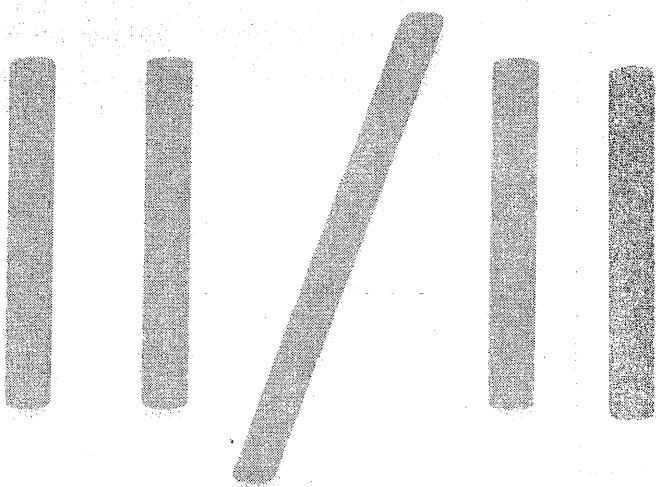
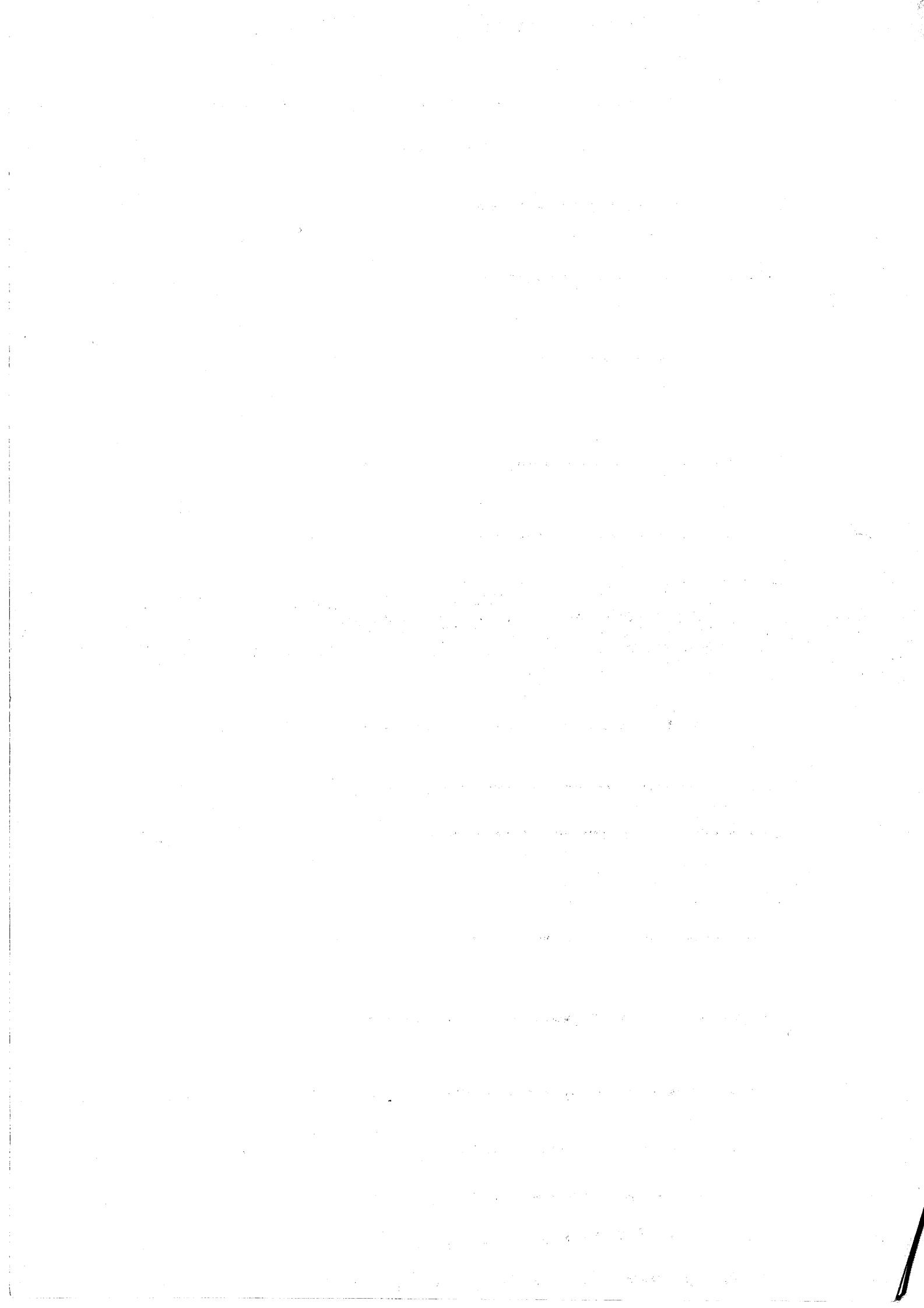


Computer



Question Bank



TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2081 Ashwin

Exam.	Back
Level	Full Marks
BEL, BEX, BCT	80
Year / Part	II / II
Time	3 hrs.

Subject: - Microprocessor (EX 551)

- ✓ 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 control unit. List its different types. Compare and contrast between them. [2+1+5]
2. How is delay calculated in 8085 microprocessor? Explain with example. How PUSH and POP instruction works in 8085 microprocessor? [5+3]
3. A set of 50, 8-bit numbers are stored in memory location A090H onward. Write a program in 8085 to set D₃ bit, reset D₅ bit and complement D₇ bit if the number is greater than 50H else store FFH in the destination table starting at B090H. [8]
4. Explain the process of assembling, linking and executing of assembly language program. List the flags in 8086 and explain control flags only. [4+4]
5. Write a program in 8086 to count the number of vowels in a sentence read from keyboard and display count on a clear screen. [8]
6. Explain in brief about different serial data transfer methods. Write RTL and draw timing diagram of instruction MVI M,55H. [3+5]
7. Explain memory mapped IO and IO mapped IO. Suppose you have two 2 KB RAM chips, draw interfacing diagram showing all the control signal to interface these RAMs to Intel 8085 with starting address at 4000H. [2+6]
8. How is interrupt handled in 8085 microprocessor? Explain in detail about different hardware interrupts available in 8085 microprocessor. [4+4]
9. Define deadlock and explain the necessary conditions responsible for deadlock. Differentiate between real and pseudo parallelism. [5+3]
10. Write short notes on: (Any Two)
 - a) Instruction formats in 8085
 - b) DMA
 - c) Memory Hierarchy

TRIBHUVAN UNIVERSITY
 INSTITUTE OF ENGINEERING
Examination Control Division
2080 Chaitra

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

Subject: - Microprocessor (EX 551)

- ✓ 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 microprocessor and micro controller. Explain fetch and execute cycle using RTL for instruction LXI B, 2050H. [4+4]
2. Draw programming model of 8085 and explain each term in detail. [3+5]
3. There are 10, 8-bit data stored from memory location 7C00H. Copy data to 7C20H if D₆ is 1 & D₄ is 0, otherwise copy by flipping bit D₆ & D₂, i.e. if D₆ is 1 change to 0 or vice versa and same for D₂. [8]
4. Why is 8086 microprocessor called as general register based microprocessor? Discuss about different parts of Bus Interface Unit (BIU) in 8086 microprocessor. [2+6]
5. Write ALP for 8086 to read password and validate user. The program should ask user for password, allow only correct password value and should display a message informing user if it is correct or incorrect. [8]
6. Draw bus timing diagram of instruction OUT 01H which is at location 4000H. Also calculate the time required to execute the instruction if clock frequency is 5 MHz. [6+2]
7. What is the need of Programmable Peripheral Interface in microprocessor system? Design an address decoding circuit to interface one PROM of 4K*8, one EEPROM of 2K*8 and one SRAM of 8K*8 with memory location starting at 3000H. [2+6]
8. Describe Polled Interrupt and Chained interrupt. Explain Interrupt processing cycle of 8085 microprocessor. [3+5]
9. Discuss about Flynn's Classification. Write the differences between RISC and CISC architecture. [4+4]
10. Write short notes on: (Any Two) [2×4]
 - a) IVT of 8086
 - b) Pseudo Parallelism and Real Parallelism
 - c) Synchronous and Asynchronous Bus

TRIBHUVAN UNIVERSITY
 INSTITUTE OF ENGINEERING
Examination Control Division
 2080 Ashwin

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

Subject: - Microprocessor (EX 551)

- ✓ 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 bus. Write about bus organization. [4]
- b) Explain Von Neumann Architecture with its limitation. [4]
2. List out and explain the 40 different PIN signals used by 8085 microprocessor with a neat diagram. [8]
3. A set of 10 numbers are stored in memory location C070 H onward. WAP in 8085 to test whether the number is odd or even. Store the even number in separate list starting from memory location C090H. [8]
4. Draw the internal architecture of 8086 microprocessor and explain its each block. [3+5]
5. Write an assembly program in 8086 to read a string, count the number of 'E' or 'e' alphabets and display the result. [8]
6. Describe RS-232C serial interface with its necessary signals. Write the bus timing cycle for an instruction LHLD 8040H stored at memory location C020H. [3+5]
7. Design an address decoding circuit to interface two 2732 EPROM of 4KB and one 6116 RAM of 2KB with starting address of 2600H using 74LS138 (i.e.) 3 to 8 Decoder. [8]
8. Differentiate between maskable and non-maskable interrupt. Explain RIM instruction with its uses. [3+5]
9. Discuss about Flynn's Classification. What are the key features having with a typical Operating system? [4+4]
10. Write short notes on: (Any Two) [2×4]
 - a) 8237 DMA Controller
 - b) 8086 Addressing Mode
 - c) Semaphore

TRIBHUVAN UNIVERSITY
 INSTITUTE OF ENGINEERING
Examination Control Division
 2079 Jestha

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

Subject: - Microprocessor (EE 551)

- ✓ 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 stored program concept used in Von-Neumann computer. [4]
- b) Write the RTL for instruction STA 3055H in 8085 microprocessor. [4]
2. a) Draw the programming model of 8085 microprocessor and explain the following instructions of 8085 with syntax and example: JNZ, POP and CALL. [2+6]
- b) 15 bytes of data are stored in first array in memory. Write an ALP in 8085 to store number of 1's and number of 0's of each byte in second and third array in memory. [8]
3. a) Define addressing modes and explain various modes available in 8086 microprocessor with examples. [8]
- b) Write an ALP in 8086 to read a string in parametric way and display number of vowels and digits in cleared window. [8]
4. a) Design the address decoding circuit or interface for one ROM and three RAMs of 8 KB each with 8085 microprocessor with base address 4000H. [6]
- b) Explain the operations of HOLD and HLDA pins of 8085 used in DMA with block diagram showing DMA controller. [5]
- c) Define serial and parallel interface. Describe the modes of parallel data transfer. [2+3]
5. a) Draw the memory structure of IVT in 8086 and explain Type 1 and Type error. [4]
- b) Define interrupt and explain its different types. [4]
6. a) Write the major features of DSP. [4]
- b) Explain Flynn's classification of computer system. [4]
7. Write short notes on: (Any Two) [2×4]
 - a) Flags of 8085
 - b) EXE and COM programs
 - c) OS and its functions

TRIBHUVAN UNIVERSITY
 INSTITUTE OF ENGINEERING
Examination Control Division
 2078 Chaitra

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

Subject: - Microprocessor (EX 551)

- ✓ 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 RTL? Write down the RTL code for the instruction LXI H, 3000H [1+7]
2. Draw the internal architecture of 8085 microprocessor and explain its each block. [8]
3. An array of bytes is stored starting from memory location C301H. Length of this array is stored in memory location C300H. Write an assembly language program in 8085 to add upper and lower nibble of each byte and store the sum starting from memory location C401H. [8]
4. Explain the addressing modes of 8085 microprocessor with examples [8]
5. Explain different types of directives of 8086 microprocessor with an example. Define assembling, linking and executing process of an assembly language program. [5+3]
6. Write ALP in 8086 which will input the user name from the keyboard. If the user is "Tribhuvan University" it will output "The username is valid "else it will output "Invalid user name". [8]
7. Draw the timing diagram for the instruction JMP 8080H. Assume the instruction is stored in memory starting at 2000H. [4]
8. Differentiate between the RS 422 and RS 423 serial interfacing standards. [4]
9. Design the address decoding interface of an input port and output port for 8085 at FAH and F8H address. Use at least one 74LS 138 decoder. Explain clearly how the microprocessor reads/ writes to this input and output devices. Assume simple input and output. [5+3]
10. Explain the SIM instruction in 8085. How interrupt are handled in 8085 microprocessor? [3+5]
11. Write notes on:
 - a) RISC and CISC Architectures
 - b) Features of operating systems

TRIBHUVAN UNIVERSITY
 INSTITUTE OF ENGINEERING
Examination Control Division
2078 Poush

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

Subject: - Microprocessor (EE 551)

- ✓ 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 stored program concept. Differentiate between Accumulator based processor with register based processor. Write the RTL for instruction LXI H, 20 H in 8085 processor.
 2. What is the use of Program Counter and Stack Pointer registers of 8085 microprocessor? How these registers get affected during CALL, RET, PUSH and POP instructions explain with suitable example.
 3. A set of 10 numbers are stored in memory location C070 H onward. WAP in 8085 to test whether the number is odd or even. Store the even number in separate list starting from memory location C090H.
 4. Discuss and differentiate between Bus Interface Unit (BIU) and Execution Unit (EU) of 8086 microprocessor. Write about flags of 8086.
 5. Write a program for 8086 to find the largest and smallest value from a list of ten 16 bit data and store the result in maxval and minval variable.
 6. What do you mean by synchronous and asynchronous bus? Draw the bus timing diagram for STA 3050H which is stored in memory location 8200H.
 7. Explain different modes of parallel data transfer. Explain in brief about PPI.
 8. How is interrupt processing differs from polling? Write general sequence to be followed when interrupt occurs.
 9. Discuss about Flynn's Classification. What are the key features having with a typical Operating system?
 10. Write short notes on: (Any Two)
 - a) USART
 - b) EXE and COM Program



TRIBHUVAN UNIVERSITY
 INSTITUTE OF ENGINEERING
Examination Control Division
 2078 Baishakh

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

Subject: - Microprocessor (EX 551)

- ✓ 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 basic characteristics that differentiate microprocessor? Define stored program concept. Differentiate between Von Neumann and Harvard Architecture. [2+2+4]
2. What are the features of 8085 microprocessor? Explain the instruction format and data format of 8085 microprocessor. [4+4]
3. There are 40 8-bit numbers in a table with address starting from 9090H. Write a program in 8085 to transfer these numbers to another table with address from A010H if lower nibble of a number is greater than higher nibble. Otherwise transfer by setting bit D2 and resetting bit D6. [8]
4. Explain Execution unit of 8086 with diagram? How is a 20 bit physical memory address calculated in the 8086 microprocessor? Explain with example. [5+3]
5. Write an assembly language program in 8086 to input two decimal numbers of single digit, multiply them and display the result in the clear screen. [8]
6. What do you mean by DMA (Direct Memory Access)? Explain the operation of a typical DMA controller in context of 8085 using HOID and HIDA pins. [2+6]
7. Explain different modes of parallel data transfer. Describe the execution of instruction ADD M using RTI or bus timing diagram. [4+4]
8. What do you mean by interrupt? How interrupt is handled in 8085 microprocessor? Explain SIM and RIM instruction in detail. [1+3+4]
9. Explain Flynn's Classification? What are the key features of a typical operating system? [4+4]
10. Write short notes on: (Any Two) [2×4]
 - a) Flag register in 8086
 - b) RS 232
 - c) PPI device 8255

TRIBHUVAN UNIVERSITY
 INSTITUTE OF ENGINEERING
Examination Control Division
 2077 Chaitra

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

Subject: - Microprocessor (EX 551)

- ✓ 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 stored program concept. How Harvard Architecture differs from von Neumann Architecture? Explain. Differentiate between hardwired and microprogrammed control unit. [2+3+3]
2. Define addressing mode. Explain different types of addressing modes of 8085 microprocessor along with examples. [2+6]
3. Write a program in 8085 to count the odd and even parity numbers of 150 data stored in the memory location starting from C050H. Store the counts at memory locations D000H and D001H. [8]
4. Draw the internal architecture of 8086 microprocessor. Explain flag register of 8086 microprocessor. [6+2]
5. Write a program in 8086 to read a string from user. Count the number of uppercase letter and lowercase letter in a string and display the count separately. [8]
6. Write down the features of 8255A PPI. Draw the timing diagram of MVI M, 30H and explain it. [3+5]
7. Design an address decoding circuit to interface two 2732 (1K×8) EPROM and one 6116 (2K×8) RAM using 74LS138 (ie.) 3 to 8 decoder starting memory location 1000H. [8]
8. What is Interrupt Service Routine. Explain how does 8086 responds to interrupts. [3+5]
9. Describe various organizations of multiprocessing system. Explain various features of modern operating system. [4+4]
10. Write short notes on: (Any Two) [2×4]
 - a) Directives used in assembly programming
 - b) DMA
 - c) RS 232.

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

Subject: - Microprocessor (EX 551)

- ✓ 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 different components of microprocessor based system with necessary figure. Differentiate between microprocessor and microcontroller. [5+3]
2. Explain the function of following pin signals of 8085 microprocessor: HOLD, HLDA, READY, RD, WR, IO/M, ALE, INTA [8]
3. Explain the operation of following instructions of 8085 with syntax, size, and flag status with examples: STA, SHLD, DCX, RLC, POP, LDAX, DAD, SBB [8]
4. Write a program in 8085 to find the largest and smallest bytes from the list of 20 bytes stored starting from memory location C050 H. Store the largest byte and smallest byte in C070 H and C071 H respectively. [8]
5. What is statement in assembly language programming? Explain most frequently used five directives. [3+5]
6. Write an assembly language program in 8086 to read a string and display it in next line with first letter in uppercase and rest in lowercase for each word. [8]
7. What are different machine operations of 8085 microprocessor? Explain the bus timing cycle of ADI 25H (op code) with timing diagram. [3+5]
8. What is programmable peripheral interface (PPI)? Write down the different modes of operation available in PPI. Explain how different modes of PPPI can be used. [2+6]
9. What are vectored and non-vectored interrupts? List and explain different interrupts available in 8085 microprocessor. How interrupts are handled by 8085 microprocessor. [2+6]
10. What are the features of RISC architecture? Differentiate register based and accumulator based architecture. [5+3]

11 TRIBHUVAN UNIVERSITY
 INSTITUTE OF ENGINEERING
Examination Control Division
 2075 Bhadra

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

Subject: - Microprocessor (EE551)

- ✓ 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 Von Neumann Machine. Differentiate Hardwired control unit and Micro programmed control unit. [4+4]
2. Draw the internal architecture of 8086 microprocessor and explain it. [8]
3. How is looping implemented in 8085 programs? Explain how nested looping can be done. Elaborate with suitable example. [8]
4. Write a program for 8085 to count the numbers for which upper nibble is higher than the lower nibble; and store the count at the end of table having 50 bytes data from C050H. [8]
5. Explain the process of assembling, linking and executing of assembly language program. Differentiate one-pass and two pass assembler. [5+3]
6. Write an assembly language program for 8086 to read a number (1 to 9 only) from user and calculate the factorial of it and display in decimal format. [8]
7. What is instruction cycle and machine cycle? Explain the timing diagram instruction LXI B, A050H with necessary diagram. [2+6]
8. Differentiate synchronous bus and asynchronous bus. Design an address decoding circuit to interface 4 KB ROM and 2KB RAM. The starting address is 4000 H. Use suitable decoder. [2+6]
9. Differentiate polling vs. interrupt. Explain how interrupt vector table is used to handle interrupts in 8086 microprocessor. [2+6]
10. What is pseudo and real parallelism? Explain Flynn's Classification. [4+4]

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

Subject: - Microprocessor (EX551)

- ✓ 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) Compare and contrast between hardwired and microprogrammed CU. [4]
- b) Write the RTL for instruction **LXI H, 75H** in 8085 microprocessor. [4]
2. a) Draw the programming model of 8085 and explain each unit. [2+4]
- b) Explain the operations and uses of **RST** instructions in 8085. [4]
- c) Write an ALP in 8085 to transfer 20 bytes of data in a table to another table by interchanging **D₁** and **D₄** bits of each byte. [6]
3. a) Explain the different types of addressing modes available in 8086 microprocessor with examples. [8]
- b) Write an ALP in 8086 to read a word and display all the alphabets in alternate case (first alphabet in lowercase, second in uppercase, third in lowercase and so on) in a clear window. [8]
4. a) Design the address decoding interface of an output port consisting of 8 LEDs with port address **ABH**. [5]
- b) Explain different modes of operation in 8255. [6]
- c) Explain the execution of instruction **ANI 4BH** in 8085 with the help of timing diagram. [5]
5. a) Describe the operation of interrupt instruction **RIM** in 8085 microprocessor. [4]
- b) Explain the Interrupt processing in 8086 microprocessor. [4]
6. a) Write the characteristics of RISC.. [4]
- b) Explain six stage pipeline technique with an example. [4]
7. Write short notes on any two: [2X4]
 - a) One pass and two pass assembler
 - b) DMA Controller
 - c) OS and Its features

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

Subject: - Microprocessor (EX551)

- ✓ 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 fetch and execution cycle of an instruction of a stored program computer. Illustrate with the help of RTL specification. [5+3]
2. What is the use of Program Counter and Stack Pointer registers of 8085 microprocessor? How these registers get affected during CALL, RET, PUSH and POP instructions explain with suitable examples. [4+4]
3. There are two tables holding twenty data whose starting address is 9000H and 9020H respectively. Write a program to add the content of first table with the content of second table having same array index. Store sum and carry into the third and fourth table indexing from 9040H and 9060H respectively. [8]
4. Describe how 8086 microprocessor is faster than 8-bit microprocessors in terms of its instruction processing. Write in brief about the uses of major registers of 8086 microprocessor. [3+5]
5. Write an assembly language program for 8086 to calculate the addition of 100 natural even numbers and display the result in screen, in decimal format. [8]
6. Explain single handshaking and double handshaking technique used in parallel interfacing with a microprocessor? Design an address decoding circuit to interface two 8k*8 ROM chips at address starting at 4000H. [3+5]
7. What do you mean by Machine cycle and T-states? Draw a bus timing diagram for an instruction ANI 55H of 8085 microprocessor. Calculate the time required to execute such instruction, if microprocessor is operating at 2MHz clock frequency. [2+5+1]
8. What are the software interrupts of 8085? Discuss the different hardware interrupts available in 8086. Write down the steps, sequentially carried out by the systems when an interrupt occurs. [3+3+2]
9. What do you mean by accumulator based microprocessor? Compare RISC and CISC architecture. [2+6]
10. Write short notes on any two:
 - a) Flags in 8086 Microprocessor
 - b) DMA Controller
 - c) Deadlock and its Remedies

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

Subject: - Microprocessor (EX551)

- ✓ 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 RTL based on any 8085 instruction. Define Stored program concept. [4+4]
2. What are the characteristics of 8085 microprocessor? Discuss all the input and output signals that are originated from microprocessor. [2+6]
3. How are the flags of 8085 processor affected during the usage of arithmetic and logic instructions? Explain with examples. Explain the following instructions with example program (i) DAA (ii) SPHL (iii) XTHL (iv) PCHL [4+4]
4. Draw the internal architecture of 8086 microprocessor. Explain each block in detail. [8]
5. Write an assembly language program for 8086 to find the largest and smallest numbers of an array having 10 numbers. Display the found numbers in the clear screen. [8]
6. Explain bus timing diagram. Draw and explain the timing diagram of the 8085 instruction STA 8050 H. [2+6]
7. Design an interfacing circuit for following problem. [8]
 - i) 74LS138:3 to 8 Decoder
 - ii) 2732 (4K*8): EP-ROM address range should begin at 0000H and additional 4K memory space should be available for future explanation
 - iii) 6116(2K*8):CMOS R/W memory
8. Differentiate between maskable and non-maskable interrupts. Explain how different interrupt pins of 8085 are used. [2+6]
9. What is interprocess communication? How does dead lock occur? How can it be solved? [2+3+3]
10. Write short notes on: [4×2]
 - i) USART
 - ii) RISC

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

Subject: - Microprocessor (EX551)

- ✓ 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 Microprocessor and Microcontrollers. Explain how the microprocessor is organized in microprocessor based systems. [4+4]
 2. What is flag? Discuss about 8085 associated flags. Along with suitable example show how these flags are affected by arithmetic and logical group of instructions. [1+2+5]
 3. Write an assembly language program for 8085 to find the square of ten 8-bit numbers which are $\leq 0FH$, stored from memory location C090H. Store the result from the end of the source table. [8]
 4. Discuss and differentiate between Bus Interface Unit (BIU) and Execution Unit (EU) of 8086 Microprocessor. List out the operators used in 8086 Assembly Language Programming. [4+4]
 5. Two tables contain ten 16-bit data each. Write an assembly language program to generate the 3rd table which contains 1FFFh if the corresponding data in the 1st table is less than that of 2nd table, else store 0000h. [8]
 6. Draw and explain the timing diagram of LXI D, 2465 H. Calculate the time required to execute this instruction if the crystal frequency is 6MHZ. [6+2]
 7. With a neat diagram explain the interfacing circuit using a 3:8 decoder (74LS138) needed to connect the following memory units to the 8085 microprocessor consecutively starting from memory location AOOOH. [8]
- 2K \times 8 ROM chip
 2K \times 8 RAM chip
 4K \times 8 EPROM chip
8. Explain the purpose of the EI, DI, SIM and RIM instructions of the 8085 processor while using interrupts. Describe how the 8085 obtains the starting address of the interrupt service routine for each of the hardware interrupts. [8]
 9. Discuss about Flynn's Classification. What are the key features having with a typical Operating system? [4+4]
 10. Write short notes on:
 i) RS232
 ii) PPI [4 \times 2]

31 TRIBHUVAN UNIVERSITY
 INSTITUTE OF ENGINEERING
Examination Control Division
 2072 Ashwin

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

Subject: - Microprocessor (EX551)

- ✓ 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 Bus? Explain Bus organization of microprocessor with diagram? Calculate the memory handling capacity of the processor having address bus of 24 lines and data bus of 16 lines. [1+5+2]
2. Explain the instruction format and data format of 8085 microprocessor. Explain different addressing modes of 8085 microprocessor. [3+5]
3. Write a program in 8085 to calculate the number of ones in the upper nibble of ten 8-bit numbers stored in a table. Store the count of ones in a location just after the table. [8]
4. What is statement in an assembly language program? Explain frequently used directives with suitable example. [2+6]
5. Write an assembly program to read a string from the user and display vowels and consonants separately. [8]
6. What do you understand by address decoding? Explain with example how PROM decoder is used in memory address decoding. [2+6]
7. Explain different modes of parallel data transfer! Explain briefly, what is PPI. [4+4]
8. What is interrupt? What is its importance in microprocessor? How interrupts from different peripherals can be handled with single INTR pin in 8086 microprocessor? Explain. [1+2+5]
9. What is register based and accumulator based architecture? Differentiate between CISC and RISC architecture? [2+6]
10. Write short notes on:
 - a) DMA
 - b) INX, XTHL, MUL, JG

31 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2072 Magh

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

Subject: - Microprocessor (EX551)

- ✓ 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 and explain the block diagram of a computer. Explain stored program concept. [4+4]
2. What is flag? Discuss about 8085 associated flags. Along with suitable examples show how these flags are affected by arithmetic and logical group of instructions. [1+2+5]
3. Write a program for 8085 to generate multiplication table of a number stored at 8230H and store the generated table starting at 8231H. For example, if location 8230H has number 05H then store 05H at 8231 H, OAH at 8232H and so on. [8]
4. Draw the internal architecture of 8086 microprocessor. Explain the function of each register accessible to programmer. [8]
5. Write a program in 8086 to read a string and display each word in a separate line in the center of the screen. [8]
6. Draw the timing diagram of STA instruction? Calculate the time taken to execute the following program if T = 1 micro second. [5+3]

MVI A,05H
ADI 20H
OUT 80H
HLT
7. Design an interfacing circuit to interface one 4 KB EPROM and two 2 KB R/W memory for 8085 microprocessor. [8]
8. What is IVT? How is it used to handle software and hardware interrupts? Explain. [2+6]
9. What is deadlock? What are the conditions for deadlock to occur? Write down the features of DSP chip. [1+3+4]

[4x2]
10. Write short notes on:
 - a) RS 232
 - b) Two pass assembler

31 TRIBHUVAN UNIVERSITY
 INSTITUTE OF ENGINEERING
Examination Control Division
 2071 Bhadra

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

Subject: - Microprocessor (EX551)

- ✓ 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 microprocessor based system showing the bus organization. Explain the processing cycle of a stored program computer. [4+4]
2. Explain briefly the programmer's model of 8085 microprocessor. [8]
3. Write a program for 8085 to add the upper and lower nibble of ten 8 bit words stored in a table that starts from location 8B20H. Store the separate results in locations just after the table. [8]
4. What do you mean by addressing mode? Explain the addressing modes of 8086 with example. [8]
5. Write an assembly language program to read a text from keyboard, convert the text into uppercase and display on the cleared screen. [3+5]
6. Draw and explain the bus timing for OUT 42H instruction of 8085 microprocessor. [8]
7. Draw the address decoding circuit to interface two RAM memory block each of 8 KB at address COOOH. [8]
8. Explain how hardware interrupt is processed in 8086 microprocessor. [8]
9. What do you mean by parallelism? Write and explain the features of a typical operating system. [8]
10. Write short notes on:
 - a) RS 232 Standard
 - b) Programmable Peripheral Interface

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

Subject: - Microprocessors (EX551)

- ✓ 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 instruction cycle and machine cycle. Explain briefly the instruction processing cycle of Von Neumann machine. [4+4]
2. Draw the internal architecture of 8085 microprocessor and explain each part. [8]
3. Write an assembly language program for 8085. Table1 contains 16 no. of 8 bit data, transfer data which have number of 1s greater than 3, from table1 to table2, otherwise store FFH in table2. [8]
4. What is statement in assembly language programming? Explain commonly used directives with examples. [8]
5. Write a program to read a string and display only the alphabetic characters from the string in a clear screen. [8]
6. Draw timing diagram of instruction LDA 2080H. Calculate the time required to execute this instruction if the crystal frequency is 6 MHZ. [6+2]
7. Determine the capacity of devices in the following memory range. [2+6]

Range	Device
0000-1FFF	ROM
2000-3FFF	RAM1

Design an interfacing circuit to interface above memory devices with 8085 microprocessor.

8. Define Interrupt Service Routine (ISR) and Interrupt Vector Table (IVT). Explain type 0 to type 4 interrupt of 8086. [2+6]
9. What are the features of digital signal processors? Describe instruction level, thread level and process level parallelism. [2+6]
10. Write short notes on:
 - a) I/O mapped and memory mapped I/O
 - b) DMA

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

Subject: - Microprocessor (EX551)

- ✓ 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 bus? Explain different types of bus. Define RTL. Write down the RTL for MOV r_1, r_2 in 8085 microprocessor. [4+4]
2. In how many ways 8085 instructions can be classified? Explain with examples. What is the purpose of the branching instructions? [6+2]
3. Write an assembly language program for 8085 to exchange the bits D6 and D2 of every byte of a program. Suppose there are 200 bytes in the program starting from memory location 8090H. [8]
4. Draw internal block diagram of 8086. Explain Bus Interface Unit. [5+3]
5. Write an assembly language program for 8086 to read string. Display each word in separate lines in a cleared screen, count how many words are there and display the count. [8]
6. Write the various machine cycle involved in LDA C030 stored at C050. Write the use of following pins of 8085 microprocessor. ALE, IO/M, READY, RD, AD₀-AD₇. [3+5]
7. Explain the execution of instruction LDA 8B7FH with the help of timing diagram. [8]
8. How interrupt vector table is used in microprocessors to manage the interrupt? Explain how software and hardware interrupts are used in 8086 microprocessor in detail. [3+5]
9. Write the conditions that may cause deadlock to arise. Explain Flynn's classification. [4+4]
10. Write short notes on:
 - a) Hardwired and micro program control unit
 - b) EXE and COM programs

Exam.	New Back (2066 & Later Batch)		
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Year / Part	II / II	Time	3 hrs.

Subject: - Microprocessor (EX551)

- ✓ 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 Hardwired and Microprogrammed Control Unit used in microprocessors? Write the fetch and execution cycle for LXI D,9050H instruction in RTL specifications. Explain each step. [4+4]
2. Write any three features of 8085 microprocessor. Explain the addressing modes of 8085 with example. [3+5]
3. Write an assembly language program in 8085 to divide a byte stored in memory location 9070 H by byte stored in 9071 H and store the remainder and quotient at 9072 H and 9073 H respectively. [8]
4. Draw the functional block diagram of 8086 microprocessor and explain each block. [8]
5. Write a program for 8086 to find the largest and smallest value from a list of ten 16 bit data and store the result in maxval and minval variables. [8]
6. What do you mean by serial interface? Differentiate between synchronous and asynchronous serial interfacing. Describe how we can use RS-232 standard to transfer data from DTE to DCE and vice versa? [1+3+4]
7. Design the address decoding interface of an input port and output port for 8085 at 81 H and 82 H address. Use block decoder. [8]
8. Differentiate Maskable and Non-Maskable interrupt. Write the general sequence to be followed when interrupt occurs. [2+6]
9. Write down the difference of RISC and CISC computers. [8]
10. Write short notes on:
 - a) Serial and parallel interface
 - b) Programmable peripheral interface

TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division

Exam. Level	Back		
	BE	Full Marks	80
Programme	BEL, BEI, BEX BCT, BAG, BGE, BCH	Pass Marks	32
2081 Ashwin	Year / Part II / II	Time 3 hrs.	

Subject: - Numerical Methods (SH 553)

- ✓ 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. Discuss the concept of absolute error, relative error, and percentage error in light of appropriate examples. [4]
2. Write an algorithm / pseudocode to find a real root of a non-linear equation using the Secant Method. [6]
3. Find a real root of $\sin x + \cos(x^2 + 1) - 1 = 0$ in the interval $[1, 2]$, correct to two decimal places, using the Bisection method. [6]
4. Solve the following system of linear equations using LU factorization method. [8]

$$\begin{aligned}x + 3y + z &= 16 \\5x + 4y - z &= 19 \\4x + 5y + 2z &= 33\end{aligned}$$

5. Find the dominant eigen value and corresponding vector in normalized form of the following matrix using the Power Method. [8]

$$\begin{bmatrix} 12 & 5 & 2 \\ 10 & 12 & 7 \\ 15 & 4 & 5 \end{bmatrix}$$

6. Using the least square method, fit a curve of the form $y = a \log_e x + b$ to the following data. [8]

x	2	3	4	5	6	7
y	5.4	6.3	6.8	7.3	7.7	8.0

7. Using appropriate polynomial interpolation formula used for equally spaced interval of the independent variable, estimate $y(15)$ and $y(42)$. [8]

x	10	20	30	40	50	60	70
y	16.8	21.2	17.2	13.6	23.2	26.4	16.8

8. Write a program in C/C++ to evaluate a definite integral using Simpson's 1/3 rule. [4]

9. Use Romberg integration to evaluate the following correct to four decimal places. [6]

$$\int_0^1 \frac{4}{1+x^2} dx$$

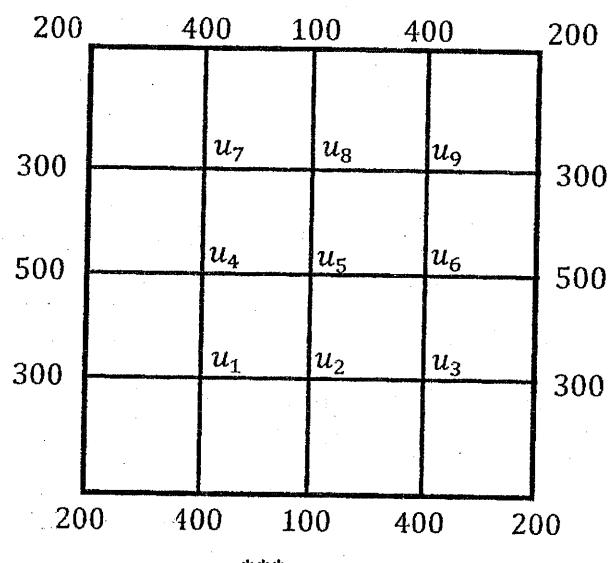
10. Solve the following initial value problem for $y(0.2)$ and $y'(0.2)$ using Runge-Kutta fourth order method, given the initial conditions: $y(0) = 1$ and $y'(0) = 0$. [6]

$$y'' = x(y')^2 - y^2$$

11. Solve the following boundary value problem using finite difference method by dividing the interval into four sub-intervals. [8]

$$y'' + 2y' + y = e^x, \quad y(0) = 3, \quad y(2) = 4$$

12. Solve the Laplace equation $u_{xx} + u_{yy} = 0$ over the following square mesh employing the Gauss-Seidal Iterative method. [8]



TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BEL, BEI, BEX, BCT, BAG, BGE, BCH	Pass Marks	32
2080 Chaitra	Year / Part	II / II	Time

Subject: - Numerical Methods (SH 553)

- ✓ 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. Express the value 0.04328675 truncated to three significant digits and evaluate the absolute, relative, and percentage error. [4]

2. Write an algorithm / pseudocode to find a real root of a non-linear equation using the Newton-Raphson Method. [6]

3. Find a positive real root of $\cos x - xe^x = 0$, correct to four decimal places, using the Secant method. [6]

4. Solve the following system of linear equations using Gauss Elimination Method with partial pivoting. [8]

$$\begin{aligned} x + 2y - 12z + 8v &= 27 \\ 5x + 4y + 7z - 2v &= 4 \\ -3x + 7y + 9z + 5v &= 11 \\ 6x - 12y - 8z + 3v &= 49 \end{aligned}$$

5. Find the dominant eigen value and corresponding vector in normalized form of the following matrix using the Power Method. [8]

$$\begin{bmatrix} 15 & 4 & 3 \\ 10 & 12 & 6 \\ 20 & 4 & 2 \end{bmatrix}$$

6. The voltage 'v' across a capacitor at time 't' seconds is given in the following table. Fit a curve of the form $v = ae^{bt}$ using the method of least squares for the given data. [8]

<i>t</i>	0	2	4	6	8	10
<i>v</i>	150	63	28	12	6	2

7. Using natural cubic spline interpolation, estimate $y(5.5)$ from the following data. [8]

<i>x</i>	2	4	6	8	10
<i>y</i>	9	12	10	14	12

8. Derive the formulae for computing the first and second order derivatives for a given data set using Newton's forward interpolation formula. [4]

9. Evaluate $\int_{-2}^2 e^{-0.5x} dx$ using Gauss-Legendre three-point formula. [6]

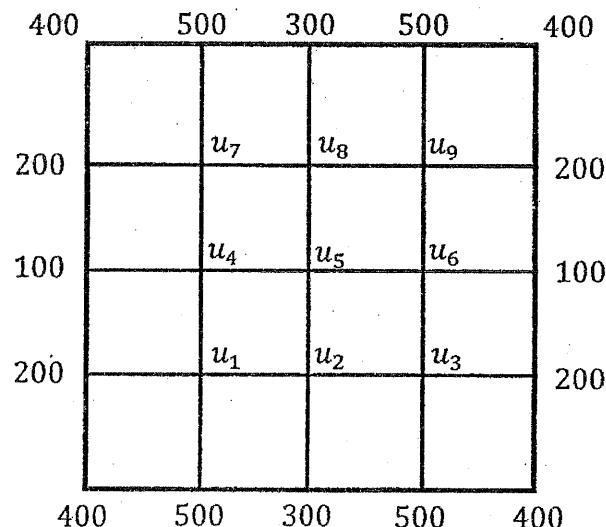
10. Using Runge-Kutta method of fourth order (RK4 method), approximate $y(0.1)$ and $y(0.2)$ for the initial value problem: $y' = x^2 - y$, $y(0) = 1$. [6]

11. Solve the following boundary value problem using finite difference method by dividing the interval into four sub-intervals. [8]

$$y'' + 3y' - y = \cos x, \quad y(0) = 2, \quad y(2) = 3$$

12. Solve the Laplace equation $u_{xx} + u_{yy} = 0$ over the following square mesh employing the Gauss-Seidal Iterative method.

