theta.\sin^2 6\theta.d\theta$ [5]
9. Find the surface area of the solid generated by the revolution of the cardioids $r=a(1+\cos\theta)$ about the initial line. [5]
10. Transform the equation $12x^2-10xy+2y^2+11x-5y+2=0$ by translating the axes into an equation with linear term missing. [5]
11. Derive the standard equation of hyperbola. [5]
12. Find the centre, Length of axes and eccentricity of the conic [5]

    $9x^2+4xy+6y^2-22x-16y+9=0$

    OR

    Describe and sketch the graph of the equation $r=\frac{12\sec\theta}{2+3\sec\theta}$
13. Solve $\frac{dy}{dx}+\frac{\sin 2y}{x}=x^3\cos^2 y$ [5]
14. Solve the differential equation of $xp^2-2yp+ax=0$ [5]
15. Solve $(D^2-1)y=\sinh(x)$ [5]
16. $(x^2D^2+xD+1)y=\sin(\log x^2)$ [5]

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01 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2074 Ashwin

Exam.	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 *(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 Leibnitz's theorem on heigher order derivative. If $y = e^{a\tan^{-1}x}$, prove that $(1+x^2)y_{n+2} + (2nx + 2x - a)y_{n+1} + n(n+1)y_n = 0$
2. State difference between Roll's Theorem and Lagrange's Mean value theorem. Verify Lagrange's mean value theorem for f(x) = x(x-1)(x-2) when $x \in \left[0, \frac{1}{2}\right]$.
3. Define inderminate form of a function. Evaluate
$$\lim_{x \to 0} \left(\frac{\tan x}{x}\right)^{1/x^2}$$
4. Define asymptote to a curve. Find the asymptotes of curve $y^3 + 2xy^2 + x^2y - y + 1 = 0$.
5. Find radius of curvature of the curve $x^3 + y^3 = 3axy$ at origin.

   OR

   Find the pedal equation of the polar curve $r^m = a^m \cos m\theta$.
6. Integrate : $\int_0^{\pi/2} \frac{\cos x \, dx}{(1+\sin x)(2+\sin x)}$
7. Apply differentiation under integral sign to evaluate $\int_0^\infty \frac{e^{-ax}\sin x}{x} dx$.
8. Define Beta and Gamma function. Use them to evaluate $\int_0^{2a} x^5\sqrt{2ax - x^2}\,dx$.
9. Show that the area of the curve $x^{2/3} + y^{2/3} = a^{2/3}$ is $\frac{3}{8}\pi a^2$.

   OR

   Find the volume of the solid formed by the revolution of the cardoid $r = a(1+\cos\theta)$ about the initial line.
10. Solve: $(1+y^2)dx = (\tan^{-1}y - x)dy$
11. Solve: $y = px - \sqrt{m^2 + p^2}$ where $p = \frac{dy}{dx}$.

12. Solve: $(D^2+2D+1)y=e^x+x^2$.

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

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. What does the equation of lines $7x^2+4xy+4y^2=0$ become when the axes are the bisectors of the angles between them?

15. Derive the equation of hyperbola in standard form.

16. Find the foci and eccentricity of the conic $x^2+4xy+y^2-2x+2y-6=0$.

OR

Describe and sketch the graph of the conic $r=\frac{12}{6+2\sin\theta}$.

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022 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2074 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.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Assume suitable data if necessary.*

1. State Leibnitz theorem. If $\log y = \tan^{-1} x$, then show that
$(1+x^2)y_{n+2} + (2nx+2x-1)y_{n+1} + (n^2+n)y_n = 0$ [1+4]
2. State Rolle's theorem. Is the theorem true when the function is not continuous at the end points? Justify your answer. Verify Rolle's theorem for $f(x) = x^2 5x + 6$ on [2,3]. [1+2+2]
3. State L-Hospital's rule. Evaluate $\lim_{x \to 1} (2-x)^{\tan\left(\frac{\pi x}{2}\right)}$ [1+4]
4. Find the asymptotes of the curve $(x+y)^2(x+2y+2) = x+9y-2$ [5]
5. Find the pedal equation of the ellipse $\frac{x^2}{b^2} + \frac{y^2}{a^2} = 1$. [5]
6. Evaluate the integral $\int_{-1}^{1} \frac{1}{x^2} dx$ [5]
7. Apply the rule of differentiation under integral sign to evaluate $\int_0^\infty \frac{e^{-ax} \sin x}{x} dx$ and hence deduce that $\int_0^\infty \frac{\sin x}{x} dx = \frac{\pi}{2}$ [5]
8. Define Beta function. Apply Beta and Gamma function to evaluate $\int_0^{2a} x^5 \sqrt{2ax - x^2}\, dx$ [5]
9. Find the area common to the circle r = a and the cordioid r = a(1+cosθ) [5]
10. Through what angle should the axes be rotated to reduce the equation $3x^2 + 2xy + 3y^2 - \sqrt{2x} = 0$ into one with the xy term missing? Also obtain the transformed equation. [2+3]
11. Derive the equation of an ellipse in standard form. [5]
12. Find the product of semi-axis of the conic $x^2 - 4xy + 5y^2 = 2$ [5]

OR

Describe and sketch the graph of conic $r = \frac{12}{3+2\cos\theta}$

13. Solve the differentiate equation of $(x^2 - y^2)dx + 2xydy = 0$ [5]
14. Solve: $y = yp^2 + 2px$ where $p = \frac{dy}{dx}$ [5]
15. Solve $(D^2 - 6D + 9)y = x^2 e^{2x}$ [5]
16. Solve the differential equation of $x^2 \frac{d^2y}{dx^2} - 2x\frac{dy}{dx} + 2y = 4x^3$ [5]

01 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2073 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 <u>All</u> questions.*
- ✓ *<u>All</u> questions carry equal marks.*
- ✓ *Assume suitable data if necessary.*

1. State Leibnitz theorem. If $y = e^{x^2}$, then show that $y_{n+1} - 2xy_n - 2ny_{n-1} = 0$.
2. Expand $e^x \log_e(1+x)$ in ascending powers of x upto the term containing x^4 in Maclaurin's series.
3. State L-hospital's rule. Evaluate,
$$\lim_{x \to 0} \left(\frac{1}{x^2}\right)^{\tan x}$$
4. State the types of asymptotes to a curve. Find the asymptotes of the curve $(x^2 - y^2)(x + 2y + 1) + x + y + 1 = 0$.
5. Find the chord of curvature through the pole for the curve r = a (1+cosθ).
6. Show that $\int_0^\infty \frac{\log(1+x^2)}{1+x^2} dx = \pi \log 2$
7. Apply the method of differentiation under integral sign to prove
$$\int_0^{\pi/2} \frac{dx}{(a^2 \sin^2 x + b^2 \cos^2 x)^2} = \frac{\pi(a^2 + b^2)}{4a^3 b^3}$$
8. Using Beta -Gamma Function, show that
$$\int_0^{\pi/4} \sin^4 x . \cos^2 x \, dx = \frac{3\pi - 4}{192}$$
9. Find the area included between an arc of cycloid x = a (θ-sinθ), y = a (1- cosθ) and its base.

OR

Find the volume of the solid formed by the revolution of the cardoid r = a (1+cosθ) about the initial base.

10. What does the equation $x^2 + 2\sqrt{3}xy - y^2 = 2a^2$ become when the axes are turned through an angle 30° to the original axes?
11. Derive the equation of an ellipse in the standard form.

12. Find the eccentricity of the conic,

$$x^2 + 4xy + y^2 - 2x + 2y - 6 = 0$$

OR

Describe and sketch the conic

$$r = \frac{10\,\mathrm{cosec}\theta}{2\,\mathrm{cosec}\theta + 3}$$

13. Solve: $\frac{dy}{dx} = \frac{x + 2y - 3}{2x + y - 3}$

14. Solve: $\frac{dy}{dx} + y \tan x = \sec x$

15. Solve: $y = 2px + p^3y^2$; where $p = \frac{dy}{dx}$

16. Solve: $x^2 \frac{d^2y}{dx^2} - 2x \frac{dy}{dx} + 2y = \frac{1}{x}$

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01 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2073 Shrawan

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 h.

Subject: - Engineering Mathematics I *(SH401)*

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

1. State Leibnitz's theorem. If $y=(\sin^{-1}x)^2$, show that
   $(1-x^2)y_{n+2}-(2n+1)xy_{n+1}-n^2y_n=0$
2. Verify Rolle's Theorem for $f(x)=\log\frac{x^2+ab}{(a+b)x}$; $x\varepsilon[a,b]$. How does Rolle's Theorem differ from Lagrange's mean value theorem.
3. Evaluate $\lim_{x\to 0^+}\left(\frac{\sin x}{x}\right)^{\frac{1}{x}}$
4. Find the asymptotes to the curve $y^3+2xy^2+x^2y-y+1=0$
5. Find the radius of curvature at origin for the curve $x^3+y^3=3axy$.
6. Show that $\int_0^{\pi} x\log(\sin x)dx=\frac{\pi^2}{2}\log\frac{1}{2}$
7. Apply the rule of differentiation under integral sign to evaluate $\int_0^{\infty}\frac{e^{-ax}\sin x}{x}dx$ and hence deduce that $\int_0^{\infty}\frac{\sin x}{x}dx=\frac{\pi}{2}$
8. Define Beta function. Apply Beta and Gamma function to evaluate $\int_0^{2a}x^5\sqrt{2ax-x^2}\,dx$
9. Find the volume generated by revolution of astroid $x^{2/3}+y^{2/3}=a^{2/3}$ about x-axis.
10. What does the equation $3x^2+3y^2+2xy=2$ becomes when the axes are turned through an angle of 45° to the original axes?
11. Find center, length of axes, eccentricity and directrices of the conic
    $3x^2+8xy-3y^2-40x-20y+50=0$

    OR

    Describe and sketch the conic $r=\frac{12}{2-6\cos\theta}$
12. Deduce standard equation of ellipse.
13. Solve the differential equation: $(1+y^2)+(x-e^{\tan^{-1}y})\frac{dy}{dx}=0$
14. Solve: $xp^2-2yp+ax=0$ where $p=\frac{dy}{dx}$
15. Solve: $\frac{d^2y}{dx^2}+3\frac{dy}{dx}+2y=e^{2x}.\sin x$
16. Resistance of 100 ohms, an inductance of 0.5 Henry are connected in series with battery 20 volts. Find the current in the circuit as a function of time.

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84 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2072 Chaitra

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

Subject: - Engineering Mathematics I *(SH404)*

- ✓ 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 $y=\sin^{-1}x$, prove that $(1-x^2)y_{n+2}-(2n+1)xy_{n+1}-n^2y_n=0$
2. State Lagrange's Mean value theorem and verify the theorem for
   $f(x)=\log x, x\in[1,e]$
3. Evaluate the limit: $\lim_{x\to b}(b-x)\tan\left(\frac{\pi x}{2b}\right)$
4. Find the asympototes of the curve: $x^3-2x^2y+xy^2+x^2-xy+2=0$
5. Find the radius of the curvature for the curve $x=a(t+\sin t)$, $y=a(1-\cos t)$ at the point $t=0$.

   OR

   Find the pedal equation of the curve $r^m=a^m\cos m\theta$
6. Use properties of definite integral to show $\int_0^{\pi/2}\frac{\sin x-\cos x}{1+\sin x\cos x}dx=0$
7. Evaluate the improper integral: $\int_1^{\infty}\frac{dx}{x^2+1}$
8. Obtain the reduction formula for $\int_0^{\Pi/4}\tan^n x\,dx$ and hence evaluate $\int_0^{\Pi/4}\tan^5 x\,dx$
9. Use Beta and Gamma function to prove $\int_0^{\pi/6}\cos^4(3\theta).\sin^2(6\theta)d\theta=\frac{5\pi}{192}$
10. Find area of the astroid $x^{2/3}+y^{2/3}=a^{2/3}$ using definite intergral.
11. Solve the differential equation: (2x+2y+3) dy = (x+y+1) dx
12. Solve the differential equation: $x\frac{dy}{dx}+y\log y=xye^x$
13. Solve the second order linear differential equation: $\frac{d^2y}{dx^2}+\frac{dy}{dx}+y=\sin 2x$

    OR

    Solve $xp^2-2yp+ax=0$ where $p=\frac{dy}{dx}$
14. What does the equation $3(x^2+y^2)+2(xy-1)=0$ become when the axes are turned through an angle 45° to the original axes.
15. Find the condition that the line *l*x + my + n = 0 will be a tangent to the curve $\frac{x^2}{a^2}+\frac{y^2}{b^2}=1$ and find the point of contact.
16. Find the center, foci, eccentricity and length of latus rectum of the hyperbola $9x^2-16y^2+72x-32y-16=0$

    OR

    Sketch and describe the graph of the conic: $r=\frac{10}{3+2\cos\theta}$

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01 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2072 Kartik

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 <u>All</u> questions.*
- ✓ *<u>All</u> 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: $\lim_{x \to 0} \left(\frac{\tan x}{x}\right)^{1/x}$
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 3θ

   OR

   Find the volume of the solid formed by the revolution of the cardioid r = a (1+cosθ) 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: $x^2\frac{d^2y}{dx^2}+x\frac{dy}{dx}-4y=x^2$

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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 <u>All</u> questions.*
- ✓ *<u>All</u> questions carry equal marks.*
- ✓ *Assume suitable data if necessary.*

1. State Leibnity's theorem on Leigher derivatives:

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

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

2. Assuming the validity of expansion, find the expansion of the function $\frac{e^x}{1+e^x}$ by Maclaurin's theorem.

3. Evaluate $\lim_{x\to 0} \frac{xe^x - (1+x)\log(1+x)}{x^2}$

4. Find the asymptotes of the curve $y^3 + 2xy^2 + x^2 y - y + 1 = 0$

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 centre, eccentricity, latus rectums and foci

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TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2071 Shawan

Exam.			
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 $y = \log\left(x + \sqrt{a^2 + x^2}\right)$, then show that $\left(a^2 + x^2\right)y_{n+2} + (2n+1)xy_{n+1} + n^2 y_n = 0$ [5]
2. State and prove Lagrange's Mean Value theorem. [5]
3. Evaluate: $\lim_{x \to \prod} (\sin x)^{\tan x}$ [5]
4. Find the asymption 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-cosθ) about the initial line.

10. Solve: $\text{Sin}x\frac{dy}{dx} + y\cos x = x\sin x$ [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 ecentricity of the conic [5]

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

OR

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

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INSTITUTE OF ENGINEERING

Examination Control Division

2070 Chaitra

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: $\lim_{x \to a} \left(2 - \frac{x}{a}\right)^{\tan\frac{\pi x}{2a}}$
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 $a^2y^2 = a^2y^2 - x^4$

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: $(D^2 - 2D + 5)y = e^{2x}.\sin x$
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 $r = \frac{10\,\mathrm{cosec}\theta}{2\,\mathrm{cosec}\theta + 3}$

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TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2070 Ashad

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: - Mathematics I *(SH401)*

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

1. State Leibnitz's Theorem on higher 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. State Rolle's Theorem and verify it for the function $f(x) = \frac{x(x+3)}{e^{\frac{x}{2}}}$, $x \varepsilon [-3,0]$

3. Evaluate: $\lim_{x \to 0} \left(\frac{\tan x}{x}\right)^{\frac{1}{x^2}}$

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

5. Show that the radius of curvature at any point (r,θ) of the curve $r^m = a^m \cos m\theta$ is $\frac{a^m}{(m+1)r^{m+1}}$

6. Show that $\int_0^1 \frac{\log(1+x)}{1+x^2}\,dx = \frac{\pi}{8}\log 2$

7. Evaluate by using the rule of differentiation under the sign of integration $\int_0^\infty \frac{e^{-x}\sin bx}{x}\,dx$

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

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

OR

Show that the volume of the solid formed by revolving the ellipse $\frac{x^2}{a^2}+\frac{y^2}{b^2}=1$ about the line $x = 2a$ is $4\pi^2a^2b$ cubic units.

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

11. Solve the differential equation $y = yp^2 + 2px$ where $p = \frac{dy}{dx}$

12. Solve the differential equation $(D^2 - 2D + 5)y = e^{2x}.\sin x$

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

OR

Newton's law of cooling states that the temperature of an object changes at the 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 the time when the temperature of water will become 40°C?

14. If the axes be turned through an angle $\tan\theta = 2$ what does the equation $4xy - 3x^2 - a^2 = 0$ becomes.

15. Find the condition that the straight line $x\cos\alpha + y\sin\alpha = p$ touches the ellipse $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$

16. Find the centre, length of axes and eccentricity of the conic $9x^2 + 4xy + 6y^2 - 22x - 16y + 9 = 0$

OR

Describe and sketch the graph of the equation $r = \frac{12}{3 + 2\cos\theta}$

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TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2079 Bhadra

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

Subject: - Engineering Chemistry (*SH 403*)

- ✓ 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 principle involved in the construction of galvanic cell. Draw the cell diagram and calculate the emf of following cell at 25°C. (Given: $E°Al^{3+}/Al$ = -1.66 V and $E°Cu^{2+}/Cu$ = 0.34V)
   Al (s) / Al^{3+} (0.75 M) || Cu^{2+} (0.50 M) / Cu (s) [2+3]
2. Give an example of a buffer solution with a pH less than 7 and show how it resists the PH change on addition of small amount of acid or base?
   100 ml of 0.2 M acetic acid solution is mixed with 300 ml of 0.3 M sodium acetate solution. Calculate the pH of resulting mixture. (pKa = 4.74) [2.5+2.5]
3. What is meant by homogenous catalysis? Explain the adsorption theory of catalysis with suitable example. [1+4]
4. What does a primary pollutant mean? What are the harmful effects of CO on human being? What is the difference between good ozone and bad ozone? [1+2+2]
5. a) Define the terms BOD and COD.
   b) Define soil pollution. What are the causes of soil pollution? [2+1+2]
6. What are the general characteristics of inorganic polymer? Write the preparation and uses of chalcogenide glasses. Also mention two uses of silicones. [2+2+1]
7. Define the term biodegradable polymer with suitable example. Write down the preparation and application of Teflon and polyurethane. [1+2+2]
8. Why does d-block element is called transitional element? Describe the 3d series elements on the basis of color formation and variable oxidation state. [1+2+2]
9. Explain the variation of ionization potential across the 3d series of elements. Why are copper (II) complexes paramagnetic but copper (I) complexes diamagnetic? [2+3]
10. Write the postulates of Werner's coordination theory. Show the Werner's representation of $Co(NH_3)_4$. Cl_2 and Co $(NH_3)_5$. Cl. Write the IUPAC name of following complexes:
    (i) Na_4 [Fe $(CN)_6$] (ii) [$Ag(CN)_2]^-$ [2+2+1]
11. Explain on the basis of valence bond theory-$[Co\ (NH_3)_6]^{3+}$ is diamagnetic but $[Cu\ (NH_3)_6]^{2+}$ is paramagnetic. [2.5+2.5]
12. What are plastic explosives? Write the preparation and uses of trinitrotoluene (TNT) and Gun cotton. [1+2+2]
13. a) What are the requisites of a good paint? Write the uses of emulsion.
    b) What is the purpose of lubrication? Mention the conditions at which the solid lubricants are used. [2.5+2.5]
14. a) Explain the condition required for optional activity of a molecule. Explain the stereoisomeric forms of 3-bromo-2-butanol.
    b) Write the cis and trans isomers of butene dioic acid. [1+2+2]
15. Explain the reaction mechanism for the hydrolysis of tertiary alkyl halide by aqueous NaOH. How the nature of solvent governs S_N1 and S_N2 reaction? [3+2]
16. What is elimination reaction? Discuss the mechanism of E2 reaction. Write your acquaintance with Sayrzeff's rule. [1+2+2]

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TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2079 Baishakh

