

TRIBHUVAN UNIVERSITY  
INSTITUTE OF ENGINEERING  
**Examination Control Division**  
2079 Bhadra

Exam.	Regular		
	Level	BE	Full Marks
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 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  $10^{-6}$ :  $\cos(x) = 1 - \frac{x^2}{2!} + \frac{x^4}{4!} - \frac{x^6}{6!} + \frac{x^8}{8!} \dots$  [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 "Gottfried". If found copy the records to a file "gotfried.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
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.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

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 precedence, 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 getch(); [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]

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

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.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

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) getch()            (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
Programme	All except BAR	Pass Marks	32
Year / Part	1/1	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.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

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%\n", g);
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]

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

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 given 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  $m \times n$  and  $p \times q$  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 All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ 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 argument. [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 All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

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.  $f(x) = 1 - x^2/2! + x^4/4! - x^6/6! + x^8/8! - \dots$  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  $m \times n$  and  $p \times q$  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]

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	1/1	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.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

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]

a

address: 65510

b

address: 65550

c

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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Exam.	Back		
Level	BE	Full Marks	80
Programme	All (Except B. Arch)	Pass Marks	32
Year / Part	1 / 1	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.
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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 repetitive 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 sort them in ascending

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Level	BE	Full Marks	80
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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 steps 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 flowchart. [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. Create 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 content of one file source.txt to another destination.txt. [8]
  9. a) Explain the FORTRAN structure. What are different types on FORTRAN? [2+3]
  - b) Write a FORTRAN program to read N number to find second largest number among



| Exam.       | Back                  |            |        |
|-------------|-----------------------|------------|--------|
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**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  $n^{\text{th}}$  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  $n^{\text{th}}$  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  $N \times N$  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  $\pi$  by evaluating the following formula for the first 25 terms. [8]

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

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| 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. 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:  $\cos(x) = 1 - x^2/2! + x^4/4! - x^6/6! + \dots$  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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| 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]

| 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]

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

**Subject: - Computer Programming (CT401)**

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

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

| 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 basis of their uses and applications. Among them which programming language is C programming? [4]
- b) List and define different steps to solve the problem in computer system. [4]
2. a) Differentiate between declaration and definition. Explain structure of C program with an appropriate example. [4]
- b) Write syntax, example and use of following: [1×4]
  - i) printf()
  - ii) scanf()
  - iii) getch()
  - iv) 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]

| Exam.       |                      | Results    |        |
|-------------|----------------------|------------|--------|
| 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:  $1 \times 10 + 3 \times 20 + 6 \times 30 + \dots + \frac{N(N+1)}{2} \times 10N$ , where N is an integer term read from the keyboard. [2+2+6]
4. a) Write a program to display Armstrong numbers between the range entered by a user and also display their counts. You must use a function to check for Armstrong numbers and display them from main. [4]
- b) What do you mean by nested function and recursive function? Give an example of recursive function. [2+2]
5. a) Write a C program to read a string and display its reverse. Use user defined function to count number of characters in it and to reverse it. [4]
- b) Write an algorithm to insert a value in an array at a position given by user. [4]
6. a) What is a tag? Must a tag be included in a structure type definition? Must a tag be included in a structure variable declaration? Explain. [1+1+2]
  - b) Write a C program that reads several different names and address using structure computer, rearrange the names into alphabetical order and write out alphabetical list. [4]
7. Illustrate with example that "Array is indirectly a pointer". Write program to calculate sum and average of integer numbers between M and N (where value of M and N are read from keyboard) using pointer. [4+4]
8. Write a program to continuously read name, age and salary of a worker and write it into a file until user confirms to end. Then read n from user and display the n<sup>th</sup> 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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| 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  $m \times n$  matrix, transpose it and display both the matrices. [8]

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|             |                           |            |        |
|-------------|---------------------------|------------|--------|
| Exam.       | N/A                       |            |        |
| Level       | BE                        | Full Marks | 80     |
| Programme   | All ( Except<br>B. Arch ) | Pass Marks | 32     |
| Year / Part | 1 / 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 ("%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<sup>th</sup> record in the file, where n is read from the user. The data for authors must be represented by structures that contain name, nationality and number of books published. [8]
9. a) Explain the FORTRAN structure. What are data types in FORTRAN. [2+2]  
b) Write a program in FORTRAN to solve quadratic equation and display roots in proper form. [8]

| Exam.       | Regular               |            |        |
|-------------|-----------------------|------------|--------|
| Level       | BE                    | Full Marks | 80     |
| Programme   | All (Except B. Arch.) | Pass Marks | 32     |
| Year / Part | 1/1                   | 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.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

1. a) How high level programming languages are similar to natural language? Describe. [3]  
 b) Does Algorithm and Flowchart design makes programming faster and easier? Describe with strong supporting points. Also draw flowchart to check whether a number is Armstrong or not. [2+3]
2. a) What are unary operators in C? Why are they named so? [2]  
 b) What are preprocessor directives in C? Why are they needed? [2]  
 c) How formatted input/output can be performed in C? Explain with example. [4]
3. Differentiate between conditional operator and if-else statement. write a program in C that calculates the sum of digits entered by the user successively until the sum reduces to a single digit number. For example, 12345 => 1+2+3+4+5=15=>1+5=6. [2+6]
4. Write a program in C to read a string and display it in reverse order. Use user defined functions to count the number of characters in it and reverse it. [8]
5. Write down the significance of array in C. Write a program to multiply two 3x3 matrix. Two matrix are input from main ( ) function and pass to a user defined function. with argument with array. The result is also displayed from main ( ) function. [2+6]
6. Why structure variable differs from array? Write a program to input name, post and salary of ten employees from main ( ) function and pass to structure type user defined function (arguments of this function should also a structure type). This function returns structure variable which keeps the record of only those employees whose salary is greater than 10,000. This modified record is also displayed from main ( ) function. [2+6]
7. Explain how pointers can be used in C. How can you access array elements using pointer. Write a C program that reads a string from user and use a user defined function to copy the contents of the read string into another character array changing lower case letters to upper if any. Use pointer to process string. [1+1+6]
8. Write a program to input and save record like name, roll, address and obtained mark of 48 students in a binary file and search and display the record of a student whose obtained mark in highest. The information should be organized in a structure. [8]
9. Write a program in FORTRAN, to check whether a positive integer entered from the keyboard is a palindrome or not. (Hints: A number is palindrome if its reverse is equal to the number itself). [8]
10. Write FORTRAN program to display greatest and smallest number form list ten elements. [8]

| 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.
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- ✓ Assume suitable data if necessary.

1. What are the features of a good computer program? Explain the process involved in converting a program written in high level language to an executable program. [4+4]
2. a) Why do we include <stdio.h> in our program? Can we write a C program without using any header file? Justify your answer. [2+2]  
b) Give the output of the following program and justify your answer with reason. [4]

```
#include<stdio.h>
int main()
{
    int x=3,y=5,z=7;

    int a,b;

    a=x*2+y/5-z*y;

    b=++x*(y-3)/2-z++*y;

    printf("a=%d",a);

    printf("b=%d",b);

    return 0;
}
```

3. a) What is the importance of control structure in programming? Compare if - else - if ladder and switch construct. Which is better? [1+3]
- b) Write a C-program to generate following pattern using unformatted output function. [6]

```
k
ok
wok
hwok
chwok
lchwok
ulchwok
pulchwok
```

4. a) What is a function? Why is it necessary in programming? [1+2]
- b) Write a program to find whether a number is prime or not using function. The function should take the number as argument and return true or false to the main program. [5]
5. a) How can we pass two dimensional arrays from one function to another? Explain with example. [4]
- b) Write a program in C to find the second largest number in an array of n numbers. Read the value of n and the elements of the array from the user. [6]
6. What is advantage of using structure? Create an array of structure named Employee with name and salary as structure member and the array of structure is passed to a function which sorts in ascending order on the basis of salary and display the sorted array from main. [2+6]
7. a) Explain call by reference. How are pointers used in call by reference? [2]
- b) Using pointer concept, write a program to count the number of characters and the number of words in a line of text entered by the user. [6]
8. a) Differentiate between text file and binary file. [2]
- b) Write a program to read integers from user until user says "no". After reading the data write all the odd numbers to a file named ODD and all the even number to file named EVEN. [6]
9. a) Differentiate "Logical if" with "Arithmetic if" in FORTRAN with suitable example. [6]
- b) Compare "Computed goto" statement (FORTRAN) and "switch" (C language). Write a program to read a day number and display whether it is Sunday, Monday, Tuesday, Wednesday, Thursday, Friday and Saturday using both concept. [6]

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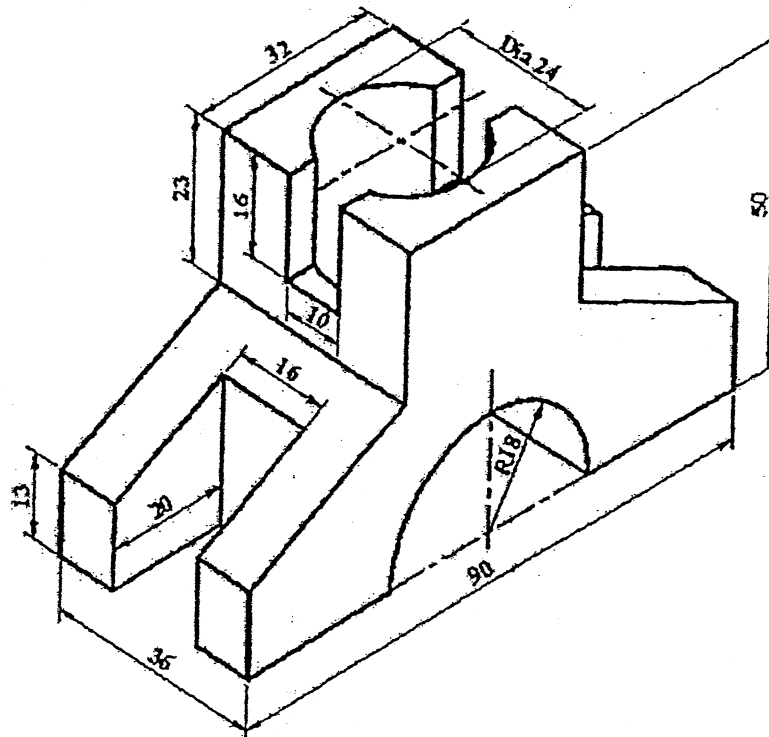
TRIBHUVAN UNIVERSITY  
 INSTITUTE OF ENGINEERING  
**Examination Control Division**  
 2079 Bhadra

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

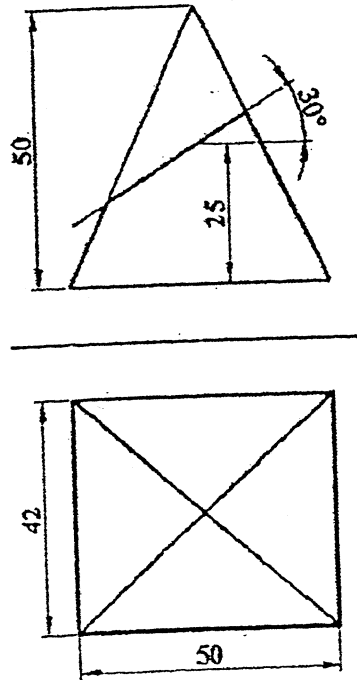
**Subject: - Engineering Drawing I (ME 401)**

- ✓ 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.

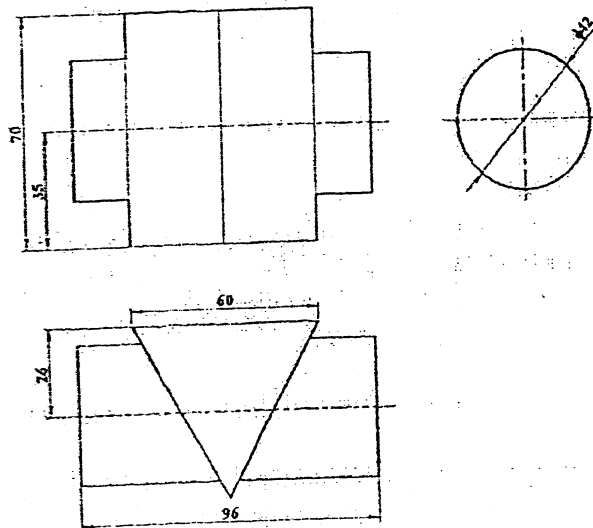
1. Draw a cycloid, one and half revolution of a circle having diameter 45 mm. [4]
2. A pentagonal plane with 30 mm side has an edge on the HP. This plane is perpendicular to the VP and inclined at 45° to the HP. Draw its projection when its corner nearer to the VP is 10 mm in front of it. [5]
3. Draw (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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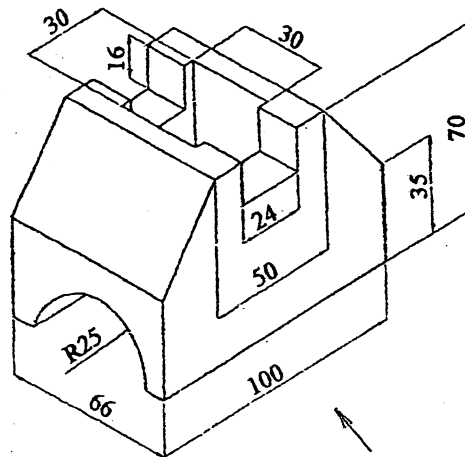
| Exam.       | Back             |            |        |
|-------------|------------------|------------|--------|
| Level       | BE               | Full Marks | 40     |
| Programme   | All (Except BAR) | Pass Marks | 16     |
| Year / Part | I / I            | Time       | 3 hrs. |

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

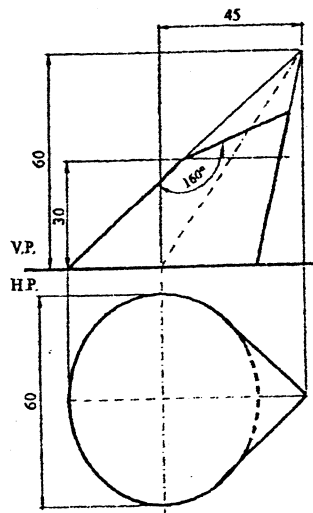
- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

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 in front of the VP. The distance between its end projectors is 45 mm. Draw the projections of the line and determine 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]

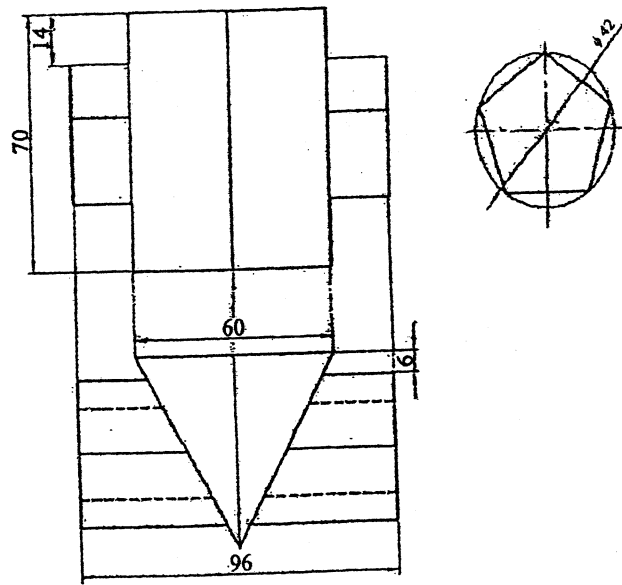
**Through holes**



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]



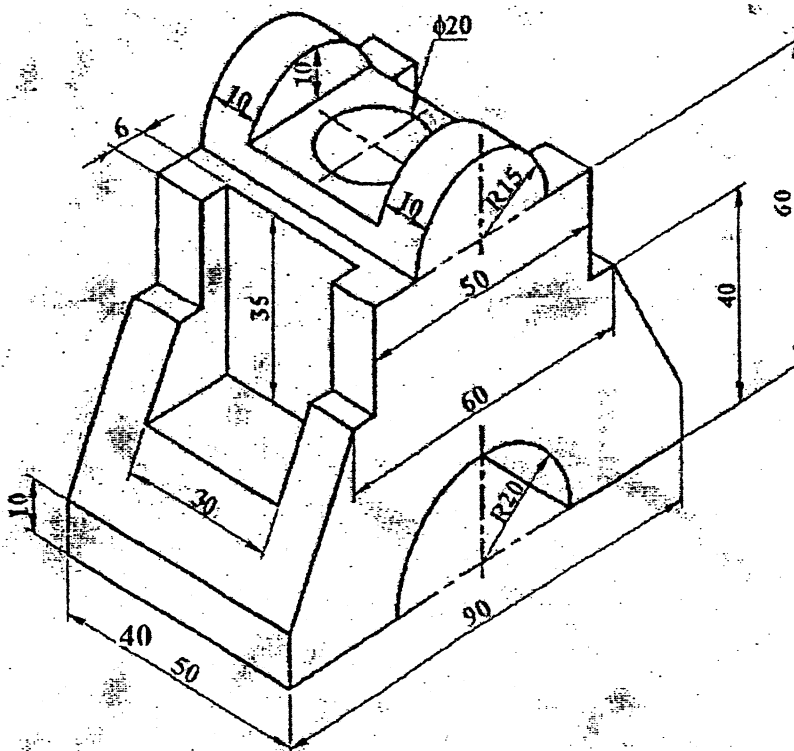
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| Exam.       | Regular |            |        |
|-------------|---------|------------|--------|
| Level       | BE      | Full Marks | 40     |
| Programme   | ALL     | Pass Marks | 16     |
| Year / Part | 1/1     | Time       | 3 hrs. |

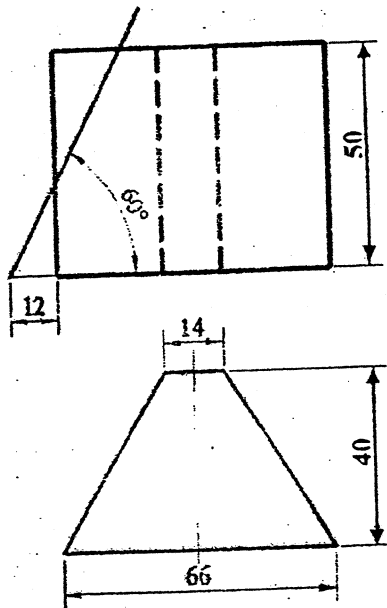
*Subject: - Engineering Drawing I (ME 401)*

- ✓ 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 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  $45^\circ$  and its top view makes an angle of  $60^\circ$  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]

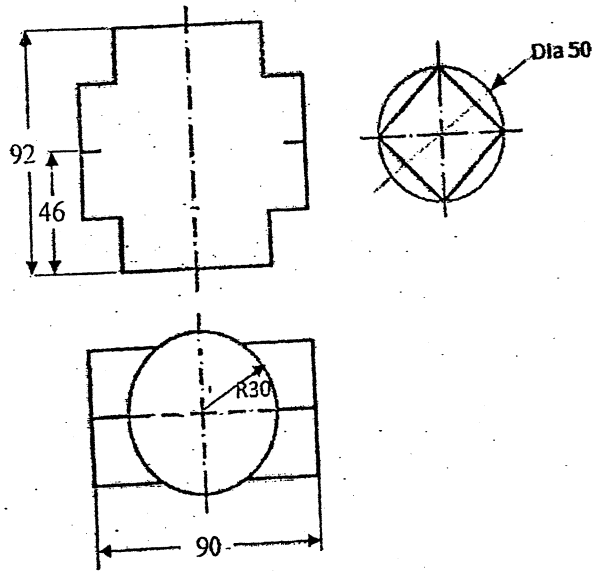


4. Make a complete orthographic drawing of a solid cut by plane as shown in figure below. Find the true shape of the section. Construct the development of surfaces of the solid. [10]



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

[6]



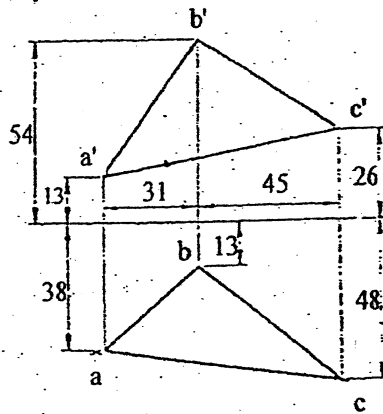
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| Exam.       | Back           |            |        |
|-------------|----------------|------------|--------|
| Level       | BE             | Full Marks | 40     |
| Programme   | All Except BAR | Pass Marks | 16     |
| Year / Part | I / I      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

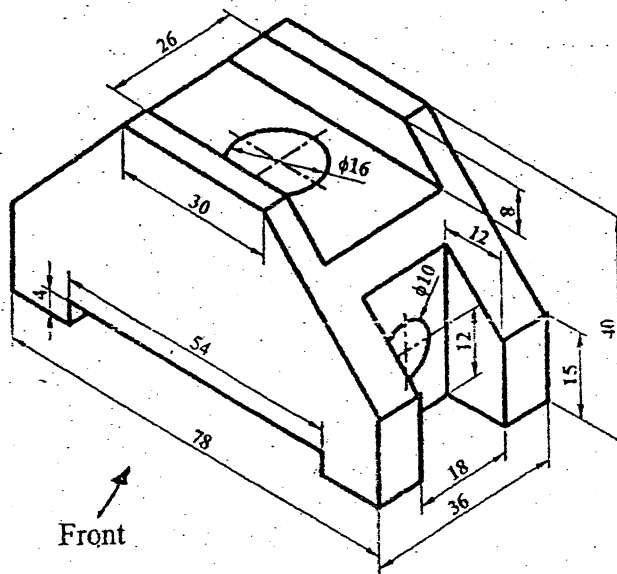
**Subject: - Engineering Drawing I (ME 401)**

- ✓ 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.

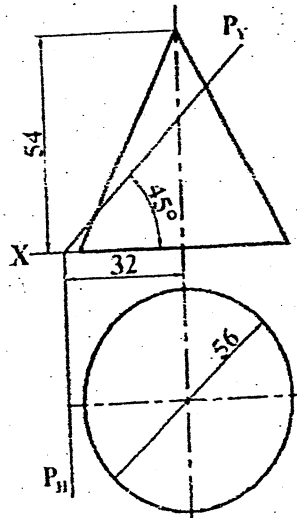
1. Construct a parabola with axis length of 60mm and double ordinate of 40mm. [4]
2. Top and front views of a triangular plane is given in figure below. Draw its true shapes. [5]



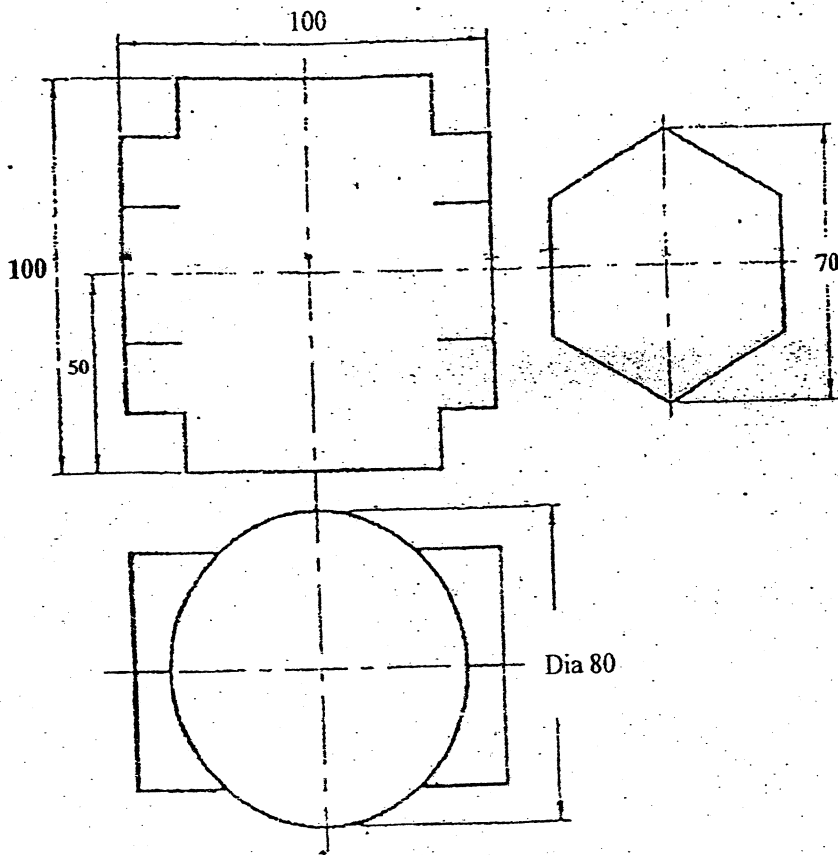
3. Draw orthographic views of the objects shown in figure below with full sectional front view. Assume all holes as through holes. [15]



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]



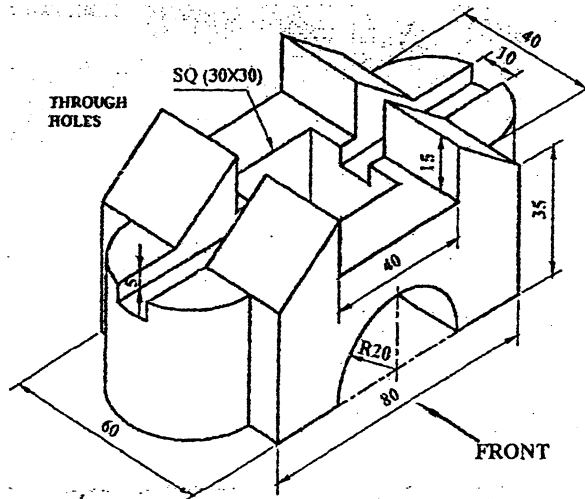
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| Exam.       | Regular        |            |        |
|-------------|----------------|------------|--------|
| Level       | BE             | Full Marks | 40     |
| Programme   | All except BAR | Pass Marks | 16     |
| Year / Part | I / I      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

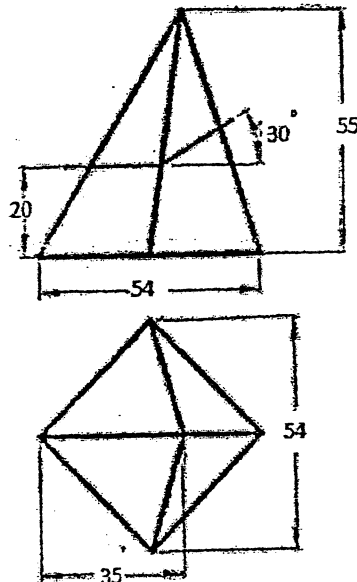
**Subject: - Engineering Drawing I (ME 401)**

- ✓ 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]

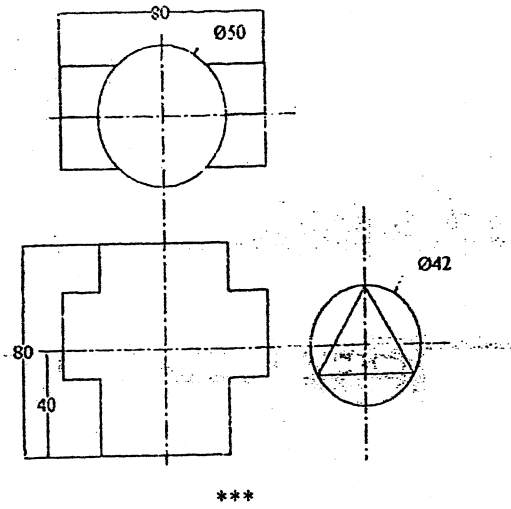


4. Complete the given orthographic drawing and develop its surfaces of figure given below: [10]



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

[6]



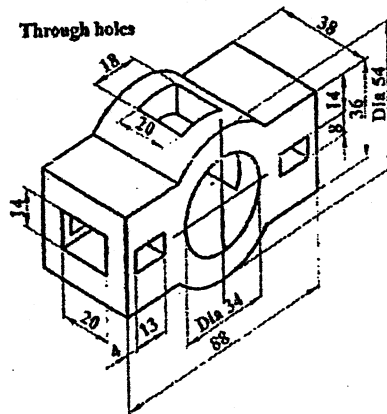


| Exam.       | Back             |            |        |
|-------------|------------------|------------|--------|
| Level       | BE               | Full Marks | 40     |
| Programme   | All (Except BAR) | Pass Marks | 16     |
| Year / Part | I / I            | Time       | 3 hrs. |

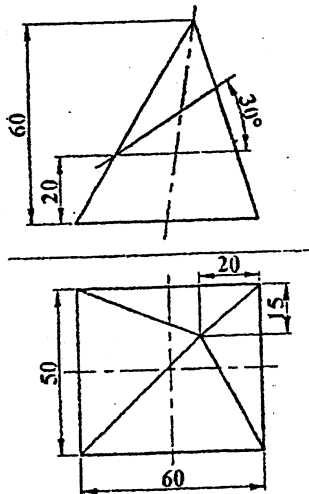
**Subject: - Engineering Drawing I (ME 401)**

- ✓ 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.

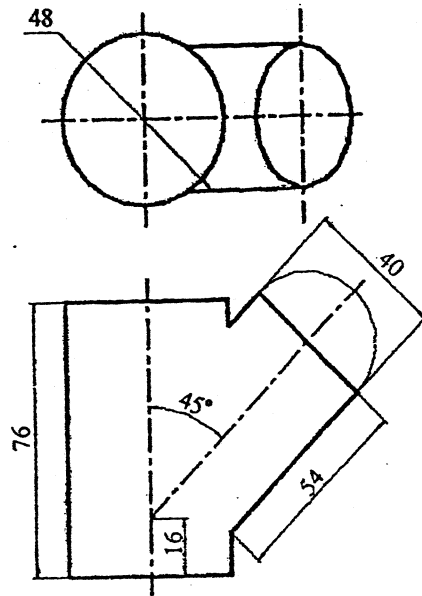
1. Draw an Archimedean Spiral for 1.5 convolutions with pitch equal to 50 mm. [4]
2. A regular hexagon ABCDEF of 25 mm side rests on one of its corner on the HP. Its plane is perpendicular to the VP and inclined to the HP at 30°. Draw its projections when its corner nearer to the VP is 15 mm in front 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]



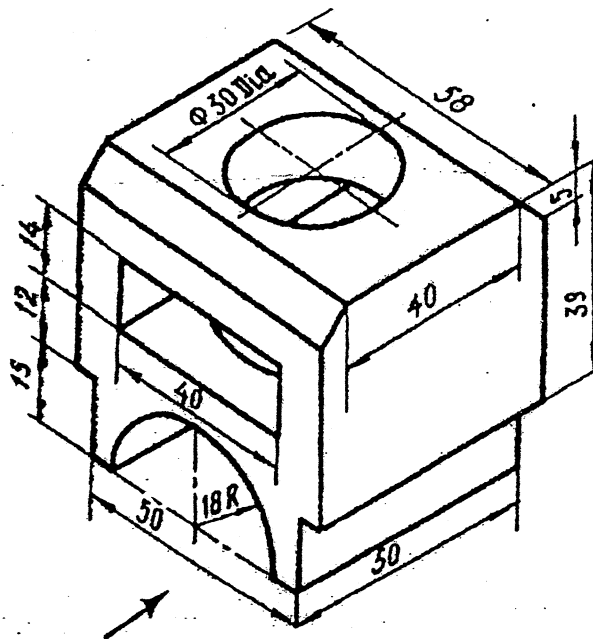
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| Exam.       | Back                 |            |        |
|-------------|----------------------|------------|--------|
| Level       | BE                   | Full Marks | 40     |
| Programme   | All (Except B. Arch) | Pass Marks | 16     |
| Year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

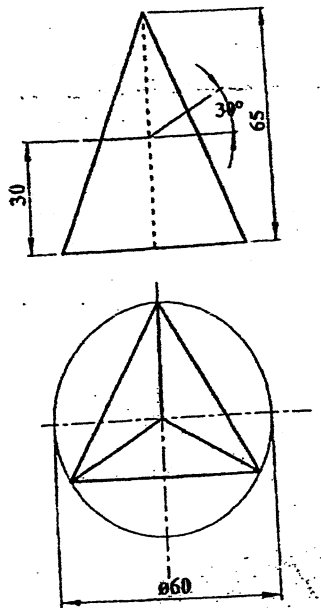
**Subject: - Engineering Drawing I (ME401)**

- ✓ 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.

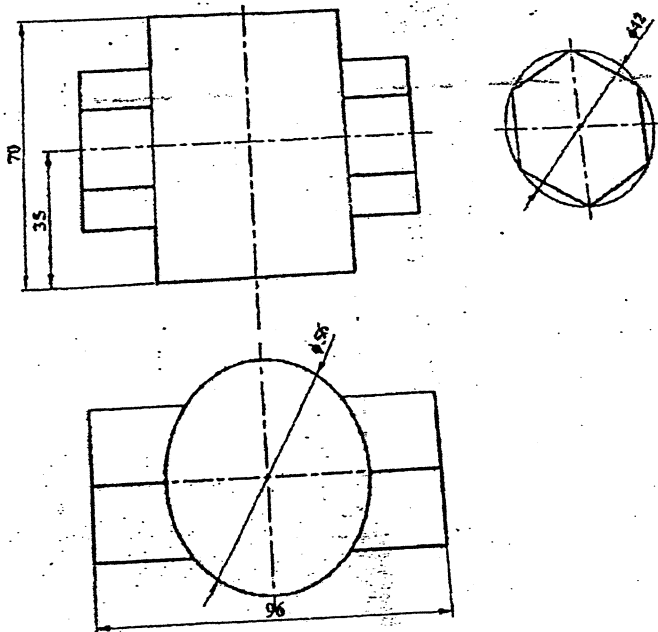
1. Draw helix having a pitch of 50 mm on a cylinder with the diameter of 40 mm and height of 75 mm. [5]
2. ABC is a triangular plane with side AB = 30 mm and sides BC = CA = 50 mm. Side AB is contained by HP and is perpendicular to VP. Draw its projections when its top view is an equilateral triangle 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]



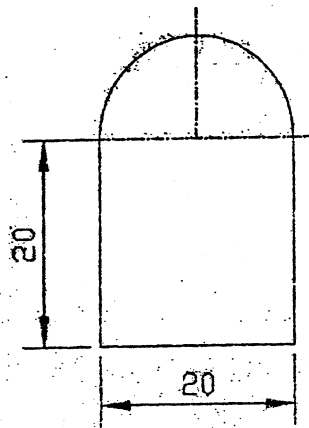
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| Exam.       | Regular               |            |        |
|-------------|-----------------------|------------|--------|
| Level       | BE                    | Full Marks | 40     |
| Programme   | All (Except B. Arch.) | Pass Marks | 16     |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

**Subject: - Engineering Drawing I (ME401)**

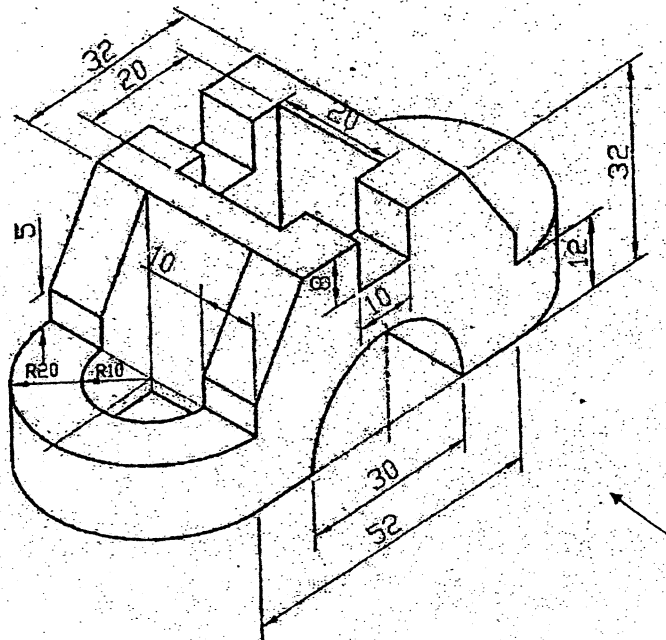
- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt **All** questions.
- ✓ The figures in the margin indicate **Full Marks**.
- ✓ Assume suitable data if necessary.

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

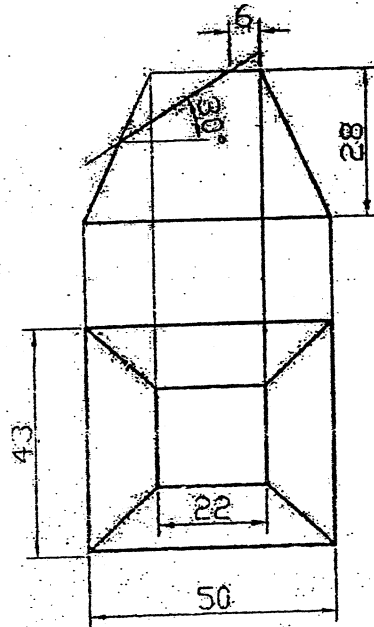


2. A regular pentagonal plane ABCDE of 20mm side has its edge BC resting on the HP. Its plane is perpendicular to the HP and inclined to the VP at 50°. Draw its projections when its corner nearer to the VP is 20 mm in front of the VP. [5]

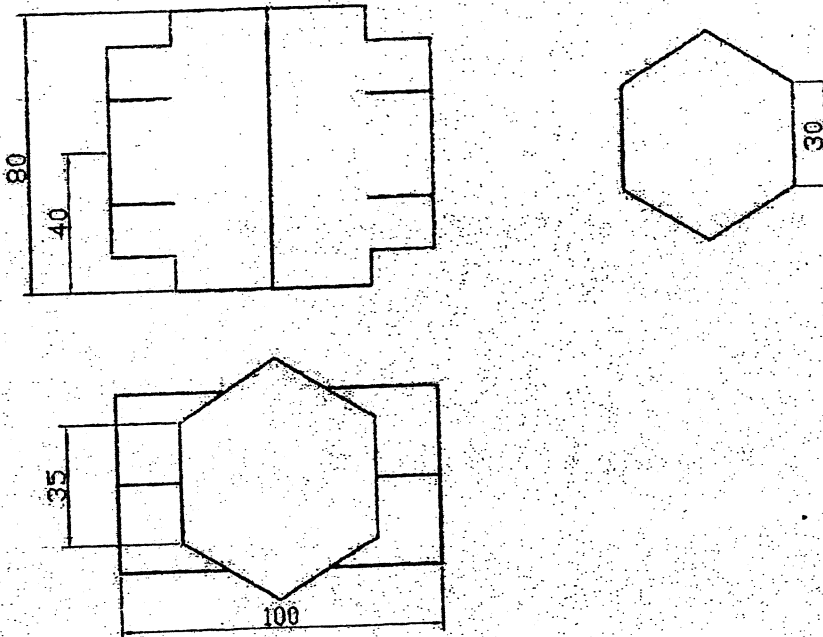
3. Draw orthographic projections with Sectional Side View, Top View and Front View of pictorial drawing as shown in figure below. [14]



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]



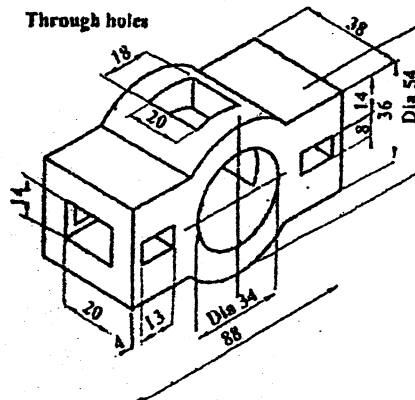
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| Exam.       | Back                |            |        |
|-------------|---------------------|------------|--------|
| Level       | BE                  | Full Marks | 40     |
| Programme   | All (Except B.Arch) | Pass Marks | 16     |
| Year /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

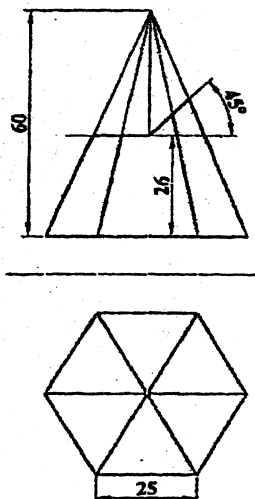
**Subject: - Engineering Drawing I (ME401)**

- ✓ 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  $30^\circ$  to the HP and  $45^\circ$  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]

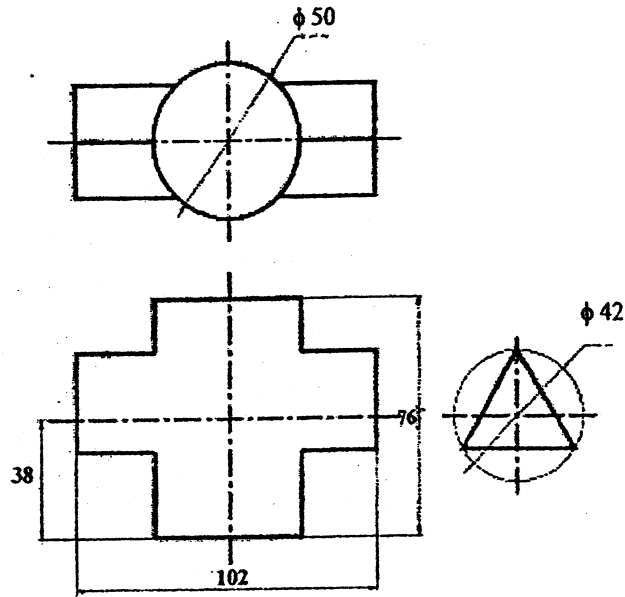


4. Make a complete orthographic drawing of geometrical solid cut by a plane as shown in figure below. Find the true shape of the section. Construct the development of the surfaces of the solid. [12]



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

[6]



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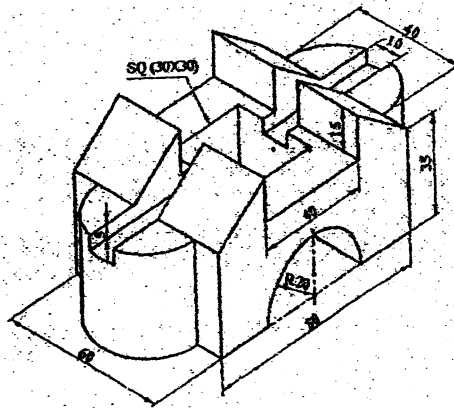


| Exam.       | Regular             |            |        |
|-------------|---------------------|------------|--------|
| Level       | BE                  | Full Marks | 40     |
| Programme   | All (Except B.Arch) | Pass Marks | 16     |
| Year / Part | 1/1                 | Time       | 3 hrs. |

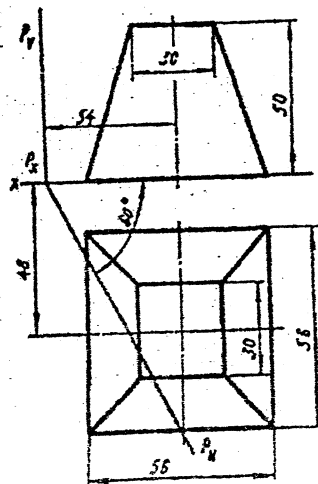
**Subject: - Engineering Drawing I (ME401)**

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

1. Construct an ellipse 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]

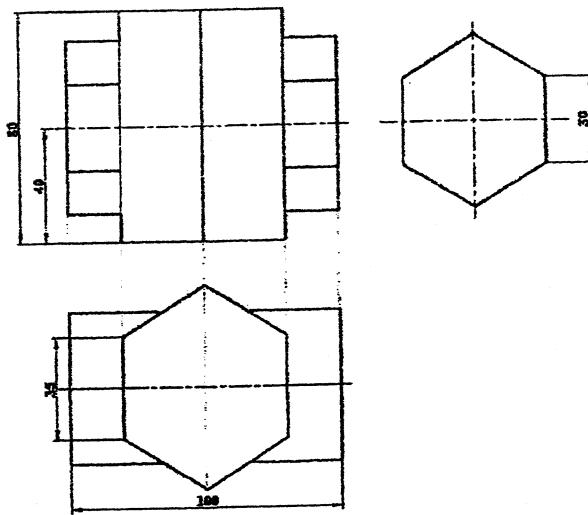


4. Make a complete orthographic drawing of a solid cut by a plane as shown in below figure. Find the true shape of the section. Construct the development of surfaces of the solid. [12]



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

[6]



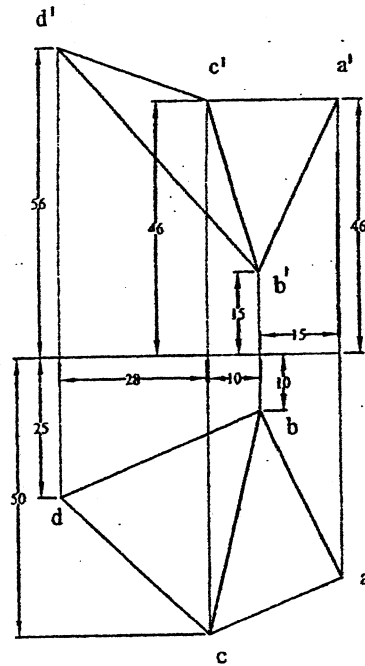
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| Exam.       | New Back (2066 & Later Batch) |            |        |
|-------------|-------------------------------|------------|--------|
| Level       | BE                            | Full Marks | 40     |
| Programme   | ALL (Except B.Arch)  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

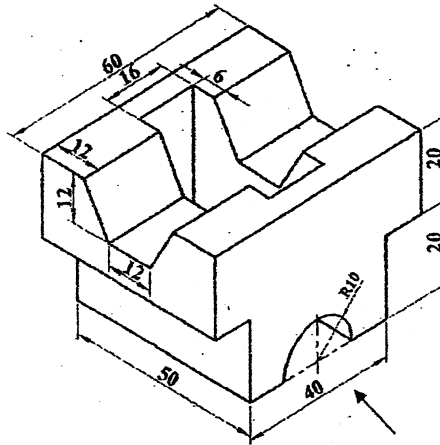
**Subject: - Engineering Drawing I (ME401)**

- ✓ 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.