[8]



Exam.	Back		
Level	BE	Full Marks	80
Programme	BEL, BEI, BEX, BCT, BAG, BGE, BCH	Pass Marks	32
Year / Part	II / II	Time	3 hrs.

Subject: - Numerical Methods (SH 553)

- ✓ 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. Discuss briefly the applications of numerical methods in the field of science and engineering. [4]
2. Solve $3x + \sin x - e^x = 0$, correct to 4 decimal place value using Newton Raphson method. [6]
3. Write a pseudocode to calculate the roots of a non-linear equation $f(x) = 0$ using secant method. How does secant method differ from regula-falsi method? [4+2]
4. Solve the following system of linear equations using Gauss elimination method with partial pivoting: [8]

$$\begin{aligned} 2a + 4b - 2c - 2d &= -4 \\ a + 2b + 4c - 3d &= 5 \\ -3a - 3b + 8c - 2d &= 7 \\ -a + b + 6c - 3d &= 7 \end{aligned}$$

5. Find the largest Eigen value and Eigen vector of the following matrix using the power method. [8]

$$A = \begin{bmatrix} 2 & 5 & 1 \\ 5 & -2 & 3 \\ 1 & 3 & 10 \end{bmatrix}$$

6. Using natural cubic spline interpolation, determine y (7) from the following set of data: [8]

x	2	4	6	8	10
y	3.2	5.6	3.7	6.3	4.2

7. Fit the exponential curve of the form $y = ae^{bx}$ to be the following data sets. [8]

x	0	1	2	3	4	5
y	1.05	2.10	3.85	8.30	15.23	25.91

8. From the following table, find the value of x for which y is maximum. Also determine the value of maximum y. [6]

x:	3	4	5	6	7	8
y = f(x):	0.205	0.240	0.259	0.262	0.250	0.224

9. Evaluate $\int_2^4 (x^2 + 2x) dx$ using Gaussian 3-point formula. [4]

10. Write a program in any high-level language (C/C++) to solve the first order ordinary differential equation using RK-4 method. [6]

11. Using finite difference method, solve the following boundary value problem by dividing the interval into four subintervals. [8]

$$\begin{aligned} y'' - 3y' + y &= \sin x + 3 \\ y(0) = 1, y(2) &= 3 \end{aligned}$$

12. Solve the elliptic equation $u_{xx} + u_{yy} = 0$ on the square mesh bounded by $0 \leq x \leq 3, 0 \leq y \leq 3$. The boundary values are $u(x, 0) = 10, u(x, 3) = 90, 0 \leq x \leq 3$ and $u(0, y) = 70, u(3, y) = 0, 0 < y < 3$. [8]

TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2079 Chaitra

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BEL, BEI, BEX, BCT, BAG, BGE, BCH	Pass Marks	32
Year / Part	II / II	Time	3 hrs.

Subject: - Numerical Methods (SH 553)

- ✓ 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 significant digits? Find the relative error if the number $X = 0.006897$ is:
 - Truncated to three decimal digits
 - Rounded off to three decimal digits.[4]
2. Write an algorithm of bisection method for finding a real root of nonlinear equation. [6]
3. Using Regula-Falsi Method, compute the real root of the following equation correct to three decimal places. [6]

$$3x + \sin x = e^x$$
4. Solve the following set of equation using LU factorization method. [8]

$$\begin{aligned} 5x - 3y + 2z &= 11 \\ 7x + 9y - 3z &= 26 \\ 3x + 2y + 4z &= 32 \end{aligned}$$
5. Find the dominant eigen-value and eigen-vector using power method for the following matrix: [8]

$$A = \begin{bmatrix} 4 & -1 & 1 \\ -1 & 3 & -2 \\ 1 & -2 & 3 \end{bmatrix}$$
6. Using natural cubic spline interpolation, determine $y(9)$ from the following set of data. [8]

x	0	5	10	15	20
y	16	9	12	8	14
7. Fit the curve of the form $y = ab^x$ to the following data using the method of least square. [8]

x	1	3	5	7	9	11
y	0.9	5.2	11.8	19.9	30.8	43.3
8. From the table below, for what value of x , y is maximum? Also find this value of y . [6]

x:	9	10	11	12	13	14
f(x):	1330	1340	1320	1250	1120	930
9. Write a program in c/c++ to evaluate a definite integral using Simpson's $\frac{3}{8}$ rule. [4] [6]
10. Solve the following system of differential equations

$$\frac{dy}{dx} = 1 + xz, \frac{dz}{dx} = -xy \text{ for } x=0.2$$
 Using the fourth order Runge-Kutta method,
 Given the initial conditions: $x_0 = 0, y_0 = 0, z_0 = 1$.
11. Using finite difference method, solve the following boundary value problem by dividing the interval into four subintervals. [8]

$$3y'' + 2y' - y = e^x + 2, \quad y(2) = 5, y(4) = 6.$$
12. Solve the Poisson's equation $u_{xx} + u_{yy} = 729 x^2 y^2$ over the square domain $0 \leq x \leq 1, 0 \leq y \leq 1$ with step size $h = 1/3$ with $u = 0$ on the boundary. [8]

TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division

2079 Ashwin

Exam. Level	BE BEL, BEI, BEX,	Back Full Marks	80
Programme	BCT, BAG, BGE BCH	Pass Marks	32
Year / Part	II / II	Time	3 hrs.

Subject: - Numerical Method (SH 553)

- ✓ 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. Discuss different types of errors in numerical computation. [4]
2. Write an algorithm to find root of an equation using Bisection method. [6]
3. Find a real root of the following equation correct to three decimals using False Position method.

$$3x + \sin x = e^x$$
 [6]
4. Solve the given system of linear equations using Gauss Elimination method by partial pivoting. [8]

$$\begin{aligned} x_1 + 6x_2 + 2x_3 &= -1 \\ 3x_1 + 5x_2 + 2x_3 &= 8 \\ 6x_1 + 2x_2 + 8x_3 &= 26 \end{aligned}$$

5. Find the largest eigen value and the corresponding eigen vector of the following matrix using power method. [8]

$$\begin{bmatrix} 5 & -2 & 1 \\ -2 & 5 & -2 \\ 1 & -2 & 5 \end{bmatrix}$$

6. Using appropriate Newton's Interpolation Techniques, estimate $y(20)$ and $y(80)$ from the following data: [8]

x	10	30	50	70	90
y	35	55	45	25	40

7. Fit the following set of data to a curve of the form $y = ab^x$. [8]

x	0	1	2	3	4	5
y	2	2.5	4	5.5	7.5	11.5

8. Estimate the value of $\cos(1.72)$ from the following table using appropriate numerical differentiation technique. [4]

x	1.7	1.74	1.78	1.82
sinx	0.9916	0.9857	0.9781	0.9691

9. Evaluate the following integral using Romberg method.

[6]

$$\int_0^2 \frac{e^x + \sin x}{1+x^2} dx$$

10. Write an algorithm to solve a system of initial value problems of first order ordinary differential equating involving two dependent variables for a given number of intervals using R-K-4 method.

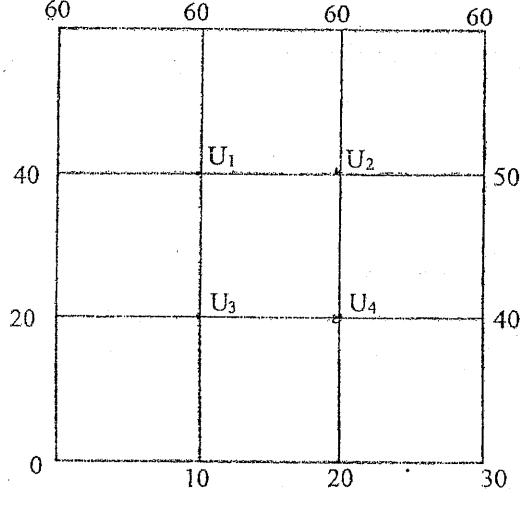
[6]

11. For $y'' = 3x + 4y$, given $y(0) = 1$ and $y(1) = 1$, obtain solution taking $h = 0.25$ using finite difference method.

[8]

12. Calculate the value of $u(x, y)$ satisfying the Laplace equation $u_{xx} + u_{yy} = 0$ at the interior points of the square region with boundary conditions shown in figure below.

[8]



TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division

2079 Jestha

Exam.	Back
Level	BE
Programme	BEL, BEX, BCT, BAG, BGE
Year / Part	II / II
	Time
	3 hrs.

Subject: - Numerical Method (SH 553)

- ✓ 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 error and write its types with suitable example. [4]
2. Find a real root of equation $x \log_e x - \sin x = 1.2$ correct to 3 decimals using Bisection method. [6]
3. Derive Newton – Raphson formula geometrically. Using the formula, find a real root of the equation $\cos x + 1.3x - 3 = 0$ using Newton – Raphson method, correct to 5 decimal places. [3+3]
4. Using Gauss – Elimination with partial pivoting technique, solve the following system of linear equations. [8]

$$\begin{aligned} 4x_2 + x_3 + 2x_4 &= 16 \\ -6x_1 + 3x_2 + 2x_4 &= -1 \\ x_1 - 2x_2 + 3x_3 &= 2 \\ 3x_1 + 3x_2 + x_3 - x_4 &= 16 \end{aligned}$$

5. Obtain the dominant Eigenvalue and its corresponding vector of following matrix using Power Method. [8]

$$\begin{pmatrix} 8 & -5 & 2 \\ -5 & 3 & -1 \\ 2 & -1 & 3 \end{pmatrix}$$

6. Derive the normal equation to fit the curve of the form $y = a + bx$. Fit this curve to the following set of data. [4+4]

x	1.0	1.7	2.4	3.1	3.8	4.5
y	1.20	7.10	9.50	10.32	12.0	13.25

7. Write a program code in C/C++ to evaluate the functional value from the given data using Lagrange interpolation. [8]
8. Write pseudo – code to evaluate the integral value using Simpson's three – eighth rule. [4]
9. Evaluate the following integral by using Gaussian 3 – point formula, correct to four decimal places. [6]

$$\int_0^{\pi} \frac{\tan^{-1} x}{x} dx$$

10. Find an approximate value of $y(1.2)$ with an initial value $y(1) = 1$, using modified Euler's method, correct to three decimal places. [Take $h = 0.1$]
Given that: $y' = x + y$

11. Solve the following boundary value problem using finite difference by dividing the interval into four sub-intervals. [8]
- $y'' = x^2 \sin x + 3y - y'$, with $y(2) = 2$ and $y(3) = 6$
12. Solve the Poisson equation $\nabla^2 u = -10(x^2 \sin(y) + y^2 \cos(x))$ over the square grid with $0 \leq x \leq 3$, $0 \leq y \leq 3$, $h = k = 1$ and $u = 50$ on the boundary using Gauss – Seidel iteration method. [Take $h = 1$] [8]

TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2078 Poush

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

Subject: - Numerical Methods (SH 553)

- ✓ 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 relative error and its significance in contrast to absolute error, with an illustrative example. [4]
2. Find a real root of the equation $x(1.2 + x) + \cos x = 10$ correct to 3 decimals using regular falsi method (Method of false position). [6]
3. Write a pseudo-code to find a real root of a non-linear equation using Bisection Method. [6]
4. What is the importance of partial pivoting in Gauss-Elimination method? Using it solve. [1+7]

$$\begin{aligned} 2x_2 + x_4 &= 0 \\ 2x_1 + 2x_2 + 3x_3 + 2x_4 &= -2 \\ 4x_1 - 3x_2 + x_4 &= -7 \\ 6x_1 + x_2 - 6x_3 - 5x_4 &= 6 \end{aligned}$$
5. Find the largest Eigen value and the corresponding Eigen vector of the following matrix using Power method [8]

$$\begin{bmatrix} 1 & 2 & 5 \\ 2 & 5 & 8 \\ 5 & 8 & 10 \end{bmatrix}.$$
6. Evaluate $y(2.25)$ and $y(6.35)$ using appropriate polynomial interpolation from the following table. [8]

x	2	4	6	8	10
y	9.584	9.346	10.96	9.855	9.161
7. Fit a second degree polynomial function to the following data. [8]

x	2	4	6	8	10	12	14
$y = f(x)$	20.4	18.6	18.1	16.5	15.9	17.4	19.3
8. Write program code in C/C++ to evaluate a given definite integral using Simpson's one-third rule. [6]
9. A rod is rotating in a plane. The following table gives the angle θ (radians) through which the rod has turned for various values of the time t second. [4]

t	0.2	0.4	0.6	0.8
θ	0.12	0.49	1.12	2.02

Calculate the angular velocity and the angular acceleration of the rod, when $t = 0.2$ second.
10. Approximate $y(0.5)$ and $y(1.0)$ using R-K4 method for the following initial value problem: [6]

$$\frac{dy}{dx} - e^x + 2y = 0, \quad y(0) = 1$$
11. Solve the following boundary value problem using the finite difference method by dividing the interval into four subintervals: [8]

$$y'' + 2y' - y = e^x, \quad y(0) = 3, \quad y(2) = 5$$
12. Solve the equation $\nabla^2 f = (x^2 y + 2)$ over the square domain $0 \leq x \leq 3, 0 \leq y \leq 3$ with $f = 0$ on the boundary and $h = 1$. [8]

TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division

2078 Chaitra

Exam.	Regular	
Level	BE	Full Marks
Programme	BEL, BEI, BEX, BCT, BAG, BGE, BCH	Pass Marks
Year / Part	II / II	Time 3 hrs.

Subject: - Numerical Methods (SH553)

- ✓ 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. Discuss the importance of numerical methods in the field of science and engineering. [4]
2. Write a pseudo-code to find a real root of non-linear equation using false position method. [6]
3. Find a real root of the equation $\sin x + \cos x + e^x - 8 = 0$ using Bisection method correct upto 3 decimal places. [6]
4. Solve the following system of equations by Gauss-Elimination method with complete pivoting. [8]

$$x + y - z = 3$$

$$4x - 2y + z = 5$$

$$3x - y + 3z = 8$$

5. Find the largest Eigen values and the corresponding Eigen vector of the following matrix using power method. [8]

$$\begin{bmatrix} 2 & -1 & 0 \\ -1 & 2 & -1 \\ 0 & -1 & 2 \end{bmatrix}$$

6. The following data are taken the steam table. [8]

temp. °C	140	150	160	170	180
Pressure (kgf.cm ²)	3.685	4.854	6.302	8.076	10.225

Find the pressure at temperature T = 142°C and T = 175°C using Newton's Interpolation.

7. Fit an exponential function of the type $y = ae^{bx}$ to the following data. [8]

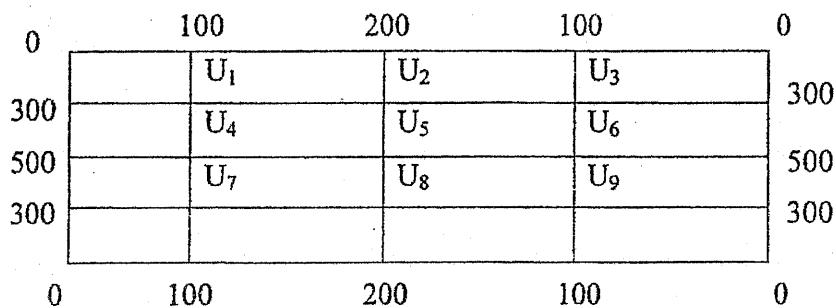
x	1	2	3	4
y	7.389	54.598	403.428	2980.958

8. The distances traveled by a vehicle at the interval of 4 minutes are given as following: [4]

t(s):	2	6	10	14
d(km):	0.25	2.2	6.5	11

Evaluate the velocity and acceleration of the vehicle at t = 2 sec.

9. Compute $\int_{0.2}^{1.5} e^{-x^2} dx$ using the 3-point Gaussian quadrature. [6]
10. Write an algorithm to solve an initial value problem of first order ordinary differential equation for a given number of sub intervals using R - K 4 method. [6]
11. Solve the following boundary value problem using the finite difference method by dividing the interval into four sub-intervals. [8]
- $$y'' = 4y' - 4y + e^{2x}; y(0) = 0, y(1) = 2$$
12. Solve the Laplace equation $u_{xx} + u_{yy} = 0$ for the square mesh with boundary values as shown in the figure below. [8]



TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2078 Baishakh

Exam.	Back
Level	Full Marks
BEL, BEI, BEX, BCT, BAG, BGE	80
II / II	32
Year / Part	Time
	3 hrs.

Subject: - Numerical Method (SH 553)

✓ 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 a program code in C/C++ find the real root of the given equation $f(x) = \sin x + \cos x$ using False – Position method. [6]

2. Find an approximate real root of the equation $x^3 - 3x - 5 = 0$ correct to three decimal places using Bisection method. [6]

3. Derive Newton-Raphson formula from Taylor's Series. Using this formula, find a real root of the equation $x^3 = 3x + 4$ using Newton-Raphson method, correct to 5 decimal places. [3+3]

4. Solve the system of equation $3x+2y+7z=32$, $2x+3y+z=40$, $3x+4y-z=56$, using LU factorization method. [6]

5. Find the dominant Eigen value and the corresponding Eigen vector of the given matrix using Power method. [8]

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

6. State the principle of Least Squares. Fit the curves of the form $y = \frac{1}{mx+c}$ to the following data set. [1+7]

x	3	4	5	6	7	8
y	4.52	7.10	9.50	10.32	12.0	13.25

7. Find a cubic spline function, and hence find $y(1.5)$ from the following data: [8]

x:	-1	0	1	2
y:	1	4	13	31

8. Write pseudo-code to evaluate the integral value using Simpson's three-eight rule. [4]

9. Derive the general Newton-Cotes quadrature formula and hence use it to derive composite Simpson's $-\frac{1}{3}$ formula. [4]

10. Apply Runge-Kutta method of order 4 to approximate the value of y at $x=0.2$ and $x=0.4$ correct to three decimal places. Given that: $y'' - 5y' + 6y = e^x$, $y(0) = 1$, $y'(0) = 2$. [8]

11. Solve the differential equation $(1+x^2)y'' - 4xy' + 2y = 1+x^2$; $y(0) = 1.25$; $y(4) = -0.95$ using finite difference method by dividing four sub-intervals. [8]

12. Derive the recurrence relation to solve Poisson's equation and hence use it to solve the following Poisson's equation: $u_{xx} + u_{yy} = -10(x^2 + y^2 + 10)$ on a square domain $0 \leq x \leq 3$, $0 \leq y \leq 3$ with $u=0$ on the boundary and step size (h) = 1. [8]

TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2077 Chaitra

Exam.		Regular	
Level	BE	Full Marks	80
Programme	BEL, BEI, BEX, BCT, BAG, BGE	Pass Marks	32
Year / Part	II / II	Time	3 hrs.

Subject: - Numerical Methods (SH 553)

- ✓ 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 error. Explain different types of errors in numerical computation. [4]

2. Find a positive real root of the equation $x^2 + \sin x = 5.23$ correct to 3 decimals using Bisection method. [6]

3. Write a pseudo-code to find a real root of non-linear equation using fixed point iteration method. [6]

4. Solve the following system of linear equations using LU factorization method. [8]

$$3x+2y+7z=4$$

$$2x+3y+z=5$$

$$3x+4y+z=7$$

5. Find the largest Eigenvalue and corresponding Eigenvetor of the matrix $\begin{bmatrix} 1 & 2 & 3 \\ 2 & -1 & 4 \\ 3 & 4 & 5 \end{bmatrix}$ using power method. [8]

6. Find the best fit curve in the form $y = ae^{bx}$ using least square approximation form the following data. [8]

x:	0.4	0.8	1.2	1.6	2.0	2.4
y:	75	100	140	200	270	375

7. From the following table, evaluate $y(3.2)$ using cubic spline interpolation technique. [8]

x	2	4	6	8	10
y	5.13	8.39	10.90	7.82	13.78

8. The following data gives corresponding values of pressure (P) and specific volume (V) of superheated steam:

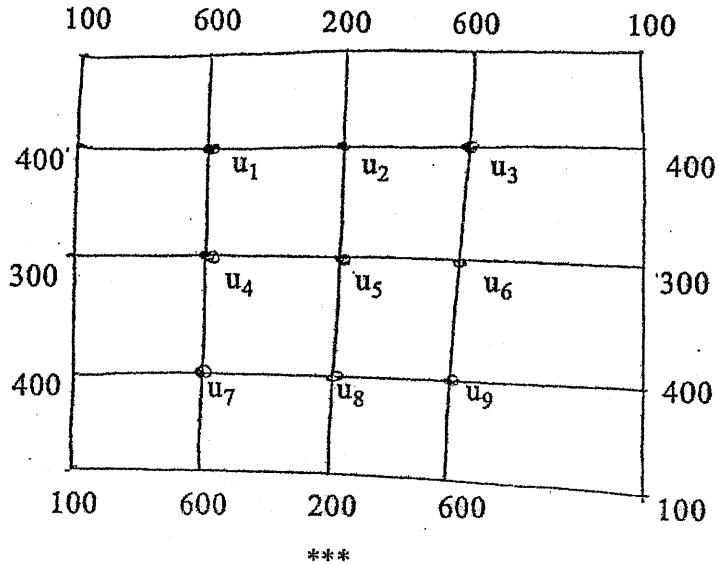
V	2	4	6	8	10
P	105	42.7	25.3	16.7	13

Find the rate of change of pressure with respect to volume when $V=2$ and $V=8$. [6]

9. Evaluate the following integral by using Gaussian 3-point formula. [4]

$$\int_2^5 \frac{\sin x + e^x}{1+x} dx$$

10. Write a program in C/C++/FORTRAN to solve a second order differential equation (initial value problem) using RK-4 method. [6]
11. Solve the following boundary value problem using shooting method by dividing the interval into four sub-intervals employ Euler's method. [8]
- $$y'' = \cos x + 3y - y', \text{ with } y(2) = 2 \text{ and } y(3) = 6.$$
12. Derive the recurrence relation for Laplace equation $u_{xx} + u_{yy} = 0$ and hence use it to solve the equation over the following square grid: [8]



TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2076 Baisakh

Exam.	Batch	
Level	Full Marks	80
Programme	Pass Marks	32
Year / Part	Time	3 hrs.

Subject: - Numerical Method (SH 553)

- ✓ 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 significant digits? Find the absolute, relative and percentage errors if the number $X=4.320106$ is truncated to four significant digits. [4]
2. Define a root of a non linear equation $f(x)=0$. Give its geometrical meaning. Derive the formula of secant method. [6]
3. Find a real root of the equation $\log(x)-\cos(x)=0$ using bisection method correct up to three decimal places. [6]
4. Solve the following system of linear equations using Gauss Elimination with partial pivot technique. [8]

$$\begin{aligned} 2x_1 + 5x_2 + x_3 + 5x_4 &= 45 \\ -8x_1 + 3x_2 + 5x_3 - 6x_4 &= -10 \\ 4x_1 - 3x_2 + x_3 + 5x_4 &= 26 \\ 2x_1 - 7x_2 - 2x_3 + 8x_4 &= 6 \end{aligned}$$

Or,

Write the program code in C/C++ to find the inverse of the given square matrix using Gauss-Jordan method. [8]

5. Obtain the dominant Eigen value and its corresponding Eigen vector of following matrix using Power Method. [8]

$$\begin{bmatrix} 1 & 2 & 4 \\ 2 & 2 & 3 \\ 4 & 3 & 2 \end{bmatrix}$$

6. From the following table, evaluate $y(2.4)$ and $y(5.2)$ using appropriate interpolation formula. [6]

x	2	3	4	5	6	7	8
y	-0.62	2.72	22.00	81.83	223.38	508.52	1023.93

7. State normal equations for fitting a straight line $y=a+bx$ to the given data $(x_i, y_i), i=1, 2, \dots, n$ and hence use it to fit the curve $y=ab^x$ to the following data: [2+6]

x:	20	25	30	35	40	45
y:	354	332	391	260	231	204

8. A slider in a machine moves along a fixed straight rod. Its distance 'x' along the rod is given below for various values of time 't' seconds. Find the velocity of the slider and its acceleration when $t=0.1$ and $t=0.6$ sec. [6]

t	0	0.1	0.2	0.3	0.4	0.5	0.6
x	30.13	31.62	32.87	33.64	33.95	33.81	33.24

9. Evaluate $\int_{0.2}^{1.5} \frac{e^{-x^2}}{1+x^2} dx$ using the 3 point Gaussian quadrature formula. [4]

10. Given that: $y' = 2\cos x - e^x + 3$, find an approximate value of $y(0.4)$ with an initial $y(0)=1$ using fourth order Runge-Kutta method, with a step size of 0.2. [6]

11. Solve the following boundary value problem using shooting method by dividing the interval into four sub-intervals using Euler's formula. [10]

$$y'' = 4e^x \sin x + 3y - xy', \text{ with } y(0)=1 \text{ and } y(1)=5$$

12. Solve the equation $u_{xx} + u_{yy} = 0$ over the square mesh of sides 3 units satisfying the following boundary conditions $u(x,0) = 0$, $u(x,3) = 10 + 3x^2$, $0 \leq x \leq 3$, $u(0,y) = y^3$, $0 \leq y \leq 3$ for

$$0 \leq y \leq 3, u(3,y) = \frac{1}{2}y^4, \text{ find the value of } u(i,j), i=1,2; j=1,2$$

[8]

13 TRIBHUVAN UNIVERSITY
 INSTITUTE OF ENGINEERING
Examination Control Division
 2075 Bhadra

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

Subject: - Numerical Method (SH553)

- ✓ 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 the divided difference table from the following data set: $(x_0, y_0), (x_1, y_1), (x_2, y_2), (x_3, y_3)$ and (x_4, y_4) . [4]
 2. Write a pseudo-code to find a real root of non-linear equation using Fixed Point Iteration method. [6]
 3. Find a real root of the equation $e^{2.80x} + \cos x = 3x^2$ correct to 3 decimals using bracketing method. [6]
 4. Solve the following system of equations using Gauss-seidel method. Correct to four decimal places. [8]
- $x_1 + x_2 + 3x_3 + 2x_4 = 12$
 $2x_1 + x_2 + x_3 + 4x_4 = 11$
 $10x_1 + 2x_2 - 4x_3 + x_4 = 3$
 $5x_1 + 8x_2 - 3x_3 + 2x_4 = -3$
5. Find the largest Eigen value and the corresponding Eigen vector of the matrix using Power Method. [8]
 6. State normal equations for fitting a parabola $y = ax^2 + bx + c$ to the given data; $(x_i, y_i); i=1,2,\dots,n$ and hence use it to fit $y = ax^2 + bx + c$ to the following data: [8]

X	1.0	2.0	2.5	3.0	3.5	4.0
Y	1.1	1.3	2.0	2.7	3.4	4.1

7. Develop a pseudocode to interpolate the given sets of data using Lagrange's interpolation. [6]
8. Derive an expression to evaluate first derivative from Newton's backward interpolation formula and evaluate $\frac{dy}{dx}$ at $x = 9$ from the following table. [6]

x	1	3	5	7	9
y	-1.20	12.80	119.60	472.80	1302.80

9. Derive the general Newton-cotes quadrature formula and hence use it to obtain simpson's -3/8 formula. [6]

10. Using finite difference method solve the following BVP: [6]

$$y'' - 3y' + 2y = 2, y(0) = 1, y(1) = 4$$

in the interval $[0,1]$. Take $h = 0.25$

11. Write a program in any high level language (C/C++/FORTRAN) to solve the second order differential equations using classical RK-4 method. [6]

12. Derive Bende-Schmidt recurrence formula for solving one-dimensional heat equation $u_t = c^2 u_{xx}$ and use it to solve the boundary value problem $u_t = u_{xx}$ under the condition $u(0, t) = u(1, t) = 0$ and $u(x, 0) = \sin(\pi x)$ upto $t = 5$ seconds. (Take $h = 0.2$) [5+5]

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

Subject: - Numerical Method (SH553)

- ✓ 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 applications of Numerical Method in engineering and science? Discuss it. [4]
2. Write an algorithm of Secant method to calculate the roots of a nonlinear equations $f(x) = 0$. Write the differences between secant and the false position methods. [4+2]
3. Find a real root of the equation $x \log_{10}x = 1.2$ by N-R method correct up to 4 decimal places. [6]
4. Write the pseudo code of the Gauss Jordan method to solve the linear system $Ax = b$. [8]
5. Find the dominant eigenvalue and eigenvector of the matrix: [8]

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

6. Estimate $y(6.5)$ using Natural cubic spline interpolation technique from the following data. [8]

x	3	5	7	9	11
y	8	10	9	12	5

7. Fit the curve $y = ax^b$ to the following data: [8]

4	5	7	10	11	13
48	100	294	900	1210	2028

8. Evaluate $\int_0^{\pi/2} e^{\sin x} dx$ using Gaussian 3-point formula. [6]

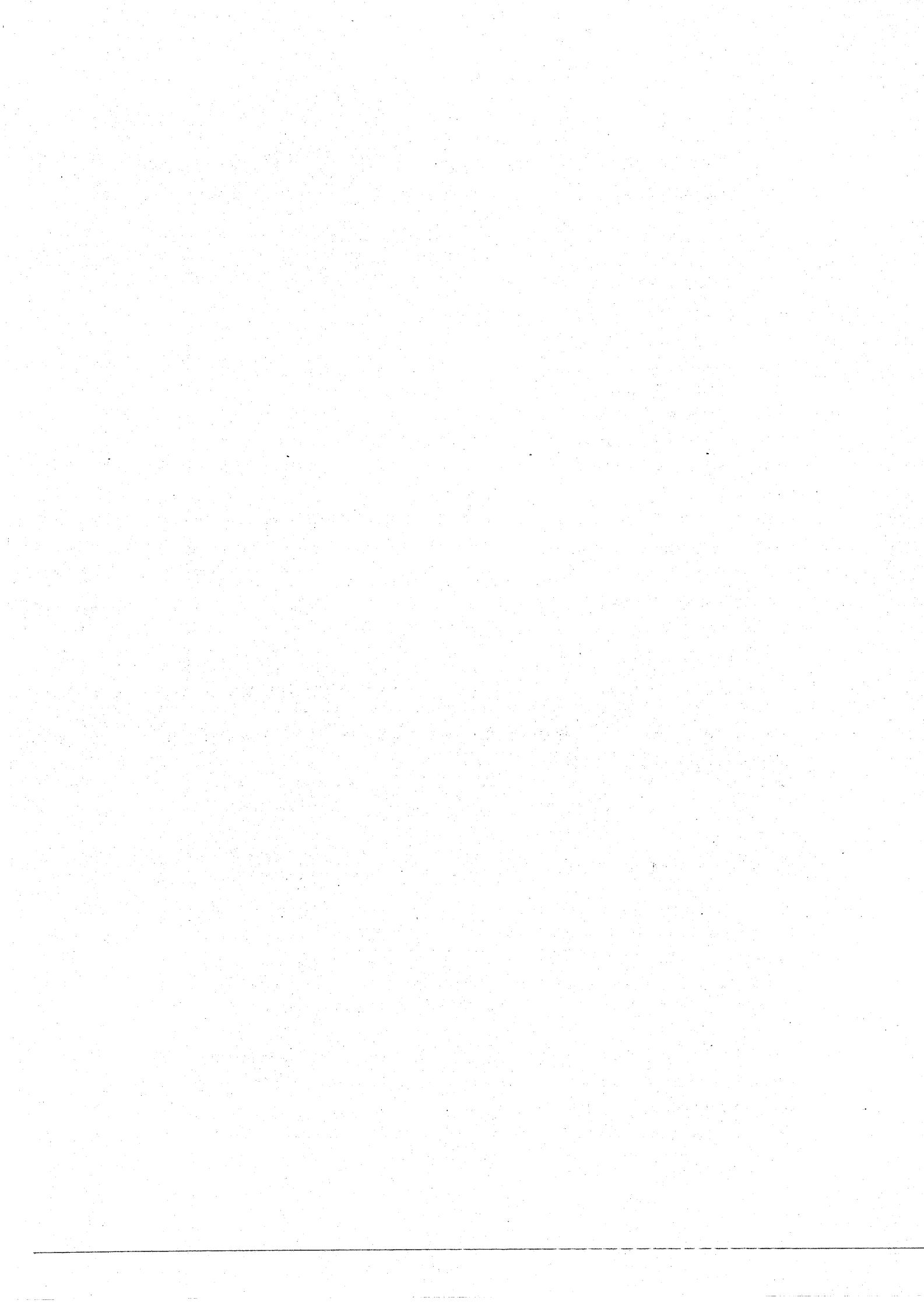
9. Find $f'(3)$ from the following table: [5]

x:	2	4	8	12	16
f(x):	20	23	30	35	40

10. Solve $y' = \frac{y}{x^2 + y^2}$, $y(0) = 1$ using R - K2 method in the range 0, 0.5, 1. [6]

11. Solve the BVP: $y'' + 3y' = y + x^2$, $y(0) = 2$, $y(2) = 5$ at $x = 0.5, 1, 1.5$ using finite difference method. [5]

12. Solve the elliptic equation $\nabla^2 u = 0$ in the square plate of size 8cm \times 8cm if the boundary values are given 50 on one side of the plate and 30 on its opposite side. On the other sides the values are given 10. Assume the square grids of size 2cm \times 2cm. [10]



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

Subject: - Numerical Method (SH553)

- ✓ 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. Discuss the significance of Numerical Methods in the field of science and engineering in modern day context. [4]
2. Write pseudo-code for finding a real of a non-linear equation using the False Position Method. [6]
3. Find a real root of the following equation, correct to six decimals, using the Fixed Point iteration method. [6]

$$\sin x + 3x - 2 = 0$$

4. Solve the following system of equations using LU factorization method. [8]

$$\begin{aligned} 5x_1 + 2x_2 + 3x_3 &= 31 \\ 3x_1 + 3x_2 + 2x_3 &= 25 \\ x_1 + 2x_2 + 4x_4 &= 25 \end{aligned}$$

5. Write a pseudo-code to determine the largest Eigen value and the corresponding vector of a square matrix using Power Method. [8]
6. The following data are provided; use least-squares method to fit these data with the following model, $y = ax + b + \frac{c}{x}$ [8]
7. From the following data, compute: (a) $y(3)$ using Newton's forward interpolation formula
 (b) $y(6.4)$ using stirling's formula [8]

x	2	4	6	8	10	12
y	5.1	4.2	3.1	3.5	6.2	7.3

8. Evaluate the following integral using Romberg's method. (correct to two decimal planes) [8]

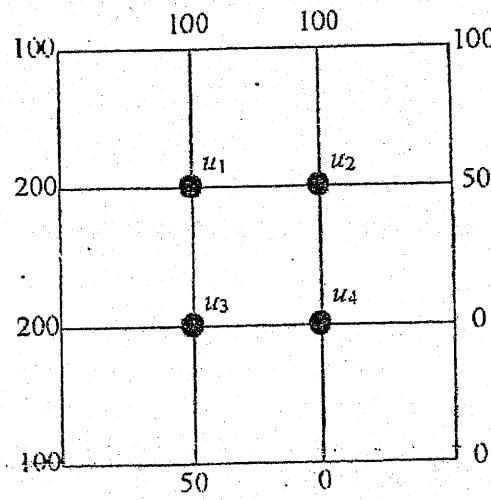
$$\int_0^2 \frac{e^x + \sin x}{1+x^2} dx$$