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

Subject: - Engineering Chemistry *(SH 403)*

- ✓ 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. Give an example of an acidic buffer and show how it resists the change in its pH on addition of strong acid or base. Calculate the pH of 200 ml of 0.2 M CH_3COOH in which 100 ml of 0.15 M NaOH is added. [3+2]
2. Define an electrochemical cell. What is the role of salt bridge in a voltaic cell? Calculate the emf of the following cell: [1+1+3]

   $Mn/Mn^{2+}//Fe^{2+}/Fe$

   When an iron rod is immersed in 1.0 M $FeSO_4$ solution and Mn rod is immersed in 0.1 M $MnSO_4$ solution. Given $E°_{Fe/Fe}{}^{++} = 0.44$ V and $E°_{Mn}{}^{++}{}_{/Mn} = -1.18$ V.
3. Define autocatalysis with examples. Write any two criteria for choosing a catalyst for industrial purposes. Explain with an example the adsorption theory of catalysis. [2+1+3]
4. What are major pollutants? Mention the possible remedies for water pollution. [1+4]
5. Write short notes on: (a) Acid rain and its effect and (b) Global warming [2.5+2.5]
6. Give an account of polymeric sulphur nitride and Silicones. [2.5+2.5]
7. What is non-biodegradable polymer? Give the preparation and uses of Polystyrene and epoxy resins. [1+4]
8. Explain diamagnetic, paramagnetic and ferromagnetic substances with example? Illustrate why does the paramagnetism in 3d – transition elements first increase, reach the maximum near the middle of the series and then decrease? [3+2]
9. a) Explain why compounds of V^{5+} are colourless but V^{3+} are coloured.
   b) Discuss complex formation in the case of transition elements. [2.5+2.5]
10. $[Ni(CN)_4]^{2-}$ ion has a square planar geometry and $[Ni(CO)_4]$ has tetrahedral geometry. Explain this on the basis of valence bond theory and discuss their magnetic behaviour. [5]
11. a) Define ligands. Classify them with examples on the basis of the number of donor sites. [1+2]
    b) Using IUPAC names, write the formula for the following: [2]
       (i) Potassium tetracyanonickelete (II)
       (ii) Pentaamminenitritocobalt (III) ion
       (iii) Tetrahydroxozincate (II) ion
       (iv) Chlorobis (ethylenediamine) nitrocobalt (III) chloride
12. What are the characteristics of an explosive? Give the preparation and uses of 2, 4, 6-trinitrotoluene and nitrocellulose. [1+2+2]
13. a) Define paints and mention their major requisites.
    b) What are lubricants? Write the functions of lubricants. [2.5+2.5]
14. Write the possible stereo isomers of 2, 3-dichloropentane and mention the possible enantiomers and diastereomers. Why is isomer less stable than trans-isomer? [3+2]
15. Why does SN_2 reaction proceed with inversion of configuration only? Explain the mechanism involved in the hydrolysis of tertiary alkyl halide with aqueous NaOH. [2+3]
16. What is meant by bimolecular elimination reaction? Describe the mechanism for the dehydrohalogenation of 3° alkyl halide. [2+3]

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TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2078 Bhadra

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

Subject: - Engineering Chemistry *(SH 403)*

- ✓ 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 normal hydrogen electrode? Calculate the emf of given combination at 20°C; [2+3]
   (i) $Fe^{++}(1M) = Fe^{+++}(0.2M) + e$, E^0=-0.77V
   (ii) $Sn^{++}(0.3M) + 2e = Sn$, $E^0 = -0.14V$
2. Could you prepare the acidific buffer of pH =1? Why and how? Calculate the pH of mixture obtained by mixing 50cc of 0.5N NH_4OH and 100cc of 0.2M NH_4Cl solutions. ($Kb = 1.8\times10^{-5}$) [2+3]
3. What are the characteristics of Catalysts? Explain their activity on the basis of adsorption theory of catalysis. [2+3]
4. a) Why are the oxides of sulphur called air Pollutants? [2]
   b) Mention the sources and consequences of greenhouse effect. [3]
5. What are the effect of soil pollution in agriculture and living beings? How is soil pollution controlled? [3+2]
6. How do you prepare polythiazyl? Mention the applications of polyphosphazines and chalcogenide glasses in engineering field. [2+3]
7. Discuss about the conducting polymers. Write the preparation and uses of Teflon and epoxy resin. [1+4]
8. Why are d-block elements called transition elements? Explain the origin of colour in transition metals on the basis of d-d transition. [1+4]
9. Explain the followings: [2×2.5]
   a) Presence of the unpaired electrons makes substance paramagnetic.
   b) Variable oxidation states are the main characteristic of transition elements.
10. a) Differentiate between double salt and complex salt with examples. [3]
    b) Write the IUPAC names of the followings: [2]
    (i) $Na_4[Fe(CN)_6]$ (ii) $[Zn(OH)_4]^{2-}$ (iii)$[Co(NH_3)_4Cl_2]Cl$ (iv)$[Co(en)_2Cl_2]^+$
11. Using VBT approach, explain the formulation of $[Fe(CN)_6]^{3-}$ and $[FeF_6]^{3-}$ and differentiate between these two. [4+1]
12. a) What is geometrical isomerism? Why is trans-isomer more stable than cis-isomer? [2]
    b) How do enantiomers differ from diastereomers? Illustrate with an example. [3]
13. a) Explain the mechanism for reaction between tertiary butyl bromide with aqueous KOH. [3]
    b) How does SN_2 reaction differ from SN_1 reaction? [2]
14. What is Saytzeff's rule? Explain it with an example. Explain the reaction mechanism for the dehydrohalogenation of tertiary alkyl halide. [2+3]
15. Give an account of low and high explosives. Write the preparation and uses of TNT. [3+2]
16. a) Show your acquaintance with liquid, semisolid and solid lubricant with examples. [3]
    b) Discuss two types of paints showing their applications in engineering works. [2]

TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2078 Kartik

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

Subject: - Engineering Chemistry *(SH 403)*

- ✓ 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 Daniel cell? Calculate the emf of the following combination. [1+4]

   $Fe^{++}(0.2M) \rightarrow Fe^{+++}(0.1M) + e^-$, $E^\circ = -0.77V$

   $Cu^{++}(0.3M) + 2e^- \rightarrow Cu$, $E^\circ = 0.34V$

2. Derive Henderson equation. To 1 liter of buffer solution containing 0.1M NH_4OH and 0.2M NH_4Cl, if 0.2 g of NaOH is added, what will be the pH of the resulting solution? [pK_b=4.74]. [2+3]

3. a) Define the terms: [2×1]

   (i) Auto Catalyst
   (ii) Catalytic poisons

   b) Describe the absorption theory of catalysis with an example. [3]

4. What is Particulate Matter (PM)? What are the types and sources of particulate matter causing air pollution? Also mention their adverse effect. [1+2+2]

5. Write the consequence of acid rain. How do oxides of Nitrogen and sulphur make water acidic? [2+3]

6. What do you mean by biodegradable polymers? Give the preparation and uses of epoxy resin and polystyrene. [1+4]

7. What is inorganic polymer? Write the preparation and uses of Polyphosphazine and Polymeric sulphur. [1+4]

8. Why are d-block elements called transition elements? Write the electronic configuration of elements of 3d series. [1.5+3.5]

9. Mention the main reasons of exhibiting variable oxidation states of transition elements. Manganese exhibits the highest oxidation state among the 3d elements, why? Cu^{+2} compounds are coloured and paramagnetic while Zn^{+2} compounds are white and diamagnetic, explain. [2+1+2]

10. Compare the magnetic behaviour of the complex $[NiCl_4]^{2-}$ and $[Ni(CN)_4]^{2-}$ using valence bond theory. [2.5+2.5]

11. a) What do you understand by a chelating ligand? Describe Sidwick theory of co-ordination compounds with an example. [1+2]

    b) Name the following complexes by IUPAC system. [4×0.5]

    (i) $[Co(NH_3)_5SO_4]Br$
    (ii) $[Co(en)_3]Br_3$
    (iii) $K_3[Cr(NO_3)_6]$
    (iv) $[Ni(CN)_4]^{2-}$

12. What is explosive? Write the preparations and uses of trinitrotoluene(TNT) and trinitrocellulose. [1+4]

13. a) Mention the functions of lubricant and discuss about solid lubricant. [2.5]

    b) Write requisites of good paints and mention the important constitutes of paints. [2.5]

14. a) Give the necessary conditions for the molecule to exhibit geometrical isomerism and write an example with Z and E notation. [2.5]

    b) Write the possible optical isomer of 2, 3-dichloropentane and distinguish enantiomers and diastereomers. [2.5]

15. a) Explain the mechanism of the reaction of bromomethane in aqueous potassium hydroxide. [3]

    b) What types of nucleophile and solvent favours SN_2 and SN_1 reaction mechanism? [2]

16. Discuss the mechanism for the reaction of tertiary alkyl halide with alcoholic sodium hydroxide. Write the differences between E_1 and E_2 reactions. [3+2]

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TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2076 Chaitra

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

Subject: - Engineering Chemistry *(SH 403)*

- ✓ 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 normal hydrogen electrode? How do you measure standard reduction potential of zinc electrode? Calculate the emf of the cell at 25°C, $Ni/Ni^{++}(0.8M)$ // $Ag^{+}(0.2M)$ / Ag
   Given, $E°\ Ni/Ni^{++} = +0.25V$, $E°\ Ag/Ag^{+} = -0.80V$. [1+1+3]
2. Explain the mechanism of basic buffer. Calculate the PH of the resulting buffer solution containing 100ml of 0.5M NH_4OH and 40ml if 1 M NH_4Cl in which 20cc of 0.5HCl is added. [2+3]
3. What is catalyst promoters? How does a catalyst increase the speed of reaction? Explain with example. Explain intermediate compound formulation theory of catalysis. [1+2+2]
4. What are the main sources of water pollution? Mention the measures to control water pollution. [2+3]
5. What is meant by ozone depletion? Write consequences of global warming and its possible remedies. [2+3]
6. What are biodegradable polymers? Write down the preparation and uses of Bakelite and Epoxy resin. [1+2+2]
7. What are polyphorphazenes? How are different types of polyphorphorzenes prepared? Mention the applications of polythiazyl in engineering field. [1+3+1]
8. Variable oxidation state is the main characteristics of transition elements, explain with reference to 3d series. [5]
9. Explain the followings.
   i) Mn^{+2} is more paramagetic than Cu^{+2}.
   ii) Zn^{+2} compounds are white while Fe^{+2} compounds are colored.
   iii) Transition elements from alloys. [2+2+1]
10. a) Differentiate between double and complex salts. Predict the magnetic properties of $[Co(NH_3)_6]Cl_3$ with the help of EAN. [2+1]
    b) Write the IUPAC name of the followings: [2]
    (i) $Na_3[Al(C_2O_4)_3]$
    (ii) $[C_o(NH_3)_4Cl_2]Cl$
    (iii) $[Cr(NH_3)_6]^{3+}$
    (iv) $[Zn(OH)_4]^{2+}$
11. With the help of VBT approach, point out the differences between $[Fe(CN)_6]^{4-}$ and $[FeF_6]^{3-}$ complex ions. [2.5×2]
12. a) Show your acquaintance with liquid and semi liquid lubricants. [2.5]
    b) What do you understand by paints? Mention the requisites of a good paint. [2.5]
13. What isomerism is shown by tartaric acid and why? Write the possible forms of tartaric acid and mention enantiomers and mesocompound. [5]
14. What is SN reaction? Explain the reaction mechanism of hydrolysis of tertiary alkyl halide by aqueous NaOH. [1+4]
15. Describe the mechanism of E^{1} reaction with suitable example. Give an account of Sayteff's rule. [4+1]
16. What are primary and low explosives? Write the preparation and uses of TNT and TNG. [5]

TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2076 Ashwin

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

Subject: - Engineering Chemistry *(SH 403)*

- ✓ 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 single electrode potential? Write down the cell notation for standard hydrogen electrode. How will you predict the spontaneity of any redox system using emf? The value of E° for the $Zn(s) + Cu^{2+}(aq) \rightarrow Cu(s) + Zn^{2+}(aq)$ is 1.10 V. What is the value of E_{cell} when the concentration of Cu^{2+} is 1.0 M and the concentration of Zn^{2+} is 0.025 M? [1+1+1+2]
2. What happens when a small amount of acid or base is added on a buffer solution of acetic acid and sodium acetate? Determine the amount of sodium acetate required in 100 ml 0.2M acetic acid solution to prepare a buffer solution of pH 5.8 pK_a for acetic acid = 4.74 [2+3]
3. Differentiate between negative catalysis and catalytic poisoning. How a catalyst work and what is the role of promoter? [2+2+1]
4. What are the primary and secondary air pollutants? Describe with examples. What is acid rain and how does it occur? [2+1+2]
5. What is water pollution? What are the major pollutants that should be monitored in order to explain the drinking water quality? [1+4]
6. a) How do you differentiate a double salt from a complex? Explain with examples. [2]
   b) Write the IUPAC name and calculate the effective atomic number of following complexes. [3]
   (i) $[Co(NH_3)_3Cl_3]$ (ii) $K_3[Fe(C_2O_4)_3]$ (iii) $[Al(OH)(H_2O)_5]^{2+}$
7. What are low and high spin complexes? How does valance bond theory explain the geometry and magnetic behavior of a complex? Explain with reference to $[Fe(CN)_6]^{3-}$ [1+2+2]
8. Give the reasons for:
   a) Cu^{+} compounds are diamagnetic where as Cu^{++} compounds are paramagnetic.
   b) Ti^{+++} compounds are colored where as Ti^{++++} compounds are colorless. [2.5+2.5]
9. What are transition elements? Why are they called so? Why do transition elements form complex. [1+1+3]

[1×5]

10. Define the following terms:
    a) Primary explosives b) Secondary explosives c) Tertiary explosives
    d) Low explosives e) High explosives
11. Explain the chemical separation of racemic mixture. Write the structure cis and trans isomers of cyclo-octene. [2+3]

12. Write all the possible stereoisomers of tartaric acid. 'The meso form of tartaric acid cannot rotate plan polarized light.' Explain. [3+2]

13. Define the following terms: [1×5]

a) Solid lubricant b) Enamel c) Varnish d) Semi solid lubricants
e) Emulsion paints

14. What are biodegradable polymers? Describe the preparation and uses of polystyrene. [1+2+2]

15. Describe the preparation and uses of polyphosphazine. 'The SN^1 reaction gives both retention and inversion product but SN^2 reaction fevers inversion product.' Explain. [2+3]

16. What do you mean by elimination reaction? Explain the reaction mechanism of E1 reaction. [2+3]

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TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2075 Chaitra

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

Subject: - Engineering Chemistry *(SH 403)*

- ✓ 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 normal hydrogen electrode? Why is salt bridge used in the construction of galvanic cell?
   Calculate the emf of the following cell at 20°C, Cr/Cr^{+++} (0.5M) // $Fe \mid Fe^{++}$ (0.2M). Given $E°_{Cr/Cr^{+++}} = 0.75V$ and $E°_{Fe^{++}/Fe} = -0.44V$. [1+1+3]
2. Differentiate between acidic and basic buffers.100 ml of 0.5 M NH_4OH is mixed with 400 ml of 0.1 M NH_4Cl. what will be the pH of this solution. When 20 ml of 0.5 M HCL is added to it? K_b for $NH_3 = 1.8 \times 10^{-5}$ [2+3]
3. Define catalytic promoter and catalytic poison. Explain the adsorption theory of catalysis with a suitable example. [2+3]
4. Write down the major water pollutants and their harmful effects on mankind. Mention their possible remedies. [5]
5. Mention the major gases for causing green house effect and how are these gases released in the atmosphere? Mention the possible measures to control the global warming. [3+2]
6. Write down the preparation of polymeric sulphur nitride. Mention the engineering applications of polymeric sulphur nitride and chalcogenide glass. [2+3]
7. What are biodegradable and non biodegradable polymers? Mention the applications of Bakelite and epoxy resin. [2+3]
8. What are transition elements? Explain the colour of transition elements on the basis of d to d transition. [1+4]
9. What are d block elements? Why does the number of unpaired electron make the compound paramagnetic? Calculate the magnetic moment if the metal ion contains five unpaired electrons. [1+3+1]
10. a) What is primary valency? Describe simple test to distinguish between the following pairs of complexes on the basis of Werner's theory, (i) $[Co(NH_3)_5Cl]SO_4$ and $[Co(NH_3)_5SO_4]Cl$.
    b) Name the following complexes by IUPAC system
    (i) $[Cr(H_2O)_4(NH_3)_2]Cl_3$ (ii) $[Pt(NH_3)_2Cl_2]$ (iii) $Na_3[Al(C_2O_4)_3]$
    (iv) $[Co(NO_3)_6]^{3-}$ [2.5+2.5]
11. Explain the formation of (i) $[Fe(CN)_6]^{4-}$ and $[FeF_6]^{3-}$ ions with the help of VBT approach. Explain which one is inner orbital complex and outer orbital complex. [2.5+2.5]
12. What are high and low explosives? Write the important uses of TNT and TNG. [2+3]
13. a) What are lubricants? Mention the function of lubricant.
    b) What is paint? What are the major constituents of paint? Mention the requisites of paints. [2.5+2.5]
14. What is optical isomerism? Show all the possible stereoisomers of tartaric acid indicating enantiomers and meso-forms. [1+4]
15. Explain why SN^1 reaction gives the products with both retention and inversion of configuration but SN^2 gives only inversion of configuration. Write the mechanism of reaction between tertiary alkyl halide and aqueous sodium hydroxide. [2+3]
16. Explain the mechanism of E^1 reaction with a suitable example. Write the differences between E^1 and E^2 reactions mechanism. [3+2]

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03 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2075 Ashwin

Exam.	Back		
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. How does a basic buffer solution resist change in pH on the addition of small amount of acid or base? An acidic buffer solution of pH 4.8 has to be prepared from acetic acid of 2N and sodium acetate. What amount of sodium acetate should be added to 1L of acetic acid? Where, pKa for acetic is 4.74. [2+3]
2. a) What is meant by single electrode potential? How does it originate? What are the factors affecting the single electrode? [1+1+1]
   b) Calculate the emf for the following cell at 25°C, [2]

   $Sn(s)/Sn^{2+}(0.15M)//Ag^{+}(0.03M)/Ag(s)$, Where $E^{0}Sn^{2+}/Sn = -0.14V$ &

   $E^{0}Ag^{+}/Ag = +0.80V$
3. What are inhibitors? Describe the intermediate compound formation theory of catalysis with a suitable example. Point out criteria of catalysts used for industrial purpose. [1+3+1]
4. What are different water pollutants? Mention the different sources of water pollution, their adverse effects and possible remedies. [1+2+1+1]
5. a) How is ozone formed and depleted in nature? What are the consequences of depletion of ozone layer in the atmosphere? [2+1]
   b) Describe the adverse effects of air pollutants and their possible remedies. [2]
6. What is biodegradable polymer? Mention preparations and use of the following. [1+2+2]
   i) Polyurethane
   ii) Nylon-6,6
7. What is conducting polymer? Give the preparation and applications of: [1+2+2]
   i) Polyphosphazenes
   ii) Polymeric Sulphure nitride $(SN)_n$
8. Explain the following features of transition elements with reference to 3-d transition series (i) Alloy formation (ii) Complex formation. [2.5+2.5]
9. Write the possible oxidation states of Sc and Cr [1+2+2]
   i) $TiCl_3$ is colored compound but $TiCl_4$ is colorless compound. Explain
   ii) $K_4[Fe(CN)_6]$ is diamagnetic compound but $K_3[Fe(CN)_6]$ is paramagnetic. Explain
10. Show your familiarity with double salt, complex salts and ligands. How does Werner's theory explain the structure of complex compounds? [3+2]

11. a) Using valence bond theory, predict the geometry and magnetic properties of $[Ni(CN)_4]^{2-}$ and $[Co(NH_3)_6]^{2+}$ [1.5+1.5]

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

i) $[Na_3[Al](C_2O_4)_3]$

ii) $[Co(NH_3)_2(en)_2]Cl_3$

iii) $K_3[Fe(C_2O_4)_3]$

iv) $[Al(OH)(H_2O)_5]^{2+}$

12. What are explosives? Classify the explosives with respect to sensitivity. What are the impurities that you expect in crude product of TNT? [1+2+2]

13. a) What are the requisites of good paints? Write about enamels. [2.5]

b) What is meant by lubricant? Write about semi solid lubricants and their uses. [2.5]

14. a) What are geometrical isomers? Show your familiarity with E and Z configuration with suitable examples. [1+2]

b) Define Cis and trans isomers. Why is trans isomer more stable than Cis isomer? [2]

15. Define enantiomers, diasteromers, racemic mixture and meso compound with a suitable example of each. Also write their optical activity. [5]

16. Give an account of SN reactions. Explain the reaction mechanism for the reaction between 3°alkyl halide and aqueous NaOH. [2+3]

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03 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2074 Ashwin

Exam.	Back		
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. What is meant by Normal Hydrogen Electrode? Discuss its use to measure standard electrode potential of copper electrode. Calculate Emf of the following cell at 20°C.