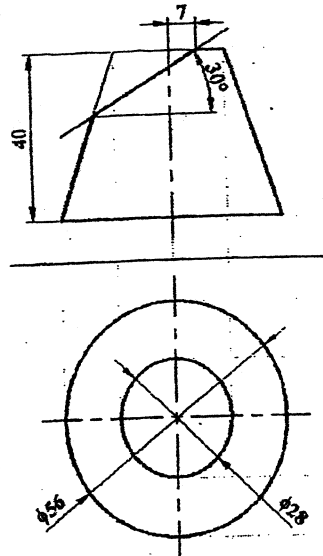
1. The distances between the foci and between the vertices of a hyperbola are 100 mm and 60 mm respectively. Construct the hyperbola. [4]
2. Determine the true size of the angle formed by the planes ABC and BCD shown in figure below. [5]



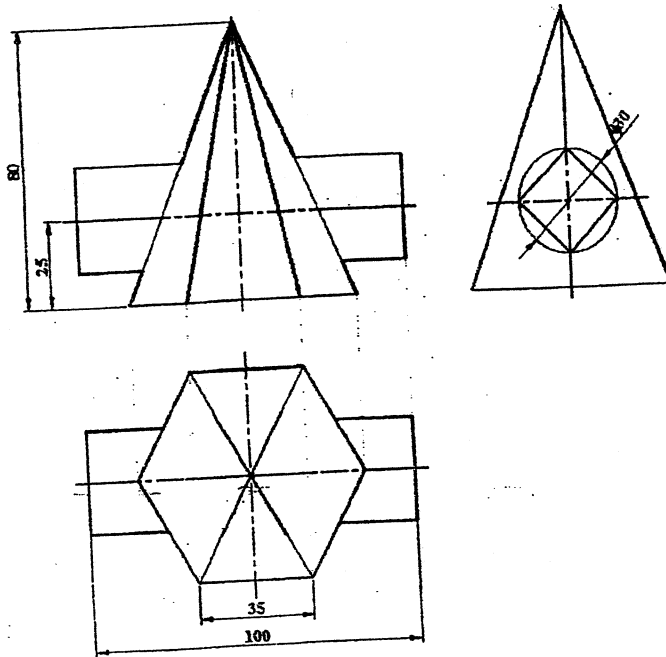
3. Draw orthographic projection with full sectional front view and full sectional side view of solid object shown in figure below. [14]



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]



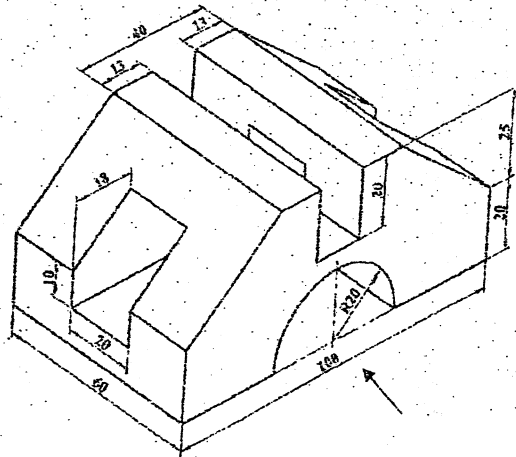
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| Exam.       | Regular              |            |        |
|-------------|----------------------|------------|--------|
| Level       | BE                   | Full Marks | 40     |
| Programme   | All (Except B. Arch) | Pass Marks | 16     |
| Year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

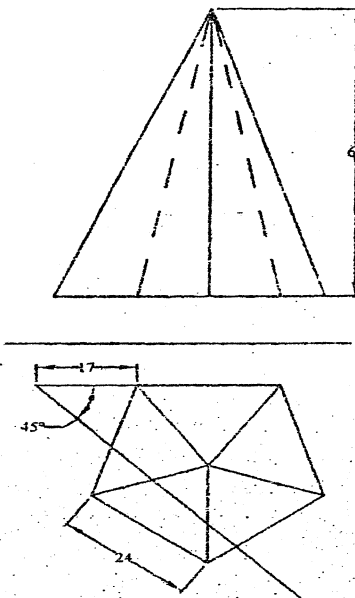
**Subject: - Engineering Drawing I (ME401)**

- ✓ 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  $45^\circ$ . 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]

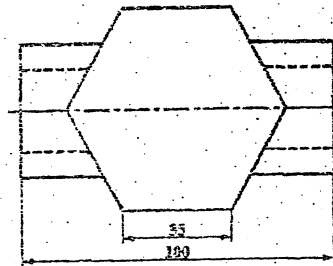
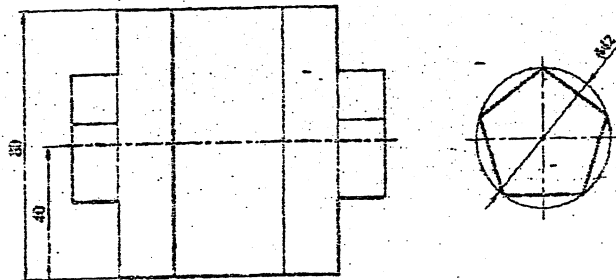


4. Complete orthographic views of the right solids shown in figure below cut by the plane. Find the true shape of the section. Then draw development of surface. [12]



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

[5]



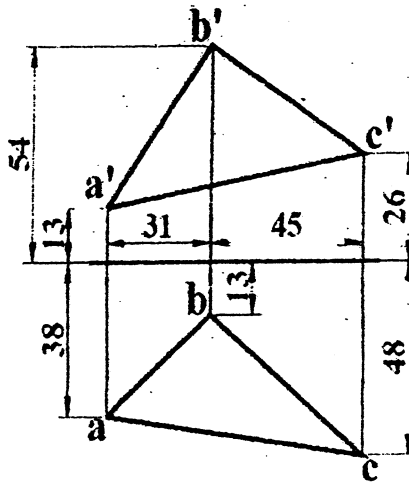
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| Exam.       | New Back (2066 & Later Batch) |            |        |
|-------------|-------------------------------|------------|--------|
| Level       | BE                            | Full Marks | 40     |
| Programme   | All (Except B. Arch) 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

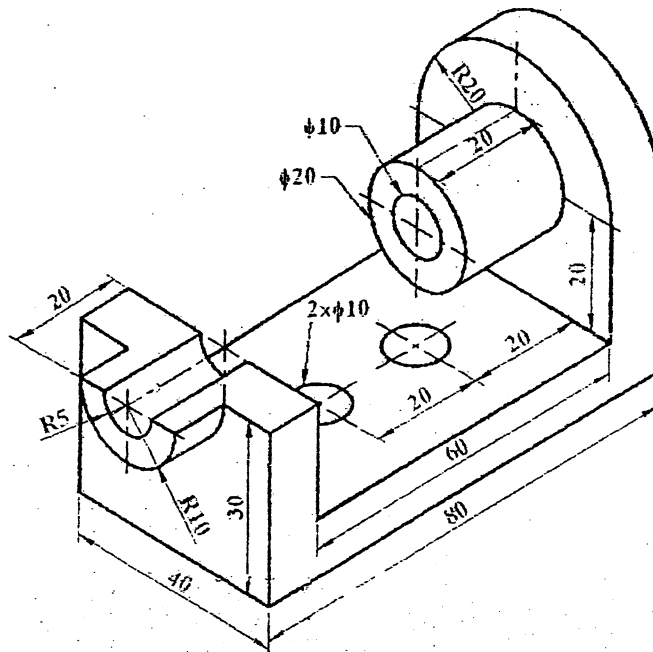
*Subject: - Engineering Drawing I (ME401)*

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

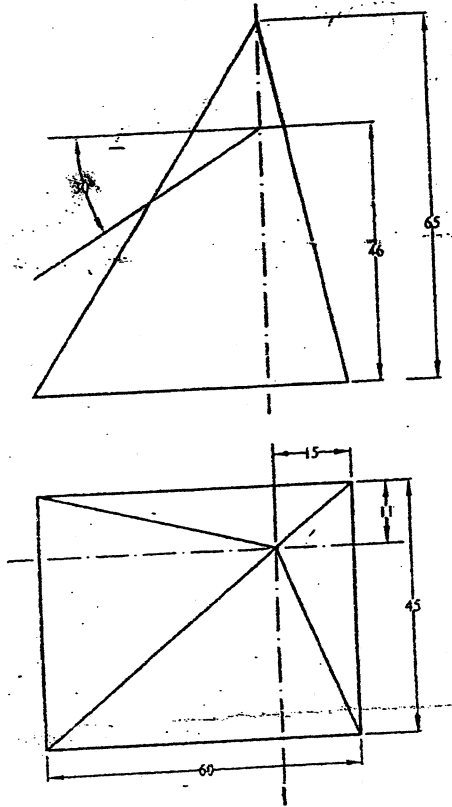
1. Draw two circles with radii 15 mm and 20 mm respectively with their centers lying on a horizontal line and 60 mm apart. Draw an arc tangent of radius 40 mm outside to both the circles. [3]
2. Reproduce the given views of the plane shown in figure below. Determine its true perimeter and true inclination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



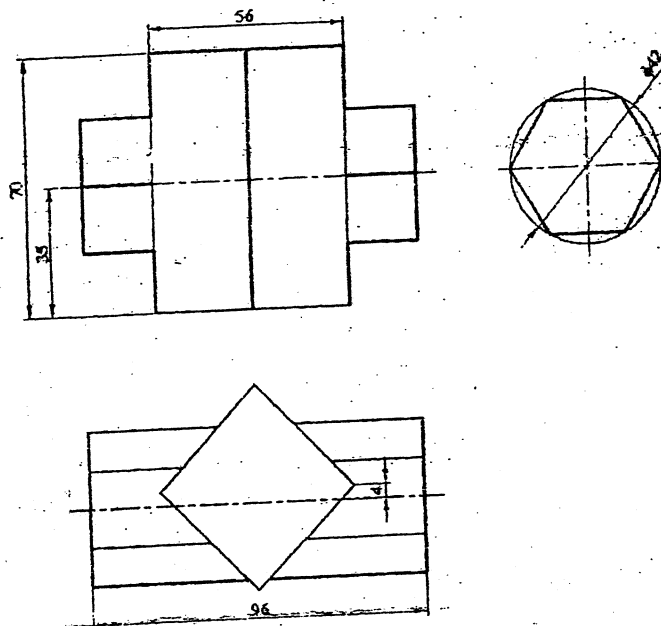
3. Pictorial view of an object is shown in figure below. Draw (with dimension) its (a) sectional front view, (b) side view and (c) top view. [15]



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



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



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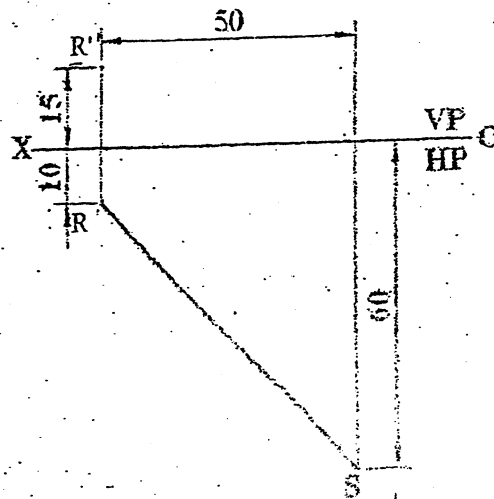


|             |                     |            |        |
|-------------|---------------------|------------|--------|
| Exam.       | BE                  | Full Marks | 40     |
| Level       | BE                  | Pass Marks | 16     |
| Programme   | All (Except B.Arch) | Time       | 3 hrs. |
|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

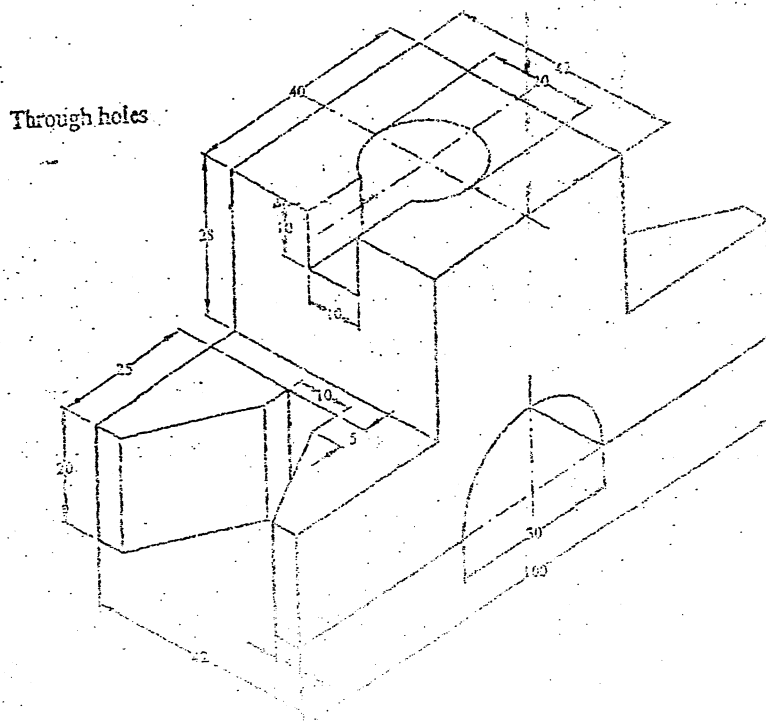
*Subject: - Engineering Drawing I (ME401)*

- ✓ 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.

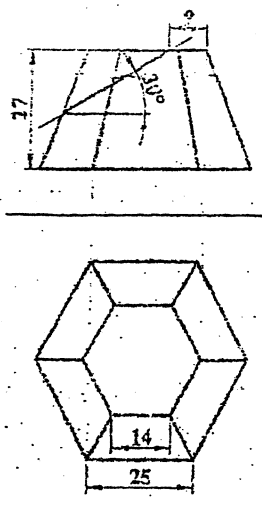
1. Construct an ellipse having a major axis 80 mm and minor axis 60 mm. [3]
2. Top view of a straight line RS and the front view of its end R are shown in figure below. Complete its projection if it is inclined at 30° to the HP. Also determine its true length and true inclination with the VP. [5]



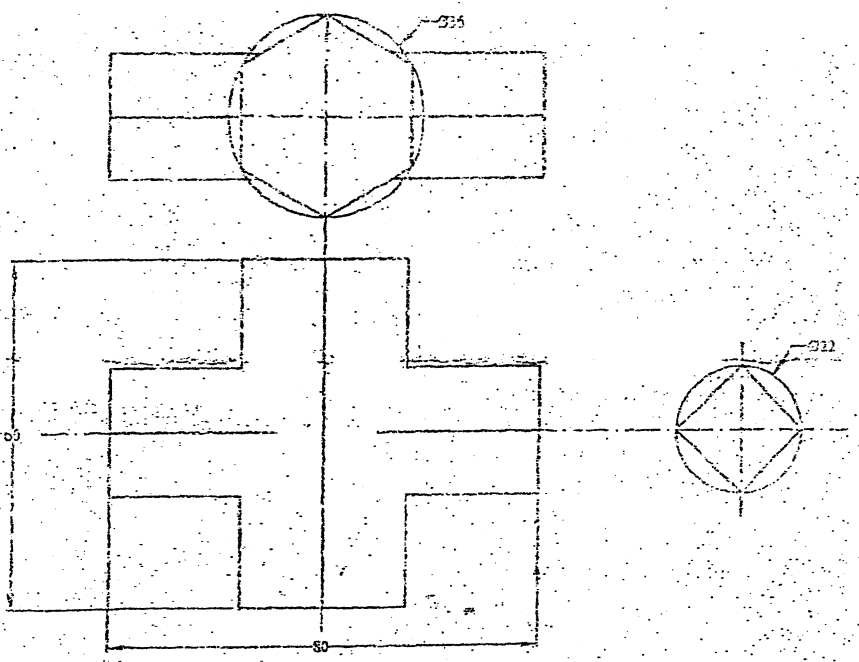
3. Draw orthographic projections with full sectional front view, top view and side view of the given object shown in figure below. [15]



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. [15]



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



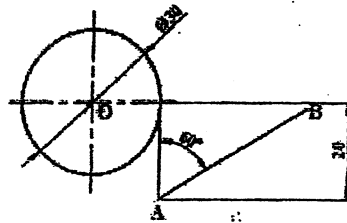
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| Exam.       | New Back (2066 & Later Batch) |            |        |
|-------------|-------------------------------|------------|--------|
| Level       | BE                            | Full Marks | 40     |
| Programme   | All (Except B.Arch)  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

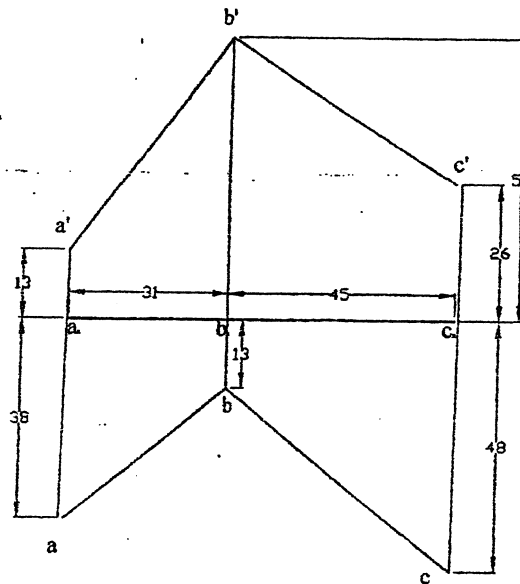
**Subject: - Engineering Drawing I (ME401)**

- ✓ 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.

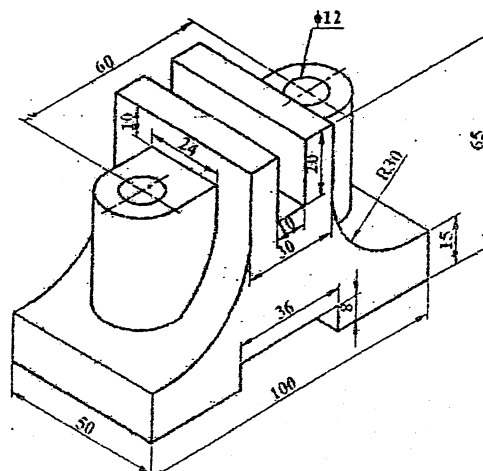
1. Figure below shows a straight line and a circle. Draw an arc of radius 18 mm tangent to both the given line and circle and outside to the given circle. [3]



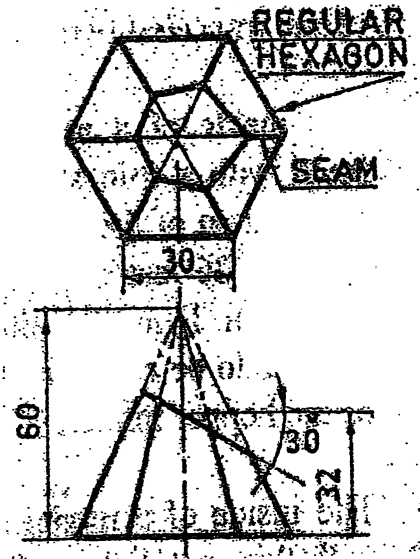
2. Find the true angle between line AB and BC. [5]



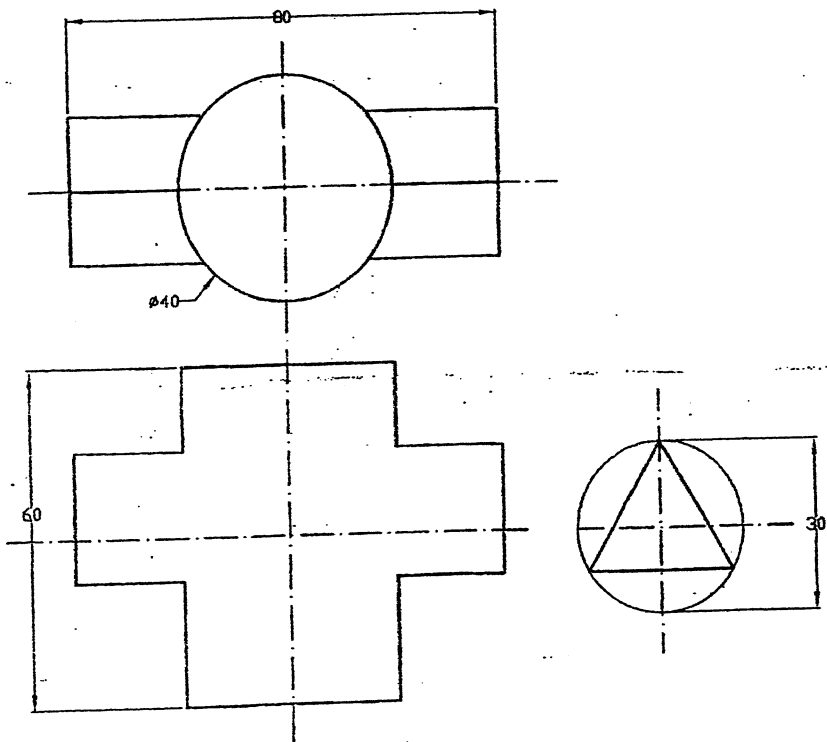
3. Pictorial view of an object is shown in figure below. Draw (with dimension) its (a) sectional front view, (b) sectional side view and (c) top view. [15]



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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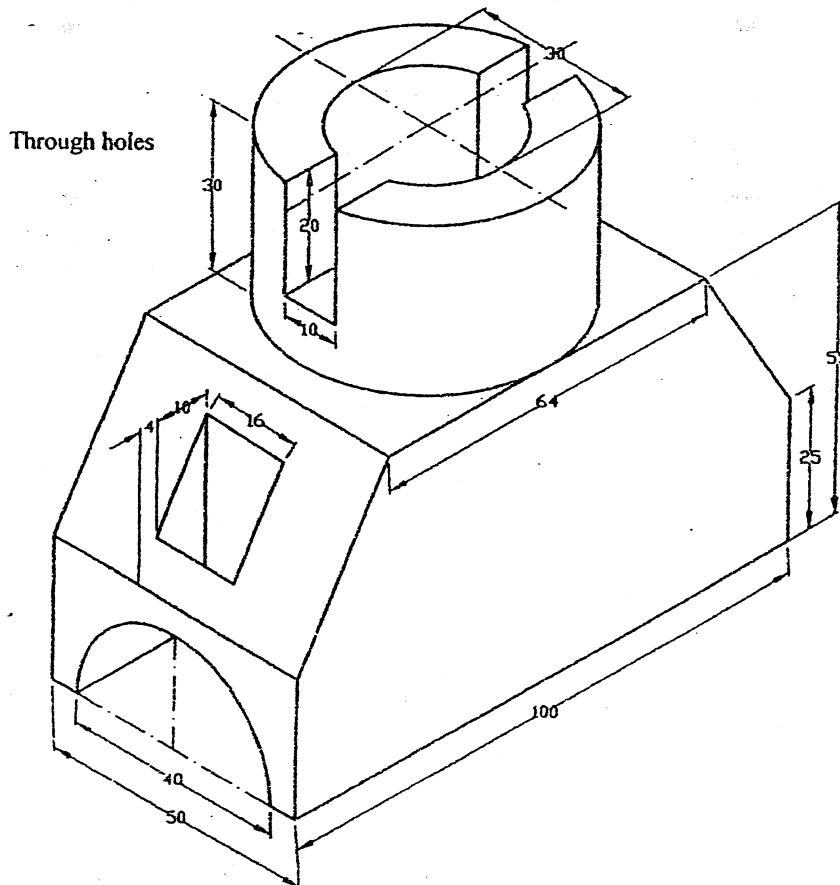
02 TRIBHUVAN UNIVERSITY  
 INSTITUTE OF ENGINEERING  
 Examination Control Division  
 2070 Chaitra

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

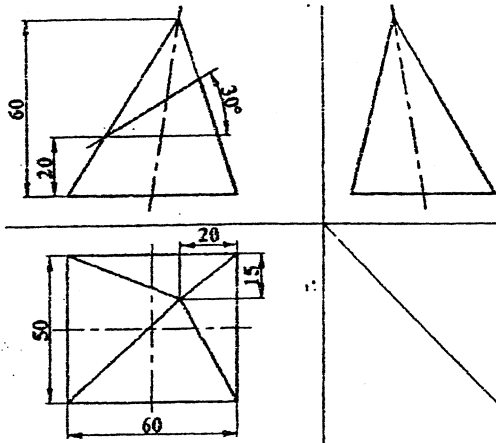
**Subject: - Engineering Drawing I (ME401)**

- ✓ 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.

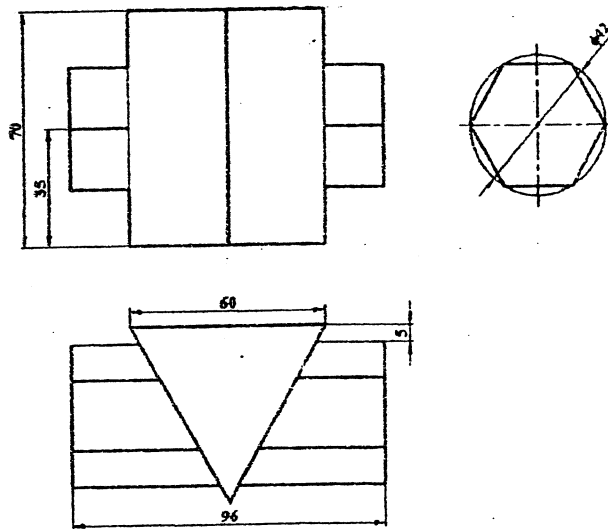
1. Draw an involute of circle having diameter of 40 mm. [3]
2. A regular pentagonal plane ABCDE of 20 mm side has its edge BC resting on the HP. Its plane is perpendicular to the HP and inclined to the VP at  $45^\circ$ . Draw its projections when its corner nearer to the VP is 18 mm in front of the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



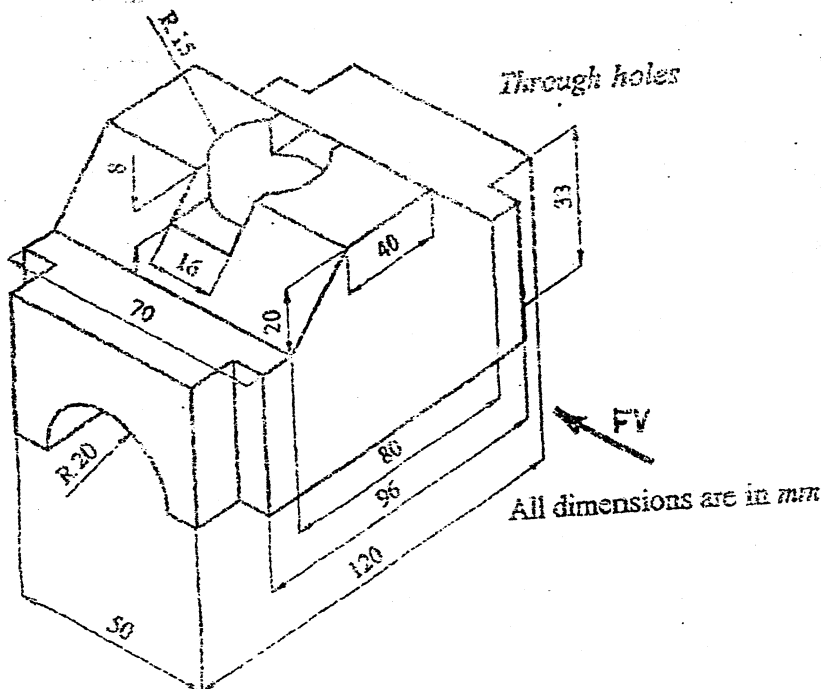
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|             |                     |            |        |
|-------------|---------------------|------------|--------|
| Exam.       | New Part (2016/17)  |            |        |
| Level       | BE                  | Full Marks | 40     |
| Programme   | All (Except B.Arch) | Pass Marks | 16     |
| Year / Part | 1 / 1               | Time       | 3 hrs. |

**Subject: - Engineering Drawing I (ME401)**

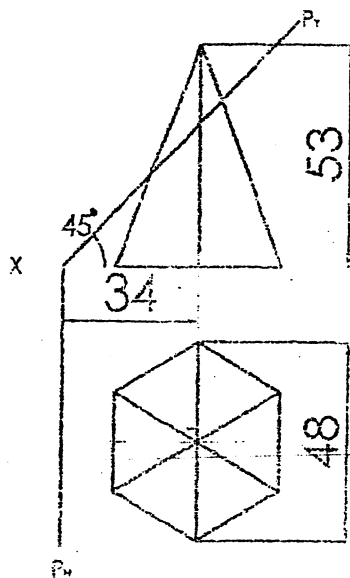
- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

1. Construct an Archimedian's spiral curve of one convolution of diameter 120mm. [4]
2. Draw three orthographic projections of a rectangular lamina 60mm×40mm, 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]



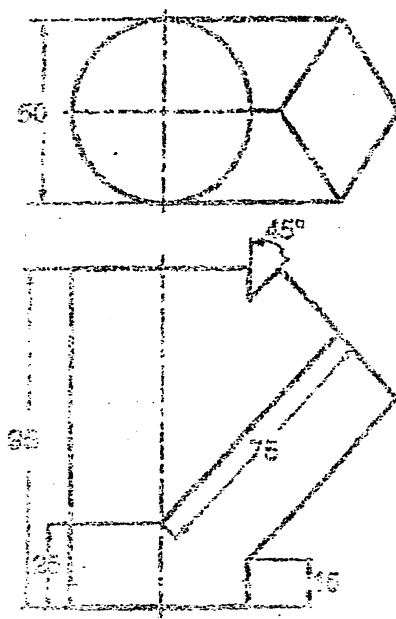
4. Make complete the orthographic view of geometrical solid cut by plane as shown in figure below. Find the true shape of the section. Construct the development of the surfaces of the solid.

[12]



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

[5]



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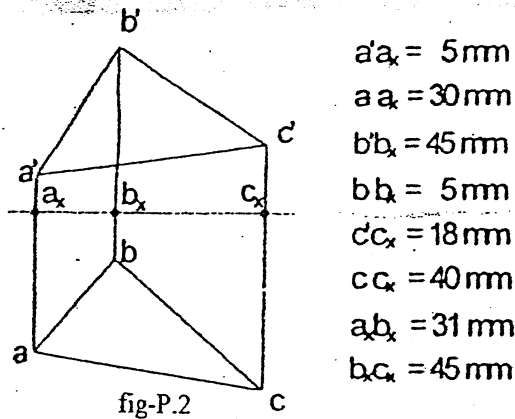


| Exam.       | Regular             |            |        |
|-------------|---------------------|------------|--------|
| Level       | BE                  | Full Marks | 40     |
| Programme   | All (Except B.Arch) | Pass Marks | 16     |
| Year / Part | I / I               | Time       | 3 hrs. |

**Subject: - Engineering Drawing I (ME401)**

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

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



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

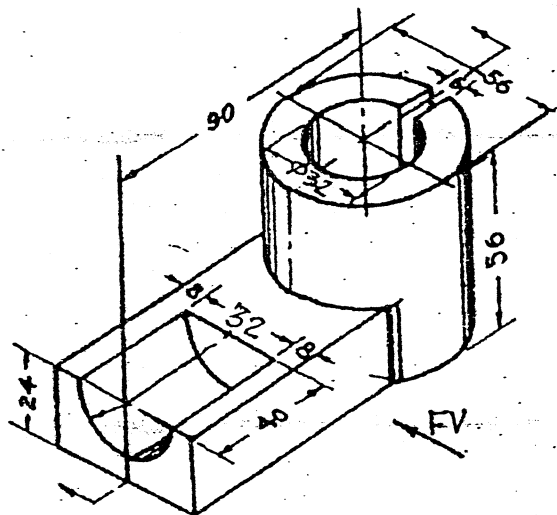


fig-P.3

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

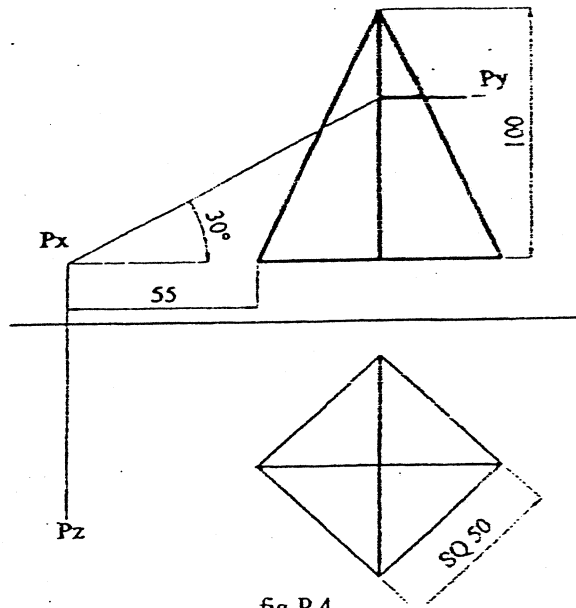


fig-P.4

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

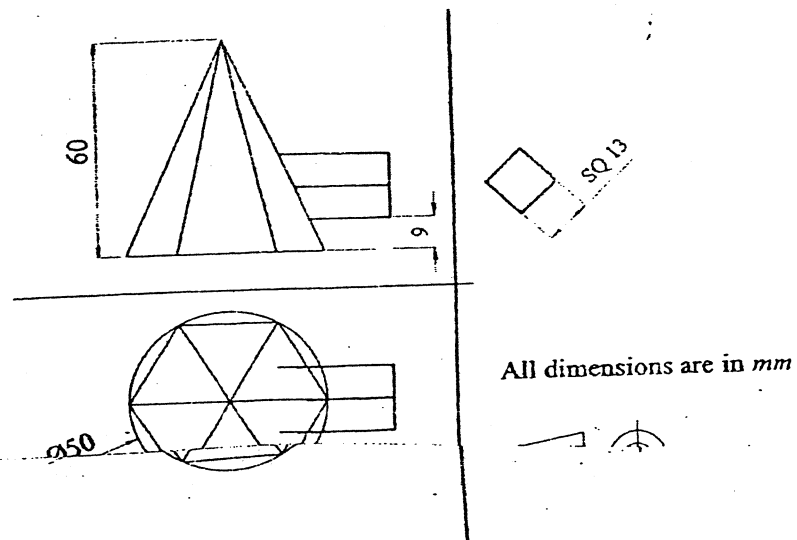


fig-P.5

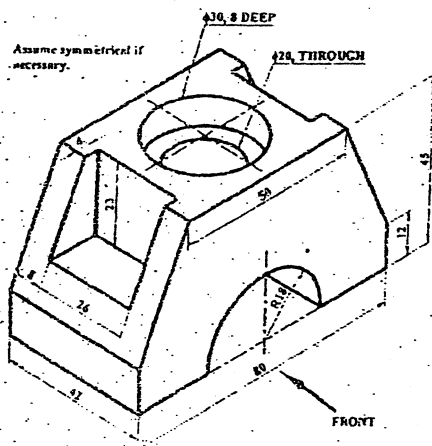
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|             |                               |            |        |
|-------------|-------------------------------|------------|--------|
| Exam.       | New Back (2066 & Later Batch) |            |        |
| Level       | BE                            | Full Marks | 40     |
| Programme   | All (Except B.Arch)           | Pass Marks | 16     |
| Year / Part | 1/1                           | Time       | 3 hrs. |

*Subject: - Engineering Drawing (ME 401)*

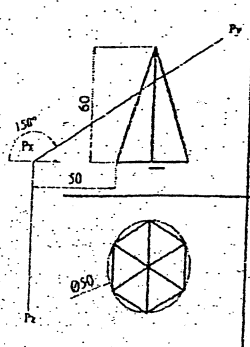
- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

1. Draw involutes of a square having side 30mm. [3]
2. A rectangle ABCD, (60mm×40mm) is parallel to HP with one of its sides inclined at 30° to VP and the end of the side near to VP is 15mm in front of the VP and 30mm above the HP. Draw its projections. [5]
3. Pictorial view of an object is shown in figure below. Draw the sectional front view, top view and side view for the same. [15]



All dimensions are in mm.

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

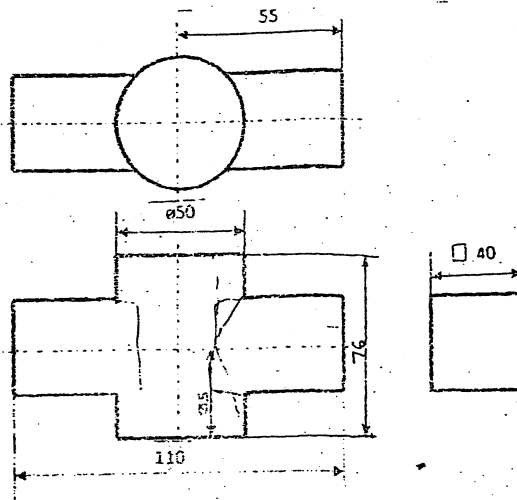


All dimensions are in mm



5. Draw the given figure as shown in figure below and complete the intersections.

[5]



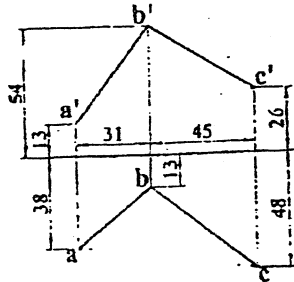
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| Exam.       | Regular               |            |        |
|-------------|-----------------------|------------|--------|
| Level       | BE                    | Full Marks | 40     |
| Programme   | All (Except B. Arch.) | Pass Marks | 16     |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

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

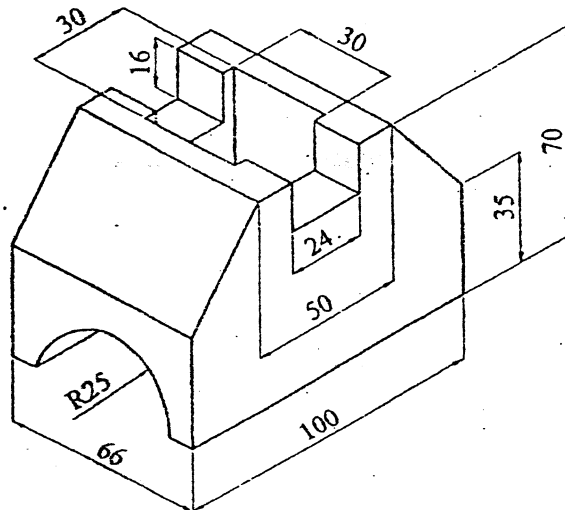
- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ Necessary figures are attached herewith.
- ✓ Assume suitable data if necessary.

1. Draw a parabola with double ordinate 80mm and axis length 60mm. [3]
2. Find the true angle between lines AB and BC. [5]

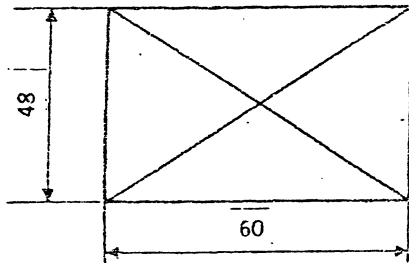
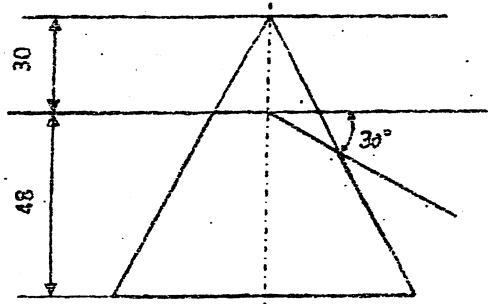


3. Draw orthographic projections with full sectional front view, side view and top view of pictorial drawing shown in figure below. [15]

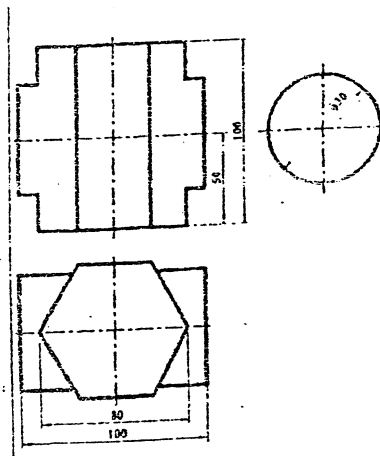
Through holes



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 solid surface. [12]



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



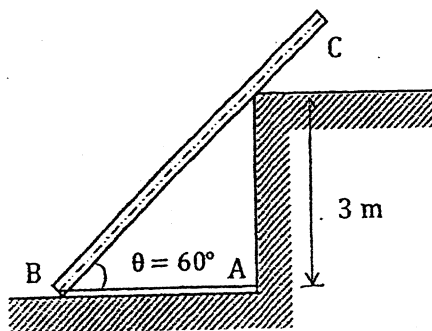
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| Exam.       | Regular                                   |            |        |
|-------------|-------------------------------------------|------------|--------|
| Level       | BE                                        | Full Marks | 80     |
| Programme   | BEL, BEX, BEL, BAM,<br>BIE, BAG, BAR, BAS | Pass Marks | 32     |
| Year / Part | I/I                                       | Time       | 3 hrs. |

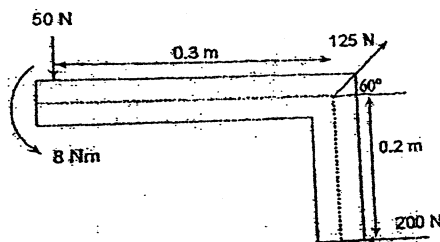
**Subject: - Applied Mechanics (CE 401)**

- ✓ 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.

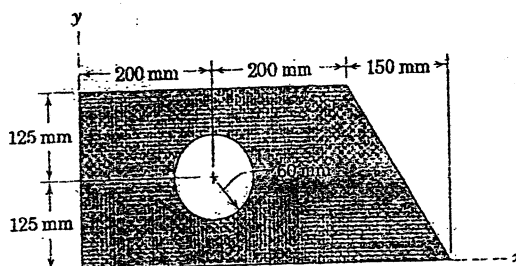
1. Why do you think idealization in applied mechanics is necessary? List out the idealization used. [3]
2. A cable AB holds a post BC of 4 m length from sliding as shown in figure. The post BC has a mass of 8 kg. Assuming all surface are smooth, determine the tension in the cable AB. How can you draw a good FBD? [6+2]



3. State and prove Varignon's theorem. An angle bracket has been subjected to three forces and a couple as shown in the figure. Determine the resultant of these forces. Locate the position of resultant. [4+8]

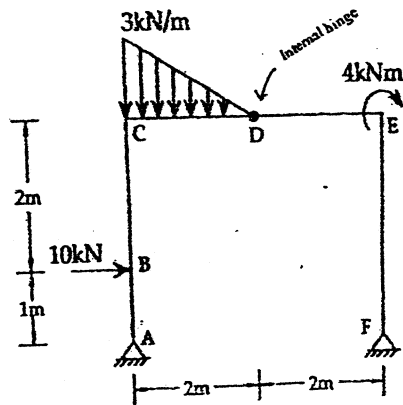


4. State and prove parallel axis theorem. Find moment of inertia of the given composite figure about its centroidal axis. [4+8]

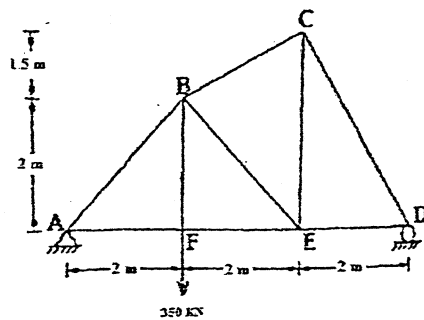


5. Define impending motion. How can we assure the condition of sliding or tipping of a block? [1+3]

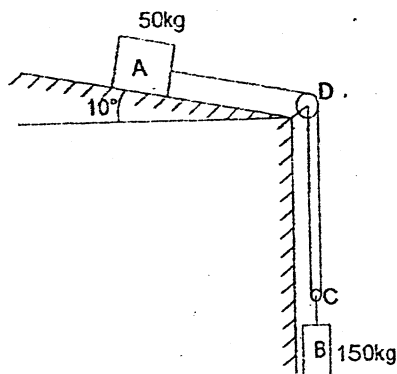
6. Draw axial force, shear force and bending moment diagram of the given frame. Indicate salient features (if any). [13]



7. What are the assumptions of an ideal truss? Determine the force developed in the members AB, BC, BF, BE of the truss loaded as shown in figure below. [2+6]



8. Explain about the radial and transverse for components of velocity and acceleration for a particle moving in a curvilinear path. A projectile is fired from the edge of a 145 m cliff with an initial velocity of 200 m/s at an angle of  $30^\circ$  with the horizontal. Neglecting air resistance, find [3+7]
- the greatest elevation above the ground
  - the horizontal distance from the gun to the point where the projectile strikes the ground
  - the velocity with which it strikes the ground
9. Define impulse momentum principle for particles. Two blocks start from rest. The pulley is frictionless and having no mass. If  $\mu_k$  between block A and inclined plane is 0.35. Determine the acceleration of each block and tension in each cord. [2+8]



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TRIBHUVAN UNIVERSITY  
INSTITUTE OF ENGINEERING  
Examination Control Division

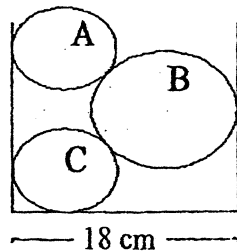
2079 Baishakh

| Exam.       | Back                                         |            |        |
|-------------|----------------------------------------------|------------|--------|
| Level       | BE                                           | Full Marks | 80     |
| Programme   | BEL, BEX, BCT,<br>BAM, BIE, BAG,<br>BAR, BAS | Pass Marks | 32     |
| Year / Part | 1 / 1                                        | Time       | 3 hrs. |

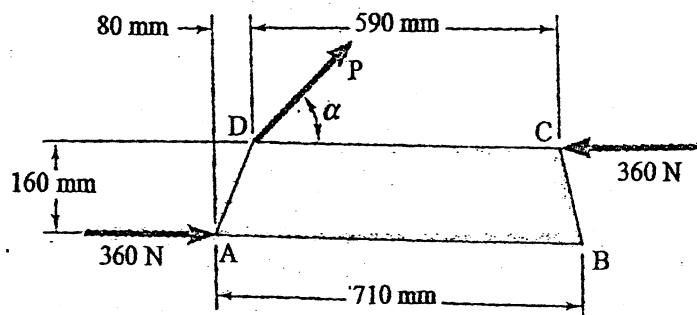
**Subject: - Applied Mechanics (CE 401)**

- ✓ 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.