9. Solve $y' = 4e^{0.8x} - 0.5y$; subject to initial condition $y(0) = 2$. for $y(0.5)$ and $y(1.0)$ using Runge-Kutta 2nd order method. [6]

10. Solve the following boundary value problem using the finite difference method by dividing the interval into four sub-intervals. [8]

$$y'' = e^x + 2y' - y; \quad y(0) = 1.5; \quad y(2) = 2.5$$

11. Find the values of $u(x, y)$ satisfying the Laplace equation $\nabla^2 u = 0$, at the pivotal points of the square region with boundary conditions as shown below. [10]



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

Subject: - Numerical Method (SH5)

- ✓ 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. Discuss the difference between absolute error and relative error with appropriate examples. [4]
2. Write an algorithm of Secant method for finding a real root of a non linear equation. [4]
3. Find a real root of the equation $\sin x = e^{-x}$ correct up to four decimal places using N-R method. What are the limitations of this method? [8]
4. Apply Gauss Seidal Iterative Method to solve the linear equations correct to 2 decimal places. [8]

$$10x + y - z = 11.19$$

$$x + 10y + z = 28.08$$

$$-x + y + 10z = 35.61$$

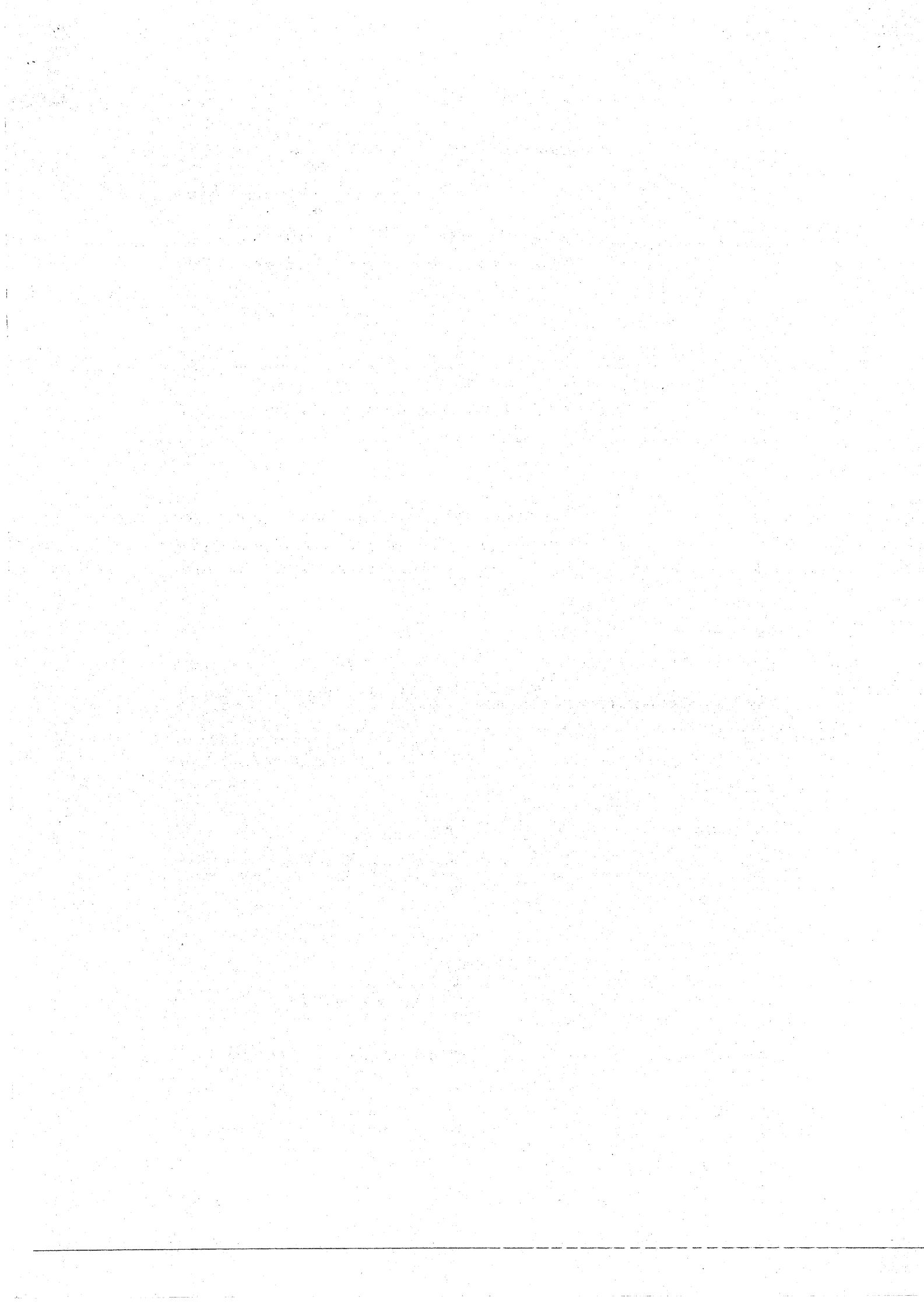
5. Find the dominant Eigen value and the corresponding Eigen vector of the given matrix using power method. [8]

$$\begin{bmatrix} 15 & -4 & -3 \\ -10 & 12 & -6 \\ -20 & 4 & -2 \end{bmatrix}$$

6. What is the practical significance of the least squares method of curve fitting? Derive the normal equations to fit a given set of data to a linear equation ($y = ax + b$) [2+6]
 7. Using stirling formula find u_{28} , given; [8]
- $u_{20} = 49225, u_{25} = 48316, u_{30} = 47236, u_{35} = 45926, u_{40} = 44306$
8. Estimate the value of cost (1.74) from the following data: [4]

x	1.7	1.74	1.78	1.82	1.86
sin(x)	0.9916	0.9857	0.9781	0.9691	0.9584

9. Evaluate $\int_{0.2}^{1.5} e^{-(x^2)} dx$ using the 3 point Gaussian quadrature formula. [6]
10. Solve the following simultaneous differential equations using Runge-Kutta second order method at $x = 0.1$ and 0.2 . $dy/dx = xz + 1; dz/dx = -xy$ with initial conditions $y(0) = 0, z(0) = 1$ [6]
11. Write a program in any high level language (C/C++/FORTRAN) to solve a first order initial value problem using classical RK-4 Method. [6]
12. Solve the elliptic equation $u_{xx} + u_{yy} = 0$ on the square mesh bounded by $0 \leq x \leq 3, 0 \leq y \leq 3$. The boundary values are $u(x, 0) = 10, u(x, 3) = 90, 0 \leq x \leq 3$ and $u(0, y) = 70, u(3, y) = 0, 0 < y < 3$. [10]



Exam.	New Back (2000 & Later Batch)		
Level	BE	Full Marks	80
Programme	BEL, BEX, BCT, B. Agri, BGE	Pass Marks	32
Year / Part	II / II	Time	3 hrs.

Subject: - Numerical Method (SH553)

- ✓ 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. Discuss the importance of Numerical Methods in Science and Engineering. [4]
2. Find a real root of $\cos x + e^x - 5 = 0$ accurate to 4 decimal places using the Secant Method. [6]
3. Write pseudo-code to find a real root of a non-linear equation using the Bisection Method. [6]
4. Compute the inverse of following matrix using the Gauss-Jordan Method. [8]

$$\begin{bmatrix} 3 & 1 & 2 \\ 1 & 2 & 3 \\ 2 & 3 & 5 \end{bmatrix}$$

5. Write algorithm for computing the dominant Eigen value and corresponding vector of a square matrix using the Power method. [8]
6. Fit the following set of data to a curve of the form $y = ab^x$. [8]

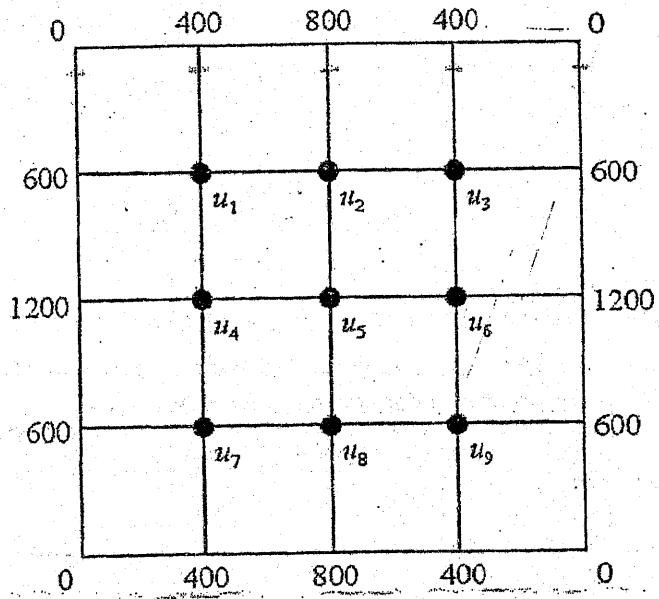
x	1.0	1.5	2.0	2.5	3.0	3.5	4.0
y	8.2	5.2	3.1	2.5	1.7	1.6	1.4

7. Estimate $y(4.5)$ from the following data using Natural Cubic Spline Interpolation technique. [8]

x	1	3	5	7	9
y	10	12	11	13	9

8. Derive the formula to evaluate $y'(x)$ and $y''(x)$ from Newton's Forward Interpolation formula. [4]
9. Evaluate $\int_0^{1.4} (\sin x^3 + \cos x^2) dx$ using Gaussian 3-point formula. [6]

10. Solve $y' = \sin x + \cos y$ subject to initial condition $y(0) = 2$ in the range $0(0.5)2$ using the [6]
Runge-Kutta second order method.
11. Write a program in C/C++/FORTRAN to solve a second order ordinary differential equation [6]
(initial value problem) using the Runge-Kutta fourth order method.
12. Solve the elliptic equation $u_{xx} + u_{yy} = 0$ for the square mesh with boundary values as shown [10]
in the figure below.



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

Subject: - Numerical Method (SH553)

- ✓ 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. Discuss the difference between Absolute error and Relative error with examples. [4]
2. Derive Newton Raphson interative formula for solving nonlinear equation, using Taylor series. [4]
3. Using the Bisection method, find a real root of the equation $f(x) = 3x - \sqrt{1+\sin x}$ correct up to three decimal points. [8]
4. Develop pseudocode to solve a system of linear equations using Gauss Jordan method. [8]
5. Find the largest Eigen value and the corresponding Eigen vector of the following matrix using the power method with an accuracy of 2 decimal points. [8]

$$\begin{pmatrix} 1 & 2 & 1 \\ 2 & 1 & 2 \\ 1 & 2 & -1 \end{pmatrix}$$

6. Using appropriate Newton's Interpolation Techniques, estimate $y(15)$ and $y(85)$ from the following data: [8]

x	10	30	50	70	90
y	34	56	45	23	36

7. Fit the following data in to $y = a + b\sqrt{x}$ [8]

X	500	1000	2000	4000	6000
Y	0.20	0.33	0.38	0.45	0.51

8. Write an algorithm to calculate the definite integral $\int_a^b f(x)dx$ using composite simpson's 1/3 rule. [4]

9. The distance travelled by a vehicle at intervals of 2 minutes are given as follows: [6]

Time (min): 2 4 6 8 10 12

Distance (km): 0.25 1 2.2 4 6.5 8.5

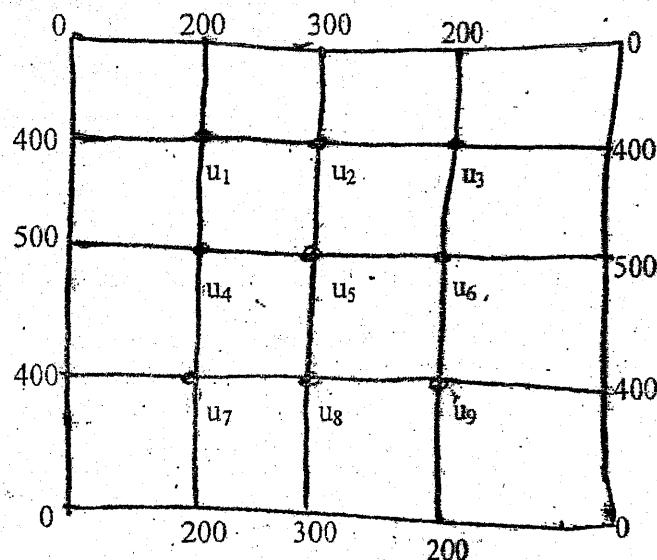
Evaluate the velocity and acceleration of the vehicle at $t = 3$ minutes. [8]

10. Solve the following by RK-2 method for $x = 0$ (0.1) 0.2

$$\frac{d^2y}{dx^2} + x \frac{dy}{dx} + y = 0 ; y(0) = 1, y'(0) = 0$$

11. Solve the Laplace equation $u_{xx} + u_{yy} = 0$ for the square mesh with boundary values as shown in the figure.

[10]



12. Derive Euler's formula for solving initial value problem.

[4]

Exam.	New Back (2060 & Later Edition)		
Level	BE	Full Marks	80
Programme	BEL, BEX, BCT, B. Agri, BGE	Pass Marks	32
Year / Part	II / II	Time	3 hrs.

Subject: - Numerical Method (SH553)

- ✓ 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. Discuss the necessity of numerical methods in the field of Science and Engineering in this modern age of computers. [4]
2. Find a real root of the equation $x \tan u - 1 = 0$ using bisection method correct up to three (3) significant digits. [6]
3. Write Psudocode for solving a Non-Linear equation using the secant method. [6]
4. Find the inverse of the matrix $A = \begin{bmatrix} 2 & -2 & 4 \\ 2 & 3 & 2 \\ -1 & 1 & 1 \end{bmatrix}$ using Gauss Jordan method. [8]
5. Find the largest eigen value and the corresponding eigen vector of the following matrix. [8]

$$\begin{bmatrix} 4 & 1 & -1 \\ 2 & 3 & -1 \\ -2 & 1 & 5 \end{bmatrix}$$

6. Using the least square method, determine the exponential fit of the form $y = ae^{bx}$ for the following data:

x	0	1	2	3	4	5
y	1.5	2.5	3.5	5.0	7.5	11.25

7. Compute $y(6)$ from the following data using Cubic Spline Interpolation. [8]

x	1	3	5	7	9
y	3	5	4	2	3

8. Derive an expression for evaluating first and second derivatives using Newton forward difference interpolation formula. [4]
9. Evaluate $\int_0^3 (\sin x + \cos x + 2) dx$ using Simpson's -3/8 rule taking $h = 0.5$. Determine the percentage error by comparing the result with exact solution. [4+2]
10. Using Finite difference method solve the BVP: $y'' = 4y' - 4y + e^{2x}$, $y(0) = 0$, $y(1) = 2$ for three internal points in $(0,1)$. [8]
11. Write algorithm for solving an initial value problem of first order using RK-4 method. [4]
12. Solve the equation $\nabla^2 u = -10(x^2 + xy + 10)$ over the square with sides $x = y = 0$, $x = y = 3$ with $u = 10$ on the boundary and mesh length 1. [10]

27
 INSTITUTE OF ENGINEERING
 Examination Control Division
 2071 Bhadra

Level	BE	Full Marks	80
Programme	BEL, BEX, BCT, BGE, B.Agric.	Pass Marks	32
Year / Part	II / II	Time	3 hrs.

Subject: - Numerical Methods (SH553)

- ✓ 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. Create difference table from following data. [4]

X	3.0	3.2	3.4	3.6	3.8
Y	0.4771	0.5051	0.5315	0.5563	0.5798

2. Use bisection method to find a real positive root of $\sin x = \frac{1}{x}$ correct upto three decimal places. [8]
3. Write a pseudo-code to find a real root of a non-linear equation using Secant Method. [4]
4. Solve the following linear equations using Gauss Elimination or Gauss Jordan method using partial pivoting. [8]

$$2x + 3y + 2z = 2$$

$$10x + 3y + 4z = 16$$

$$3x + 6y + z = 6$$

5. Find the largest eigen-value and the corresponding eigen-vector of the following matrix. [8]

$$\begin{bmatrix} 25 & 1 & 2 \\ 1 & 3 & 0 \\ 2 & 0 & -4 \end{bmatrix}$$

6. Find the best fit curve in the form of $y = a + bx + cx^2$ using least square approximation from the following discrete data. [8]

x	1.0	1.5	2.0	2.5	3.0	3.5	4.0
y	1.1	1.3	1.6	2.0	2.7	3.4	4.1

7. Use Lagrange's Interpolation formula to find the value of y when x = 3.0, from the following table. [8]

x	3.2	2.7	1.0	4.8	5.6
y	22.0	17.8	14.2	38.3	51.7

8. Evaluate $\int_0^2 f(x)dx$, for the function $f(x) = e^x + \sin 2x$, using composite Simpson's 3/8 formula taking step size h = 0.4. [5]

9. Evaluate $\int_0^2 \frac{dx}{x^2 + 2x + 1}$ using Gaussian 3 point formula. [5]

10. Solve $\frac{dy}{dx} = \frac{y^2 - x^2}{y^2 + x^2}$ using RK - 4 method, for y(0.4). (Given, y(0) = 1, h = 0.2) [6]

11. Using the finite difference method, find y(0.25), y(0.5) and y(0.75) satisfying the differential equation $xy'' + y = 0$, subject to the boundary conditions y(0) = 1, y(1) = 2. [6]

12. Solve the Poisson equation $u_{xx} + u_{yy} = -81xy$, $0 < x < 1$, $0 < y < 1$ given that $u(0, y) = 0$, $u(x, 0) = 0$, $u(1, y) = 100$, $u(x, 1) = 100$ and $h = 1/3$. [10]

11 TRIBHUVAN UNIVERSITY
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 Examination Control Division
 2071 Magh

Exam.	New Back Log & Theory Based		
Level	BE	Full Marks	80
Programme	BEL, BEX, BCT, BGE, B.Agric.	Pass Marks	32
Year / Part	II / II	Time	3 hrs.

Subject: - Numerical Method (SH553)

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

1. Find a root of the equation $\cos x = xe^x$ using the regula-falsi method correct upto four decimal places. [8]
2. Derive Newton-Raphson iterative formula for solving non-linear equation. [4]
3. Define error. Discuss different types of errors in numerical computation. [4]
4. Solve the following set of linear equations using LU factorization method. [8]

$$x - 3y + 10z = 3$$

$$-x + 4y + 2z = 20$$

$$5x + 2y + z = -12$$

5. Use Gauss Seidel method to solve the following equations: [8]

$$20x + y - 2z = 17$$

$$3x + 20y - z = -18$$

$$2x - 3y + 20z = 25$$

6. The following data are taken from the steam table. [8]

Temp. °C	140	150	160	170	180
Pressure kgf/cm²	3.685	4.854	6.302	8.076	10.225

Find the pressure at the temperature $T = 142^\circ\text{C}$ and $T = 175^\circ\text{C}$ using Newton's interpolation.

7. Derive expression for least square method of fitting a linear curve. [8]

OR

Develop pseudocode to interpolate the given set of data using Langrange interpolation.

8. If 'x' is in cm and 't' is in time then find velocity and acceleration when $t = 0.1$ second. [4]

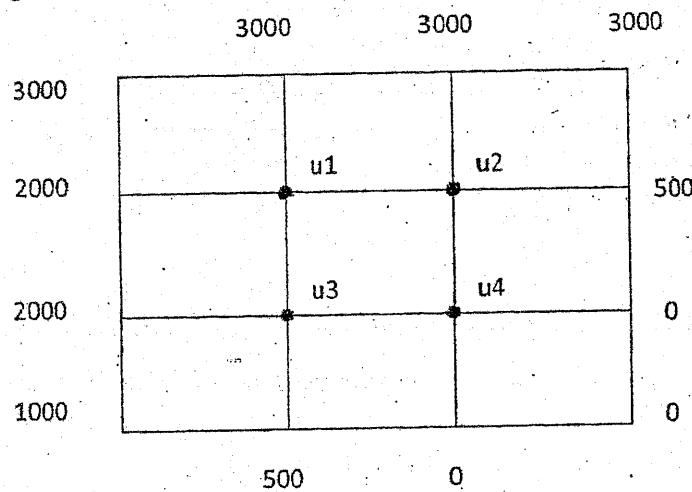
t	0	0.1	0.2	0.3	0.4	0.5	0.6
x	30.13	31.62	32.87	33.64	33.95	33.81	33.24

9. Compute integration of the following function using Romberg integration $\int_{-1}^1 \frac{dx}{1+x^2}$. [6]

10. Using Euler's method find $y(0.2)$ from following equation $y' = x + y$, $y(0) = 0$, take $h = 0.1$. [4]

11. Using the Runge-Kutta method of second order, obtain a solution of the equation $y'' = y + xy'$ with the initial condition $y(0) = 1$, $y'(0) = 0$ to find $y(0.2)$ and $y'(0.2)$. (Take $h = 0.1$) [8]

12. Calculate the value of $u(x, y)$ satisfying the Laplace equation $\nabla^2 u = 0$ at the interior points of the square region with boundary conditions shown in figure below. [10]



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

Subject: - Numerical Method (SH55)

- ✓ 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 error. Explain different types of errors in numerical computation. [6]

2. Find a real root of the following equation correct to four decimals using False Position method. [6]

$$e^{\cos x} - \sin x - 1 = 0$$

3. Discuss the limitations of Newton-Raphson method while finding a real root of a non-linear equation. [4]

4. Solve the following system of equations using LU factorization method. [8]

$$5x_1 + 2x_2 + 3x_3 = 31$$

$$3x_1 + 3x_2 + 2x_3 = 25$$

$$x_1 + 2x_2 + 4x_3 = 25$$

5. Write an algorithm for solving a system of linear equations of 'N' unknowns using Gauss-Jordan Method. [8]

6. Find y at x = 8 from the following data using Natural Cubic Spline interpolation. [8]

x	3	5	7	9
y	3	2	3	1

7. Fit the following set of data to a curve of them form $y = a b^x$. Also evaluate y(7). [8]

x	2	4	6	8	10	12
y	16.0	11.1	8.7	6.4	4.7	2.6

8. Evaluate the following integral using Romberg method. [6]

$$\int_0^2 \frac{e^x + \sin x}{1+x^2} dx$$

9. Determine y'(1) and y''(1) from the following data. [4]

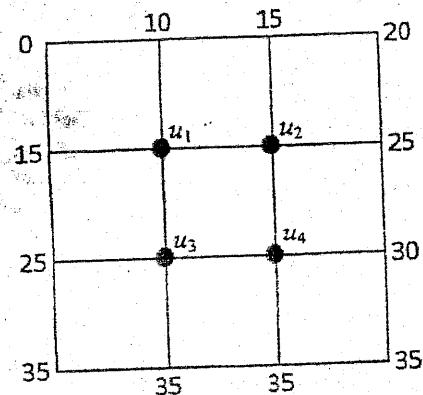
x	0.5	1.0	1.5	2.0	2.5
y	6	3	2	1.2	0.8

10. Solve the following initial value problem for y(1.2) using the Runge-Kutta fourth order method. [6]

$$y'' - 3y' + y = \sin x; \quad y(1) = 1.2; \quad y'(1) = 0.5$$

11. Write an algorithm to solve two point boundary value problem using shooting method. [6]

12. Solve $u_{xx} + u_{yy} = 0$ for the following square mesh with boundary conditions as shown in figure below. [10]



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

Subject: - Numerical Method (SH553)

- ✓ 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. Discuss the importance of Numerical Methods in the field of Science and Engineering. [4]

2. Write pseudo-code for finding a real root of a non-linear equation using False Position Method. [6]

3. Find a real root of the following equation, correct to three decimals, using the Fixed Point iteration method. [6]

$$\sin x + 3x - 2 = 0$$

4. Solve the following systems of linear equations using the Gauss-Seidal iteration method. [8]

$$x_1 + 3x_2 - x_3 + 7x_4 = 19$$

$$2x_1 + 8x_2 + x_3 - x_4 = 17$$

$$3x_1 + x_2 + 9x_3 - x_4 = 15$$

$$9x_1 - x_2 - x_3 + 2x_4 = 13$$

5. Find the largest Eigen value and corresponding vector of the following matrix using power method. [8]

$$\begin{bmatrix} 2 & 5 & 1 \\ 5 & -2 & 3 \\ 1 & 3 & 10 \end{bmatrix}$$

6. Compute the value of $y(3)$ and $y(7)$ from the following data using Newton's interpolation formula. [8]

x	2	4	6	8	10	12
y	5.1	4.2	3.1	3.5	6.2	7.3

7. Fit the following data to the curve $y = \log_e(ax+b)$. [8]

x	0	1	2	3	4	5	6
y	0.9	1.0	1.5	1.9	2.1	2.4	2.5

8. Evaluate the following, using Simpson's 1/3 rule. (take $h = 0.2$) $\int_0^2 \frac{4e^x}{1+x^3} dx$ [5]

9. Evaluate $\int_2^3 \frac{\cos 2x}{1+\sin x} dx$ using Gauss quadrature three-point formula. [5]

[8]

10. Solve the following boundary value problem using finite difference method.

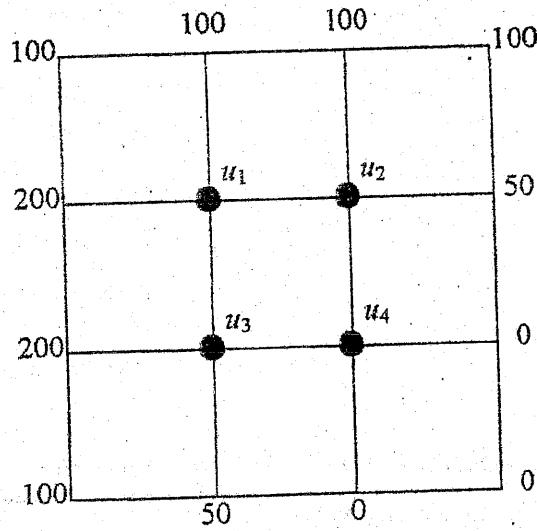
$$y'' = e^x + 2y' - y; \quad y(0) = 1.5; \quad y(2) = 2.5$$

[4]

11. Explain the technique of solving an initial value problem using Euler's method.

12. Find the value of $u(x,y)$ satisfying the Laplace equation $\nabla^2 u = 0$, at the pivotal points of the square region with boundary conditions as shown below.

[10]



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2081 Ashwin

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

Subject: - Instrumentation I (EE 552)

- ✓ 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 analog and digital signal. Describe the operation of the functional components of Instrumentation system with the help of block diagram. [6]
2. Explain the various types of error encountered in electrical measurement. How they can be eliminated? [6]
3. A Voltmeter whose accuracy is 2% of the full-scale reading is used on 0-50V scale. It is used to measure a voltage of 15 V and 42V. Calculate the possible error of both readings and comment on your result. [4]
4. Explain working principle of capacitive transducer. Also explain how linear relation between output & input can be obtained in case of capacitive transducer working on the principle of change in separation distance. [6]
5. Define piezo - resistive effect and gauge factor of a resistance strain gauge and derive the expression for the gauge factor. [6]
6. A compressive force is applied to a structure members. The strain is 5μ strain. Two separate Strain gauge are attached to the structural member, one is nickel wire strain gauge having gauge factor of -12.1 and other is Nichrome wire gauge having gauge factor of 2. Calculate the value of resistance of the gauges after they are strained. The resistance of strain gauges before being strained is 120Ω . [4]
7. Draw the block diagram of optical fiber communication system and write advantages of it. [6]
8. Explain the operation of sample and hold circuit with the help of circuit diagram. [6]
9. Design an integrator circuit which will produce a ramp voltage of -20 V/msec . [4]
10. Describe the circuit of 3 amplifier configuration of an instrumentation amplifier. Also derive the expression for output voltage in terms of two input voltage. [6]
11. Describe the working principle of successive approximation ADC in detail with flowchart and diagram. [6]
12. Consider a 6 bit DAC with a resistance of $320 \text{ k}\Omega$ in LSB position. The converter is designed with WRN. The reference voltage is 10v, the output of the resistive network is connected to an operational amplifier with a feedback resistance of $5\text{k}\Omega$.What is the analog output for a binary input of 111010? [4]
13. Explain the construction and working principle of single-phase electro-dynamometer type of wattmeter and derive the expression of deflection for ac operation. [8]
14. Explain the working principle of instrument transformer. Also explain why the secondary winding of current transformer should never be kept open circuited while primary is energized. [8]



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

Subject: - Instrumentation I (EE 552)

- ✓ 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 instrumentation system with example. Explain its different components with the help of a block diagram. [6]
2. Explain the difference between static and dynamic characteristics of measurement system. Briefly explain following static performance parameter. [6]
 - i) Accuracy (ii) Precision (iii) Sensitivity (iv) Resolution (v) Linearity
3. An AC bridge circuit is working at 1000 Hz. Arm AB has $0.2 \mu\text{F}$ pure capacitance, arm BC has 500Ω pure resistance, arm CD contains an unknown impedance, and arm DA has 300Ω resistance in parallel with $0.1 \mu\text{F}$ capacitor. Find the constants of arm CD considering it as a series circuit. [4]
4. What is piezo electric transducer? What are the materials used in such transducer? Define voltage sensitivity, charge sensitivity and derive the expression for the output voltage developed due to applied force. [6]
5. Explain how magnitude and direction of displacement can be measured using linear variable differential transformer. [6]
6. A linear resistance potentiometer is 50 mm long and is uniformly wound with a wire of total resistance 5000Ω . Under normal condition, the slider is at the centre of the potentiometer. Determine the linear displacement when the resistance of the POT as measured by a wheatstone bridge is 1850Ω . If it is possible to measure a minimum value of 5Ω resistance with the above arrangement determine the resolution of the POT in mm. [4]
7. Explain the features of instrumentation amplifier and derive the expression for its Gain. [6]
8. Explain the operation of sample and hold circuit with the help of circuit diagram. [6]
9. Design an Op-Amp summer circuit to obtain output voltage as $V_{\text{out}} = -(V_1 + 10V_2 + 25V_3)$. Use minimum value of resistance as $10k\Omega$. [4]
10. Explain how analog to digital conversion is achieved by using Dual ramp ADC. [6]
11. What are the drawbacks of weighted resistor network? With suitable diagram explain the R-2R ladder digital to analog converter. [6]
12. What will be a 4-bit successive approximation digital output for an analog input of 4.287V if full range of converter E_R is 5V . [4]
13. Describe the construction and working principle of a single phase induction type energy meter. [8]
14. Explain the operating principle of electrical resonance type frequency meter in detail. [8]

TRIBHUVAN UNIVERSITY
 INSTITUTE OF ENGINEERING
Examination Control Division
 2080 Ashwin

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

Subject: - Instrumentation I (EE 552)

- ✓ 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) Prove that linearity and sensitivity of potentiometer are two conflicting requirements. [8]
- b) Explain different types of errors in measurement with their remedies. [8]
2. a) Obtain the balance equation for an a.c. bridge and explain with diagram how Schering bridge can be used to measure unknown capacitance. [6]
- b) How linear relation between out-put and input can be obtained in the case of capacitive sensor working on the principle of change in separation distance? [6]
- c) A strain gauge is bonded to a beam that is 16 cm long and has a cross-sectional area of 4 cm^2 . The unstrained resistance of the strain gauge is 300Ω and the gauge factor is 2. There is a change in resistance of 0.015Ω on the application of load. If the modulus of elasticity for steel is 207 GN/m^2 , calculate the amount of force applied on the beam and the change in length of the steel beam. [4]
3. a) Explain the working principle of photo-conductive cell. [6]
- b) Explain the features of instrumentation amplifier and derive the expression for its gain. [6]
- c) A potentiometer has a resistance of 1000Ω and is rated as 5W . What is the maximum allowable excitation voltage? Calculate the sensitivity and resolution if the length of potentiometer is 0.5m and there are 500 turns. Also calculate percentage loading error at 0.87 of the travel if a voltmeter of 5000Ω is connected across the potentiometer. [4]
4. a) Consider a 6-bit DAC with a resistance of $320 \text{ K}\Omega$ in LSB position. The converter is design with weighted resistor network. The reference voltage is 10V . The output of the resistive network is connected to an operational amplifier with a feedback resistance of $5 \text{ K}\Omega$. What is the analog output for a binary input of 111010? [4]
- b) Explain how analog to Digital conversion can be achieved by using Dual Ramp ADC. [6]
- c) What is data acquisition system? Explain function of the different components of digital data acquisition system. [6]
5. a) What is wattmeter? Write its types. Explain the wattmeter which can measure ac as well as dc power with the help of construction and working principle. [8]
- b) Show how the instrument transformers are used to measure high voltage and current. Also explain why secondary winding of CT should never be kept open circuited while primary is energized? [8]

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

Subject: - Instrumentation I (EE 552)

- ✓ 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 Instrumentation system? Describe the operation of the functional components of Instrumentation system with the help of block diagram. [1+5]
- b) What are the different parameters to define the static performance of an instrument? Distinguish between accuracy and precision of an instrument with a suitable example. [3+3]
- c) Describe the construction and working principle of permanent magnet moving coil instrument with neat and clean diagram. What will happen if we connect PMMC instrument for the measurement of AC quantity? [4]
2. a) Show how "Loading effect "causes a non-linear relationship between the input and output in a measurement made by a potentiometer. Also write the methods to reduce loading effect. [6]
- b) Explain how magnitude and direction of displacement can be measured with the help of inductive sensor. [6]
- c) An AC bridge working at 500 Hz has following parameters: [4]

Arm AB, $R = 500 \Omega$ in parallel with $L = 30 \text{ mH}$,
 Arm BC, $R = 1000 \Omega$ in parallel with $C = 0.5 \mu \text{F}$,
 Arms CD, $R = 800 \Omega$ in series with $C = 0.9 \mu \text{F}$.
 Determine the parameters of the remaining arm for the bridge to be balanced considering the possibility that the missing arm could be either in series or parallel.
3. a) Explain working principle of piezo-electric sensor and derive the expression for out-put voltage. Also explain its equivalent circuit. [6]
- b) Explain the working principle of hall- effect sensor. Also prove that this effect is more pronounced in the case of semiconductor than metal. [6]
- c) Determine the thermoelectric sensitivity and emf developed in a thermocouple made of copper and constantan for a temperature of 50°C between its junction. Given that thermo electric emf of copper and constantan against platinum are $7.4 \mu\text{V}/^\circ\text{C}$ and $-34.4 \mu\text{V}/^\circ\text{C}$ respectively. [4]
4. a) Highlight the advantages of optical fiber transmission over conventional data transmission system. [6]
- b) Describe the instrumentation amplifier in detail with a circuit diagram. How is it better than other amplifiers? Also derive the expression for its gain. [10]
5. a) Describe the construction and working principle of a single- phase induction type" energy meter. Show that the total number of revolutions made by disc during particular time is proportional to the energy consumed. [8]
- b) Show how the instrument transformers are used to measure high voltage and current. And also explain why the secondary of current transformer should not be kept open circuited while primary is energized. [8]

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

Subject: - Instrumentation I (EE 552)

- ✓ 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 the function of different stage of measuring system with the help of block diagram. [6]
- b) An AC bridge has following constants:
 Arm AB: $R = 1000 \Omega$ in parallel with $C = 0.5 \mu F$
 Arm BC: $R = 3000 \Omega$
 Arm CD: unknown capacitance C_x in series with R_x
 Arm DA: $C = 0.55 \mu F$
 Supply frequency = 1000 Hz
 Determine the unknown resistance R_x and capacitance C_x to make the bridge balanced. [4]
- c) Differentiate between static and dynamic characteristics of measurement system. Also explain different static and dynamic performance parameters of measurement system. [6]
2. a) Using statistical analysis of random error of data measurement, explain how probable error in measurement can be obtained. [6]
- b) Explain loading effect in the context of potentiometer. Also describe the method to minimize this effect. [6]
- c) A Piezoelectric pressure transducer having a charge sensitivity of $2 \times 10^{-12} C/N$ is connected to a charge amplifier, the gain being set to 5mv/pc. The amplifier output is connected to an ultraviolet chart recorder whose sensitivity is 25 mm/V. Determine the overall sensitivity and deflection of the chart due to a force of 500 N. [4]
3. a) Define transducer with example. Explain the working principle strain gauge and derive the expression for gauge factor. [6]
- b) What is an Instrumentation Amplifier and derive the expression for its gain. [6]
- c) A Barium Titanate piezoelectric pickup has dimensions of $12 \text{ mm} \times 12 \text{ mm} \times 3 \text{ mm}$ and a voltage sensitivity of 0.015 Vm/N . Relative permittivity and modulus of elasticity for Barium Titanate is 1400 and $10 \times 10^{10} \text{ N}$. If the force applied is 20 N, determine: output voltage, strain, charge sensitivity, charge generated. [4]
4. a) State and explain Nyquist criterion. Also explain the phenomenon aliasing and the way to eliminate it. [6]
- b) Explain how analog to digital conversion can be achieved by using Dual Ramp ADC. [6]
- c) Consider a 6 bit DAC with a resistance of $320 \text{ k}\Omega$ in LSB position. The converter is designed with WRN. The reference voltage is 10v, the output of the resistive network is connected to an operational amplifier with a feedback resistance of $5 \text{ k}\Omega$. What is the analog output for a binary input of 111010? [4]
5. a) Describe the construction and working principle of a single phase induction type energy meter. Show that the total number of revolution made by disc during particular time is proportional to the energy consumed. [8]
- b) Show how the instrument transformers are used to measure high voltage and high current. [8]

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

Subject: - Instrumentation I (EE 552)

- ✓ 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 block diagram of instrumentation system and briefly describe its components. Also illustrate two examples of instrumentation system. [5+1]
2. a) What do you mean by resolution of instrument? A moving coil galvanometer has a uniform scale with 100 divisions and gives full scale reading of 200V. The instrument can read upto $\frac{1}{5}$ th of a scale division with fair degree of certainty. Determine the resolution of instrument in volts. [1+3]
 - b) Explain about possible error in measurement system with their corresponding corrective measures. [6]
 - c) A 1000 Hz bridge has following constants: [6]

Arm AB: $R = 1000 \Omega$ in parallel with $C = 0.5 \mu F$

Arm BC: $R = 1000 \Omega$ in series with $C = 0.5 \mu F$

Arm CD: $R = 2000 \Omega$ in series with $L = 30mH$

(i) Find the constants of arm DA to make the bridge balanced.