   $Al(s) / Al^{+3}(0.2M) // Cu^{+2}(0.1M) / Cu(s)$
   Given: $E^0_{Al/Al^{+3}} = +1.66V$ and $E^0_{Cu/Cu^{+2}} = -0.34$ V [1+1.5+2.5]

2. What is meant by 'buffer solution' and buffer action? A litre of solution containing 0.5 mole of CH_3COOH and 0.5 mole of CH_3COONa provides a buffer of pH 4.74. Calculate the pH of solution after the addition of 0.02 mole NaOH [$K_a = 1.8\times10^{-5}$] [2+3]

3. Define Heterogenous catalysis. What are the general characteristics of a catalyst? Explain adsorption theory of catalysis. [1+2+2]

4. Write short notes on: [2.5+2.5]

   a) Global warming b) Acid Rain

5. What is soil pollution? Point out major soil pollutants, their effects and possible remedies? [1+4]

6. a) Why do the transition elements form complexes? [2.5]

   b) Why do the transition metals exhibit variable valency? [2.5]

7. a) What are transition elements? Which of the d-block elements are not considered as typical elements and why? [1+2]

   b) Write the electronic configuration and group of the following elements Cr, Fe, Cu and Zn. [2]

8. $[Fe(CN)_6]^{3-}$ and $[FeF_6]^{3-}$, both are octahedral complexes. Explain the difference between these two complexes on the basis of VBT. [5]

9. a) How do you distinct a double salt from a complex salt?

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

   (i) $[Co(H_2O)_2(OH)_4]^-$ (ii) $[Ni(CN)_4]^{2-}$

   (iii) $K_3[Al(C_2O_4)_3]$ (vi) $[Cu(NH_3)_4]SO_4$ [3+2]

10. Define the following terms with example. [1×5]

    a) pigment b) thinner c) solid lubricant d) varnishes e) lacquers

11. Write the differences between organic and inorganic polymers. Write the preparation and applications of polyphosphazines. [2+3]

12. Write the method of preparation and two important uses of Bakelite and polyurethane. [2.5+2.5]

13. Write preparation and two important uses of

    a) TNT b) TNG [2.5+2.5]

14. How do enantiomers differ from diasteromers? Write all the possible stereoisomers of a compound that contain two asymmetric carbon atoms. [3+2]

15. What is elimination reaction? Explain the reaction mechanism for the dehydrohalogenation of primary alkyl halide. [1+4]

16. What are the factors affecting S_N^1 and S_N^2 reactions. Explain SN^2 reaction mechanism with reference to hydrolysis of alkyl halide. [2.5+2.5]

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03 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2074 Chaitra

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. What is an electrochemical series? How does an electrolytic cell differ from a galvanic cell? Calculate the emf of the following cell at 25°C [1+2+2]

   $Zn/Zn^{++}(0.1M)//Cu^{++}(0.05M)/Cu$

   Given, $E^0Zn^{++}/Zn = -0.76V$. $E^0Cu^{++}/Cu = 0.34V$

2. a) How does an acidic buffer solution containing acetic acid and sodium acetate resist the change in p^H in in spite of the addition of the small amount of acid or base? Explain it. [2]

   b) Calculate the pH of resulting solution when 0.01 mole of NaOH is added to 500ml of 0.1M acetic acetic acid (p^{ka} for acetic is 4.74) [3]

3. What is homogeneous catalyst? How does a catalyst alter the rate of reaction? Explain with example. [1+4]

4. What is water pollution? Write down the major sources of water pollution and mention the possible measure to control. How does the oxides nitrogen make the water acidic? [1+3+1]

5. Write short notes on: [2.5+2.5]

   i) Ozone layer depletion
   ii) Global warming due to air pollution

6. What is conducting polymer? Describe the preparation and uses of polyurethane and Epoxy resin. [1+2+2]

7. a) Write down the structure of cyclic and cross linked silicones and also give the engineering applications of silicones. [1+1]

   b) What are the general characteristic of inorganic polymer? Write the preparation and uses of polymeric sulphur. [1+2]

8. Give reasons: [5]

   a) Transition elements are mostly paramagnetic
   b) Transition elements and their compounds show catalytic behavior
   c) $Fe_2(SO_4)_3$ is more stable then $FeSO_4$
   d) Compound of Ti^{+3} are coloured but those if Ti^{+4} are colourless
   e) Zn in 3d series is called typical transition element

9. Write the expected and actual electronic configuration of Cr in box notation. Why the actual electronic configuration of Cr is different from expected electronic configuration? In the 3-d transition series the size of atom decreases from Sc to Cr but the size remains almost similar from Cr to Zn. Explain. [1+1+1+2]

10. How does valence bond theory explain the geometry and magnetic behavior of a complex? Explain with suitable example. [5]

11. a) Explain the formation of $[FeF_6]^{3-}$ on the basis of VBT and predict its geometry as well as magnetism. [3]

    b) Write IUPAC names of the given examples. [2]

    i) $[Ni(CO)_4]$

    ii) $K_4[Fe(CN)_6]$

    iii) $Na[Ag(CN)_2]$

    iv) $K_2[HgI_4]$

12. What primary explosives, low explosives and high explosives? Write the preparation and uses of nitroglycerine. [3+2]

13. a) What is lubricant? In what situation grease and solid lubricant are used? [1+2]

    b) What are the characteristics of good paints? [2]

14. Explain enantiomers, racemic mixture and meso compounds with examples. Draw the structures and specify Z and E configuration of 4-methyl hept 3-ene and 2-chlori pent 2-ene. [3+2]

15. Describe the bimolecular nuclephilic substitution reaction in haloalkane with suitable example. What type of solvent is favour for this reaction? Write down the differences between S_{N_1} and S_{N_2} reactions? [2+1+2]

16. Explain the reaction mechanism of dehydrohalogenation of tertiary butyl bromide by alcoholic caustic soda. Mention the factors governing the mechanism of E1 reaction. [3+2]

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03 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2073 Chaitra

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 Buffer. Write the mechanism of acidic buffer. Calculate the pH of the solution formed by adding 0.2 g of sodium acetate in 200 mL 0.1 M acetic acid. pKa for acetic acid = 4.74. [1+2+2]
2. What is standard hydrogen electrode? How is it used to measure the single electrode potential? Why is salt bridge used in construction of galvanic cell? Calculate the emf of the following cell at 25°C. [1+1+1+2]

   [$E^0_{Ni^{++}/Ni}$ = -0.24V and $E^0_{Pb^{++}/Pb}$ = -0.12V].

   $Ni(s)/Ni^{2+}(aq)\ (1M)//Pb^{2+}(aq)\ (1M)/Pb(s)$
3. Explain with an example the mechanism of adsorption theory of catalysis. Write the differences between homogenous and heterogenous catalysis. [4+1]
4. Define soil pollution. Write the major sources of soil pollution, their negative effects and control measures. [1+2+2]
5. Write the formation, effects and remedies of SOx and NOx. [2.5+2.5]
6. What are biodegradable polymers? Give the preparation and uses of Nylon 6,6 and polyurethane. [1+2+2]
7. Describe the preparation and uses of polymeric sulphur $(PS)_n$ and polyphosphazines. [2.5+2.5]
8. Give an account for the following: [1+1+3]
   a) Cu^{2+} ($3d^9$) is more stable than Cu^+ ($3d^{10}$). Justify the statement.
   b) Why Zinc is called non-typical transition element?
   c) Explain magnetic properties of transition elements.
9. Explain with reasons:
   a) Transition metals can form most of the complex compounds.
   b) Zinc (II) compounds are white and diamagnetic while copper (II) compounds are colored and paramagnetic. [2.5+2.5]
10. Explain the formation of $[Co(NH_3)_6]^{3+}$ and $[CoF_6]^{3-}$ on the basis of Valence Bond Theory and also predict their magnetic property. [2+2+1]
11. Write the basic assumptions of Werner's theory of co-ordination compounds. $CoCl_3.4NH_3$ gives a precipitate with $AgNO_3$ solution. Explain it on the basis of Werner's theory. [3+2]
12. What are plastic explosives? Write the advantages of plastic explosives. Write the preparation of TNT, TNG and nitrocellulose. [1+1+3]

13. a) What are lubricants? Show your familiarity with application of different types of lubricants.
    b) Explain the method of application of paints in galvanized iron. [1+2+2]

14. a) Explain geometrical isomerism with examples. [1.5]
    b) Write all possible stereoisomers of 2,3-dibromopentane. Identify all possible enantiomers and diastereomers from the stereoisomers. [3.5]

15. What are the differences between E^1 and E^2 reactions? Explain the reaction mechanism for the reaction of primary alkyl halide with alcoholic NaOH. [2+3]

16. Why does SN^1 reaction give both retention and inversion isomers but SN^2 gives only inversion isomer? Write the mechanism for the reaction between bromoethane and aq.NaOH. [2+3]

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03 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2073 Shrawan

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: - 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. What is salt bridge? Write its functions. Write electrode reaction, net cell reaction, EMF of the cell at 25°C and cell notation of the following electrode couple and also predict the spontaneity of the cell reaction. [1+1+3]

   $E^0Fe/Fe^{++} = 0.44V$, $E^0Ag/Ag^{+} = -0.80V$

   $[Fe^{++}] = 0.01M$, $[Ag^{+}] = 0.1M$

2. What is buffer capacity? Write the characteristics of buffer solution. 200 ml of 0.1M C_6H_5 COONa is mixed with 400 ml of 0.2 M C_6H_5COOHa at 30°C dilute solution. Calculate the pH of solution. [1+2+2]

3. Explain the terms: (a) Acetocatalyst (b) Catalytic poisoining and (c) Promoters. [2+3]

4. Explain the mechanism of ozone layer depletion. Write its preventive measures and secondary pollution effects in troposphere. [2+1.5+1.5]

5. Define soil pollution. Write the major sources of soil pollution, their negative effects and control measures. [1+2+2]

6. Write short notes on: [2.5×2]

   i) Polyphosphazine
   ii) Chalcogenide glasses

7. a) Give an account for biodegradable and non biodegradable polymer with suitable example.

   b) What are fibers reinforced plastics? Write down the characteristics and its application. [2.5+2.5]

8. What are transition elements? How do they show: (i) catalytic behaviour (ii) coloured ions and (iii) variable oxidation states? [0.5+1.5+1.5+1.5]

9. Explain the formation of $[NiCl_4]^{2-}$ and $[Ni(CN)_4]^{-2}$ on the basic of VBT of coordination compounds. [2.5×2]

10. a) Write the formula of the following IUPAC name: [2]

    i) Potassium penta cyano nytrosyl ferate (III)
    ii) Pentaammine chloro cabalt (III) ion
    iii) Tetracarbonyl cabalt (O)
    iv) Pentamminenitrito cobalt (III) sulphate

    b) "$[Fe(CN)_6]^{4-}$ is diamagnetic but $[Fe(CN)_6]^{3-}$ is paramagnetic" justify. [1.5+1.5]

11. What are lubricants? What are the characters of good lubricants? What is emulsm paint? Write its applications? [1+2+1+1]

12. Define explosive. How it is used for defense purpose? What are the uses of TNT, TNG and cellulose nitrate? [1+1+1+1+1]

13. What are geometrical isomers? Geometrical isomer is not possible in the compound $CH_3CH = CH_2$ explain. Why are trans isomers more stable than Tis-isomers? [1+2+2]

14. What is a nucleophilic substitution reaction? Differentiate between SN^2 and SN^1 reactions. Write the factors affecting SN^2 and SN^1 reactions. [1+2+2]

15. Explain reaction mechanism for dehydrohalogenation of tertiary butyl bromide. What solvent favours the reaction mechanism? [4+1]

16. Write ground state electronic configuration of 3d transition series. How do you explain the formation of complexes by 3d transition elements? [2+3]

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03 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2072 Chaitra

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. What is buffer solution? Derive Henderson's equation for basic buffer. Calculate pH of a mixture of 10 ml of 0.1M ammonium chloride solution and same volume of 0.2 M ammonia solution. (pKb for ammonia solution = 4.74). [1+1+3]
2. How does a galvanic cell generate electricity? Construct a cell with the following cell reaction, write its notation and calculate standard emf of the cell. [1+1+1+2]
   $2Al + 3Z_nSO_4 \rightarrow Al_2(SO_4)_3 + Z_n$ at 298K
   (1M) (1M)
   Given, standard reduction potential of Al and Zn are -1.66V and 0.76 V respectively.
3. What is catalysis? Explain intermediate compound formation theory and an industrial application of catalysis. [1+2.5+1.5]
4. What are the parameters of water pollution? Explain its causes and adverse effects. [3+1+1]
5. Write the functions of lubricant. Show your acquaintance with fluid film lubrication and its role in engineering. Give an example each of (a) semi solid lubricant and (b) emulsion. [1+2+1+1]
6. Write short notes on: (any two) [2.5+2.5]
   i) Global warming
   ii) Formation and depletion of ozone layer
   iii) Acid rain and its effects
7. What is conducting polymer? Give an account of polyphosphazines and chalcogenide galsses. Also write their applications in engineering field. [1+2+2]
8. Explain the following: [2+3]
   i) 3d- transition series show variable axidation states
   ii) Completely filled 3-d transition series are unable to form coloured compounds
9. What is a complex ion? Give example of a (i) complex cation and (ii) complex anion, with their IUPAC name. Also calculate EAN of central metal of these ions. [1+1+1+1+1]
10. Show your acquaintance on the basis of hydbridisation with inner orbital and outer orbital complexes with example. [2.5+2.5]
11. Differentiate between high explosive and low explosives. Write the preparation and applications of TNT. [3+2]
12. Write the method of preparation and uses of (a) polystyrene (b) Bakelite [2.5+2.5]
13. Distinguish between enantiomers and diastereomers. Show all optical isomers of (a) 3-Bromo 2-butanol and (b) Tartaric acid. Also show optically inactive meso form of tartaric acid. Explain why 3-Bromo 2-butanol doesn't exist in meso form. [1+1.5+1+1+0.5]
14. Explain E_2 and E_1 reactions with referance to dehydrohalogenation of haloalkane and point out the factors affecting these mechanism. [1.5+1.5+2]
15. Why does haloalkane favour S_N reaction? Explain why there is only inversion product in S_N2 and both inversion and retention products in S_N1 path. [1+2+2]
16. What is plastic explosive? Write preparation and uses of following: (a) TNT (b) Dynamite [1+2+2]

03 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2072 Kartik

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: - Engineering Chemistry *(SH403)*

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

1. Derive the equation required to calculate the emf of cell at non-standard condition. What are the factors that affect the single electrode potential value? Calculate the oxidation electrode potential of given half cell reaction at 20°C. [2+1+2]

   $Fe^{+++}(0.1M) + e \rightarrow Fe^{++}(0.2M), E^0 = +0.77V$

2. What are the criteria for buffer system? Calculate the change in pH of buffer system having 200 cc of 0.1 m CH_3COOH and 0.1 M CH_3COONa when 1 millimole NaOH is added into it. ($K_a = 1.8\times10^{-5}$) [2+3]

3. What is autocatalysis? Explain the mechanism of adsorption theory of catalysis with example. [1+4]

4. What are the major pollutants responsible for water pollution? How do the oxides of sulphur and nitrogen make water acidic? [2+3]

5. What is meant by ozone depletion? Write its causes and consequences. [2+3]

6. a) What are chalcogenide glasses? Give an account of preparation and uses of chalcogenide glasses in the engineering field. [1+2+2]

   b) Write down the preparation of cyclic silicones.

7. a) Give an account for the biodegradable and non-biodegradable polymers with suitable examples. [2.5×2]

   b) What are fibers-reinforced plastics? Write down its applications.

8. Explain the origin of the adsorption spectra of transition elements with d to d transitions. [5]

9. Mention the main applications of 3d elements and give main causes of variable oxidation states shown by transition elements. [3+2]

10. a) Describe the simple test to distinguish between the following pairs of compounds on the basis of Werner's theory. $[Co(NH_3)_5Cl]SO_4$ and $[Co(NH_3)_5SO_4]Cl$ [2+2+1]

    b) Name the following complexes by IUPAC system.

       i) $K_3[AlF_6]$

       ii) $[Co(en)_3]Br_3$

       iii) $[Cr(H_2O)_5Cl]Cl_2$

       iv) $[Pt(NH_3)_4Cl_2]Cl_2$

    c) State EAN rule.

11. Using VBT, predict the possible number of unpaired number in the following complex compounds. $K_4[Fe(CN)_6]$ and $[FeF_6]^{3-}$ [2.5+2.5]

12. Write the mechanism for the conversion of Bromomethane into methanol in presence of aqueous alkali. Also explain the stereochemistry of the reaction. [3+2]

13. What do you mean by Elimination reactions? Explain the reaction mechanism for the dehydrohalogenation of tertiary alkyl halide. [2+3]

14. Write down the possible geometrical isomer of but-2-ene-1, 4-dioic acid. Why does this compound exhibit geometrical isomerism? Explain the difference between enantiomer and diastereoisomer giving an example of 3-bromo-2-butanol. [1+1+3]

15. What is the requisite of good explosive? How can you prepare TNT form benzene? Why does detonator required for the explosion of TNT? [2+2+1]

16. a) Show your acquaintance with liquid and semi-liquid lubricants. Under what situations greases are used? [3+2]

    b) What do you understand by paints? Mention the requisites of good paint.

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33 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2072 Ashwin

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

Subject: - Engineering Chemistry *(SH453)*

- ✓ 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 meant by standard hydrogen electrode? Explain briefly with diagram. Calculate the emf of the following cell at 25°C Mg/Mg^{++} (0.1M)//Ag^{+}(1M)/Ag. Given $E°Mg^{++}/Mg$ = -2.37 V $E°Ag^{+}/Ag$ = +0.80V [3+2]
2. a) What is meant by buffer capacity of a buffer solution? How does a solution containing a mixture of benzoic acid and sodium benzoate maintain its constant pH value even on the addition of small amount of strong acid or alkali? Explain. [3]
   b) Derive Henderson's equation for basic buffer solution. [2]
3. Show your acquaintance to homogenous and heterogeneous catalysis. Describe the intermediate compound formation theory of catalysis. [2+3]
4. a) What are the main sources of water pollution? Write the various impacts of water pollution. [3]
   b) What are the causes of soil pollution? How it can be controlled? [2]
5. What are air pollutants? Give a brief account about the adverse effects of air pollutants on human beings and their possible remedies. [2+1.5+1.5]
6. What do you meant by cross linked polymer? What are the general characteristics of inorganic polymer? What are the engineering application of chalcagenide polymer? [1+2+2]
7. a) What are fiber reinforced polymers? Write their application in the field of engineering. [3]
   b) What are non-biodegradable polymers? What are the demerits of using them? [2]
8. a) Are all d-block elements called transition elements? Justify your answer with reason. Why do transition elements called so? [2]
   b) Why do transition elements show variable oxidation state? Point out the industrial applications of 3d-series elements. [3]
9. Explain why: [2.5×2]
   a) Compounds of Titanium in +3 oxidation state are coloured but those in +4 oxidation state are colourless.
   b) Transition elements formed significant number of complexes.
10. How would you account for the difference in structures and magnetic properties between $[Ni(Cl_4)]^{2-}$ and $[Ni(CN)_4]^{2-}$? [2.5×2]

11. a) Name the following complexes by IUPAC system [2+3]

i) $[Cr(H_2O)_5Cl]Cl_2$
ii) $[Co(en)_3]Br_3$
iii) $K_2[NiCl_4]$
iv) $[Cr(C_6H_6)_2]$

b) How does Werner's theory explain the structures of complex compounds?