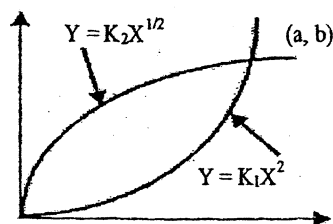
1. Explain in brief about fundamental concepts and principle of mechanics. [4]
2. Determine the reactions at the contact points, if three cylinders are piled in a rectangular ditch as shown in figure. Given that the weight of the cylinders are  $W_A = 3 \text{ kN}$ ,  $W_B = 5 \text{ kN}$ ,  $W_C = 3 \text{ kN}$  respectively and radius of cylinders  $R_A = 4 \text{ cm}$ ,  $R_B = 6 \text{ cm}$ ,  $R_C = 4 \text{ cm}$ . Explain resolution and composition of force. [7+4]



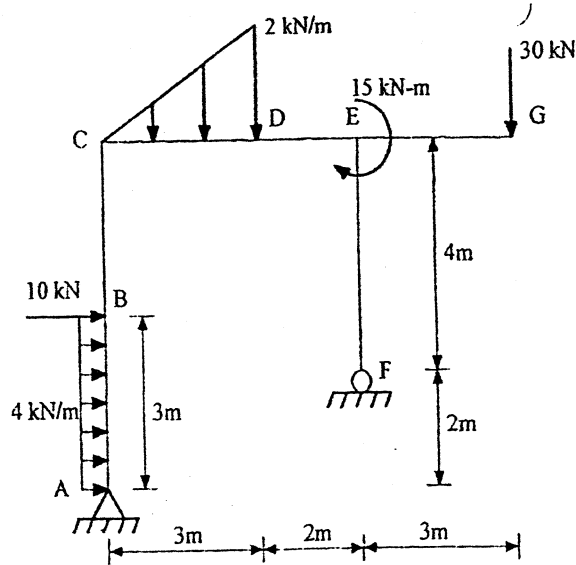
3. A trapezoidal plate is acted upon by the force 'P' and the couple shown. Determine [4+4]
  - a) the point of application on the plate of the smallest force 'F' that is equivalent to given system
  - b) the magnitude and direction of 'F'



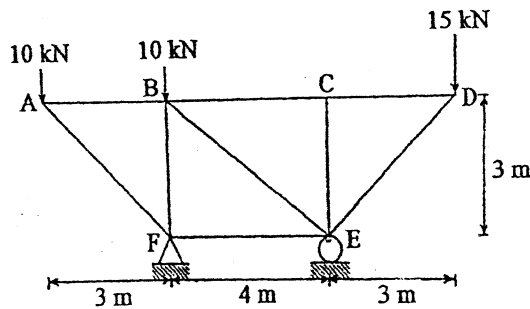
4. State and prove the parallel axis theorem for moment of inertia. Determine the moment of inertia about centroidal X-axis of given plane figure by using integration method. [4+8]



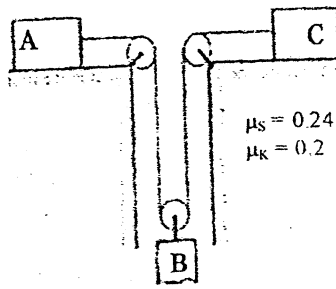
5. "The four different situation that can occur when a rigid body is in contact with a horizontal surface having coefficient of static and kinetic friction as  $\mu_s$  and  $\mu_k$  respectively are: a) No friction, b) No motion, c) Motion impending and d) Motion". Justify the statement with suitable example. [4]
6. Draw axial force, shear force and bending moment diagram of the given frame. Indicate salient features if any. [13]



7. What are the assumptions of an ideal truss? Find the member force in the members AF, BF, BE, CE of the truss shown below. [2+6]



8. Define uniformly rectilinear motion and uniformly accelerated motion. The relation for  $r$  and  $\theta$  for the motion of a particle is given by  $r = \theta^3$  and  $\theta = t^2$  where  $r$  is in meters,  $\theta$  is in radians and  $t$  is in sec. Find the velocity and acceleration when  $\theta = 0.3$  radian. [2+8]
9. Show that, "rate of change of angular momentum about a point is equal to moment of the force about same point". Three blocks A, B and C of mass 5 kg, 10 kg and 10 kg respectively are connected by rope and pulley arrangement as shown in figure. Neglecting mass of pulley, determine acceleration of each block and tension in each cable. [2+8]



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TRIBHUVAN UNIVERSITY  
INSTITUTE OF ENGINEERING  
Examination Control Division

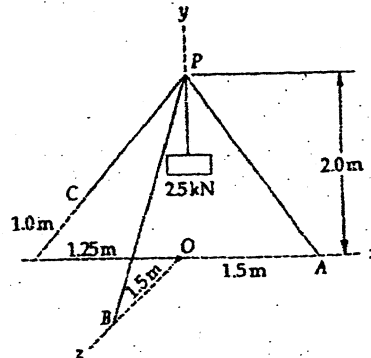
2078 Bhadra

| Exam.       | Regular                                      |            |        |
|-------------|----------------------------------------------|------------|--------|
| Level       | BE                                           | Full Marks | 80     |
| Programme   | BEL, BEX, BCT,<br>BAM, BIE, BAG,<br>BAR, BAS | Pass Marks | 32     |
| Year / Part | 1/1                                          | Time       | 3 hrs. |

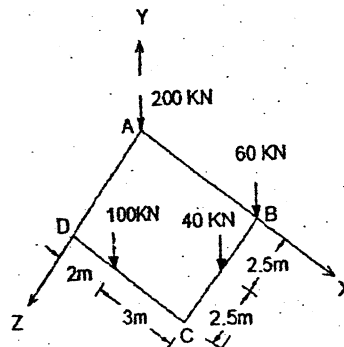
**Subject: - Applied Mechanics (CE 401)**

- ✓ 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.

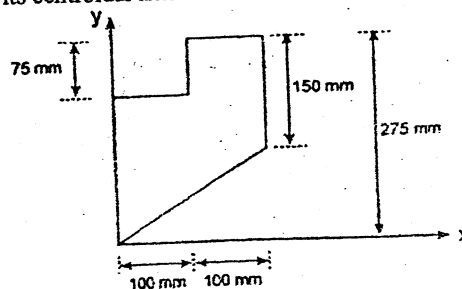
1. Explain the basic concepts used to study the condition of rest or motion of particles and rigid body under the action of force. Define transmissibility of force. [2+2]
2. A tripod supports a load of 2.5 kN at point P as shown in figure. The end points A, B, C of the three legs in the x-z plane. Make calculations for the force developed in each leg. Explain free body diagram and its importance. [6+4]



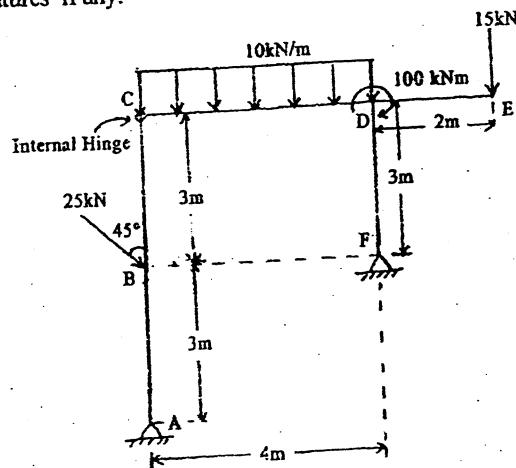
3. How does "Varignon's theorem" differ from "Principle of Moments"? Explain. Determine the magnitude and point of application of resultant for a system of force consisting of a square foundation ABCD supporting the four column loads as shown. [3+6]



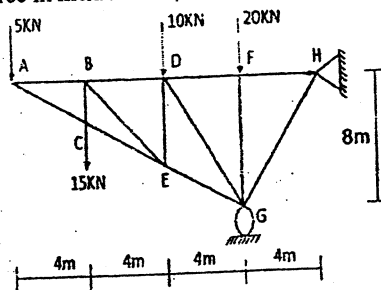
4. State & prove parallel axis theorem. Calculate polar moment of inertia of the given composite area about its centroidal axis. [4+8]



5. What is impending motion? Explain why coefficient of static friction is always greater than that of the kinetic friction coefficient? [2+2]
6. Draw axial force, shear force and bending moment diagram for the given frame. Also indicate salient features if any: [13]

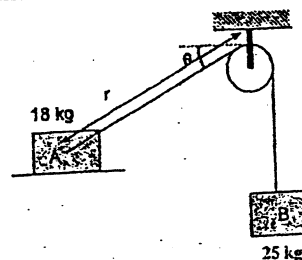


7. Determine the member force in member BE, BD, FG and EG of given loaded truss. [8]



8. Explain about dependent motion of particles with suitable example. The acceleration of a particle is defined by the relation  $a = kt - 4$ . Knowing that  $v = 4\text{m/s}$  when  $t = 2\text{s}$  and  $v = -1\text{m/s}$  when  $t = 1\text{s}$ . Determine the value of constant  $k$  and write the equations of motion when  $x = 0$  at  $t = 3\text{s}$ . [2+8]
9. Explain angular momentum and rate of change of angular momentum. The velocity of the block A is  $2\text{ m/sec}$  to the right at the instant when  $r = 0.73$  and  $\theta = 30^\circ$ . Neglecting mass of the pulley and effect of friction, determine at this instant. [2+8]

- (i) tension in the cable  
 (ii) acceleration of block A  
 (iii) acceleration of block B



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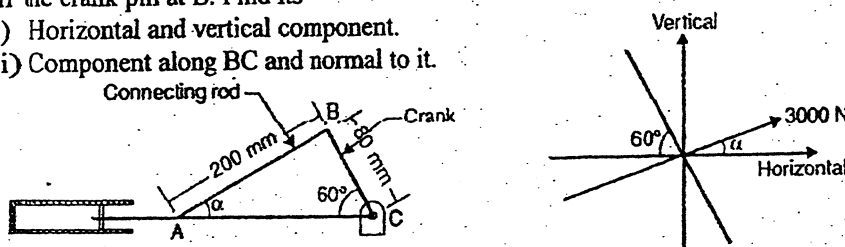
2078 Kartik

| Exam.       | Back                                              |            |        |
|-------------|---------------------------------------------------|------------|--------|
| Level       | BE                                                | Full Marks | 80     |
| Programme   | BEL, BEX, BEI,<br>BCT, BAM, BIE,<br>BAG, BAR, BAS | Pass Marks | 32     |
| Year / Part | I/I                                               | Time       | 3 hrs. |

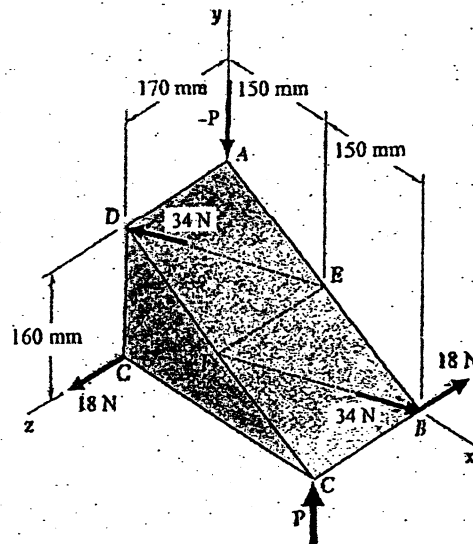
**Subject: - Applied Mechanics (CE 401)**

- ✓ 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.

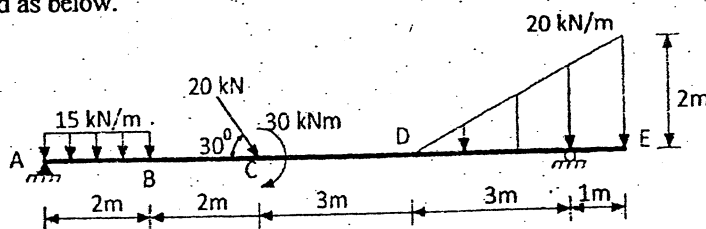
1. What do you mean by Mechanics? Explain the principle of mechanics. [3]
2. Figure below shows a particular position of 200mm connecting rod AB and 80mm long crank BC. At this position, the connecting rod of the engine experience a force of 3000N on the crank pin at B. Find its [3+3]
  - (i) Horizontal and vertical component.
  - (ii) Component along BC and normal to it.



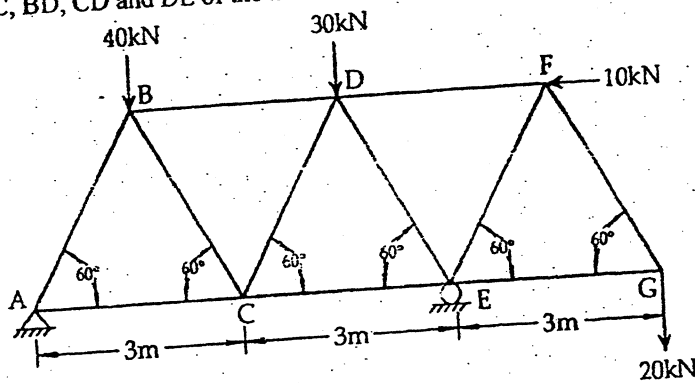
3. Prove that couple is a free vector. Explain how we can reduce a given force into force and couple at a point. If  $P=20\text{N}$ , replace the three couples with a single equivalent couple, specifying its magnitude and the direction of its axis. [3+3+8]



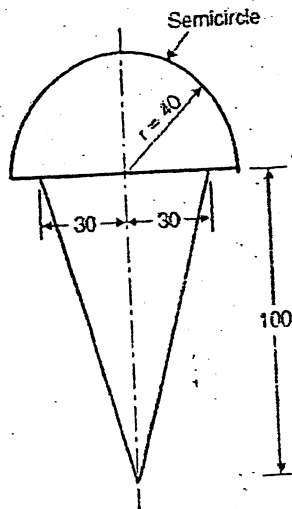
4. Deduce the relationship between load, shear force and bending moment of the beam section loaded uniformly with intensity of load  $w$ . Draw AFD, SFD and BMD for the beam loaded as below. [4+9]



5. Explain the use of truss in engineering approach. Determine the force developed in the members BC, BD, CD and DE of the truss loaded as shown in figure. [2+6]

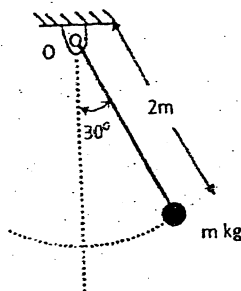


6. Define centroid and radius of gyration with examples. Find the moment of inertia of the given section about centroidal axes. [4+8]



All dimension are in mm

7. Define friction, static and kinetic friction. Also explain about impending motion. [4]
8. Determine motion of particle when acceleration is given function of position. A ball is thrown vertically up from 20m level in an elevator shaft with velocity of 20m/s. After 1 sec, an open platform elevator passes the 5m level, moving upward with constant velocity 2m/s. Calculate when & where ball hits the elevator. [4+6]
9. The bob of 3m pendulum describes an arc of circle in a vertical plane. If the tension in the cord is 2 times the weight of bob of the position shown, find the velocity and acceleration of the bob in that position. Define impulse momentum principle and dynamic equilibrium. [6+2+2]



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TRIBHUVAN UNIVERSITY  
INSTITUTE OF ENGINEERING  
Examination Control Division

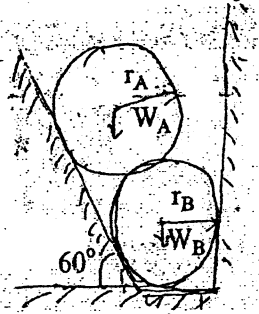
2076 Chaitra

| Exam.       | Regular                                           |            |        |
|-------------|---------------------------------------------------|------------|--------|
| Level       | BE                                                | Full Marks | 80     |
| Programme   | BEL, BEX, BEL,<br>BCT, BAM, BIE,<br>BAG, BAR, BAS | Pass Marks | 32     |
| Year / Part | 1/1                                               | Time       | 3 hrs. |

**Subject: - Applied Mechanics (CE 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.

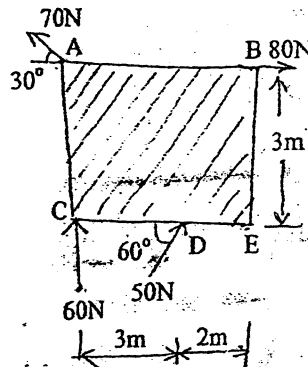
1. What are the equations of static equilibrium for 2D and 3D analysis of particle and rigid body? Define free body diagram with examples. [4+2]
2. Find the reactions at contact points of Ball A and Ball B. [7]



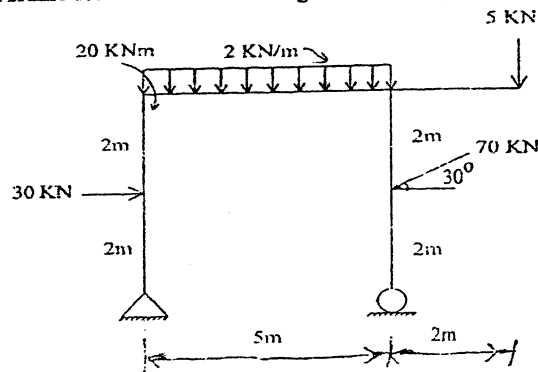
$$W_A = 50\text{N}, W_B = 40\text{N}$$

$$r_A = 10\text{cm}, r_B = 8\text{cm}$$

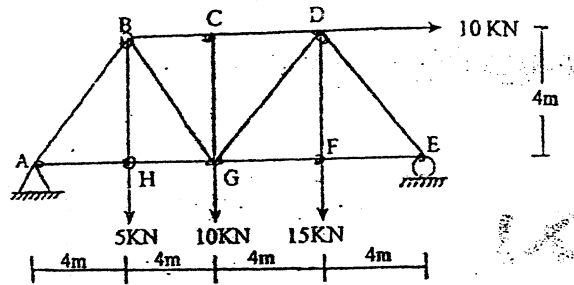
3. Define Applied Mechanics and concept of rigid & deformed body. Find the magnitude, direction and line of action of the resultant force as shown in figure below. [2+7]



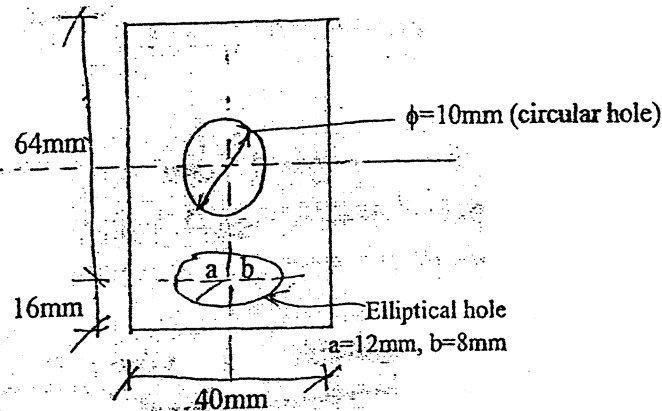
4. What do you mean by determinate and indeterminate structures? Draw AFD, SFD and BMD of the given frame loaded as shown in figure. Indicate the salient features if any. [2+12]



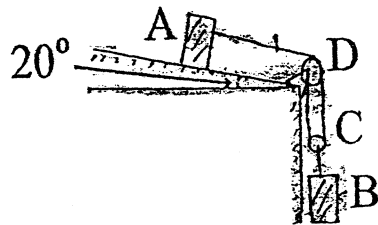
5. Calculate the force developed in member BC, BG, HG and GD of the truss loaded as shown in figure. Define determinate, stable, unstable structures. [5+2]



6. Find MOI about Centroidal XX and YY axes of the composite area. Define Centroid, Center of Gravity and axis of symmetry. [8+4]



7. What do you mean by friction? What are the laws of dry friction? Explain about static and kinetic friction. [1+2+2]
8. Define Kinematics and Kinetics of particle. A train runs at a speed of 120 km/hr in a curved track of radius 900 m the application of brake suddenly, causes the train to slow down at a constant rate. After 6 seconds the speed has been reduced to 72 km/hr. Determine the acceleration immediately after the brakes is applied. [2+8]
9. Determine the acceleration of two block & tension in the wire when two blocks start from rest. There is no friction & no mass of pulley. Coeff. of kinetic friction is 0.4 and  $m_A=100\text{kg}$  and  $m_B=300\text{kg}$ . What do you mean by impulse momentum principle and dynamic equilibrium? [7+3]



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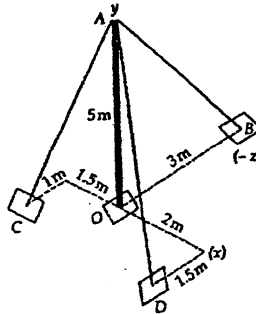
**TRIBHUVAN UNIVERSITY**  
**INSTITUTE OF ENGINEERING**  
**Examination Control Division**  
 2076 Ashwin

| Exam.       | Back                                      |               |
|-------------|-------------------------------------------|---------------|
| Level       | BE                                        | Full Marks 80 |
| Programme   | BEL, BEX, BCT, BAM,<br>BIE, BAG, BAE, BAS | Pass Marks 32 |
| Year / Part | I / I                                     | Time 3 hrs.   |

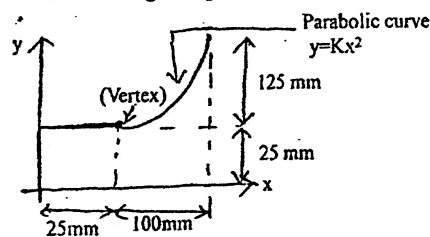
**Subject: - Applied Mechanics (CE 401)**

- ✓ Candidates are required to give their answers in their own words as far as practicable.
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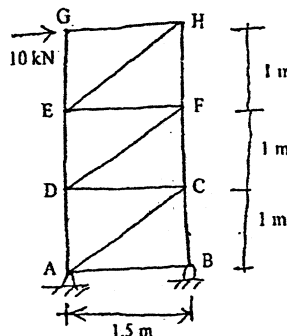
1. Define the terms Rigid body and particles. [2]
2. What do you understand by Free Body Diagram? Explain with sketches. What is the physical significance of static equilibrium? [4+4+2]
3. In the system shown in figure, a 5m long pole is held in vertical position by three guy wires AB, AC and AD. If the tension of 600 N is induced in AD and the resultant force at A is to be vertical, determine the tension in cables AB and AC. [8]



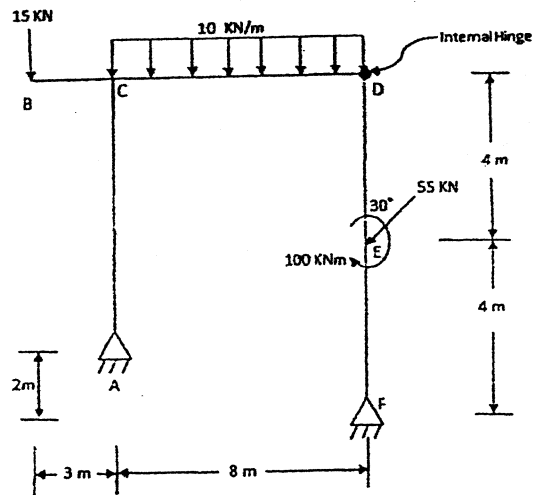
4. What are the characteristics of couple? [4]
5. What are the uses of friction in engineering field? [2]
6. Determine the centroid of the following composite figure. [10]



7. Analyze the following pin-jointed frame regarding the members AD, DC, DF, ED and FC, using Method of Moment. [10]



8. Draw axial force, shear force and bending moment diagram of the given frame. Indicate salient features if any. [14]

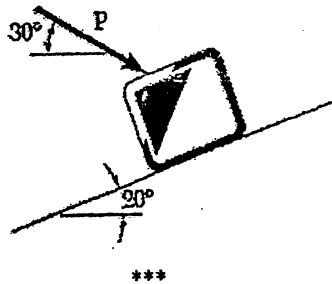


9. What do you mean by dependent motion, explain with example? [2+8]

A projectile is fired from the top of a 30 m high building with an initial velocity of 45 m/s at an angle of  $35^\circ$  with the horizontal. Neglecting air resistance, find

- the greatest elevation above the ground,
- the horizontal distance from the point of projection to the point where the projectile strikes the ground
- the velocity with which it strikes

10. Define principle of impulse momentum for particle. A 20-kg package is at rest on an incline when a force  $P$  is applied to it. Determine the magnitude of  $P$  if 10 s is required for the package to travel 5 m up the incline. The kinetic coefficients of friction between the package and the incline is equal to 0.3. [2+8]

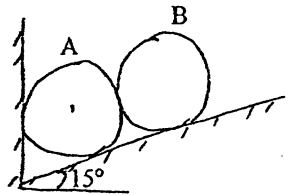


| Exam.       | Regular / Back                            |            |        |
|-------------|-------------------------------------------|------------|--------|
| Level       | BE                                        | Full Marks | 80     |
| Programme   | BEL, BEX, BCT, BAM,<br>BIE, BAG, BAE, BAS | Pass Marks | 32     |
| Year / Part | I / I                                     | Time       | 3 hrs. |

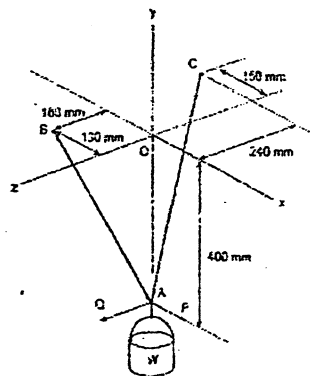
**Subject: - Applied Mechanics (CE 401)**

- ✓ 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.

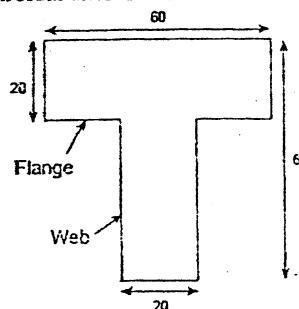
1. Differentiate between particle and rigid body. [2]
2. Determine the forces developed on the contact surfaces of the following body. Neglect the effect of friction. Given: Mass of body A = Mass of body B = 100 kg  
Dimensions of body A = Dimension of body B [9]



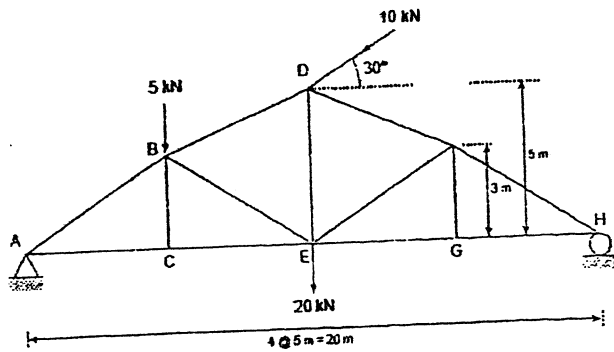
3. A container of weight  $W$  is suspended from ring A. Cable BAC passes through the ring and is attached to fixed supports at B and C. Two forces  $P = P_i$  and  $Q = Q_k$  are applied to the ring to maintain the container in the position shown. Knowing that  $W = 376$  N, determine  $P$  and  $Q$ . [7]



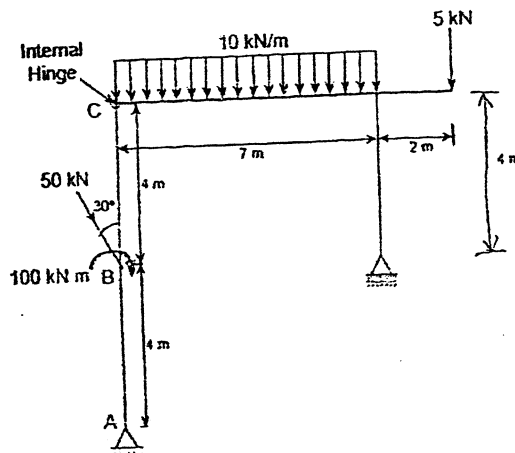
4. State and prove varignon's theorem. [4]
5. Define the angle of friction, impending motion and condition of tipping and sliding of block. [4]
6. Calculate the MOI about centroidal axes. All dimensions in cm. [10]



7. Determine the member force in AB, CE, BE, ED and BD for given truss. [10]



8. Draw AFD, SFD and BMD for the beam loaded as shown in figure. Also show the salient point (if any). [14]



9. Define tangential and normal component of acceleration. The motion of particle is given by the relation  $v_x = 2 \cos t$  and  $v_y = \sin t$ . It is known that initially both x and y coordinate are zero. Determine

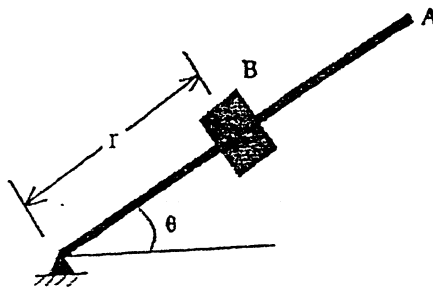
- Total acceleration at the instant of 2 sec
- The equation of path

[2+8]

10. What do you mean by the principle of impulse and momentum? The motion of a 1000 gm block B in a horizontal plane is defined by the relations  $r = 3(1 + \sin 2\pi t)$  and  $\theta = 2\pi t$ , where r is expressed in metres, t in seconds and  $\theta$  in radians. Determine the radial and transverse components of the force exerted on the block when

[2+8]

- $t = 0$  and
- $t = 0.5$  sec.



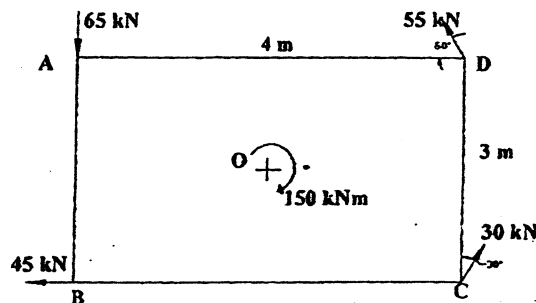
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| Exam.       | Back                                              |            |        |
|-------------|---------------------------------------------------|------------|--------|
| Level       | BE                                                | Full Marks | 80     |
| Programme   | BEL, BEX, BCT,<br>BAME, BIE, B. Agri,<br>B. Arch. | Pass Marks | 32     |
| Year / Part | 1 / 1                                             | Time       | 3 hrs. |

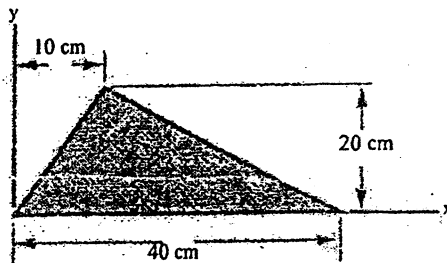
**Subject: - Applied Mechanics (CE401)**

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
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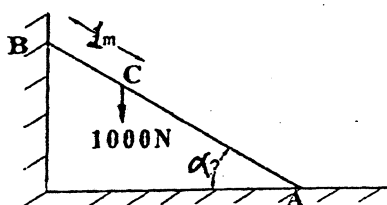
1. Define rigid body. Explain about the principles of Mechanics? [1+2]
2. It is very important to draw free body diagram for the analysis of problem in statics, Explain. Describe about the equations of static equilibrium for 2-D and 3-D analysis of a particle and a rigid body. [3+3]
3. State principle of transmissibility with its limitations. Explain, couple is a free vector. [2+2]
4. Determine the magnitude; direction and position with respect to center 'O' of the resultant of the forces acting on the resultant plate ABCD as shown in the figure below. [8]



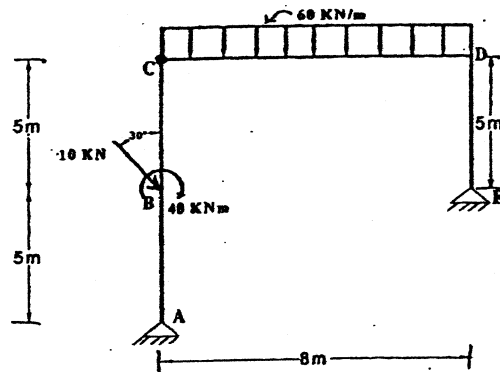
5. Define centroid, centre of gravity and axis of symmetry. Find  $I_{xx}$  and  $I_{yy}$  for the given triangle about its centroidal axes. [3+9]



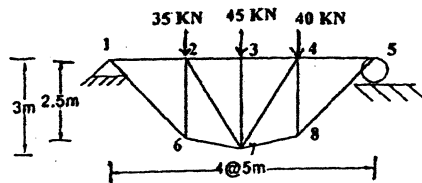
6. A ladder shown in figure is 4m long and is supported by a horizontal floor and a vertical wall. The co-efficient of friction at the wall is 0.3 and at the floor is 0.45. The weight of the ladder is 300N. The ladder supports a vertical load of 1000N at C. Determine the reactions at A, B and C and compute the least value of  $\alpha$  at which ladder may be placed without slipping to right. [5]



7. Draw AFD, SFD and BMD for the following structure. Also show salient features, if any. [13]



8. Determine the member forces in the members 26,23,27,67,37. How can we check the determinacy and stability of the plane truss? Explain with examples. [5+4]



9. Define average and instantaneous velocity. Two cars A and E travel along the same straight route. At any time  $t$  their distance  $x_a$  and  $x_e$  from the starting point are given by: [2+8]

$$x_a = 2.5t + 1.2t^2$$

$$x_e = 3t^2 - 0.25t^3$$

Where  $t$  in seconds and  $x_a$  and  $x_e$  are in meters.

- Which car is ahead just after they leave the starting point?
  - At what time are the cars at the same point?
  - At what time is the distance between A and E neither increasing nor decreasing?
  - At what time do A and E have the same acceleration?
10. The resultant of the force applied on a 3kg particle is given by the relation;

$$\vec{F} = (12t\hat{i} - 24t^2\hat{j} - 40t^3\hat{k}) \text{ N. The particle is initially at origin at rest. Determine the}$$

$y$ -component of acceleration, velocity and position at the instant of 3 sec. What do you mean by dynamic equilibrium for a particle?

[7+3]

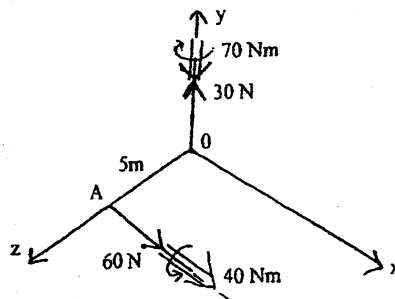
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| Exam.       | Back                                            |            |        |
|-------------|-------------------------------------------------|------------|--------|
| Level       | BE                                              | Full Marks | 80     |
| Programme   | BEL, BEX, BAME,<br>BCT, BIE, B.Agr.,<br>B.Arch. | Pass Marks | 32     |
| Year / Part | I / I                                           | Time       | 3 hrs. |

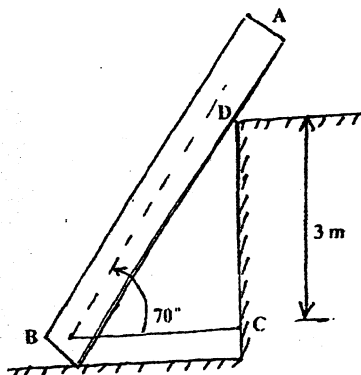
**Subject: - Applied Mechanics (CE401)**

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1. Define Equilibrium and its essence. What are the equations of static equilibrium for 2D and 3D analysis of particle and Rigid Body? [6]
2. Replace the two wrenches as shown in figure below by a single equivalent wrench and determine the point where its axis intersects the XZ plane. [8]

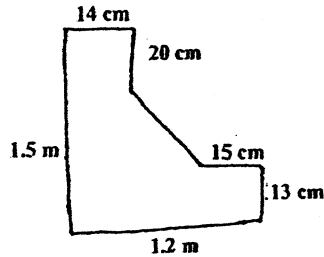


3. Determine the tension in the cable BC which holds a part AB of length 4m from sliding. The part has a mass of 10 kg. Assume all the contact surfaces are smooth. [6]

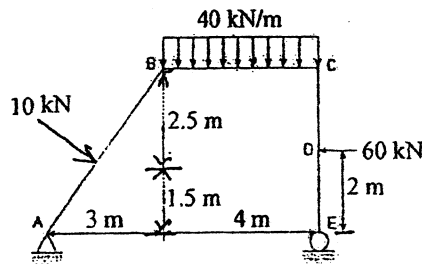


4. Illustrates the conditions of no friction, no motion, impending motion and motion with necessary sketches. How can you assure condition of sliding or overturning of the block? [3+2]

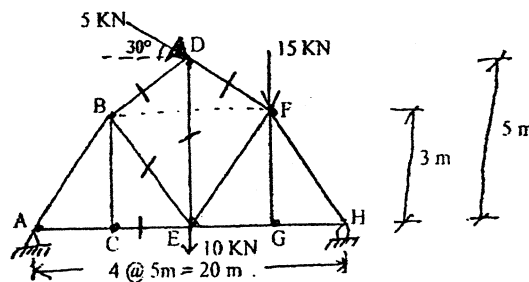
5. Determine moment of inertia about centroidal XX and XY axes of the plane figure shown in figure below. Define centroid, centre of gravity and axes of symmetry. [9+3]



6. a) How can you check the determinacy and stability of the frame? Explain with examples. [3]  
 b) Calculate and draw the axial force, shear force and bending moment diagram; with its salient features for the given frame. [12]



7. Find the member force in the indicated members of the truss shown below. [8]



8. Explain about relative motion of particle with example. A projectile is fired from position A with an initial velocity of 200 m/sec at a target B on right located 500m above from the position A. The horizontal distance between A and B is 3000 m. Determine the firing angle neglecting air resistance. [2+8]

9. The resultant external force acting on a 2 kg particle in space is

$$\vec{F} = (12t \hat{i} - 24t^2 \hat{j} - 40t^3 \hat{k}) \text{ N}, \text{ where } t \text{ is the time measured in seconds. The particle is at}$$

rest at the origin when  $t = 0$ . Determine the acceleration component  $a_y$ , the velocity component  $V_y$ , and the coordinate  $y$  of the particle at the instant of 4 sec. What do you mean by principle of impulse and momentum? [8+2]

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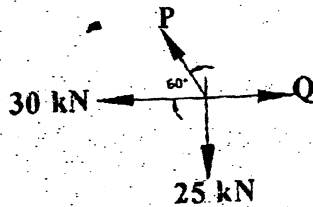
2074 Chaitra

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

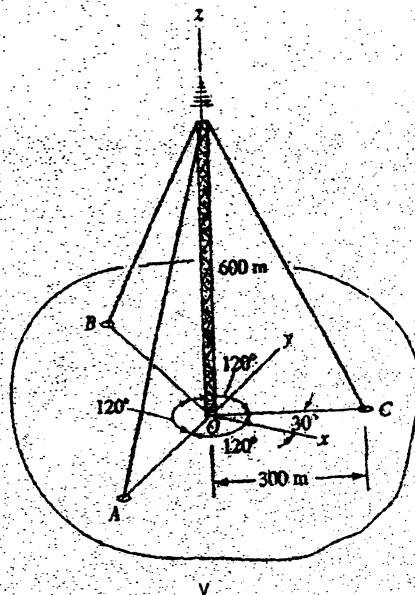
**Subject: - Applied Mechanics (CE401)**

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

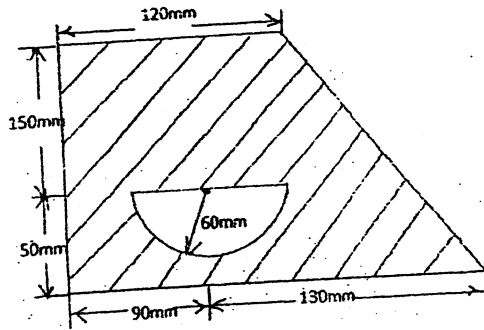
1. Explain in brief about fundamental concepts and principles of mechanics. [3]
2. What do you understand by Free Body Diagram? Explain with sketches. Also state Varignon's Theorem and prove it. [4+4]
3. Determine the values of the unknown forces P and Q for the system of forces to be in equilibrium. [4]



4. Three guy wires are used in the support system for a television transmission tower that is 600m tall. Wire A and B are tightened to a tension of 60KN, whereas wire C has only 30 KN of tension. What is the moment of wire forces about the base O of the tower? The Y axis is collinear with AO. [7]

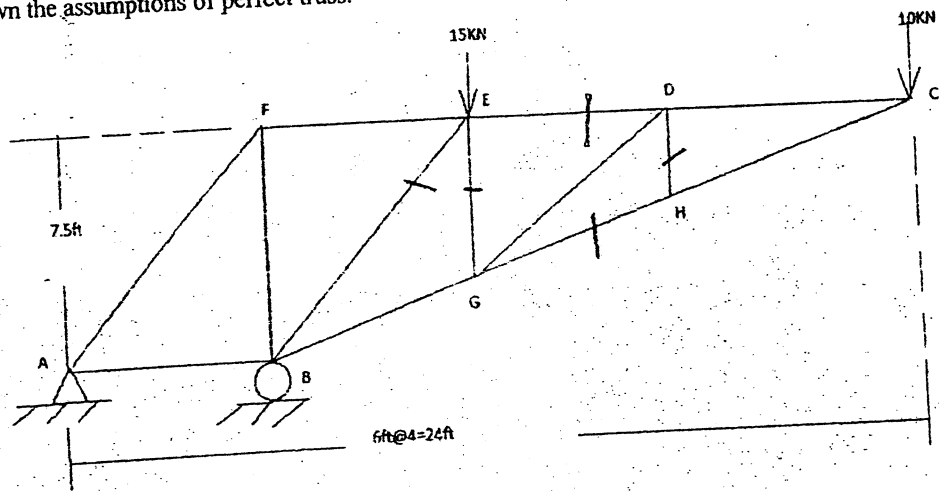


5. State and prove parallel axis theorem for moment of inertia. Determine moment of inertia about centroidal axes of the plane figure shown in below. [4+8]

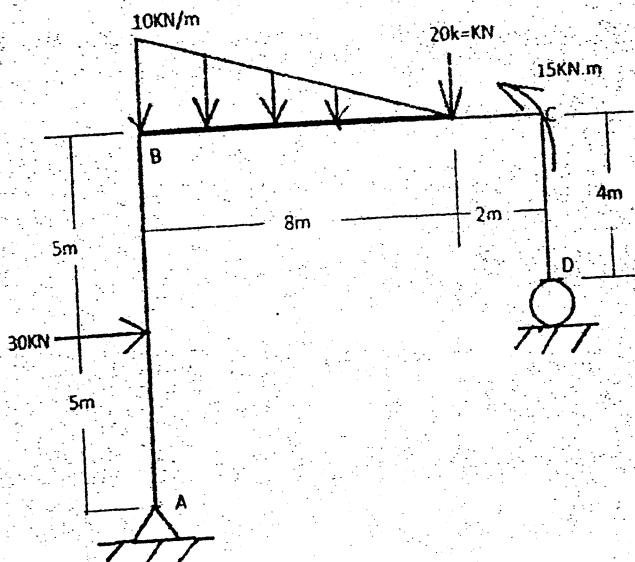


6. Define limiting friction, angle of friction and coefficient of the static and dynamic friction. [4]

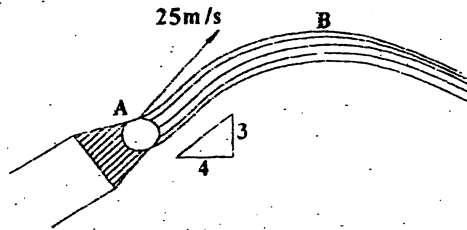
7. Find the member forces of indicated members of the truss shown in figure below. Write down the assumptions of perfect truss. [5+4]



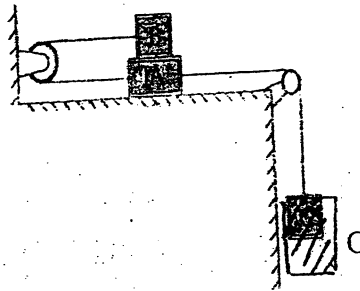
8. Draw axial forces, shear force and bending moment diagram and indicate the salient features if any for the given frame loaded as shown in figure below. [13]



9. Derive the relationship for normal and tangential components of acceleration for a particle moving in a curvilinear path. A nozzle discharge a stream of water in direction as shown in figure below with an initial velocity of 25m/sec. Determine the radius of curvature of the stream (i) as it leaves the nozzle (ii) at the maximum height of the stream. [4+6]



10. Determine the acceleration of block "A" for the system, if the system starts from rest. Coefficient of friction between block "A" and table is 0.25 and that between blocks "A" and "B" is 0.35. Where weight of block A, B and C are 100 N, 50 N and 500 N respectively. [10]



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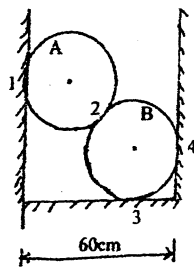
2073 Chaitra

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

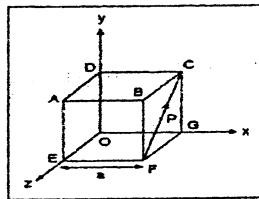
**Subject: - Applied Mechanics (CE401)**

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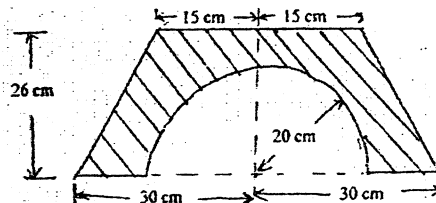
1. Enlist the fundamental principles of Applied Mechanics. Define rigid body. [3+1]
2. Two smooth spheres of weight 200N each are kept inside a channel shown in figure. The radius of each sphere is 20cm. Determine reactions at contact surfaces. [6]



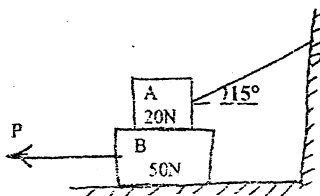
3. Define couple and show that couple is a free vector. How will you reduce a system of forces to a wrench? A cube of side  $a = 4m$  is acted upon by a force  $P = 20kN$  as shown. Determine the moment of force P. [2+3+6]
  - a) about A
  - b) about edge AB
  - c) about diagonal AG of cube



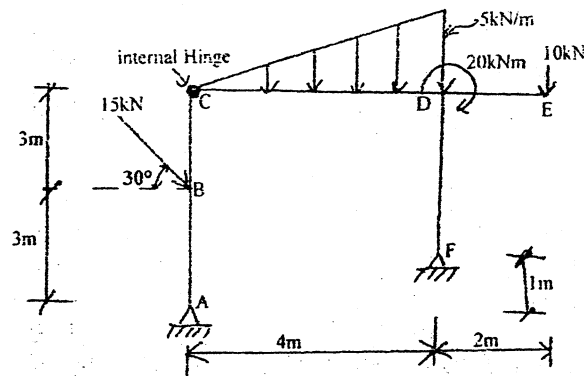
4. State parallel axis theorem and radius of gyration. Calculate the moment of inertia of the given shaded area about its centroidal axes. [3+9]



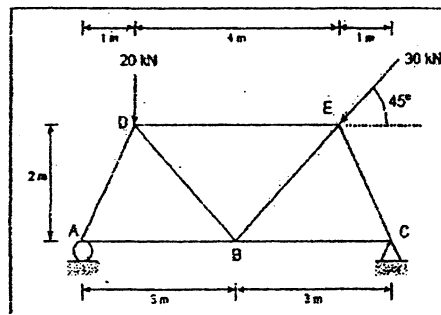
5. Determine the force required for just motion of the block B shown in figure below. Take  $\mu_s = 0.25$  for all surfaces. [5]



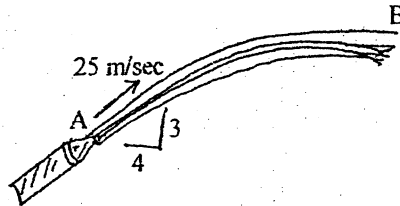
6. Draw the axial force, shear force and bending moment diagram for the given frame shown in figure below. Also show the salient features. [14]



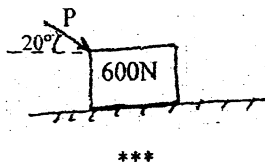
7. Determine the force developed in the members of the given truss. What are the assumptions of perfect truss? [6+2]



8. A nozzle discharges a stream of water in the direction shown below with an initial velocity of 25 m/sec. Determine the radius of curvature of the stream (a) as it leaves the nozzle, (b) at the maximum height of the stream. What do you mean by dependent motion of particle? Explain with suitable example. [8+2]



9. A 600N block rests on a horizontal plane. Find the magnitude of P required to produce the block an acceleration of  $2\text{m/s}^2$  to the right. The coefficient of friction is 0.25. What do you mean by dynamic equilibrium? [8+2]