(ii) Express the result as a pure resistor (R) in parallel with a pure capacitor (C) or a inductor (L).
3. a) Introduce transducer and describe briefly about any one resistive transducer. [4]
 - b) A capacitive transducer is made up of two concentric cylinder electrodes. The outer diameter of inner cylinder electrode is 3 mm and dielectric medium is air. The inner diameter of the outer electrode is 3.1 mm. Calculate the dielectric stress when a voltage of 100V is applied across the electrodes. The length of electrode is 20 mm. Calculate the change in the capacitance if the inner electrode is moved through a distance of 2 mm. The breakdown strength of air is 3 KV/mm. [6]
 - c) A strain gauge is bonded to a beam which is 12 cm long and has a cross-sectional area of 3.8 cm^2 . The unstrained resistance and gauge factor of the strain gauge are 220Ω and 2.2 respectively. On the application of load, the resistance of the gauge changes by 0.015Ω . If the modulus of elasticity for steel is 207 GN/m^2 . Calculate: [6]
 - (i) The change in length of the steel beam
 - (ii) The amount of force applied to the beam
 4. a) What is an operational amplifier? Mention its ideal characteristics and applications. [4]
 - b) Describe about Instrumental amplifier. [6]
 5. a) Differentiate Analog and Digital signal. Explain why ADC and DAC conversion is performed. [4]
 - b) Explain working of R-2R ladder DAC. What is its advantage over WRN? [6]
 6. a) What is sampling and sampling theorem? find the sampling frequency for input: [3+2]

$$v(t) = 200 \sin 50\pi t + 100 \sin 200\pi t - 50 \cos 600\pi t$$
 - b) Describe about Data Acquisition system. [5]
 7. a) Explain about single phase Energy meter with a neat construction diagram and working. Why is it called an integrating instrument? [8]
 - b) What is instrument transformer and why is it required? Explain why the secondary winding of current transformer should never be open circuited while primary winding is still energized. [4]

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

Subject: - Instrumentation I (EE 552)

- ✓ 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 measurement and measurement system. Briefly explain different components of measurement system. Also explain difference between analog and digital system. [8]
- b) Explain different errors which may occurs in any measurement system and the method to minimize them. [8]
2. a) Derive balanced condition for AC. Bridge circuit. [4]
- b) Explain how both magnitude and direction of displacement can be measured with the help of linear variable differential transformer. [8]
- c) A potentiometer has a resistance of $5 \text{ k}\Omega$ and is rated at 3W. What is maximum allowable excitation voltage? Calculate the sensitivity and resolution if the length of the potentiometer is 0.1 m and there are 200 turns. Also calculate the percentage loading error at 0.65 of the travel if a meter of $5 \text{ k}\Omega$ is connected across the potentiometer. [4]
3. a) How do Hall effect sensor work? Also explain why this effect is more pronounced in the case of semiconductor than in metal. [6]
- b) Explain the ideal characteristics of Op-amp. Also prove that if a d.c. voltage is applied to an integrator, it produce a ramp-voltage. [6]
- c) In order to measure the strain in a cantilever beam, a single strain gauge of resistance $1 \text{ k}\Omega$ and gauge factor 5 is mounted on the beam and connected to one arm of the bridge circuit. The other arms of the bridge have a resistance of 1000Ω each. The bridge detector resistance is 200Ω and its sensitivity is $20 \text{ mm} / \mu\text{A}$. Calculate the detector deflection for 0.1% strain. The supply to the bridge is 50 V. [4]
4. a) Explain how data is transfer in optical fiber communication system and mention the advantages of optical fiber communication system. [6]
- b) Explain how digital to analog conversion can be achieved by using weighted Resistor network DAC. Also mention its drawbacks. [6]
- c) An 6 bit converter has maximum supply voltage of 12 V. Find:
 - (i) What voltage change does LSB represent?
 - (ii) What voltage does 101011 represent? [4]
5. a) Explain the construction detail and operating principle of a single phase induction type energy meter. [6]
- b) What is aliasing and how can it be avoided? [4]
- c) Explain the features of instrumentation amplifier and derive the expression for its gain. [6]

TRIBHUVAN UNIVERSITY
 INSTITUTE OF ENGINEERING
Examination Control Division
 2078 Chaitra

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

Subject: - Instrumentation I (EE 552)

- ✓ 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 measurement and measurement system. Draw the block diagram of measurement system showing each component of measurement system and also explain the functions of each block. [2+4]
- b) Using statistical evaluation of random errors or data of measurement, explain how probable error in a measurement can be obtained. [6]

Find out the probable error of the observation given in table below

Current readings in ampere	Number of readings
9.97	1
9.98	3
9.99	13
10.00	23
10.01	15
10.02	4
10.03	1

- c) If a voltmeter having accuracy of 1% and full scale range 100V is used to measure 80V and 12V. Calculate the possible percentage error of both readings. Comment on your answer. [4]
2. a) Explain how the nonlinear characteristics of a capacitive transducer used for the measurement of displacement using the principle of change in capacitance due to change in distance between plates can be made linear. [6]
- b) Explain the construction and working principle of a linear variable differential transformer. [6]
- c) A resistance gauge is used to measure stress on steel. The steel is stressed to 1400 Kg/m^2 . Assume Young's modulus of elasticity of steel is $2.1 \times 10^6 \text{ Kg/cm}^2$. Calculate the % change of resistance of a strain gauge and poison's ratio assuming gauge factor equal to 2. [4]
3. a) Why signal conditioning is done in instrumentation system? Derive the expression for closed loop gain of op-amp in inverting mode. Also explain ideal characteristics of an operational amplifier. [6]
- b) Explain the features of instrumentation amplifier and derive the expression for its gain. [6]
- c) Determine the thermoelectric sensitivity and emf developed in a thermocouple made of Cu and Const for a temperature of 60°C between its junctions. Given that thermoelectric emf of Cu and Const against Pt are $7.4 \mu\text{V}/^\circ\text{C}$ and $-34.4 \mu\text{V}/^\circ\text{C}$ [4]

4. a) Using flowchart diagram, example the working of successive approximation ADC. What will be 4-bit, digital output for the analog impute of 3.217 V if $E_R = 5V$, using successive approximation ADC? [6]
- b) What is data acquisition system? Explain the function and objective of each component of a digital data acquisition system. [6]
- c) An 8-bit DAC has reference voltage of 12V. Find the minimum value of resistance R such that the output current doesn't exceed 10mA if it uses i) WRN DAC ii) R:2R ladder network DAC. Also, find the smallest value of the quantized current in both cases. [4]
5. a) Explain the working principle of dynamometer type wattmeter and also prove that the deflection torque is directly proportion to power consumed by the load in both ac and dc circuit. [8]
- b) Explain the working principle of instrument transformer. Also explain why the secondary winding of current transformer should never be kept open circuited while primary is energized? [8]

TRIBHUVAN UNIVERSITY
 INSTITUTE OF ENGINEERING
Examination Control Division
 2078 Baishakh

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

Subject: - Instrumentation I (EE 552)

- ✓ 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 types of errors which may occur in any measurement system. Also explain the methods to minimize them. [6]
- b) Show that Hay's Bridge can be used to measure the value of unknown inductance of a coil having high Quality Factor. Also derive expression for unknown inductor. [6]
- c) A voltmeter whose accuracy is 2% of the full scale reading is used on its 0-50V scale. It is used to measure a voltage of 15V and 42V. Calculate the possible error of both readings. Comment on your answer. [4]
2. a) Explain the construction and working principle of Linear Variable Differential Transformer. [6]
- b) What is piezo electric transducer? What are the materials used in such transducer? Define voltage sensitivity, charge sensitivity and derive the expression for the output voltage developed due to applied force. [6]
- c) Design an integrator circuit which will produce a ramp voltage of -50V/ms. [4]
3. a) Explain the "loading effect" on input-output relationship in measurement made by a potentiometer. How can the error due to loading be minimized? [6]
- b) Explain ideal characteristics of operation amplifier. Also explain different application of operational amplifier in measurement system. [6]
- c) What is aliasing? Also explain how it can be eliminated. [4]
4. a) Explain how analog to digital conversion is achieved by using Dual Ramp ADC. [6]
- b) Explain briefly optical fiber communication system and also mention advantages of it. [6]
- c) Describe in detail the successive approximation method of analog to digital (A/D) conversion taking an example of 4-bit converter having full range of 5V and input voltage of 3.271v. [4]
5. a) Describe the constructional details and working of a ferro-dynamic type of frequency meter for the measurement of frequency. [8]
- b) Explain the working principle of instrument transformer. Also explain why the secondary winding of current transformer should never be kept open while primary is energized? [8]

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

Subject: - Instrumentation I (EE 552)

- ✓ 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 how probable error can be calculated with the help of statistical analysis in a measurement system. [6]
 - b) Explain the difference between static and dynamic characteristics of measurement system. Also explain following static performance parameter. [6]
 - (i) Accuracy
 - (ii) Precision
 - (iii) Sensitivity
 - c) Following reading were obtained in respect of a capacitor: $1.003\mu F$, $0.998\mu F$, $1.001\mu F$, $1.009\mu F$, $1.005\mu F$, $0.991\mu F$, $0.996\mu F$, $0.997\mu F$, $1.008\mu F$, & $0.994\mu F$. Calculate: [4]
 - (i) Arithmetic mean
 - (ii) Deviation from mean
 - (iii) Standard deviation
 2. a) Explain how the liquid level can be measured by using capacitive sensor. [6]
 - b) Define transducer with example. Explain the working principle of strain gauge and derive the expression for the gauge factor. [6]
 - c) A linear resistance potentiometer is 50mm long and is uniformly wound with a wire of total resistance of $20k\Omega$. Under normal conditions, the slider is at the center of the potentiometer. Determine the linear displacement when the resistance of the potentiometer, as measured by wheatstone bridge are 1550Ω and 5600Ω . Are the two displacements in the same direction? If it is possible to measure a minimum value of $10k\Omega$ resistance with the above arrangement, determine the resolution of the potentiometer in mm. [4]
 3. a) Explain how both direction & magnitude of the displacement can be measured with help of linear variable differential transformer. [6]
 - b) Describe the circuit of 3 amplifier configuration of an instrumentation amplifier. Also derive the expression for output voltage in terms of two input voltage. [6]
 - c) Hall effect element is used for the measurement of magnetic flux of $0.8Wb/m^2$. The thickness of element is 2.5mm. If the current passed through the element is $5A$, calculate the Hall emf developed. Given that $K_H=5\times 10^{-7}$. [4]
 4. a) Explain how analog to digital conversion is achieved by using ramp ADC. [6]
 - b) What are the drawbacks of weighted resistor network? With suitable diagram explain the R-2R ladder digital to analog converter. [6]
 - c) Given 12-bits, 10v successive approximation ADC that has $20\mu s$ conversion time and is used without sample and hold circuit. Find the maximum rate of change of input signal and its maximum frequency that can be applied. [4]
 5. a) Explain the working principle of dynamometer type wattmeter and also prove that the deflection torque is directly proportion to power consumed by the load in both a.c. and d.c. circuit. [8]
 - b) What is Data Acquisition system? Also explain the different component of analog data-acquisition system. [8]

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

Subject: - Instrumentation I (EE 552)

- ✓ 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 Instrumentation system with example. Explain the main elements of measurement system with the help of block diagram. [6]
- b) Differentiate between static and dynamic performance parameter with describing each parameter in brief. [4]
- c) A 1000 Hz bridge has the following constants: [6]
 - Arm AB: $R=1000\Omega$ in parallel with $C=0.5\mu F$
 - Arm BC: $R=1000\Omega$ in parallel with $C=0.5\mu F$
 - Arm CD: $R=200\Omega$ in parallel with $L=30mH$
 Find the constants of Arm DA to balance the bridge express the result as a pure R in parallel with a pure C or L.
2. a) Explain how magnitude & direction of displacement can be measured using inductive sensor. [6]
- b) Explain working principle of capacitive sensor. Also explain how linear relation between output & input can be obtained in the case of capacitive sensor working on the principle of change in separation distance. [6]
- c) A strain gauge is bonded to a beam which is 12cm long & has a cross-sectional area of $3.8cm^2$. The unstrained resistance & gauge factor of the strain gauge are 220Ω & 2.2 respectively. On the application of load, the resistance of the gauge changes by 0.015Ω . If the modulus of elasticity for steel is 207 GN/m^2 , calculate (i) the change in length of the steel beam. (ii) the amount of force applied to the beam. [4]
3. a) Explain the ideal characteristics of operational amplifier & derive the expression for closed loop gain in non-inverting mode. [6]
- b) Explain the "loading effect" on input-output relationship in measurement made by a potentiometer. How can the error due to loading be minimized? [6]
- c) A capacitive transducer is made up of two concentric cylindrical electrodes. The outer diameter of inner cylindrical electrode is 3 mm and the dielectric medium is air. The inner radius of the outer electrode is 3.1mm. Calculate the dielectric stress when a voltage of 100V is applied across the electrodes. Is it within safe limit? The length of electrode is 20mm. Calculate the change in capacitance if the inner electrode is moved through a distance of 2mm. the breakdown strength of air is 3KV/mm. [4]
4. a) Explain the method of Digital-Analog conversion using R-2R ladder network. Why do we prefer to use this DAC instead of WRN type, explain. [6]
- b) What is data acquisition system. Explain function of the different components of digital data acquisition system. [6]
- c) An 8 bit DAC has maximum supply voltage 12V. Find
 - i) What voltage change does LSB represent?
 - ii) What voltage change does MSB represent?
 - iii) What voltage does 10111100 represent?
[4]
5. a) State and explain Sampling theorem. What is aliasing? Define the terms analog signal and discrete signal. [8]
- b) Write short notes on:
 - i) Frequency meter
 - ii) Instrument transformer
[2 x 4]



Exam.	Level	Full Marks	Regular
Programme	BEL, BEX, BCT	Pass Marks	80
Year / Part	II / II	Time	3 hrs.

Subject: - Instrumentation I (EE552)

- ✓ 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 the difference between static and dynamic characteristics of measurement system. Also explain following static performance parameter. [6]

- i) Accuracy
- ii) Precision
- iii) Sensitivity
- iv) Resolution
- v) Linearity

b) Explain quality factor in Maxwell's bridge. Why Maxwell bridge cannot be used for the measurement of inductance having quality factor less than 1 and greater than 10 ($1 \leq Q \leq 10$). [6]

c) An AC bridge has following constants

Arm AB, $R = 1000 \Omega$ in parallel with $C = 0.5 \mu F$

Arm BC, $R = 3000 \Omega$

Arm CD, unknown capacitance C_x in series with R_x

Arm DA, $C = 0.55 \mu F$

Supply frequency 1000HZ

Determine the unknown resistance R_x and capacitance C_x to make the bridge balance. [4]

2. a) Discuss the methods to reduce loading effect in a Potentiometer. Also prove that linearity and sensitivity of potentiometer is two conflicting requirements. [6]

b) Explain how the nonlinear characteristics of a capacitive transducer used for the measurement of displacement using the principle of change in capacitance due to change in distance between plates can be made linear. [6]

c) A rotatory POT having 100 turns and total resistance of 1000Ω is made up of wire of 1 meter length. It has the power limit of 10 watt. Calculate the maximum excitation voltage that can be applied to the POT. Also calculate the resolution (in volts) of the potentiometer under that maximum excitation. [4]

3. a) Explain the working principle of Piezo-electric sensor and derive the expression for the output voltage in the piezo-electric Sensor. [6]

b) What are the characteristics of an ideal operational amplifier? Derive the expression for close loop gain of operational amplifier in inverting and non-inverting mode. [6]

c) Design an integrator circuit which will produce a ramp voltage of $-20V/ms$. [4]

4. a) Explain how analog to digital conversion can be achieved by using dual Ramp ADC. [8]
- b) A 6-bit DAC has $20\text{ k}\Omega$ resistance in MSB position. The converter is designed with weighted resistor network. The reference voltage is 12 V. The output of the resistive network is connected to an op amp with a feedback resistance of $5\text{ k}\Omega$. What will be the analog output for a binary input of 111010? [8]
5. a) State and explain Nyquist criterion. Also explain the phenomenon of aliasing and the way to eliminate it. [4]
- b) Explain the function of sample and hold circuit with the help of circuit diagram. [6]
- c) Explain the construction and working of single phase electrodynamic wattmeter with expression for ac operation. [6]

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

Subject: - Instrumentation I (EE552)

- ✓ 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) Sketch basic blocks of a generalized measurement system. Write function of each block. [6]
- b) Explain analog and digital modes of operation. Why digital instruments are becoming popular now? [4]
- c) An AC bridge circuit is working at 1000 Hz. Arm AB has $0.2 \mu\text{F}$ pure capacitance, arm BC has 500Ω pure resistance, arm CD contains an unknown impedance and arm DA has 300Ω resistance in parallel with $0.1 \mu\text{F}$ capacitor. Find the constant of arm CD considering it as a series circuit. [6]
2. a) What are the different parameters to define the static performance of an instrument? Distinguish between accuracy and precision of an instrument with a suitable example. [6]
- b) A strain gauge is bonded to a beam which is 12 cm long and has a cross sectional area of 3.8 cm^2 . The unstrained resistance and gauge factor of the strain gauge are 220Ω and 2.2 respectively. On the application of load the resistance of the gauge changes by 0.015Ω . If the modulus of elasticity for steel is 207 GN/m^2 , calculate [4]
 - (i) the change in length of the steel beam
 - (ii) the amount of force applied to the beam.
- c) Explain the working principle of a thermocouple for measuring temperature. State different laws associated with it. [6]
3. a) Explain the principles of operation of capacitive sensor. Also explain how linear relation between output and input can be obtained when capacitive sensor works on the principle of change in separation distance. [6]
- b) Explain the features of instrumentation amplifier and derive the expression for its Gain. [6]
- c) State and explain sampling theorem. [4]
4. a) A 6 bit DAC has a reference voltage of 11 volts if it uses [4]
 - (i) R-2R ladder network.
 - (ii) Weighted resistive network.

Find the minimum value of resistance in both cases such that the output current does not exceed 10mA.
- b) What are the drawbacks of weighted resistor network? With suitable diagram explain the R-2R ladder digital to analog converter. [6]
- c) What is the purpose of using a S/H circuit in A/D conversion system. Explain its operation along with basic circuit and characteristic waveform. [6]

5. a) Describe the construction and working principle of a single phase induction type energy meter. Show that the total number of revolution made by disc during particular time is proportional to the energy consumed.
- b) Explain the working principle of instrument transformer. Also explain why the secondary winding of current transformer should never be kept open circuited while primary is energized?

[8]

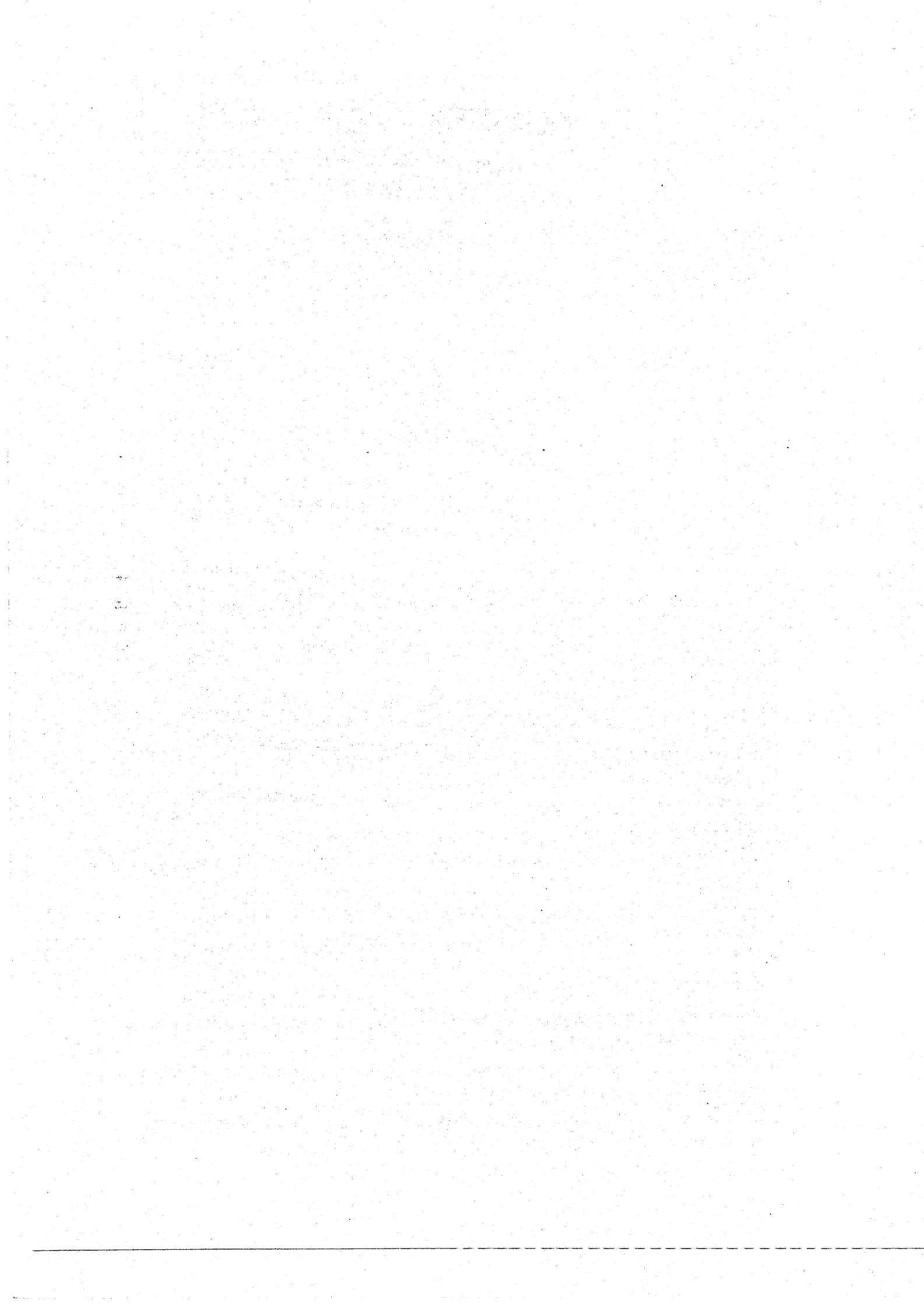
[8]

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

Subject: - Instrumentation I (EE552)

- ✓ 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 an instrumentation system, explain the function of each of its component with the help of a block diagram? [6]
- b) The wire in a strain gauge is 0.1 m long and has an initial resistance of 120Ω . On application of a force the wire length increases by 0.1 mm and resistance increases by 0.21Ω , determine the gauge factor of the device. [4]
- c) How do you define error in a measurement system? How the Gaussian curves can be used to explain the normal distribution of random errors in a measurement. Also state the properties of the curve. [6]
2. a) Explain how magnitude and direction of displacement can be measured with the help of inductive sensor. [6]
- b) What do you mean by piezoelectric effect? Explain how this effect can be the design basis of piezoelectric pressure transducer. Define voltage sensitivity and charge sensitivity. Give its equivalent circuit and derive the expression for the output voltage by making suitable assumptions. [6]
- c) A linear resistance potentiometer is 50 mm long and is uniformly wound with a wire of total resistance 5000Ω . Under normal conditions, the slider is at the centre of the potentiometer. Determine the linear displacement when the resistance of the pot as measured by a wheatstone bridge is 1850Ω . If it is possible to measure a minimum value of 5Ω resistance with the above arrangement determine the resolution of the pot in mm. [6]
3. a) Why signal conditioning is done in instrumentation system? Derive the expression for closed loop gain of op-amp in inverting mode. Also explain ideal characteristics of operational amplifier. [6]
- b) Design an integrator circuit which will produce a ramp voltage of -20 V/msec . [4]
- c) Draw the block diagram of optical fiber communication system and write advantages of it. [6]
4. a) Explain how analog to digital conversion is achieved by using Dual Ramp ADC. [6]
- b) Explain the operation of sample and hold circuit. Also explain aperture time and acquisition time of the circuit. [6]
- c) What will be a 4-bit successive approximation digital output for an analog input of 4.287V if full range of converter (ER) is 5V ? [4]
5. a) What is wattmeter? Write its types. Explain the wattmeter which can measure ac as well as dc power with the help of construction and working principle. [8]
- b) What is data acquisition system? Explain the function of different component of digital data acquisition system. [8]



32 TRIBHUVAN UNIVERSITY
 INSTITUTE OF ENGINEERING
Examination Control Division
 2073 Bhadra

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

Subject: - Instrumentation I (EE552)

- ✓ 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) Point out the difference between analog and digital measurement system. Explain the functional elements of an Instrumentation system with block diagram. [6]
- b) Explain different types of errors in measurement with their remedies. [6]
- c) A capacitive transducer uses two quartz diaphragm of area 600 mm^2 separated by a distance of 2.5 mm. A pressure of $8 \times 10^5 \text{ N/m}^2$, when applied to the top diaphragm causes a deflection of 0.5 mm. The capacitance is $400 \times 10^{-12} \text{ F}$ when no pressure is applied to the diaphragm. Determine the value of capacitance after the application of $8 \times 10^5 \text{ N/m}^2$. [6]
2. a) Explain how can the response of capacitive transducer, which works on the principle of variation of capacitance with displacement between two plates, be made linear. Also give the sensitivity of such an arrangement. [4]
- b) Show that Hay's Bridge can be used to measure the value of unknown inductance of a coil having high quality factor. [6]
- c) Determine the thermo electric sensitivity and emf developed in a thermocouple made of copper and constantan for a temperature of 50°C between its junction. Given that thermo electric emf of copper and constantan against platinum are $7.4 \mu\text{V}/^\circ\text{C}$ and $-34.4 \mu\text{V}/^\circ\text{C}$ respectively. [6]
3. a) Derive voltage gain of 3 Op-Amp Instrumentation amplifiers. Write the advantages of fiber optical communication. [4]
- b) Explain how A/D conversion can be achieved by using dual slope analog to digital converter. [6]
- c) The basic step of a 9 bit DAC is 10.3 mV (000000000) represents 0V, what O/P is produced if the input is (10110111)? [6]
4. a) Describe the constructional details and working of a ferro dynamic type of frequency meter for the measurement of frequency. [4]
- b) Draw the block diagram of Digital Data Acquisition System (DAS). Explain each block briefly. Differentiate analog DAS and digital DAS in terms of their scope. [8]
5. a) Explain the requirement of a sample and hold circuit. Explain its operation and discuss its characteristic waveform to illustrate its specifications. [6+2]
- b) Explain ideal characteristics of operational amplifier. Also explain different application of operational amplifier in measurement system. [8]

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

Subject: - Instrumentation I (EE552)

- ✓ 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 an instrumentation system? Explain its different components with the help of a block diagram. [6]
- b) What is random error? Which method do you think is the most appropriate to find its distribution among a given set of data, make a complete analysis and hence define probable error. [6]
- c) The output of an LVDT is connected to a 5V-voltmeter through an amplifier whose amplification factor is 250. An output of 2 m V appears across the terminals of LVDT when core moves through a distance of 0.5 mm. calculate the sensitivity of LVDT and that of whole set-up. The milli-voltmeter scale has 100 divisions. The scale can be reads to 1/5 of divisions. Calculate the resolution of the instrument in mm. [4]
2. a) Explain the principle of operation of an inductive transducer used for the measurement of linear displacement. Why differential arrangement of such a transducer is required? [8]
- b) "Maxwell's bridge is not suitable for the measurement of high Q-coils", verify the statement and draw and explain the modified bridge which can measure the inductance of high Q-coils. [8]
3. a) Explain the construction and working of a megger used for the measurement of high resistance. [4]
- b) Describe how digital to analog conversion is achieved by using the R-2R ladder network. How this DAC over comes the limitations of WRN type of DAC? [8]
- c) An analog to digital converter having an input of (0-8)V is able to distinguish a change of 10.3 mv in its input signal, calculate:
 - i) The number of bits
 - ii) What voltage change does each LSB represent
 - iii) What voltage does IMSB represent
[4]
4. a) Explain the working principle of dy-nanometer type, wattmeter and also prove that the deflection torque is directly proportion to power consumed by the load in both a.c. and d.c. circuit. [8]
- b) What do you understand by a Data Acquisition system? Explain with a neat sketch, the role of multiplexer in a DAS. [8]
5. a) What do you understand by sample and hold circuit. Explain its functioning with the help of circuit diagram. [6]
- b) Explain the working and application of OP-amp as
 - i) an integrator
 - ii) a differentiator and
 - iii) a subtractor
[6]
- c) A piezoelectric pressure transducer having unknown charge sensitivity is connected to a charge amplifier, the gain being set to 5 mv/PC. The amplifier output is connected to an ultraviolet chart recorder, whose sensitivity is set to 25 mm/volt. Determine the sensitivity of the piezoelectric transducer if deflection of chart recorder is 100 mm due to a pressure of 300 N. [4]

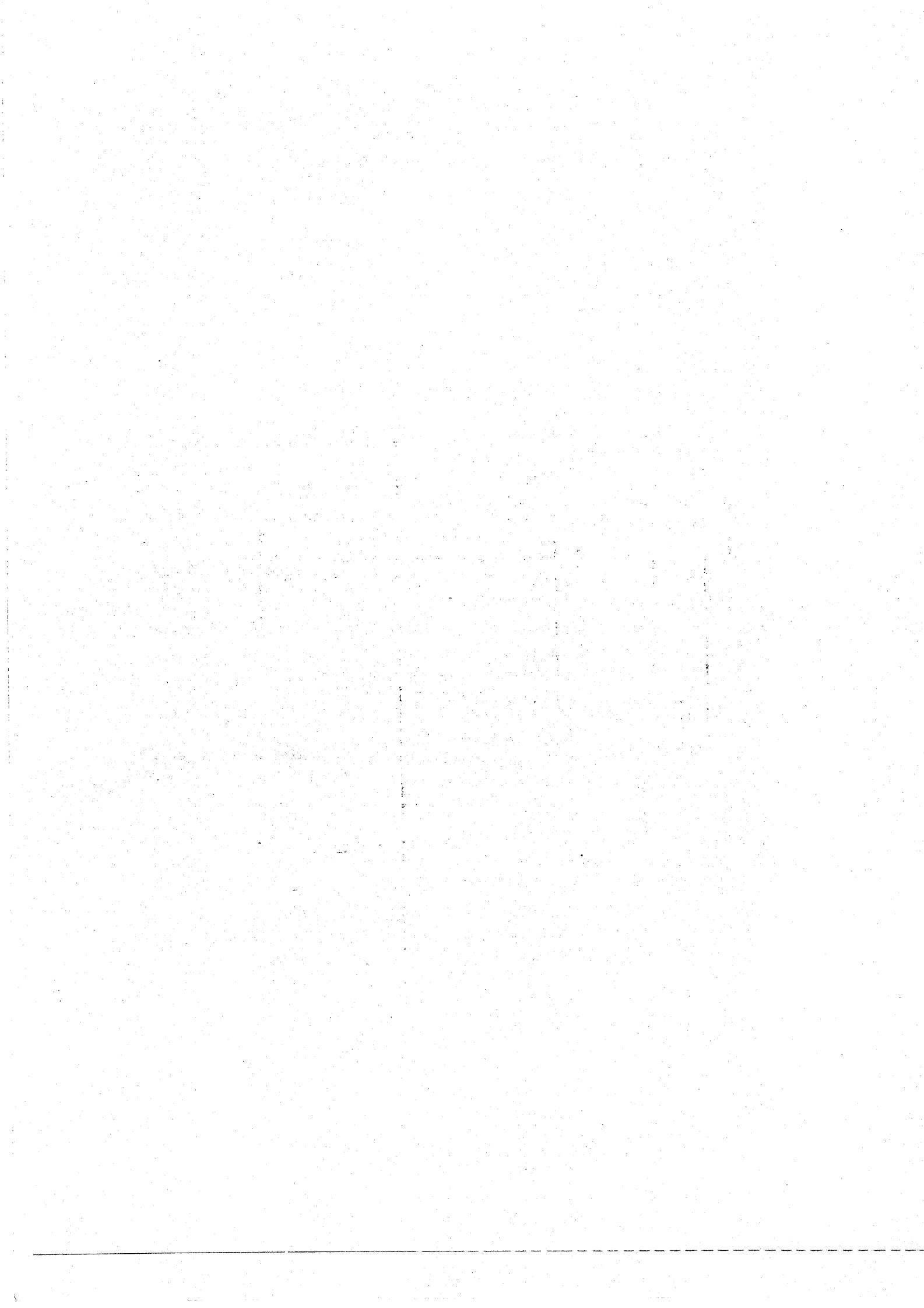
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2072 Ashwin

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

Subject: - Instrumentation I (EE552)

- ✓ 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. a) Distinguish between static and dynamic characteristic of a measurement system. Define the various parameter used to study these characteristics.
b) How an unknown inductance can be measured from Maxwell's Bridge circuit and Hay's Bridge circuit. Why these different bridge circuits are used for measurement of unknown inductance instead of using single Bridge circuit, Explain.
2. a) Define transducer with example. Explain the working principle of strain gauge and derive the expression for the gauge factor.
b) A barium titanate pickup has the dimensions of $5\text{mm} \times 5\text{mm} \times 1.25\text{mm}$. The force acting on it is 5N . The charge sensitivity of barium titanate is 150pC/N and its permittivity is $12.5 \times 10^{-9} \text{ F/m}$. If the modulus of elasticity of barium titanate is $12 \times 10^6 \text{ N/m}^2$, calculate the strain. Also calculate the charge and the capacitance.
3. a) Explain ideal characteristics of operational amplifier. Also explain different applications of operational amplifier in measurement system.
b) Explain how data can be transferred by Optical Fiber Cable and write advantages of optical fiber communication.
4. a) What are the advantages of inverted R-2R DAC over others DAC? Derive its output expression for R-2R DAC.
b) What will be 6 bit successive approximation digital output of the analog input 6.127 V if V_R is 8V ?
5. a) Explain the operating principle of electrical resonance type frequency meter in detail.
b) Show how the instrument transformers are used to measure high voltage and current. And also explain why the secondary of current transformer should not be kept open circuited while primary is energized.

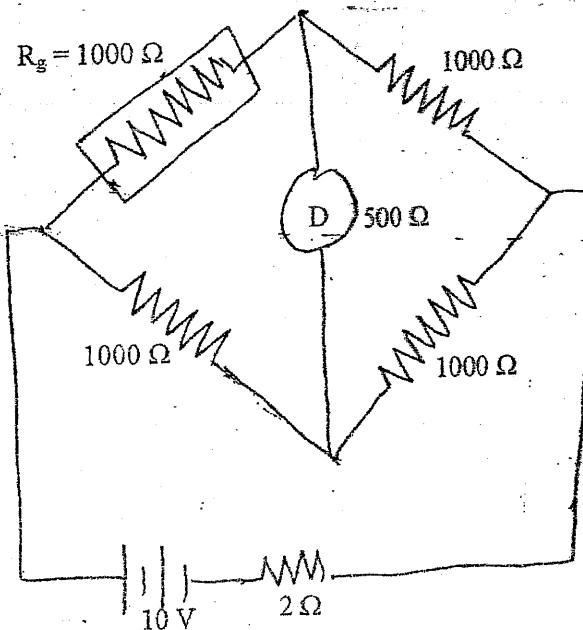


New Back (2066 & Later Batch)			
Exam.	BE	Full Marks	80
Level	BEL, BEX, BCT	Pass Marks	32
Programme			
Year / Part	I / II	Time	3 hrs.