12. What are primary and low explosives? Give the preparation and uses of glycerol trinitrate. [2+3]

13. a) What is paint? Give the requisites of a good paint. [3+2]

b) What are lubricating oils? Indicate their importance in engineering fiels.

14. a) What isomerism is shown by butenedioic acid and why? [3+2]

b) Differentiate between racemic mixture and meso compound.

15. What are elimination reactions? Write the mechanism of E^2 reaction taking an example. Show your acquaintance to Saytzeff's rule. [1+2+2]

16. What do you mean by SN reactions? Explain reaction mechanism for the hydrolysis of 3° alky halide by aqueous sodium hydroxide. [1+4]

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BCE I/I 190

03 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2071 Chaitra

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. What is SHE? Calculate the emf of electrode couple of $E^{\circ}_{Sn/Sn^{+2}} = -1.4V$ and $E^{\circ}_{Fe^{+2}/Fe^{+3}} = -0.77V$. Where the concentration of Sn^{+2}, Fe^{+2} and Fe^{+3} are 0.2M 0.1M and 1 M respectively. [2+3]
2. Explain the mechanism of buffer action with a suitable example. Calculate the weight in gram of NH_4Cl required to prepare buffer solution having pH = 9.35 in 200 cc of 0.2N ammonia solution. (pkb = 4.74) [3+2]
3. What is heterogeneous catalysis? How does a catalyst alter the rate of reaction? Give a brief account on the intermediate compound formation theory of catalysis. [1+1+3]
4. a) What is ozone depletion? Write the chemical reactions involved in the stratospheric ozone depletion by nitric oxide? [1+2+2]
   b) How does carbon dioxide cause atmospheric pollution?
5. What are the major water pollutants and their harmful effect? Mention the possible measures to control water pollution. [2+3]
6. a) Write the engineering applications of Silicone and give the structure of cyclic and cross linked silicons. [3+2]
   b) Write the preparation of polyphosphazine and its uses.
7. What are biodegradable polymers? Write down the preparation and uses of Nylon 6.6 and Teflon. [1+4]
8. a) Why do transition metals form complex compound? [3+2]
   b) Explain why the 3d transition series having completely filled d-orbital cannot form coloured compounds.
9. What are transition elements? Why does the presence of unpaired electrons make a substance paramagnetic in nature? Explain it with magnetic moment measurement. [1+4]
10. Name the following complexes by IUPAC system: [2+3]
    i) $[Cr(H_2O)_4(NH_3)_2]Br_3$
    ii) $[CuCl_2(CH_3NH_2)_2]$
    iii) $Ni[PtCl_6]$
    iv) $[Cr(NH_3)_6]^{3+}$

    State and explain EAN rule as applied to metal complexes.
11. Differentiate between inner and outer orbital complexes. Magnetic measurement on $K_3[Fe(CN)_6]$ indicates the presence of one unpaired electron, predict on the basis of VBT whether the given complex is inner or outer complex. [2+3]

12. Define explosives. Why are the primary explosives called "detonators"? Write the reaction of toluene forming an explosive. Mention the important uses of GTN and plastic explosives.[1+1+1+2]

13. a) What are solid lubricants? Mention the types and function of lubricants with examples.[1+2+2]

    b) Explain the method of application of paint in galvanized iron.

14. a) What isomerism is shown by tartaric acid and why? [2+3]

    b) Define enantiomers with examples. Differentiate between racemic mixture and mesocompound.

15. Explain the reaction mechanism for the hydrolysis of tertiary alkyl halide by aqueous NaOH. What solvent favours the reaction mechanism? [4+1]

16. What is Saytzeff's rule? Describe the mechanism for the reaction of 3°alkyl halide in alcoholic alkali. [2+3]

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03 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2071 Shawan

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: - 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. What is buffer solution? Calculate the pH of 500 cc of 0.2 M CH_3COOH solution when 2 g of sodium acetate is added. [K_a for CH_3COOH is 1.8×10^{-4}] [1+4]
2. What is Daniell cell? Answer the following question using equation (a) and (b) [1+4]
   (a) Fe^{++} (0.2M) = F^{+++} + e (0.1M), E^0 = -0.77V, (b) Cu (0.3M) - 2e = Cu^{++}, E^0 = -0.34V
   (i) net cell reaction (ii) spontaneity of redox reaction (iii) cell notation (iv) emf of cell
3. What are catalytic promoter and catalytic poison? Explain their activity on the basis of adsorption theory of catalysis. [2+3]
4. a) What are chlorofluorocarbons? Explain their photolytic reactions in the upper atmosphere [3]
   b) Discuss about the air pollution caused by oxide of nonmetals? [2]
5. What are the major water pollutants? Point out their adverse effect and the possible measures to control water pollution. [1+2+2]
6. Write the preparation and uses of Teflon and epoxy resin. What are conducting polymers? Point out their applications in engineering field. [3+1+1]
7. a) Give preparation and uses of the nonmetallic super conductor. [3+2]
   b) Write down the main characteristic of inorganic polymers.
8. Give an account for the followings:
   i) Transition metals are well known to form complexs. [2]
   ii) Copper (I) compounds are white and diamegnetic where as copper (II) compounds are colored and paramagnetic. [2]
   iii) Zinc is nontypical transtion metal. [1]
9. a) Explain the variable oxidation states of transition elements. Which divalent metal has maximum paramagnetic character among the first transition metals? [2.5+1+1.5]
   b) A transition metal forms alloys with other transition metals easily. Why? Explain.
10. Explain how the two complexes of Ni, $[Ni(CN)_4]^{2-}$ and $[Ni(CO)_4]^{\circ}$ have different structures but do not differ in their magnetic behavior (Ni = 28). [5]
11. a) Write the IUPAC name of the following compounds/ions [2+1+2]
    i) $[Co(NH_3)_5NO_2]Cl_2$
    ii) $[Fe(C_2O_4)_3]^{3-}$
    iii) $[Cr(en)_2Cl_2]^+$
    iv) $NH_4[Cr(H_2O)_2(NCS)_4]$
    b) What is complex compound? What do you understand by principal and auxiliary valency of the central ion in complex compound? Illustrate them in $[Co(NH_3)_6]Cl_3$.

12. a) What are lubricating oils? Indicate its application in engineering work. [1+2]

b) Show your familiarity with the types of paint. [2]

13. a) Write the difference between enantiomers and diásterioisomers giving appropriate examples. [3+2]

b) Write Cis, Trans and Z, E notations for the possible isomes of but-2-endioic acid.

14. a) Explain the mechanism involved in the reaction between bromomethane and aqueous NaOH. [3]

b) How do nucleophile and solvent affect this type of reaction? [2]

15. a) Differentiate between E^1 and E^2 reaction. [2+3]

b) Explain the reaction mechanism for the dehydrohalogination of 3°alkyl halide.

16. What are low explosives? Write the preparation and uses of GTN and TNT. [1+4]

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32 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division

2071 Magh

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

Subject: - Engineering Chemistry *(SH453)*

- ✓ 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 is single electrode potential originate? From the given electrode system, answer the following questions. [2+3]

   $Ni \rightarrow Ni^{++} + 2e^-$ $\quad E^\circ = +0.25$ V
   $Ag \rightarrow Ag^+ + e^-$ $\quad E^\circ = -0.80$ V
   $[Ni^{++}] = 0.3$ M, $[Ag^+] = 0.2$ M, $R = 8.314\ JK^{-1}\ mol^{-1}$

   a) Which of the given electrodes acts as anode and why?
   b) Construct a galvanic cell using proper cell notation when the given electrodes are coupled.
   c) Calculate the EMF of the cell at 27°C.

2. What is buffer solution? How acidic buffer resists the change in pH on the addition of small amount of acid and base? 0.005 mole of KOH is added to 400 ml of 0.1 M CH_3COOH. Calculate the pH of the mixture. Given pKa = 4.74. [1+2+2]

3. What is catalysis? How a catalyst alters the rate of reaction? What happens to the equilibrium position of a reaction by the application of a catalyst? What is promoter? [1+2+1+1]

4. Differentiate between pollutant and pollution. Describe the air pollution with reference to gaseous pollutant and particulate matter. [1+2+2]

5. Write the pollutants responsible for soil pollution. Briefly describe the adverse affect of soil pollution and their possible remedies. [1.5+2+1.5]

6. What are polystyrene and PTFE? How can they be prepared? What are the main reasons for their wide range of applications? [2.5+2.5]

7. What is phosphonitrilic compounds? How phosphonitrilic chloride can be prepared? Write the monomers of polydimethoxy and polydiethoxy phosphazines. Mention the uses of phosphazines. [1+2+1+1]

8. Explain the following properties [2.5+2.5]

   a) Paramagnetic properties increase from Sc to Mn and then decreases to Zn.
   b) Cupric salts are blue in color while cuprous slats are colorless.

9. a) Why do transition elements formed significant number of complexes than others? [2.5]

   b) What are transition elements? Which of 3d-series elements is not a typical transition element and why? [1+1.5]

10. What are the main postulates of Werner's theory? Write the IUPAC name of the following complexes. [3+2]

a) $[Cu(NH_3)_4(H_2O)_2]^{2+}$
b) $[Co(H_2O)_2(OH)_4]^-$
c) $[Co(NH_3)_6]Cl_3$
d) $K_2[Ni(CN)_4]$

11. What are the tetrahedral and square planar complexes? How do they differ? Explain the formation of $[Ni(NH_3)_4]^{2+}$ on the basis of valance bond theory and explain its magnetic behavior. [1+1+3]

12. Define high explosive and plastic explosive with example. Write the reaction to prepare (a) Nitrocellulose and (b) TNT. [2+3]

13. What are the functions of lubricants? What is paint? Describe varnishes and enamels. [2+1+2]

14. What are cis and trans isomers? Explain the condition required for geometrical isomerism with examples. Draw the structure of 2-chloro-3-methyl pent-2-ene and specify Z and E configuration. [1+2+2]

15. Describe mechanism and kinetics of nucleophilic bimolecular substitution reaction. Why does S_N2 reaction take place with stereochemical inversion? [3+2]

16. What is dehydrohalogination of alkyl halide? Give the mechanism, stereochemistry and kinetics of E1 reaction. [1+2+1+1]

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32 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division

2071 Bhadra

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

Subject: - Engineering Chemistry *(SH453)*

- ✓ 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 buffer capacity and buffer range. Calculate the concentration of sodium benzoate that must be present in 0.1 M benzoic acid to make a buffer solution of pH 3.7 (K_a for benzoic acid is 1.8×10^{-4}) [2+3]
2. What is electrode potential? How does it originate? What will be the reduction potential of Zn^{2+}/Zn electrode when zinc metal in contact with 0.1 M H_2SO_4 at 25°C. Given $E^0_{Zn/Zn^{2+}} = +0.76$ V. [1+1+3]
3. Define heterogenous catalysis. Describe the absorption theory of catalysis with suitable example. Write any two criteria of choosing catalyst for industrial purpose. [1+3+1]
4. Global warming is one of the burning issues of the world. Point out major causes of global warming, its impacts and also control measures. [1+2+2]
5. What do you mean by water pollution? What are the major water poilutants, mention their adverse effects. [1+2+2]
6. Explain preparation and uses of polyphosphazines and polymeric sulfur nitride. [2.5+2.5]
7. What is biodegradable polymer? Mention preparation and uses of the following. [1+2+2]

   a) Epoxy resin b) Polyurethane [2.5+2.5]
8. Give reasons for

   a) Cu(I) is diamagnetic where as Cu(II) is paramagnetic.
   b) TiO_2 is white but $TiCl_3$ is violet. [2.5+2]
9. Give reasons:

   a) The components formed by symbol 'V' element in +5 oxidation state are colourless but those formed in +3 oxidation state are colourful.
   b) Transition elements are mostly paramagnetic.
10. What do you mean by effective atomic number? Give IUPAC name and calculate the effective atomic number of the following complexes. [1+4]

    a) $[Fe(CN)_6]^{3-}$
    b) $[Ag(NH_3)_4]^+$
    c) $[Ni(CN)_4]^{2-}$
    d) $[Cr(H_2O)_6]^{3+}$
11. What are the inner orbital and outer orbital complexes? Explain formation of $[Fe(CN)_6]^{4-}$ on the basis of valance bond theory and predict its magnetic behavior. [2+3]

12. Explain why SN^1 reaction gives both retension and invertion isomers but SN^2 gives only invertion isomer. Write the mechanism of given chemical reaction. [2+3]

$$(CH_3)_3C-Br + NaOH \rightarrow (CH_3)_3COH + NaBr$$

(aa)

13. Distinguish between enantiomers and diasteriomers. Show these isomers in 3-bromo-2-butanol. [2+3]

14. What is an explosive? Classify explosives with examples. What is the requirement of good explosives? [1+2+2]

15. What are elimination reactions? Write the differences between E_1 and E_2 reaction mechanism taking suitable example. [1+4]

16. a) What is lubricant? Write about the application of different types of lubricants. [1+2]

b) Write the characteristics of good paint. [2]

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13

32 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2070 Magh

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

Subject: - Engineering Chemistry *(SH453)*

- ✓ 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 a buffer solution? Calculate the PH of the resulting buffer by mixing 400 ml of 0.2 M ammonium hydroxide and 150 ml of 0.3 M ammonium chloride solution. [kb=1.8×10^{-5}] [1+4]
2. What is meant by standard electrode potential? Calculate the EMF of a Daniel cell at 25°C, when the concentration of $ZnSO_4$ and $CuSO_4$ are 0.001 M and 0.1 M respectively. The standard potential of the cell is 1.2 V. [1+4]
3. a) Give an account how a catalyst increases the speed of a reaction. [2]
   b) Describe the adsorption theory of catalysis with a suitable example. [3]
4. a) Give an account on the sources of organic and inorganic substances responsible for water pollution with its adverse effect and possible remedies. [3]
   b) Why are the oxides of sulphur and nitrogen assumed as air pollutants? [2]
5. What do you mean by soil pollution? Mention its major sources, adverse effect and possible remedies. [1+2+2]
6. What are the general characteristics of inorganic polymer? Describe the preparation and uses of polyphosphazines. [2+3]
7. How do thermoplastic polymers differ from thermosetting polymers? Give the applications of Bakelite and Epoxy resins. [3+2]
8. What are double and complex salts? How does Werner's theory explain the bonding in complex salts? [1+4]
9. a) Explain the formation of $[Fe(CN)_6]^{4-}$ complex on the basis of VBT. Also predict its geometry and magnetic behavior. [3]
   b) Write IUPAC name of the following co-ordination compounds [0.5×4]
      i) $[Fe(H_2O)_6]SO_4$
      ii) $Na_3[(AL(C_2O_2)_3]$
      iii) $K_3[ALF_6]$
      iv) $[PtCl(NO_2)(NH_3)_2]$
10. What are transition elements? Why do transition metal (a) form complex compounds and (b) exhibit variable oxidation states? [1+2+2]
11. Explain the following:
    a) Transition metal compounds are coloured [2.5]
    b) Transition metal compounds are paramagetic [2.5]
12. Give an account of low and high explosives. Write the preparation and uses of TNT. [3+2]
13. a) What are paints? Give an account of any two types of paints indicating their applications in engineering works. [1+2+2]
    b) Show your acquaintance with solid lubricants.
14. a) What isomerism is shown by butanedioic acid and why? [2]
    b) Differentiate between enantiomers and diastereomers. [3]
15. Explain the reaction mechanism of primary alkyl halide in aqueous medium. Which type of solvent favours this reaction, give reason? [4+1]
16. Describe the reaction mechanism of E_1 and E_2 with the suitable example. [3+2]

03 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2067 Ashwin

Exam.	New Back (2066 Batch)		
Level	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 <u>All</u> questions.*
- ✓ *The figures in the margin indicate <u>Full Marks</u>.*
- ✓ *Assume suitable data if necessary.*

1. What are galvanic cells? Write down the cell reaction and cell notation of a Zu-Cu galvanic cell with a suitable diagram. What is the role of salt bridge in galvanic cells? [1+3+1]
2. How does acidic buffer solution resists its pH value? An undergraduate student of engineering wishes to prepare one liter of a solution buffered at pH 10.How many grams of NH_4Cl have to be mixed to one litre of 0.25 MNH_3 to make such buffer? (pkb of NH_3 = 4.74) [2+3]
3. Discuss the adsorption theory of catalysis and give the various steps involved in the hydrogenation of ethene. [2+3]
4. What is plastic explosive? How do you prepare the following explosives? [1+2+2]
   a) Dynamite b) Gun cotton
5. What is water pollution? List its major sources. How can it be minimized? [1+2+2]
6. Write short notes on: (any two) [2.5+2.5]
   a) Green house effect
   b) Formation and depletion of ozone layer
   c) Adverse effects of soil pollution and possible remedies
7. Write the method of preparation and two important uses of followings: [2+2+1]
   a) Diamine epoxy resin and b) Nylon 6,6.
8. What is non-biodegrable polymer? Point out the contribution of silicone and chalcogenide glass in engineering. [2.5+2.5]
9. What are transition elements? Which of the 3-d series elements is not a transition element and why? Explain why compounds of V^{5+} are colourless but those of V^{3+} are colourful? [1+2+2]
10. Explain the cause of origin of paramagnetism and complex formation in transition elements. [3+2]
11. What is complex salt? Write the basic assumptions of Werner's theory of co-ordination compounds. [1+4]
12. Explain the formation of $[Ni(CN)_4]^{2-}$ complex on the basis of VBT. Also predict its geometry and magnetism with reason. Write the IUPAC names of the following co-ordination compounds. [3+2]
    a) $[Co(NH_3)_2(en)_2]Cl_3$ b) $[Al(OH)(H_2O)_5]^{2+}$
    c) $[Pt(py)_4][PtCl_4]$ d) $K_4[Fe(CN)_6]$
13. What is paint? Write characteristics of a good paint and explain the method of application of paint in galvanised iron. [1+2+2]
14. Distinguish between enantiomers and diasteromers. Write all possible stereo isomers of a compound that contain two asymmetric carbon atoms. [3+2]
15. What is a nucleophilic substitution reaction? Briefly explain SN^1 reaction in halo-alkane. Point out the factors governing these paths. [1+3+1]
16. What is elimination reaction? Mention the differences between E_2 and E_1 mechanism with examples. [1+4]

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03 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2070 Ashad