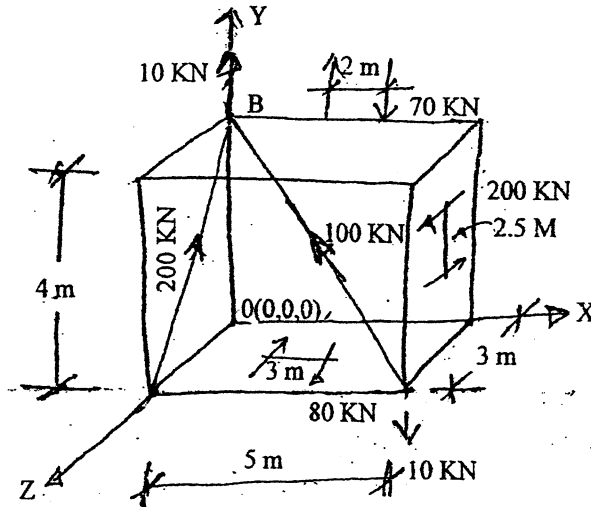


| Exam.       | New Back (2066 & Later Batch)                     |            |        |
|-------------|---------------------------------------------------|------------|--------|
| Level       | BE                                                | Full Marks | 80     |
| Programme   | BEL, BEX, BCT,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

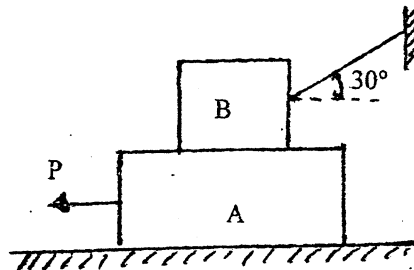
**Subject:** - Applied Mechanics (CE401)

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

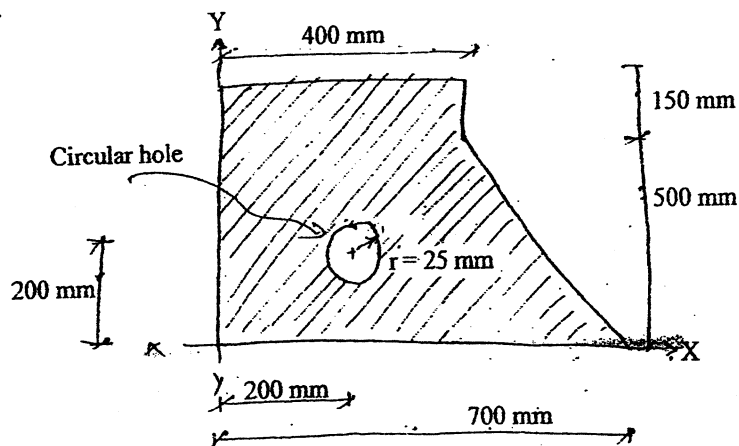
1. What do you understand by a Rigid Body? Why it is necessary to assume a body as 'perfectly rigid' for your present study? [3]
2. Write down the concept of rigid bodies and deformable bodies. What is Free Body Diagram and why it is used during analysis of structure? [8]
3. Determine the resultant force and moment of the following system about the point 'O' as shown in figure below. [10]



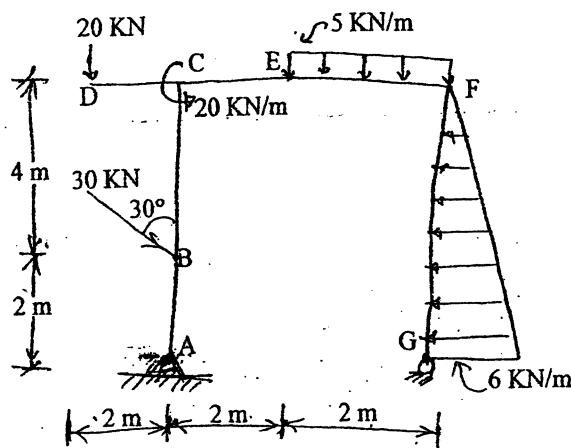
4. Two blocks A and B of 40 N and 20 N respectively are in equilibrium position as shown in figure below. Calculate the force P required to move block A. Take  $\mu = 0.3$  for all surface. [5]



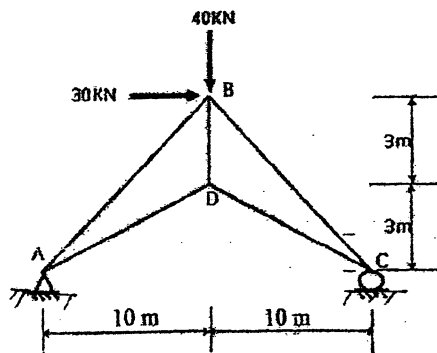
5. Calculate the moment of inertia of the composite area as shown in figure about its central axes. Define centroid, center of gravity, axis of symmetry and radius of gyration. [8+4]



6. Draw AFD, SFD and BMD for the given frame and loading. Indicate salient points, if any. [14]



7. Write down the ideal assumptions of Truss. Calculate the member forces in all members of the truss loaded as shown in figure below by using suitable method. [2+6]



8. Define the uniformly rectilinear motion and the uniformly accelerated rectilinear motion. A projectile is fired with an initial velocity of 244 m/s at a target B located 610 m above the gun A and at a horizontal distance of 3658 m. Neglect air resistance, determine the value of the firing angle  $\alpha$ . [2+8]
9. The motion of a 1000 gm block B in a horizontal plane is defined by radius,  $r = 2(1 + \cos 2\pi t)$  and  $\theta = 2\pi t$  where 'r' is expressed in meters and t in seconds. Determine the radial and transverse components of the force exerted on the block B at 0.8 sec. Explain about principle of impulse and momentum. [8+2]

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21 TRIBHUVAN UNIVERSITY  
INSTITUTE OF ENGINEERING  
Examination Control Division

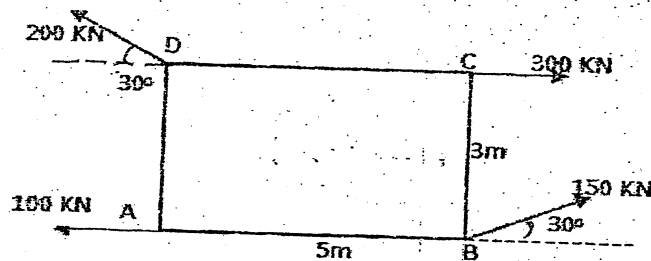
2072 Chaitra

| Exam.       | Regular                                           |            |        |
|-------------|---------------------------------------------------|------------|--------|
| Level       | BE                                                | Full Marks | 80     |
| Programme   | BEL, BEX, BCT,<br>BAME, BIE, B. Agri.<br>B. Arch. | Pass Marks | 32     |
| Year / Part | 1 / 1                                             | Time       | 3 hrs. |

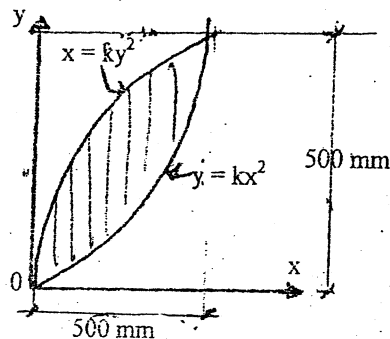
- Subject: - Applied Mechanics (CE401)

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

1. Describe about the fundamental principle of applied mechanics. [3]
2. Write down the steps to be considered while drawing a free body diagram. Illustrate equilibrium condition of particle and rigid body in two and three dimensional analysis. [8]
3. Find the magnitude, direction and Position of resultant force of the following system as shown in figure. [10]

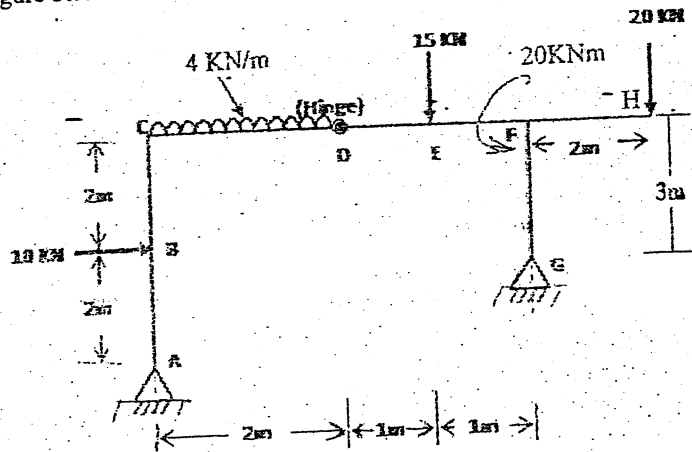


4. Describe the condition illustrating No friction, No motion, Impending motion and motion with proper sketches. How can we assure condition of sliding and over turning of a block? Explain with suitable figure. [3+2]
5. State and prove parallel axes theorem for moment of inertia. Determine centroid of the given plane in figure below. [4+8]

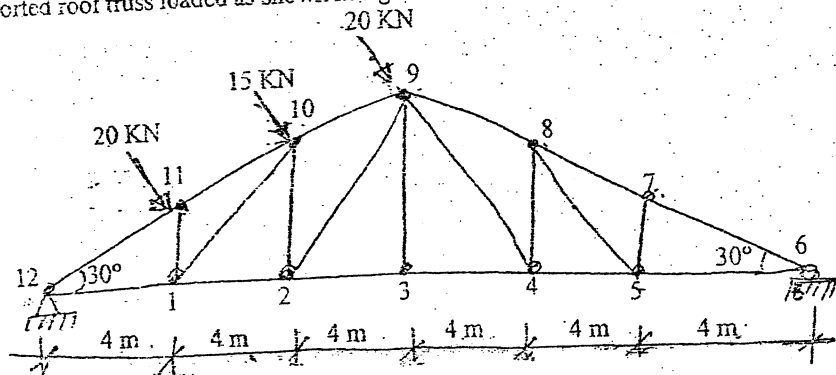




6. Draw the Axial Force, Shear Force and Bending Moment diagram for the given frame shown in figure below. Also show the salient features. [14]



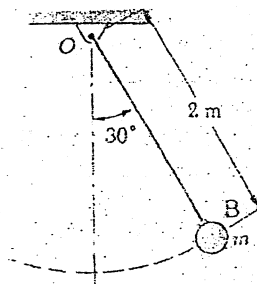
7. Find the member force of members 1-11, 1-10, 1-2, 2-10 and 10-11 of the simply supported roof truss loaded as shown in figure below. [8]



8. A ball is tossed with velocity of 10 m/s directed vertically upward from a window located 20 m above the ground. Knowing that the acceleration of the ball is constant and equal to  $9.81 \text{ m/s}^2$  downward, determine: [8+2]

- The velocity 'v' and the elevation 'y' of the ball above the ground at any time 't'.
  - The highest elevation reached by the ball and the corresponding value of 't'.
  - The time when the ball will hit the ground and the corresponding velocity.
- What do you mean by dependent motion? Explain with example.

9. Define the linear momentum and angular momentum. Find the velocity and the acceleration of the bob in the given position. The bob of a 2 m pendulum describes an arc of a circle in a vertical plane, which is shown in figure below. If the tension in the cord is 2.5 times the weight of the bob for the position shown. [2+8]



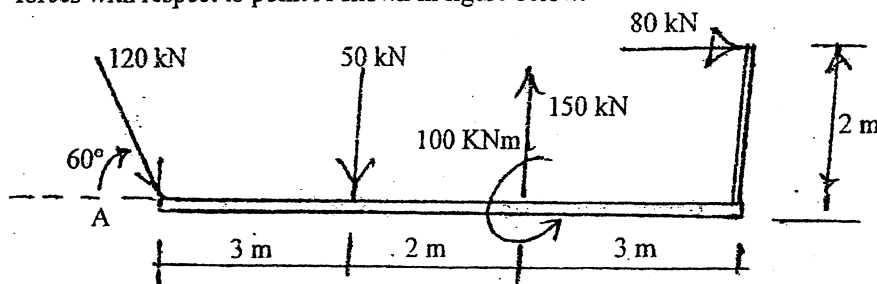
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| Exam.       | New Back (2066 & Later Batch)            |            |        |
|-------------|------------------------------------------|------------|--------|
| Level       | BE                                       | Full Marks | 80     |
| Programme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

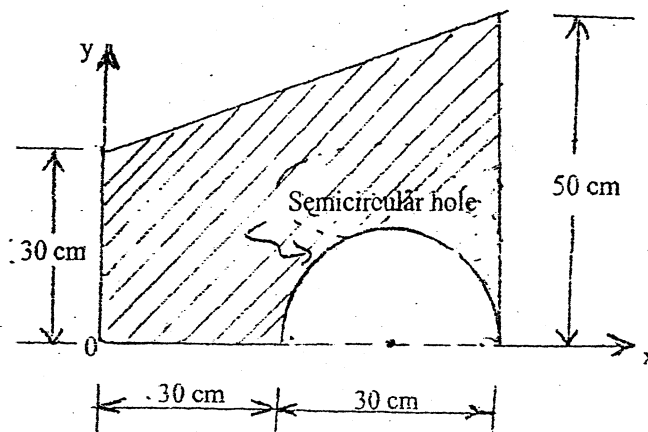
**Subject: - Applied Mechanics (CE401)**

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

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

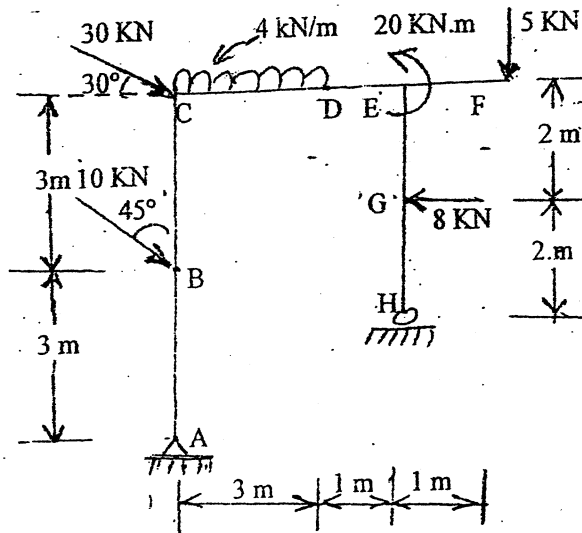


3. State and prove the parallel axis theorem for moment of inertia. Determine the moment of inertia of the given composite area as shown in figure below about its centroidal X-X axis. [4+8]

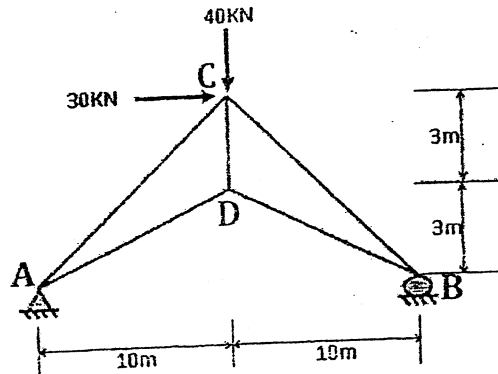


4. Define friction force and explain condition of tipping and sliding of a block. [1+3]

5. Draw AFD, SFD and BMD of the given frame loaded as shown in figure below. Indicate also the salient features if any. [14]



6. Write down the ideal assumption of truss. Calculate the force developed in all members of the truss loaded as shown in figure by using suitable methods. [2+8]



7. What do you mean by dependent motion of particles? Illustrate it with suitable example. A particle starting from origin is subjected to acceleration such that  $a_x = -2\text{m/sec}^2$  and  $a_y = -5\text{m/sec}^2$ . The initial velocity is 60 m/sec directed at a slope of  $30^\circ$  w.r.t. horizontal. Compute the radius of curvature at the end of 3 sec. Also determine its position at the end of 3 sec. [3+7]
8. Show that, "rate of change of angular momentum about a point is equal to moment of the force about the same point." The resultant external force acting on a 5 kg particle in space is  $\vec{F} = (12t\hat{i} - 24t^2\hat{j} + 40t^3\hat{k})$  N, where  $t$  is seconds. The particle is initially at rest at origin. Determine the x component of acceleration, velocity and position at the instant of 5 sec. [4+6]

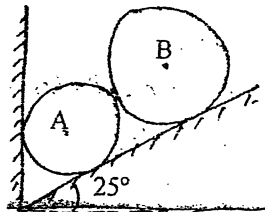
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| Exam.       | New Back (2066 & Later Batch)        |            |
|-------------|--------------------------------------|------------|
| Level       | BE                                   | Full Marks |
| Programme   | BEL, BEX, BCT,<br>BIE, B.Agr, B.Arch | Pass Marks |
| Year / Part | 1/1                                  | Time       |
|             |                                      | 3 hrs.     |

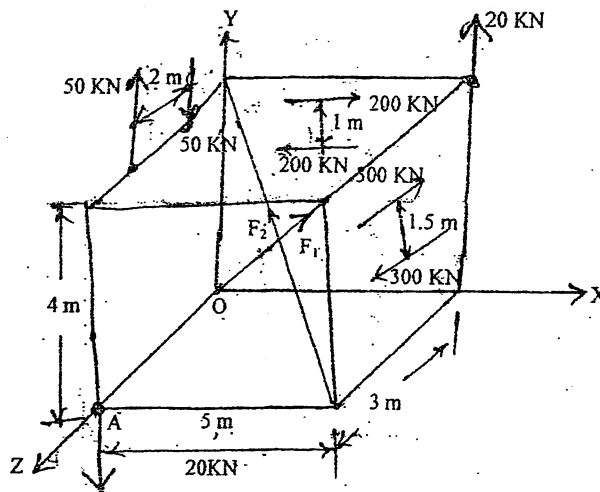
**Subject: - Applied Mechanics (CE401)**

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

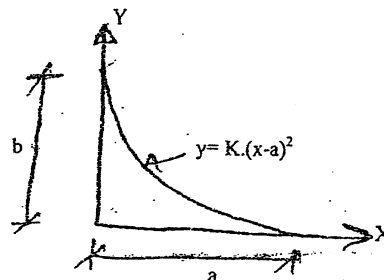
1. Why it is necessary to assume a solid body as a perfectly rigid in the Engineering study. [3]
2. What is free body diagram? The cylinder A and B rest in an inclined surface which makes an angle of  $25^\circ$  with horizontal as shown in figure below. Determine reaction at contact points. Take: [2+6]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



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

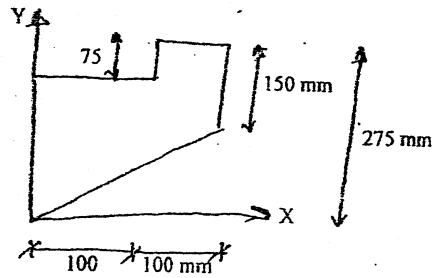


4. Determine by direct integration method, the centroid of the area shown in figure below: [5]



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

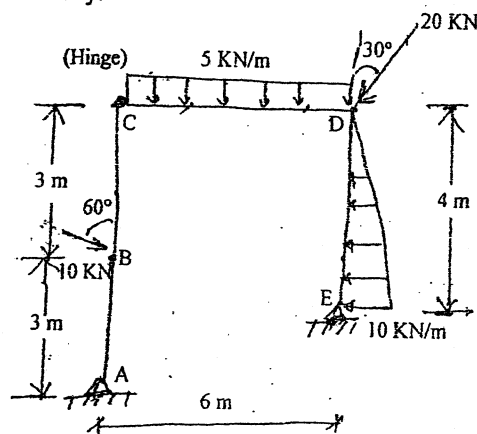
[6]



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

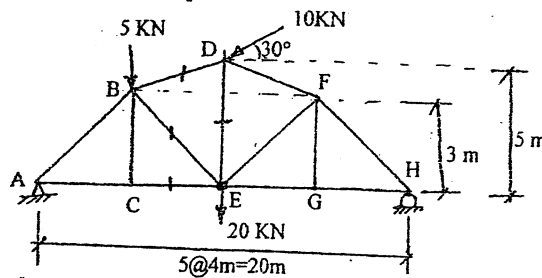
[2+3]

[14]



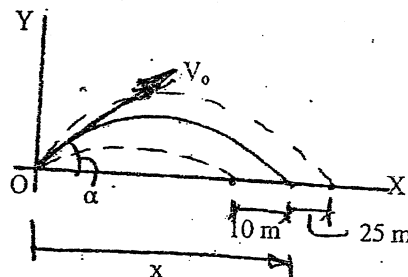
8. Find the member forces in CE, BE, BD and DE for the given truss. Define stability and determinacy of structures with examples.

[5+3]



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

[8+2]



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

[2+8]

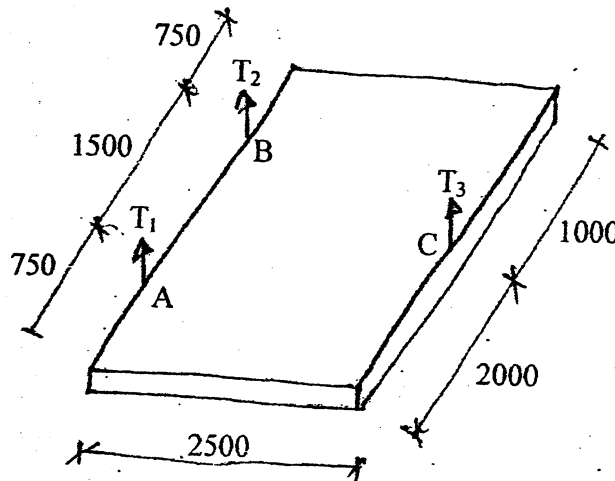
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| Exam.       | Regular / Back   |            |        |
|-------------|------------------|------------|--------|
| Level       | BE               | Full Marks | 80     |
| Programme   | BCE, BME,<br>BGE | Pass Marks | 32     |
| Year / Part | I / II           | Time       | 3 hrs. |

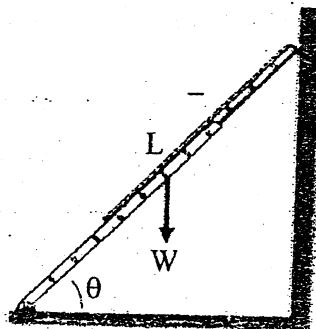
**Subject: - Applied Mechanics (CE451)**

- ✓ 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.

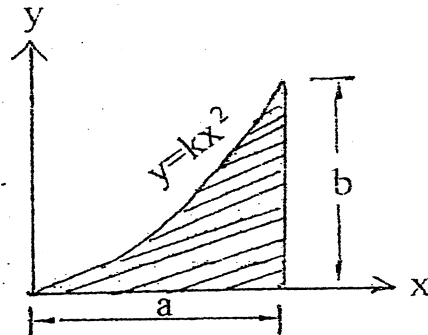
1. What is mechanics? Mention scope of Applied Mechanics in engineering. [2]
2. Illustrate equilibrium condition of a rigid body and concept of free body diagram with suitable examples. [8]
3. Three vertical wires as shown in figure support a plate of 50 kg. Determine the tension in each wire. All dimensions are in mm. [8]



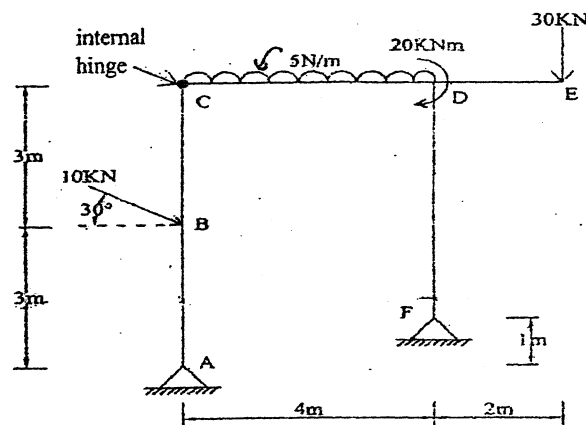
4. Force  $\vec{F} = (3\hat{i} - 6\hat{j} + 4\hat{k})\text{N}$  passes through point (6, 3, 2) m. Replace this force with an equivalent system, where the force  $\vec{F}$  passes through point (2, 5, 10) m. [4]
5. Determine the minimum angle  $\theta$  (made by the ladder AB of length 'L' with the floor) at which a uniform ladder can be placed against a wall without slipping under its own weight (W). The coefficient of friction for all surfaces is 0.2. [4]



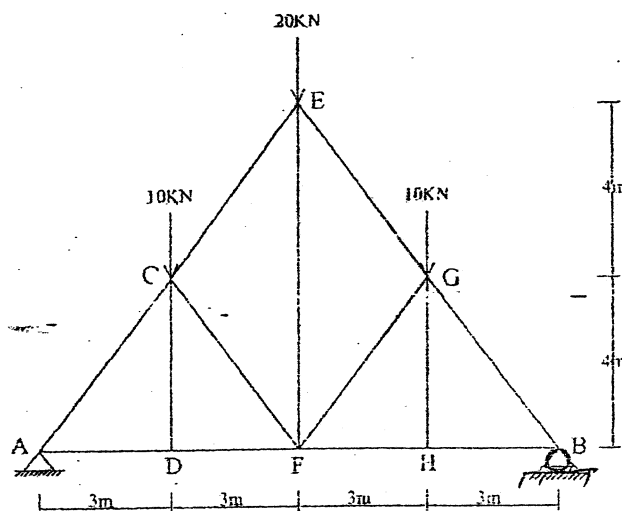
6. Determine the moment of inertia about centroidal axis of the shaded plane area by using Direct integration method. [12]



7. Draw the axial force, shear force and bending moment diagram of given frame. Indicate also the salient features if any. [14]



8. Determine the force developed in members CE, DF, EF, GH of given truss loaded as shown in figure. [8]

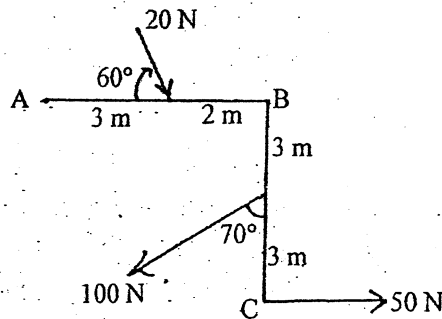


| Exam.       | New Back (2066 & Later Batch)          |            |        |
|-------------|----------------------------------------|------------|--------|
| Level       | BE                                     | Full Marks | 80     |
| Programme   | BEL, BEX, BCT,<br>BIE, B.Agric, B.Arch | Pass Marks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

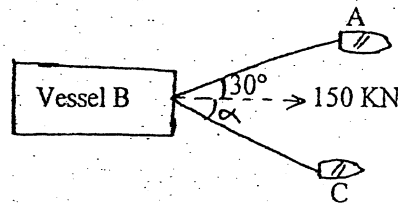
**Subject: - Applied Mechanics (CE401)**

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

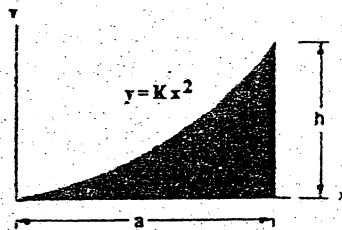
1. Describe the scope of applied mechanics in engineering. [3]
2. What is the physical meaning of equilibrium and why it is important in structure? How can we draw good Free Body Diagram? Explain with suitable examples. [4+4]
3. Determine magnitude, direction and line of action of the resultant of forces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



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

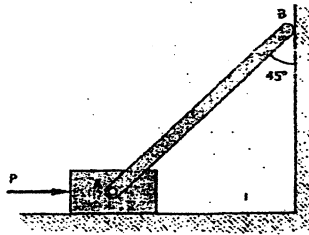


5. State and prove parallel axis theorem. Also determine the centroidal X and Y coordinate of the hatched area. [3+8]

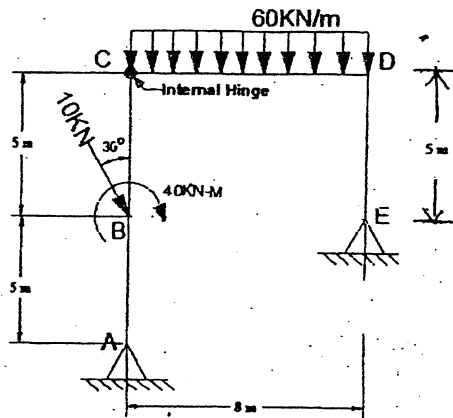




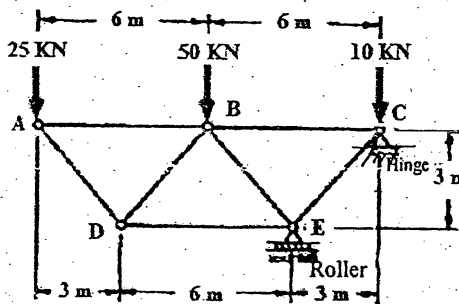
6. A uniform bar AB, weighing 424 N, is fastened by a frictionless pin to a block weighing 200 N as shown in figure. At the vertical wall,  $\mu = 0.268$  while under the block,  $\mu = 0.20$ . Determine the force P needed to start motion to the right. [5]



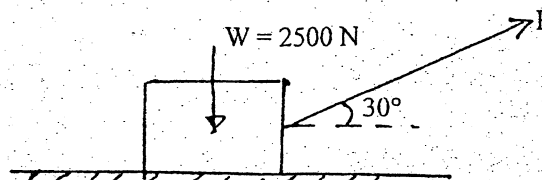
7. Draw the Axial Force, Shear force and Bending Moment diagram of the given frame. Also show the salient features if any. [13]



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



9. The motion of a vibrating particle is defined by the equations  $x = 100 \sin \pi t$  and  $y = 25 \cos 2\pi t$  where x and y are expressed in mm and t in sec. [10]
- Determine the velocity and acceleration when  $t = 1$  sec
  - Find the nature of path of the particle
10. Determine the magnitude of force P required to give the block an acceleration of  $10 \text{ m/s}^2$ . Coefficient of friction between the block and the floor is 0.25. [10]



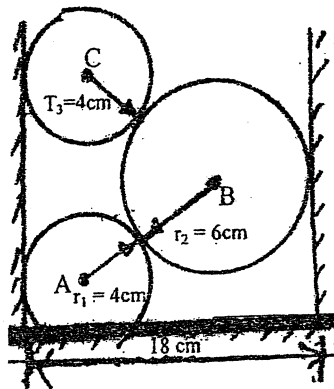
B.E.X  
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| Exam.       | Regular                              |            |        |
|-------------|--------------------------------------|------------|--------|
| Level       | BE                                   | Full Marks | 80     |
| Programme   | BEL, BEX, BCT, BIE<br>B.Agri, B.Arch | Pass Marks | 32     |
| Year / Part | I/I                                  | Time       | 3 hrs. |

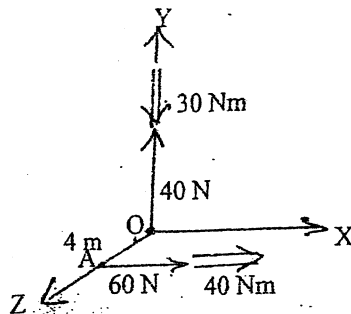
**Subject: - Applied Mechanics (CE401)**

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

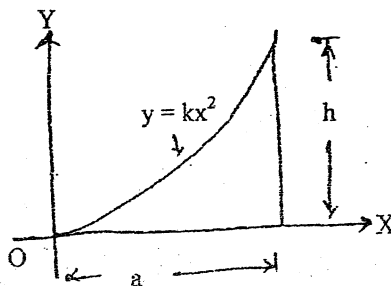
1. Describe the scope and importance of applied mechanics in engineering study. Define free body diagram with examples. [2+2]
2. Determine the reactions at the contact points, if three cylinders are piled in a rectangular ditch as shown in figure. Given that the weight of the cylinders are:  $W_A = 2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



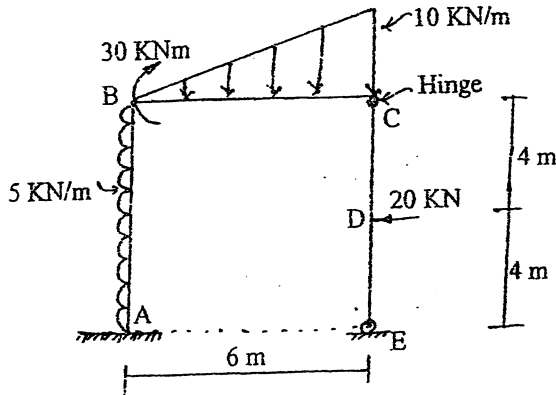
3. How can you reduce a force into a force and couple? Obtain the resultant of the two pairs of wrench shown in the figure. Indicate its line of action. [3+8]



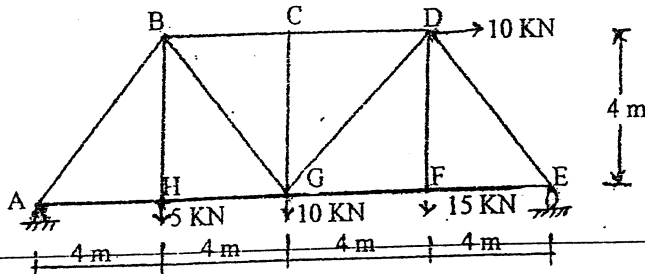
4. Determine centroid of the given plane figure. State and prove parallel axes theorem for moment of inertia. Define centroid and center of gravity. [7+3+2]



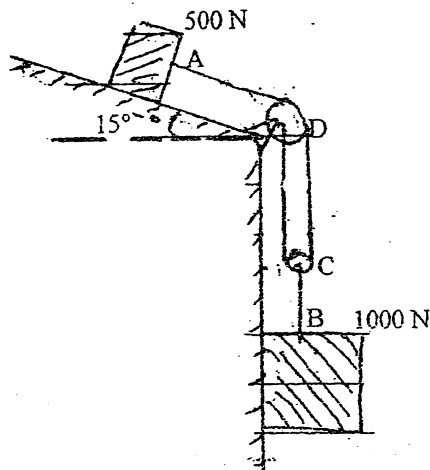
5. Define the angle of friction and also write the laws of static friction. [4]
6. Draw axial force, shear force and bending moment diagram for the loaded frame as shown in figure below. Also indicate the salient features if any. [13]



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



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



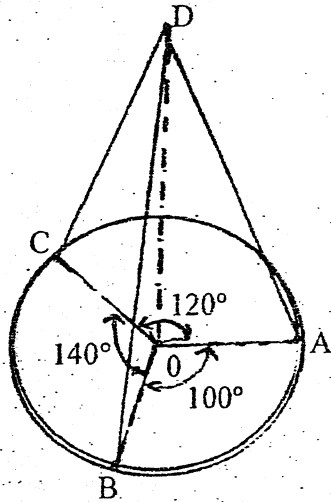
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| Exam.       | New Batch (2066) / Later Batch (2070) |            |        |
|-------------|---------------------------------------|------------|--------|
| Level       | BE                                    | Full Marks | 80     |
| Programme   | BCE, BGE, BME                         | Pass Marks | 32     |
| Year / Part | I / II                                | Time       | 3 hrs. |

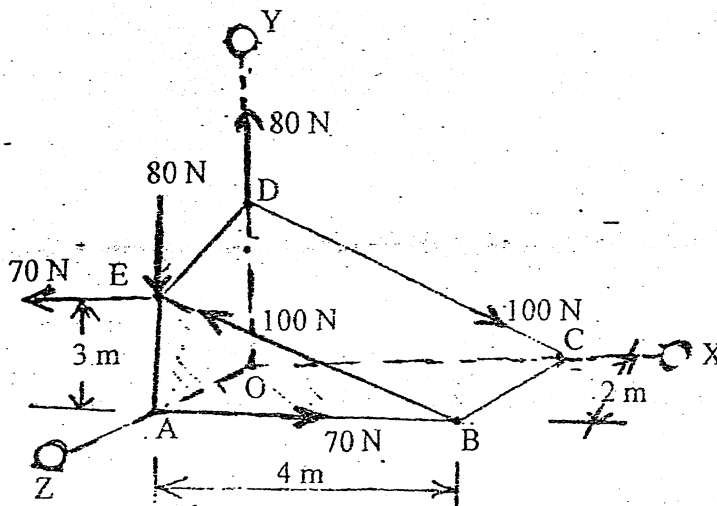
**Subject: - Applied Mechanics (CE451)**

- ✓ 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.

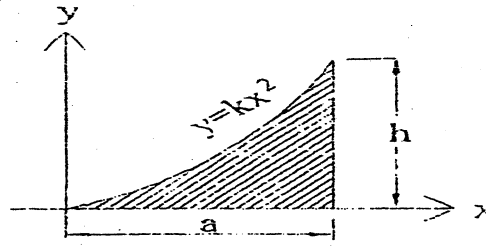
1. Differentiate between rigid body and deformable body. [3]
2. Explain about the physical meaning of equilibrium. Define free body diagram and concept of particle. [3+2+2]
3. A homogeneous circular plate of mass 50 kg is supported by three wires. The angular distance between the points of attachment on the circumference of the plate w.r.t center of the plate makes an angle of  $100^\circ$  while other two angular distances are  $120^\circ$  and  $140^\circ$  as shown in figure below. The three wires are attached to a single point on the ceiling which is 5 m vertically above the centroid of the plate. The plate has diameter of 1 m. Calculate the force developed in each wires. [8]



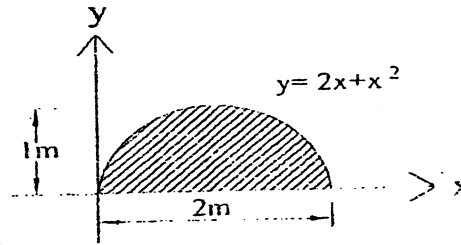
4. Three pairs of couples are acted on the triangular block as shown in figure below. Determine the resultant of them. [4]



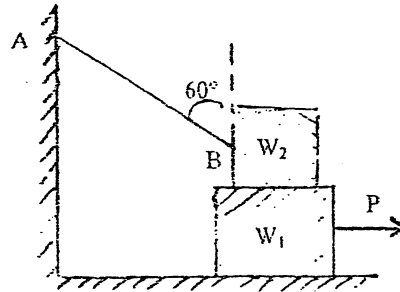
5. Determine the centroidal X and Y coordinate of the shaded area. [6]



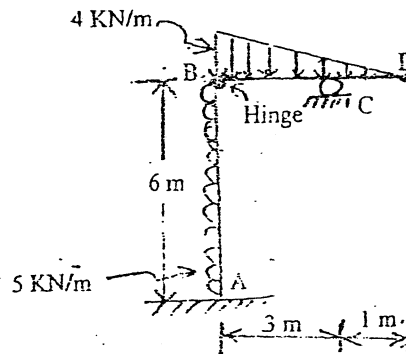
6. Determine the moment of inertia area about X-axis. [5]



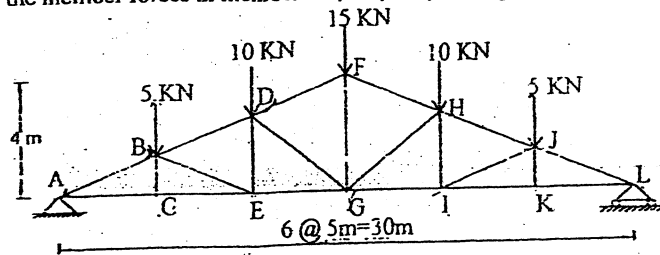
7. A block of weight  $W_1 = 1800 \text{ N}$  rests on a horizontal surface and supports on the top of it another block of weight  $W_2 = 1000 \text{ N}$  as shown in figure below. The block  $W_2$  is attached to a vertical wall by the inclined string AB. Find the magnitude of the horizontal force  $P$ , applied to the lower block as shown, that will be necessary to cause sliding to impend. The coefficient of static friction for all contact surfaces is 0.4. [6]



8. Deduce the relationship between load, shear force and bending moment for a beam section loaded uniformly with intensity of load  $W$ . Draw AFD, SFD and BMD of the given frame loaded as shown in figure below. Indicate also the salient features if any. [4+9]



9. Determine the member forces in member CE, FH, GH, GI of given truss. [8]



10. Two ships A and B are at a distance of 4800 m apart B being south east of A. Speed of A is 2.6 m/s due east and B is travelling at speed of 4.47 m/s due north. Determine:  
 (a) The relative velocity of B w.r.t A (b) The shortest distance between them (c) Time taken to reach the shortest distance. [10]

11. What do you mean by principle of impulse and momentum? The resultant external force acting on a 30 N particle in space is,  $\vec{F} = (12t\hat{i} - 24t^2\hat{j} + 30t^3\hat{k})$  N, where t is the time measured in seconds. Initially, particle is at origin and at rest. Determine Y-component of acceleration, velocity and position at the instant of 5 sec. [3+7]

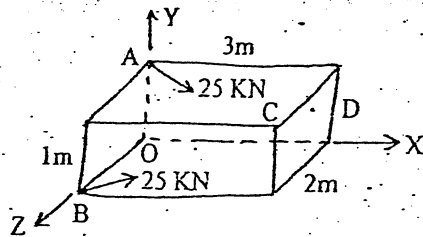
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| Exam.       | Regular          |            |        |
|-------------|------------------|------------|--------|
| Level       | BE               | Full Marks | 80.    |
| Programme   | BCE, BGE,<br>BME | Pass Marks | 32     |
| Year / Part | I / II           | Time       | 3 hrs. |

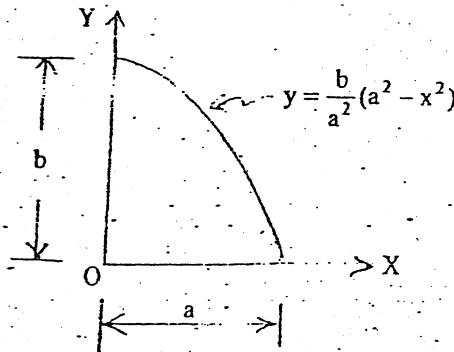
**Subject - Applied Mechanics (CE451)**

- ✓ 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.