Subject: - Instrumentation I (EE552)

- ✓ 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. a) Discuss different errors in measurement system and the methods to minimize them. [8]
 b) Differentiate between analog and digital measurement system. [4]
- c) A voltmeter whose accuracy is 2% of the full scale reading is used on its 0-50V scale. It is used to measure a voltage of 15 V and 42 V. Calculate the possible error of both readings. Comment on your answer. [4]
2. a) What is piezoelectric transducer? Define the voltage sensitivity and charge sensitivity. Give the equivalent circuit for piezoelectric transducer. Derive the expression for the output voltage by making suitable assumptions. [6]
- b) A capacitive transducer is made up of two concentric cylindrical electrodes. The length of electrodes is 0.025 m, the inner diameter of the outer cylindrical electrode is 4.2 mm and the outer diameter of inner cylindrical electrode is 4.0 mm. Assume air medium. Determine the change in capacitance for a displacement of the inner electrode of 0.0025 m. Determine also the electric stress when a voltage of 150 V is applied across the electrodes. [4]
- c) What is Linear variable differential transformer (LVDT). Point out its merits and demerits. [6]
3. a) Explain the loading effect on a potentiometer and explain the effect of load resistance on the Linearity of the potentiometer. Also show that the error occurs at the mid-point of the potentiometer. [8]
- b) A strain gauge is connected in the bridge circuit shown in figure below. Find the deflection in the detector for a applied strain of 0.5%, if the detector has a sensitivity of $10 \text{ mm}/\mu\text{A}$ and an internal resistance is 500Ω . The guage factor of strain guage is 2. [8]



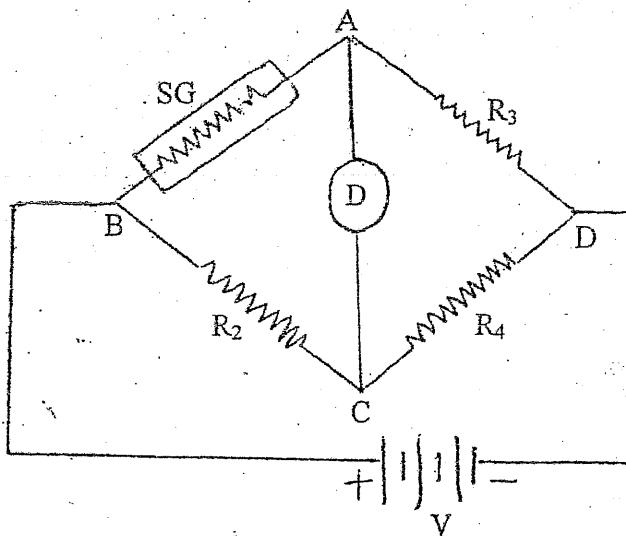
4. a) Describe at least two methods of analog to digital conversion. [8]
- b) Derive maximum allowable rate of change of input and maximum allowable frequency to the n bit ADC. [4]
- c) The basic step of a 9 bit DAC is 10.3 mV. If (000000000) represent OV, what output is produced if the input is (101101111)? [4]
5. a) What is meant by sampling? Define the terms analog signal, discrete signal, discrete pulse in instrumentation system. Discuss data acquisition system in brief. [8]
- b) Describe the construction and working principle of a single phase induction type energy meter. Show that the total number of revolutions made by its disc during a particular time is proportional to the energy consumed. [8]

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

Subject: - Instrumentation I (EE552)

- ✓ 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 an instrumentation system? Explain the different components the system possesses, in detail. [8]
- b) What are the different parameters to define the static characteristics of an instrumentation system, explain establish a co-relation between linearity and sensitivity of an instrument with suitable example. [8]
2. a) Explain how the non-linear characteristics of a capacitive transducer, used for the measurement of displacement using the principle of change in capacitance due to change in distance between plates can be made linear. [8]
- b) Obtain the balance equation for an ac bridge and explain with diagram how Schering bridge can be used to measure unknown capacitance. [8]
3. a) Explain how flow rate of conducting fluid can be measured by using electromagnetic flow meter. Also explain disadvantage of d.c. excitation used in it. [8]
- b) A strain gauge of resistance 200Ω and gauge factor 2 is connected in the arm AB of the bridge as shown below. [8]



The resistance of arms CD and DA are 100Ω each. R_2 is adjusted for balance under unstrained condition. The supply voltage to the bridge is 10V connected across BD. Determine the output voltage when a detector of infinite resistance is connected across output terminals and strain is of 500μ strain. Determine the current flowing through the detector for the same strain if resistance of detector is 250Ω .

4. a) State and explain sampling theorem. What is "aliasing" and how can it be avoided? [8]
- b) Explain how A/D conversion can be achieved by using dual slope analog to digital analog. [8]
5. a) Explain the method of D/A conversion using R-2R ladder network. Why do we prefer to use this DAC instead of WRN type, explain. [8]
- b) Explain the working principle of dynamometer type wattmeter and also prove that the deflection torque is directly proportion to power consumed by the load in both a.c. and d.c. circuit. [8]

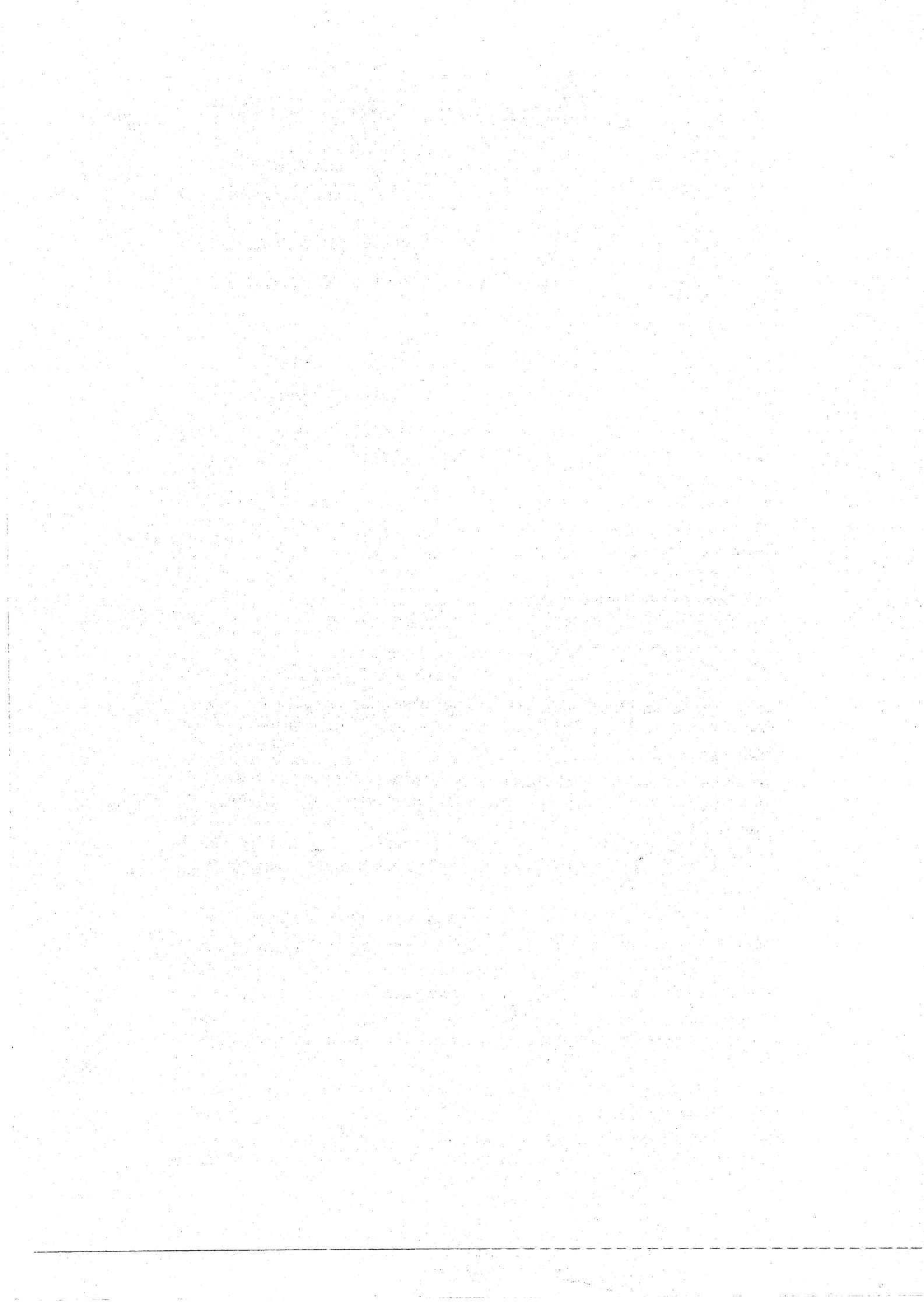
Exam.	New Back (2066 & Later Batch)		
Level	BE	Full Marks	80
Programme	BEL, BEX, BCT	Pass Marks	32
Year / Part	II / II	Time	3 hrs.

Subject: - Instrumentation I (EE552)

- ✓ 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 analog and digital measurement system with the help of their respective block diagrams. [6]
- b) An ac bridge circuit is working at 1000 Hz. Arm AB has $0.2 \mu\text{F}$ pure capacitance, arm BC has 500Ω pure resistance, arm CD contains an unknown impedance and arm DA has 300Ω resistance in parallel with $0.1 \mu\text{F}$ capacitor. Find the constant of arm CD considering it as a series circuit. [10]
2. a) What is loading effect of a potentiometer? Show that the error will be maximum when the slider of the potentiometer is at midpoint of the potentiometer. [8]
- b) Determine the thermoelectric sensitivity and emf developed in a thermocouple made of copper and constantan for a temperature of 50°C between its junction. Given that thermo electric emf of copper and constantan against platinium are $7.4 \mu\text{V}/^\circ\text{C}$ and $-34.4 \mu\text{V}/^\circ\text{C}$ respectively. [4]
- c) Explain how the flow of fluid can be measured by using Hot Wire Anemometers. [4]
3. a) Prove that "Linear relationship between capacitance and separation distance between two plates can be achieved by using differential arrangement". [8]
- b) Describe the construction and working of linear variable differential transformer for the measurement of displacement. [8]
4. a) Show how can an R-2R ladder network be used to generate a binary weighted sequence of current. [6]
- b) Highlight the advantages of optical fiber transmission over conventional data transmission system. [4]
- c) What is an instrumentation amplifier? Derive the expression for its gain. [6]
5. a) Explain the constructional detail and operating principle of a single phase induction type energy meter. [8]
- b) A 3-bit DAC has a voltage range of (0 - 12) V. Calculate the [8]
 - i) weight of LSB
 - ii) weight of MSB
 - iii) exact range of the converter
 - iv) percentage error

If now, the bit of the converter is increased to 6, show by how much amount the error is increased or decreased? Justify your answer.



22 TRIBHUVAN UNIVERSITY
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Exam.	Regular		
Level	BE	Full Marks	80
Programme	BEL, BEX, BCT	Pass Marks	32
Year / Part	II / II	Time	3 hrs.

Subject: - Instrumentation I

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

1. a) Explain different component of measurement system with suitable examples. [4]
- b) A balanced AC bridge has the following constants [6]

arm AB: $R = 1000 \Omega$ in parallel with $C = 0.5 \mu F$
 arm BC: $R = 1000 \Omega$ in series with $C = 0.5 \mu F$
 arm CD: $R = 200 \Omega$ in series with $L = 30 \text{ mH}$

Find the constant of arm CD. Express the result as a pure R in parallel with pure C or L.
- c) Using statistical analysis of random error of data measurement, explain how probable error in measurement can be obtained. [6]
2. a) Explain how can the response of capacitive transducer, which works on the principle of variation of capacitance with displacement between two plates, be made linear. Also give the sensitivity of such an arrangement. [6]
- b) Explain ideal characteristics of operation amplifier. Also explain different application of operational amplifier in measurement system. [6]
- c) A piezo-electric pressure transducer having sensitivity of $4 \times 10^{-12} \text{ C/N}$ is connected to a charge amplifier, the gain being set to 10 mV/pc . The amplifier output is connected to a ultra-violet chart recorder whose sensitivity is set in such a way that the deflection of the chart recorder due to a force of 400 N is 100 mm . Find the overall sensitivity of the device and the sensitivity of the chart recorder. [4]
3. a) Explain how analog to digital conversion can be obtained by using flash ADC. [6]
- b) State and explain Nyquist criterion. Also explain the phenomenon of aliasing and the way to eliminate it. [4+2]
- c) Consider a 6-bit digital to analog converter with a resistance of $20 \text{ K}\Omega$ in MSB position. The converter is designed with weighted resistive network. The reference voltage is 12 V . The output of the resistive network is connected to an operational amplifier with a feedback resistance of $10 \text{ K}\Omega$. What is the analog output for a binary input of 101011? [4]
4. a) Describe the construction and working of a single phase induction type energy meter. Show that the total number of revolutions made by its disc during a particular time is proportional to the energy consumed. [8]
- b) Show how the instrument transformers are used to measure high voltage and current. [4]
- c) The basic step of a 9 bit DAC is 10.3 mV . If (000000000) represents 0 V , what O/P is produced if the input is (101101111)? Write the advantages of R-2R ladder type DAC over WRN type. [2+2]
5. a) List out different types of frequency meter. Explain the constructional detail and working principle of any one of them to measure frequency. [8]
- b) What do you understand by communication of data in an instrumentation system? Explain the principle of optical fibre data communication system and highlight its advantages over conventional data communication system. [8]

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

Subject: - Instrumentation I (EE552)

- ✓ 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) Draw the functional block diagram of an instrumentation system. Explain each block briefly. [6]
- b) Explain how inductance of a coil can be measured using Hay's Bridge. Also explain why this bridge is suitable for the measurement of inductance of coil having high quality factor. [6]
- c) Show how the capacitor transducer can be used to measure the liquid level. [4]
2. a) What is an electrical transducer? How can it be classified? Also explain how direction and magnitude of displacement can be measured with Linear variable differential transformer [LVDT]. [6]
- b) In order to measure the strain in a cantilever beam a single strain guage of resistance 1000Ω and gauge factor 2 is mounted on the beam and connected to arm AB of the bridge circuit. The other arms BC, CD and DA of the bridge have a resistance of 1000Ω each. A.d.c. voltage of 10 V. is applied to terminal AC. Find:
 i) The output voltage across terminal BD for 0.1 percent strain.
 ii) The output voltage across BD for the same strain if a voltmeter having internal resistance 2000Ω is connected across BD. [6]
- c) An operation amplifier is used as in integrator to produce a ramp signal of -10 V/ms . Design the circuit for this. [4]
3. a) Explain the loading effect on the accuracy of a resistance potentiometer transducer when used for the measurement of displacement. Also show that maximum error occurs at the mid-point of the potentiometer. [6]
- b) Explain the purpose and operation of Dual slope ADC with necessary figures. [6]
- c) What is a Data Acquisition system? Draw the block diagram of Digital Data Acquisition System. Explain its operation. [4]
4. a) How can ac power be measured using dynamometer type wattmeter? Explain with the help if its construction and operation in detail. [8]
- b) Explain the purpose of using instrument transformers in measurement. [4]
- c) An analog voltage signal whose highest significant frequency is 1 KHZ is to be digitally coded with a resolution of 0.01% covering a voltage range of 0-10 V. Determine:
 i) Minimum number of bits in the digital code
 ii) Analog value of LSB
 iii) Minimum sampling rate
 iv) Aperture time required for the A/D converter [4]
5. a) Explain the purpose and use of S/H circuit with necessary circuit diagrams. Discuss its various characteristics with the help of waveform associated. [6]
- b) Define precision and resolution in measurement. Explain the working principle of Megger. [6]
- c) Draw the block diagram of optical communication system. Briefly explain each block. [4]

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2081 Ashwin

Exam.	Back		
Level	BE	Full Marks	80
Programme	BEX, BCT, BME, BAM, BIE	Pass Marks	32
Year / Part	II / II	Time	3 hrs.

Subject: - Electrical Machines (EE 554)

- ✓ 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 role of commutator in dc generator? Explain load characteristics of DC series generator. [3+5]
- b) A mild steel ring of 30cm mean circumference has a cross sectional area of 6cm^2 and has a winding of 500 turns on it. The ring is cut through a point so as to provide an air gap of 1 mm in the magnetic circuit. It is found that a current of 4A in the winding, provides flux density of 1T in the air gap. Find:
 - i) The relative permeability of steel.
 - ii) Inductance of the winding.
2. a) Explain how does the auto transformer work. Show that the autotransformer is more economical when the transformation ratio 'k' nearly equals to 1. [3+5]
- b) An 80 KVA, 2000/200 V, 50 Hz single phase transformer has impedance drop of 8% and resistance drop of 4%. Calculate the voltage regulation of transformer at full load at 0.8 pf lagging. Also find the power factor at which voltage regulation will be zero. [4+4]
3. a) Explain torque-slip characteristics of 3-phase induction motor. Why induction motor works only in linear portion of torque slip characteristics? [5+3]
 - b) A dc series motor connected to 440 V supply runs at 600 rpm when taking a current of 50 A. Calculate the value of resistance which when inserted in series with motor will reduce the speed to 400 rpm, the gross torque then being half the previous value. The total series resistance of motor is 0.2 ohm. [8]
4. a) Explain the construction details of synchronous generator. Also explain the role of exciter in it. [6+2]
 - b) With the help of phasor diagram, explain the effect of excitation in a 3-phase synchronous motor. [8]
5. a) How does the rotating magnetic field produce in 3-phase induction motor and how does the rotor rotate in the motor? Define terms slip and slip frequency. [4+2+2]
- b) Write short notes on: (Any Two)
 - i) Stepper motor
 - ii) Reluctance motor
 - iii) Servo motor

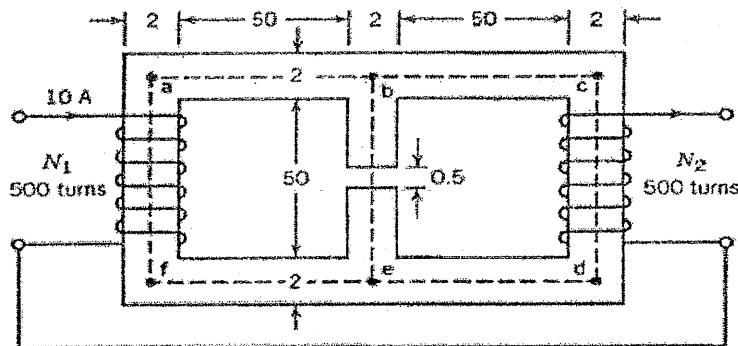
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2080 Chaitra

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BEX, BCT, BME, BAM, BIE	Pass Marks	32
Year / Part	II / II	Time	3 hrs.

Subject: - Electrical Machines (EE-554)

- ✓ 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 Flemings right hand rule? Describe the construction details of DC generator with clear diagram and also derive the emf equation of DC generator. [2+4+2]
- b) State Ohm's law for magnetic circuit. For the given magnetic circuit, neglecting magnetic leakage and fringing, calculate air gap flux, flux density and magnetic field intensity at the air gap. Given that relative permeability of ferromagnetic material is 1200 and all dimensions are in cm. [2+6]



2. a) Why transformer is generally rated in KVA and not in kW? Explain factors affecting the efficiency of transformer with proper mathematical justification and graph. [2+6]
- b) A single-phase transformer working at unity pf has an efficiency of 90% on both half load and at full load of 500kW. Determine:
 - i) iron loss
 - ii) Full load copper loss
 - iii) maximum efficiency
3. a) Describe the working principle of three phase induction generator. Also explain how voltage build up in it. [4+4]
- b) A 230V, dc shunt motor takes 5A at no load. The resistance of the armature and field circuit are 0.25Ω and 115Ω respectively. If the motor is loaded so as to carry 40A, determine:
 - i) iron loss and friction loss
 - ii) Efficiency
4. a) Explain the phenomenon of armature reaction and its effects in three phase synchronous generator for following type of loads:
 - i) Resistive Load
 - ii) Inductive Load
 - iii) Capacitive Load
- b) With the help of phasor diagram, explain the effect of excitation in a 3-phase synchronous motor. [8]

5. a) Derive torque developed by a 3-phase induction motor at running condition. Draw a Torque-slip characteristic and deduce the condition for maximum torque? [5+3]
- b) Write short notes on: (Any Two) [2×4]
- i) Working and application of Stepper motors
 - ii) Resistant start single phase motor
 - iii) Universal motors

Exam.	Back	
Level	BE	Full Marks 80
Programme	BEX, BCT, BME, BAM, BIE	Pass Marks 32
Year / Part	II / II	Time 3 hrs.

Subject: - Electrical Machines (EE 554)

- ✓ 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) "Area of hysteresis loop gives the measure of energy loss per unit volume." Support the statement mathematically. How can hysteresis loss be reduced? [8]
- b) Explain the operation of signal phase transformer when secondary is open circuited with proper mathematical justification. What are instrument transformers? [8]
2. a) Why testing of transformer is necessary? A single phase 5 KVA, 220/400 V, 50 Hz transformer gave the following test results:
 Open circuit Test: 220 V, 2 A, 100 W on LV side
 Short circuit Test: 40 V, 11.4 A, 200 W on HV side
 Calculate the efficiency and approximate regulation of the transformer at full load and 0.9 power factor lagging. [8]
- b) Draw the connection and circuit diagram of dc machines. Explain different characteristics of dc series motors with proper mathematical justifications. [8]
3. a) Explain the operation of dc machine as dc generator with proper mathematics and diagram. Mention the roles of commutator and carbon brushes. [8]
- b) A 4 pole DC shunt motor working on 250V, takes a current of 50A when running on 800 rpm. It is required to increase the speed at 1000 RPM at constant load torque. Suggest the method and solve it. Given that armature and field winding resistance are 0.2Ω and 150Ω respectively. [8]
4. a) Derive the condition for maximum torque of three phase induction motor. Draw the Torque-slip characteristics of induction motor for different supply voltage and for different rotor resistance. [6+2]
- b) 3-phase star connected, 5 MVA, 11KV synchronous generator has resistance of 0.12Ω and synchronous reactance of 2Ω per phase. Calculate voltage regulation if the generator delivers full load at rated terminal voltage at 0.9 lagging p.f. Also find power angle. [4+4]
5. a) Why three phase synchronous motors are not self started? Explain. Write the application of synchronous motor. [8]
- b) Why single phase induction motor is not self starting? Explain the operation and applications of capacitor star and run motor. [4+4]

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BEX, BCT, BME, BAM, BIE	Pass Marks	32
Year / Part	II / II	Time	3 hrs.

Subject: - Electrical Machines (EE 554)

- ✓ 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 the term magneto motive force and magnetizing force for magnetic circuit. A ring has mean diameter of 21 cm and a cross sectional area of 10 cm^2 . The ring is made up of semicircular section of cast iron and cast steel, with each joint having a reluctance equal to an air gap of 0.2 mm. Find the ampere turns required to produce a flux of 0.8 m Wb. The relative permeability of cast steel and cast iron are 800 and 166 respectively. [8]
- b) Explain the no load and loaded operation of single phase ideal transformer. Prove that net magnetic flux in the core is remain constant in any loaded condition. [2+2+4]
2. a) A transformer is rated at 100 KVA. At full load its copper loss is 1200 W and its iron loss is 960 W. Calculate: [8]
 - i) The efficiency at full load and 0.8 p.f. lagging.
 - ii) The load KVA at which maximum efficiency occur and the maximum efficiency.
 b) Why dc shunt generator shall not be started at load? Explain the voltage build up process in dc generator. [8]
3. a) A 200 V dc shunt motor has an armature winding resistance of 0.25Ω and field winding resistance of 100Ω . It draws current of 4A and runs with a speed of 1000 rpm at no-load. When the motor is loaded, its speed drops to 960 rpm. Calculate the current drawn by the motor when loaded and speed regulation. [8]

b) Explain the operation of dc machine as dc motor. Explain electrical and mechanical characteristics of dc shunt motors with proper mathematics. [8]
4. a) Draw the equivalent circuit diagram of three phase induction motor. Explain how the torque is produced in three phase induction motor. [8]

b) Define regulation in an alternator. A 3 phase, 10 KVA, 400V, 50 HZ star connected alternator with a resistance of 0.5Ω and a synchronous reactance of 10Ω per phase delivers full load rated current at a power factor of 0.8 lagging and at normal rated voltage. Find the power angle and voltage regulation. What will be regulation if power factor of load is 0.8 leading? [8]
5. a) What do you mean by excitation control in synchronous motor? How synchronous motor can work both leading and lagging power factor mode? [8]

b) Write short notes on: [2×4]
 - i) Double field revolving theory.
 - ii) Universal motor

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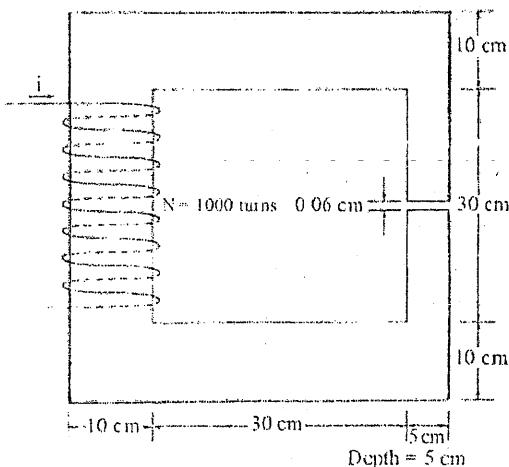
Exam.	Back		
Level	BE BEX, BCT, BME, BAM, BIE	Full Marks	80
Programme	Pass Marks	32	
Year / Part	II / II	Time	3 hrs.

Subject: - Electrical Machines (EE 554)

- ✓ 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 retentivity and coercivity of core using hysteresis loop of a magnetic material used in electrical machine. Prove that energy spent per cycle per unit volume is proportional to the area of loop. [8]

b) A two-legged magnetic core with an air gap is shown in figure below. The depth of the core is 5 cm, the length of the air gap in the core is 0.06 cm, and the number of turns on the coil is 1000. The relative permeability of iron core is 2000. Assume no fringing in air gap. How much current is required to produced an air-gap flux density of 0.5 T? [8]



2. a) What are the different types of losses in transformer? Derive the expression of efficiency of transformer. [8]

b) A 10 kVA, 1000 V / 200 V, 50 Hz, single phase transformer has HV and LV side winding resistance as 1.1Ω and 0.05Ω respectively. The leakage reactances of HV and LV sides are respectively 5.2Ω and 0.15Ω respectively. Calculate (i) the voltage to be applied to the HV side in order to circulate rated current with LV side shorted, (ii) Also calculate the power factor under this condition. [8]

3. a) A shunt generator gives full load output of 30 kW at a terminal voltage of 200 V. The armature and field resistance are 0.05Ω and 50Ω respectively. The iron and friction losses are 1000 watt. Calculate generated voltage, copper losses and efficiency. [8]

b) A 600 V dc shunt motor drives a 60 kW at 750 rpm. The shunt field resistance is 100Ω and armature resistance is 0.16Ω . If motor efficiency is 85%, calculate the speed at no load and speed regulation. [8]

4. a) The power crossing the air gap of a 60 Hz, four-pole induction motor is 25 kW and the power converted from electrical to mechanical form in the motor is 23.2 kW. [6]
- (i) What is the slip of the motor at this time?
(ii) What is the induced torque in this motor?
(iii) Assuming that the mechanical losses are 300 W at this slip, what is the load torque of this motor?
- b) "For a three phase induction motor the rotor speed is always less than synchronous speed." Justify. [4]
- c) What do you mean by V-curve and inverted V-curved for a synchronous motor? Explain with a neat diagram. [6]
5. a) A 1200 kVA, 6600 V, 3-phase star connected stator of a synchronous generator has a armature resistance of 0.4Ω per phase and synchronous reactance of 6Ω per phase. The generator delivers full load current at pf of 0.8 lagging at normal rated voltage. Calculate the terminal voltage for the same excitation and load current at 0.8 pf leading. [8]
- b) Write short notes: (Any Two) [2×4]
- (i) AC Servo motor
(ii) Universal motor
(iii) Double revolving field theory

Exam.	Back	
Level	BE	Full Marks 80
Programme	BEX, BCT, BME, BAM, BIE,	Pass Marks 32
Year / Part	II / II	Time 3 hrs.

Subject: - Electrical Machine (EE 554)

- ✓ 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 the significance of hysteresis loop for ferromagnetic materials used in the electrical machine. Justify that hysteresis power loss is dependent on the volume of core material. [2+6]
- b) What is capacity of transformer? A 150 kVA single phase transformer has an iron loss of 700 W and a full load copper loss of 1800 W. Calculate the copper loss, iron loss, output power and efficiency of transformer at 0.8 power factor lagging when secondary is 25% overloaded. [8]
2. a) Why is iron loss neglected in short circuit test of transformer? A single phase 400/200 V, 50 Hz transformer gave the following test results:
Open circuit Test: 200 V, 1.5 A, 110 W on LV side
Short circuit Test: 30 V, 18 A, 350 W on HV side
Calculate the equivalent circuit parameters referred to primary side and draw the equivalent circuit showing calculated parameters. [2+6]
- b) Why secondary of CT should not be left open? Show that auto transformer is economical when the transformation ratio is very close to unity mentioning its application. [2+6]
3. a) How unidirectional torque is produced in dc machine when armature is supplied by dc source and field winding is supplied by dc current. What are the factors affecting torque produced? [8]
- b) A short shunt compound dc generator supplies a load current of 175 A to a series of parallel heater load whose effective resistance is 1.4Ω . The generator has armature, series and shunt field resistances are 15Ω , 0.1Ω and 100Ω respectively. Calculate emf generated, copper losses and electrical efficiency of generator if carbon brush drop is 2 V per brush. [8]
4. a) What are the condition to be fulfilled for the operation of induction machine as induction generator? Explain with the help of T-S curve. [8]
- b) Why is the starting current very high in dc motor? A 4 pole DC shunt motor working on 250 V, takes a current of 2A when running on 1000 rpm. What will be its speed and percentage speed drop if the motor takes 51 A at certain load. Given that armature and field winding resistance are 0.2Ω and 250Ω respectively. [2+6]
5. a) What is universal motor? Explain its operation and applications. [8]
- b) A 1500 kVA, 6600, 3 phase star connected alternator with a resistance of 0.4Ω and a reactance of 6Ω per phase delivers full load current at a power factor of 0.8 lagging and at normal rated voltage. Calculate the (i) excitation EMF (ii) terminal voltage for same excitation and the load current at 0.8 power factor leading. [8]

Exam.	Back		
Level	BE	Full Marks	80
Programme	BEX, BCT, BME, BAM, BIE	Pass Marks	32
Year / Part	II / II	Time	3 hrs.

Subject: - Electrical Machines (EE 554)

- ✓ 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) An iron ring of 0.15 meter diameter and 0.001 m^2 in cross section with a saw cut 2 mm wide is wound with 300 turns of wire. The gap flux density is 1 Tesla. The relative permeability of the iron is 800. Determine the exciting current and inductance. [8]
- b) How practical transformer is different from ideal one? Explain with phasor diagram the operation of practical transformer when secondary is connected to load. [2+6]
2. a) Explain load characteristics of synchronous generator. Why terminal voltage of a synchronous generator is greater than internal generated emf (E) in case of capacitive load? Explain with the help of armature reaction and phasor diagram. [2+3+3]
- b) A 10 kVA, single phase transformer for 2500/500 at no load has $R_1 = 5.5\Omega$, $X_1 = 12 \Omega$, $R_2 = 0.2 \Omega$, $X_2 = 0.45 \Omega$. Determine the appropriate value of secondary voltage and % voltage regulation at full load, 0.8 pf lagging, when primary applied voltage is 2000 V. Also calculate the power factor for maximum regulation. [6+2]
3. a) Why single phase induction motor is not self-starting? Explain Double Field Revolving theory of single phase motor. [2+6]
- b) A 4 pole, 250 V dc long shunt compound generator supplies a load of 10 kW at rated voltage. The armature, series field and shunt field resistances are 0.1Ω , 0.15Ω and 250Ω respectively. The armature is lap wound with 50 slots, each slot containing 6 conductors. If the flux per pole is 50 m Wb, calculate the speed of generator. What would be the speed of same generator if armature is wave wound? [8]
4. a) Define Rotating magnetic field in three phase induction motor. Explain the Torque-Speed (T-N) characteristics of three phase induction motor. [2+6]
- b) State the importance of back EMF in dc motor. A 240V dc series motor has total resistance of 0.2Ω . When the speed is 1800 rpm, the motor draws a current of 40A. Calculate the value of resistance to be connected in series with the armature so as to limit the speed to 2400 rpm when the line current is 10A. [3+5]
5. a) The power input to a 500 V, 50 Hz, 6-pole, 3-phase induction motor running at 975 rpm is 40 kw. The stator losses are 1 kW and friction loss is 2 kW. Calculate:
 (a) slip (b) Rotar copper loss (c) output HP (d) efficiency [2+2+2+2]
- b) What is hunting in synchronous motor? Explain the loaded operation of three phase synchronous motor. [8]

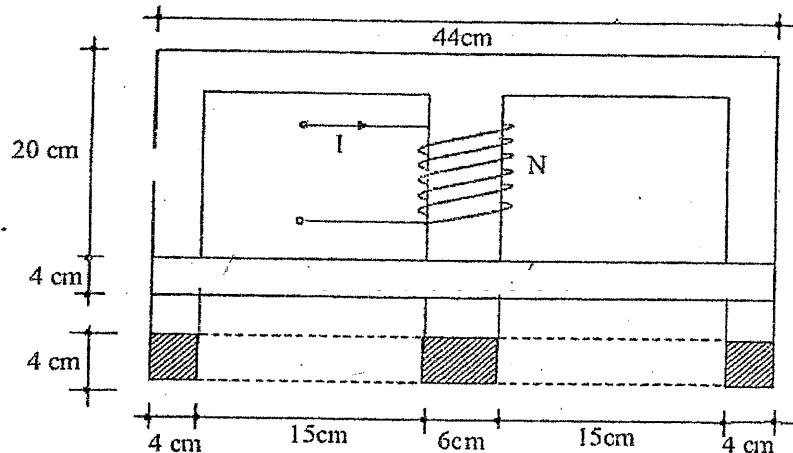
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 2078 Chaitra

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BEX,BCT,BME, BAM,BIE	Pass Marks	32
Year / Part	II / II	Time	3 hrs.

Subject: - Electrical Machine (EE554)

- ✓ 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 reluctance and permeance in the magnetic circuits? Derive their expressions in any type of magnetic circuits. [8]
- b) For the Magnetic circuit shown below, calculate the Amp-turn (NI) required to establish a flux of 0.75 wb in the central limb. Given that $\mu_r = 4000$ for iron core. [8]



2. a) What is an auto transformer? State its merits and demerits over a two winding transformer. Derive an expression of cu-saving in auto transformer. [2+6]
- b) A 1000- VA 230/115-V transformer has been tested to determine its equivalent circuit. The results of the tests are shown below. [8]

Open – Circuit test (On secondary side)	Short – circuit test(On primary side)
$V_{OC} = 115 \text{ V}$	$V_{SC} = 17.1 \text{ V}$
$I_{OC} = 0.11 \text{ A}$	$I_{SC} = 8.7 \text{ A}$
$P_{OC} = 3.9 \text{ W}$	$P_{SC} = 38.1 \text{ W}$

- (i) Find the equivalent circuit of this transformer referred to the low – voltage side of the transformer.
 (ii) Determine the transformer' s efficiency at rated conditions and 0.8 PF lagging.
3. a) A DC compound generator delivers 50A to the load at 500V. The armature, series field and shunt field windings resistance are 0.05Ω , 0.03Ω and 250Ω respectively. The voltage drop in carbon brush is 1 V per brush. Calculate the generated emf i) for long shunt compound ii) for short shunt compound. [8]
- b) Explain the working principle of a d.c motor and derive the equation of torque developed by the armature of the d.c motor. [4+4]

4. a) Define slip. Why does the induction motor operates only in the linear portion of torque-slip characteristics? [4]
- b) A three phase 6 pole, 50 Hz induction motor develops a maximum torque of 30 Nm at 960 rpm. Calculate the torque produced by the motor at 6% slip. The rotor resistance per phase is 0.6Ω . [6]
- c) How does three phase synchronous generator work? What do you mean by armature reaction? Comment the results of different load power factor on armature flux. [6]
5. a) A 1200 kVA, 6600 V, 3-phase star connected stator of a synchronous generator has a armature resistance of 0.4Ω / phase and synchronous reactance of 6Ω / phase. The generator delivers full load current at pf of 0.8 lagging at normal rated voltage. Calculate the terminal voltage for the same excitation and load current at 0.8 pf leading. [8]
- b) Write short notes on: (Any Two) [2x4]
- (i) Capacitor start and run motor
 - (ii) Universal motor
 - (iii) Stepper motor

TRIBHUVAN UNIVERSITY
 INSTITUTE OF ENGINEERING
Examination Control Division
 2078 Baishakh

Exam.	Time	Back	Max.
Level	BE	Full Marks	80
Programme	BEX, BCT, BME, BAM, BIE	Pass Marks	32
Year / Part	II / II	Time	3 hrs.

Subject: - Electrical Machines (EE 554)

- ✓ 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 magnetic circuit consists of a circular iron core having mean diameter of 10cm and cross sectional area of 100mm^2 and air gap of 2mm. The core has 600 turns of winding. Calculate the magnitude of current to be passed through the winding to produce air gap flux density of 1 Tesla. Given that relative permeability of the core is 4000. [8]
- b) Test data on a 1-phase, 250/500, 50Hz transformer are:
 No-load Test: 250V, 1A, 80W (carried on LV side)
 Short circuit Test: 20V, 12A, 100W (carried on HV side)
 Then draw equivalent circuit referred to primary side. [8]
2. a) An 11000/230V, 150kVA, 50Hz, single-phase transformer has a core loss of 1.4kW and full load Copper loss of 1.6kW. Determine (i) the kVA load for maximum efficiency and the maximum efficiency (ii) the efficiency at half load and full load at 0.8 p.f. lagging. [8]
- b) Explain the operating principle of a DC generator. Derive the emf equation for the DC generator. [8]
3. a) A 250V dc shunt motor has armature winding resistance of 0.5 ohm and field winding resistance of 125 ohms. It draws a current of 25 amp at a speed of 900 rpm. It is required to increase the speed to 1100 rpm keeping the load torque constant. Calculate the value of additional keeping the load torque constant. Calculate the value of additional resistance to be connected in series with the field winding to achieve this speed. [8]
- b) What is back emf in dc motor? How back emf helps to develop required torque according to load applied in the shaft. [8]
4. a) Derive emf equation of an alternator. [6]
- b) What should be the rpm of a 4 pole and 6 pole alternators to produce a frequency of 50Hz. [4]
- c) Why synchronous motor is not self starting? What are the methods used to start this motor. [6]
5. a) A 3.3KV, 3-phase star connected synchronous motor impendence of $0.2+j2.2\Omega/\text{phase}$ of the armature winding. The motor is operated at 0.5pf leading with line current of 100A. Determine the back emf per phase and also draw phasor diagram. [8]
- b) What do you understand by double field revolving theory? Explain it with the help of a neat diagram. [8]

TRIBHUVAN UNIVERSITY
 INSTITUTE OF ENGINEERING
Examination Control Division
 2077 Chaitra

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BEX, BCT, BME, BAM, BIE	Pass Marks	32
Year / Part	II / II	Time	3 hrs.