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

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. What is buffer and buffer capacity? To 100 ml of 0.1 M acetic acid, 0.1 gm of sodium hydroxide is added. Find the pH of the resulting solution. (pk_a for acetic acid is 4.74) [2+3]
2. How does a galvanic cell differ from an electrolytic cell? Calculate the EMF of the cell: Zn/Zn^{++} (0.001M) / / Ag^{+} (0.1M) / Ag. The standard potential of Ag/Ag^{+} half cell is 0.080 V and Zn/Zn^{++} is - 0.76 V [2+3]
3. a) What are promoters? Mention the action of promoters. [1+1]
   b) Describe the adsorption theory of catalysis with a suitable example. [3]
4. a) Write down the sources and defects of sulphur oxides. [3]
   b) Explain the causes and effects of ozone layer depletion. [2]
5. What are the major water pollutants and their harmful effect? Mention the possible measures to control water pollution. [3+2]
6. Write short notes on (i) Sulphur based polymers (ii) Chalcogenide glass. [3+2]
7. a) Give preparation and uses of Nylon.6,6 and polyurethane. [4]
   b) What are engineering applications of conducting polymer? [1]
8. a) Write the important characteristics of transition elements. [2.5]
   b) Explain the magnetic properties of the transition elements. [2.5]
9. Explain the following: [2.5+2.5]
   a) Complexes of transition elements are generally coloured.
   b) Most of the transition elements are paramagnetic.
10. What are primary and secondary valencies of metal? Explain the structure of $K_4[Fe(CN)]_6$ on the basis of Werner's theory. [2+3]
11. a) With the valence bond concept, explain the geometry and magnetic character of the complex $[Ni(CO)_4]$. Write down one of the limitations of valence bond theory. [2+1]
    b) Write the IUPAC name of the following co-ordination compounds. [2]
       i) $K_2[PtF_6]$
       ii) $K_3[Al(C_2O_4)_3]$
       iii) $[Co(NH_3)_5SO_4]Br$
       iv) $[Pt(NH_3)_4Cl_2]SO_4$
12. Explain the reaction mechanism for the hydrolysis of tertiary butyl bromide by aqueous NaOH. Differentiate between SN^1 and SN^2 mechanism. [3+2]
13. a) How do enantiomers differs with diasteoisomers? Illustrate with an example. [1+2]
    b) What isomerism is shown by 2-bromo 1-chloropropene? Mention Z and E notation for the compound. [2]
14. What are secondary explosives? Give preparation and properties and uses of GTN and TNT. [2+3]
15. What do you mean by Elimination reactions? Explain the reation mechanism for the reaction between primary alkyl halide and alcoholic NaOH. [2+3]
16. a) What are lubricating oils? Indicate their importance. [1+2]
    b) Show your familiarity with types of paints. [2]

32 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division

2070 Bhadra

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

Subject: - Engineering Chemistry *(SH453)*

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

1. What is meant by buffering capacity? A research student desires to prepare one litre of a solution buffered at pH 9.00. How many grams of ammonium chloride have to be added to one litre of 0.20 M NH_3 to make such a buffer? [pK_b value of ammonia is 4.75] [1+4]
2. a) What is normal hydrogen electrode? [3]
   b) Calculate the EMF of the following cell at 25°C. [4]

   $E° Fe^{+++} / Fe^{++} = -0.77V$, $E° SN^{++} / SN = -0.14$ V in which $[Fe^{+++}] = 0.4$ M, $[Fe^{++}] = 0.1$ M $[SN^{++}] = 0.2$ M
3. What do you mean by catalytic poisoning? Explain the adsorption theory of catalysis with an example. [2+3]
4. Point out the major sources of soil pollution, their adverse effect and their possible remedies. [1+2+2]
5. Give your familiarity with water pollution. Write the CFC involve for ozone layer depletion and harmful effects. [3+2]
6. Write short notes on (a) Chalcogenide glasses (b) Silicones. [2+3]
7. What are biodegradable polymers? Give the preparation and uses of epoxy resins and polystyrene. [1+4]
8. a) Explain the formation of $[Ni(NH_3)_6]^{2+}$ on the basis of valance bond approach and predict its geometry and magnetic behavior. [3]
   b) Write the IUPAC name of the following co-ordination compounds. [2]

   i) $Na[Au(CN)_2]$
   ii) $K_3[Fe(C_2O_4)_3]$
   iii) $[PtCl_2(NH_3)_4]Br_2$
   iv) $[Co(NH_3)_6]Cl_3$
9. How does a double salt differ from a complex salt? How does Werner's theory explain the structure of complex compounds? [2+3]
10. a) Write the general outer electronic configuration of transition elements. [1]
    b) Give reasons why transition elements are coloured and paramagnetic. [4]
11. a) Give reasons why Zn and Cd are not considered as typical transition metals. [2]
    b) Explain the main characteristics of 3d transition elements. [3]

03 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division

2070 Chaitra

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 (I I) Compounds are white and diamagnetic while copper (I I) 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. List the important characteristics of explosives. Give the preparation and uses of trinitrotoluene (TNT). [2+3]

13. a) Write the important functions of lubricant. What are solid lubricant and specify in which conditions it is used. [2.5]

    b) Mention the requisites of good paints and write about varnish. [2.5]

14. a) Define the geometrical isomerism and write an example with Z and E notation. [2]

    b) Write the possible isomers of 3-bromo-2-butanol and specify enantiomers, racemization and resolution of recemic mixture. [3]

15. Explain the reaction mechanism for the dehydrohalogenation of tertiary butyl bromide. Differentiate between E^1 and E^2 mechanism. [3+2]

16. Give an account of SN reactions. Explain the reaction mechanism for the reaction between 3° alkyl halide and aqueous NaOH. [2+3]

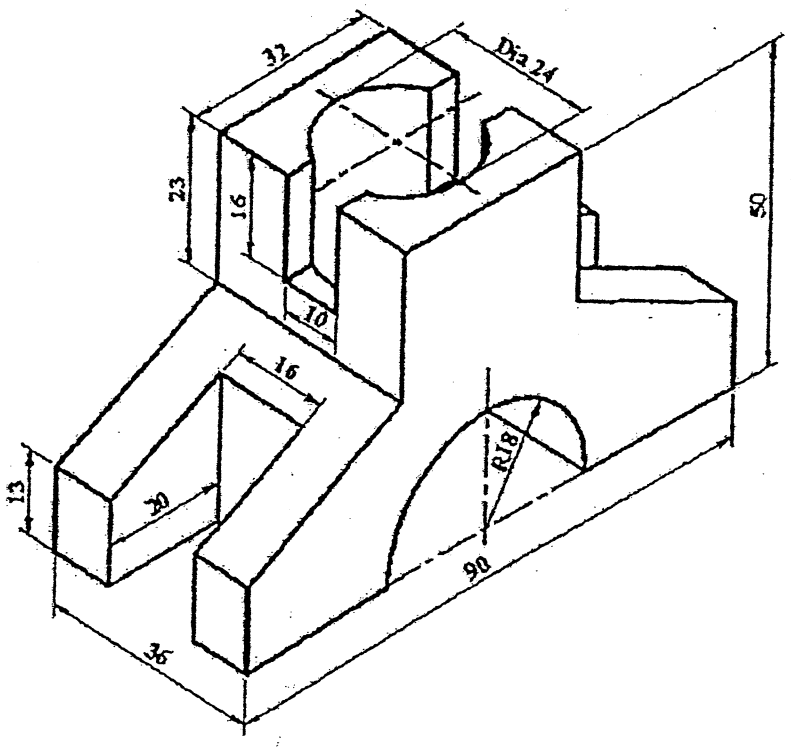
TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2079 Bhadra

Exam.	Regular		
Level	BE	Full Marks	40
Programme	All except BAR	Pass Marks	16
Year / Part	I / I	Time	3 hrs.

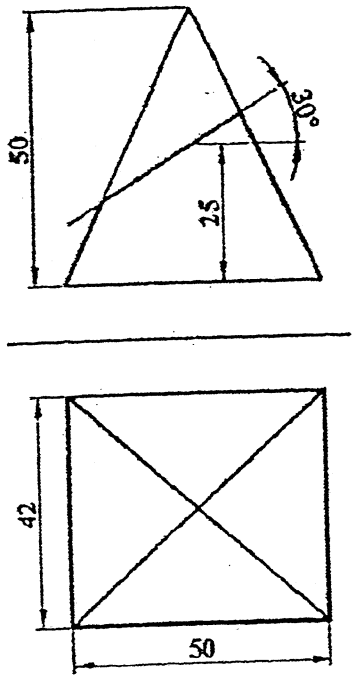
Subject: - Engineering Drawing I (*ME 401*)

- ✓ 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.*

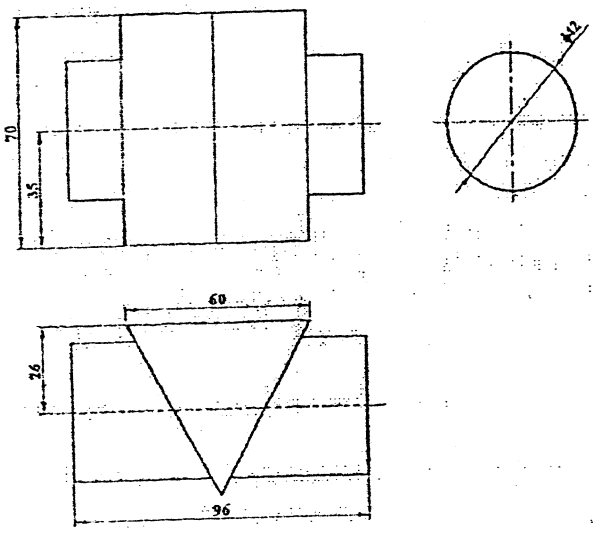
1. Draw a cycloid, one and half revolution of a circle having diameter 45 mm. [4]
2. A pentagonal plane with 30 mm side has an edge on the HP. This plane is perpendicular to the VP and inclined at 45° to the HP. Draw its projection when its corner nearer to the VP is 10 mm infront of it. [5]
3. Draw (a) full sectional front view, (b) top view and (c) side of an object shown in figure below. Also dimension it. [6+4+3+2]



4. Draw a complete orthographic drawing of a geometrical solid cut by planes as shown in figure below. Find the true shape of the section. Then develop the complete surface of the solid. [10]



5. Draw the lines of intersection of the surfaces of geometrical solids in figure below. [6]



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TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2079 Baishakh

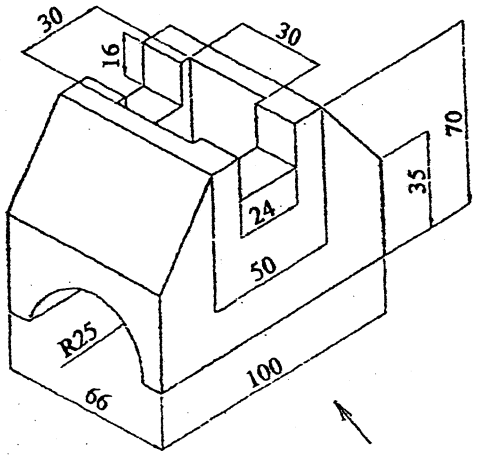
Exam.	Back		
Level	BE	Full Marks	40
Programme	All (Except BAR)	Pass Marks	16
Year / Part	I / I	Time	3 hrs.

Subject: - Engineering Drawing I *(ME 401)*

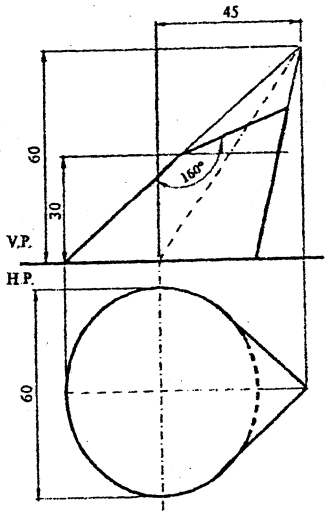
- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt All questions.*
- ✓ *The figures in the margin indicate Full Marks.*
- ✓ *Assume suitable data if necessary.*

1. Draw an ellipse with major and minor axes of 80 mm and 60 mm respectively. [4]
2. A line AB has its end A 15 mm above the HP and 10 mm in front of the VP and its end B 40 mm above the HP and 35 mm infront of the VP. The distance between its end projectors is 45 mm. Draw the projections of the line and determine the its true length and inclination with the HP and VP. [5]
3. Draw a complete orthographic projection of an object shown in figure below with a sectional front view. [14]

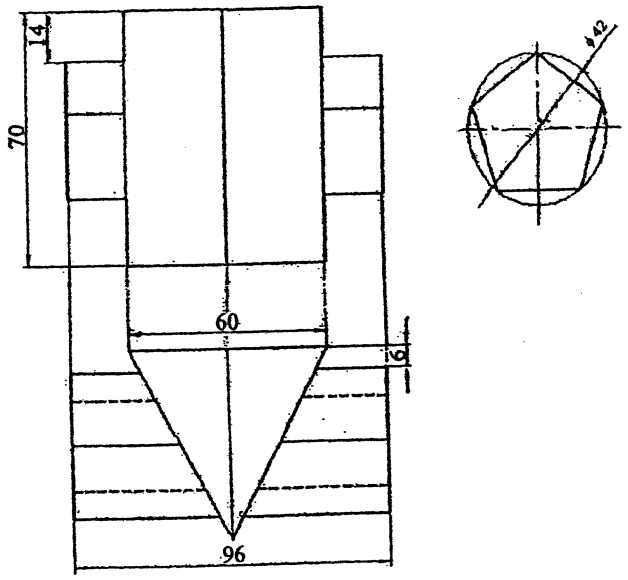
Through holes



4. Make a complete top view of orthographic drawing of a solid cut by a plane as shown in the figure below. Find the true shape of the section. Construct the development of whole surfaces of the solid. [12]



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



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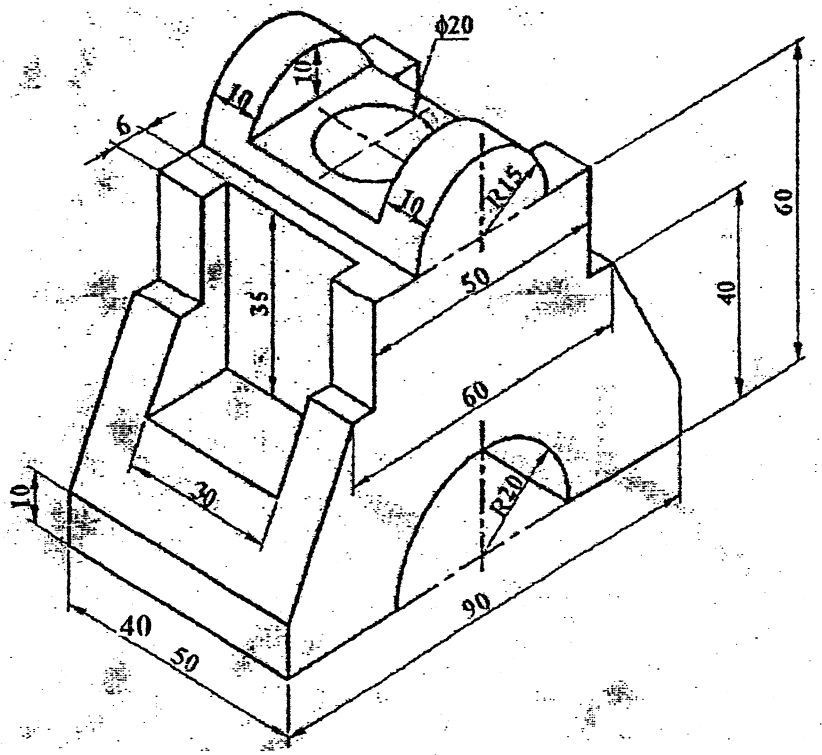
TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2078 Bhadra

Exam.	Regular		
Level	BE	Full Marks	40
Programme	ALL	Pass Marks	16
Year / Part	I / I	Time	3 hrs.

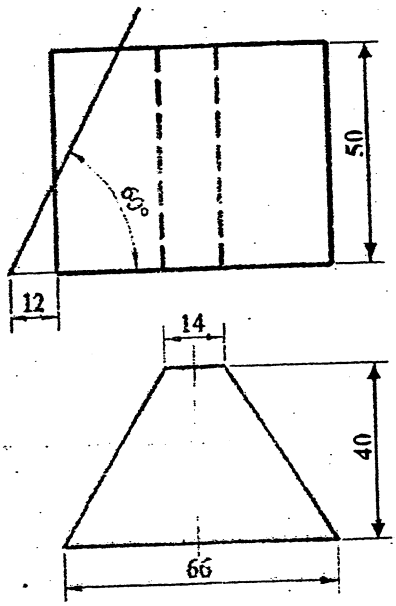
Subject: - Engineering Drawing I *(ME 401)*

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

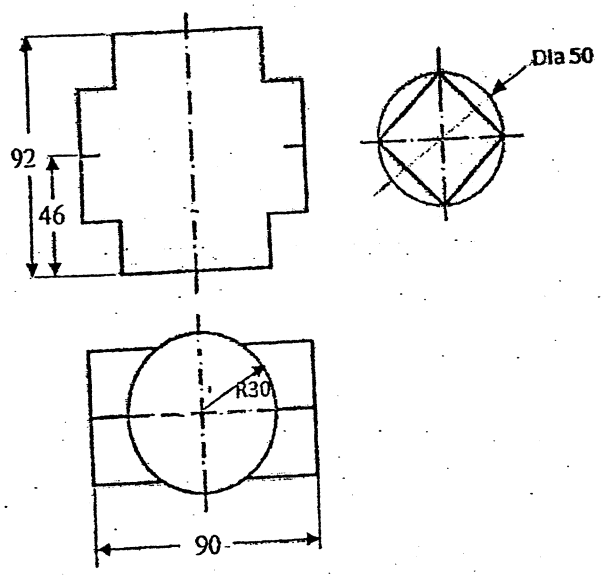
1. Draw an helix of pitch 60mm and height 90mm on a cylinder of diameter 44mm. [5]
2. A straight line AB 60mm long is inclined to the HP at 45° and its top view makes an angle of 60° with the reference line. Its end A is in the HP and 10 mm in front of the VP. Draw its projections and determine its inclination with the VP. [5]
3. Draw the top view side view and full sectional front view from the given pictorial view in figure given below. Show all the necessary dimensions. [14]



4. Make a complete orthographic drawing of a solid cut by plane as shown in figure below. Find the true shape of the section. Construct the development of surfaces of the solid. [10]



5. Draw a line intersection of the solids given in figure given below. [6]



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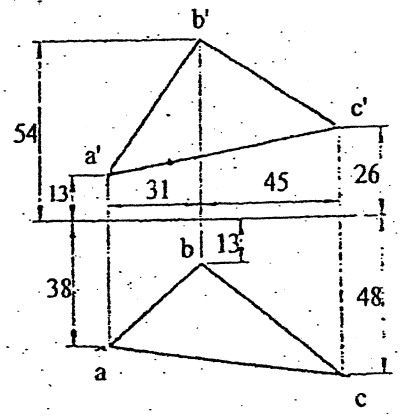
TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2078 Kartik

Exam.	Back		
Level	BE	Full Marks	40
Programme	All Except BAR	Pass Marks	16
Year / Part	I / I	Time	3 hrs.