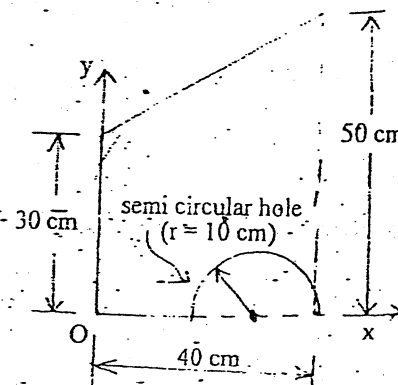
1. What do you mean by rigid body? Why it is necessary to assume a body as "perfectly rigid" for the study of statics. [1+2]
2. What is free body diagram? Why is it necessary to draw free body diagram in solving any structural problems? Also describe equation of equilibrium in two dimension. [2+3+3]
3. If two forces of same magnitude 25 kN act at points A and B as shown in figure and force at A passes through C and force at B passes through D. (a) Find equivalent force-couple system at 'O' (b) Find equivalent wrench and give pitch and axis of wrench. [12]



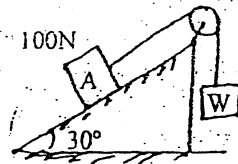
4. Locate the centroid of the area bounded by the curve as shown in figure, by the method of integration. [6]



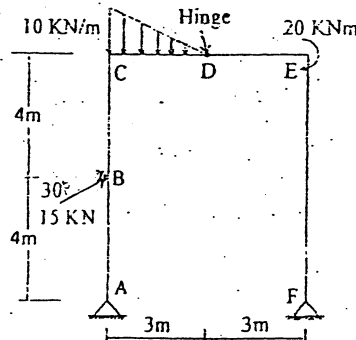
5. Calculate the moment of inertia of the composite area as shown in figure, about x-axis. [6]



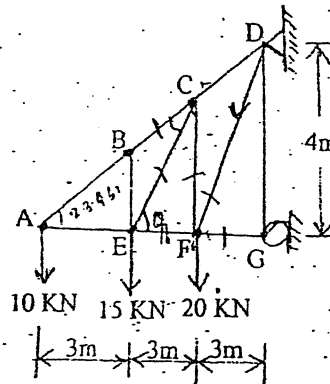
6. A block 'A' of weight 100 N rests on an inclined plane and another weight  $w$  is attached to the first weight through a string as shown in figure. If the coefficient of friction between the block and plane is 0.3, determine the maximum value of  $W$  so that equilibrium can exist. [5]



7. Draw axial force, shear force, bending moment diagram for the loaded frame shown in figure. Indicate also the salient features, if any. [12]

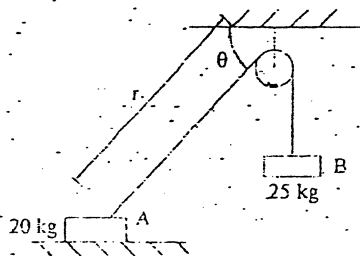


8. Calculate the force developed in members BC, EC, EF, FC, FD and EG of the cantilever truss loaded as shown in figure. [8]



9. Deduce the relationship of radial and transverse components of velocity and acceleration for a particle moving along the curve path. The acceleration of a particle is defined by the relation,  $a = kt^2$ , knowing that velocity is  $-32$  m/sec when time is zero second and again velocity is  $+32$  m/sec when time is 4 sec. (a) Determine, the value of the constant  $K$ , (b) Write the equations of motion knowing also that position of the particle is zero at the instant of 4 sec. [4+6]

10. The velocity of block 'A' is 2 m/s to the right at the instant when  $r = 0.8$  and  $\theta = 30^\circ$ . Neglecting the mass of pulleys, and the effect of friction in the pulley, and between block 'A' and the horizontal surfaces. Determine at this instant (a) the tension in the cable (b) the acceleration of the block 'A' (c) the acceleration of the block 'B'. [10]



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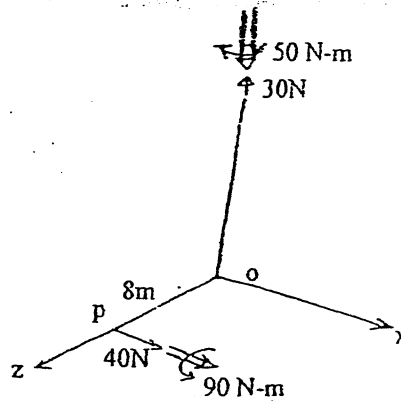


| Exam.       | Regular                            |            |        |
|-------------|------------------------------------|------------|--------|
| Level       | BE                                 | Full Marks | 80     |
| Programme   | BEL, BEX, BCT, BIE, B.Agr. B.Arch. | Pass Marks | 32     |
| Year / Part | 1/1                                | Time       | 3 hrs. |

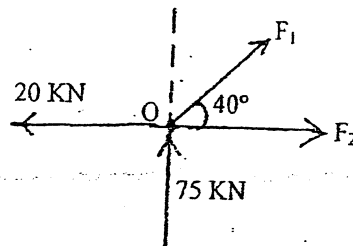
*Subject: - Applied Mechanics (CE401)*

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

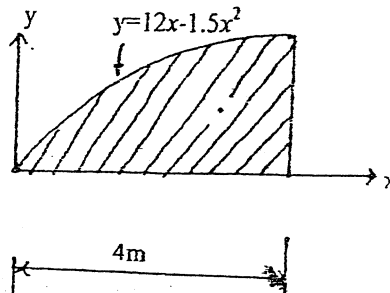
1. Describe briefly the concept of particle, rigid body and deformable body. [3]
2. Describe Free Body Diagram and physical meaning of equilibrium. Also describe the importance of Free Body Diagram and equilibrium in structural analysis. [2+2+2+2]
3. Replace the two wrenches as shown in figure by a single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



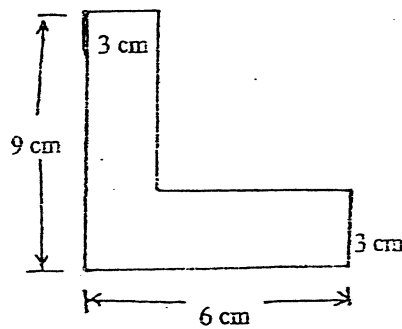
4. Determine the value of  $F_1$  and  $F_2$  if the forces shown in figure below are in equilibrium. [4]



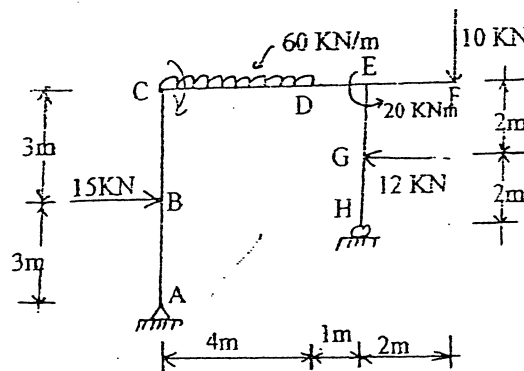
5. Determine centroidal x coordinate of the shaded area shown in figure below. [4]



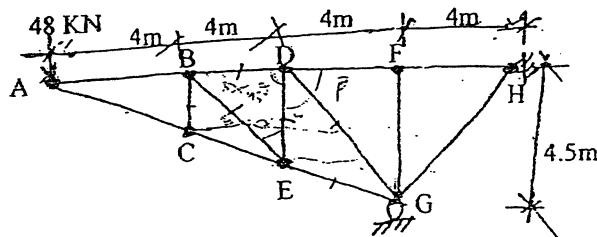
6. Determine radius of gyration ( $r_x$ ) of the angle section shown in figure below about centroidal x-axis. [8]



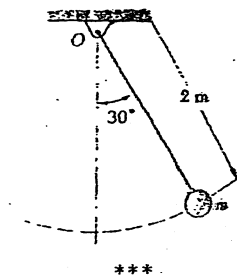
7. Illustrate impending motion state of friction and demonstrate the change in frictional force for different motion stages using relevant figure. [4]
8. Draw AFD, SFD and BMD of the given frame loaded as shown in figure below. Indicate the salient feature if any. [14]



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



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

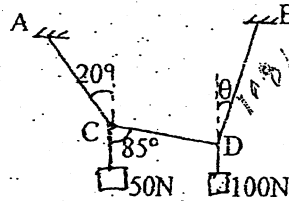


| Exam.       | New Back (2066 & Later Batch)            |            |        |
|-------------|------------------------------------------|------------|--------|
| Level       | BE                                       | Full Marks | 80     |
| Programme   | BEL, BEX, BCT,<br>BIE, B.Agric, B. Arch. | Pass Marks | 32     |
| Year / Part | 1 / 1                                    | Time       | 3 hrs. |

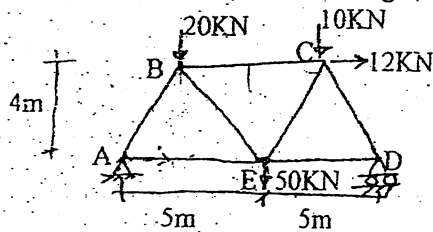
**Subject: - Applied Mechanics (CE401)**

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

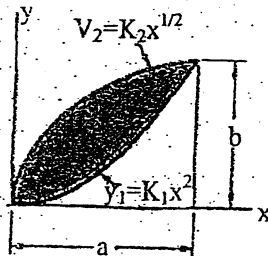
1. Write down the concept of rigid bodies and deformable bodies. [4]
2. What is free body diagram? How is it drawn? Determine the tension on the strings AC, CD and BD and the angle  $\theta$  in figure below. [3+5]



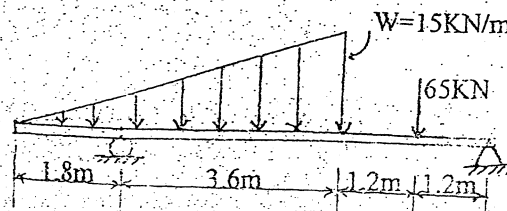
3. Determine the forces in all members of the truss shown in figure below. [8]



4. Explain the laws of friction. Also give two examples of engineering usage of friction. [4]
5. Determine the moment of inertia and the radius of gyration of the shaded area given below. [12]

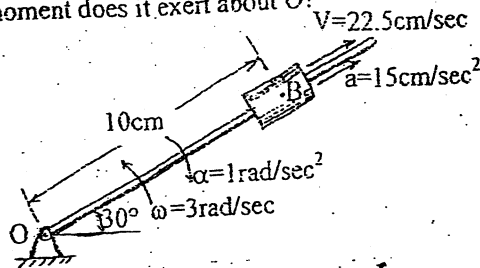


6. What do you understand by statically determinate and indeterminate structure? Explain with an example for each. Write the equations for shear force and bending moment for the beam shown in figure below. Plot the variation of the shear force and bending moment in the beam. Also indicate the salient features associated with the shear force and bending moment. [4+10]



7. Define position, velocity and acceleration of a particle. The acceleration of a particle is defined by the relation  $a = -2m/s^2$ . Initially if the velocity of the particle is  $10m/s$  at  $O$  position, determine the velocity, position and the total distance travelled at the instant of 5 seconds. [3+7]

8. Discuss dynamic equilibrium with an example. In figure below, the motion of block B on a smooth horizontal table is controlled by the rod which rotates about a vertical axis at  $O$ . At the position shown, B has the given values of velocity and acceleration relative to the rod which is rotating with the given values of angular velocity  $\omega$  and angular acceleration  $\alpha$ . If B weighs  $60N$ , what moment does it exert about  $O$ ? [2+8]

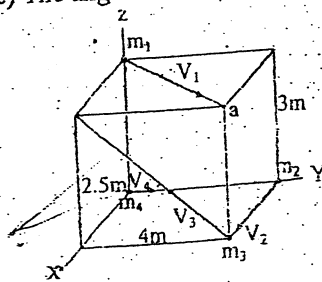


OR

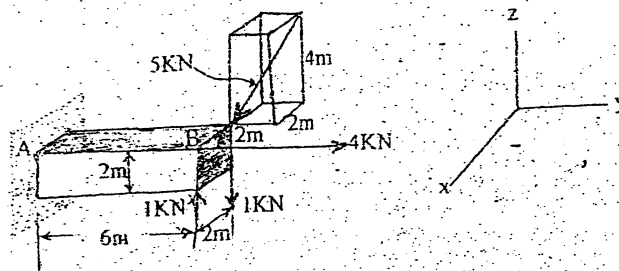
Shown in figure below is a system of particles at time  $t$ . The following data apply at this instant:

|                |               |
|----------------|---------------|
| $V_1 = 7m/s$   | $m_1 = 0.5kg$ |
| $V_2 = 6m/s$   | $m_2 = 1.5kg$ |
| $V_3 = 5m/s$   | $m_3 = 1kg$   |
| $V_4 = 1.5m/s$ | $m_4 = 0.5kg$ |

Determine (a) The total linear momentum of the system, (b) The angular momentum of the system about the origin, (c) The angular momentum of the system about point a. [3+3+4]



9. Compute the resultant force system of the applied loads at position A. What is the equivalent force system at the origin for the force  $\vec{F} = -50\hat{i} - 70\hat{j} + 55\hat{k}KN$  going through position P whose position vector is  $10\hat{i} - 8\hat{j} + 8\hat{k}m$ . [6+4]



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INSTITUTE OF ENGINEERING  
Examination Control Division

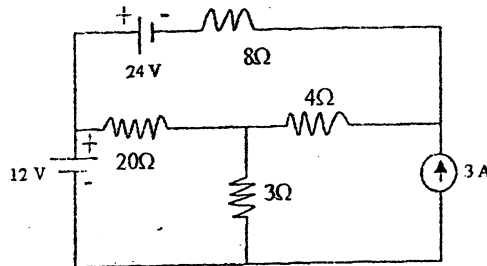
2079 Bhadra

| Exam.       | Regular                                          |            |        |
|-------------|--------------------------------------------------|------------|--------|
| Level       | BE                                               | Full Marks | 80     |
| Programme   | BEL, BEX/BEI,<br>BCT, BAM, BIE,<br>BAG, BAS, BCH | Pass Marks | 32     |
| Year / Part | 1/1                                              | Time       | 3 hrs. |

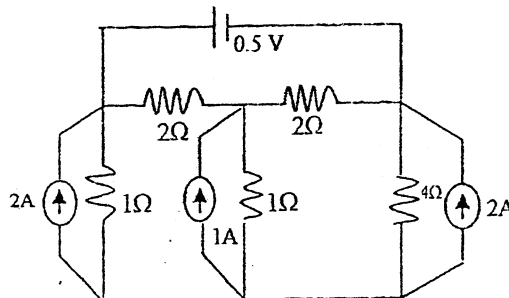
**Subject:** - Basic Electrical Engineering (EE 401)

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

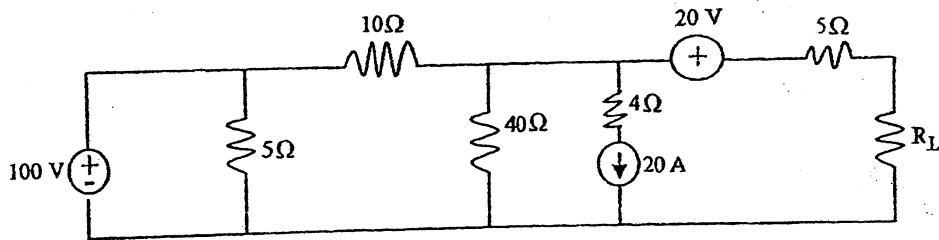
1. a) A coil is connected across a constant dc source of voltage 240V, draws a current of 12A at room temperature. After running 4 hours, temperature rises to 65° C and current reduces to 8A. Calculate the current when temperature increases to 80° C and the coefficient of resistance at 30°C and temperature coefficient of resistance at 40°C. [consider room temperature = 25°C] [6]
- b) Explain about ideal and practical current and voltage sources. [4]
- c) A 100 W, 250 V bulb is connected in series with a 40 W, 250 V bulb across 500 V supply. What will be the current drawn? What will be the power consumed by each bulb? Will such a combination work normally? [6]
2. a) Prove that maximum power is transferred to the load when load resistance is equal to source resistance. [4]
- b) Find the current flowing through the 20Ω resistor using by superposition theorem the circuit shown below. [8]



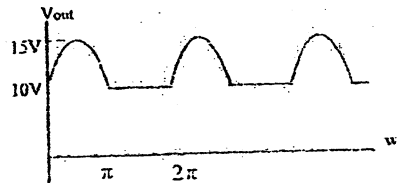
- c) Find power dissipated through 4Ω resistor, using nodal analysis. [4]



3. a) Find the max power through the load  $R_L$  of the circuit given below. [8]



- b) The total capacitance of two capacitors is  $0.25 \mu\text{F}$ , when connected in series and  $0.15 \mu\text{F}$ , when connected in parallel. Find the capacitance of each capacitor. [4]
- c) What is power factor? Write down the drawbacks of poor factor. Explain how connecting a capacitor across the load improves the power factor. [4]
4. a) Calculate the average and rms value of the voltage signal given below. Also find the form factor and peak factor. [6]



- b) Two impedances  $(10+j5)$  and  $(8+j6)$  are connected in parallel an ac voltage source of  $V=200+j0$ . Calculate magnitude and power factor of circuit current and branch currents. Also find the total active power, reactive power, apparent power and draw the phasor diagram. [6]
- c) An alternating current of 50 Hz, has a maximum value of 200 A. Reckoning time from the instant current is zero and is becoming positive, calculate: [4]
- the instantaneous value after 2.5 m sec.
  - the time taken for the current to reach 150 A for the first and second time.
5. a) Non-inductive loads of 8 kW, 6kW, and 4kW are connected between neutral and R,Y,B phase respectively of a 3-phase 4-wire system. The line voltage is 400 V. Find the current in each line conductor and neutral conductor. [8]
- b) Show that  $V_L = \sqrt{3} V_p$  for 3-phase star connected load. Derive an expression for power factor measurement of the load by two wattmeter method. [8]

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Examination Control Division

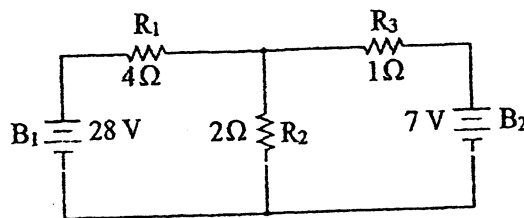
2079 Baishakh

| Exam.       | Back                                              |               |
|-------------|---------------------------------------------------|---------------|
| Level       | BE                                                | Full Marks 80 |
| Programme   | BEL, BEX, BEL,<br>BCT, BAM, BIE,<br>BAG, BAS, BCH | Pass Marks 32 |
| Year / Part | 1 / 1                                             | Time 3 hrs.   |

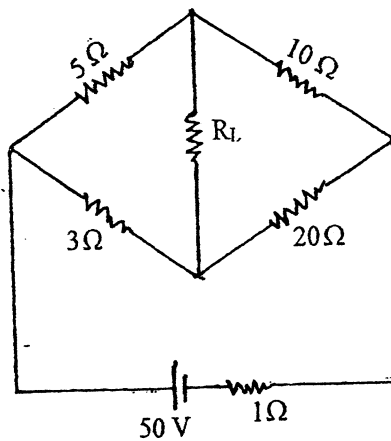
**Subject: - Basic Electrical Engineering (EE 401)**

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

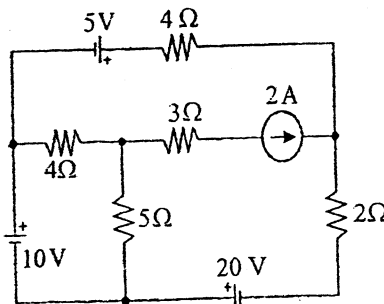
1. a) State and explain Krichof's current and voltage laws. Find the current flowing through 2 ohm resistor using KCL equations. [6]



- b) Find voltage across the given load resistance  $R_L$ . [10]



2. a) Find the current supplied by 10V source using Nodal Analysis in the circuit shown in figure below. [8]



- b) State and verify Reciprocity Theorem with an example. [8]

3. a) Explain the parallel connection of inductors with suitable example and also find the equivalent inductance of the circuit. [8]
- b) A full wave rectified sinusoidal voltage shown in figure below. Find the average and effective value of the voltage. [8]

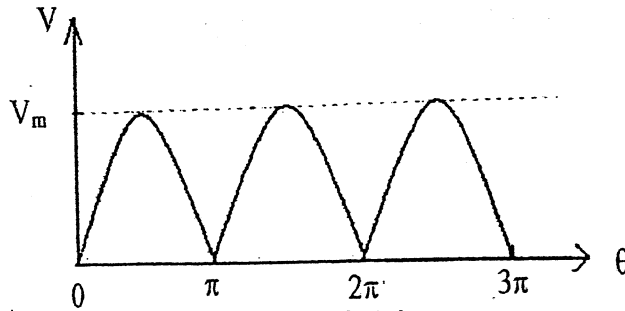
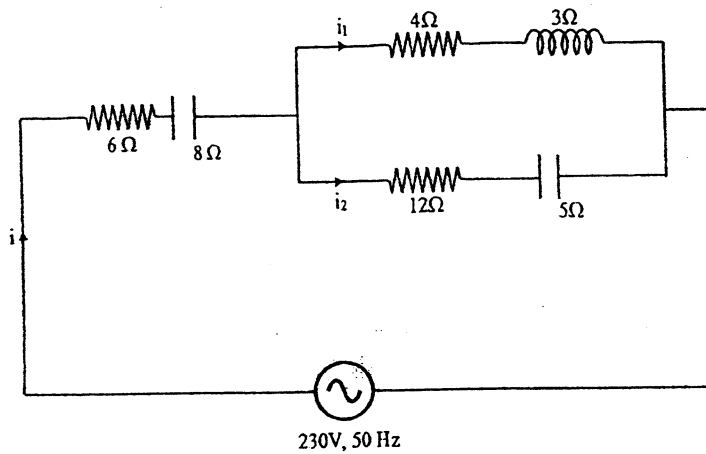


Fig: Full wave rectified sine wave

4. For the circuit shown below. Calculate [16]
- Overall impedance of the circuit
  - Total current taken from supply and overall power factor of the circuit
  - Currents in each parallel branch
  - Active, reactive and apparent power
  - Construct Phasor diagram for given circuit



5. a) Discuss the advantages of three phase system over single phase system. Mention the causes of low power factor and its measures to improve. [6]
- b) A 380 V, 3- $\Phi$  voltage is applied to a balanced star connected 3- $\Phi$  load of phase impedance  $(5+j9)\Omega$ . If wattmeters are connected taking Y phase reference, calculate wattmeter readings and also reactive power, apparent power and active power consumed. Take RYB phase sequence. [10]

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INSTITUTE OF ENGINEERING  
Examination Control Division

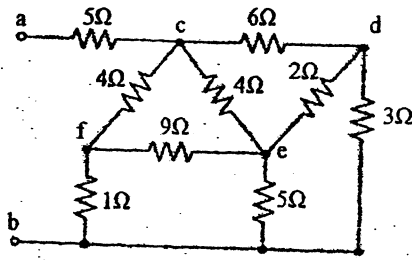
2078 Bhadra

| Exam.       | Regular                                         |            |        |
|-------------|-------------------------------------------------|------------|--------|
| Level       | BE                                              | Full Marks | 80     |
| Programme   | BEL, BEX/BEL<br>BCT, BAM, BIE,<br>BAG, BAS, BCH | Pass Marks | 32     |
| Year / Part | 1/I                                             | Time       | 3 hrs. |

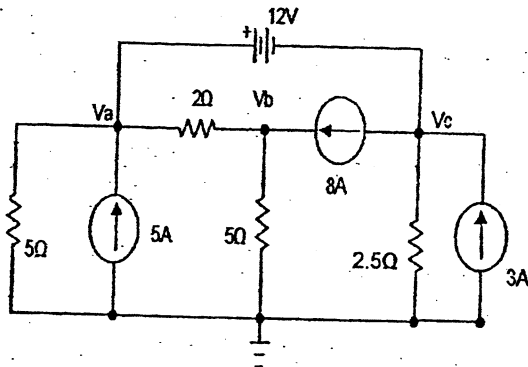
Subject: - Basic Electrical Engineering (EE 401)

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

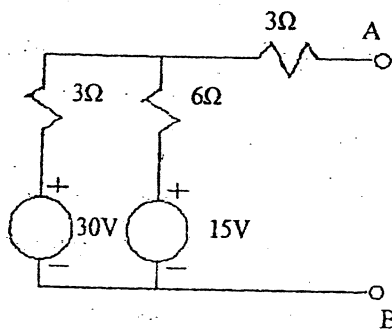
1. a) Define ideal and practical voltage source. Explain the role of internal resistance in practical voltage source with an example. [8]
- b) Using Delta-Star transformation, determine resistance between terminals a and b in the circuit shown in the figure. [8]



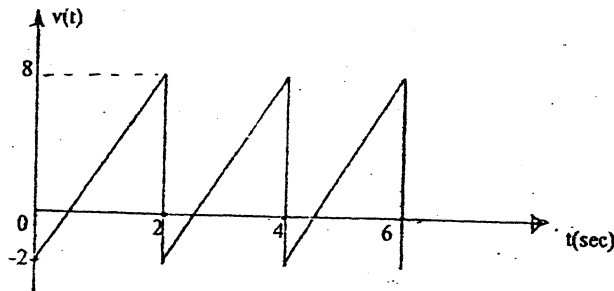
2. a) Find the current through 2Ω resistor using mesh analysis. [8]



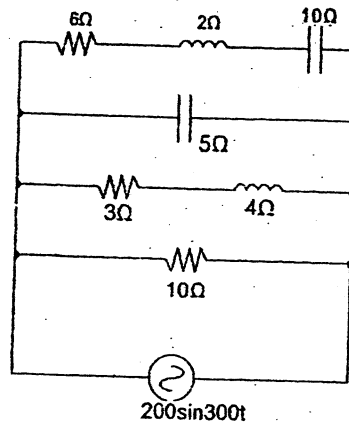
- b) Find the value of resistance to be connected across the terminals A and B to transfer maximum power to it and find the value of this maximum power for the network shown below. [8]



3. a) Calculate the average value, rms value and form factor of the given voltage signal. [8]



- b) A single phase inductive load of 4kW at a power factor of 70% (lagging) is connected across 240V, 50Hz supply. Calculate the kVAR capacity of the capacitor bank and value of capacitance that must be installed in parallel with load to bring the overall power factor to (i) unity, (ii) 85% lagging. [8]
4. In the network shown in figure below, determine: [16]
- Total impedance
  - Total current drawn from source
  - The overall power factor
  - Total Volt Amperes, Active Power and Reactive Power
  - Is the circuit capacitive or inductive?
  - Construct the phasor diagram for given circuit.



5. a) The star-connected load having impedance of  $(12-j16)\Omega$  per phase fed from a 50Hz three-phase, 400V, balanced supply, with the phase sequence as R-Y-B. Find the line current, power factor, active power, reactive power, reactive VA and total volt-amperes (VA). [10]
- b) Describe the measurement of 3-phase power by two wattmeter method. [6]

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Examination Control Division

2078 Kartik

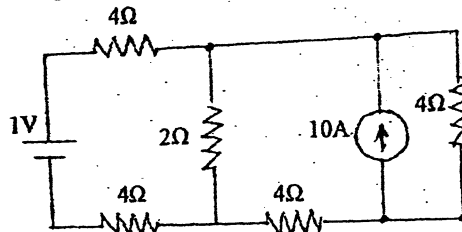
| Exam.       | Back                                              |            |        |
|-------------|---------------------------------------------------|------------|--------|
| Level       | BE                                                | Full Marks | 80     |
| Programme   | BEL, BEX, BEI,<br>BCT, BAM, BIE,<br>BAG, BAS, BCH | Pass Marks | 32     |
| Year / Part | I / I                                             | Time       | 3 hrs. |

**Subject: - Basic Electrical Engineering (EE 401)**

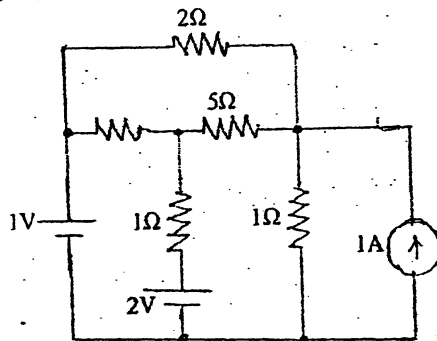
- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

1. a) At  $20^{\circ}\text{C}$ , two coils connected in series having resistance of  $600\Omega$  and  $300\Omega$  respectively. The temperature coefficient at  $20^{\circ}\text{C}$  are  $0.002/^{\circ}\text{C}$  and  $0.004/^{\circ}\text{C}$  respectively for the coils. Find the resistance of combination at a temperature of  $50^{\circ}\text{C}$ . What is the effective temperature co-efficient of the combination at  $50^{\circ}\text{C}$ ? [8]

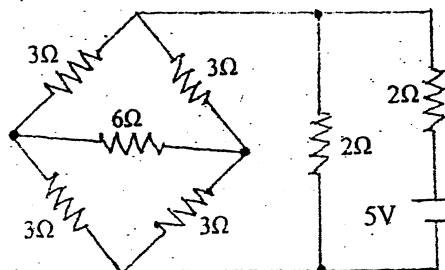
- b) Find the current through  $2\Omega$  resistor using super position theorem in the circuit below. [8]



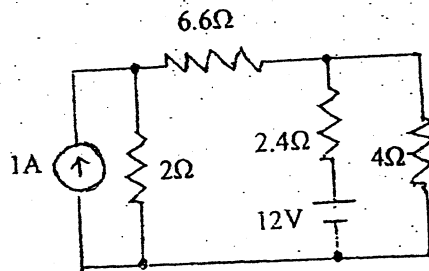
2. a) Using Nodal Analysis, determine the current in  $5\Omega$  resistor in the circuit below. [8]



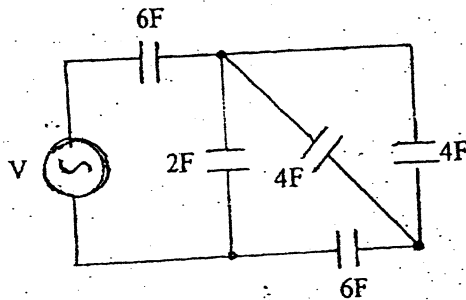
- b) State Thevenin's theorem. Determine the current through  $6\Omega$  resistor using Thevenin's theorem. [8]



3. a) Use Norton's theorem to calculate the current through  $4\Omega$  resistance in the circuit below. [8]

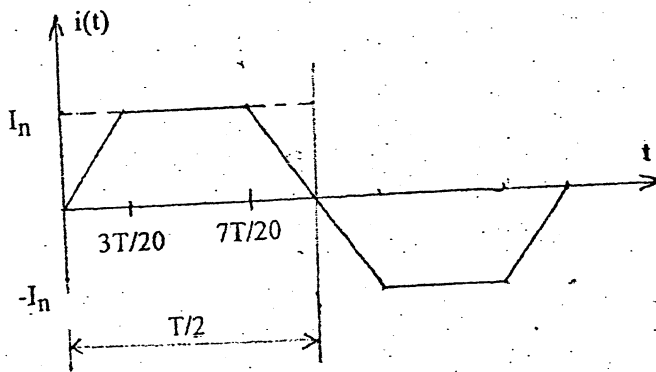


- b) Calculate the equivalent capacitance in the circuit shown below. [4]



- c) What are the drawbacks of low power factor? Explain a measure to improve power factor. [4]

4. a) Determine the rms and average value of the given waveform. [8]



- b) Two circuits the impedances of which are given by  $Z_1=(10+j15)$  and  $Z_2=(6-j8)$  are connected in parallel. If the applied voltage to the combination is  $230V$ , find (i) current and pf of each branch (ii) overall current and p.f. of the combination (iii) power consumed by each impedance and (iv) Draw the phasor diagram. [8]

5. a) Derive an expression to calculate the power factor of load (lagging) using two wattmeter meter readings. Also, explain the effect of power factor on wattmeter readings. [4+4]

- b) Three loads  $3+j5$ ,  $3-j4$  and  $8+j6$  are connected in delta to a 3-phase,  $400V$  supply. Find the phase currents, line currents and total power consumed. [8]

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Examination Control Division

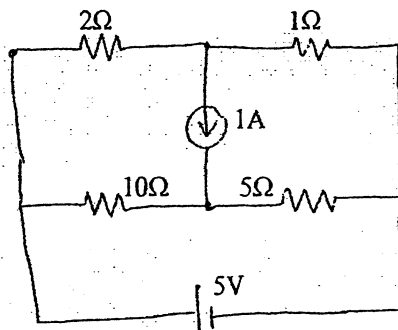
2076 Chaitra

| Exam.       | Regular                                           |            |        |
|-------------|---------------------------------------------------|------------|--------|
| Level       | BE                                                | Full Marks | 80     |
| Programme   | BEL, BEX, BEI,<br>BCT, BAM, BIE,<br>BAG, BAS, BCH | Pass Marks | 32     |
| Year / Part | I/I                                               | Time       | 3 hrs. |

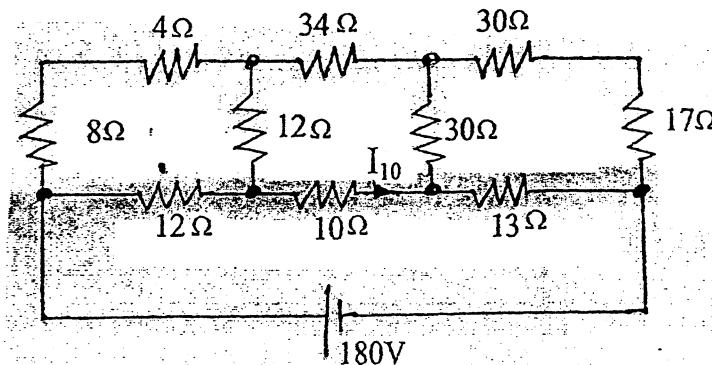
**Subject:** - Basic Electrical Engineering (EE 401)

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

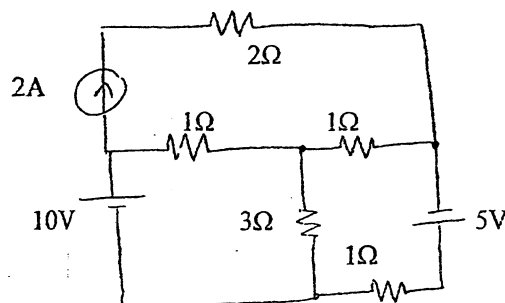
1. a) What do you mean by ideal and practical voltage source? Explain the effect of an internal resistance of voltage and current sources on their terminal characteristics. [4+4]
- b) Using loop current method, determine the current through  $5\Omega$  resistor in the circuit below. [8]



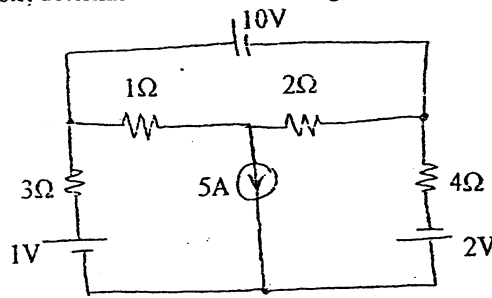
2. a) Find the  $I_{10}$  using Y/ $\Delta$  transformation method, in the network given below. [8]



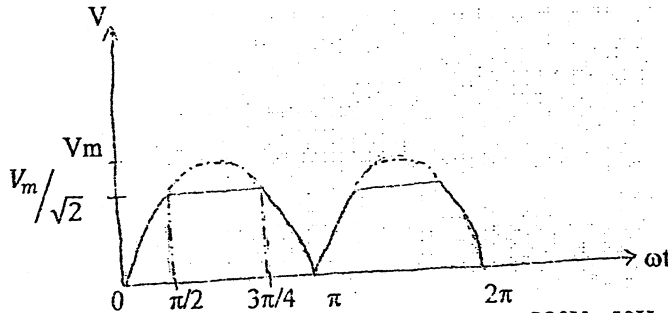
- b) Find the current through  $3\Omega$  resistor using Thevenin's theorem. [8]



3. a) Using Nodal analysis, determine the current through  $2\Omega$  resistor in the circuit below. [8]



- b) What is a self inductance? Derive the expression of equivalent inductance, when the two inductances are connected in series (opposing). [4]
- c) "The average power over complete cycle in a purely inductive circuit is zero". Justify with necessary waveforms and mathematical expression. [4]
4. a) Find the rms and average value of the following waveform. [8]



- b) Two coils A & B are connected in series across a 230V, 50Hz ac supply. The resistance and inductance of coil A & B are  $5\Omega$  and  $0.018\text{H}$  respectively. The input from the supply is  $2\text{KW}$  and  $2\text{kVAR}$ , find the inductance of coil A and resistance of coil B. Also calculate the voltage across each coil. [8]
5. a) A two wattmeters measured an input power of  $30\text{KW}$  and  $40\text{KW}$  respectively to a motor. If the power factor of the motor be changed to  $0.85$  leading, determine the two wattmeter readings. The total input power remains the same. Draw a phasor diagram for the second condition. [8]
- b) Three loads  $4-3j$ ,  $6+8j$ , and  $8+6j$  are connected in delta to a 3-phase,  $400\text{V}$  supply. Find phase currents, line currents and total power consumed. [8]

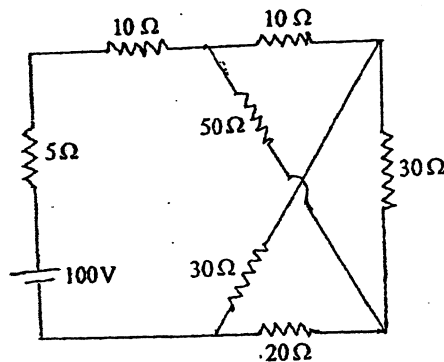
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| Exam.       | Back                                      |            |        |
|-------------|-------------------------------------------|------------|--------|
| Level       | BE                                        | Full Marks | 80     |
| Programme   | BEL, BEX, BEI, BCT,<br>BAM, BIE, BAG, BAS | Pass Marks | 32     |
| Year / Part | 1 / 1                                     | Time       | 3 hrs. |

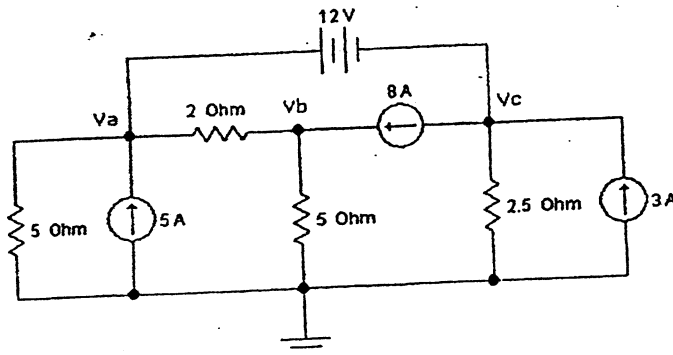
**Subject: - Basic Electrical Engineering (EE 401)**

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

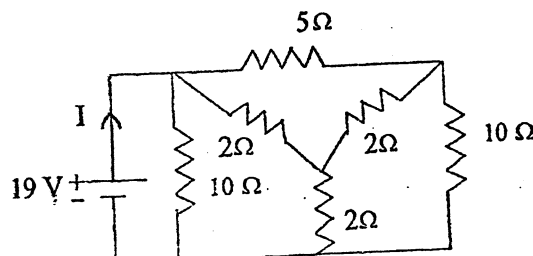
1. a) What are ideal and practical voltage and current source? Explain. [4]
- b) A coil has a resistance of  $18 \Omega$  when its mean temperature is  $20^\circ\text{C}$  and of  $20 \Omega$  when its mean temperature is  $50^\circ\text{C}$ . Find its mean temperature rise when its resistance is  $21 \text{ ohm}$  and the surrounding temperature is  $15^\circ\text{C}$ . [6]
- c) State and explain Kirchoff's voltage laws. Determine the current supplied by the battery in the circuit shown in figure below. [6]



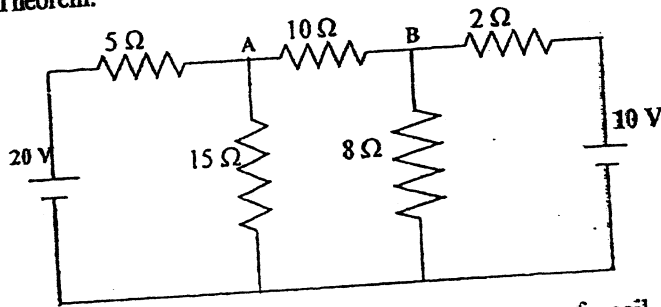
2. a) Use Nodal Analysis Method to determine the  $V_a$ ,  $V_b$  and  $V_c$  and Calculate current through 2 ohm. [8]



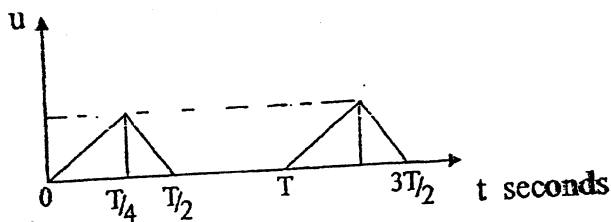
- b) Find the current  $I$  as shown in figure using star - delta transformation. [8]



3. a) Calculate the current in the  $10\Omega$  resistor in the networks shown in the circuit using Thevenin's Theorem. [8]



- b) Explain what is meant by self inductance and mutual inductance of a coil. [4]
- c) Calculate the average and rms value of the waveform shown below, over one cycle. [4]



4. a) State and explain reciprocity theorem with a suitable example. [4]
- b) A resistance of  $20\Omega$ , an inductance of  $0.2\text{ H}$  and a capacitance of  $100\ \mu\text{F}$  are connected in series across a  $220\text{ V}$ ,  $50\text{ Hz}$  supply. Determine the following (i) impedance (ii) current (iii) voltage across R, L and C. [4]
- c) Two impedances  $z_1$  and  $z_2$  are connected in parallel. The first branch takes a leading current of  $16\text{ A}$  and has a resistance of  $5\Omega$ , while the second branch takes a lagging current at power factor  $0.8$ . The total power supplied is  $5\text{ kW}$ , the applied voltage being  $(100+j200)\text{ V}$ . Determine the branch and total currents. [8]
5. a) What are the disadvantages of supplying a low power factor? A  $100\text{ kW}$  load at  $0.85$  lagging power factor is being supplied by a  $230\text{ V}$ ,  $50\text{ Hz}$  source. Calculate the reactive power drawn from the source. If a capacitor connected parallel to the load improves its power factor to  $0.9$ , find the capacitance of the capacitor. Also, calculate the current drawn from the source before and after connecting the capacitor. [2+6]
- b) A three phase delta connected system with  $400\text{ V}$  line voltage is connected to three unbalanced loads:  $(12-j16)\Omega$ ,  $(3+j4)$ , and  $20\Omega$ , are also connected in delta. Find (i) phase currents (ii) line currents (iii) total active power consumed. [8]

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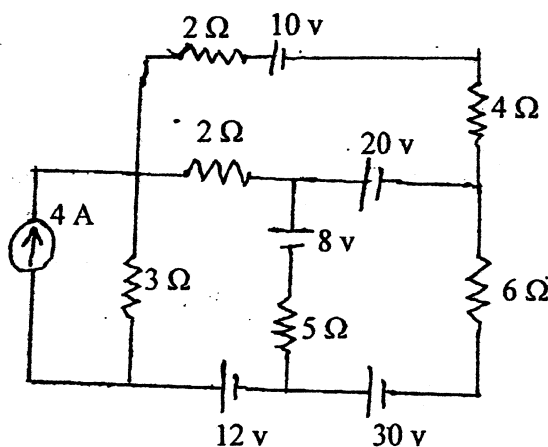


| Exam.       | Back                                  |            |        |
|-------------|---------------------------------------|------------|--------|
| Level       | BE                                    | Full Marks | 80     |
| Programme   | BEL, BEX, BCT,<br>BAME, BIE, B. Agri. | Pass Marks | 32     |
| Year / Part | 1 / I                                 | Time       | 3 hrs. |

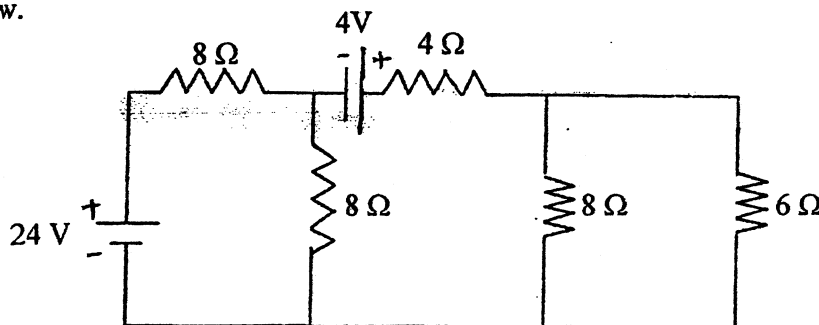
**Subject: - Basic Electrical Engineering (EE401)**

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

1. a) Differentiate between Practical Voltage Source and Practical Current Source. [4]
- b) The field winding of dc motor takes 1.15 A current at 20°C. If current falls to 0.26 A after working for some hours, supply voltage remaining constant, find the final working temperature of field winding. Given,  $\alpha_0 = \frac{1}{234.5}$  and voltage = 230V. [6]
- c) Three lamps of rating 220 V and 150 watt, 200 watt and 450 watt are connected across 200 V supply. Calculate the resistance of each lamp and the power consumed by each lamp at 200 V. [6]
2. a) Solve the given network with mesh analysis to find voltage drop on 5 Ω resistors. [6]

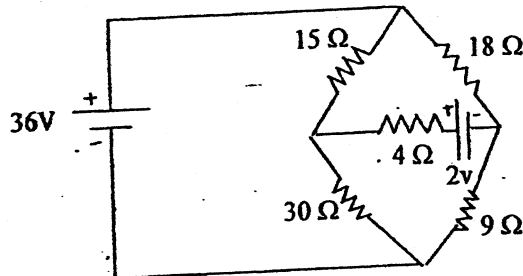


- b) Use nodal analysis to find the current through 4Ω resistor for the network shown below. [6]

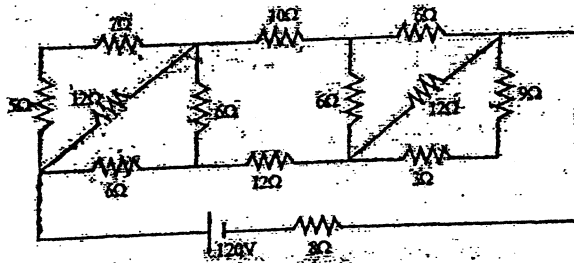


- c) State and explain superposition theorem with suitable example. [4]

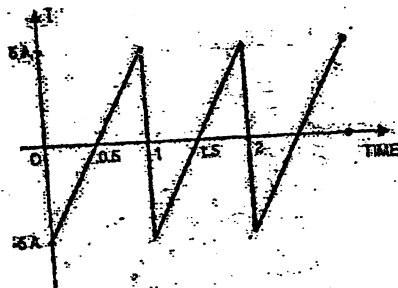
3. a) Using thevenin's theorem find the current through the  $4\Omega$  for the network shown below. [6]



- b) Determine the power dissipated in the  $8\Omega$  resistor of the given network using star-delta and delta-star transformation. [6]

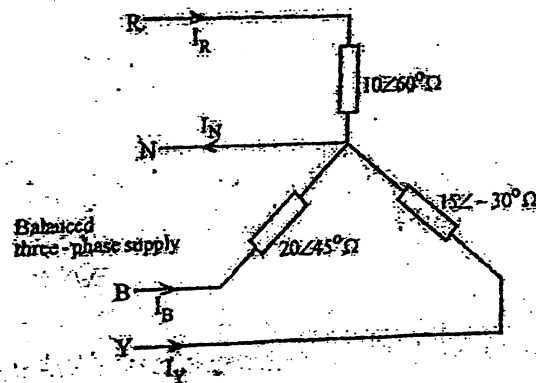


- c) How mutual inductance between two coils depends upon dimensions of core and coils. [4]
4. a) Find the form factor and peak factor of the current waveform given below. [4]



- b) A coil of inductance  $318.3\text{ mH}$  is connected in series with a  $200\Omega$  resistor to a  $240\text{ V}$ ,  $50\text{ Hz}$  supply. Calculate the current flowing, power factor, active and reactive power of the circuit. Also draw the phasor diagram. [6]
- c)  $Z_1 = (40 - j318.31)$  and  $Z_2 = (50 + j62.83)$  are connected in parallel to each other and a source of  $100\text{ V}$ ,  $50\text{ Hz}$  is applied across the overall circuit. Calculate (i) circuit current (ii) Active, reactive and apparent power. [6]

5. a) Discuss the effect of low power factor. A single phase load of 7Kw operates at a power factor 0.7 lagging. It is proposed to improve the power factor to 0.9 lagging by connecting a capacitor the load. Calculate the KVAR rating of the capacitor. [3+5]
- b) For the following unbalanced system with balanced three phase supply of 400 V, 50 Hz, calculate: [8]
- The line currents and neutral current
  - Active and reactive power absorbed by the circuit
  - Draw the phasor diagram.