Subject: - Electrical Machines (EE 554)

- ✓ 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) An iron ring of mean length 1.2m and cross sectional area of 0.005 m^2 is wound with a coil of 900 turns. If a current of 2A in the coil produces a flux density of 1.2T in the iron ring, calculate: (i) The mmf (ii) Total Flux in the ring (iii) The magnetic field strength (iv) The relative permeability of iron at this flux density. [8]
- b) Explain the no-load and loaded operation of an ideal transformer. Prove that the flux in the transformer core remains constant irrespective of the change in load. [8]
2. a) Describe different types of losses on the transformer and how the efficiency is calculated? Derive the condition at which the efficiency of transformer will be maximum. [8]
- b) Explain the functions of commutator and carbon brushes in d.c. generator. Explain why dc shunt generator should be started without load. [8]
3. a) Explain voltage build up process in DC shunt generator. Why DC series generator is not started at no load? [8]
- b) A long shunt dc compound generator deliver a current of 80A to the load at 230V. The shunt field, series and armature winding resistances are 100Ω , 0.04Ω and 0.2Ω respectively. Calculate the emf generated by the armature. [8]
4. a) A three-phase delta-connected 440volts, 50 Hz, 4-pole induction motor has a rotor standstill emf per phase of 130 volts. If the motor is running at 1440 rpm, calculate slip, frequency of rotor induced emf, the value of the rotor induced emf per phase and stator to rotor turn ratio for same speed. [8]
- b) With the help of phasor diagrams, explain the effect of excitation in power factor of a three phase synchronous motor. [8]
5. a) Explain Double field revolving theory. How do we make single phase induction motor self starting? [8]
- b) Explain the construction and working of Servo Motor. [8]

TRIBHUVAN UNIVERSITY
 INSTITUTE OF ENGINEERING
Examination Control Division
 2076 Baisakh

Exam.		Back	
Level	BE	Full Marks	80
Programme	BEX, BCT, BME, BIE, BAM	Pass Marks	32
Year / Part	II / II	Time	3 hrs.

Subject: - Electrical Machines (EE 554)

- ✓ 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 voltage regulation of a transformer. Derive an expression for voltage regulation if a transformer is loaded with an inductive load. [8]
- b) A 20 kVA, 250V/2500V, 50Hz single phase transformer gave the following test result:
 Open circuit test: 250V, 1.4A, 105watts
 Short circuit test: 120V, 8A, 320watts
 Calculate the equivalent circuit parameters referred to primary side and draw the equivalent. Also calculate voltage regulation and efficiency at half full load for an 0.8 p.f. lagging. [8]
2. a) Define the efficiency of transformer and find the condition for maximum efficiency of transformer and current at maximum efficiency. [8]
- b) Explain the operating principle of DC generator and obtain the expression for emf induced. [8]
3. a) A short shunt cumulative compound dc generator supplies 7.5kw at 230V. The shunt field, series field an armature resistance are 100, 0.3 and 0.4 ohms respectively. Calculate the induced emf and the load resistance. [8]
- b) A 1.25KW, 250V dc shunt motor on no load runs at 1000 rpm. The armature and field circuit resistance are 0.2 ohm and 250 ohm respectively. Calculate the speed of motor when it is loaded and draw current of 50A. [8]
4. a) A 250V dc shunt motor draws an armature current of 20A and runs with a speed of 1500 rpm. If a resistance of 250 ohm is inserted in series with field winding keeping the load torque constant, find the new speed. Given that armature winding resistance is 0.25ohm and field winding resistance is 250ohm. [8]
- b) With the help of phasor diagrams, explain the effect of excitation in 3-phase synchronous motor. [8]
5. a) A 3 phase star connected alternator is rated at 1600Kva, 13.5Kv having per phase armature effective resistance and synchronous reactance of 1.5Ω and 30Ω respectively., calculate the line value of emf generated, voltage regulation and power angle for a load of 1.28Mw at,
 i) 0.8 Pf lagging
 ii) Unity power factor [8]
- b) Explain constriction and the operating principle of stepper motor. [8]

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BEX, BCT, BME, BAME, BIE	Pass Marks	32
Year / Part	II / II	Time	3 hrs.

Subject: - Electrical Machine (EE554)

- ✓ 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 wrought iron bar 30 cm long and 2 cm diameter is bent into a circular shape. It is then wound with 500 turns of wire. Calculate the current required to produce a flux of 0.5 m Wb in magnetic circuit with an air gap of 1 mm. Assume that relative permeability (μ_r) = 4000. [8]
- b) Describe a working principle of a current transformer. Why secondary winding a CT shall not be kept open without ammeter? [5+3]
2. a) DC shunt generator is started keeping its output terminal open and DC series generator is started keeping its output terminal closed. Justify the statement. [8]
- b) A 4 pole, 250 V long shunt dc compound generator supplies a load of 10KW at the rated voltage. The armature, series and shunt field resistances are 0.1Ω , 0.15Ω and 250Ω respectively. The armature is lap wound with 300 conductors. If the flux per pole is 50 mWb, calculate the speed of the generator. [8]
3. a) A separately excited DC generator, when running at 1000 rpm supplied 200 A to the load at 25 V. What will be the load current when the speed drops to 800 rpm if the field current is unchanged? Given that the armature resistance is 0.04Ω and brush drop is 2 V. [8]
- b) Explain torque-slip characteristics of 3-phase induction motor and explain the effect of rotor resistance on T-S characteristics. [8]
4. a) With the help of phasor diagrams, explain the effects of excitation in a 3-phase synchronous motor. [8]
- b) A 8-pole, 50 Hz, 3 phase induction motor develops a starting torque of 50 N-m. The rotor winding has an impedance of $(0.8+j2) \Omega$ per phase. At what speed the motor will develop maximum torque and calculate magnitude of the maximum torque. [8]
5. a) A 3-phase, 50 Hz, 20 pole salient pole synchronous alternator with star connected stator winding has 180 slots on the stator. Each slot consists of 8 conductors. The flux per pole is 25 mWb and is sinusoidally distributed. The coils are full-pitched. Calculate (i) the speed of the alternator (ii) winding factor (iii) generated emf per phase and (iv) line voltage. [8]
- b) Explain the operating and characteristics of capacitor start and run motor with neat sketches. [8]

42 TRIBHUVAN UNIVERSITY
 INSTITUTE OF ENGINEERING
Examination Control Division
 2075 Baisakh

Exam.		Back	
Level	BE	Full Marks	80
Programme	BEX, BCT, BME, BIE, BAM	Pass Marks	32
Year / Part	H / H	Time	3 hrs.

Subject: - Electrical Machine (EE554)

- ✓ 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 the losses, which occur when magnetic materials are subjected to an alternating flux. How can we reduce these losses practically? [5+3]
- b) What do you mean by armature reaction in a synchronous generator? How the resistive inductive, and capacitive load affects the nature of armature reaction. [8]
2. a) Explain, how can we make equivalent circuits referred to primary side and referred to secondary side. What happens, when a power transformer is connected to a d.c. supply of the same voltage ratings? [6+2]

O.C. test : 200V, 1.3A, 120W, on L.V. side.
 S.C. test : 22V, 30 A, 200 W, on H.V. side.
 Calculate: I_μ , I_w , R_o , X_o , R_{o2} X_{o2} and Z_{o2} . [8]
- a) Explain the functions of commutator and carbon brushes in d.c generator with neat sketch. [8]
- b) A 230V, shunt motor takes 5A at no load. The resistance of the armature and field circuit are 0.25Ω and 115Ω respectively. If the motor is loaded so as to carry 40 A, determine (i) Iron and friction losses (ii) efficiency [8]
4. a) Explain the operating principle of three phase induction motor with neat sketches. Why rotor speed is always less than synchronous speed. Justify. [6+2]

b) An alternator on open circuit generates 360V at 60 Hz, when the field current is 3.6 A. Neglecting saturation, determine the open circuit emf. When the frequency is 40 Hz and the field current is 2.4 A. [8]
5. a) Explain the operating principle and characteristics of split phase induction motor with neat sketches. [8]
- b) Explain construction, operation and characteristics of universal motor. Why is it called so? Give reason. [8]

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BEX, BCT, BME, BIE, BAM	Pass Marks	32
Year / Part	II / II	Time	3 hrs.

Subject: - Electrical Machine (EE554)

- ✓ 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.

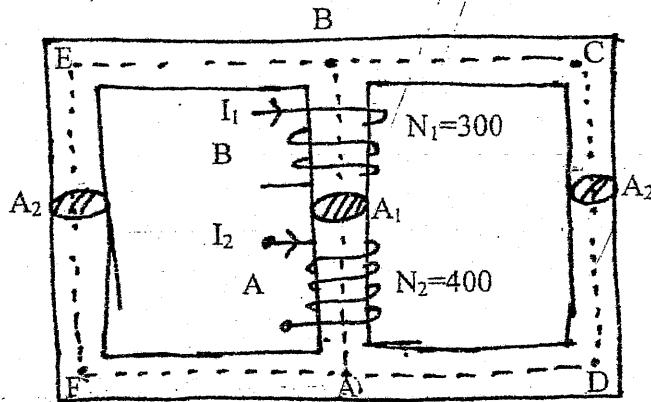
1. a) A steel ring of 12 cm mean radius and of circular cross-section 1 cm in radius has an air gap of 2 mm length. It is wound uniformly with 550 turns of wire carrying 3A of current. The air gap takes 60% of total magnetomotive force. Find the total reluctance. [5]
- b) Explain hysteresis and eddy current losses in electrical machines. Prove that hysteresis loss in a magnetic material is equal to the area of hysteresis loop. [5]
- c) Explain the following: [2x3]
 - (i) Faraday's laws of electromagnetic induction
 - (ii) Fleming's right and left hand rules
2. a) Derive expression giving amount of copper saving in an auto-transformer. [4]
- b) Discuss how to conduct open-circuit and short-circuit tests on a single phase transformer. From the test results how the efficiency and voltage regulation of the transformer is determined? [6]
- c) An ideal 3-phase delta/star step-down transformer delivers power to a balanced 3-phase load of 120 kVA at 0.8 power factor. The input line voltage is 11 kV and the turns ratio of the transformer, phase to phase is 10. Determine the line voltage, line currents, phase voltages and phase currents on both the primary and secondary sides. [6]
3. a) In a 220 V compound generator, the armature, series and shunt windings have resistances of 0.3Ω , 0.2Ω and 60Ω respectively. The load consists of 80 lamps, each rated at 60 W and 220 V. find the total emf and armature current when the machine is connected for i) long shunt and ii) short shunt. [6]
- b) What do you mean by back emf in DC motors? Explain the significance of back emf. [4]
- c) Explain the speed-current, torque-current and speed-torque characteristics of a DC shunt motor. [6]
4. a) Explain the torque-slip characteristics of a three phase induction motor. Starting with the expression for torque as a function of slip, show that the value of maximum torque is independent of rotor resistance. [6]
- b) The power input to the rotor of a 440 V, 50 Hz, 3-phase, 6-pole, induction motor is 50 kW. The rotor emf makes 120 cycles per minute. Friction and windage losses are 2 kW. Calculate (i) slip (ii) rotor speed (iii) rotor copper losses (iv) mechanical power developed (v) output power (vi) output torque [6]
5. a) Explain about constructional details and working principle of three phase synchronous generator. [8]
- b) Describe briefly the effect of varying excitation upon the armature current and power factor of a 3-phase synchronous motor when input power to the motor is maintained constant. [6]
- c) Using double revolving field theory, explain the working of a single phase induction motor. [6]

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

Subject: - Electrical Machine (EE551)

- ✓ 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) For magnetic circuit shown in figure below, find out the current to be passed through coil B so that magnetic flux in CD section is 2 mWb. Given $\mu_r = 1000$



Given:

$$I_2 = 3 \text{ Amp}, A_1 = 6 \text{ cm}^2, A_2 = 3 \text{ cm}^2$$

$$AB = CD = EF = 20 \text{ cm}$$

$$BC = AD = BE = AF = 20 \text{ cm}$$

- b) Copper loss is assumed to be negligible in no load test and iron loss is assumed negligible in short circuit test. Explain why it is so.
2. a) The following test result were obtained on 20 KVA, 2200/220 V, 50 HZ single phase transformer

[8]

[8]

Open circuit test: 220 V, 1.1 A, 125 W

Short circuit test: 52.7 V, 8.4 A, 287 W

- Calculate the equivalent circuit parameters referred primary sides and draw the equivalent circuits
- Calculate maximum efficiency at full load
- Calculate the efficiency at half full load with 0.8 power factor lagging

- b) How current transformer is different from conventional transformer. Explain how CT is used to measure high currents. Also explain, what happens if the secondary of CT is open when there is high current flowing in primary side.

[8]

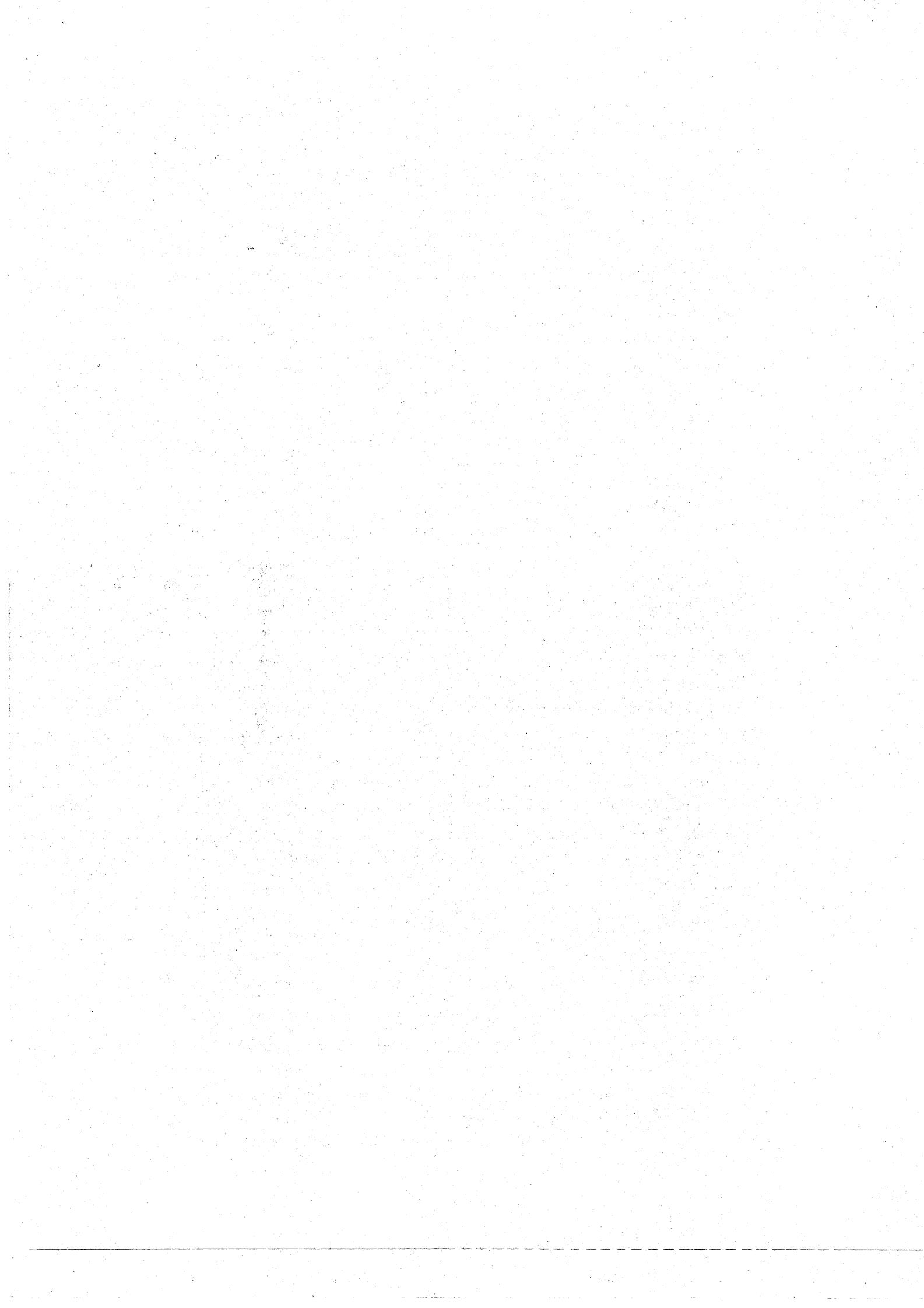
3. a) Using circuit diagram and graphical representation, explain the characteristics of DC series generator and DC shunt generator. Also mention their applications. [8]
- b) A 220 V, DC series motor draws 100 A current and runs at 1200 RPM. What is value of armature resistance required to run the motor at 800 RPM keeping load torque constant. Given armature resistance = 0.2 ohm, field winding = 0.05 ohm [4+4]
4. a) Explain the torque-slip characteristics of an induction motor. Show the condition for which the maximum torque develops in the induction motor. [5+3]
- b) A 6-pole, 50 Hz, three-phase induction motor has rotor resistance of $0.4 \Omega/\text{phase}$, maximum torque is 200 Nm at 850 rpm. Find (i) torque at 4% slip, and (ii) additional rotor resistance to get $(2/3)^{\text{rd}}$ of maximum torque at starting. [8]
5. a) Explain effect of excitation on pf of synchronous motor with necessary diagrams. [8]
- b) Explain double field revolving theory refer to single phase induction motor and prove that a single phase induction motor is not self starting. [8]

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

Subject: - Electrical Machine (EE551)

- ✓ 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 coercitivity and retaintivity with the help of BH curve. [6]
 - b) A magnetic circuit consists of a circular iron core having mean length of 10 cm and cross sectional area of 100 square mm. The air gap is 2 mm and the core has 600 turns of winding. Calculate the magnitude of current to be passed through the winding to produce air gap flux of 1 tesla (permeability of iron = 4000) [10]
 2. a) Explain working principle of an auto-transformer. Derive an expression for Cu saving in an auto-transformer. [8]
 - b) A 4-kVA, 200/400V single phase transformer has following test results: [8]
- | | | |
|----------------|------|-----|
| O.C Test: 200V | 0.8A | 70W |
| S.C Test: 20V | 10A | 60W |
- Obtain equivalent circuit parameters of the transformer refer to L.V side.
3. a) Make a detail comparison of dc shunt generator and dc series generator with their diagrams, equations and characteristics curve. [8]
 - b) A dc shunt motor is supplied by a source of 200 V. It draws a current of 20 A and runs at speed of 1500 rpm. The armature and field winding resistance are 0.08Ω and 110Ω respectively. A resistance of 0.02Ω is added in series with armature and load torque is increased by 30%, calculate new speed. [8]
 4. a) How does induction motor and synchronous motor adjust the current according to the change in load? Explain briefly using mathematical expression. [4+4]
 - b) A 4 pole, 50 Hz, 3-phase slip ring induction motor has star connected stator and rotor windings. The rotor winding has impedance of $(1+j4)\Omega$ per phase at stand still. The stator to rotor turn ratio is 2. Given that emf induced in rotor circuit is 400 V between two slip rings at stand still. Calculate starting current and running current at 1400 rpm. [8]
 5. a) A 1200 KVA, 6000 V, 3 phase star connected stator of a synchronous generator has a armature resistance of 0.4 ohms/phase and synchronous reactance of 6 ohm/phase. The generator delivers full load current at pf 0.8 lagging at normal rated voltage. Calculate the terminal voltage for the same excitation and load current at 0.8 pf leading. [8]
 - b) Why single phase induction motors are not self-starting? Explain any two starting methods for single phase induction motor. [8]



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

Subject: - Electrical Machine (EE554)

- ✓ 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. a) An iron ring has a mean length of 2m and cross-sectional area of 0.01 m^2 . It has a radial air gap of 4 mm. The ring is wound with 250 turns. What dc current would be needed in the coil to produce a flux of 0.8 Weber in the air gap? Assume that $\mu_r = 400$.
 b) Explain the operation of transformer with no-load and load. Prove that the magnetic field in a transformer core remains constant at any load.
2. a) A 20 kVA, 250/2500V, 50. Hz, single phase transformer has $R_o = 595.2 \Omega$, $X_o = 187.26 \Omega$, $R_{01} = 0.05 \Omega$ and $X_{01} = 0.14 \Omega$. Calculate (i) iron loss of the transformer (ii) efficiency of the transformer at half load with 0.8 pf lagging.
 b) A short shunt compound generator delivers a load current of 30 A at 220 V and has armature, series and shunt field resistances of 0.05Ω , 0.03Ω and 200Ω respectively. Calculate the induced emf and the armature current. Allow 1 V per brush contact drop.
3. a) A 200 V DC series motor draws full-load line current of 38 A at the rated speed of 600 rpm. The motor has armature resistance of 0.4Ω and the series field resistance is 0.2Ω find:
 i) The speed of the motor when the load current drops to 19 A
 ii) The speed on removal of load when the motor takes only 1 A from supply
 b) Explain torque-slip characteristics of 3 phase induction. Deduce the condition for which maximum torque. Discuss the effect of variation of rotor resistance on this maximum torque.
4. a) Explain why a 3 phase synchronous motor is not self starting. Explain a method of starting a 3 phase synchronous motor.
 b) Draw equivalent circuit of 3 phase induction motor at stand still and running conditions. Derive the expression for starting torque and running torque.
5. a) Explain the operating principle of servo motor.
 b) The no-load test and short circuit test on a 220V/2200 volt single phase transformer gave following results.

No load test (on L.V side): 220V 1.2 Amp 100 watts

Short circuit test (on HV side): 110V 8Amp 300 watts

Calculate equivalent circuit parameters refer to primary side and draw the equivalent circuit.

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

Subject: - Electrical Machine (EE554)

- ✓ 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. a) Explain the operating principle of an ideal transformer and derive the emf equation.
 b) A ring of 30 cm mean diameter is made up of round iron rod 2.5 cm in diameter. A saw cut of 1 mm is made on the ring. It is uniformly wound with 500 turns of wire. Calculate the current required by the exciting coil to produce a total flux of 4m Wb. Assume a relative permeability of iron at this flux density as 800.
2. a) Explain the operation principle of dc generator. What are main functions of carbon brush in dc generator?
 b) A 20 kVA, 250V/2500V, 50Hz single phase transformer gave the following test results:
 No-load test (on L.V. side): 250V, 1.4A, 105 watts
 Short circuit test (on H.V. side): 120V, 8 A, 320 watts
 Calculate the equivalent circuit parameters referred to primary side and draw the equivalent circuit.
3. a) Sketch and explain the torque slip characteristics of a 3-phase induction motor indicating the starting torque, maximum torque and the operating region. How does rotor resistance affect the torque slip characteristics?
 b) A 200V DC shunt motor drives a centrifugal pump where constant torque is required. The motor draws a current of 50 A when running at 1000rpm. What value of resistance must be inserted in the armature circuit to reduce the speed to 800rpm at constant torque? Given that armature winding resistance, $R_a = 0.1 \Omega$ and field winding resistance, $R_f = 100 \Omega$
4. a) With the help of phasor diagrams, explain the effect of excitation in a 3-phase synchronous motor.
 b) A 4-pole, 50 Hz, 3 phase induction motor develops a starting torque of 50 N-m. The rotor winding has an impedance of $(0.8+j2) \Omega$ per phase at stand still. At what speed the motor will develop maximum torque and calculate magnitude of the maximum torque.
5. a) What do you understand by double field revolving theory? Explain it with the help of a neat diagram.
 b) A 500 KVA, 50 Hz, 6600V/400V, 1- phase transformer have primary and secondary winding resistances are 0.4Ω and 0.001Ω respectively. If the iron loss is 3.0 KW, Calculate the efficiency at (a) full load (b) half full load.

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

Subject: - Electrical Machine (EE554)

- ✓ 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 rectangular iron core is shown in figure 1. It has a mean length of magnetic path of 100 cm, cross-section of $(2 \text{ cm} \times 2 \text{ cm})$, relative permeability of 1400 and an air-gap of 5 mm cut in the core. The three coils carried by the core have number of turns, $N_a = 335$, $N_b = 600$ and $N_c = 600$; and the respective currents are 1.6 A, 4 A and 3 A. The directions of the currents are as shown in the figure. Find the flux in the air-gap. [6]

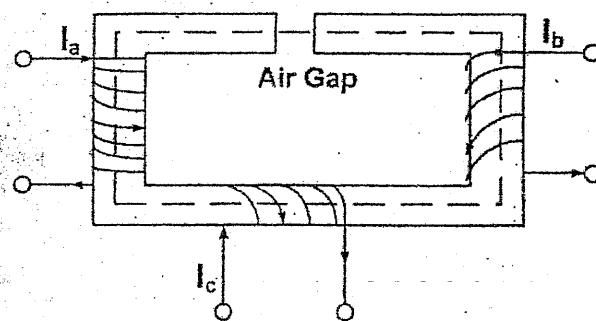


Figure 1

- b) State Faraday's Laws of electromagnetic induction. Distinguish between statically induced emf and dynamically induced emf. [6]
2. a) Explain the working of an ideal transformer under (i) no-load and (ii) loaded conditions and derive expressions for voltage and current ratios relating to transformer turns ratio. [4+4]
- b) The following test results were obtained for open circuit and short circuit tests on a 8 kVA, 400/120 V, 50 Hz transformer:
- Open-circuit Test (LV Side) : 120 V, 4 A, 75 W
 Short-circuit Test (HV Side) : 9.5 V, 20 A, 110 W
- Calculate the equivalent circuit parameters referred to high voltage side. Also calculate the efficiency at half full load and 0.8 power factor lagging load. [8]
3. a) Explain the working principle of dc generator with neat diagram. [3+3]
- b) A short shunt compound generator supplies a load current of 100 A at 250 V. The generator has the following winding resistances: shunt field 130Ω , armature 0.1Ω and the series field 0.1Ω . Find the emf generated and the armature current, if the brush drop is 1 V per brush. [6]

4. a) What is back emf? How does back emf play an important role in DC motor? [2+4]
- b) A dc shunt motor runs at 600 RPM taking 60 A from a 230 V supply. Armature resistance is 0.2Ω and field resistance is 115Ω . Find the speed when the current through the armature is 30 A. [6]
5. a) Explain the torque-slip characteristics of an induction motor. Show the condition for which the maximum torque develops in the induction motor. [3+3]
- b) A 3-phase delta connected 440 volts, 50 Hz, 4-pole induction motor has a rotor standstill emf per phase of 130 volts. If the motor is running at 1,440 RPM, calculate for this speed : (i) the slip, (ii) the frequency of rotor induced emf, (iii) the value of the rotor induced emf per phase, and (iv) stator to rotor turn ratio. [4]
6. a) What do you mean by V-curve and inverted V-curve for a synchronous motor? Explain with a neat diagram. [6]
- b) What are the advantages of rotating magnetic system and stationary armature system in ac machine? [4]
- c) Write short notes on the following: [2x4]
- i) Universal motor
 - ii) AC servo motor

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

Subject: - Electrical Machine (EE554)

- ✓ 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) The flux in transformer remains practically constant from no load to full load. Justify the statement. [4]
- b) Derive an expression for Cu saving in an auto-transformer. [4]
- c) A 230 V / 2300 V single-phase transformer is excited by 230 V ac voltage. The equivalent resistance and reactance referred to primary side are 0.1Ω and 0.4Ω respectively. Given that $R_0 = 500 \Omega$ and $X_0 = 200 \Omega$. The load impedance is $(400 + j600) \Omega$. Calculate: (i) Primary current and input power factor (ii) Secondary terminal voltage. [8]
2. a) Derive an emf equation for a dc generator. [4]
- b) DC shunt generator shall be started keeping its output terminal open. Justify the statement. [4]
- c) A 4 pole, 250 V long shunt dc compound generator supplies a load of 10 KW at the rated voltage. The armature, series and shunt field resistances are 0.1Ω , 0.15Ω and 250Ω respectively. The armature is lap wound with 300 conductors. If the flux per pole is 50 mWb, calculate the speed of the generator. [8]
3. a) With the help of a neat sketch, explain the working principle of three terminal DC motor starter. [5]
- b) A dc series motor of resistance 1Ω between terminals runs at 1,000 RPM at 250 V with a current of 20 A. Find the speed at which it will run when connected in series with a 6Ω resistance and taking the same current at the same supply voltage. [5]
- c) A circular iron core has a cross-sectional area of 5 sq.cm. and mean length of 25 cm including an air gap of 4 mm. The core is wound with 500 turns of winding. Calculate the inductance of the coil. If a dc current of 10 Ampere passed through the coil, calculate magnetic flux in the core. Given that relative permeability of the core is 2000. [6]
4. a) What will be the condition for maximum torque and explain torque slip characteristics of 3-phase induction motor. [8]
- b) A 3-phase, 50 Hz induction motor has starting torque which is 1.25 times full load torque and a maximum torque which is 2.5 times the full load torque. Neglecting stator resistance and rotational losses and assuming constant rotor resistance. Find [8]
 - i) slip at maximum torque
 - ii) the slip at full load
 - iii) the current at starting in per unit full load current
5. a) With the help of phasor diagrams, explain the effect of excitation in a 3-phase synchronous motor. [8]
- b) A 1200 KVA, 6600 V, 3-phase star connected stator of a synchronous generator has a armature resistance of $0.4 \Omega/\text{phase}$ and synchronous reactance of $6 \Omega/\text{phase}$. The generator delivers full load current at pf of 0.8 lagging at normal rated voltage. Calculate the terminal voltage for the same excitation and load current at 0.8 pf leading. [8]

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

Subject: - Electrical Machine (EE554)

- ✓ 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 the working of an ideal transformer under (i) no-load and (ii) loaded conditions and derive expressions for voltage and current ratios relating to transformer ratio. [8]
- b) The following test results were obtained on a 20 kVA, 2200/220 V, 50 Hz single phase transformer: [8]

Open-circuit Test (LV Side): 220 V, 1.1 A, 125 W

Short-circuit Test (HV Side): 52.7 V, 8.4 A, 287 W

Calculate the equivalent circuit referred to L.V side and draw the equivalent circuit.

2. a) Explain torque-armature current and speed-torque characteristics of DC shunt and DC series motor. [8]

- b) A 220V dc shunt motor draws a current of 40A at full load and runs with speed of 1400rpm. Calculate the value of resistance required to be inserted in the armature circuit so that speed drops to 1200rpm at constant load. Given that $R_a=0.02\text{ohm}$ and $R_f=100\text{ohms}$. [8]

3. a) Explain why synchronous motor is not self starting? Explain the starting method using damper winding. [8]

- b) A 4-pole dc shunt generator has wave wound armature. The armature and field winding resistance are 0.2 ohm and 60 ohms respectively. The brush contact drop is 1V per brush. The generator is delivering a power of 3 kW at 120V. Calculate: [8]

- i) Total armature current coming out from the brush
- ii) Current in each armature conductor
- iii) Generated EMF (E)

4. a) Explain the torque-slip characteristics of 3 phase induction motor. Show the condition for which the maximum torque develops in the induction motor. Discuss the effect of variation of rotor resistance on this maximum torque. [8]

- b) A 8-pole, 50 Hz, 3 phase induction motor develops a starting torque of 50 N-. The rotor winding has an impedance of $(0.8+j2) \Omega$ per phase. At what speed the motor will develop maximum torque and calculate the magnitude of maximum torque. [8]

5. a) What do you understand by double field revolving theory? Explain it with the help of a neat diagram. [8]

- b) A ring of 30 cm mean diameter is made up of round iron rod 2.5 cm in diameter. At one end, a saw cut of 1 mm wide is made through it. It is uniformly wound with 500 turns of wire. Calculate the current required by the exciting coil to produce a total flux of 4 mWb. Take relative permeability of iron as 800. Neglect leakage and fringing. [8]

43 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division

2071 Bhadra

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

Subject: - Electrical Machine (EE554)

- ✓ 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 different types of losses in transformer? Derive the expression of efficiency of transformer. [8]

b) An iron ring of mean diameter 100cm and cross sectional area 10cm^2 is wound with 1000 turns and has $\mu_r = 2000$. Compute (i) reluctance (ii) flux produced when the current through the coil is 1A (iii) Flux in the ring if a saw cut of 1mm length is made, the current through the coil remaining the same. [8]

2. a) A 25 KVA, single phase, 11 KV / 400V transformer has impedance of primary and secondary $0.4 + j2\Omega$ and $0.02 + j1\Omega$ respectively. Determine the load terminal voltage and primary current at half load. [8]

b) Describe the construction and working principle of a dc generator with neat diagram. Also derive the emf equation of a dc generator. [8]

3. a) Describe different methods of controlling the speed of shunt DC motor. [8]

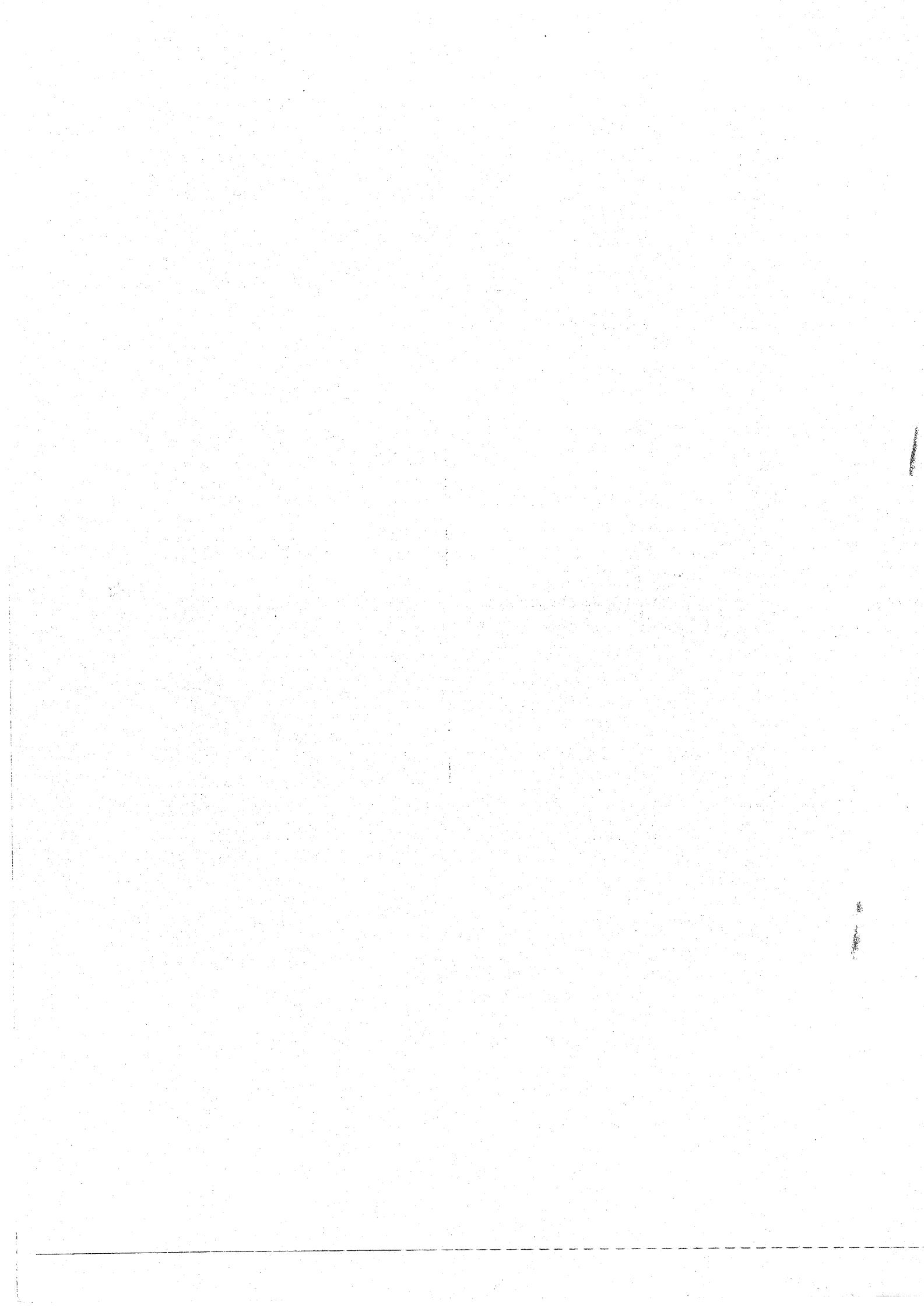
b) Explain with necessary vector diagram how rotating magnetic field is produced in a three phase induction motor. Also explain how this rotating magnetic field helps the motor to rotate. [8]

4. a) Explain torque slip characteristics of 3-phase induction motor. Why the induction motor operates only in linear portion of torque-slip characteristics. [8]

b) A 3.3 KV, 3-phase star connected synchronous motor has impedance of $0.2 + j2.2\Omega/\text{phase}$ of the armature winding. The motor is operated at 0.5 pf leading with line current of 100 A. Determine the back emf per phase and also draw phasor diagram. [8]

5. Give reasons for the following statements. [4x4]

- a) Single phase induction motors are not self starting
- b) Servo motor has longer length and smaller diameter compared to other normal motor
- c) DC series motor can also be operated from ac supply
- d) Hysteresis and eddy current losses depends on the frequency of supply system



TRIBHUVAN UNIVERSITY
 INSTITUTE OF ENGINEERING
Examination Control Division
 2081 Ashwin

Exam.	Back		
Level	BE	Full Marks	80
Programme	BEI, BCT,	Pass Marks	32
Year / Part	II / II	Time	3 hrs.