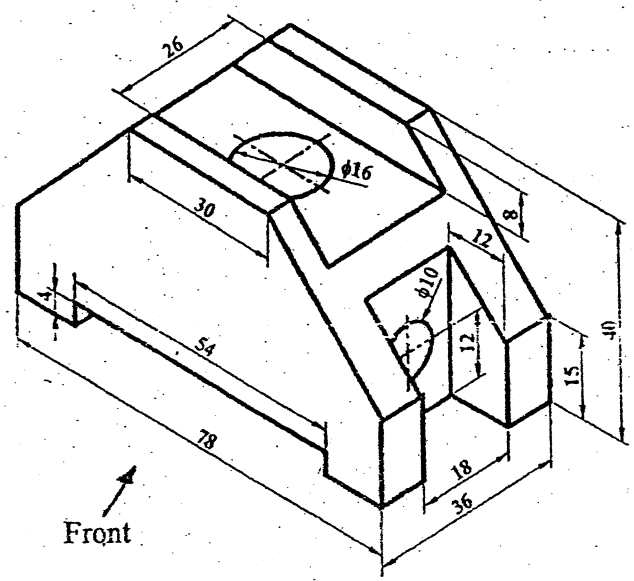
Subject: - Engineering Drawing I *(ME 401)*

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

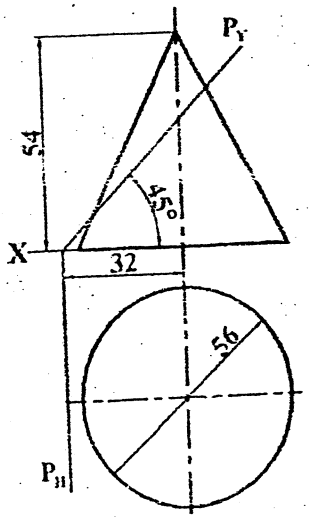
1. Construct a parabola with axis length of 60mm and double ordinate of 40mm. [4]
2. Top and front views of a triangular plane is given in figure below. Draw its true shapes. [5]



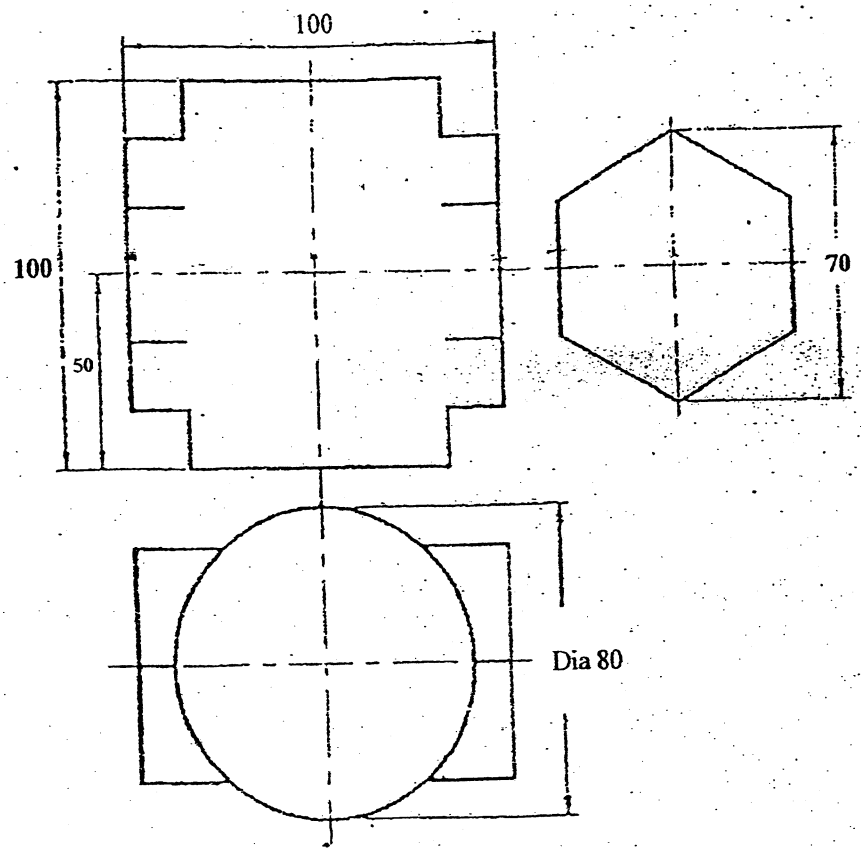
3. Draw orthographic views of the objects shown in figure below with full sectional front view. Assume all holes as through holes. [15]



4. Draw a complete orthographic drawing of the right solids shown in figure below cut by the planes. Find the true shape of the section. Then draw development of the solid. [10]



5. Find the line of intersection of the surfaces of given geometrical solids shown in figure below. [6]



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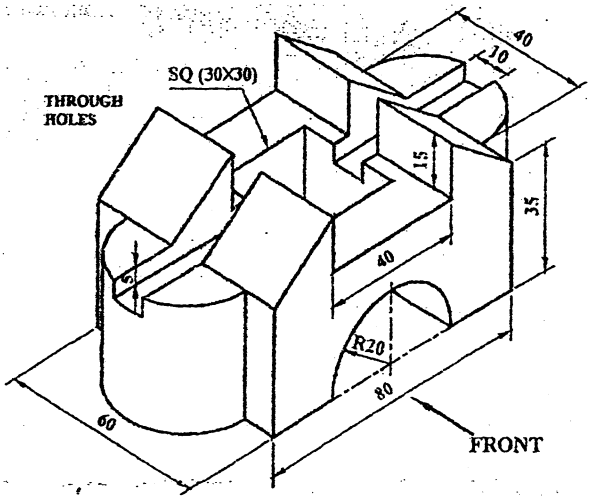
TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2076 Chaitra

Exam.	Regular		
Level	BE	Full Marks	40
Programme	All except BAR	Pass Marks	16
Year / Part	I / I	Time	3 hrs.

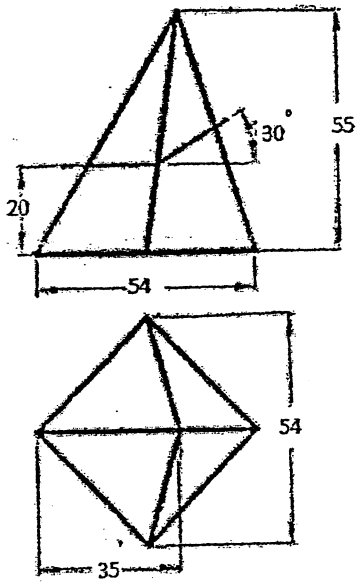
Subject: - Engineering Drawing I *(ME 401)*

- ✓ 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.*

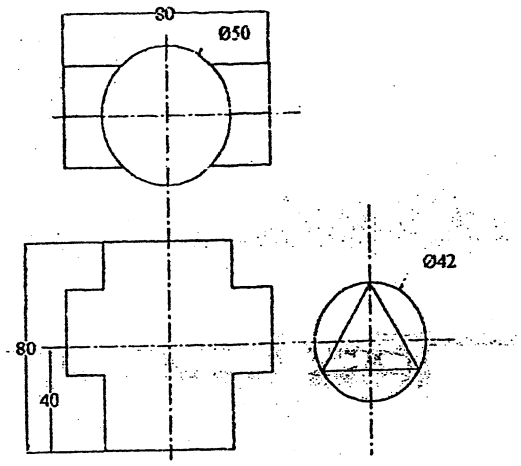
1. Draw a parabola with axis length of 70mm and double ordinate of 90mm. [5]
2. The front view p'q' of a line PQ 94mm long measures 60mm and its top view pq is 72mm. Its end Q is 24mm from both the planes. Draw its projections and find inclinations with VP and HP. [5]
3. Draw orthographic projections with full sectional front view, side view and top view of the pictorial drawing as shown in figure below. [14]



4. Complete the given orthographic drawing and develop its surfaces of figure given below: [10]



5. Draw the intersection curve for vertical cylinder and horizontal triangular prism shown in figure below. [6]



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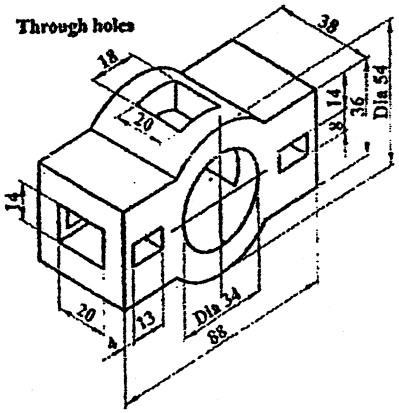
TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2076 Ashwin

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

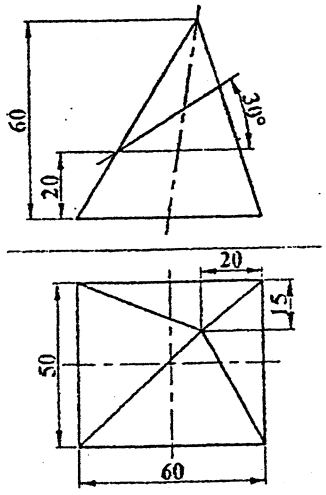
Subject: - Engineering Drawing I *(ME 401)*

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

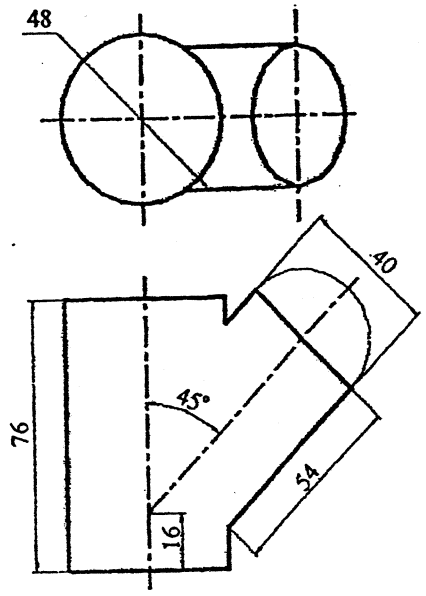
1. Draw an Archemedian Spiral for 1.5 convolutions with pitch equal to 50 mm. [4]
2. A regular hexagon ABCDEF of 25 mm side rests on one of its corner on the HP. Its plane is perpendicular to the VP and inclined to the HP at 30°. Draw its projections when its corner nearer to the VP is 15 mm in front of it. [5]
3. Draw complete Orthographic views with sectional front view of the figure below. [14]



4. Make a complete orthographic drawing of a solid cut by a plane as shown in figure below. Find the true shape of the section. Construct the development of surfaces of the solid. [10]



5. Draw orthographic projection of given geometrical figure by showing curve of intersection. [7]



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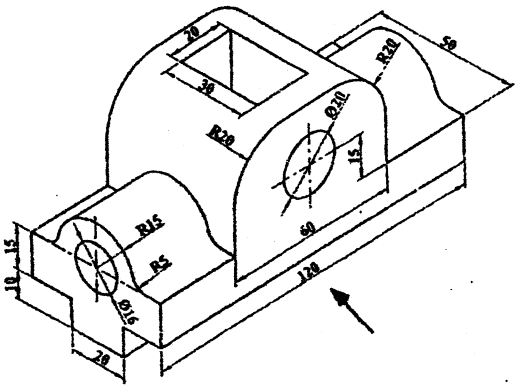
TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2075 Chaitra

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

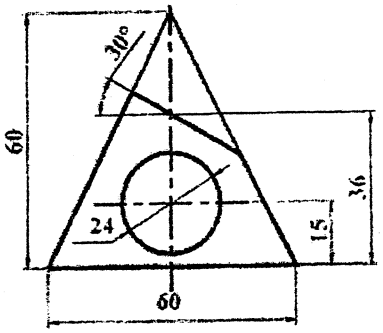
Subject: - Engineering Drawing I *(ME 401)*

- ✓ 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.*

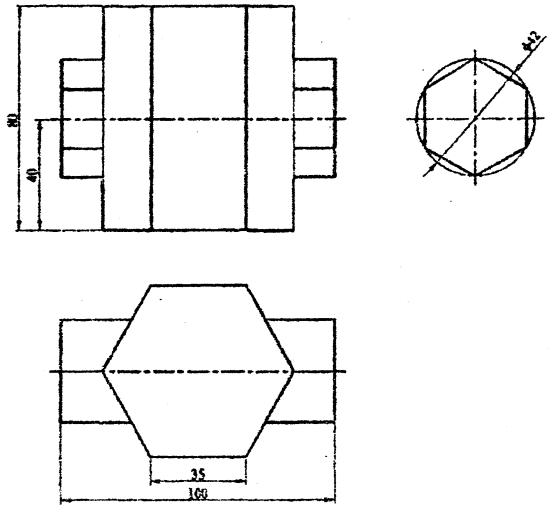
1. Draw an ellipse of Major axis 90 mm and minor axis 66 mm. [4]
2. A regular pentagon ABCDE, of 25 mm side, has its side BC in HP. Its plane is perpendicular to the HP and inclined at 45° to the VP. Draw the projections of the pentagon when its corner nearest to VP is 10 mm from it. [5]
3. Draw orthographic projections with full sectional front view, side view and top view of the pictorial drawing as shown in figure below. [15]



4. A right circular cone is cut as shown in given figure. Develop its lateral surface. [10]



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



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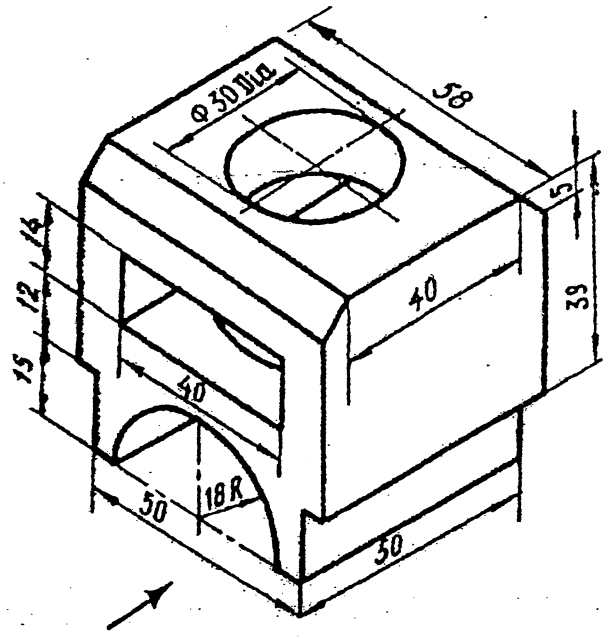
05 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2075 Ashwin

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

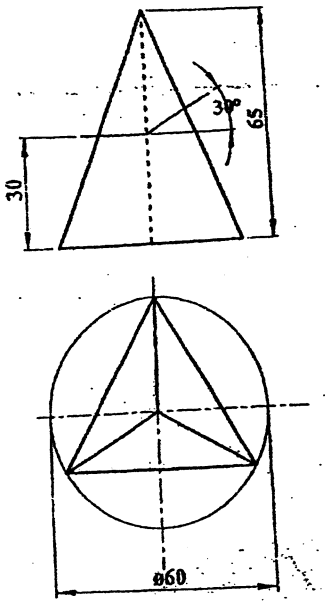
Subject: - Engineering Drawing I *(ME401)*

- ✓ 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.*

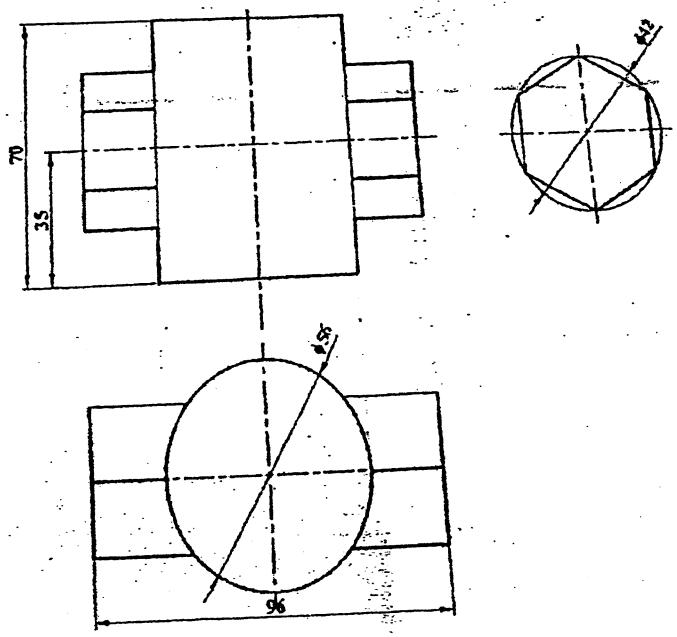
1. Draw helix having a pitch of 50 mm on a cylinder with the diameter of 40 mm and height of 75 mm. [5]
2. ABC is a triangular plane with side AB = 30 mm and sides BC = CA = 50 mm. Side AB is contained by HP and is perpendicular to VP. Draw its projections when its top view is an equilateral triangle and the nearest point A is 15 mm away from VP. Also find its inclination with the HP. [5]
3. Draw and dimension orthographic projections with full sectional side view, front view and top view of the pictorial drawing as shown in figure below. [14]



4. Make complete orthographic projections of a solid cut by planes as shown in figure below. Find the true shapes of the sections. Construct the development of all the surfaces of the solid. [10]



5. Draw the effects of intersection of the surfaces of geometrical solids shown in figure below. [6]



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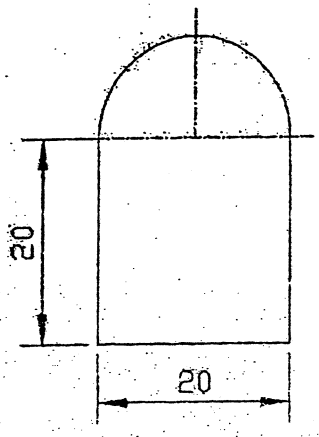
05 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2074 Chaitra

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)*

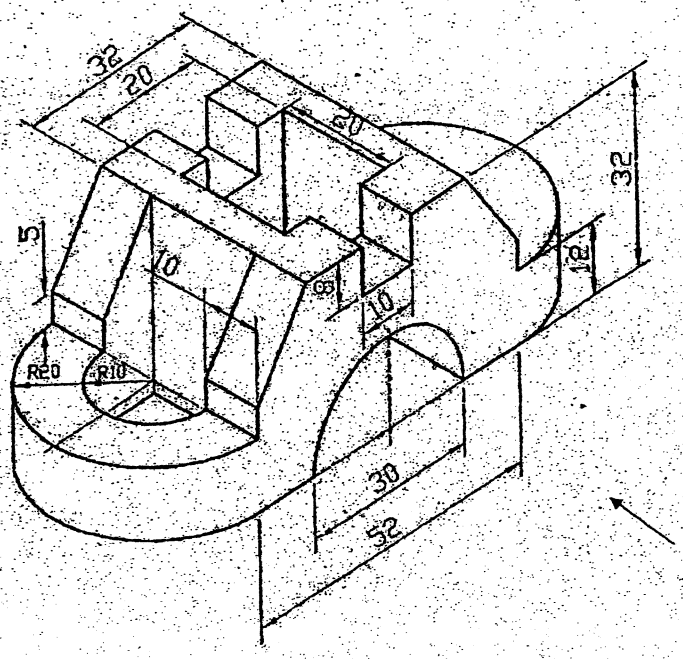
- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Assume suitable data if necessary.*

1. Geometrically construct one complete rotation of an involute curve on the solid with cross sectional shape as given in figure below. [5]

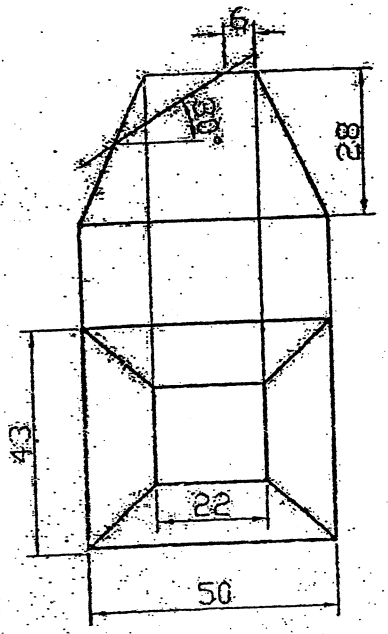


2. A regular pentagonal plane ABCDE of 20mm side has its edge BC resting on the HP. Its plane is perpendicular to the HP and inclined to the VP at 50°. Draw its projections when its corner nearer to the VP is 20 mm in front of the VP. [5]

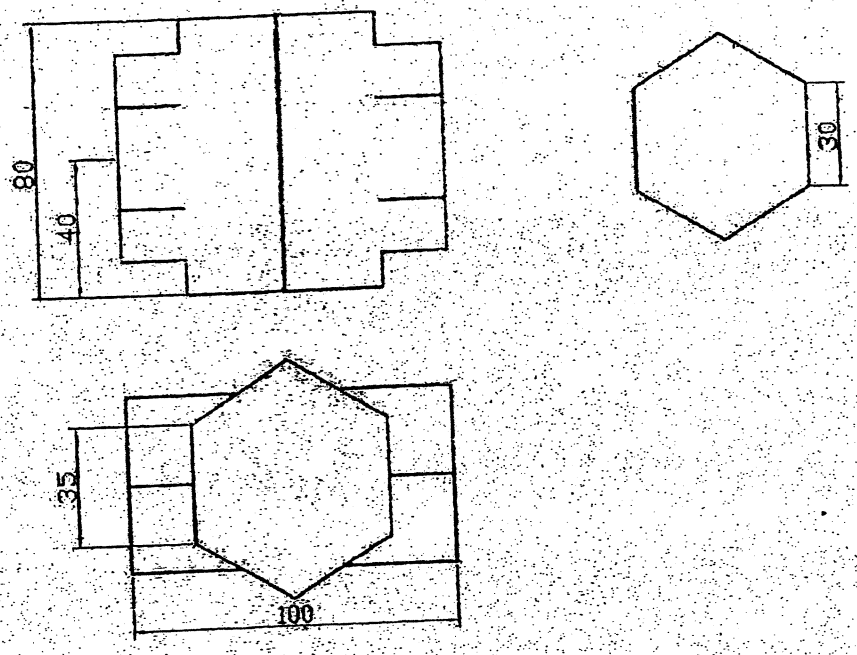
3. Draw orthographic projections with Sectional Side View, Top View and Front View of pictorial drawing as shown in figure below. [14]