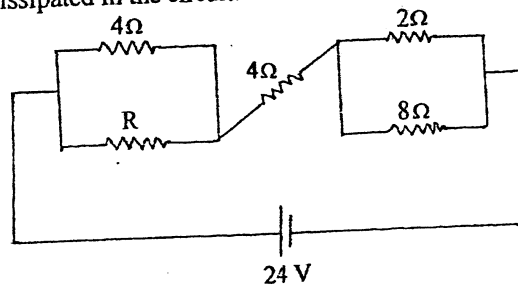
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| Exam.       | Regular / Back                            |            |        |
|-------------|-------------------------------------------|------------|--------|
| Level       | BE                                        | Full Marks | 80     |
| Programme   | BEL, BEX, BEI, BCT,<br>BAM, BIE, BAG, BAS | Pass Marks | 32     |
| Year / Part | 1/1                                       | Time       | 3 hrs. |

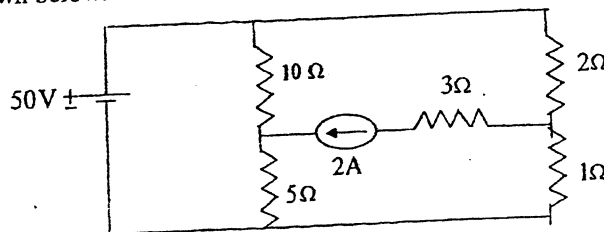
**Subject: - Basic Electrical Engineering (EE 401)**

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

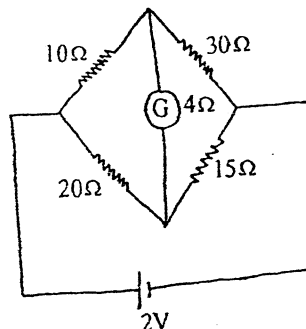
1. a) Discuss on brief voltage and current sources. Also justify the statement "terminal voltage goes on increasing on decreasing load current". [4]
- b) The resistance of the certain length of wire is 4.60 ohm at 20°C and 5.68 ohm at 80°C. Determine (i) the temperature coefficient of resistance of the wire at 0°C, (ii) the resistance of the wire at 60°C. [6]
- c) State and explain Kirchoff's current laws. Determine the value of unknown resistance R and the total current drawn from the source in the circuit of figure. Also compute the total power dissipated in the circuit. [6]



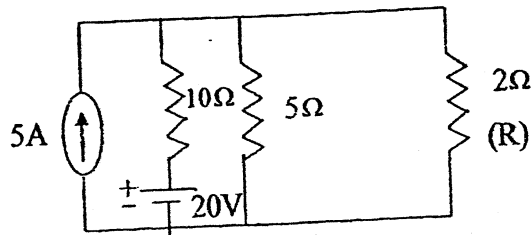
2. a) Use loop current method to calculate the current through the 5 Ω resistance for the network shown below. [8]



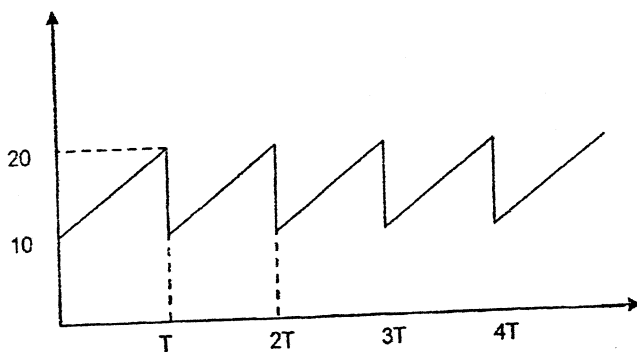
- b) Using delta/star transformation, find the galvanometer current in the Wheatstone bridge. [8]



3. a) Find the current through R using thevenin's theorem. Also, find the value of R such that maximum power transfer takes place from the source to R in the network shown below. [8]



- b) Derive an expression for the equivalent capacitance of a group of capacitors when they are connected in series. [4]
- c) Calculate the form factor and peak factor of the following waveform. [4]



4. a) State and explain Norton's theorem with a suitable example. [4]
- b) A resistance of  $12\ \Omega$ , an inductance of  $0.15\ \text{H}$  and a capacitance of  $130\ \mu\text{F}$  are connected in series across a  $100\text{V}$ ,  $50\text{Hz}$  supply. Calculate the impedance, current and phase angle and power factor. [4]
- c) A parallel circuit consists of two branches, one containing a coil of resistances  $5\ \Omega$  and inductance  $38.2\text{mH}$ , the other a non-inductive resistance  $16\ \Omega$  in series with a capacitor of  $300\ \mu\text{F}$  capacitance. The circuit is connected to a  $240\ \text{V}$ ,  $50\ \text{Hz}$  supply. Determine (i) the current in each branch (ii) the total current (iii) the circuit phase angle (iv) the circuit impedance (e) the components of an equivalent circuit consisting of a resistance and reactance. [8]
5. a) Define power factor and explain causes of low factor. A single phase  $240\text{V}$ ,  $50\ \text{Hz}$  induction motor takes  $20\text{A}$  at power factor of  $0.75$  lagging. It is desired to raise the power factor to  $0.95$  lagging by connecting a capacitor across the load. Calculate the capacitance of the capacitor to be used in parallel with induction motor. [2+6]
- b) A three phase  $400\ \text{V}$ ,  $50\ \text{Hz}$  power line has two loads connected to it. The first is delta-connected and draws  $25\ \text{Kw}$  at  $0.70$  power factor lagging. The second is wye-connected and draws  $6.25\ \text{kVA}$  at  $0.8$  power factor leading. What is the total line current and the combined power factor. [8]

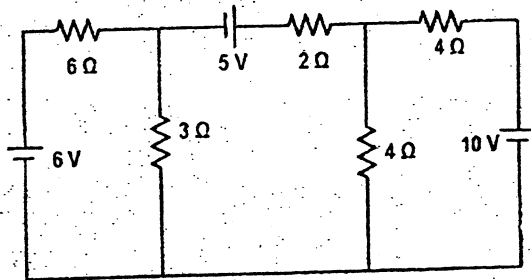
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| Exam.       | Back          |            |        |
|-------------|---------------|------------|--------|
| Level       | BE            | Full Marks | 80     |
| Programme   | BCE, BGE, BME | Pass Marks | 32     |
| Year / Part | I / II        |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

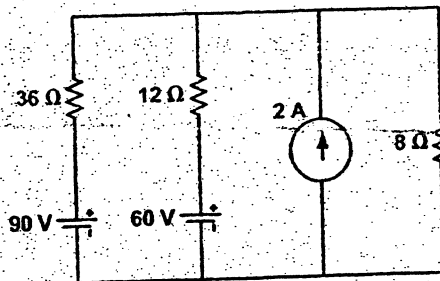
**Subject: - Basic Electrical Engineering (EE451)**

- ✓ 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) Derive a relation between the known resistance  $R_1$  at  $t_1$  °C and the unknown resistance  $R_2$  at  $t_2$  °C, when  $\alpha_0$  is not known. [6]
- b) Explain the process of source conversion. How is it helpful in solving electrical networks? [4]
- c) A circuit, containing of three resistances  $12 \Omega$ ,  $18 \Omega$ , and  $36 \Omega$  respectively jointed in parallel, is connected in series with a fourth resistance. The whole is supplied at  $60 \text{ V}$  and it is found that the power dissipated in the  $12 \Omega$  resistance is  $36 \text{ W}$ . Determine the value of the fourth resistance and the total power dissipated in the group. [6]
2. a) Find the branch currents in the circuit of given figure below by using nodal analysis? [6]

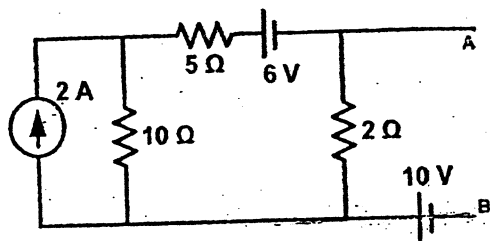


- b) Find current in  $8 \Omega$  resistor of the network shown in figure below using superposition theorem. [6]



- c) State and explain Thevenin's theorem with suitable example. [4]

3. a) In the network shown in figure below, find resistance  $R_L$  connected between terminals A and B so that maximum power is developed across  $R_L$ . What is the maximum power? [6]



- b) Derive an expression for the energy stored in the magnetic field of an inductor. [4]
- c) Derive an expression for the current drawn by a pure capacitor when connected across a voltage. Explain with the help of a power diagram that the value of average power drawn by the capacitor during one cycle is zero. [6]
4. a) A resistance of  $20 \Omega$ , an inductance of  $0.2 \text{ H}$  and a capacitance of  $100 \mu\text{F}$  are connected in series across a  $220 \text{ V}$ ,  $50 \text{ Hz}$  supply. Determine the following (a) impedance (b) Current (c) Voltage across R, L and C and (d) Power factor. Also calculate the total power consumed by the circuit. [6]
- b) A coil resistance  $50 \Omega$  and inductance  $0.318 \text{ H}$  is connected in parallel with a circuit comprising a  $75 \Omega$  resistor in series with a  $159 \mu\text{F}$  capacitor. The resulting circuit is connected to a  $240 \text{ V}$ ,  $50 \text{ Hz}$  ac supply. Calculate: (a) The supply current (b) The circuit impedance, resistance and reactance (c) Power factor and (d) Total power consumed by the circuit. [6]
- c) Describe the method of measuring power in 3- $\Phi$  circuit by using two watt meters. [4]
5. a) A  $220 \text{ V}$ ,  $50 \text{ Hz}$  single phase ac motor draws a power of  $10 \text{ kW}$  at a power factor of  $0.75$  lagging. Calculate the change in current taken from the supply and the new power factor when a  $250 \mu\text{F}$  capacitor is connected in parallel with the motor. If the motor is supplied through a cable of  $0.05 \Omega$  resistances, calculate the power loss in the cable before and after connecting the capacitor. [8]
- b) A three-phase  $\Delta$ -connected load consists of three similar coils, each of resistance  $50 \Omega$  and inductance  $0.3 \text{ H}$ . The supply is  $415 \text{ V}$ ,  $50 \text{ Hz}$ . Calculate (i) The line currents (ii) The power factor (iii) Total active and reactive powers when the load is  $\Delta$ -connected. Draw the phasor diagram. [8]

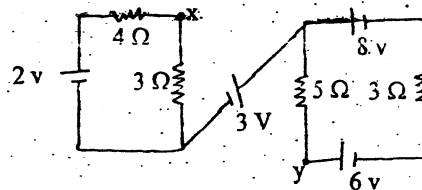
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|             |                                       |            |        |
|-------------|---------------------------------------|------------|--------|
| Level       | BE                                    | Full Marks | 80     |
| Programme   | BEL, BEX, BCT,<br>BAME, BIE, B. Agri. | Pass Marks | 32     |
| Year / Part | 1 / 1                                 | Time       | 3 hrs. |

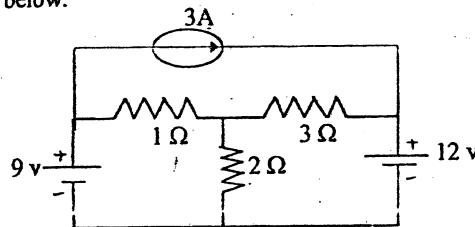
**Subject: - Basic Electrical Engineering (EE401)**

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

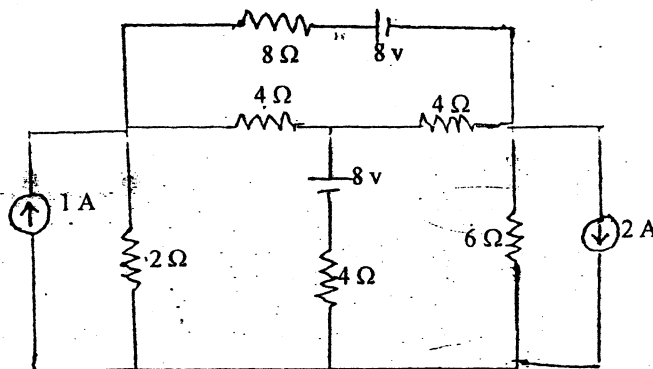
1. a) What is source transformation? Explain with the help of an example. [4]
- b) A coil of stranded copper wire having a resistance of  $12\Omega$  at  $25^\circ\text{C}$  is embedded in the core of a large transformer supplied at 230 V. After the transformer has been in service for several hours, the resistance of the coil is found to be  $13.4\Omega$ . What is the temperature of the core? Also find the power rating of the resistance. Assume temperature coefficient of wire as  $0.00125^\circ\text{C}$  at  $15^\circ\text{C}$ . [6]
- c) Find  $V_{xy}$  in the following circuit diagram. [6]



2. a) Use loop current method to calculate the current through the  $2\Omega$  resistance for the network shown below. [6]



- b) Solve the given network with nodal analysis to find voltage drop on  $8\Omega$  resistor. [6]

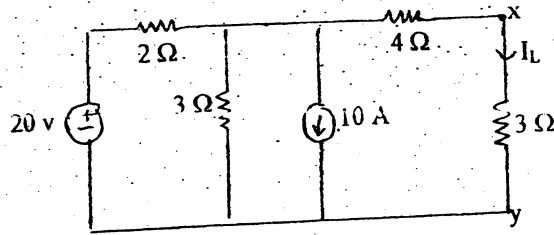


- c) State and explain Norton's theorem with suitable example. [4]

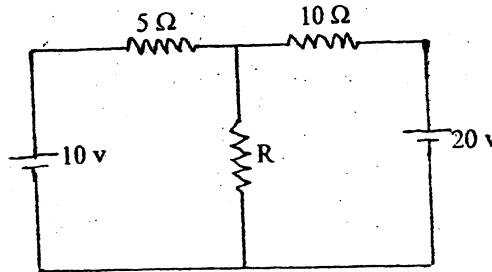
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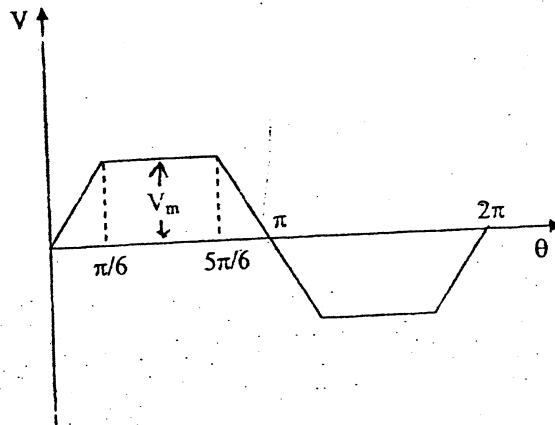
3. a) Find power dissipated in  $3\ \Omega$  resistor using Norton's theorem. [6]



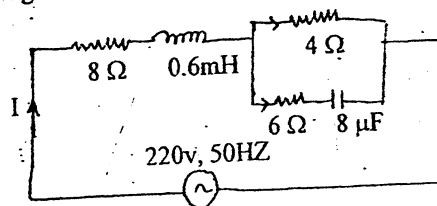
- b) Calculate the value of 'R' such that maximum power will be absorbed by it in the given circuit. [6]



- c) What is inductance? Derive the expression for two inductances in series, with mutual flux aiding each other. [4]
4. a) Calculate the average (half period) value and rms value of the waveform shown below. [4]



- b) An alternating source of emf  $v = 200\sin(314t)$  volts is applied to a practical coil with resistance  $20\ \Omega$  and inductance  $0.1\ \text{H}$  respectively. Determine (i) expression for instantaneous current and power factor (ii) active reactive and apparent power of circuit (iii) voltage drop on resistor and inductor and (iv) construct phasor diagram for above circuit. [6]
- c) Find current flowing in each branches of the following circuit: [6]



5. a) A 400V, 50 HZ, 3 phase induction motor takes 60 KW power from supply mains at 0.8 power factor lagging. Calculate the capacitance per phase and KVAR rating per phase of capacitor in order to improve the power factor to 0.9 lagging using (i) star connected capacitor bank and (ii) Delta connected capacitor bank. [8]
- b) Define phase order and explain its significance. A three phase balanced star connected load with  $(6+j8)$  ohm per phase is supplied by 400V, 50 HZ three phase source. Find the line and phase currents and the total power dissipated in the load. [2+6]

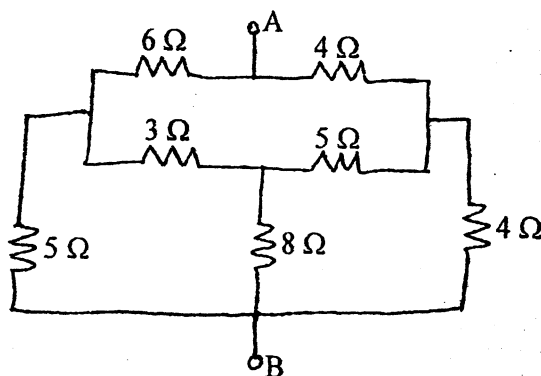
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| Exam.       | Back                                  |            |        |
|-------------|---------------------------------------|------------|--------|
| Level       | BE                                    | Full Marks | 80     |
| Programme   | BEL, BEX, BAME,<br>BCT, BIE, B.Agric. | Pass Marks | 32     |
| Year / Part | 1 / 1                                 | Time       | 3 hrs. |

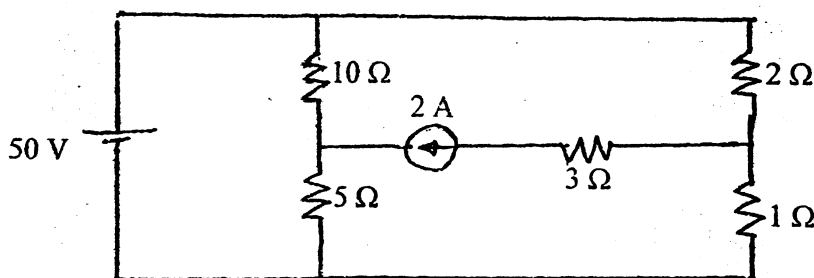
**Subject: - Basic Electrical Engineering (EE401)**

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

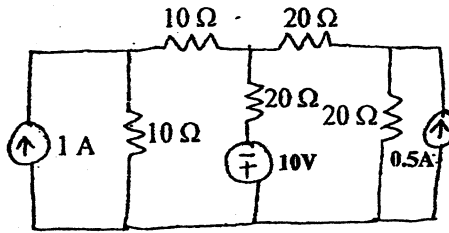
1. a) What do you mean by ideal and practical voltage and current source? Explain the method for converting practical voltage source into current source and vice versa. [5]
- b) A 60 watt, 240 V incandescent filament lamp is switched on at 20°C. The operating temperature of the filament is 2000°C. Determine the current taken by the lamp at the instant of switching ON. The temperature coefficient of resistance of the filament material is 0.0045°/k. [6]
- c) A circuit containing three resistors with resistances 12Ω, 18Ω and 36Ω respectively joined in parallel is connected in series with a fourth resistance. The whole circuit is supplied at 60V and it is found that power dissipated in 12Ω resistance is 36watt. Determine the value of fourth resistance and the total power dissipated in the group. [5]
2. a) Make comparison table between series and parallel circuit. [4]
- b) For the circuit shown in below figure, determine the resistance between points A and B using star / delta transformation theorem. [6]



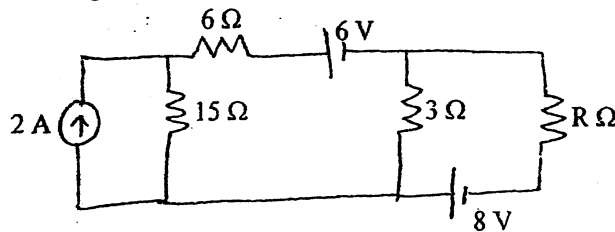
- c) Find all branch currents in the given circuit by using mesh current method. [6]



3. a) Using Nodal analysis, determine currents in each branch of the network shown in below figure. Also find the total power loss in the network. [8]



- b) Find the value of Resistance 'R' to have maximum power transfer in the circuit as shown in below figure. Also obtain the amount of maximum power. [8]



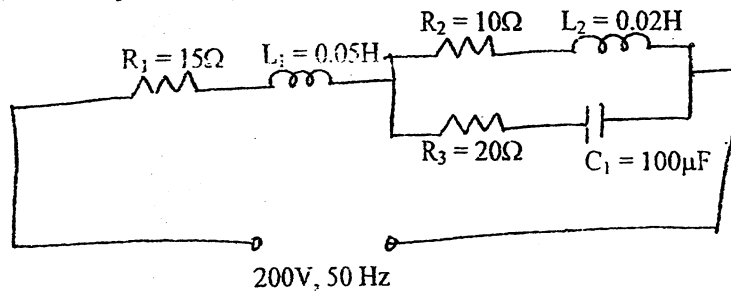
4. a) Two inductances  $L_1$  and  $L_2$  are connected in parallel. Derive the relation showing the equivalent inductance of the combination when mutual flux helps the individual flux. what will be the equivalent inductance of the combination when mutual flux opposes the individual flux? [4]

- b) Two alternating currents represented by the equations  $i_1 = 7\sin\omega t$  and  $i_2 = 10\sin\left(\omega t + \frac{\pi}{2}\right)$  are fed into a common conductor. Find the equation for the resultant current and its RMS value. [4]

- c) Below Figure shows a series parallel circuit. Find: [8]

- (i) total impedance
- (ii) current drawn from the circuit
- (iii) voltage across the parallel branches
- (iv) current flowing through each parallel branch
- (v) power factor
- (vi) Active, reactive and apparent power

Also, draw the phasor diagram of the circuit.



5. a) A fluorescent lamp takes a current of 0.75A when connected across a 240V, 50Hz a.c supply. The power consumed by the lamp is 80 watt. Calculate the value of the capacitance to be connected in parallel with the lamp to improve the power factor to (i) unity (ii) 0.95 lagging. [6]
- b) The following balanced three phase loads are connected to a 415 V, three phase, four wire supply. [4]
- (i) 160 kVA at 0.7 power factor lagging  
(ii) 50 kVA at 0.65 power factor leading  
(iii) 50 kW at unity power factor
- Calculate (a) the total load in kVA (b) the line current (c) the combined power factor
- c) Prove that sum of the readings of two wattmeters is equal to the total three phase power in measurement of power of 3-phase circuit by 2 wattmeter method. [6]

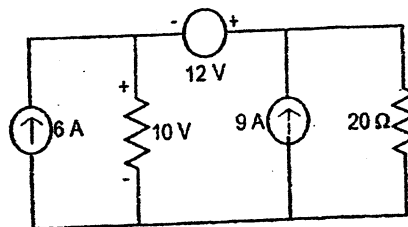
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| Exam.       | Regular                               |            |        |
|-------------|---------------------------------------|------------|--------|
| Level       | BE                                    | Full Marks | 80     |
| Programme  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

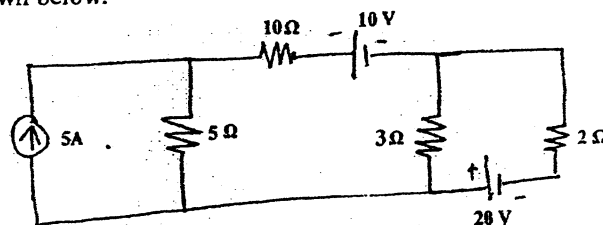
**Subject: - Basic Electrical Engineering (EE401)**

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

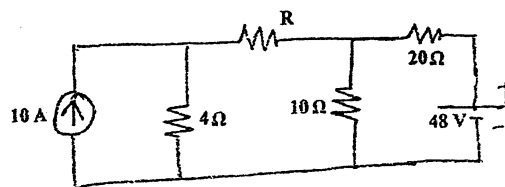
1. a) Describe the open circuit, close circuit and short circuit with diagram. [4]
- b) Two conductors, one of copper and the other of iron are connected in parallel and at 20°C carry equal currents. What proportion of current will pass through each, if the temperature is raised to 100 °C? Assume temperature coefficient of resistance at 20 °C for copper as 0.0042 per °C and for iron as 0.006 per °C. [6]
- c) A direct current circuit comprises two resistors A of value 25Ω and B of unknown value, connected in parallel together with a third resistor C of value 5Ω connected in series with the parallel group. The potential difference across C is found to 90V. If the total power in the circuit is 4320 watt. Calculate (i) the value of resistor B, (ii) the voltage applied to the ends of the whole circuit, (iii) the current in each resistor. [6]
2. a) Using mesh analysis, calculate the voltage across the 20 Ω resistor shown in the figure below. [6]



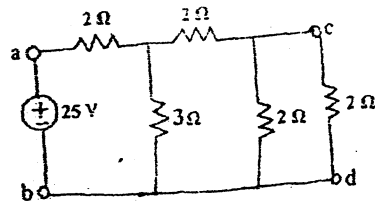
- b) Use the nodal voltage method to find the current flowing through 10Ω resistor for the network shown below. [6]



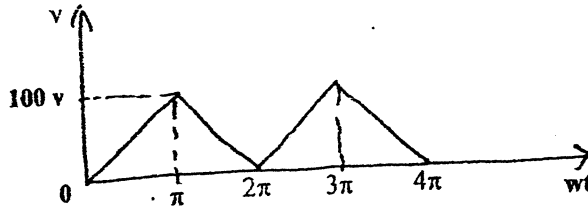
- c) State and explain thevenin's theorem with suitable example. [4]
3. a) What is the value of R such that maximum power is transferred to it? Find the value of this maximum power for the circuit shown below. [6]



- b) State reciprocity theorem. Verify the reciprocity theorem for the network shown in figure below in branch cd. [6]



- c) Define capacitance and derive relation for connection of capacitors in series. [4]
4. a) Calculate the form factor and peak factor of the following triangular waveform. [4]



- b) A choke coil having a resistance of  $10\Omega$  and inductance of  $0.05\text{H}$  is connected in series with a condenser of  $100\ \mu\text{F}$ . The whole circuit has been connected to  $200\text{V}$ ,  $50\text{ Hz}$  supply. Calculate (i) impedance (ii) current (iii) power factor (iv) power input (v) Apparent and reactive power of circuit. [6]
- c) A  $10\ \text{ohm}$  resistor, a  $31.8\ \text{mH}$  inductor and  $318\ \mu\text{F}$  capacitor are connected in parallel and supplied from a  $200\text{V}$ ,  $50\text{Hz}$  supply source. Calculate the supply current and power factor and also calculate current in each branch. [6]
5. a) Define power factor and explain the disadvantages and causes of low power factor? [4]
- b) A balanced star-connected load of  $(8 + j6)\Omega$  per phase is connected to a balanced 3 phase  $400\text{V}$ ,  $50\text{Hz}$  supply. Find the line current, phase current and total power consumed. Take RYB phase sequence. [6]
- c) With the help of connection and phasor diagrams, show that the power of a balanced three phase load can be determined using two-wattmeters. [6]

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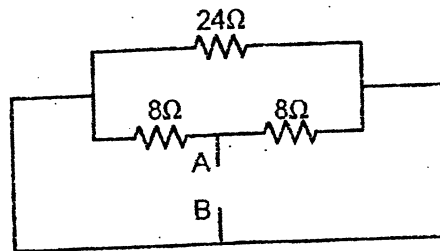
2073 Shrawan

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

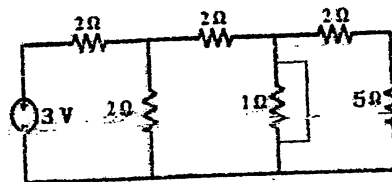
Subject: - Basic Electrical Engineering (EE401)

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

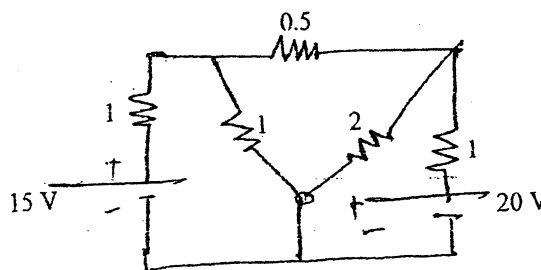
1. a) A coil has a resistance of 100 ohms, when the temperature is 20°C and 110 ohms when the temperature is 45° C. Find temperature rise when its resistance is 124 ohms, and surrounding temperature is 15° C. [6]
- b) Find the equivalent resistance between A and B for the network shown in figure below. [4]



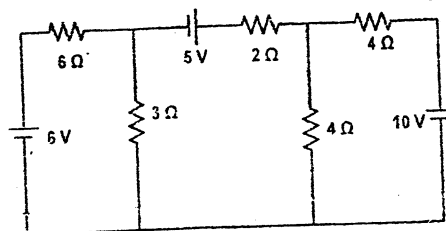
- c) Find current from the source in the following circuit diagram. [6]



2. a) Find the current in 5-ohm resistor in the network shown below by using superposition theorem. [8]

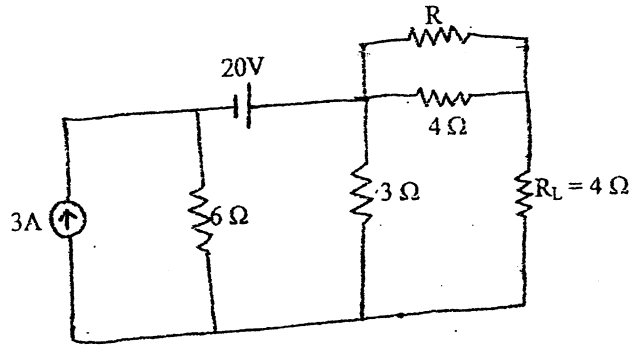


- b) Find the branch currents in the circuit of figure below by using nodal analysis. [8]

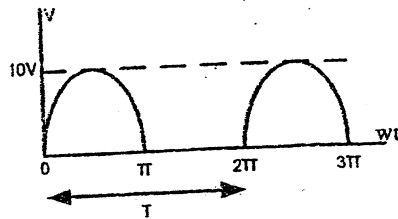




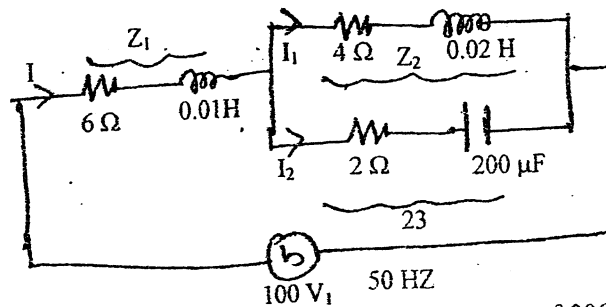
3. a) Find the value of Resistance 'R' such that the load resistance 'R<sub>L</sub>' which is equal to 4 Ω, will deliver maximum power. Also find that maximum power. [8]



- b) Derive an equation for inductance L in terms of flux linkages and current change. [4]  
 c) Calculate the (i) average value and (ii) RMS value of voltage wave shown in figure below: [4]



4. a) Determine the value of current I<sub>1</sub>, I<sub>2</sub> and I and overall factor of the circuit shown in figure below for series and parallel circuit. Also draw the phasor diagram and find the total power consumed by the circuit. [8]



- b) A coil is connected in series with a non-inductive resistance of 30Ω across 240V, 50Hz, 1-φ supply. The reading of voltmeters across the coil is 180 V and across the resistance is 130 V. Calculate, [8]  
 i) Inductance of coil  
 ii) Resistance of coil  
 iii) Power absorbed by coil  
 iv) Power absorbed by whole circuit
5. a) Define power factor and explain why in general it should be kept on high as possible in power supply system. [8]  
 b) Three similar coils each of resistance 7Ω and inductance of 0.03 H are connected in Delta to a 400 V, 3 phase, 50 Hz supply. Calculate the line current and the total power consumed. [8]

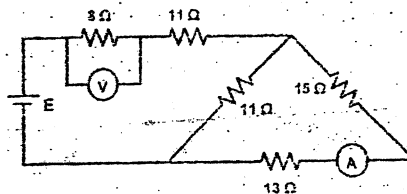
2072 Chaitra

| Exam.       | Regular                                  |            |        |
|-------------|------------------------------------------|------------|--------|
| Level       | BE                                       | Full Marks | 80     |
| Programme   | BEL, BEX, BCT,<br>BAME, BIE,<br>B.Aagri. | Pass Marks | 32     |
| Year / Part | 1 / 1                                    | Time       | 3 hrs. |

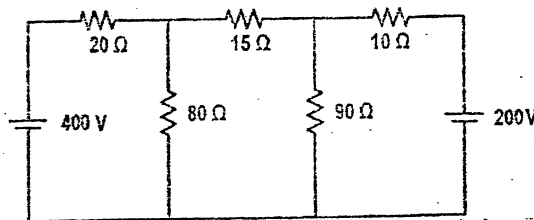
**Subject:** - Basic Electrical Engineering (EE401)

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

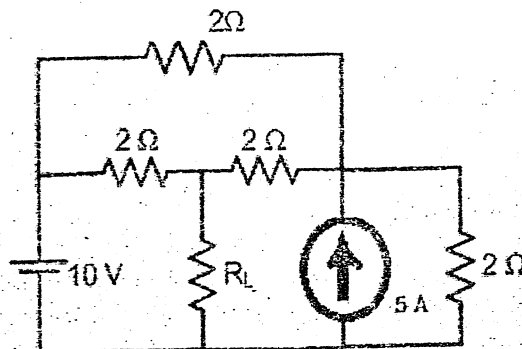
1. a) A 60 W, 240 V incandescent filament lamp is switched on at 20°C. The operating temperature of the filament is 2000°C. Determine the current taken by the lamp at the instant of switching ON. the temperature coefficient of resistance of the filament material is 0.0045/K. [6]
- b) A battery of unknown emf is connected across resistances, as shown in figure below. The voltage drops across the 8 Ω resistor is 20 V. What will be the current reading in the ammeter? What is the emf of the battery? [5]



- c) What do you mean by ideal and practical voltage and current sources? [5]
2. a) Find the power dissipation in 15 Ω resistor shown in figure below using mesh analysis. [6]

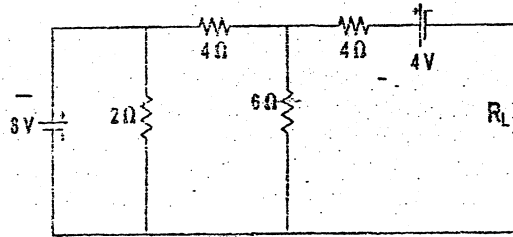


- b) Find current on load resistor  $R_L$ , if its resistance is 2 Ω, using superposition theorem. [6]

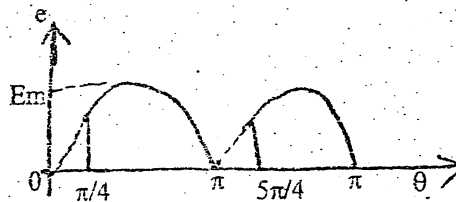


- c) State and explain Norton's theorem with an appropriate example. [4]

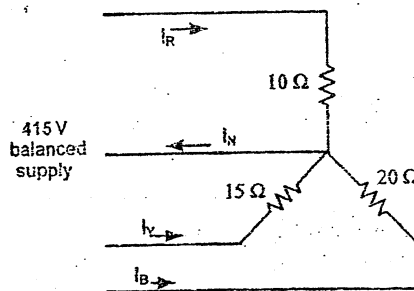
3. a) Find the value of  $R_L$  for which the maximum power is transferred in the load resistance  $R_L$ . Also find the maximum power that can be transferred to the load resistance  $R_L$ . [8]



- b) Derive the expression for the inductance of inductor in terms of its physical dimensions. [4]  
 c) Calculate the average and rms value of full-wave rectified sine wave as shown below. [4]



4. a) A circuit consisting of a resistance of  $30\ \Omega$  in series with an inductance of  $75\ \text{mH}$  is connected in parallel with a circuit consisting of a resistance of  $20\ \Omega$  in series with a capacitance of  $100\ \mu\text{F}$ . If the parallel combination is connected to a  $240\ \text{V}$ ,  $50\ \text{Hz}$  single phase supply, calculate (i) The current in each branch (ii) The total current and power factor and (iii) Power consumed. Also draw a neat phasor diagram. [8]  
 b) For a series path with a resistance of  $8\ \Omega$ , capacitor of  $120\ \mu\text{F}$  and an inductance of  $0.1\ \text{H}$ , a capacitor  $180\ \mu\text{F}$  is kept in parallel. Then the combination is fed by  $240\ \text{V}$ ,  $50\ \text{Hz}$ ,  $1\text{-}\phi$  supply. Calculate branch currents, total current from supply, power factor of whole circuit, active power and reactive power consumed by the circuit. Also show phasor diagram. [8]  
 5. a) Develop relation between phase voltage and line voltage in  $3\text{-}\phi$  star connected system. [4]  
 b) For the circuit shown in figure below, calculate the current through the neutral and the total power consumed in the load. [8]



- c) Explain with connection diagram the measurement of  $3\text{-}\phi$  power using two wattmeters. [4]

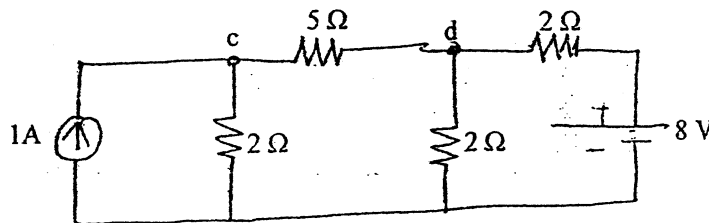
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| Exam.       | New Back (2066 & Later Batch) |            |        |
|-------------|-------------------------------|------------|--------|
| Level       | BE                            | Full Marks | 80     |
| Programme   | BEL, BEX, BCT,<br>BIE,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

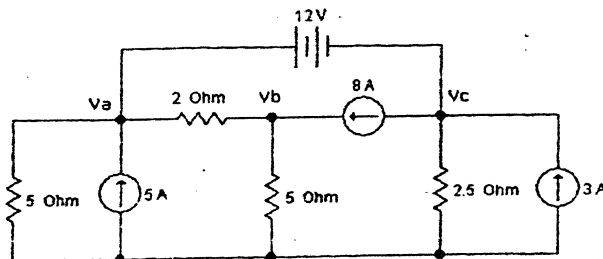
**Subject:** - Basic Electrical Engineering (EE401)

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

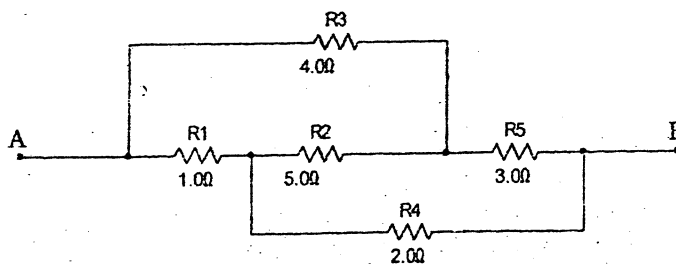
1. a) Explain ideal current and voltage sources. [4]
- b) Define temperature coefficient of resistance. The resistance of a certain length of wire is  $4.6\Omega$  at  $20^\circ\text{C}$  and  $5.88\Omega$  at  $80^\circ\text{C}$ . Determine (a) The temperature coefficient of resistance of the wire at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



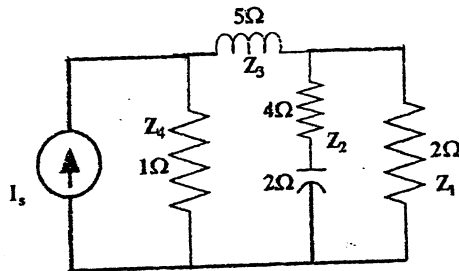
- b) Use Nodal Analysis Method to determine the  $V_a$ ,  $V_b$  and  $V_c$  and calculate current through  $2.5\Omega$ . [8]



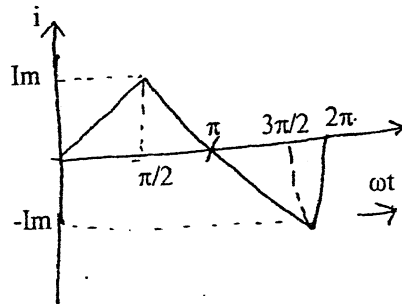
3. a) Find the resistance between the terminals A and B in the circuit segment below. [4]



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



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



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

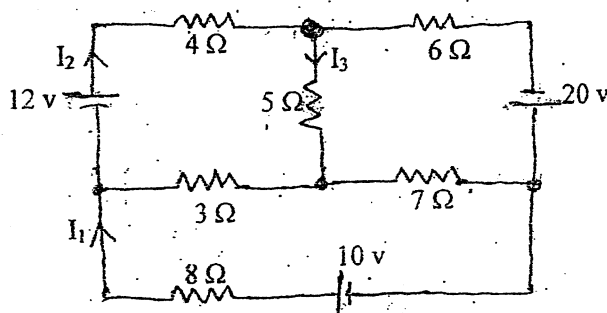
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| Exam.       | New Back (2066 & Later Batch) |            |        |
|-------------|-------------------------------|------------|--------|
| Level       | BE                            | Full Marks | 80     |
| Programme   | BEL, BEX, BCT, BIE,<br>B.Agr.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

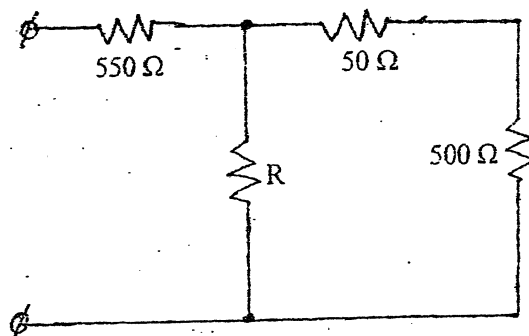
**Subject: - Basic Electrical Engineering (EE401)**

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

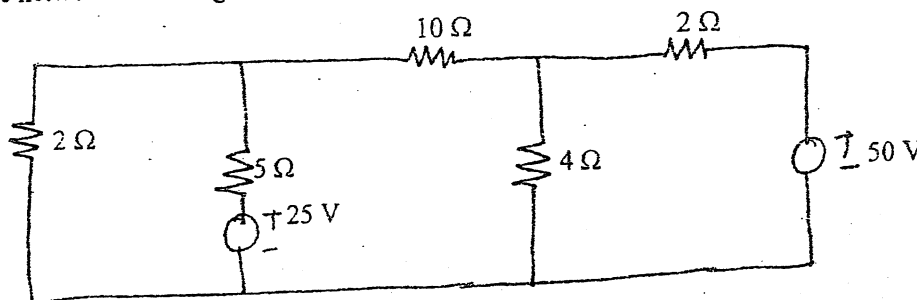
1. a) What is the difference between the potential difference and electromotive force? [4]  
 b) Find  $I_1$ ,  $I_2$  and  $I_3$  in the circuit shown in the figure using Kirchh-off's law. [6]



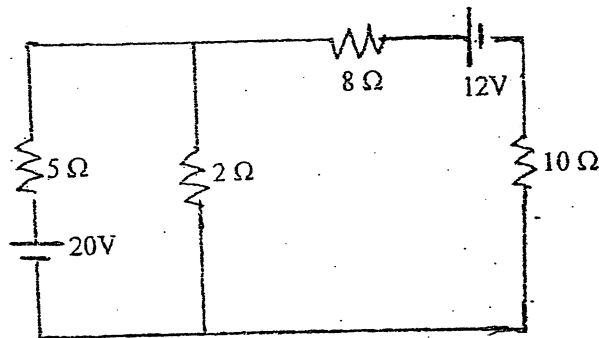
- c) What is the value of the unknown resistor 'R' in figure below, if the voltage drop across 500Ω resistor is 2.5 volts? [6]



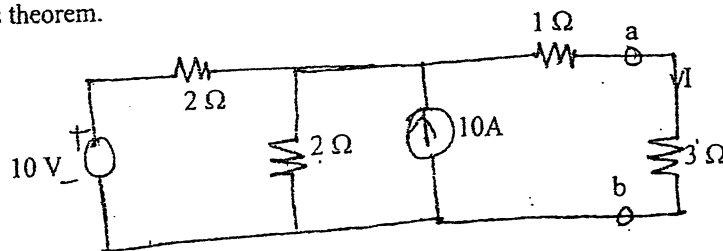
2. a) Use the node voltage method (nodal) to find the current flowing through 10Ω resistor in the network shown figure below. [8]



- b) For the circuit shown in figure below, calculate the current in the 10 ohm resistance using Thevenin's theorem. [8]



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



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

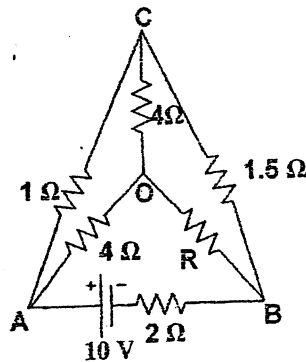
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| Exam.       | Regular                      |            |        |
|-------------|------------------------------|------------|--------|
| Level       | BE                           | Full Marks | 80     |
| Programme   | BEL, BEX, BCT, BIE, B.Agric.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

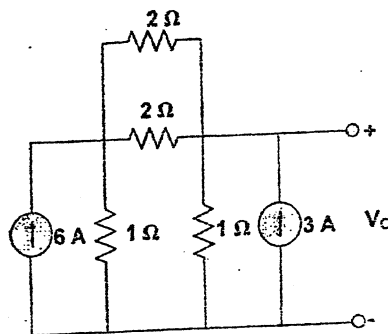
**Subject: - Basic Electrical Engineering (EE401)**

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

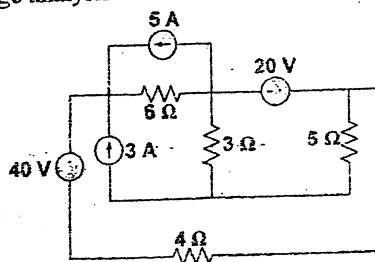
1. a) What do you understand by terms 'resistance' and 'resistivity'? On what factors the resistance offered by a conductor depends? [4]
- b) Two resistors made of different materials having temperature coefficients of resistance  $\alpha_1 = 0.004/^\circ\text{C}$  and  $\alpha_2 = 0.005/^\circ\text{C}$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



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



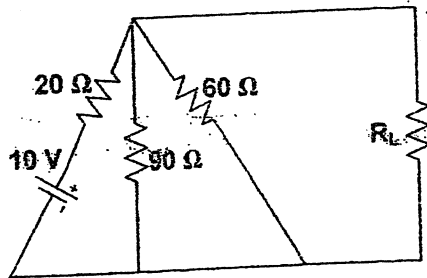
- b) Determine the power dissipated by  $5\Omega$  resistor in the circuit shown in figure below by applying nodal voltage analysis. [6]



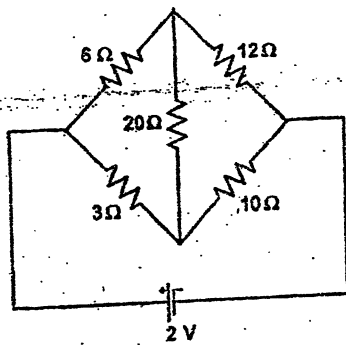
- c) State and explain superposition Theorem with an appropriate example. [5]



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



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



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

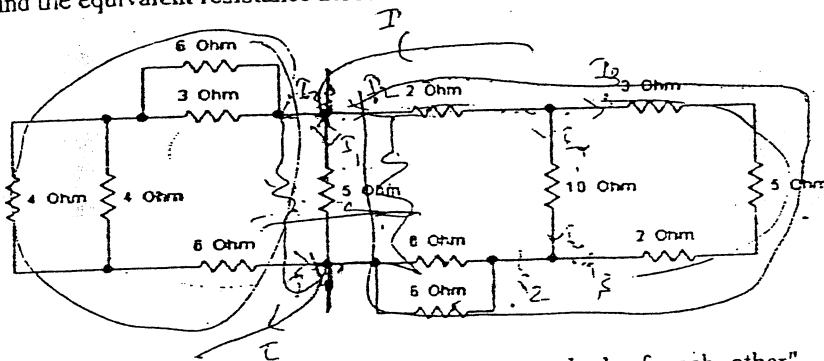
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| Exam.       | New Back (2066 & Later Batch)   |            |        |
|-------------|---------------------------------|------------|--------|
| Level       | BE                              | Full Marks | 80     |
| Programme   | BEL, BEX, BCT,<br>BIE,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

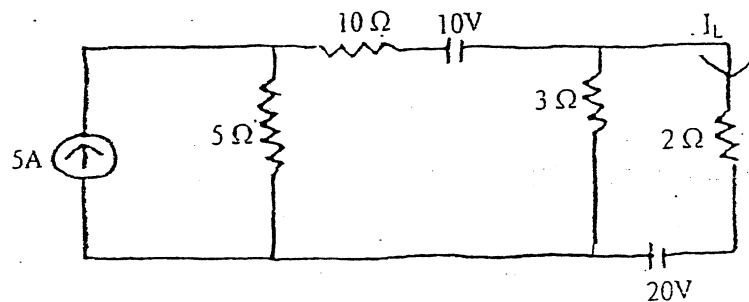
Subject: - Basic Electrical Engineering (EE401)

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

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

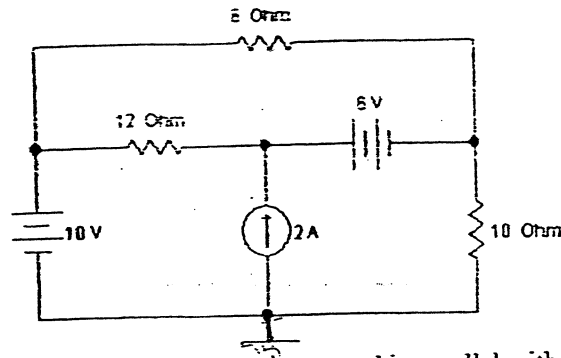


- c) "Thevenin's theorem and Norton's theorem are dual of each other". Justify the statement with suitable example. [6]
3. a) Use Superposition theorem to find the current  $I_L$  through  $2 \Omega$  resistors in figure below. [8]



OR

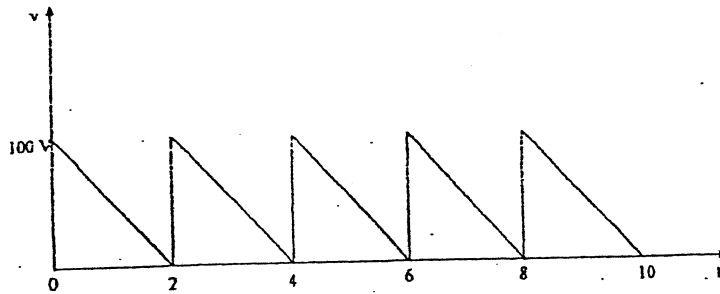
Find the current passing through  $10\ \Omega$  resistor using loop current method.



b) Calculate the inductance that must be connected in parallel with a  $100\ \text{mH}$  inductor to give a total inductance of  $70\ \text{mH}$ . Assume no mutual inductance between the two. [4]

c) Two impedances  $(3-4j)$  and  $(8+6j)$  are connected in parallel across an ac voltage source. If the total current drawn from the source is  $25\ \text{A}$ , find the total active power consumed by the impedances. [4]

4. a) Find the average value, rms value of the voltage waveform given below. [8]



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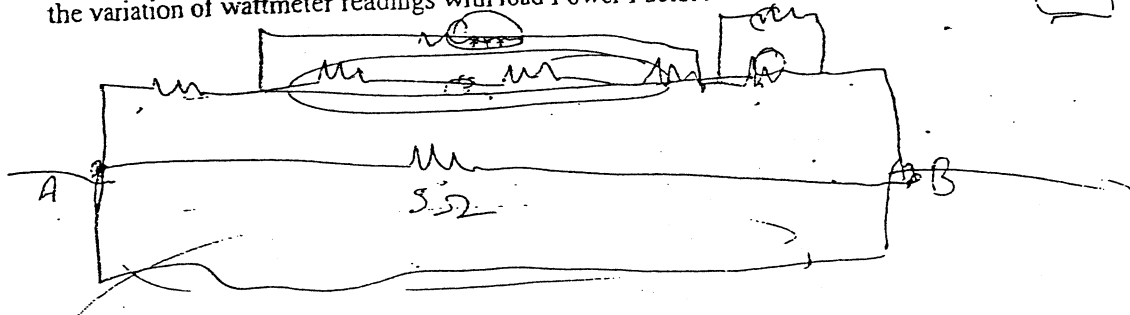
b) An Industrial load consists of the following: [8]

- i) A load of  $200\ \text{KVA}$  @  $0.8$  power factor lagging
- ii) A load of  $50\ \text{KW}$  @ unity power factor
- iii) A load of  $48\ \text{KW}$  @  $0.6$  power factor leading

Calculate the total KW, Total KVAR, Total KVA and the overall power factor.