Subject: - Data Structure and Algorithm (CT 552)

- ✓ 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 ADT? Define algorithm and its properties. [2+2]
2. Convert the expression $A + ((B - C)*(D - E) + F) / G \wedge (H - I)$ to postfix expression showing stack status in each step. Evaluate the converted postfix expression using stack for $A=2, B=5, C=3, D=7, E=4, F=10, G=8, H=5$ and $I=3$. [4+4]
3. Define Queue. Explain Enqueue and Dequeue operations in linear queue. [1+4]
4. Explain static implementation of a list. How it differs from dynamic implementation? [4]
5. What do you mean by a node of a linked list and how it is created? Write an algorithm to implement push and pop operation of a stack as doubly linked list. [3+5]
6. Which algorithm would you refer between iterative and recursive? Write an algorithm for TOH with 'n' disks and generate a recursion tree of TOH problem with 3 disks. [3+2+3]
7. Define expression tree. Create an expression tree from given postfix expression $AB * CD * E ++$. Evaluate its Infix and Prefix expressions by traversing. [2+4+2]
8. Define red-black tree with its properties. Do you prefer Red-Black tree over AVL tree? State reason. [3+2]
9. Explain insertion sort algorithm with suitable example. Sort the following numbers using Radix sort: 2, 529, 8, 25, 0, 22, 373, 16, 43, 33 [3+5]
10. What are popular hash functions? Draw the hash table obtained from double hashing with hash functions: $h1(K) = K \bmod 11$ and $h2(K) = K \bmod 9$ for the given keys: 87, 47, 58, 49, 76, 54 with table size 11. Use $h(K, i) = (h1(K) + i * h2(K)) \bmod m$ [2+6]
11. Briefly explain the significance of asymptotic notations with suitable diagram. [4]
12. Explain Depth First traversal with an example. Explain Warshall's algorithm with suitable example. [4+6]

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BEI, BCT	Pass Marks	32
Year / Part	II / II	Time	3 hrs.

Subject: - Data Structure and Algorithm (CT 552)

- ✓ 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 linear and nonlinear data structures? Define abstract data type (ADT) with suitable example. [1+3]
2. Convert following infix expressions to Postfix and Evaluate the postfix expressions using A=8, B=5, C=4, D=6, E=2, F=1, G=12 and H=3. [5+3]

$$A + (B * C - (D/E + F) - G) * H$$
3. Explain how circular queue is efficient compared to linear queue. Write down an algorithm to perform insertion and deletion operation in a linear queue. [2+3]
4. Explain array representation of list. How it is different from dynamic list? [2+2]
5. Write an algorithm to insert a new node after any given node in doubly linked list. Explain how you add two polynomials with the help of linked list. [4+4]
6. Write an algorithm to find n^{th} Fibonacci number using tail recursion. Generate a recursion tree of TOH problem with 4 disks. [3+5]
7. What do you mean by complete binary tree? Explain with example. Create an AVL balanced tree for the following sequence of elements: 10, 9, 8, 4, 5, 7, 32, 16, 11, 1, 12 and 2. [2+6]
8. Create a Binary Search Tree by inserting the nodes: 12, 15, 25, 18, 20, 30, 28, 10 and 5. Then delete element 25 from it. [3+2]
9. Explain Heap as priority queue. Use heap sort to sort the following numbers: 27, 23, 16, 82, 47, 18, 38, 15, 2, 76, 22 and 12. [2+6]
10. What is collision? What are the techniques used for collision resolution in hashing? Insert the keys: 52, 27, 16, 14, 97, 21, 82, 41 and 31 using quadratic probing method. The hash function is $h = (\text{key}) \mod 10$ (Where 10 is the table size). [1+2+5]
11. Define Big-Oh and Theta notation with suitable example. [4]
12. What is minimum spanning tree? Explain Warshall's algorithm with example. Define Dijkstra's algorithm with explanation. [2+4+4]

TRIBHUVAN UNIVERSITY
 INSTITUTE OF ENGINEERING
Examination Control Division
 2080 Ashwin

Exam.	Back		
Level	BE	Full Marks	80
Programme	BEI, BCT	Pass Marks	32
Year / Part	II / II	Time	3 hrs.

Subject: - Data Structure and Algorithm (CT 552)

- ✓ 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.

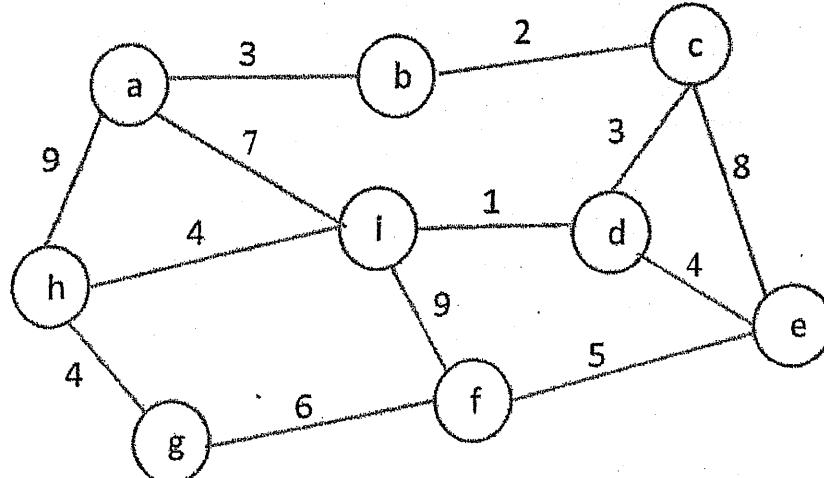
1. What do you mean by Abstract Data Type? Compare linear and non-linear data structure. [2+2]
2. Convert the given infix expression into postfix expression using stack method. [5+5]

$M^N/O-P^Q*R-S+T^U$

Also evaluate the outputted postfix expression using given data:

$M = 4, N = 2, O = 4, P = 2, Q = 1, R = 1, S = 1, T = 5, U = 3$

3. What are the problem with linear queue? Write an algorithm for circular queue operations. [2+4]
 4. Explain array representation of list. [4]
 5. What is linked list? Write an algorithm to insert a node after first node in a linked list. [2+4]
 6. Explain about tail and non-tail recursion. Generate a recursion tree of TOH problem with 3 disks along with the algorithm. [2+4]
 7. Construct a binary tree from following pre-order and in-order traversals. [6]
- Pre-order: 1, 2, 4, 8, 9, 10, 11, 5, 3, 6, 7
- in-order: 8, 4, 10, 9, 11, 2, 5, 1, 6, 3, 7
8. What is the advantage of AVL tree over binary search tree? Construct an AVL tree from the given set of data 5, 6, 8, 3, 2, 4, 7. [1+5]
 9. Define big-O and Big-omega notation with their respective curves. [4]
 10. Write an algorithm for Radix sort. Use Radix sort to sort the following data: 18, 2, 250, 36, 12, 88, 22, 504, 106, 46. [3+5]
 11. Explain double hashing technique and chaining technique used to resolve collision. Insert keys {89, 18, 49, 58 and 69} with the hash-table size 10 using double hashing. [4+6]
 12. Define graph. Find the shortest paths from the source node "i" to all other vertices using Dijkstra's algorithm. [2+8]

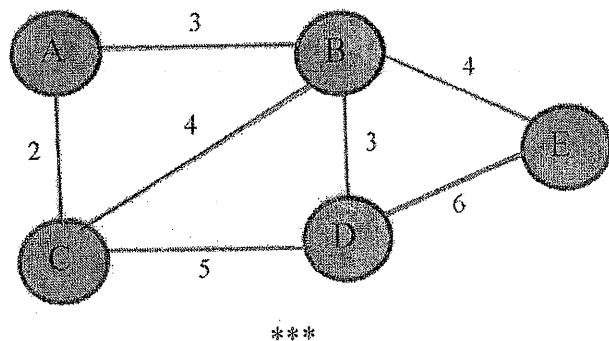


Exam.	Regular		
Level	BE	Full Marks	80
Programme	BEI, BCT	Pass Marks	32
Year / Part	II / II	Time	3 hrs.

Subject: - Data structure and Algorithm (CT 552)

- ✓ 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 data structure. Differentiate between primitive and non primitive structure. [2+2]
2. What is stack? Convert the infix expression $a+b*c+(d*e+f)*g$ into infix expression. [2+6]
3. Define Queue with its logical representation. Write an algorithm to enqueue () and dequeue () element in Circular Queue. [2+4]
4. Write algorithm to insert data at the beginning in array implementation of lists. [4]
5. Write an algorithm to insert a new node after a given node and to delete the last node of singly linked list. [4+4]
6. What is recursion? Explain recursive module for Tower of Hanoi (TOH) problem. [2+4]
7. Construct an AVL tree for following sequence of elements: 42, 36, 56, 27, 63, 72, 30, 25, 20, 10. [6]
8. Construct a B-tree of order 5 from the following data:
4, 23, 12, 45, 3, 21, 41, 31, 26, 10, 12, 32 [6]
9. Explain about Big Omega (Ω) and Big Theta (θ) notions. [2+2]
10. Define Sorting and its types. Sort the given elements using Shell Sort:
Elements: 25, 31, 17, 21, 33, 9, 11, 7, 3 [3+5]
11. Explain how collision occurs? Use quadratic probing to insert following keys: 72, 27, 36, 24, 63, 81, and 101 into the hash table, considering hash table size 10. And also list out its advantages and disadvantages. [2+7+1]
12. Define minimum spanning tree. Create a minimum spanning tree for the following graph using Kruskal's algorithm. [2+8]



Exam.	Back		
Level	BE	Full Marks	80
Programme	BEI, BCT	Pass Marks	32
Year / Part	II / II	Time	3 hrs.

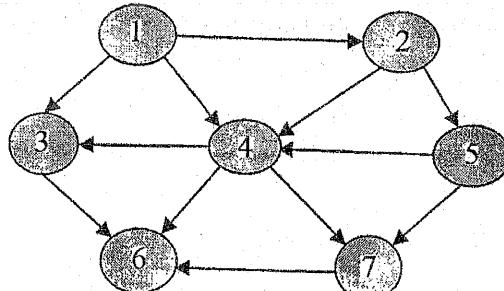
Subject: - Data Structure and Algorithm (CT 552)

- ✓ 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.

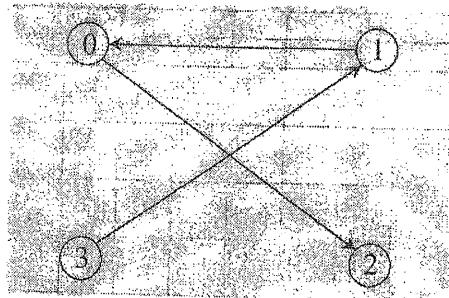
1. "Data Structure play important role in writing efficient and effective algorithm." Elaborate the statement. [4]
2. For circular queue, write algorithms to implement enqueue () and dequeue () operations with all the required conditions and appropriate diagrams. Convert the following infix expression to postfix expression with required status of stack. [5+5]

((a + ((b * c) / (d - e))))
3. How do you implement array to represent queue as list? [4]
4. Explain the application areas of doubly linked lists. Write algorithms to implement all the basic operations of stack using singly linked list. [3+7]
5. Write an algorithm for Tower of Hanoi (TOH) with 'n' disks. Construct a recursion tree for TOH problem with 4 disks. [3+3]
6. Create an AVL balanced tree for following sequence of elements:
5, 18, 35, 65, 25, 15, 10, 12, 14, 3, 2. [6]
7. Illustrate the importance of Huffman algorithm in data communication over the network using the following string. Also generate Huffman code. [6]

BCCAAADDACACB
8. Differentiate internal and external sorting. Consider the following max heap: 50, 30, 20, 15, 10, 8, 16. Insert a new node with value 60. [2+6]
9. What is Hashing? Why do we need Hashing? Discuss linear probing in detail. [1+2+5]
10. Define Big-Oh and Theta notation with suitable example. [4]
11. Determine the breadth first and depth first topological sorting for the following graph. [4+4]



12. Explain the concept of transitive closure and use Warshall's algorithm to find transitive closure for following graph: [2+4]



TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2078 Chaitra

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BEI, BCT	Pass Marks	32
Year / Part	II / II	Time	3 hrs.

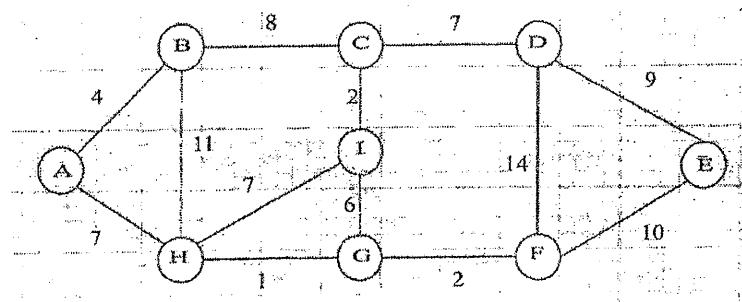
Subject: - Data Structure & Algorithm (CT 552)

- ✓ 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 importance of data structures and point out the areas in which data structures are being applied extensively. Explain why List is called as Abstract Data type (ADT). [2+2]
2. Define stack. Convert following infix expression to postfix expression showing stack status in each step: $A \times (B+C) - (B^D) \times A + E / F$. [2+6]
3. Explain the significance of dynamic list data structures over static list. Write algorithms to implement list structure using array for the operations:
 - a) Insert at given position in the list
 - b) Delete from given position in the list
[2+4]
4. Consider two linked lists that represent two polynomials. Subtract them and return the difference as a linked list. Write an algorithm and program to implement above scenario. [10]
5. Explain how recursion uses stack data structures, use factorial of number calculation to illustrate the concept. [6]
6. Explain pre-order and in-order tree traversal with example. Construct an AVL balanced tree with given set of data: 15,20,24,10,13,7,30,36,25 [3+3+6]
7. Construct a Huffman code for the given symbols. [6]

Symbol	A	B	C	D	E	F
Frequency (in thousands)	35	18	10	20	9	8

8. Write an algorithm for quick sort. Sort the following numbers using quick sort: 30,25,79,19,48,28,21,44 and 120. [8]
9. What is collision? What are the techniques used for collision resolution in hashing? Insert the keys: 62,37,36,44,67,91,82, and 31 using quadratic probing method. The hash function is: $h(key) = key \% 10$ (where 10 is the table size). [1+2+5]
10. How do you find complexity of any algorithm? Explain with suitable example. [4]
11. Explain the concept of minimum spanning tree (MST) and find MST for the following graph using Kruskal's algorithm: [2+6]



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Examination Control Division
2078 Poush

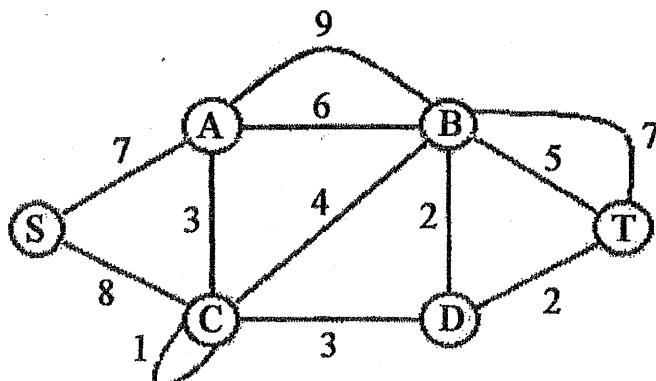
Exam.		Back
Level	BE	Full Marks
Programme	BEI, BCT	Pass Marks
Year / Part	II / II	Time

Subject: - Data Structure and Algorithm (CT 552)

- ✓ 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 Data Structure. Write down the difference between linear and non-linear data structure. [2+3]
- b) Convert the following infix expression postfix expression showing stack status in each step.

$$A + (B * C - (D / E ^ F) * G) * H$$
 [5]
2. a) What is a queue? Explain circular queue as an ADT. [2+3]
- b) How do you represent polynomial equation using linked list? Write an algorithm to add two polynomial equations using linked list. [2+3]
3. a) Explain different types of recursion. Construct a recursion tree for Tower of Hanoi with 3 disks. [2+4]
- b) Define Omega and Theta notation with suitable example. [4]
4. Why do you need external sorting? Sort the following elements using max heap and also analyse its computational complexity.
 42, 36, 56, 27, 63, 72, 62, 15 [2+6+2]
5. Define B-tree with its properties. construct a B-tree of order 5 from the following data:
 1, 7, 6, 2, 11, 4, 8, 13, 10, 5, 19, 9, 18, 24, 3, 12, 14, 20, 21, 16 [3+7]
6. a) Construct a binary tree from its given pre-order and in-order traversals. [6]
 Pre order: A, H, G, I, F, E, B, C, D
 In order: G, H, F, I, E, A, B, D, C
 b) Briefly explain pre-order, in-order, post-order tree traversal methods with example. [4]
7. Briefly explain different types of collision resolution techniques. Consider a hash table of size 10. Using quadratic probing, insert the keys 52, 77, 26, 44, 33, 91 and 81 into the table. (Take C1 = 1 and C2 = 3) [4+6]
8. Differentiate between breadth first and depth first search algorithms. Create a minimum spanning tree for the following graph using Kruskal's algorithm. [4+6]

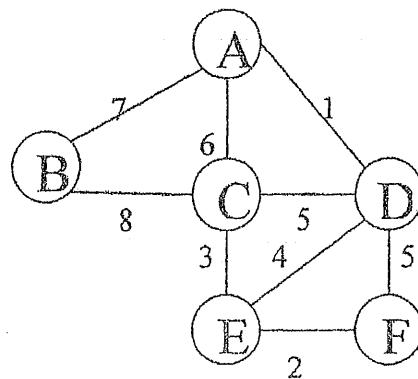


Exam.
Level	BE	Full Marks	80
Programme	ECT	Pass Marks	32
Year / Part	II / II	Time	3 hrs.

Subject: - Data Structure and Algorithm (CT 552)

- ✓ 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. Compare primitive and non-primitive data structures. [4]
2. Convert the infix expression: $A+B-(C*D/E+F)-G*H$ into postfix expression using stack. Evaluate the converted postfix expression using stack for $A=10$, $B=5$, $C=4$, $D=6$, $E=3$, $F=8$, $G=2$, and $H=1$. [4+4]
3. What are the problems with linear queue? Explain different queue operations in circular queue. [2+6]
4. What is recursion? Write recursive module for Tower of Hanoi (ToH) problem. [2+4]
5. Explain about Big-Oh notation with its significance and limitation. [4]
6. What are different traversal methods in tree? Construct a binary tree from its given pre-order and in-order traversal.
 Pre-order: A H G I F E B C D
 In-order: G H F I E A B D C [2+6]
7. Insert 2, 3, 9, 6, 11, 13, 7, 12 in a hash table using modulo division method with 2^k+3 as hash function. Resolve collision using double hashing. Take second hash function as 3^k+1 . [8]
8. Define stability and efficiency of sorting algorithms. Sort 14, 2, 205, 918, 231, 4, 44, 1110, 666 and 840 radix sort. [3+5]
9. What are the advantages of doubly linked list over singly linked list? Write an algorithm to insert a node before a given node in a singly linked list. [2+4]
10. Define red-black tree with example. Construct an AVL tree by inserting following elements in given order: 63, 9, 19, 27, 18, 108, 99, 81, 41. [4+6]
11. Define minimum spanning tree with suitable example. Show step by step solution to find the minimum spanning tree of the graph below using Prim's algorithm. [4+6]



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 2077 Chaitra

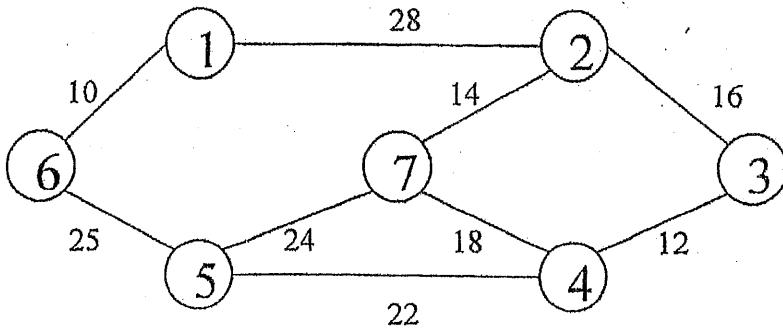
Exam.	Regular		
Level	BE	Full Marks	80
Programme	BCT, BEI	Pass Marks	32
Year / Part	II / II	Time	3 hrs.

Subject: - Data Structure and Algorithm (CT 552)

- ✓ 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. Briefly explain the statement "ADT provides extraction" with suitable example. [4]
2. Define stack. Convert following infix expression showing stack status after every step. [2+6]

$$(A*B*((C^X+D^Y)+E/Z)^*F))$$
3. What is queue? What are different operations that can be performed over queue? [2+6]
4. Illustrate the use of stack in recursion taking any recursive program of your choice. [6]
5. Briefly explain the significance of asymptotic notations with suitable diagram. [4]
6. Describe an AVL tree. Construct AVL tree for following sequence of elements: 5, 10, 15, 30, 25, 20, 4, 2, 1 [2+6]
7. Define collision. Insert the keys 30, 15, 69, 28, 49, 58, 79 and 91 using quadratic probing method. The hash function is : $h(key) = key \% 10$ where 10 is the table size. [2+6]
8. Create a heap tree showing each insertion steps for the following data: 28, 24, 50, 36, 42, 58, 22, 56, 46. Use same heap tree to sort the data showing each intermediate step. [8]
9. Explain with example how n^{th} node in a singly linked list can be deleted? [6]
10. Explain balancing of B-tree with example. Construct an AVL tree from following sequence of data: 10, 20, 15, 25, 30, 16, 18, 19. [4+6]
11. Define depth first and breadth first traversal. Construct the minimum spanning tree (MST) for the given graph using Kruskal's algorithm. [4+6]



Exam.	Back	
Level	Full Marks	80
Programme	Pass Marks	32
Year / Part	Time	3 hrs.

Subject: - Data Structures and Algorithm (CT 552)

- ✓ 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 data structure with its types. [4]
2. Define stack. Evaluate the postfix expression $A^*BC-DE^*F/+G^*$ with status of stack where $A=2$, $B=3$, $C=10$, $D=5$, $E=2$, $F=4$ and $G=6$. [1+4]
3. Differentiate linear queue and circular queue with suitable example. [5]
4. Explain array representation of list ? How is it different from dynamic list? [4+2]
5. Explain operations of stack using linked list. How do you add a node at the K^{th} position of the doubly linked list? [5+5]
6. What are tail and non- tail recursions? Write an algorithm for TOH with 'n' disks and generate a recursion tree of TOH problem with 3 disks. [2+2+4]
7. What do you mean by asymptotic notation? Define Big-O notation with its properties. [2+2]
8. Explain deletion of node with two children in BST with suitable example. Construct an AVL tree for following data: 36, 12, 42, 23, 65, 96, 37, 79, 19, 24, 33 and 44. [5+5]
9. Explain selection sort. Sort the numbers 92, 73, 22, 49, 46, 98, 21, 9, 70 and 63 using selection sort. [4+4]
10. Define binary search with example. What is the cause of collision in hashing and explain any one method for the collision resolution. [4+2+4]
11. What are different representation methods of graph? Explain Kruskal's algorithm to find Minimum Spanning Tree with example. [4+6]

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

Subject: - Data Structure and Algorithm (CT552)

- ✓ 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 Abstract Data Type? What is difference between primitive and non primitive data structure? [2+2]
2. Define stack. Convert given infix expression to postfix showing stack status in each step: [2+6]

$$(A+B^*(C+D/E)^F*G)$$
3. Define linear queue and circular queue. Explain queue operation in circular queue. [3+5]
4. Discuss advantages and disadvantages of recursion. Generate a recursion tree for TOH problem consisting 3-discs. [3+5]
5. Differentiate between array implementation and Dynamic implementation of list with suitable example. [4]
6. Write an algorithm and element after K^{th} node in doubly linked list. Explain the advantages and disadvantages of using doubly linked list. [4+4]
7. Define almost complete binary tree. Construct a tree from its given preorder and inorder traversals. [2+6]

Inorder: EACKFHDBG

Preorder: FAEKCDHGB

8. Write an algorithm for insertion sort. Sort the following number using radix sort: 141, 456, 342, 789, 90, 2, 870, 192, 938 and 243 [4+6]
9. Draw hash table obtained from double hashing with hash functions: $h_1(K) = K \bmod 11$ and $h_2(K) = K \bmod 9$ for the given keys: 76, 36, 47, 49, 21, 65 with table size 11. Use $hp(k,i) = (h_1(k) + i * h_2(k)) \bmod m$. [8]
10. Explain Big-oh notation with its significance and limitation. [4]
11. What is minimum spanning tree? Explain Warshall's algorithm with example. [2+8]

Examination Control Division

2075 Baisakh

Exam.	Back		
Level	BE	Full Marks	80
Programme	BCT	Pass Marks	32
Year / Part	II / II	Time	3 hrs.

Subject: - Data Structure and Algorithm (CT552)

- ✓ 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.

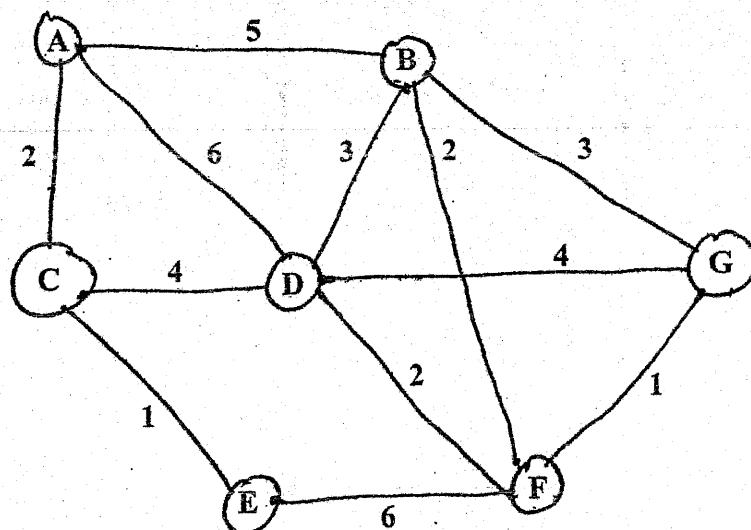
1. Define ADT and construct ADT of Linked List using value definition and operator definition. [2+4]
2. Define stack. How to convert infix to postfix notation? Explain with example. Evaluate the postfix expression $AB+C^*DEFG-*+$ with status of stack where $A = 2$, $B = 3$, $C = 10$, $D = 5$, $E = 2$, $F = 4$ and $G = 6$. [2+4+4]
3. Explain array representation of list? How does it differ from dynamic list? [4+2]
4. Write algorithms of implementation of stock and queue using singly linked list. [10]
5. How recursive algorithm uses STACK to store intermediate results, illustrate with an example? Distinguish between normal function and recursive function. [5+3]
6. Explain deletion of node with one child in BST with suitable example. Construct a B-tree of order 5 for following data: 82, 12, 22, 23, 56, 96, 37, 99, 59, 74, 28, 65, 60 and 44. [5+5]
7. Explain shell sort. Sort the numbers 92, 83, 22, 49, 36, 98, 12, 9, 70 and 51 using shell sort. [4+4]
8. Compare sequential search with binary search. Discuss about linear probing and quadratic probing. [5+5]
9. Describe the importance of growth function in algorithm. Discuss about theta function, Big-Oh function and Omega function. [2+4]
10. Write an algorithm for Warshall's algorithm and illustrate with an example. [6]

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

Subject: - Data Structure and Algorithm (CT552)

- ✓ 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 data structure with its importance. [4]
2. Convert $A + B - C * (D - E + F/G) / H$ expression into postfix expression using stack. [10]
3. Define queue. Explain enqueue and dequeue operation with example. [1+4]
4. Write algorithms of insertion and deletion of data in array implementation of lists. [6]
5. How do you delete a node at the end of the doubly linked list? Explain how the addition of polynomial equations is done using linked list. [5+5]
6. What is tree recursion? Write an algorithm for TOH with 'n' disks and generate a recursion tree of TOH problem with 3 disks. [1+3+4]
7. Discuss about AVL rotations with suitable examples. Create a AVL balanced tree for data sequence 10 20 30 50 45 40 8 5 3. [6+6]
8. Explain selection sort. Sort data sequence 40 90 20 -10 30 5 60 100 80 using selection sort method. [10]
9. Define big-O notation and Big-Ω notation with their respective curves. [5]
10. Explain Depth first traversal in graph. Create minimum spanning tree for the following graph using Kruskal's algorithm. [4+6]



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

Subject: - Data Structure and Algorithm (CT552)

- ✓ 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 primitive and non-primitive data structure. [4]
2. Explain how a circular queue differ from linear queue with suitable example. Show status of stack while converting following infix expression to postfix expression:
 $A+B-(C*D/E+F)-G*H$. [5+5]
3. Differentiate between a static and dynamic list structure and write an algorithm forgetnode () and freenode () of static list structure. [2+2+2]
4. How do you perform a push and pop operation in stack as a linked list? How do you insert and delete a node at the k^{th} position of the doubly linked list. [5+5]
5. Explain how a recursive algorithm uses stack with suitable illustrative stack diagram. [8]
6. Draw a binary Tree: [6]

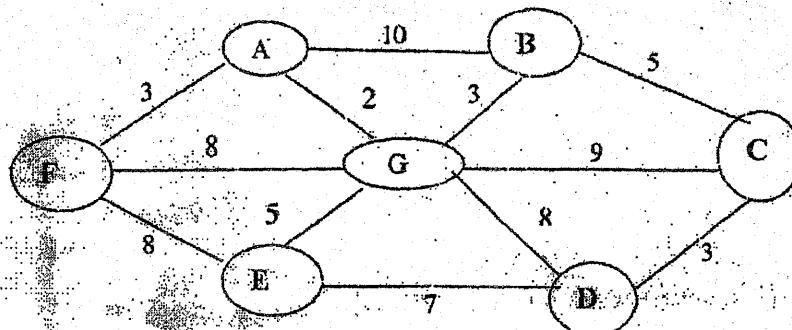
Preorder F A E K C D H G B
 Inorder E A C K F H D B G
7. Prove that strictly binary tree with n leaves contain $2n-1$ nodes. [6]
8. Provide best case, average case and worst case for following algorithms in Big-Oh: bubble sort, insertion sort, merge sort and selection sort. Construction heap sort for following given list with an algorithm: 37, 33, 26, 92, 57, 18, 48, 25, 12, 86, 42, 22. [2+6]
9. Explain a binary search with example. Consider a hash table of size 10. Using linear probing, insert the keys 62, 37, 36, 44, 67, 91, 82 and 107. [3+5]
10. Define Omega and theata notation with suitable example. [4]
11. Write an algorithm for warshall's algorithm with suitable example. Define Breadth first traversal and depth first traversal with an example. Define Kruskal's Algorithm with suitable example. [3+3+4]

Exam.	New Back (2066 & Later Batch)		
Level	BE	Full Marks	80
Programme	BCT	Pass Marks	32
Year / Part	II / II	Time	3 hrs.

Subject: - Data Structure and Algorithm (CT552)

- ✓ 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 value definition and operator definition of ADT and apply it to describe STACK. [4]
2. What is a stack data structure? Is stack a linear or non linear data structure. [3+2]
3. When do you get error message "Queue overflow and Queue underflow"? Explain with example. [2+3]
4. How do you implement array to represent queue as list? [6]
5. In a linked list data cannot be accessed randomly. Justify with suitable example. Write complete algorithm to implement circular queue linked list. [2+8]
6. Explain a Tower of Hanoi for '3' disks and also generate recursion tree. Explain the basic principle of recursion with example. [6+2]
7. Write an algorithm to implement a Binary Search Tree using doubly linked list. [6]
8. Describe an AVL tree. Construction AVL tree for following sequence of elements 3, 2, 1, 4, 5, 6, 7, 16, 15, 14, 13, 12 [2+4]
9. Explain Radix sort and sort the numbers 345, 654, 924, 123, 56, 72, 555, 808, 911 and 57. [8]
10. Write down the algorithm for binary search with suitable example. [8]
11. Explain about Big-oh notation with its significance and limitation. [4]
12. Explain Kruskal algorithm for finding minimum spanning tree in a graph. [10]



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

Subject: - Data Structure and Algorithm (CT552)

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

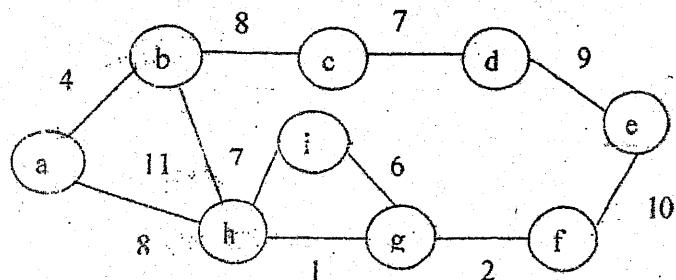
1. Define a data structure? Explain the basic data structure operations. [4]
2. What is a stack? Write an algorithm to convert infix expression into postfix expression using stack. [1+4]
3. Define a queue. Explain enqueue and dequeue operation in circuit queue. [1+4]
4. Differentiate static and dynamic implementation of list with suitable example. [6]
5. Define different types of linked list with suitable example. [5]
6. Write an algorithm creates a single linked list. [5]
7. Do you think recursive function is slow? Compare recursive and non-recursive functions.
Draw recursion tree for Tower of Hanoi assuming 4 disks. [1+2+5]
8. Create an AVL balanced tree for the set of data 10, 20, 30, 35, 50, 70, 40, 80, 60, 65 by explaining each rotation rules used. [6]
9. Construct B-tree of order 5 for the set of data C N G A H E K Q M F W L T Z D P R X Y S showing each steps. [6]
10. Define a radix sort with its algorithm. Trace the steps to sort the following set of data using merge sort: 85, 76, 46, 92, 30, 41 and 12. [5+3]
11. How a linear probing, quadratic probing and double hashing techniques are used to resolve collision? Explain with suitable example. [8]
12. Define an Omega and Theta notation with suitable example. [4]
13. Explain a breadth first traversal in graph with suitable example. Explain Kruskal's algorithm to find minimum spanning tree with suitable example. [5+5]

Exam.	New Back (2066 & Later Batch)		
Level	BE	Full Marks	80
Programme	BCT	Pass Marks	32
Year / Part	II / II	Time	3 hrs.

Subject: - Data Structure and Algorithm (CT552)

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

1. Define a data structure and also write down the difference between primitive data structure and non-primitive data structure. [2+2]
2. Convert $a^* b^* c - d + (e/f^* g)/(k-1)$ into prefix and postfix expression. Write an algorithm for top of stack fix stack operation. [4+3]
3. Write an algorithm to design a data structure that provides enqueue, dequeue and display operations. The first two are the normal circular queue operations and the last one returns all elements in the circular queue without removing them from queue. [5]
4. Why do you choose either static implementation or dynamic implementation for list? State the reasons. [4]
5. Define a doubly linked list with its advantages and disadvantages. Write an algorithm to insert an element before K^{th} node in doubly linked list. [3+3]
6. Explain how do you add two polynomials using linked list. [4]
7. Define a recursion. Which algorithm would you refer between iterative and recursion. [1+2]
8. Explain TOH problem with its solution for 'n' disks. [5]
9. Define Huffman tree with its properties and example. Construct a B-tree of order 3 for given set of data: 52, 46, 27, 81, 90, 108, 72, 110, 35, 115, 121 and 86. [6+6]
10. Create a heap tree showing each insertion steps for the following data. Use the same heap tree to sort the data showing each intermediate steps 14, 12, 25, 18, 21, 29, 11, 28, 23. [8]
11. Explain a binary search with example. Explain the chaining strategy for collision resolution. [4+4]
12. Define Big O, Big Omega and Big Theta notation. [4]
13. What are the differences between DFs and BFs? [5]
14. Find the minimum spanning tree of the following graph using Kruskals algorithm. [5]



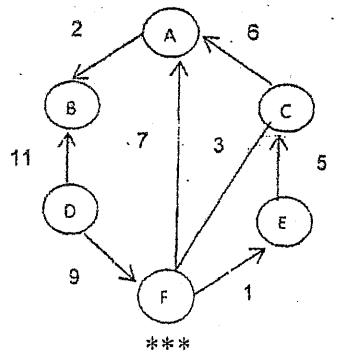
Exam.	Regular/Supplementary		
Level	BE	Full Marks	80
Programme	BCT	Pass Marks	32
Year / Part	II / II	Time	3 hrs.