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



5. Draw the complete orthographic drawing for the intersection of hexagonal prisms as shown in figure below and complete the intersections. [6]



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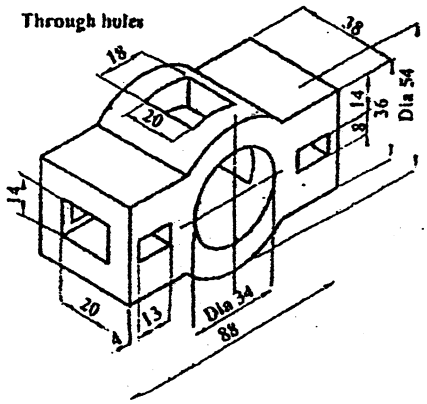
05 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2074 Ashwin

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

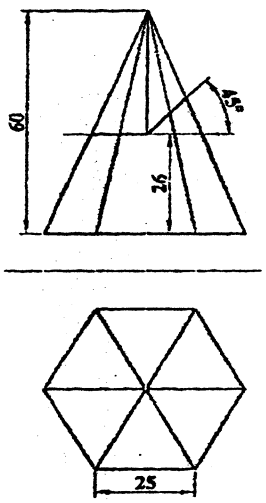
Subject: - Engineering Drawing I *(ME401)*

- ✓ 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.*

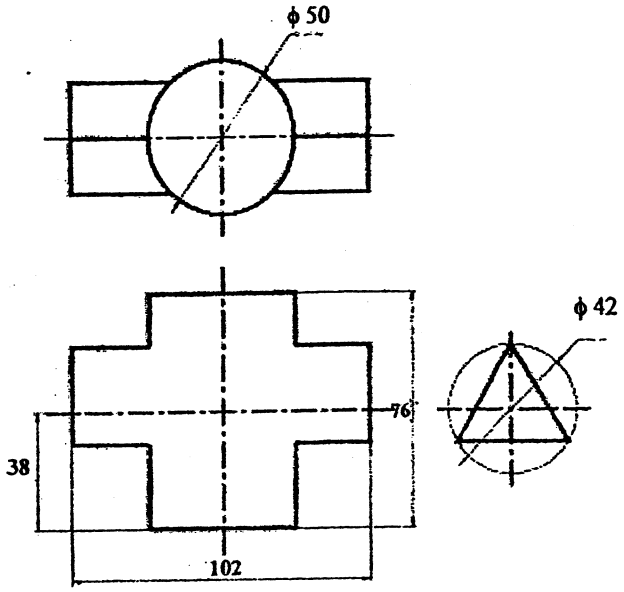
1. Draw an involute of an regular square of side 20mm. [3]
2. A straight line AB 80mm long is inclined at 30° to the HP and 45° to the VP. Its midpoint is 30mm above the HP and 35mm in front of VP. Draw its projection. [5]
3. Draw complete Orthographic views with sectional front view of the figure below. [14]



4. Make a complete orthographic drawing of geometrical solid cut by a plane as shown in figure below. Find the true shape of the section. Construct the development of the surfaces of the solid. [12]



5. Draw the line of intersection of the surfaces of the solids shown in figure below. [6]



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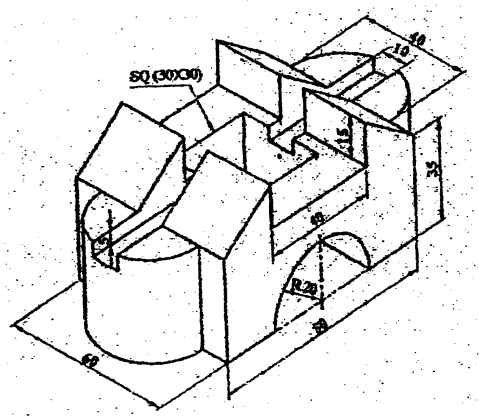
05 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2073 Chaitra

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

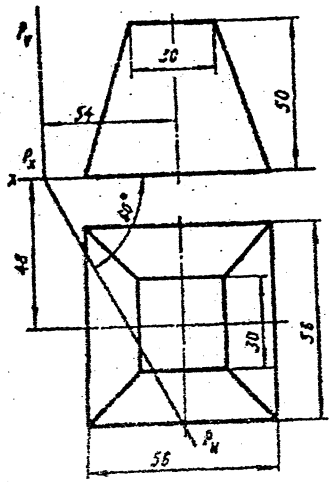
Subject: - Engineering Drawing I *(ME401)*

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

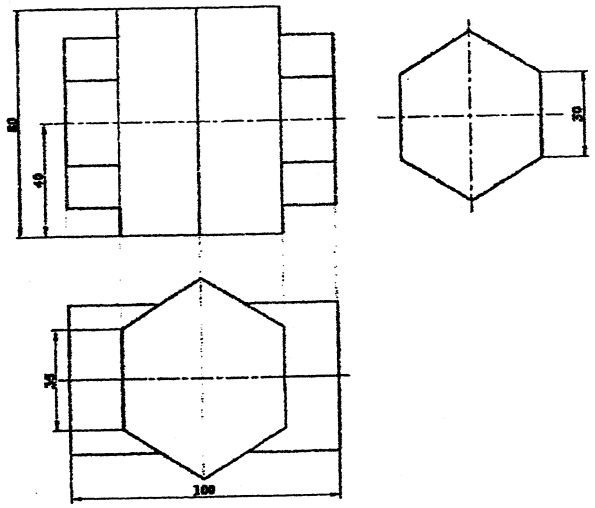
1. Construct an ellipse of major axis 120mm and minor axis 80mm. [3]
2. A regular hexagon ABCDEF of 25 mm side rests on one of its corner on the HP. Its plane is perpendicular to the VP and inclined to the HP at 30°. Draw its projections when its corner nearer to the VP is 15 mm in front of it. [5]
3. Draw orthographic projections with full sectional front view, side view and top view of pictorial drawing as shown in figure below. [14]



4. Make a complete orthographic drawing of a solid cut by a plane as shown in below figure. Find the true shape of the section. Construct the development of surfaces of the solid. [12]



5. Draw the lines of intersection of the surfaces of geometrical solids in below figure. [6]



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02 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2073 Shrawan

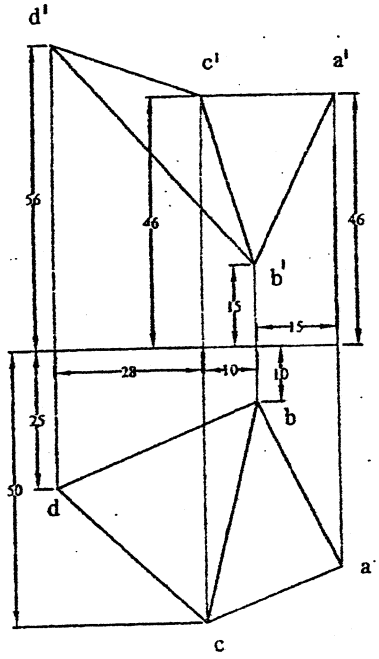
Exam.	New Back (2066 & Later Batch)		
Level	BE	Full Marks	40
Programme	ALL (Except B.Arch)	Pass Marks	16
Year / Part	I / I	Time	3 hrs.

Subject: - Engineering Drawing I *(ME401)*

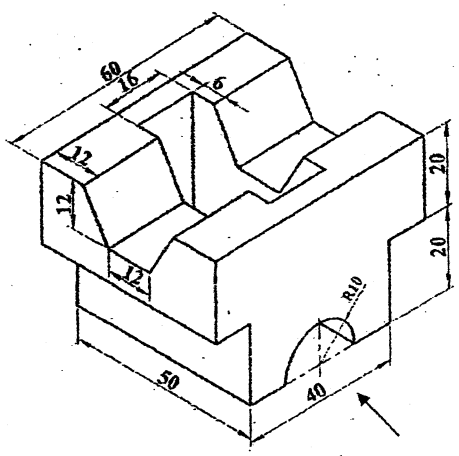
- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Assume suitable data if necessary.*

1. The distances between the focii and between the vertices of a hyperbola are 100 mm and 60 mm respectively. Construct the hyperbola. [4]

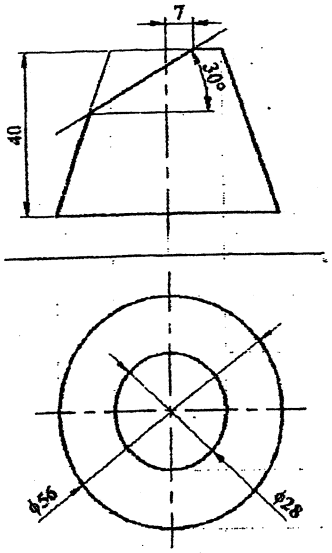
2. Determine the true size of the angle formed by the planes ABC and BCD shown in figure below. [5]



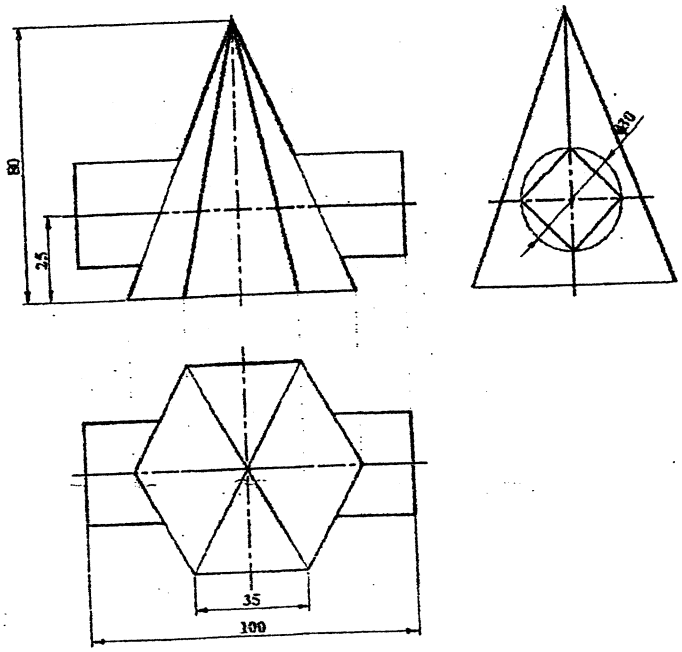
3. Draw orthographic projection with full sectional front view and full sectional side view of solid object shown in figure below. [14]



4. Make a complete orthographic drawing of the solid frustum cone cut by a plane as shown in given figure. Find the true shape of the section and draw the lateral surface development of the lower portion of the solid. [12]



5. Draw the lines of intersection of the surfaces for given orthographic drawing in figure below. [5]



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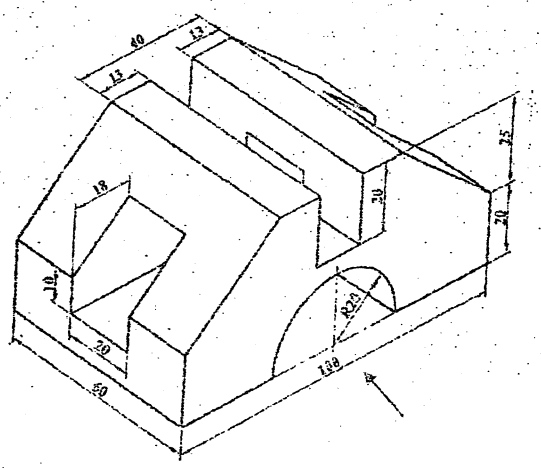
02 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2072 Chaitra

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

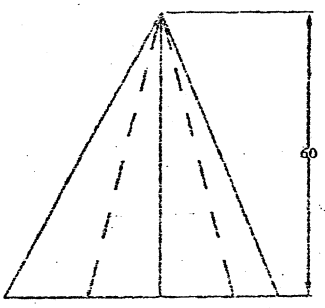
Subject: - Engineering Drawing I *(ME401)*

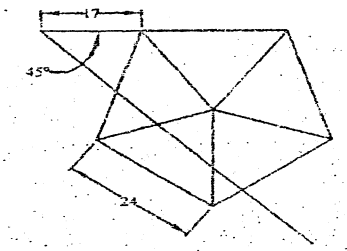
- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Assume suitable data if necessary.*

1. Draw an involute of the regular hexagon having side length 15 mm. [4
2. A square lamina ABCD of 30 mm side is perpendicular to VP and inclined to HP at 45°. Its side BC lies in HP. Draw its projection when the nearest side is 15 mm in front of VP. [5
3. Draw the views of the objectives given in figure below with full sectional front view, full sectional side view and top view. Also dimension the views. [14

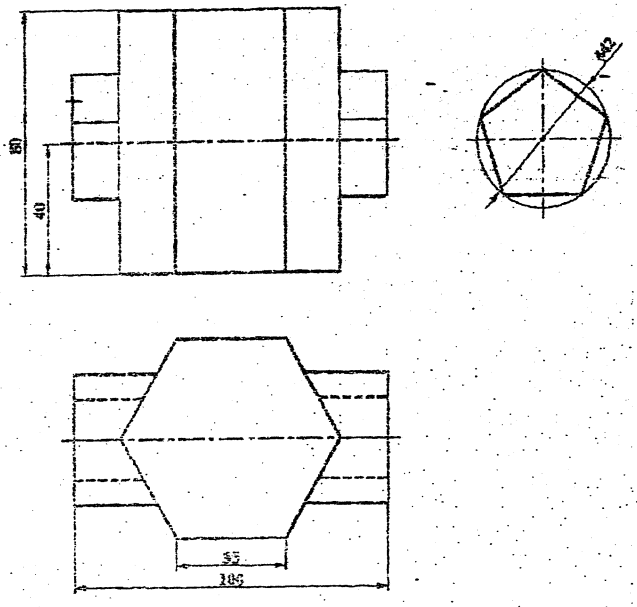


4. Complete orthographic views of the right solids shown in figure below cut by the plane. Find the true shape of the section. Then draw development of surface. [12





5. Draw the intersection profile of intersecting solid objects in figure below. [5]



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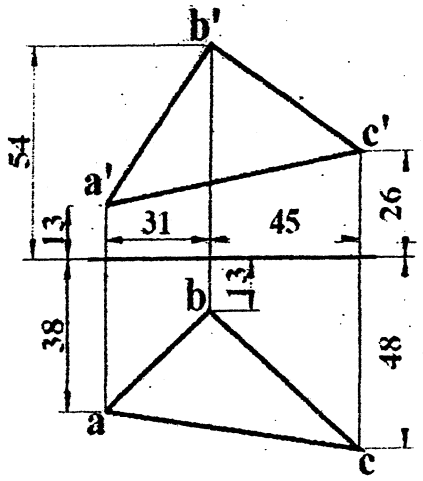
02 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2072 Kartik

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.

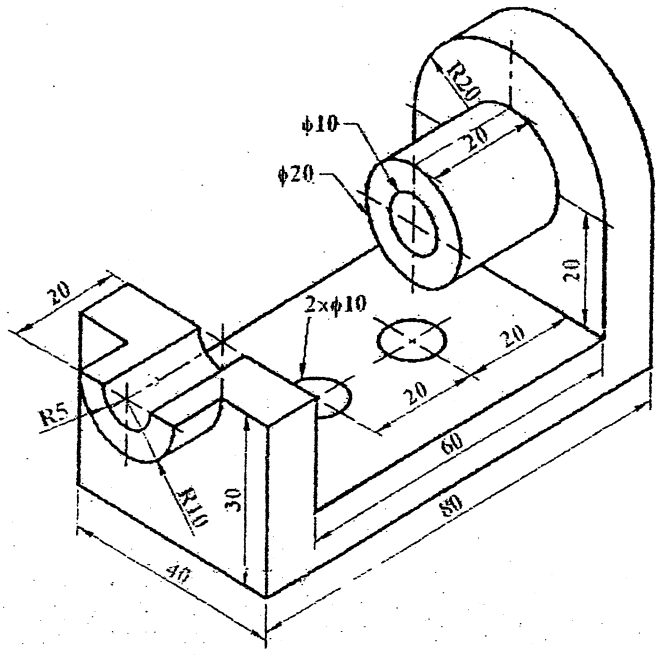
Subject: - Engineering Drawing I *(ME401)*

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

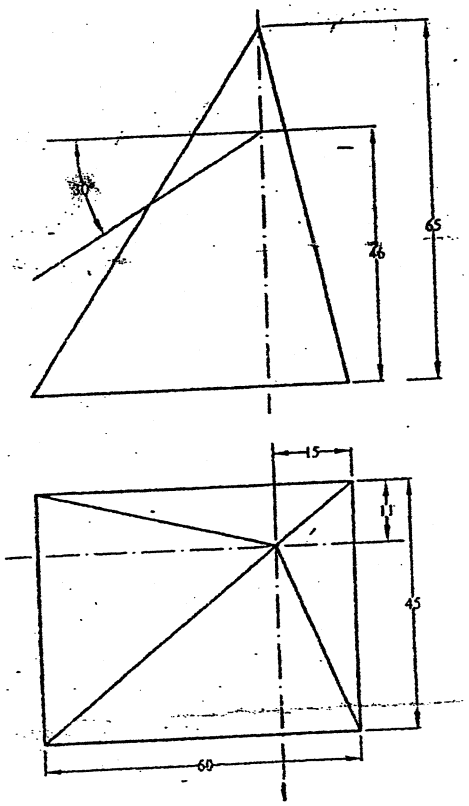
1. Draw two circles with radii 15 mm and 20 mm respectively with their centers lying on a horizontal line and 60 mm apart. Draw an arc tangent of radius 40 mm outside to both the circles. [3]
2. Reproduce the given views of the plane shown in figure below. Determine its true perimeter and true inclination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



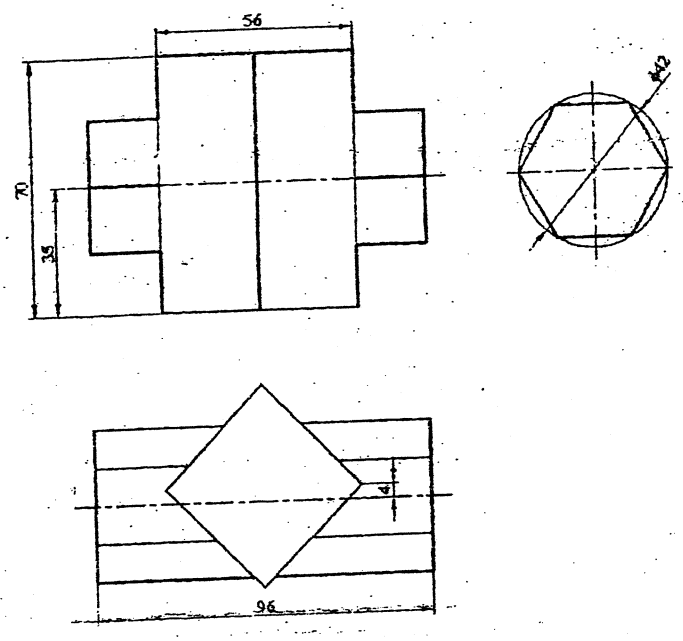
3. Pictorial view of an object is shown in figure below. Draw (with dimension) its (a) sectional front view, (b) side view and (c) top view. [15]