5. a) A  $100\ \text{KW}$  load at  $0.8$  lagging power factor is being supplied by a  $220\ \text{V}$ ,  $50\ \text{Hz}$  source. Calculate the reactive power drawn from the source. If a capacitor connected parallel to the load improves its power factor to  $0.9$ . Find the capacitance of the capacitor. Also calculate the current drawn from the source before and after connecting the capacitor. [8]

b) With the help of necessary Phasor diagram and circuit diagram, explain the two wattmeter method of Active Power Measurement in Three Phase AC system? What is the variation of wattmeter readings with load Power Factor? [8]

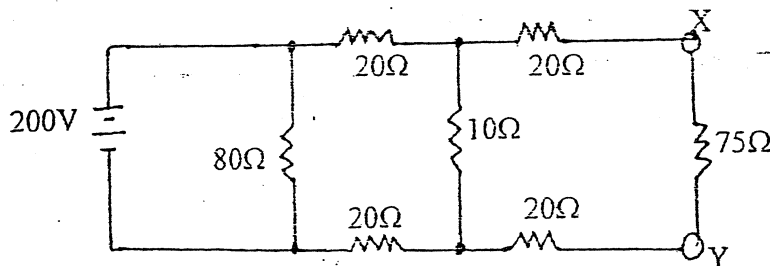


| Exam.       | Regin                         |            |       |
|-------------|-------------------------------|------------|-------|
| Level       | BE                            | Full Marks | 80    |
| Programme   | BEL, BEX, BCT,<br>BIE, B.Agr. | Pass Marks | 32    |
| Year / Part | I / I                         | Time       | 3 hrs |

**Subject: - Basic Electrical Engineering (EE401)**

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

1. a) Explain the methods for converting practical current source in to practical voltage source.
- b) Calculate the power which would be dissipated in a  $75\ \Omega$  resistor connected across XY in the network shown below.



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

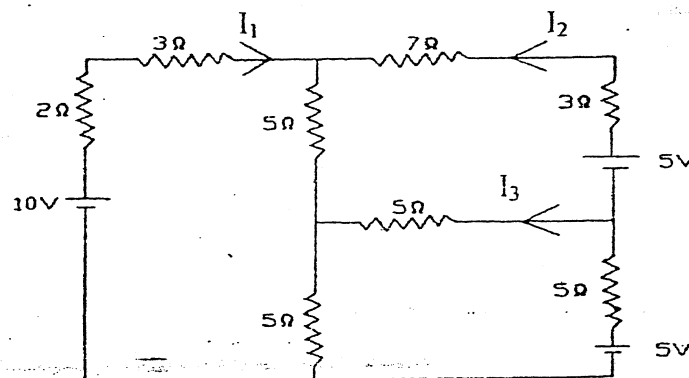
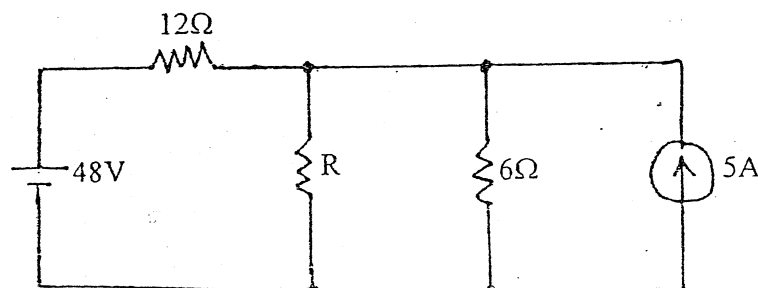
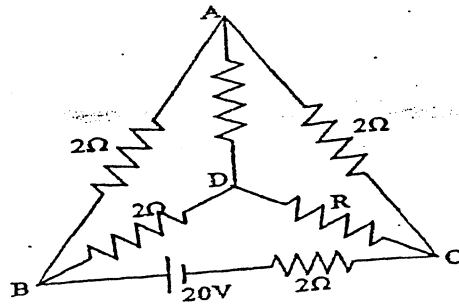


Fig: 1.2

2. a) The resistivity of a metal alloy is  $50 \times 10^{-8}\ \Omega\text{-m}$ . A sheet of material 15 cm long, 6 cm wide and 0.014 cm thick. Calculate the resistance in the direction: (a) along the length and (b) along the thickness.
- b) Use Norton's theorem to calculate the value of R that will absorb maximum power from the circuit shown in the figure below. Also calculate the maximum power drawn by it.



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



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

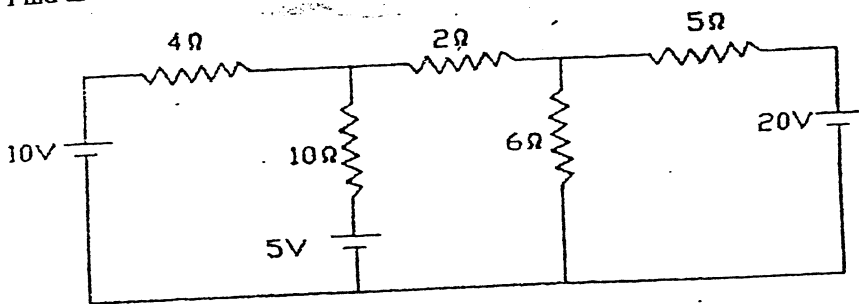
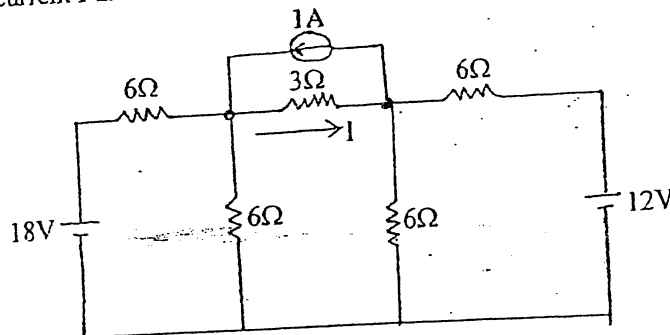


Fig: 3.1

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

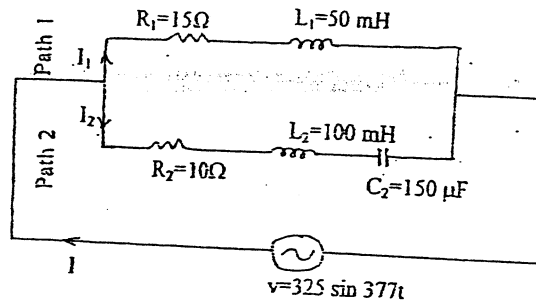


- a) Explain generation of sinusoidal emf with diagram and define angular velocity. [6]
- b) A sinusoidal voltage is applied to three parallel branches yielding branch currents,  $i_1=14.14 \sin(\omega t-45^\circ)$ ,  $i_2=28.3 \cos(\omega t-60^\circ)$  and  $i_3=7.07 \sin(\omega t+60^\circ)$  (i) Find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

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

[8]

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



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

[6+2]

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

[8]

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

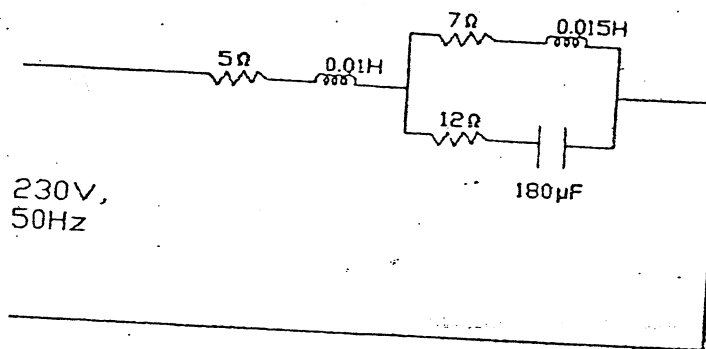


Fig: 5.1

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

[8]

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TRIBHUVAN UNIVERSITY  
INSTITUTE OF ENGINEERING  
**Examination Control Division**  
2079 Bhadra

| Exam.       | Regular                                   |            |        |
|-------------|-------------------------------------------|------------|--------|
| Level       | BE                                        | Full Marks | 80     |
| Programme   | BEL, BEX, BEL, BCI,<br>BAM, BIE, BAG, BAS | Pass Marks | 32     |
| Year / Part | 1/1                                       | Time       | 3 hrs. |

**Subject: - Engineering Physics (SH 402)**

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

1. Define centers of suspension and oscillation of a compound and show that they are interchangeable. Find the expression for minimum time period. [2+2+1]

OR

Define EM oscillation. Compare it with Mechanical Oscillation. Develop a relation of frequency of LC oscillation for under damped condition. [1+2+2]

2. A 750 gm block oscillates on the end of a spring whose force constant is 56 N/m. The mass moves in a fluid of damping const 0.162 Ns/m. Find the period of oscillation. [5]
3. A room has dimension 5m × 4m × 4m. Find (i) the mean free path of the sound wave in the room. (ii) No. of reflection made/sec by sound waves with the walls of the room. Given the velocity of sound in air is 350 m/sec. [5]
4. What is the power of combination of lenses of focal lengths 50 cm and 10 cm which are separated by 10 cm? [5]
5. Explain briefly, with well-labeled ray diagram, the diffraction at single slit. Show that the intensity of first maxima is 4.54% of intensity of central maxima. [2+3]

OR

What is Nicol prism? How can linearly, circularly and elliptically polarized light be produced? Derive the relation. [2+3]

6. What is Newton's ring? Describe a necessary theory of Newton's rings method for the determination of wavelength of light. [1+4]
7. Calculate the minimum number of lines in a grating which will just resolve the sodium lines in the first order spectrum. The wavelengths are 5890 Å and 5896 Å. [5]
8. Starting from energy level diagram, explain how lasers can be produced by Helium-Neon gas. [5]
9. What is an electric quadrupole? Calculate potential for points on the axis of the quadrupole. [1+4]

OR

Find the electric field at a distance z above the center of a flat circular disc of radius R which carries a uniform surface charge density  $\sigma$ . What does your formula give in the limit  $R \rightarrow \infty$ ? [4+1]

10. A long cylindrical conductor has length 1 m and is surrounded by a coaxial cylindrical conducting shell with inner radius double that of long cylindrical conductor. Calculate the capacitance for this capacitor assuming that is vacuum in space between cylinders. [5]
11. State Gauss Law of electrostatics. Show that electric field intensity at the surface of infinitely long non-conducting cylindrical symmetric uniform charge distribution is maximum. [1+4]

12. Calculate the mean free path and mean free time between collisions for the conduction electrons in copper having electron density  $8.5 \times 10^{22}/\text{cm}^3$  and resistivity  $1.7 \times 10^{-8} \Omega\text{m}$ . Given: charge of an electron =  $1.6 \times 10^{19}\text{C}$ , mass of an electron =  $9.1 \times 10^{-31} \text{kg}$  and speed of an electron =  $1.6 \times 10^6 \text{m/s}$ . [5]
13. Compare the methods of Biot and Savart law and Ampere's law to calculate magnetic fields due to current carrying conductor. Calculate magnetic field at an axial distance 'x' from the center of the circular coil carrying current. [2+3]

OR

- Explain Hall Effect. Derive an expression for Hall coefficient for an electron. [1+4]
14. In a LR circuit, the current builds up to 20% of its steady state value in 3 sec. What is the inductive time constant? [5]
15. Prove that  $\frac{E}{B} = \frac{1}{\sqrt{\mu_0 \epsilon_0}}$  where E is electric field, B is magnetic field;  $\mu_0$  and  $\epsilon_0$  are the permeability and permittivity of free space. [5]
16. A beam of electrons having energy of each 3eV is incident on a potential barrier of finite height 4eV. If the width of the barrier is 1 nm, calculate the percentage transmission of the beam through barrier. [5]

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TRIBHUVAN UNIVERSITY  
INSTITUTE OF ENGINEERING  
Examination Control Division

2079 Baishakh

| Exam. Level | Back                                         |            |        |
|-------------|----------------------------------------------|------------|--------|
|             | BE                                           | Full Marks | 80     |
| Programme   | BEL, BEX, BEI,<br>BCT, BAM, BIÉ,<br>BAG, BAS | Pass Marks | 32     |
|             | Year / Part                                  | Time       | 3 hrs. |

*Subject: - Engineering Physics (SH 402)*

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

1. Derive a differential equation for damped oscillation. Write its solution and angular frequency. Hence discuss all three cases of damped angular frequency and corresponding motion.

OR

Derive a relation to determine the radius of gyration of a compound pendulum. Why is the determination of acceleration due to gravity more accurate from a compound pendulum than a simple pendulum?

2. A circuit has  $L = 12 \text{ mH}$ ,  $C = 1.6 \text{ } \mu\text{F}$  and  $R = 1.5 \text{ } \Omega$ 
  - a) After what time  $t$ , will the amplitude of the charge oscillations drop to one half of its initial value?
  - b) To how many periods of oscillation does this correspond?
3. What are particle velocity and wave velocity? Find the relation between them.
4. What is chromatic aberration of a lens? Obtain the condition of achromatism in the case of combination of two lenses of the same material.
5. What is diffraction of light? Explain how can you obtain the wavelength of light using a diffraction grating.

OR

Define interference of light. Analytically explain the condition for maximum and minimum intensity and hence show graphically the variation of intensity with phase angle.

6. A screen is placed 2m away from a narrow slit which is illuminated with light of wavelength  $6000 \text{ } \text{Å}$ . If the first minimum lies 5 mm on either side of the central maximum, calculate the slit width.
7. Find the specific rotation of a given sample of sugar solution if the plane of polarization is turned through an angle  $25.2^\circ$ . The length of the tube containing 15% sugar solution is 20 cm.
8. Calculate the numerical aperture and acceptance angle of optical fiber in which refractive index of core is 1.62 and that of cladding is 1.52.

9. Give the general method to calculate the electric field due to continuous charge distribution. Use it to calculate the electric field intensity at a perpendicular distance 'y' from the infinite rod having a linear charge density  $\lambda$ .

OR

What is electric field? Calculate the electric field at a distance x from the center of ring of charge. Show that if a negative charge  $-q$  is placed near the center of charged ring, the motion of charge  $-q$  will be simple harmonic.

10. A parallel plate capacitor has a capacitance of 110 pF, with a plate area of  $90 \text{ cm}^2$  is filled with a substance of dielectric constant  $k = 5.5$ . A potential difference of 50 V is maintained between plates. Determine:
- The electric field strength in the dielectrics.
  - The magnitude of free charge on the plate.
  - The magnitude of induced surface charge.
  - The magnitude of polarization vector.
11. Discuss microscopic view of conduction. Show that resistivity and conductivity are independent of applied field and depends on nature of material.
12. Compare Biot-Savart law with Amper's law to calculate magnetic field due to current carrying conductor. Calculate the magnetic flux density at an axial distance 'x' from the centre of the coil of radius 'R' carrying a current 'i'.

OR

Describe the working mechanism of cyclotron. Find the expression for maximum energy of a rotating particles in a cyclotron. Write its limitation. How can you overcome its limitation?

13. A long circular coil consisting of 100 turns with diameter 1.2 m carries a current of 5A
- Calculate the magnetic field at a point along the axis 80 cm from the center.
  - At what distance from the center, along the axis, the magnitude of field is  $1/8$  times its value at the center?
14. A uniform magnetic field of strength 8.0 T is applied perpendicularly on a rectangular metal strip of width 2.0 mm and thickness  $15.0 \mu\text{m}$ . A current of 1.5A is passed along the length of strip and a transverse voltage equal to  $350 \mu\text{V}$  is measured across its width. Calculate
- The average velocity of the electron in the metal.
  - The number of conduction electron per unit volume in this metal.
15. Mention the Maxwell's electromagnetic equations in integral and differential form. Show that the electromagnetic wave propagate with the speed of light in free space.
16. A particle of mass M is confined in one dimensional infinitely deep potential well of width 'L'. Calculate the wave function and energy eigen value. Hence draw the wave function and its corresponding probability density for first three Quantum number.

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TRIBHUVAN UNIVERSITY  
INSTITUTE OF ENGINEERING  
Examination Control Division

2078 Bhadra

| Exam.       | Regular                                      |            |        |
|-------------|----------------------------------------------|------------|--------|
| Level       | BE                                           | Full Marks | 80     |
| Programme   | BEL, BEX, BEL,<br>BCT, BAM, BIE,<br>BAG, BAS | Pass Marks | 32     |
| Year / Part | I / I                                        | Time       | 3 hrs. |

*Subject: - Engineering Physics (SH 402)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
  - ✓ Attempt All questions.
  - ✓ All questions carry equal marks.
  - ✓ Assume suitable data if necessary.
1. Deduce the formula for the time period of compound pendulum and show that it is minimum when length of the pendulum is equal to radius of gyration.  
Or,  
Develop a differential equation of forced oscillations in LCR series circuit and find an expression for resonant frequency.
  2. A string has linear density 525gm/m and tension 45N. When a sinusoidal wave of frequency 120Hz and amplitude 8.5mm is sent along the string, at what average rate does the wave transport energy.
  3. What is meant by reverberation time. Derive the relation of sabine's formula. Also explain the growth and decay of sound in a hall.
  4. What is chromatic aberration? Derive an expression for the condition of achromatism of two thin lenses in contact.
  5. What do you mean by coherent sources? Derive necessary theory of interference due to wedge shape thin film.
  6. The spacing of atomic planes in a crystal is  $3.1 \times 10^{-10}$ . When a monochromatic beam of X-ray is incident on them at incident angle  $82^\circ 30'$  second order image is produced, calculate the glancing angle for the 4<sup>th</sup> order image.
  7. A 200mm long glass tube is filled with a solution of sugar, containing 15 gram of sugar in 100ml of water. The plane of polarized light, passing through this solution, is rotated through  $20^\circ 30'$ . Find the specific rotation of sugar.
  8. An optical fiber has numerical aperture 0.22 and refractive index change 0.012. What are the values of refractive index of core and cladding?
  9. Define the term quadrupole. Derive the relation of the electric potential due to linear quadrupole along its axial line.

OR

Derive an expression for electric field intensity due to the non-conducting spherically symmetric charge distribution of radius R at point (i) inside sphere (ii) outside sphere by using Gauss law. Also write down the significance of Gaussian surface.

10. Two similar balls of mass  $m$  and charge  $q$  are hanging from silk thread of length  $l$ . These two balls are repelled by angle  $2\theta$ , prove that the separation of the balls as

$$x = \left( \frac{q^2 l}{2\pi\epsilon_0 mg} \right)^{1/3}, \text{ assuming } \theta \text{ is very small.}$$

11. An electron with kinetic energy 2.5 KeV circles in a plane perpendicular to a uniform magnetic field. The radius of the orbit is 25cm. Calculate (i) the speed of the electron (ii) the flux density of magnetic field (iii) the number of revolutions per second.
12. What is the average time between collisions of free electrons in copper wire? Given, atomic weight = 63 gm/mol, density =  $9\text{gm/cm}^3$ , resistivity =  $1.7 \times 10^{-8} \Omega\text{m}$  and Avogadro's no =  $6.02 \times 10^{23} \text{mol}^{-1}$ .
13. State and explain Biot and Savart's law. Derive an expression for magnetic field due to current carrying circular loop at axial line.

OR

Derive an expression for the growth and decay of current in LR circuit. Explain the meaning of inductive time constant.

14. A 10eV electron is circulating in a plane at right angles to a uniform field of magnetic induction of  $1 \times 10^{-4} \text{Wb/m}^2$ . Calculate its orbital radius, cyclotron frequency and period of revolution.
15. Sun light just outside the earth in atmosphere has an intensity of  $1.4\text{kW/m}^2$ . Calculate the maximum electric and magnetic fields for sun light, assuming it to be a plane wave. Given  $c = 2.99 \times 10^8 \text{m/s}$ .
16. Show that energy of an electron that is confined in the infinite potential well is quantized and sketch that energy level and wave function diagram for  $n=1, 2$  and  $3$  for that well.

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TRIBHUVAN UNIVERSITY  
INSTITUTE OF ENGINEERING  
Examination Control Division

2078 Kartik

| Exam.     | Back          |                            |            |      |
|-----------|---------------|----------------------------|------------|------|
|           | Level         | BE                         | Full Marks | 80   |
| Programme | BEL, BEX, BEI | BCT, BAM, BIE,<br>BAG, BAS | Pass Marks | 32   |
|           | Year / Part   |                            | I / I      | Time |

**Subject: - Engineering Physics (SH402)**

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

1. Derive the time period of physical pendulum. Show that its time period is minimum when length of pendulum is equal to radius of gyration.

OR

Derive a differential equation for LC oscillation. Show that the maximum values of electric and magnetic energies stored in LC circuit in equal.

2. A solid sphere of mass 3kg and diameter 0.20m is suspended on a wire. Find the period of angular oscillation for small displacements if the torsional constant of the wire is  $6 \times 10^{-3} \text{ Nm/rad}$ .
3. A string has linear mass density 530g/m and tension 50N. We send a sinusoidal wave with frequency 120Hz and amplitude 6.5mm along the string. At what average rate does the wave transport energy?
4. What are Newton's rings? Give the necessary theory for the determination of refractive index of liquid using Newton's ring method.

OR

What is double refraction? Show that linearly and circularly polarized light are the special cases of elliptically polarized light.

5. Light is incident normally on a grating 0.5cm wide with 2500 lines. Find the angular separation for the principle maxima of two sodium lines ( $\lambda_1 = 589.0\text{nm}$  and  $\lambda_2 = 589.6\text{nm}$ ) in the first order. Are the two lines resolved?
6. Show that diameter of the circle of least confusion is independent of the focal length of lens in the case when object is at infinity.
7. Two lenses of focal length +5.5cm and +4.5cm are separated by a finite distance. Find the position of principle points if the combination satisfies the condition of achromatism.
8. Define optical fiber. Derive the expressions for acceptance angle and numerical aperture of optical fiber.
9. Prove that the electric field due to a short dipole at a point on axial line is twice that on the equatorial line.

OR

Discuss Gauss's law in electrostatics. Find the electric field intensity at a point outside and inside the uniformly charged non-conducting sphere of radius R.

10. A capacitor of capacitance  $C$  is discharged through a resistor of resistance  $R$ . After how many time constants is the stored energy  $\frac{1}{4}$  of its initial value.
11. Discuss a microscopic view of Ohm's law and show that resistivity of a conductor is independent of the external electric field.
12. Derive the expression of magnetic flux density at a point on the axis of a circular coil carrying current with  $N$  number of turns. Explain how the coil behaves for large distance.

OR

Show that the electrical energy density and the magnetic energy density are proportional to square of their corresponding fields.

13. Deuterons in cyclotron describe a circle of radius  $0.32\text{m}$  just before emerging from dees. The frequency of the applied emf is  $10\text{ MHz}$ . Find the flux density of the magnetic field and velocity of deuterons emerging out of the cyclotrons. (Mass of deuteron is  $3.32 \times 10^{-27}\text{ kg}$ )
14. Find an expression of the self inductance of a toroid having  $N$  number of turns, radius  $r$  and carrying current  $i$ .
15. The maximum electric field  $20\text{m}$  from an isotropic point source is  $1.5\text{V/m}$ . Determine:
  - a) the maximum value of magnetic field
  - b) average intensity of light
  - c) power of the source
16. Prove that the energy levels are quantized, when an electron is confined in an infinite potential well of width  $a$ .

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TRIBHUVAN UNIVERSITY  
INSTITUTE OF ENGINEERING  
**Examination Control Division**

2076 Chaitra

| Exam.       | Regular                                    |            |        |
|-------------|--------------------------------------------|------------|--------|
| Level       | BE                                         | Full Marks | 80     |
| Programme   | BEL, BEX, BEI<br>BCT, BAM, BIE<br>BAG, BAS | Pass Marks | 32     |
| Year / Part | I / I                                      | Time       | 3 hrs. |

**Subject: - Engineering Physics (SH 402)**

- ✓ Candidates are required to give their answers in their own words as far as practicable.
  - ✓ Attempt All questions.
  - ✓ All questions carry equal marks.
  - ✓ Assume suitable data if necessary.
1. Define point of suspension & oscillation of bar pendulum & show that they are interchangeable. Also show that the time period will be minimum, when these points are equidistance from centre of gravity.  
Or,  
What is damped oscillation? Develop a relation for damped frequency in LCR oscillation. Hence discuss the underdamped, overdamped and critically damped oscillations.
  2. In an oscillation, the amplitude drops to  $1/e$  of its original amplitude in 50sec. Find the relaxation time. Also, obtain the time required to drop the amplitude to  $1/e^2$  of the original amplitude.
  3. The reverberation time for an empty hall is 1.5 sec. With 500 audiences present in the hall, the reverberation time falls to 1.4 secs. Find the number of persons present in the hall if the reverberation time falls to 1.312 sec.
  4. A coaxial lens system placed in air has two lens of focal length 36cm & 12cm separated by a distance 24cm. Find the position of the cardinal points.
  5. What is Newton's Ring? How can it be used to determine the refractive index of the liquid?  
Or,  
Discuss the similarities & difference of Young's double slit interference & single slit diffraction. Interrelate the discussion to explain the formation of spectra by diffraction in a single slit.
  6. Show the intensity in the first and second order in a single slit diffraction reduced approximately to 4.5% and 1.6% of its central maxima.
  7. Two polarizing sheets are placed together with their transmission axes crossed. A third sheet is inserted between them with its transmission axis at an angle of  $45^\circ$  with respect to each of the other axes. Find the fraction of incident unpolarised light intensity transmitted by the combination.
  8. What is the fiber optics? Discuss the physics behind the optical fiber transmission. Derive an expression for acceptance angle of an optical fiber.
  9. Define electric quadrupole and quadrupole moment. Hence, determine the expression for electric field intensity due to the quadrupole at axial line.  
Or,  
State and prove the Gauss's law in electrostatics. Apply this law to determine the electric field intensity at a point inside the uniformly charged non conducting solid sphere.

10. A parallel plate capacitor each of area  $100\text{cm}^2$  has potential difference of 50V and capacitance 100pF, if a mica of dielectric constant 5.4 is inserted between plate, find the magnitude of
- Electric field intensity
  - Displacement vector
  - Polarization vector
11. Define Faraday's laws of electromagnetic induction and Lenz's law. Obtain an expression for self inductance of toroid.
12. If the carrier density of intrinsic Germanium at 300K is  $2.29 \times 10^{13}/\text{cm}^3$ . Calculate the resistivity at the same temperature given that electron & hole mobilities are  $0.39\text{m}^2\text{v}^{-1}\text{s}^{-1}$  &  $0.19\text{m}^2\text{v}^{-1}\text{s}^{-1}$  respectively.
13. Compare Biot-Savart law with Amper's law. Calculate the magnetic field outside & inside due to a long, straight wire of radius R carrying a steady current 'I' that is uniformly distributed through the cross-section of the wire.
14. A long solenoid of radius 2cm has  $1 \times 10^3$  turns per meter and carries a sinusoidally varying current  $I = 5\sin 100\pi t$ , where I is in ampere & t is in second. Determine the magnitude of induced electric field at a radius  $r = 1\text{ cm}$  &  $r = 3\text{ cm}$  from its central axis.
15. What is Displacement current? Define and derive the relation of Poynting vector in electromagnetism.
16. An electron with an energy of 8eV is incident on a potential barrier which is 9.2eV high & 0.2 nm wide.
- what is the maximum transmission coefficient that the electron will pass through the barrier?
  - what is the probability of transmission that the electron will pass through the barrier.

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TRIBHUVAN UNIVERSITY  
 INSTITUTE OF ENGINEERING  
**Examination Control Division**  
 2076 Ashwin

| Exam.       | Back                                      |            |            |
|-------------|-------------------------------------------|------------|------------|
|             | Level                                     | BE         | Full Marks |
| Programme   | BEL, BEX, BEI, BCT,<br>BAM, BIE, BAG, BAS | Pass Marks | 32         |
| Year / Part | I / I                                     | Time       | 3 hrs.     |

**Subject: - Engineering Physics (SH 402)**

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

1. Derive an expression for the time period of a physical pendulum and establish the interchangeability of the center of oscillation and suspension.

**OR**

Give the necessary theory of forced electromagnetic oscillation and deduce the condition for resonance amplitude in LCR series circuit with ac source.

2. Write down the characteristics of simple harmonic progressive wave. Derive an expression of energy of a progressive wave.
3. A spring is stretched by 5 cm when a load of 1kg is suspended to the lower and (upper end of spring is fixed). What will be the maximum velocity of object if it is pulled down further by 5cm from equilibrium position and then released?
4. Two thin lenses of focal lengths  $f_1$  and  $f_2$  separated by a distance  $d$  have an equivalent focal length 0.3m and both lenses are of same material. The combination of lenses satisfies the condition of achromatism and minimization of spherical aberration. Find the value of  $f_1$  and  $f_2$ .
5. Explain the formation of Newton's ring in reflected system of monochromatic light. Prove that in reflected light diameters of the dark rings are proportional to the square root of natural numbers.

**OR**

What is double refraction of light? Using the concept of double refraction, show that the plane polarized light and circularly polarized light are the special cases of elliptically polarized light.

6. A plane transmission grating of width 6 cm has 5000 lines/cm. Find the resolving power of grating for second order spectrum and the smallest wavelength difference that can be resolved for light of wavelength 5000 Å.
7. A plano-convex lens of radius 300 cm is placed on an optically flat glass plate and is illuminated by monochromatic light. The diameter of the 8<sup>th</sup> dark ring in the transmitted system is 0.72 cm. Calculate the wavelength of light used.
8. Differentiate between LASER and white light. Why the light in He-Ne laser is produced from Neon and not from Helium?
9. A ring shaped conductor with radius  $R$  carries a charge  $q$  uniformly distributed around it. Find the electric field intensity at an axial point of ring at distance  $y$  from the centre.

**OR**

Define capacitance. Give a general method to calculate capacitance of a capacitor. Find expression for the capacitance of a cylindrical capacitor.

10. An electric dipole consists of charges  $10\mu\text{C}$  and  $-10\mu\text{C}$  separated by a distance of  $1\text{mm}$ . What is the maximum torque experienced by the dipole if placed in the uniform electric field of intensity  $400\text{ V/cm}$ ?
11. Calculate the (i) mean free time and (ii) mean free path between collisions for the conduction electrons in copper having electron density  $8.5 \times 10^{28} / \text{m}^3$  and resistivity  $1.7 \times 10^{-8} \Omega\text{m}$ . Charge of electron  $1.6 \times 10^{-19}\text{ C}$ , mass of electron  $9.1 \times 10^{-31}\text{ kg}$ , effective speed of electron  $1.6 \times 10^6\text{ m/s}$ .
12. Using Ampere's law, calculate the magnetic field inside, outside and on the surface of a long current carrying conductor and hence plot a graph between the magnetic field and the distance from the center of the conductor.

OR

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

13. A series circuit has  $25\text{ ohm}$  resistance and  $0.1\text{ henry}$  inductance. What will be initial rate of increase of current if the circuit contains a  $12\text{V}$  steady source? What time is required for the current to attain a value of  $100\text{mA}$ ?
14. A wire of length  $L$  carries a current  $I$ . If the wire is formed into a circular coil, then the maximum torque in a given magnetic field  $B$  developed for a single turn is  $\tau = \left(\frac{1}{4\pi}\right)L^2IB$
15. Write Maxwell's equations in integral form. Convert them into differential form.
16. An electron is confined to an infinite potential well of size  $8.5\text{ nm}$ . Calculate the ground state energy of the electron and radian frequency. Given: Planck's constant  $= 6.62 \times 10^{-34}\text{ Js}$ , mass of electron  $= 9.1 \times 10^{-31}\text{ kg}$ .

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TRIBHUVAN UNIVERSITY  
INSTITUTE OF ENGINEERING  
**Examination Control Division**  
2075 Chaitra

| Exam.       | Regular / Back                            |            |        |
|-------------|-------------------------------------------|------------|--------|
| Level       | BE                                        | Full Marks | 80     |
| Programme   | BEL, BEX, BEI, BCT,<br>BAM, BIE, BAG, BAS | Pass Marks | 32     |
| Year / Part | 1/1                                       | Time       | 3 hrs. |

**Subject: - Engineering Physics (SH 402)**

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

1. Define torsional pendulum. Derive an expression for its time period. Explain why the time period of the torsional pendulum remains unaffected even if the amplitude is large.

**OR**

What is a damped EM oscillations? Which factor in the circuit is responsible to produce such a motion? Derive a differential equation for this motion and write its solution. What will be the remedy of such motion to make it smooth?

2. A meter stick swings as a compound pendulum when suspended from one of its end. Calculate (a) period of the oscillations and (b) equivalent length of the simple pendulum that would have the same period.
3. Mention the conditions for good acoustics of a hall and derive an expression for reverberation time.
4. Why Newton's interference fringes are circular? Derive an expression for radius of the Newton's ring due to the transmitted light.

**OR**

Define dispersive and resolving power of a diffraction grating. Derive an expression for the resolving power of the grating having N slits.

5. A plane transmission grating having 5000 lines/cm is used to obtain a spectrum of light from a sodium lamp in the second order. Calculate the angular separation between the two sodium lines whose wavelengths are 589 nm and 589.6 nm.
6. Calculate the specific rotation if the plane of polarization is turned through  $30.5^\circ$  traversing 25 cm length of 10% sugar solution.
7. Define an optical fiber and mention its types. Explain the numerical aperture and acceptance angle for the optical fiber and derive the expression to establish a relationship between them.
8. Dispersive powers for crown and flint glass lenses are 0.015 and 0.030 respectively. How can you design an achromatic contact of the lenses of focal length 50 cm?
9. What is an electric Quadrupole? Derive an expression for the electric potential at any point on the axial line at a distance 'r' from the centre of a short Quadrupole. Also, show that the electric potential at that point is inversely proportional to  $r^3$ .

**OR**

Discuss the modification of Gauss law due to the presence of the dielectrics and derive a relation among displacement vector, polarization vector and the electric field.

10. A particle of charge  $-q$  and mass  $m$  is placed midway between two equal positive charges  $q_0$  of separation  $d$ . If the negative charge executes SHM between the positive charges, then derive an expression for the time period of the oscillations.
11. Calculate the mean free time and mean free path between the collisions for the free electrons in copper with number density of the electron  $8.5 \times 10^{28} \text{ m}^{-3}$  and resistivity  $1.7 \times 10^{-8} \text{ ohm-m}$ . ( $e = 1.6 \times 10^{-19} \text{ C}$ ,  $m_e = 9.1 \times 10^{-31} \text{ kg}$  and effective speed of the electron  $= 1.6 \times 10^6 \text{ m/s}$ )
12. Define the cyclotron and cyclotron frequency. show that energy of a charged particle in a cyclotron is independent to the oscillating electric field.

*OR*

State Ampere's law in magnetism. Calculate the magnetic field outside and inside a current carrying long straight conductor.

13. An inductance of an inductor  $L$  connected to a battery of emf  $\epsilon$  through a resistor of resistance  $R$ . Show that the p.d. across the inductor after time  $t$  is  $V_L = \epsilon e^{-(R/L)t}$ . At what time the p.d. across the inductor is equal to the p.d. across the resistor such that  $i = i_0/2$ .
14. What is magnetic flux density at the center of a circular coil of radius 2 cm and with 20 turns carrying current of 10 A?
15. Write Maxwell equations in differential form. State and explain the pointing vector and theorem.
16. What is the physical significance of wave function? Derive the relation of Schrodinger wave equation in time dependent form.

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| Exam.       | BE                                    | Back       |        |
|-------------|---------------------------------------|------------|--------|
| Level       | BE                                    | Full Marks | 80     |
| Programme   | BEL, BEX, BCT,<br>BAME, BIE, B. Agri. | Pass Marks | 32     |
| Year / Part | 1/1                                   | Time       | 3 hrs. |

**Subject: - Engineering Physics (SH402)**

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

1) Deduce the **time period** of a simple harmonic vibration. Explain why a loaded bus is more comfortable than an empty bus. (3+2)

2) Explain **forced oscillation** with its differential equation. Write the relation for the frequency dependent **amplitude** and hence give a rough sketch of the resonance curve. (3+2)

Or

Calculate the **average amplitude** of a sinusoidal sound wave in air of a frequency of 1.5 KHz and average **intensity**  $10^{-5} \text{W/cm}^2$ , where density of air is  $1.29 \text{kg/m}^3$ . (5)

3) Give an **account of bad** acoustic properties of a hall and discuss the method to improve these defects. (5)

4) Explain the **physical meaning** of Dispersive and resolving powers of a Grating. Two spectral lines have **wavelengths**  $\lambda$  and  $\lambda + \Delta\lambda$  respectively where  $\Delta\lambda \ll \lambda$ . Show that their angular separation  $\Delta\theta$  in a grating spectrometer is  $\Delta\theta = \frac{\Delta\lambda}{\sqrt{\left(\frac{d}{m}\right)^2 - \lambda^2}}$ , where 'd' and 'm' are grating

elements and no. of order respectively. (2+3)

Or

In newton's ring experiment, "Central spot is dark in reflected system" and "Fringes get closer as the no. of order increased" explain. Is it possible to make central spot bright in reflected system? If so how? (3+2)

5) A soap film  $5 \times 10^{-5} \text{cm}$  thick is viewed at an angle of  $35^\circ$  to the normal. Find the **wavelength of the visible light** which will be absent from the reflected light. (5)

6) Light of wavelength 580nm falls on a calcite crystal of certain thickness. The emerging light is circularly polarized. What must be the thickness of such crystal? (5)

7) Calculate the focal length of combination of two thin lenses of focal length  $f_1$  and  $f_2$  separated by a distance 'd'. Find the position of two principal points. (5)

8) Trace the ray diagram that shows the propagation of light through the step and graded index optical fiber. Write the importance of self-focusing in an optical fiber. (3+2)

- 9) Charge of uniform density  $\rho = 3.2 \mu\text{C}/\text{m}^2$  fills a non-conducting solid sphere of radius of 5.0 cm. What is the magnitude of the electric field a) at 3.5 cm b) 8.0 cm from the sphere's center (5)

Or

Two large parallel plates are separated by a distance of 5cm. The plates have equal but opposite charges that create an electric field in the region between the plates. An alpha particle ( $q = 3.2 \times 10^{-19} \text{ C}$ ,  $m = 6.68 \times 10^{-27} \text{ kg}$ ) is released from the positively charged plate, and it strikes the negatively charged plate  $2 \times 10^{-6} \text{ sec}$  later. Assuming that the electric field between plates is uniform and perpendicular to the plates, what is the strength of electric field? (5)

- 10) Calculate the potential at a point due to a uniform line of charge of length L at a distance D from its one end which lies in the perpendicular line. (5)

- 11) Explain how electric energy is stored in a capacitor and derive an expression for energy density of electric field. (2+3)

- 12) Explain super conductivity and its types with examples. Write the difference(s) between super conductor and perfect conductor. (3+2)

- 13) If a test charge revolves round a circular path of radius 8.5cm where the magnetic field increases at steady rate  $0.13 \text{ T/s}$ , calculate the magnitude of induced electric field at a point 12.5 cm? (5)

- 14) Derive expression for inductances of a solenoid and toroid. Then show that inductance is the property of the coil. (5)

Or

What is Hall Effect? Write its importance. Show that the hall coefficient  $R_H = -1/ne$ , where the symbols have their own meanings. (1+1+3)

- 15) The Sun delivers about  $10^3 \text{ W/m}^2$  of energy to the earth's surface through EM radiation calculate a) the total power incident on a roof of dimensions  $8 \text{ m} \times 20 \text{ m}$ . b) Radiation pressure and force exerted on the roof, assuming roof is perfect absorber. (2+3)

- 16) A beam of electrons having energy of each 3eV is incident on a potential barrier of height 4eV. If the width of the barrier is 20nm, calculate the percentage transmission of the beam through the barrier. (5)

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| Exam.       | Back          |            |            |
|-------------|---------------|------------|------------|
|             | Level         | RE         | Full Marks |
| Programme   | BCE, BGE, BME | Pass Marks | 32         |
| Year / Part | I/II          | Time       | 3 hrs.     |

**Subject: - Engineering Physics (SH452)**

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

1. Derive the resonance condition in an LCR circuit. Briefly explain the quality factor and hence show the quality factor will be higher if the band width of the circuit is lower.
2. What is Ultrasound? How these waves are produced? Write the fields of major application of Ultrasound.
3. Show that the wave equation of a transverse wave in a string is

$$\frac{d^2y}{dx^2} = \frac{1}{v^2} \frac{d^2y}{dt^2}, \text{ where } v = \sqrt{\frac{F}{\mu}}, \text{ where } \mu = \text{mass per unit length}$$

4. Explain how Newton's rings are formed and describe the method for the determinations of refractive index of liquid using Newton's ring formula.

OR

Discuss Fraunhofer diffraction due to a single slit. Draw a curve indicating distribution of intensity of diffraction patterns. Is there any fundamental difference between interference and diffraction? Give the reasons.

5. What is double Refraction? Explain how Nicol prism can be used as polariser and analyser?
6. A diffraction grating has 4000 lines per cm and is used at normal incidence. Calculate the dispersive power of the grating in the third order spectrum for the wavelength 500nm.
7. Write down the characteristics of LASER and its use in holography. How semi conductor laser is produced?
8. It is desired to make a converging achromatic lens of mean focal length 30 cm by using two lenses of materials A and B. If the dispersive powers of A and B are in the ratio 1:2. Find the local length of each lens.
9. Define electric flux. Determine electric field due to an infinite line of charge.

OR

What is dielectric constant? Prove the relation  $\vec{D} = \epsilon_0 \vec{E} + \vec{P}$ , Where symbols carry their usual meanings.

10. Two tiny conducting balls of identical mass  $m$  and charge  $q$  hang from non conducting thread each of length  $L$ . Derive an expression for the equilibrium separation ' $x$ ' between the balls assuming that the separation angle to be small.

OR

What is a damped em oscillations? Which factor in the circuit is responsible to produce such a motion? Derive a differential equation for this motion and write its solution. What will be the remedy of such motion to make it smooth?

11. A parallel plate capacitor contains two dielectric slabs (of equal dimensions) of dielectrics  $K_1$  and  $K_2$  as shown in figure below (i) Find the capacitance in each case if  $A$  is the area of each plate. (ii) If  $K_1 = 2$  and  $K_2 = 3$ , what will be the ratio of the capacitance in two cases.



12. A p.d. of 1V is applied to a 30.5 m length of copper wire (diameter 0.02 inch). Calculate (i) The current (ii) Current density (iii) The electric field strength (Given, Resistivity of copper is  $1.7 \times 10^{-8} \Omega m$ ).
13. Discuss the Hall Effect. Derive (i) Hall voltage (ii) Hall coefficient and (iii) Hall resistance. Explain that the Hall resistance leads to the quantum Hall effect.
14. Derive an expression for the magnetic flux density inside a long solenid, carrying current  $I$ , at a point near its center.

OR

Derive an expression for growth and decay of current in inductance and resistance circuit. Also explain the decay current in LR circuit.

15. Prove that charge conservation theorem with the help of maxwell's equation of electromagnetism.
16. Using the uncertainly principle, calculate the minimum uncertainty in velocity when an electron is confined to a box having a length 1nm. Given,  $m = 9.1 \times 10^{-31} \text{ Kg}$ ,  $h = 6.6 \times 10^{-34} \text{ Js}$ .

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| Exam.       | Regular                               |            |        |
|-------------|---------------------------------------|------------|--------|
| Level       | BE                                    | Full Marks | 80     |
| Programme   | BEL, BEX, BCT,<br>BAME, BIE, B. Agri. | Pass Marks | 32     |
| Year / Part | 1/1                                   | Time       | 3 hrs. |

*Subject: - Engineering Physics (SH402)*

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

1. Describe L.C oscillation qualitatively by using necessary circuits and graph.

OR

Define the terms sharpness of resonance and quality factor. Derive the relation of quality factor in terms of band width.

2. Define transverse wave. Develop a differential equation of the wave in a stretched string and then find the velocity of transverse wave.
3. A reverberation time of 2.3 sec is observed in a hall of volume  $5500 \text{ m}^3$ . The sound absorbing surface of the hall has an area of  $750 \text{ m}^2$ . Calculate the average absorption coefficient.
4. What are constructive and destructive interference? Prove that the path difference for constructive interference is integer multiple of  $\lambda$  and that for destructive interference is odd integer multiple of  $\lambda/2$ .

OR

How can you distinguish the plane, circularly and elliptically polarized light by using nicol prised and wave plate?

5. What is diffraction of light? Explain the dispersive power and resolving power of a diffraction grating. Derive the relation and also relate them.
6. A 30 cm long polarimeter tube containing  $50 \text{ cm}^3$  of sugar solution produces an optical rotation  $14.5^\circ$  when placed on a polarimeter tube. If the specific rotation of sugar solution is  $65^\circ$ , calculate the quantity of sugar contained in the tube.
7. Two thin converging lenses of focal lengths 30 cm and 40 cm respectively are placed co-axially in air separated by a distance of 20 cm. An object is placed 40 cm in front of the first lens. Find the position and nature of the image.
8. What is optical fiber? Explain numerical aperture and acceptance angle. Also compare the attenuation property efficiency and cost of single mode and multimode optical fibers.
9. What is electrical dipole and dipole moment? Derive an expression of the electric field intensity at a point due to dipole at equatorial line?

10. Define the three electric vectors E,P,D and develop a relation between them.

**OR**

A cylindrical capacitor has radii 'a' and 'b'. Show that half the energy stored lies within the cylinder whose radius is  $r = \sqrt{ab}$ .