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]



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TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2071 Chaitra

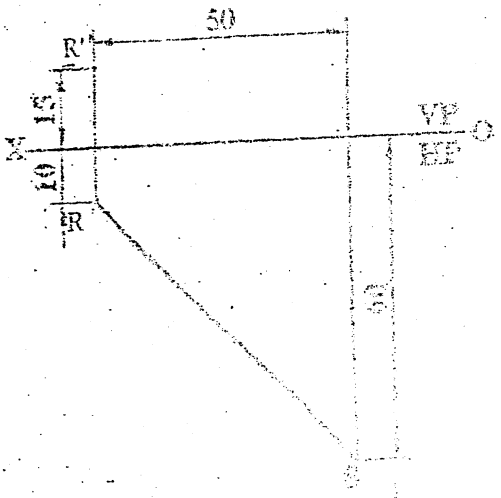
Exam.	[redacted]	Full Marks	80
Level	BE	Pass Marks	36
Programme	All (Except B.Arch)	Time	3 Hrs.
Year / Part	1 / I		

Subject: - Engineering Drawing I (ME401)

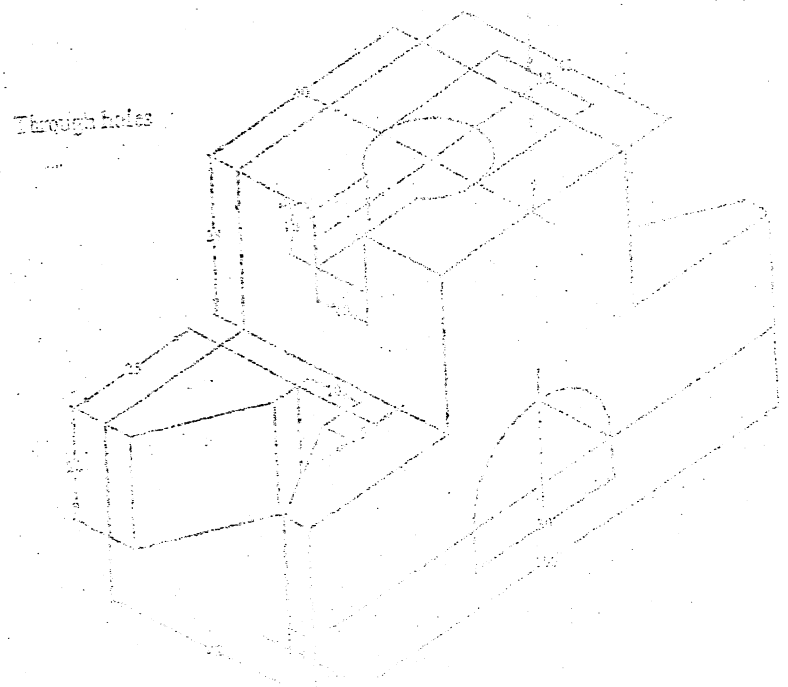
- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Assume suitable data if necessary.*

1. Construct an ellipse having a major axis 80 mm and minor axis 60 mm. [3]

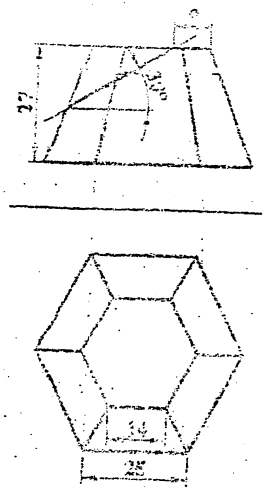
2. Top view of a straight line RS and the front view of its end R are shown in figure below. Complete its projection if it is inclined at 30° to the HP. Also determine its true length and true inclination with the VP. [5]



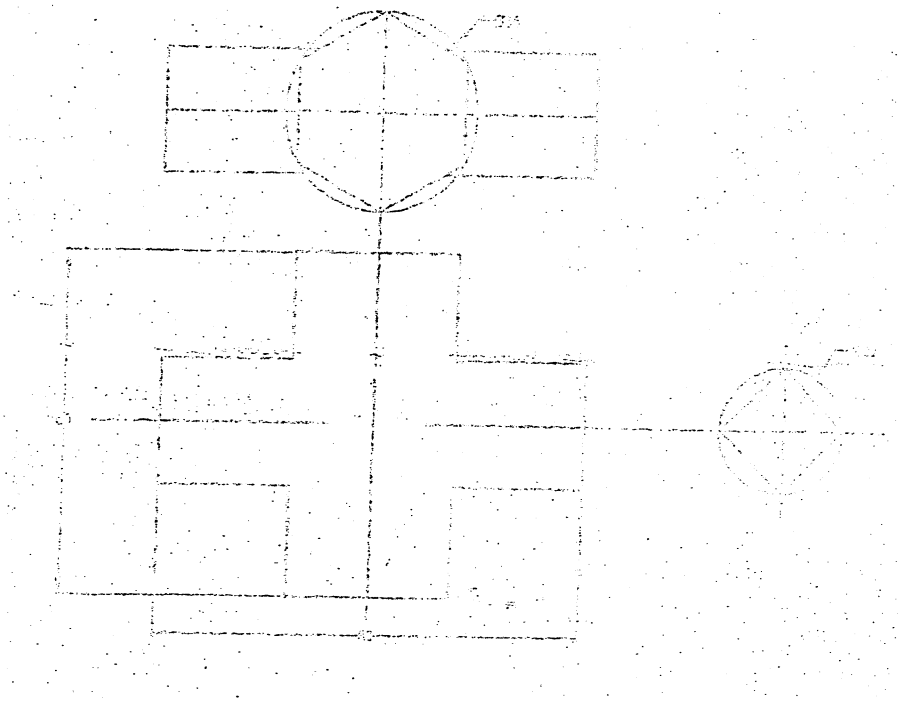
3. Draw orthographic projections with full sectional front view, top view and side view of the given object shown in figure below. [15]



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. [8]



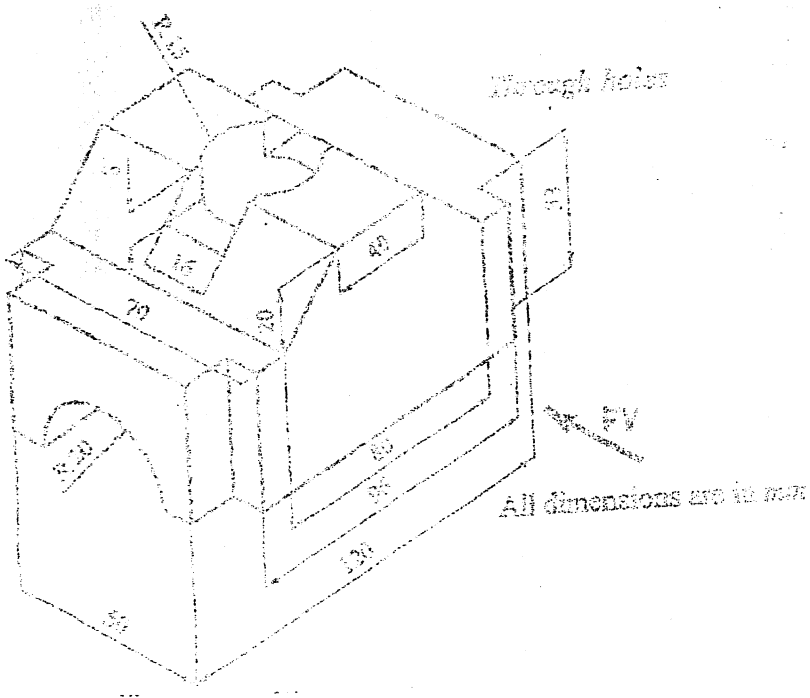
02 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2070 Ashad

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

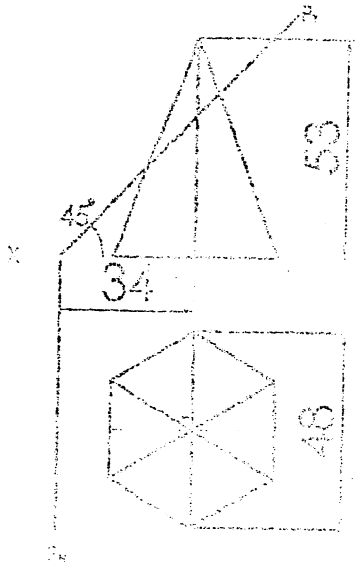
Subject: - Engineering Drawing I *(ME401)*

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

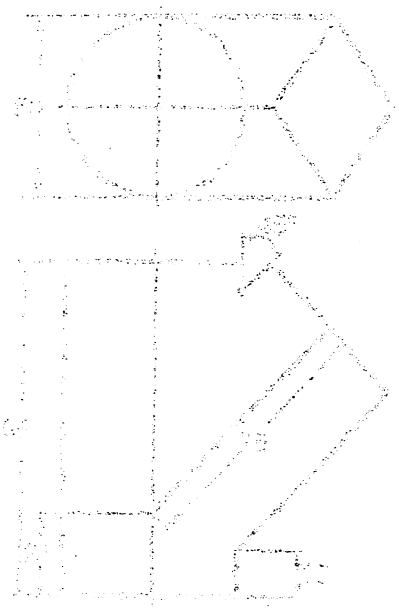
1. Construct an Archimedian's spiral curve of one convolution of diameter 120mm. [4]
2. Draw three orthographic projections of a rectangular lamina 60mmx40mm, which is parallel to H.P with one of its side inclined at 30 degree to V.P. The corner nearer to V.P is 25mm in front of V.P and 30mm above H.P. [5]
3. Pictorial view of an object is shown in figure below. Draw the views with sectional front view. [14]



4. Make complete the orthographic view of geometrical solid cut by plane as shown in figure below. Find the true shape of the section. Construct the development of the surfaces of the solid. [12]



5. Draw the common curve of intersection of a prism with a cylinder as shown in figure below. [12]



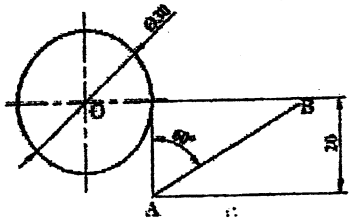
02 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2071 Shawan

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.

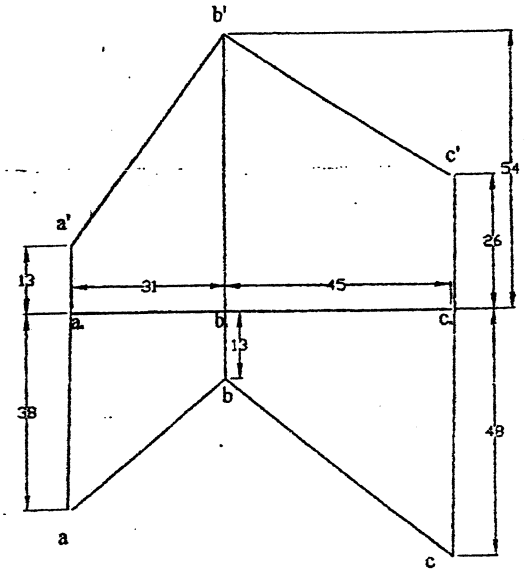
Subject: - Engineering Drawing I *(ME401)*

- ✓ 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.*

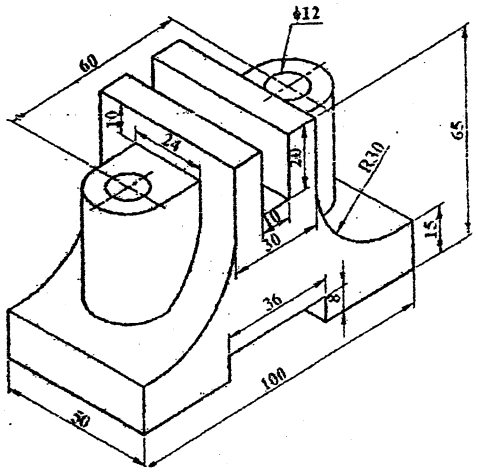
1. Figure below shows a straight line and a circle. Draw an arc of radius 18 mm tangent to both the given line and circle and outside to the given circle. [3]



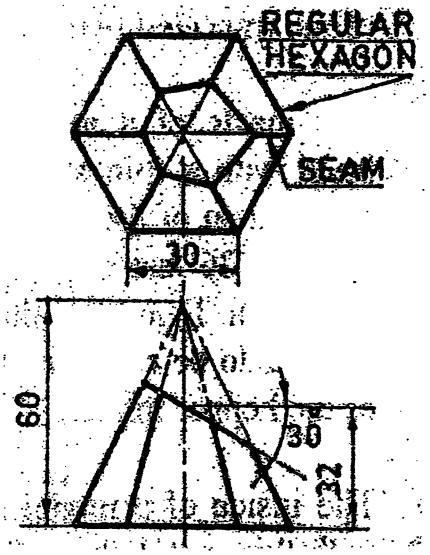
2. Find the true angle between line AB and BC. [5]



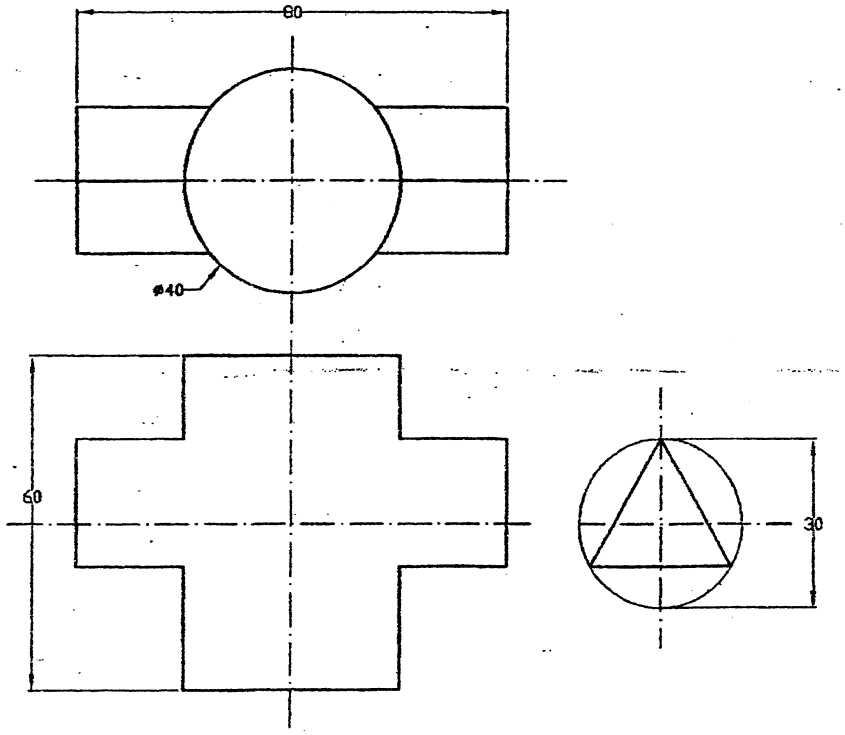
3. Pictorial view of an object is shown in figure below. Draw (with dimension) its (a) sectional front view, (b) sectional side view and (c) top view. [15]



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]



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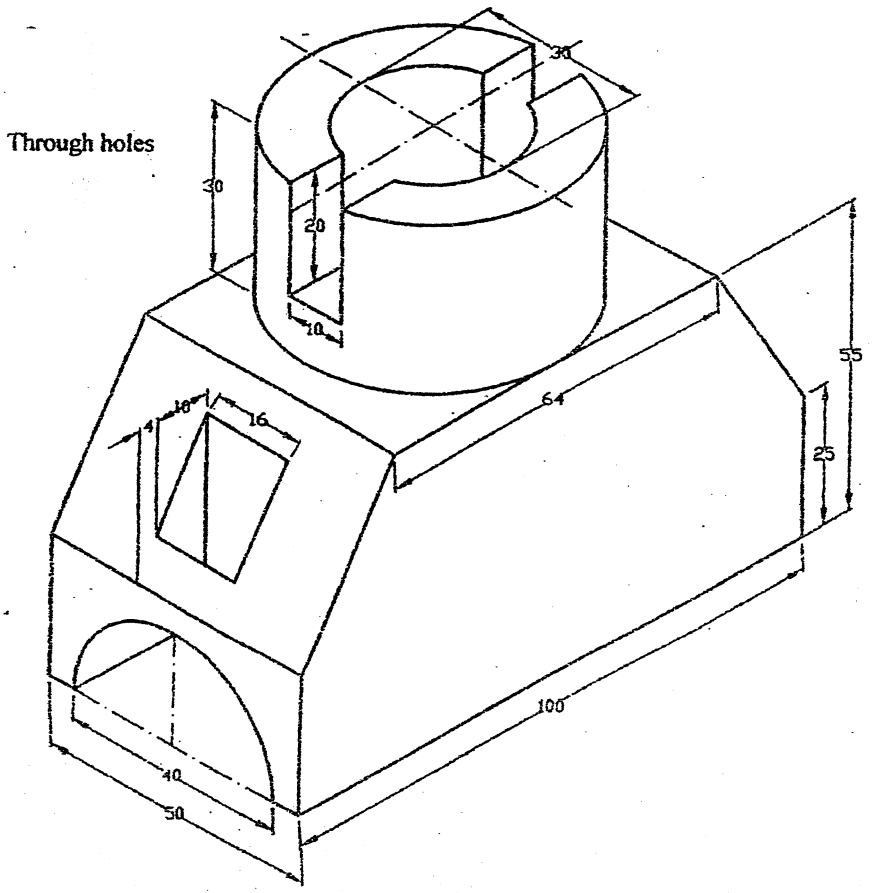
02 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2070 Chaitra

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

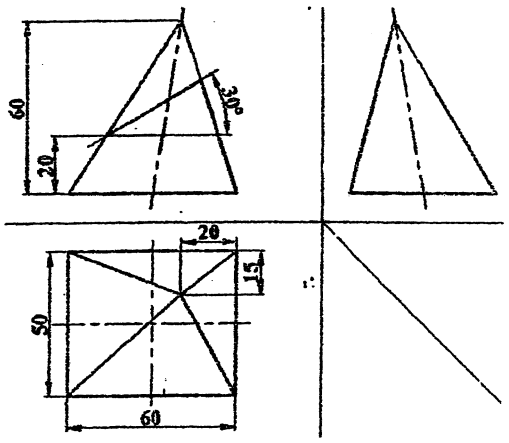
Subject: - Engineering Drawing I *(ME401)*

- ✓ 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.*

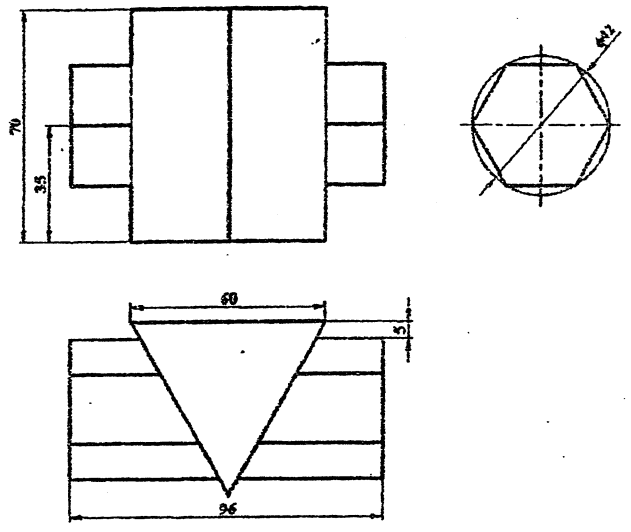
1. Draw an involute of circle having diameter of 40 mm. [3]
2. A regular pentagonal plane ABCDE of 20 mm side has its edge BC resting on the HP. Its plane is perpendicular to the HP and inclined to the VP at 45°. Draw its projections when its corner nearer to the VP is 18 mm in front of the VP. [5]
3. 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]



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