11. What will be the conductivity of sodium metal having atomic weight 22.9 and density  $1.013 \text{ gm/cm}^3$ ? The relaxation time of sodium metal is  $3 \times 10^{-14}$  sec.
12. What type of particles can be accelerated by a cyclotron? Explain the working of cyclotron and synchrotron with their differences.

**OR**

Differentiate between electromagnetic induction and self-induction. Develop an expression for self-inductance of a toroid.

13. Using Ampere's law, calculate the magnetic field inside, outside and on the surface of a long current carrying conductor and hence plot a graph between the magnetic field versus distance from the center of the conductor.
14. Determine the energy stored in an inductor. Also, determine the energy density in magnetic field.
15. A radio wave transmits  $25 \text{ W/m}^2$  of power per unit area. The flat surface area is perpendicular to the direction of propagation of the wave. Calculate the radiation pressure on it and maximum electric and magnetic field associated with the wave.
16. What are the significances of wave-function? Using the wave function derive and expression for the time dependent Schrodinger wave equation.

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| Exam.       | Back                                  |            |        |
|-------------|---------------------------------------|------------|--------|
| Level       | BE                                    | Full Marks | 80     |
| Programme   | BEL, BEX, BAME,<br>BCT, BIE, B.Agric. | Pass Marks | 32     |
| Year / Part | I / I                                 | Time       | 3 hrs. |

**Subject: - Engineering Physics (SH402)**

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

1. Define centers of suspension and oscillation of a compound pendulum and show that they are interchangeable. What length of the pendulum has its minimum time period?

**OR**

Define SHM. Derive the expression for energy of SHM. Show that the KE and PE of simple harmonically oscillating object changes with time however the total energy is invariant.

2. What is LC oscillation? Derive the differential equation of free oscillation and compare its solution with mass spring system.
3. What is piezoelectric effect? Describe the construction of a piezoelectric oscillator for the production of ultrasonic waves.
4. Explain how interference fringes are formed by a thin wedge shaped film examining by normally reflected light. Derive a relation for the fringe width on such system of interference fringes.

**OR**

What is double refraction? Explain how would you use the phenomenon to produce linear polarized light and circularly polarized light.

5. A diffraction grating used at normal incidence gives a line (540 nm) in a certain order superposed on the violet line (405 nm) of the next higher order. How many lines per cm are there in the grating if the angle of diffraction is  $30^\circ$ ?
6. In Ramsden's eyepiece a coaxial lens system is used. There are two lenses in air and are of equal focal length of separated by a distance  $2f/3$ . Find positions of the cardinal points.
7. Discuss the physical significance of numerical aperture (NA). How does it depend on refractive index of core and cladding?
8. Calculate the thickness of doubly refracting plate capable of producing a path differences of  $\frac{\lambda}{4}$  between extraordinary and ordinary rays of wavelength 5890 Å. (Use  $\mu_o = 1.53$ ; and  $\mu_e = 1.54$ )
9. What is an electric dipole and dipole moment? Show that electric field for a short dipole drops inversely to cube of the distance at any point from the dipole on an axial line.

**OR**

What is an electric quadrupole? Calculate potential for points on the axis of the quadrupole.

10. Two point charges  $6\mu\text{C}$  and  $-24\mu\text{C}$  are 18 cm apart in air. Locate the positions of zero potential on the line joining the charges.
11. Two capacitors having capacitance  $25\mu\text{F}$  and  $5\mu\text{F}$  are connected in parallel and charged with a 100V power supply. Calculate the total energy stored in the two capacitors.
12. What is superconductor? Explain critical magnetic field. Describe the characteristics of superconductor.

*OR*

Explain Biot-Savart law. Show that a current carrying circular coil behaves as a magnetic dipole for a large distance.

13. Explain meaning of self induction. Calculate inductance for a solenoid and Toroid.
14. Deuterons in a cyclotron describe a circle of radius 0.32 m just before emerging from dees. The frequency of the applied emf's 10 MHz. Find the flux density of the magnetic field and the energy of deuterons emerging out of the cyclotron. (mass of deuterons =  $3.32 \times 10^{-27}$  kg.)
15. What are Maxwell's equations? Using Maxwell equations derive electromagnetic (em) wave equation in dielectric medium. Prove that em wave travels with velocity less than velocity of light in such medium.
16. A non relativistic particle is moving three times as fast as an electron. The ratio of the de-Broglie wavelength of the particle to that of the electron is  $1.813 \times 10^{-4}$ . Calculate the mass of the particle.

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

**Subject: - Engineering Physics (SH402)**

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

1. Define compound pendulum. Show that the motion of torsional pendulum follows angular SHM. Use it to find modulus of rigidity of a given wire.

**OR**

Prove that LC circuit is an analogy of spring mass system. Hence prove that maximum energy stored in the capacitor is equal to maximum energy stored in inductor.

2. If the relaxation time of a damped harmonic oscillator is 50 sec, find the time in which the amplitude falls to  $\frac{1}{e^3}$  times the initial value and energy of the system falls to  $\frac{1}{e^4}$  of its initial value.
3. A room has dimensions of 6×4×5m. Find (a) the mean free path of the sound wave in the room (b) the number of reflections per second made by sound wave with the walls of the room. (Given, velocity of sound in air is 330ms<sup>-1</sup>)
4. Write down the conditions for interference of light? Give the necessary theory for the interference in thin film due to reflected light.

**OR**

Describe how will you produce linearly, circularly and elliptically polarized light. Explain with mathematical calculation.

5. A grating with 250 grooves/mm is used with an incandensent light source. Assume visible spectrum to range in wavelength from 400 to 700 nm. In how many orders can one see the entire visible spectrum?
6. Newton's rings formed by sodium light viewed normally. What is the order of dark ring which will have double the diameter of 50<sup>th</sup> ring?
7. What do you mean by population inversion and pumping? Describe the working of He-Ne laser with the help of energy level diagram.
8. What is chromatic Aberration? Show that a single lens is always accompanied with such aberration. Discuss in brief how can we minimize chromatic Aberration in the combination of lenses.
9. Derive an expression for the electric potential at a point P at an axial distance x from center of the ring of radius 'a' and linear charge density  $\lambda$ . Hence develop the expression for electric field intensity at the same point.

**OR**

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

10. Charge of uniform volume density  $\rho = 3.2 \mu\text{C}/\text{m}^3$  fills a non conducting solid sphere of radius 5 cm. What is the magnitude of the electric field 3 cm from the sphere's center?
11. A parallel plate capacitor has a capacitance of 100  $\mu\text{F}$ , a plate area of 100  $\text{cm}^2$  and a mica dielectric. At 50 volts potential difference calculate (a) E in the mica (b) the free charge on the plates and (c) the induced surface charge. [Dielectric constant for mica,  $k = 5.4$ ]
12. What will be the conductivity of sodium metal having electron density  $2.5 \times 10^{28} \text{ m}^{-3}$  and relaxation time  $3 \times 10^{-14} \text{ sec}$ ?
13. Derive an expression for Hall Voltage. How do you differentiate the type of charge carrier from the result of Hall experiment? What is Hall resistance?

**OR**

Derive the relation for rise and fall of current in LR circuit. Plot a graph between current and time and explain the figure.

14. A parallel plate capacitor with circular plates is being charged by varying electric field of  $1.5 \times 10^{12} \text{ V/m-s}$ . Calculate the induced magnetic field if the diameter of the plate is 110 mm and displacement current of this condition.
15. Write Maxwell equations in differential form in free space. Derive electromagnetic wave equations in vacuum. Find their plane wave solutions.
16. Write down Schrodinger time dependent and time independent wave equations. Prove that the energy levels are quantized when the electron is confined in an infinite potential well of width 'a'.

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| Exam.       | New Back (2066 & Later Batch)         |            |        |
|-------------|---------------------------------------|------------|--------|
| Level       | BE                                    | Full Marks | 80     |
| Programme   | BAME, BEL, BEX,<br>BCT, BIE, B. Agri. | Pass Marks | 32     |
| Year / Part | 1 / 1                                 | Time       | 3 hrs. |

**Subject: - Engineering Physics (SH402)**

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

1. Write the differences between mechanical oscillation and e.m. oscillation. Set up the differential equation of damped harmonic mechanical oscillation. Obtain the relation for frequency of such oscillation. Hence explain the conditions for different types of damped oscillation

OR

Define sharpness of resonance. Derive the relation for current amplitude of forced e-m oscillation.

2. What are the measures of good acoustic building? Show that the reverberation time decrease with increase in absorbing factors in a hall.
3. Two thin lenses of focal length  $f_1$  and  $f_2$  separated by a distance having an equivalent focal length 50 cm. The combination satisfies the condition for no chromatic aberration and minimum spherical aberration. Find the separation between the two lenses if both lenses are of same materials.
4. Prove that the intensity of first maxima is 4.54% of the central maxima in Fraunhofer's single slit diffraction.

OR

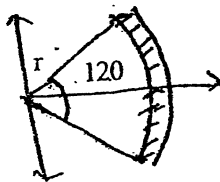
Write the physical meaning of dispersive power and resolving power of grating. Show that resolving power is directly proportional to the total number of rulings on the grating.

5. Newton's Rings arrangement is used with a source emitting two wavelength  $\lambda_1$  and  $\lambda_2$ . It is found that the  $n^{\text{th}}$  dark ring due to  $\lambda_1$  coincides with  $(n+1)^{\text{th}}$  dark ring to  $\lambda_2$ . Find the diameter of  $n^{\text{th}}$  dark ring. ( $\lambda_1 = 6 \times 10^{-5}$  cm,  $\lambda_2 = 5.9 \times 10^{-5}$  cm radius of curvature of the lens  $R = 90$  cm).
6. A quartz crystal has refractive indices 1.553 and 1.544. Calculate the thickness of a quarter wave plate for sodium light of wavelength  $5890 \text{ \AA}$ .
7. Explain the terms stimulated emission, population inversion, optical pumping and metastable. Explain working principle of He-Ne laser.
8. A heavy circular ring of radius  $R$  oscillates in a vertical plane about a horizontal axis at a distance  $x$  from the center. Show that the time period is minimum when  $x = R$

9. Derive the relation for potential at any point due to an electric dipole and show that no work is done in bringing a charge from infinity to dipole along the perpendicular bisector of the dipole.

OR

A plastic rod contains uniformly distributed  $Q$  charge. The rod has been bent in  $120^\circ$  circular arc of radius ' $r$ ' as shown in figure below. Prove that the electric field intensity at the center of bent rod is  $E = \frac{0.83Q}{4\pi\epsilon_0 r^2}$ .



10. Derive the relation for rise and fall of current in charging and discharging of capacitor through resistor. Plot graphs between current and time and explain the figures.
11. The space between two concentric conducting spherical shells of radii  $b = 1.70$  cm and  $a = 1.20$  cm is filled with a substance of dielectric constant  $k = 23.5$ . A potential difference  $V = 73$  V is applied across the inner and outer shells. Determine (a) the capacitance of the device (b) the free charge  $q$  on the inner shell.
12. What is Hall-effect? Derive an expression for the Hall coefficient and established the relation between mobility of charge carrier and conductivity of material of wire.

OR

Derive a relation resistivity of a conductor using microscopic view. From your result, explain why resistivity of a conductor increase with necessary with increasing temperature.

13. Explain the phenomenon of self induction. Calculate the value of inductance for (a) long solenoid and (b) Toroid.
14. What is Ampere's law? Derive the expression for magnetic flux density outside and inside a long straight conductor carrying current  $I$ .
15. Define Poynting vector. Prove that  $\vec{S} = (\vec{E} \times \vec{B}) / \mu_0$ , where the symbols have their usual meanings.
16. Discuss the significance of the wave function and deduce the time independent Schrodinger's wave equation.

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24 TRIBHUVAN UNIVERSITY  
INSTITUTE OF ENGINEERING  
Examination Control Division

2072 Chaitra

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

*Subject: - Engineering Physics (SH402)*

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

1. Differentiate between bar pendulum and torsional pendulum. Prove that there exists four collinear points in bar pendulum.

**OR**

Prove that LC circuit is an analogy of simple harmonic motion and hence prove that maximum energy stored in electric field is equal to maximum energy stored in magnetic field.

2. In simple harmonic motion, when the displacement is one-half the amplitude, what fraction of the total energy is KE and what fraction is PE? At what displacement is the energy half KE and half PE?
3. A source of sound has a frequency of 256 Hz and amplitude of 0.50 cm, calculate the energy flow across a square cm per sec. The velocity of sound in air is 330 m/s and density of air is  $1.29 \text{ kg/m}^3$ .
4. Prove that interference in thin film of reflected and transmitted light are complementary to each other.

**OR**

What is diffraction of light? Discuss the intensity distribution with special reference to diffraction of light in a single slit.

5. Two thin converging lenses of focal lengths 30 cm and 40 cm respectively are placed co-axially in air separated by a distance of 20 cm. An object is placed 40 cm in front of the first lens. Find the position and nature of the image.
6. A 200 mm long tube and containing  $48 \text{ cm}^3$  of sugar solution produces an optical rotation of  $11^\circ$  when placed in a saccharimeter. If the specific rotation of sugar solution is  $66^\circ$ , calculate the quantity of sugar contained in the tube in the form of a solution.
7. In a Newton's ring experiment the diameter of the  $10^{\text{th}}$  ring changes from 1.40 cm to 1.27 cm when a liquid is introduced between the lens and the plate. Calculate the refractive index of the liquid.
8. What is an optical fiber? Show that Numerical aperture of an optical fiber is given by the expression,  $NA = \mu \sqrt{2\Delta}$ , where the symbols carry their usual meanings.
9. Determine the electric field at a distance  $z$  on the central axis from the center of a charged ring. Also, find the maximum value of electric field.

**OR**

Calculate the potential at any point due to an electric dipole. Also, find the potential on the axial line.

10. Over certain region of space the electric potential is  $v = 15x - 3x^2y + 12yz^2$ . Find the expression for the x, y and z components of the electric field over this region. What is the magnitude of the field at the point P that has coordinates (1, 0, -2) m?
11. Write the general methods to calculate the capacitance of a capacitor and hence determine the capacitance of a cylindrical capacitor of inner and outer radii 'a' and 'b' respectively.
12. Calculate the drift speed of electrons when 20 A current is supplied through a copper wire of cross-sectional area  $1 \text{ mm}^2$  and electron density  $10^{28} \text{ m}^{-3}$ .
13. Determine the energy stored in an inductor. Hence, prove that the energy density in magnetic field is directly proportional to square of magnetic field.

OR

Obtain an expression for magnetic field intensity due to a circular coil carrying current at its axial point

14. A copper strip 3.0 cm wide and 2.0 mm thick is placed in a magnetic field 1.75T. If a current of 150 A is setup in the strip, calculate (i) Hall voltage and (ii) Hall mobility if the number of electrons per unit volume is  $8.4 \times 10^{28} \text{ m}^{-3}$  and resistivity is  $1.72 \times 10^{-8} \text{ ohm-m}$ .
15. Define poynting vector. Prove that  $\vec{S} = \frac{1}{\mu} (\vec{E} \times \vec{B})$
16. A beam of electrons having energy of 3eV is incident on a potential barrier of height 4 eV. If the width of the barrier is  $20 \text{ \AA}$ , calculate the percentage transmission of the beam through the barrier.

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

**Subject: - Engineering Physics (SH402)**

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

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

OR

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

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

OR

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

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

OR

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

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

**OR**

- A solenoid having an inductance of  $6.3\ \mu\text{H}$  is connected in series with a  $1.2\ \text{k}\Omega$  resistance. If a  $14\ \text{V}$  battery is connected across the pair, how long will it take for the current through the resistor to reach 80% of its final value?
14. Explain Hall effect. What results you can draw from Hall experiment? Obtain an expression for the Hall voltage in a current carrying specimen placed in a magnetic field.
  15. State Maxwell equation in integral form. Convert them into differential form. Explain each of these equations.
  16. A free particle is confined in a box of width  $L$ . Using Schrodinger wave equation find an expression for energy eigen value.

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

**Subject: - Engineering Physics (SH402)**

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

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

OR

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

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

OR

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

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

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

OR

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

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

OR

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

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

**Subject: - Engineering Physics (SH402)**

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

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

**OR**

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

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

**OR**

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

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

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

*OR*

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

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

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

**Subject: - Engineering Physics (SH402)**

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

1. Derive an expression for the time period of a physical Pendulum and establish the interchangeability of the center of oscillation and suspension.
2. Give the necessary theory of forced vibration and deduce the condition for resonance amplitude.

**OR**

Show that the fractional change in frequency of damped oscillation is  $1/8Q^2$  where Q is quality factor.

3. The reverberation time for an empty hall is 1.5 sec. With 500 audiences present in the hall, the reverberation time falls to 1.4 sec. Find the number of persons present in the hall if the reverberation time falls down to 1.312 sec.
4. What is interference? Explain the intensity distribution in interference with mathematical treatment.

**OR**

Show that the intensity of second primary maxima is 1.62% of central maxima in Fraunhofer's single slit diffraction.

5. A beam of plane polarized light is converted into circularly polarized light by passing it through a crystal slice of thickness  $3 \times 10^{-5}$  m. Calculate the difference in the refractive indices of the two rays inside the crystal. Wavelength of light is 600nm.
6. What are active medium population inversion and optical pumping? Give the importance in the study of LASER. Write a method for getting He-Ne LASER.
7. Write the physical meaning of dispersive power and resolving power of plane transmission grating. Show that the product of the total number of ruling and the order of spectrum gives the resolving power of the plane transmission grating.
8. Two thin ~~lenses~~ lenses of focal length 8 cm and each are coaxial and 4 cm apart. Find the principal points and the position of object for which image is formed at infinity.
9. What is electric quadrupole? Calculate the electric potential of a linear quadrupole of separation  $2z$  at an axial distance R from its center.

**OR**

A ring radius "R" is carrying a uniformly distributed charge "q". Find an expression for electric field at any point on the axial line. Find the point at which electric field is maximum.

10. A cylindrical resistor of radius 6 mm and length 2.5 cm is made of material that has a resistivity of  $4 \times 10^{-5} \Omega \cdot \text{m}$ . What are (i) The magnitude of the current density and (ii) the potential difference when the energy dissipation rate in the resistor is 2 Watt?
11. A solenoid 2.6 m long and 1.3 cm in diameter carries a current of 9A. The magnetic field inside the solenoid is 20mT. Find the length of the wire forming the solenoid.
12. Compare the methods of Biot and Savart Law and Ampere's Law to calculate magnetic fields due to current carrying conductor. Calculate magnetic field at an axial distance "x" from the center of the circular coil carrying current.
13. In a Hall experiment, a current of 25A is passed through a long foil of silver, which is 0.1 mm thick and 3 m long. Calculate the Hall voltage produces across the width by a flux of  $1.4 \text{ Wb/m}^2$ . If the conduction of silver is  $6.8 \times 10^7 \text{ mho/m}$ , estimate the mobility of the electrons in silver.
14. A parallel plate capacitor with circular plates is charged by current "i" (a) What is the magnitude of  $\int \mathbf{B} \cdot d\mathbf{s}$  in terms of  $\mu_0$  and i between the plates if  $r = (a/5)$  from the center? What is the magnitude of induced magnetic field for  $r = (a/5)$  in terms of displacement current?

OR

An inductance L is connected to a battery of emf E through a resistance. Show that the

potential difference across the inductance after time t is  $V_L = \epsilon e^{\left(\frac{-R}{L}\right)t}$ . At what time is the potential difference across the inductance equal to that across the resistance such that  $i = \frac{i_0}{2}$ .

15. Write Maxwell equations in integral form. Convert them in differential form. Explain the physical meaning of each equation.
16. Describe the physical significance of the wave function. Derive an expression of time dependent Schrodinger equation.

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

**Subject: - Engineering Physics (SH402)**

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

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

OR

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

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

OR

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

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

OR

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

10. What is the magnitude of the electric field at the point (3,2) m if the electric potential is given by  $V = 2x - 5xy + 3y^2$  volts. What acceleration does an electron experiences in the x-direction.

11. Derive an equation  $\vec{J} = \sigma \vec{E}$ . Explain why resistivity of a conductor increases with increasing temperature plot a graph between  $R_0$  (Resistance at any temperature  $\theta$ ) and temperature. Based on the graph, explain what are superconductor? How they differ from perfect conductor? Describe the characteristics of superconductor.

12. Derive an expression for energy stored in magnetic field. Show that the energy stored per unit volume is directly proportional to the square of the magnetic flux density. Compare this result with electric energy density.

OR

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

13. A long circuit coil consisting of 50 turns with diameter 1.2m carries a current of 10Amp. (a) Find the magnetic field at a point along the axis 90cm from the center. (b) At what distance from the center, along the axis, the field is 1/8 greater as at the center.

14. Describe the principal and working of Cyclotron. Show that the time taken by the ion in a Dee to travel a semicircle is exactly same whatever be its radius and velocity.

15. Write Maxwell's equations in free space and dielectric medium. With the help of Maxwell's equations, Derive charge conservation theorem.

16. A beam of electrons having energy of each 3eV is incident on a potential barrier of height 4eV. If the width of the barrier is  $20\text{\AA}$ , calculate the transmission coefficient of the beam through the barrier.

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

**Subject: - Engineering Physics (SH 402)**

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

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

OR

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

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

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

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

OR

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

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

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

OR

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

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

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

11. A cylindrical capacitor has radii  $a$  and  $b$ . Show that half the stored electric potential energy lies within a cylinder of radius  $r = \sqrt{ab}$ .

12. A flat silver strip of width 1.5cm and thickness 1.5mm carries a current of 150A. a magnetic field of 2.0 Tesla is applied perpendicular to the flat face of the strip. The emf developed across the width of strip is measured to be  $17.9\mu\text{V}$ . Estimate the number density of free electrons in the metal.

13. A straight wire segment of length  $l$  carries current  $I$ . Show that the magnetic field  $B$  produced by that segment at a distance  $y$  from it along a perpendicular bisector is  $B = (\mu_0 / 2\pi y) [l / (l^2 + 4y^2)^{\frac{1}{2}}]$ .

14. Find the inductance of a toroid having  $N$  number of turns and radius  $R$ .

OR

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

15. State and explain Maxwell's equations. Derive the continuity equation:  $\nabla \cdot \vec{J} = -\frac{\partial \rho}{\partial t}$ .

16. Determine the total energy of a particle using Schrodinger equation, when the potential energy has value  $V=0$  for  $0 < x < a$ , and  $V=\alpha$  for  $x \leq 0$  and  $x \geq a$ .

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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 | 1 / 1          | 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.
- ✓ All 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  $x^2 y_{n+2} + (2n+1)xy_{n+1} + (n^2+1)y_n = 0$ .
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  $\lim_{x \rightarrow 0} \left( \frac{\sin x}{x} \right)^{\frac{1}{x^2}}$

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 cardioid  $r = a(1+\cos\theta)$  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

$$3x^2 + 2xy + 3y^2 - \sqrt{2}x = 0$$

into 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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|             |                  |            |        |
|-------------|------------------|------------|--------|
| 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:  $\log(\sec x)$  by using Maclaurin's theorem. [5]
3. What do you mean by indeterminate form? State various forms of indeterminacy. Evaluate  $\lim_{x \rightarrow 0} \left( \frac{\sin x}{x} \right)^{\frac{1}{x^2}}$ . [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 cardioid  $r = a(1 + \cos \theta)$  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 Clairaut'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]



| Exam.       | Regular        |            |        |
|-------------|----------------|------------|--------|
| Level       | BE             | Full Marks | 80     |
| Programme   | All except BAR | Pass Marks | 32     |
| Year / Part | 1 / 1          | 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 form. Evaluate:  $\lim_{x \rightarrow 0} (\cot x)^{\frac{1}{\log x}}$  [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 directrices 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]

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 **All** questions.
- ✓ **All** questions carry equal marks.
- ✓ Assume suitable data if necessary.

1. If  $y = a \cos(\log x) + b \sin(\log x)$  prove that:

(i)  $x^2 y_2 + x y_1 + y = 0$

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

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

3. State L' Hospital's Rule and hence evaluate  $\lim_{x \rightarrow 0} (\cot x)^{\sin 2x}$

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  $y = Px + x^4 p^2$

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

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

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  $45^\circ$  with the original axes.

15. Obtain the equation of hyperbola in standard form.

16. Find the center for the conic  $3x^2 + 8xy - 3y^2 - 40x - 20y + 50 = 0$ .

| 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  $\lim_{x \rightarrow 0} \left(\frac{\tan x}{x}\right)^{1/x}$  [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  $\int_0^e \ln x dx$ . [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  $r = a(1 + \cos \theta)$  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  $(x^2 D^2 + xD + 1)y = \sin(\log x^2)$  [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]

| 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

$$(1+x^2)y_{n+2} + (2nx+2x-1)y_{n+1} + (n^2+n)y_n = 0 \quad [1+4]$$

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  $\lim_{x \rightarrow 1} (2-x)^{\tan\left(\frac{\pi x}{2}\right)}$  [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 cardioid  $r = a(1+\cos\theta)$  [5]

10. 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]

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 differential 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  $x^2 \frac{d^2 y}{dx^2} - 2x \frac{dy}{dx} + 2y = 4x^3$  [5]

| 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  $\lim_{x \rightarrow 0} \left( \frac{\sin x}{x} \right)^{\frac{1}{x^2}}$  [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]  

$$\int_0^{\infty} \frac{\log(1 + a^2 x^2)}{1 + b^2 x^2} dx$$
8. Define Beta-Gamma function and use it to evaluate  $\int_0^{\frac{\pi}{6}} \cos^4 3\theta \cdot \sin^2 6\theta \cdot d\theta$  [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.  $(x^2 D^2 + xD + 1)y = \sin(\log x^2)$  [5]

| 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 All questions.
- ✓ All questions carry equal marks.
- ✓ Assume suitable data if necessary.

- If  $y = e^{a \sin^{-1} x}$ , then prove that  $(1-x^2)y_{n+2} - (2n+1)xy_{n+1} - (n^2 + a^2)y_n = 0$
- Assuming the validity of expansion, find the expansion of  $\log(1+e^x)$  by using Machlaurin's Theorem.

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

- Find the asymptotes of the curve:

$$y^2 = \frac{(a-x)^2}{a^2+x^2} x^2$$

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

- 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:  $\int_0^{\infty} \sqrt{y} e^{-y^2} dy \times \int_0^{\infty} \frac{e^{-y^2}}{\sqrt{y}} dy = \frac{\pi}{2\sqrt{2}}$

- Find the surface area of solid generated by revolution of cycloid.

$$x = a(\theta + \sin \theta), y = a(1 + \cos \theta) \text{ about its axis.}$$

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

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

- Derive the standard equation of an ellipse.

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

- 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:  $r = \frac{4}{1+3 \cos \theta}$

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| Exam.       | Back                 |            |        |
|-------------|----------------------|------------|--------|
| Level       | BE                   | Full Marks | 80     |
| Programme   | All (Except B.Arch.) | Pass Marks | 32     |
| Year / Part | 1/1                  | 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 higher 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 indeterminate form of a function. Evaluate

$$\lim_{x \rightarrow 0} \left( \frac{\tan x}{x} \right)^{1/x^2}$$

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 cardioid  $r = a(1 + \cos\theta)$  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:  $x^2 \frac{d^2y}{dx^2} - 2x \frac{dy}{dx} - 4y = x^4$ .

*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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| Exam.       | Regular              |            |        |
|-------------|----------------------|------------|--------|
| Level       | BE                   | Full Marks | 80     |
| Programme   | All (Except B.Arch.) | Pass Marks | 32     |
| Year / Part | 1/1                  | 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 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,

$$\lim_{x \rightarrow 0} \left( \frac{1}{x^2} \right)^{\tan x}$$

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  $r = a(1 + \cos\theta)$ .
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

$$\int_0^{\pi/4} \sin^4 x \cdot \cos^2 x dx = \frac{3\pi - 4}{192}$$

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 the revolution of the cardioid  $r = a(1 + \cos\theta)$  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  $30^\circ$  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

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

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

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

15. Solve:  $y = 2px + p^3 y^2$ ; 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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| Exam.       | New Back (2066 & Later Batch) |            |        |
|-------------|-------------------------------|------------|--------|
| Level       | BE                            | Full Marks | 80     |
| Programme   | ALL (Except B.Arch)           | Pass Marks | 32     |
| Year / Part | I / I                         | Time       | 3 hrs. |

**Subject: - Engineering Mathematics I (SH401)**

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

1. 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  $f(x) = \log \frac{x^2 + ab}{(a+b)x}$ ;  $x \in [a, b]$ . How does Rolle's Theorem differ from Lagrange's mean value theorem.

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

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  $45^\circ$  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:  $\frac{d^2y}{dx^2} + 3\frac{dy}{dx} + 2y = e^{2x} \cdot \sin x$

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

| 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. If  $y = (x^2 - 1)^n$ , then prove that

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

2. Assuming the validity of expansion, expand  $\log(1 + \sin x)$  by Maclaurin's theorem.

3. Evaluate  $\lim_{x \rightarrow 0} \frac{(1+x)^{1/x} - e}{x}$

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

5. Find the radius of curvature at any point  $(r, \theta)$  for the curve  $a^2 = r^2 \cos 2\theta$

6. Show that:  $\int_0^{\pi} \frac{x \sin x}{1 + \cos^2 x} dx = \frac{\pi^2}{4}$

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

8. Define Gamma function. Apply Beta and Gamma function to evaluate:

$$\int_0^{\pi/6} \cos^2 6\theta \cdot \sin^4 3\theta = \frac{7\pi}{192}$$

9. Find the area inclosed by  $y^2(a-x) = x^3$  and its asymptotes.

10. If the axes be turned through an angle of  $\tan^{-1} 2$ , what does the equation  $4xy - 3x^2 - a^2 = 0$  become?

11. Find the center, length of axes, eccentricity and directrices of the conic.

$$2x^2 + 3y^2 - 4x - 12y + 13 = 0$$

**OR**

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

12. Deduce standard equation of hyperbola.

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

14. Solve:  $(x-a)p^2 + (x-y)p - y = 0$ : where  $p = \frac{dy}{dx}$

15. Solve:  $(D^2 - D - 2)y = e^x + \sin 2x$

16. Find a current  $i(t)$  in the RLC circuit assuming zero initial current and charge  $q$ , if  $R = 80$  ohms,  $L = 20$  Henry,  $C = 0.01$  Faradays and  $E = 100$  volts.

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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 All questions.
- ✓ All questions carry equal marks.
- ✓ Assume suitable data if necessary.

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

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

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

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

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

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

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  $\int_0^{2a} x^5 \cdot \sqrt{2ax - x^2} \cdot dx$

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

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

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

**OR**

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

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

**OR**

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

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

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

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

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

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

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

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

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

**Subject: - Engineering Mathematics I (SH401)**

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

1. State Leibniz's theorem on Leibniz derivatives:

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

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

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

OR

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

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

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

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

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

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

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

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

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

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

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

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

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

OR

Show that the conic section represented by the equation

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

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

**Subject: - Engineering Mathematics I (SH401)**

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

1. If  $y = \log(x + \sqrt{a^2 + x^2})$ , then show that  $(a^2 + x^2)y_{n+2} + (2n+1)xy_{n+1} + n^2y_n = 0$  [5]
2. State and prove Lagrange's Mean Value theorem. [5]
3. Evaluate:  $\lim_{x \rightarrow \pi} (\sin x)^{\tan x}$  [5]
4. Find the asymptote of the curve  $a^2y^2 + x^2y^2 - a^2x^2 + 2ax^3 - x^4 = 0$  [5]
5. Find the radius of curvature at the origin for the curve  $x^3 + y^3 = 3axy$
6. Evaluate  $\int_0^a \frac{\sqrt{x}}{\sqrt{x} + \sqrt{a-x}} dx$  [5]
7. Apply differentiation under integral sign to evaluate  $\int_0^\infty \frac{e^{-ax} - e^{-bx}}{x} dx$  [5]
8. Using Gamma function show that  $\int_0^{\frac{\pi}{4}} \sin^4 x \cos^2 x dx = \frac{3\pi - 4}{192}$  [5]
9. Find the area bounded by the curve  $x^2 = 4y$  and the line  $x = 4y - 2$

OR

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

10. Solve:  $\sin x \frac{dy}{dx} + y \cos x = x \sin x$  [5]
11. Solve:  $xp^2 - 2yp + ax = 0$  where  $p = \frac{dy}{dx}$  [5]
12. Solve:  $\frac{d^2y}{dx^2} - 2\frac{dy}{dx} + y = x^2e^{3x}$  [5]
13. Solve:  $x^2 \frac{d^2y}{dx^2} - x \frac{dy}{dx} + y = \log x$  [5]
14. Transform the equation  $x^2 - 2xy + y^2 + x - 3y = 0$  to axes through the point  $(-1, 0)$  parallel to the lines bisecting the angles between the original axes. [5]
15. Find the center, length of axes and the eccentricity of the ellipse  $2x^2 + 3y^2 - 4x - 12y + 13 = 0$  [5]
16. Find the length of axes and eccentricity of the conic [5]

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

OR

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

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01 TRIBHUVAN UNIVERSITY  
 INSTITUTE OF ENGINEERING  
 Examination Control Division  
 2070 Ashad

| Exam.       | New Batch (2066 & Later Batches) |            |        |
|-------------|----------------------------------|------------|--------|
| 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 All questions.
- ✓ All 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  $f(x) = \frac{x(x+3)}{e^x}$ ,  $x \in [-3, 0]$

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

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  $(r, \theta)$  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  $\int_0^\pi \cos^4 3\theta \sin^2 6\theta d\theta = \frac{5\pi}{192}$

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  $4\pi^2 a^2 b$  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  $(D^2 - 2D + 5)y = e^{2x} \cdot \sin x$
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  $100^\circ\text{C}$  cools to  $80^\circ\text{C}$  in 10 minutes in a room temperature of  $30^\circ\text{C}$  find the time when the temperature of water will become  $40^\circ\text{C}$ ?

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

**Subject:** - Engineering Mathematics I (SH401)

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

**OR**

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

|             |                     |            |        |
|-------------|---------------------|------------|--------|
| Level       | BE                  | Full Marks | 80     |
| Programme   | All (Except B.Arch) | Pass Marks | 32     |
| Year / Part | 1/1                 | Time       | 3 hrs. |

**Subject:** - Engineering Mathematics I (SH401)

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

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

2. State and prove Lagrange's Mean Value theorem.

3. If  $\lim_{x \rightarrow 0} \frac{a \sin x - \sin 2x}{\tan^3 x}$  is finite, find the value of  $a$  and the limit.

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

5. Find the radius of curvature at any point  $(x, y)$  for the curve  $x^{2/3} + y^{2/3} = a^{2/3}$

6. Prove that  $\int_0^{\infty} \frac{\sin bx}{x} dx = \frac{\pi}{2} (b > 0)$

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

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

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

OR

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

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

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

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

13. Solve  $y = px - \sqrt{m^2 + p^2}$  where  $p = \frac{dy}{dx}$

OR

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

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

15. Find the equation of ellipse of the form  $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$  where  $a > b$

16. Describe and sketch the graph of the equation  $r = \frac{4 \sec \theta}{2 \sec \theta - 1}$

| Exam.       | New Back (2066 & 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 (SH 401)**

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

2. State and prove Lagrange's mean value theorem and verify  $f(x) = \log x$ ,  $x \in [1, e]$ .

3. Evaluate  $\lim_{x \rightarrow 0} \left( \frac{1}{x^2} - \frac{1}{\sin^2 x} \right)$ .

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

5. Find the tangent at  $(a, b)$  to the curve  $\left(\frac{x}{a}\right)^3 + \left(\frac{y}{b}\right)^3 = 2$ .

6. Evaluate  $\int_{-\infty}^{\infty} \frac{dx}{x^3}$ .

7. Use Gamma function to prove  $\int_0^{\pi} \sin^6 \frac{x}{2} \cos^6 \frac{x}{2} dx = \frac{5\pi}{2^{11}}$

8. Use method of differentiation under integral sign, evaluate  $\int_0^{\infty} \frac{\tan^{-1}(ax)}{x(1+x^2)} dx$ .

9. Find the area between the curve and its asymptotes  $y^2(a-x) = x^3$ .

OR

Find the volume of the ellipsoid formed by the revolution of an ellipse  $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$ .

10. Transform the equation  $3x^2 - 2xy + 4y^2 + 8x - 10y + 8 = 0$  by translating the axis into an equation with linear term missing.

11. Find the equation of ellipse whose centre is origin and whose axis are the axis of coordinates and passes through the pair of curves  $(1, 6)$  and  $(2, 3)$ .

12. Prove that the product of the semi axis of conic  $5x^2 + 6xy + 5y^2 + 12x + 4y - 4 = 0$  is 3.

13. Solve the differential equation  $xdy - ydx = \sqrt{x^2 + y^2} dx$ .

14. Find the general solution of the differential equation  $xy^2(p^2 + 2) = 2py^3 + x^3$

15. Find the general solution of the differential equation  $(x^2 D^2 + 4xD + 2)y = e^x$ .

16. A tank contains 1000 liters of fresh water. Salt water which contains 150gms of salt per liter, runs into it at the rate of 5 liter per minute and well-stirred mixture runs out of it at the same rate. When will the tank contain 500gms of salt?

OR

Solve  $\frac{d^2 y}{dx^2} - y = x^2 \cos x$ .

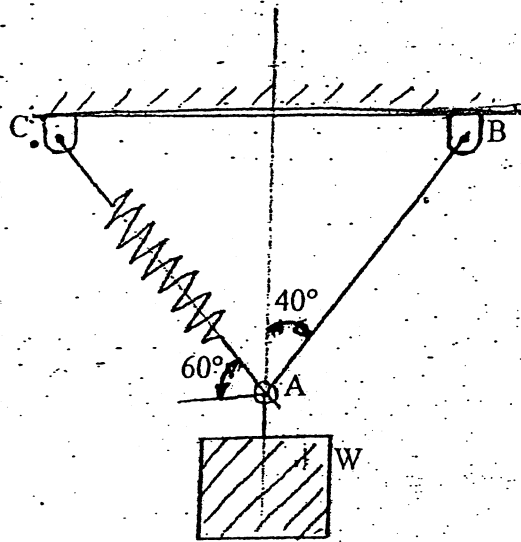
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| Exam.      | Regular (2066 & Later Batch) |            |        |
|------------|------------------------------|------------|--------|
| Level      | BE                           | Full Marks | 80     |
| Programme  | BCE, BME                     | Pass Marks | 32     |
| Year /Part | I/II                         | Time       | 3 hrs. |

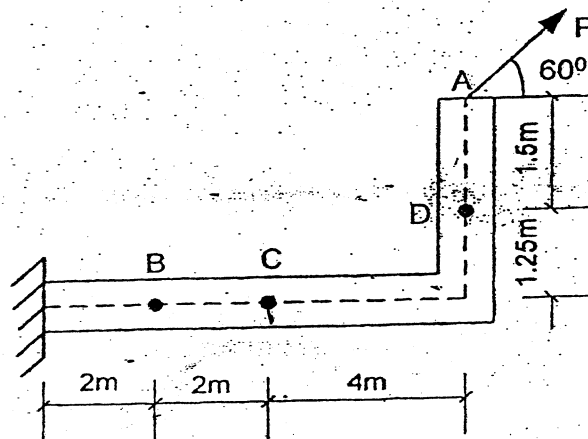
*Subject: - Applied Mechanics (CE 401)*

- ✓ 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.

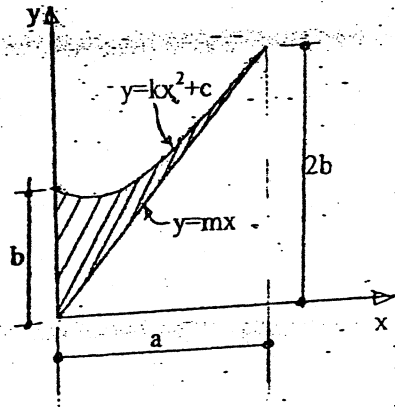
1. Differentiate between rigid body and deformable body. [3]
2. A container of weight  $W$  is subjected from ring  $A$  to which cable  $AB$  and spring  $AC$  are attached. The constant of spring is  $100\text{N/m}$  and its unstretched length is  $3\text{m}$ . Determine the tension in the cable; when (a)  $W = 120\text{N}$  (b)  $W = 160\text{N}$ . [8]



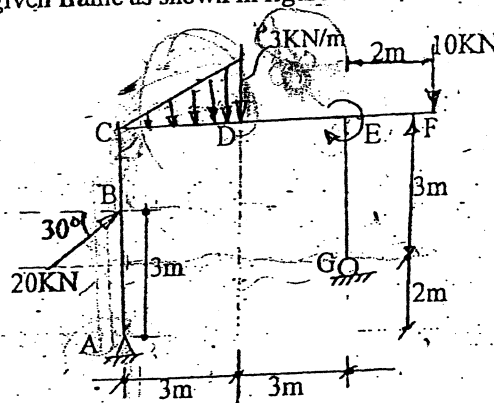
3. A  $160\text{N}$  force  $P$  is applied at point  $A$  of a structural member. Replace  $P$  with (a) An equivalent force-couple system at  $C$ , (b) and equivalent system consisting of a vertical force at  $B$  and a second force at  $D$ . [12]



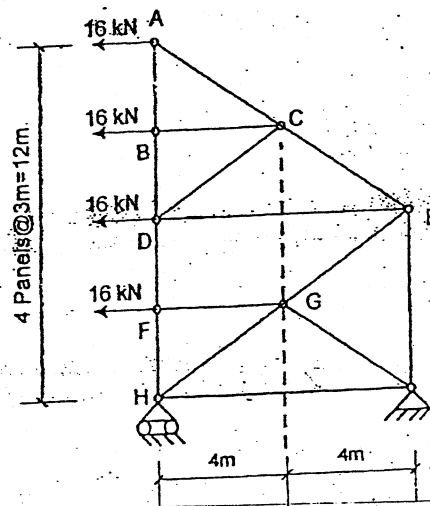
4. Determine the polar moment of inertia and the polar radius of gyration of the shaded area as shown in figure below with respect to centroid. [12]



5. Define static friction. Explain why coefficient of static friction is always less than that of kinetic friction coefficient. Support your answer with relevant equations. [1+3]
6. Calculate and draw the axial force, Shear force and bending moment diagram with its salient features; for the given frame as shown in figure below. [13]



7. Use method of section to determine member forces DE, DF and GI for the given pin jointed truss and also indicate the nature of forces. [8]



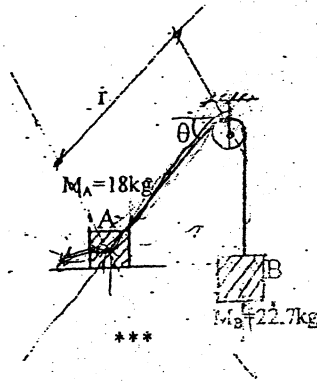


8. A particle moving in a straight line has an acceleration,  $a = \sqrt{v}$ , its displacement and velocity at time  $t = 2$  sec, are  $\frac{128}{3}$  m and 16m/s. Find the displacement velocity and acceleration at time  $t = 3$  sec. [10]

9. The two blocks as shown in figure below are released from rest when  $r = 0.73$  m and  $\theta = 30^\circ$ . Neglecting the mass of the pulley and the effect of the friction in the pulley and between block A and the horizontal surface. Determine:

a) The initial tension in the cable

b) Acceleration of the block 'A' and 'B' [10]



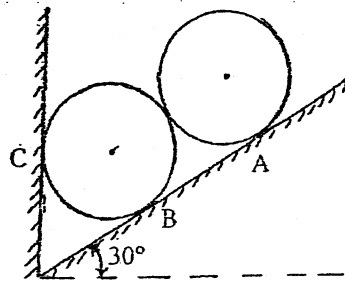
2068 Chaitra

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

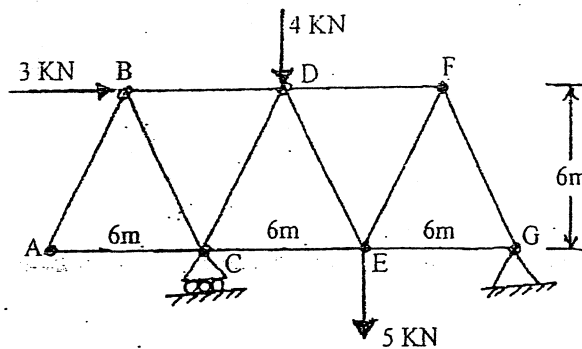
**Subject: - Applied Mechanics (CE401)**

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

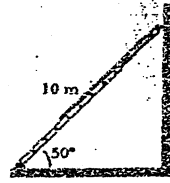
1. What are the fundamental principles of mechanics? Explain briefly. [3]
2. Two identical rollers each of weight  $W = 500\text{N}$  are supported by an inclined plane and a vertical wall as shown figure below. Draw the free body diagram of each roller separately. Assuming smooth surfaces, find the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



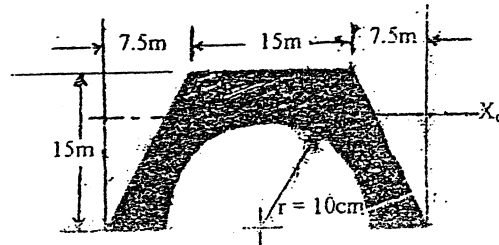
3. Use the method of sections to compute the force in bars BC, DF and CE of the Warren truss loaded as shown in figure below. [8]



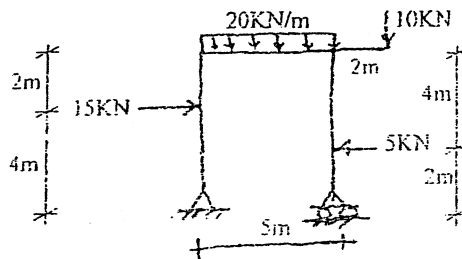
4. A 10m ladder is leaning against a smooth vertical wall and the floor with the friction coefficient 0.4. Determine the normal reactions and the friction force at the top and bottom of the ladder. [4]



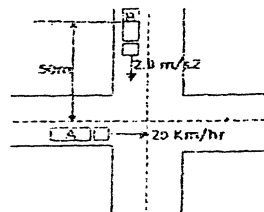
5. Determine the moment of inertia of the shaded area shown in figure below about its centroidal  $X_0$  axis. [12]



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



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



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

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

OR

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

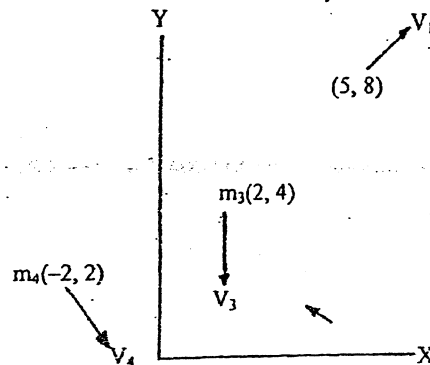
$$m_1 = 0.5 \text{ kg} \quad V_1 = 1.5i + 1.5j \text{ m/s}$$

$$m_2 = 0.35 \text{ kg} \quad V_2 = -1.3i + 1j$$

$$m_3 = 1 \text{ kg} \quad V_3 = -1.3i$$

$$m_4 = 0.75 \text{ kg} \quad V_4 = 1i - 1.3j$$

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



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