Subject: - Data Structure and Algorithm (CT552)

- ✓ 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 ADT and Data Structure. What are the significant traits of good algorithm? [2+2]
2. a) What is the importance of postfix expression? Convert the given infix expression $(a+b*c+(d/e*f)-g)$ into equivalent postfix expression showing the status of stack in each steps. [2+3]
 - b) How elements are inserted and deleted in circular queue? Explain with example. [5]
3. Compare static and dynamic implementation of list with suitable example. [6]
4. Suppose you have a doubly linked list that stores bank customers information. Explain how a customer with account number 00056PR can be deleted and how a new customer can be inserted. What is the difference in this implementation relative to singly linked list? [6+4]
5. a) What are the main characteristics of recursion? Write three methods for solving recurrences. [2+2]
 - b) How do you solve TOH using recursion? Show the steps to solve TOH problem for 3 disks. [4]
6. a) Construct expression tree for $(a+(b*c)-d+(e*f/g))$ and traverse it according to pre-order and in-order traversal algorithm. [6]
 - b) Write an algorithm for the insertion of B-Tree. Create an AVL tree for the following data: jan, feb, mar, apr, may, jun, jul, aug, sep, oct, nov, dec [6]
7. Discuss the algorithm merge sort. Show the steps to sort the data 5, 2, 4, 6, 1, 3, 2, 6 using merge sort. [3+5]
8. What is collision? What are the techniques used for collision resolution in hashing technique? Explain two different methods with suitable example. [8]
9. Why do we use asymptotic notations during algorithm analysis? Show that whether the following assertion is true or false, justify. [1+3]

$$\frac{1}{2} n(n - 1) \in \Theta(n^2)$$
10. a) Define graph with its different representation techniques. [1+3]
 - b) Discuss Dijkstra's shortest path algorithm. Find the shortest paths for given graph with source node 'F' using Dijkstra's algorithm. [2+4]

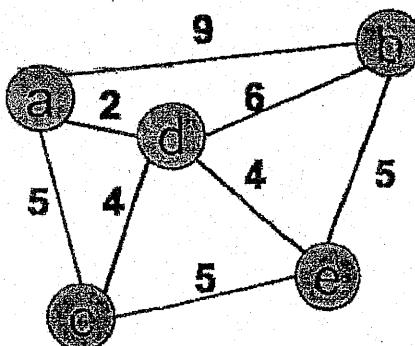


Exam.	New Back (2066 & Later Batch)		
Level	BE	Full Marks	80
Programme	BCT	Pass Marks	32
Year / Part	II / II	Time	3 hrs.

Subject: - Data Structure and Algorithms (CT552)

- ✓ 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 data structure? What are the different types of data structures and operations that can be carried out on them? [1+3]
2. a) Define Stack. Write an algorithm to convert given infix expression to postfix expression. [1+4]
- b) What is polish notation and reverse polish notation? Convert the following expression to postfix expression using Stacks: P: $(a + b * c + (d * e + f) * g)$ [2+3]
3. Implement a linear queue as a list by using static implementation. Write pseudo code for this implementation. [6]
4. a) Mention the significance of circular linked list with suitable example. [5]
- b) Explain how you add two polynomials with the help of linked list. [5]
5. a) Explain direct and indirect recursion with suitable example. [4]
- b) What is box trace? Construct a recursion tree for tower of Hanoi problem consisting of 3 disks. [1+3]
6. a) Discuss the advantage of AVL Tree. Construct an AVL Tree for given integers: 52, 65, 72, 15, 11, 32, and 20. [2+5]
- b) Define an almost complete binary tree. Show that the depth of complete binary tree is $\log_2(T + 1) - 1$ where T is the total number of nodes in a tree. [2+3]
7. Trace the sorting steps in merge sort and radix sort for sorting the data 142, 523, 228, 375, 462, 198, 249, 144, 123 in ascending order. [8]
8. How does quadratic probing help to reduce bad clustering problem associated with linear probing. Insert the following data elements into hash table using hash function $h(k) = k \bmod m$, take $m = 13$, assume collisions are handled by chaining. [2+6]
 Keys for hashing are: 5, 28, 19, 25, 20, 43, 22, 27, and 30.
9. What is the usage of asymptotic notation? Explain big-O notation with its properties. [1+3]
10. Write two properties of spanning tree. Find MST of graph-1 using Round Robin Algorithm. [2+8]

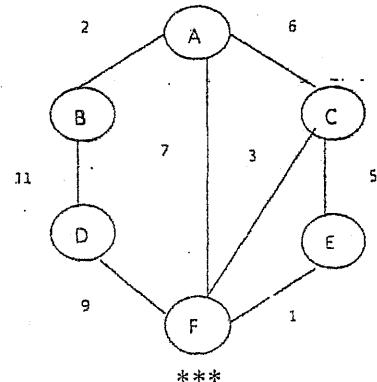


Exam.	Regular		
Level	BE	Full Marks	80
Programme	BCT	Pass Marks	32
Year / Part	II / II	Time	3 hrs.

Subject: - Data Structure & Algorithm (CT552)

- ✓ 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 ADT with suitable example. [4]
2. a. Define Stack. How does static implementation and dynamic implementation of stack differ? Explain. [1+4]
- b. What is queue? Explain enqueue and dequeue operation. [1+4]
3. Explain array implementation of list. State the reason why would you choose either static implementation or dynamic implementation for list. [3+3]
4. a. Define different types of linked list with suitable example. [5]
- b. Explain how you insert and delete k^{th} element in doubly linked list. [5]
5. a. What are the conditions for solving the problems recursively? [3]
- b. Explain TOH problem with its solution for 'n' disks. [5]
6. a. Explain different traversal methods for a binary tree. What will be the result of pre-order traversal for given binary search tree with nodes: 20, 10, 18, 4, 8, 5, 13, 16, 47, 11, and 27. [3+4]
- b. Write down the properties of B-tree. Construct a B-tree of order 5 for following data: 3, 14, 7, 1, 8, 5, 11, 17, and 13? [2+3]
7. Explain radix sort. Sort the given data 32, 45, 60, 83, 75, 43, 70, and 69 using radix sort. [3+5]
8. Write down the algorithm for binary search with suitable example. What is the complexity of binary search? [6+2]
9. Define Omega and Theta notation with suitable example. [4]
10. a. Discuss depth-first traversal for graph with example. [5]
- b. What do you mean by minimum spanning tree? Find out the minimum spanning tree for given graph using Kruskal's algorithm. [5]



Exam. New Back (2066 & Later Batch)			
Level	BE	Full Marks	80
Programme	BCT	Pass Marks	32
Year / Part	II / II	Time	3 hrs.

Subject: - Data Structure and Algorithm (CT552)

- ✓ 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 data structures? Give an example of abstract data type. [1+3]
2. Convert the following infix expression into postfix and also evaluate it: [4+1]

$$A + (B * C - (D / E ^ F) * G) * H$$
3. Write an algorithm to implement circular queue with the condition for insertion, deletion, queue full and queue empty. [5]
4. Write algorithms to insert and delete a node before a node in a singly linked list. How can you implement stack and queue using linked list? [5+5]
5. What is list? Explain the operations that can be performed in lists. [2+4]
6. What is tail and non-tail recursion with example? Write an algorithm for solving a Tower of Hanoi (TOH) problem using recursion. [3+5]
7. What is an almost complete binary tree? Create an AVL tree using the following data sets: jan, feb, mar, apr, may, jun, july, aug, sept, oct, nov, dec. [2+4]
8. Define Red Black tree. Write an algorithm for constructing a Huffman Code. [2+4]
9. Differentiate between stable and unstable sorting with example. Construct a heap for the following data: 8, 10, 5, 12, 14, 18, 19. What is the time complexity for sorting the unsorted elements using heap-sort? [2+4+2]
10. What is the importance of using Sentinel during sequential searching? Explain three different methods of collision resolution with reference to hashing. [2+6]
11. Justify $\frac{1}{2} (n(n-1)) \leq n^2$. Differentiate between small o and small ω notations. [2+2]
12. What is transitive closure? How is the breadth first algorithm implemented? Explain Prim's algorithm for finding minimum spanning tree along with an example. [2+3+5]

TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division

2081 Ashwin

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

Subject: - Applied Mathematics (SH 551)

- ✓ 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 an analytic function of a complex variable. Show that $u(x, y) = 2x + x^3 - 3xy^2$ is harmonic and find corresponding harmonic conjugate. [1+4]
2. Find linear transformation which maps the points $z = 0, 1, \infty$ into the points $w = -3, -1, 1$ respectively. Also find fixed point of transformation. [4+1]
3. Evaluate $\int_C \frac{2z+1}{z^2+z} dz$ where $C: |z| = \frac{1}{2}$ by Cauchy's integral formula. [5]
4. Expand the function $f(z) = \frac{1}{1-z}$ at $z = 3i$ in a Taylor's series. [5]
5. Define the pole of order m of a complex variable. Using Cauchy's Residues theorem evaluate the integral $\oint_C \frac{e^z}{\cos nz} dz$, where C is the unit circle $|z|=1$. [1+4]
6. Evaluate $\int_0^{2\pi} \frac{d\theta}{5-4 \sin \theta}$ by contour integration in the complex plane. [5]
7. Obtain the Z-transform of (i) $t e^{-at}$ (ii) $\sin at$ [2.5+2.5]
8. State and prove final value theorem of Z-transform. [5]
9. Find the inverse Z-transform of $\frac{3z^2+2z+1}{z^2+3z+2}$. [5]
10. Solve the difference equation $x(k+2) - 3x(k+1) + 2x(k) = 4^k$ given that $x(0) = 0, x(1) = 1$ by using Z-transform. [5]
11. A string is stretched between two fixed points $(0,0)$ and $(l, 0)$ and released from rest using the initial deflection given by $u(x, 0) = \begin{cases} \frac{2kx}{l}, & 0 < x < \frac{l}{2} \\ \frac{2k(l-x)}{l}, & \frac{l}{2} < x < l \end{cases}$. Find the displacement $u(x, t)$ of the particles of the string. [10]
12. A rectangular metallic plate with insulated surface is 8 cm. wide and so long compared to its width that it may be considered infinite in length without any appreciable error. If the temperature along one short edge $y = 0$ is given by $u(x, 0) = 100 \sin \frac{\pi x}{8}$ for $0 \leq x \leq 8$ while the long edges $x = 0$ and $x = 8$ as well as the short edge are kept at $0^\circ C$. Find the steady temperature function $u(x, y)$. [10]
13. Find the Fourier sine integral of function $f(x) = e^{-kx}$ ($x > 0, k > 0$) and hence show that $\int_0^{\infty} \frac{\lambda \sin \lambda x}{\lambda^2 + k^2} d\lambda = \frac{\pi}{2} e^{-kx}; x > 0, k > 0$. [5]
14. Find Fourier transform of $f(x) = \begin{cases} \sin x ; & 0 < x < \pi \\ 0, & \text{otherwise} \end{cases}$ and hence show that $\int_0^{\infty} \frac{\cos \frac{\pi x}{2}}{1-x^2} dx = \frac{\pi}{2}$. [5]

TRIBHUVAN UNIVERSITY
 INSTITUTE OF ENGINEERING
Examination Control Division
 2080 Chaitra

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

Subject: - Applied Mathematics (SH 551)

- ✓ 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 harmonic function of a complex variable. Show that $u(x, y) = y^3 - 3x^2y$ is harmonic and find its corresponding analytic function. [5]
2. Find the linear transformation which maps the points $z = 2, i, -2$ into the points $w = 1, i, -1$. [5]
3. Evaluate $\int_C \frac{\cos \pi z^2}{(z-1)(z-2)} dz$ where $C: |z| = 3$ by using Cauchy's integral formula. [5]
4. Obtain the Laurent's series expansion of function $f(z) = \frac{z^2-1}{(z+2)(z+3)}$ in the region $2 < |z| < 3$. [5]
5. Define zeros and poles of order m for function of a complex variable. Find poles and residues of $f(z) = \frac{z(z-2)}{(z+1)^2(z^2+1)}$ [5]
6. Evaluate integral $\int_0^{2\pi} \frac{1}{2+\cos \theta} d\theta$ by contour integration in the complex plane. [5]
7. Find the Z-transform of; (i) $t^2 e^{-at}$, $t \geq 0$ (ii) $\sin h k\theta$, $k \geq 0$ [2.5+2.5]
8. Obtain the Z-transform of $(1 - e^{-at})$, $t \geq 0$ and hence evaluate $x(\infty)$ by using the final value theorem. [5]
9. Find the inverse Z-transform of function $X(z) = \frac{z^2}{(z+1)(z-1)^2}$. [5]
10. Solve the difference equation $x(k+2) + 5x(k+1) + 6x(k) = 2^k$ given that $x(0) = 0$, $x(1) = 1$. [5]
11. Solve the one-dimensional wave equation for a tightly stretched string of length ℓ fixed at both ends if the initial deflection is $u(x, 0) = \ell x - x^2$ and the initial velocity is zero. [10]
12. Derive one dimensional heat equation $\frac{\partial u}{\partial t} = c^2 \frac{\partial^2 u}{\partial x^2}$ and find it's all possible solutions. [10]
13. Find Fourier cosine integral of $f(x) = e^{-x}$ and hence show that $\int_0^\infty \frac{\cos \omega x}{1+\omega^2} d\omega = \frac{\pi}{2} e^{-x}$. [5]
14. Find the Fourier transform of $f(x) = \begin{cases} 1 & \text{for } |x| < 1 \\ 0 & \text{for } |x| > 1 \end{cases}$ and then evaluate $\int_0^\infty \frac{\sin x}{x} dx$ [5]

TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2080 Ashwin

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

Subject: - Applied Mathematics (SH 551)

- ✓ 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 analytic function of a complex variable. Show that the function $f(z) = \frac{1}{z^n}$ is analytic everywhere except at origin. [1+4]
2. Find the linear transformation which maps the points $Z = 2, i, -2$ into the points $w = 1, i, -1$. [5]
3. Evaluate $\int_C \frac{2z^2 + z}{z^2 - 1} dz$ where C is unit circle $|z|=1$ using Cauchy integral formula. [5]
4. Find the Laurent's series of $f(z) = \frac{2z+1}{z^3 + z^2 - 2z}$ in the region $0 < |z-1| < 1$ [5]
5. Evaluate $\int_C \frac{z^2}{(z-1)(z+3)} dz$ where $C: |z|=2$ by Cauchy Residue Theorem. [5]
6. Evaluate integrals $\int_{-\infty}^{\infty} \frac{x^2}{(x^2 + 1)(x^2 + 4)} dx$ by contour integration in complex plane. [5]
7. Define Z – transform and find the z-transform of
 - te^{-at}
 - $\sin at$
8. State and prove shifting theorem to the right of z-transform [5]
9. Find the inverse z-transform of $\frac{2z}{z^2 - z + 1}$ using inversion integral method [5]
10. Solve the difference equation by using Z-transform [5]

$$x(k+2) - 4x(k+1) + 4x(k) = 2^k \text{ given that } x(0) = 0, x(1) = 1.$$
11. The vibration of an elastic string is governed by the partial differential equation $\frac{\partial^2 u}{\partial t^2} = \frac{\partial^2 u}{\partial x^2}$. The length of string is π and ends are fixed. The initial velocity is zero and initial deflection is $u(x, 0) = k(\sin x - \sin 2x)$. Find the deflection $u(x, t)$ of the vibration of string. [10]
12. Derive two-dimensional heat equation in steady state (Laplace's equation) and solve it. [10]
13. Show that by using Fourier sine integral representation of $f(x) = e^{-x} \cos x$

$$\text{is } \int_0^\infty \frac{W^3 \sin wx}{W^4 + 4} dw = \frac{\pi}{2} e^{-x} \cos x \text{ for } x > 0. \quad [5]$$
14. Find the Fourier transform of $(x) = 1$ for $|x| < 1$

$$= 0 \text{ for } |x| > 1. \quad [5]$$

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

Subject: - Applied Mathematics (SH 551)

- ✓ 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 harmonic function. Determine the analytical function

$$f(z) = u + iv \text{ if } u = 3x^2y - y^3. \quad [1+4]$$

2. Find the linear fractional transformations that maps $z = 0, -i, 2i$ into the points $w = 5i, \infty, -i/3$ respectively. [5]

3. State cauchy's integral theorem. Apply cauchy's integral formula to evaluate

$$\int_C \frac{e^z}{(z-1)(z-3)} dz \text{ where } C: |z| = 2. \quad [1+4]$$

4. Expand the laurent's series of the function

$$f(z) = \frac{1}{z^2 - 3z + 2} \text{ in the region } |z| < 2. \quad [5]$$

5. Evaluate $\int_C \frac{2z-1}{z(z+1)(z-3)} dz$ where C is the circle $|z|=2$ by residue method. [5]

6. Evaluate $\int_0^{2\pi} \frac{2d\theta}{2 + \cos\theta}$ by contour integration. [5]

7. Find the z-transform of a^k for $k \geq 0$, and hence obtain the z-transform of $a^k \sin k\theta$. [2+3]

8. State and prove initial value theorem. [5]

9. Find the inverse Z – transform of $\frac{z}{(z-1)^2(z-2)}$ by inversion integral method. [5]

10. Solve the difference equation [5]

$$x(k+2) - 4x(k+1) + 4x(k) = 0 \text{ with given conditions } x(0) = 0, x(1) = 1.$$

11. Derive one dimensional wave equation and find its all possible solutions. [10]

12. Solve the one dimensional heat equation $\frac{\partial u}{\partial t} = c^2 \frac{\partial^2 u}{\partial x^2}$ with boundry and initial condition

$$u(0, t) = 0, u(\int_1 t, t) = 0 \text{ and } u(x, 0) = \frac{100x}{t} \quad [10]$$

13. Find that the Fourier Cosine integral representation of $f(x) = e^{-kx}$ ($x > 0, k > 0$) and [5]

$$\text{Hence show that } \int_0^\infty \frac{\cos \omega x}{k^2 + \omega^2} d\omega = \frac{\pi}{2k} e^{-kx}, x > 0, k > 0.$$

14. Find the Fourier transform of the function e^{-x^2} , also verify that convolution theorem for the functions $f(x) = e^{-x^2}$ and $g(x) = e^{-x^2}$ [5]

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

Subject: - Applied Mathematics (SH 551)

- ✓ 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. Show that $u(x, y) = \sin x \cosh y$ is a harmonic function. Also find its harmonic conjugate $v(x, y)$ such that $u + iv$ is analytic. [5]
2. Define Bilinear transformation. Find the Bilinear transformation that maps $z_1 = -2, z_2 = 0, z_3 = 2$ into the points $\omega_1 = 0, \omega_2 = i$ and $\omega_3 = -i$ respectively. [1+4]
3. State and prove Cauchy's integral theorem. [5]
4. State Taylor's theorem for function $f(z)$ of complex variable z . When does Taylor's series reduce to Maclaurin's series? Find Maclaurin's series expansion of the function $f(z) = \tan z$ upto four terms. [1+2+2]
5. Evaluate $\oint_C \frac{2z-1}{z(z+1)(z-3)} dz$, where C is the circle $|z| = 2$ by residue method. [5]
6. Evaluate $\int_0^{2\pi} \frac{d\theta}{2 + \cos \theta}$ by contour integration in the complex plane. [5]
7. Define Z-Transform. Find the Z-Transform of $e^{-bt} \sin \omega t$. [5]
8. State and prove final value theorem for Z-Transform. [5]
9. Find the inverse z-transform of $\frac{2z^2 + 3z}{(z+2)(z-4)}$ by using partial fraction method. [5]
10. Solve the difference equation $x(k+2) - 3x(k+1) + 2x(k) = 4^k$ given that $x(0) = 0, x(1) = 1$. [5]
11. A tightly stretched string with fixed ends, $x = 0$ and $x = l$ is initially in position given by $u(x, 0) = u_0 \sin \left(\frac{3\pi x}{l}\right)$. If it is released from rest in this position, find the displacement at any time t at distance x from one end. [10]
12. Derive one dimensional heat equation and find its possible solutions. [10]
13. Show that the Fourier Cosine integral representation of $f(x) = e^{-x}$ is $\int_0^\infty \frac{\cos \omega x}{1 + \omega^2} d\omega = \frac{\pi}{2} e^{-x}$. [5]
14. Find the Fourier sine transform of $e^{-x}, x \geq 0$ and hence by Parseval's identity, show that $\int_0^\infty \frac{x^2}{(1+x^2)^2} dx = \frac{\pi}{4}$. [5]

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

Subject: - Applied Mathematics (SH 551)

- ✓ 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 prove Cauchy-Riemann equations in cartesian forms. [5]
 - b) Show that $u = \sin x \cosh y + 2 \cos x \sinh y + x^2 - y^2 + 4xy$ is harmonic and find corresponding analytic function. [1+4]
 2. a) Find the linear transformation which maps the points $z_1 = 0, z_2 = -1, z_3 = \infty$ into the points $w_1 = 1, w_2 = i, w_3 = -1$. [5]
 - b) State Cauchy's integral formula. Use it to evaluate: [1+4]
- $$\int_C \frac{e^z}{(z-1)(z-3)} dz \text{ where } c: |z| < 2.$$
3. a) State Taylor's theorem for complex variable. Expand the Laurent's series of the function $f(z) = \frac{1}{z^2 - 3z + 2}$ in the region $1 < |z| < 2$. [1+4]
 - b) By using Cauchy Residue theorem evaluate $\int_C \tan z dz$ where c is circle $|z| = 2$. [5]
 4. a) State and prove final value theorem for z-transform. [1+4]
 - b) Obtain z-transform of $\sin wt$ and hence evaluate z-transform of $a e^{at} \sin wt$. [5]
 5. a) Obtain the inverse z-transform of $X(z) = \frac{2z}{(z+1)(z^2+1)}$ by using partial fraction method. [5]
 - b) Solve the difference equation: $x(k+2) + 2x(k+1) + 3x(k) = 0$ given that $x(0) = 0$ and $x(1) = 2$. [5]
 6. Derive one dimensional wave equation and solve it completely. [10]
 7. Solve one dimensional heat equation: $\frac{\partial u}{\partial t} = c^2 \frac{\partial^2 u}{\partial x^2}$ under boundary condition $\frac{\partial u}{\partial x} = 0$ when $x = 0$ and $x = l$ and the initial condition $u(x, 0) = x$ for $0 < x < l$. [10]
 8. a) Find the Fourier sine transform of e^{-x} , $x \geq 0$ and show that $\int_0^\infty \frac{x \sin mx}{1+x^2} dx = \frac{\pi e^{-m}}{2}$ where $m > 0$. [3+2]
 - b) Solve the integral equation: $\int_{-\infty}^{\infty} y(u) y(x-u) du = e^{-x^2}$. [5]

TRIBHUVAN UNIVERSITY
 INSTITUTE OF ENGINEERING
Examination Control Division
 2078 Chaitra

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

Subject: - Applied Mathematics (SH 551)

- ✓ 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 an analytic function $f(z)$ of complex variable z at a point. If $f(z) = u(x,y) + i v(x,y)$ is analytic, show that $u_x = v_y$ and $u_y = -v_x$. [1+4]
2. Define conformal mapping. Find the linear transformation which maps the points $z=0, 1, \infty$ in to the points $w = -3, -1, 1$ respectively. [5]
3. State and proof Cauchy's Integral theorem. [5]
4. Obtain the Taylor's series expansion of the complex function $f(z) = \frac{z+1}{(z-3)(z-4)}$ about the center $z = 2$ up to four term. [5]
5. State Cauchy residue theorem. Apply it to evaluate $\int_C \frac{4-3z}{z(z-1)(z-2)} dz$ where C is the circle $|z| = \frac{3}{2}$. [1+4]
6. Evaluate integrals $\int_0^\pi \frac{1}{3+2\cos\theta} d\theta$ by contour integration. [5]
7. If $x(t) = 0$ for $t < 0$, $Z[x(t)] = X(z)$ for $t \geq 0$, then prove that $Z[e^{-at} x(t)] = X(ze^{aT})$. [5]
8. Obtain the Z- transform of (i) te^{-at} (ii) $\sin at$ [2.5+2.5]
9. Obtain the inverse Z- transform of $X(z) = \frac{(1-e^{-aT})z}{(z-1)(z-e^{-aT})}$ where T is the sampling period. [5]
10. Solve the difference equation $y_{n+2} - 4y_{n+1} + 4y_n = 0$ with given condition $y_0 = 0, y_1 = 1$. [5]
11. A tightly stretched string with fixed ends $x = 0$ and $x = \ell$ is initially in position given by $u(x,0) = u_0 \sin^3 \frac{\pi x}{\ell}$. If it is released from rest in this position, find the displacement at any time t at any distance x from one end. [10]
12. Derive one dimensional heat equation and solve it completely. [10]
13. Obtain the fourier sine and cosine integral of $f(x) = x$ for $0 < x < a$,
 $= 0$ for $x > a$. [5]
14. Find the fourier cosine transform of $f(x) = e^{-x}, x > 0$ and hence parseval's identity, show that $\int_0^\infty \frac{1}{(1+x^2)^2} dx = \frac{\pi}{4}$. [5]

TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2078 Poush

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

Subject: - Applied Mathematics (SH 551)

- ✓ 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 Harmonic function. Show that the function $u(x, y) = e^x \sin y$ is harmonic and hence construct an analytic function $f = u(x, y) + iv(x, y)$. [5]
- b) Find the linear fractional transformation that maps $z = 2, i, -2$ into the points $w = 1, i, -4$. Also find the fixed points of the transformation. [5]
2. a) State and prove Cauchy Integral theorem. [5]
- b) State Laurent's theorem and expand the function $f(z) = \frac{z^2 + 1}{(z-1)(z-2)}$ as a Laurent series in the region $1 < |z| < 3$. [5]
3. a) Using Cauchy's residue theorem, evaluate the integral $\int_C \tan z dz$ where c is the circle $|z| = 2$. [5]
- b) Using contour integration, evaluate the integral $\int_0^{2\pi} \frac{d\theta}{3 + 2 \sin \theta}$ [5]
4. a) State and prove final value theorem for z-transform. [5]
- b) Find the z-transform of the following sequences for $k \geq 0$: [5]
 - (i) $k a^k$
 - (ii) $\sin k \theta$
5. a) Using the partial fraction decomposition method, find the inverse z-transform of the $X(z) = \frac{3z^3 + z}{(z-1)^2(z-2)}$ [5]
- b) Using the z-transform technique, solve the following difference equation:
 $y(k+2) - 4y(k+1) + 3y(k) - 2^k = 0$, with $y(0) = 0, y(1) = 1$. [5]
6. Derive one dimensional wave equation and solve it completely. [10]
7. A rod of length L has its end at A and B maintained at 0°C and 100°C respectively until steady state prevails. If B is suddenly reduced to 0°C , then find the temperature at a distance x from the end A at time t . [10]
8. a) Find the Fourier sine transform of the function $f(x) = e^{-m} (x > 0, m > 0)$ and hence show that $\int_0^{\infty} \frac{\alpha \sin(\alpha x)}{\alpha^2 + \beta^2} d\alpha = \frac{\pi}{2} e^{-mx}$ [5]
- b) Starting from the Fourier cosine transform of $f(x) = e^{-x}$ for $x > 0$, show that $\int_0^{\infty} \frac{1}{(1+x^2)^2} dx = \frac{\pi}{4}$ [5]

TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2078 Baishakh

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

Subject: - Applied Mathematics (SH 551)

- ✓ 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) Show that the function $u = e^x \cos y$ is harmonic, find its harmonic conjugate and hence construct the corresponding analytic function. [1+3+1]
- b) Find the linear transformation which maps the points $z_1=2$, $z_2=i$, $z_3=-2$ into the points $w_1=1$, $w_2=i$, $w_3=-1$. [5]
2. a) State Cauchy's Integral formula. Use it to evaluate: $\int_C \frac{e^z}{(z-1)(z-3)} dz$ where $c:|z|=2$. [1+4]
- b) Expand $f(z) = \cos z$ in Taylor's series about $z = \frac{\pi}{2}$. [5]
3. a) State Cauchy's Residue theorem. Use it to evaluate: $\int_C \tan z dz$ where c is circle $|z|=2$. [5]
- b) Evaluate by using contour integration in a complex plane: $\oint_0^{2\pi} \frac{2d\theta}{2+\cos\theta}$. [5]
4. a) Find the z-transform of:
 - te^{-at} , $t \geq 0$
 - $\sin at$
 b) State initial value theorem for z-transform. Find the initial value $x(0)$ and $x(1)$ for the function: $X(z) = \frac{(1-e^{-T})z^{-1}}{(1-z^{-1})(1-e^{-T}z^{-1})}$. [1+4]
5. a) Find the inverse z-transform of $\frac{z}{(z+1)^2(z-1)}$. [5]
- b) Solve the difference equation $x(k+2) - x(k+1) + 0.25x(k) = u(k)$ given that $x(0) = 1$ and $x(1) = 2$ and $u(k)$ is unit step function. [5]
6. Derive one dimensional wave equation and solve it completely. [5+5]
7. A rectangular plate with insulated surfaces is 10cm wide and so long compared to its width introducing an appreciable error. If the temperature along the short edge $y = 0$ is given by $U(x,0) = \begin{cases} 20x, & 0 < x \leq 5 \\ 20(10-x), & 5 < x < 10 \end{cases}$ while the two long edges $x=0$ and $x=10$ as well as the other, short edges are kept at 0°C . Find the steady state temperature at any point (x,y) of the plate. [10]
8. a) Obtain the Fourier integral of $f(x) = \begin{cases} \cos x, & \text{for } |x| < \frac{\pi}{2} \\ 0, & \text{for } |x| > \frac{\pi}{2} \end{cases}$. [5]
- b) Show that the Fourier Cosine Integral representation of $f(x) = e^{-x}$ is $\int_0^{\infty} \frac{\cos ax}{1+\omega^2} d\omega = \frac{\pi}{2} e^{-x}$. [5]

TRIBHUVAN UNIVERSITY
 INSTITUTE OF ENGINEERING
Examination Control Division
 2077 Chaitra

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

Subject: - Applied Mathematics (SH 551)

- ✓ 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 Cauchy-Riemann equation in polar form. Prove that $f(z) = |z|$ is not an analytic function. [1+4]
- b) Find the linear transformation which maps the points $z = 0, 1, \infty$ into the points $w = -3, -1, 1$ respectively. Find also fixed point of the transformation. [4+1]
2. a) State and prove Cauchy's Integral Formula. [1+4]
- b) Find the Laurent's series of $f(z) = \frac{z^2 - 1}{(z+2)(z+3)}$ in the region $2 < |z| < 3$. [5]
3. a) State Cauchy Residue theorem and hence evaluate the integral $\int_C \frac{z-1}{(z+1)^2(z-2)} dz$ where $C : |z-i| = 2$. [1+4]
- b) Using counter Integration, evaluate $\int_0^{2\pi} \frac{1}{2 + \cos \theta} d\theta$ in the complex plane. [5]
4. a) State and prove initial value theorem of z-transform. [5]
- b) Find the z-transform of the following sequence for $t \geq 0$. [2.5+2.5]
 - (i) te^{-at}
 - (ii) $\sin at$
5. a) Find the inverse z-transform of the function $\frac{2z^3 + z}{(1-2)^2(z-1)}$. [5]
- b) Solve the difference equation $x(k+2) - 4x(k+1) + 4x(k) = 0$ with conditions $x(0) = 1, x(1) = 0$. [5]
6. Derive one dimensional heat equation and solve it completely. [5+5]
7. A string is stretched and fastened to two points apart. Motion is started by displacing the string in the form $u(n, 0) = u_0 \sin \frac{\pi x}{l}$ from which it is released at time $t=0$. Show that the displacement at any point at a distance x from one end at a time t is given by $u(x, t) = u_0 \sin \frac{\pi x}{l} \cos \frac{\pi ct}{l}$. [10]
8. a) Define the complex form of Fourier integral of a given function with usual notation. Find the Fourier integral representation of the function $f(x) = \begin{cases} 1 & \text{if } |x| < 1 \\ 0 & \text{if } |x| > 1 \end{cases}$ and hence evaluate $\int_0^\infty \frac{\sin w}{w} dw$. [1+3+1]
- b) Find the Fourier sine transformation of $f(x) = e^{-|x|}$ and hence evaluate the integral $\int_0^\infty \frac{s \sin sx}{s^2 + 1} ds$. [5]

TRIBHUVAN UNIVERSITY
 INSTITUTE OF ENGINEERING
Examination Control Division
 2076 Baisakh

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

Subject: - Applied Mathematics (SH 551)

- ✓ 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. Obtain polar form Cauchy-Riemann equations for function of complex variable. [5]
2. Find the linear fractional transformation which maps the points $z=0, 1, \infty$ into the points $w=-3, -1, 1$ respectively. [5]
3. Define Complex integration. How does it differ from real integration? Derive Cauchy integral formula for function $f(z)$. [1+1+3]
4. Define Laurent's Series for the function of complex variable. Obtain Taylor's series for function [1+4]

$$f(z) = \frac{z}{z^2 + 4} \text{ about } z=i$$

5. State Cauchy residue theorem. Apply it to evaluate $\oint_C \tan z dz$, where C is the region $|z|=2$. [1+4]
6. Evaluate integral $\int_0^{2\pi} \frac{d\theta}{a + \sin \theta}$; $a > 1$ by contour integration in complex plane. [5]
7. Obtain z-transform of $\sin \omega t$ and hence obtain z-transform of $e^{at} \sin \omega t$. [3+2]
8. Obtain the inverse z-transform of $X(z) = \frac{z^2}{(z-1)^2(z-e^{-aT})}$. [5]
9. State and prove shifting to the right theorem for z-transform. [5]
10. Solve the difference equation:
 $x(k+2) - x(k+1) + 0.25x(k) = u(k)$ where $x(0)=1$ and $x(1)=2$ and $u(k)$ is a unit step function; by z-transform method. [5]
11. Find Fourier integral of the function [5]

$$f(x) = \begin{cases} 0 & \text{if } x < 0 \\ e^{-x} & \text{if } x \geq 0 \end{cases}$$

12. Find the Fourier Sine transform of e^{-x} , $x \geq 0$ and hence show that $\int_0^{\infty} \frac{x^2}{(1+x^2)^2} dx = \frac{\pi}{4}$ [5]
13. Solve the wave equation $\frac{\partial^2 u}{\partial t^2} = c^2 \frac{\partial^2 u}{\partial x^2}$ with the given boundary conditions; $u(0,t)=0$, $u(\pi,t)=0$, $u(x,0)=0$ and $\left(\frac{\partial u}{\partial t}\right)_{t=0} = 3(Lx - x^2)$. [10]
14. Derive one dimensional heat equation and solve it completely. [10]

25 TRIBHUVAN UNIVERSITY
 INSTITUTE OF ENGINEERING
Examination Control Division
 2075 Bhadra

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

Subject: - Applied Mathematics (SH551)

- ✓ 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 harmonic function of complex variable. Show that $u(x, y) = y^3 - 3x^2y$ is harmonic and find corresponding analytic function. [1+4]
2. Define conformal mapping for function of complex variable. Show that function of complex variable $w = iz$ is transformed through an angle $\frac{\pi}{2}$ in w-plane. [1+4]
3. State and prove Cauchy's integral theorem. [5]
4. Define Laurent's Series for the function of complex variable. Find Laurent's series of the function $f(z) = \frac{z}{(z+2)(z+3)}$ in the region $2 < |z| < 3$. [1+4]
5. Define pole of order m for function of complex variable. Find residues of $f(z) = \frac{z^2 - 2z}{(z+1)^2(z^2 + 1)}$ at its poles. [1+4]
6. Evaluate $\int_{-\infty}^{\infty} \frac{x^2}{(x^2 + 1)(x^2 + 4)} dx$ by contour integration in the complex plane. [5]
7. Find the Z-transform of:
 - $t^2 e^{at}$
 - $e^{-at} \cos wt$
8. Find the inverse Z-transform of: [2.5+2.5]
 - $X(z) = \frac{2z^2 - 5z}{(z-2)(z-3)}$ (By partial fraction method)
 - $X(z) = \frac{z^{-2}}{(1-z^{-1})^3}$ (By inversion integral method)
9. State final value theorem for Z-transform. Obtain Z-transform of $(1 - e^{-at})$; $a > 0$ and hence evaluate $x(\infty)$ by using final value theorem. [1+4]
10. Solve the difference equation:
 $x(k+2) - 3x(k+1) + 2x(k) = 0$; given that $x(0) = 0$ and $x(1) = 1$ by using z-transform method. [5]
11. Find the Fourier integral of the function: [5]

$$f(x) = \begin{cases} 1, & \text{for } 0 < x < \pi \\ 0, & \text{for } x > \pi \end{cases}$$

12. Find the Fourier transform of e^{-x^2} . Also verify the convolution theorem for $f(x) = e^{-x^2}$
and $g(x) = e^{-x^2}$ [5]
13. Derive one dimensional wave equation and solve it completely. [10]
14. Solve completely the Laplace equation $\frac{\partial^2 u}{\partial x^2} + \frac{\partial^2 u}{\partial y^2} = 0$ under the conditions: [10]

$$u(0, y) = u(l, y) = u(x, 0) = 0, u(x, \infty) = \sin\left(\frac{n\pi x}{l}\right)$$

14 TRIBHUVAN UNIVERSITY
 INSTITUTE OF ENGINEERING
Examination Control Division
 2075 Baisakh

Exam.	Back
Level	BE
Programme	BGE, BEL, BEX, BCT
Year / Part	II / II
	Time
	3 hrs.

Subject: - Applied Mathematics (SH551)

- ✓ 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 harmonic function. Is $V = \arg(z)$ is harmonic? If yes, find a corresponding harmonic conjugate. [1+1+3]
- b) Define conformal mapping. Find the bilinear transformation which maps the points $z = 0, 1, \infty$ into the points $w = -3, -1, 1$ respectively. [1+4]
2. a) Distinguish between Cauchy integral Theorem and Cauchy integral formula. Using Cauchy integral formula evaluate $\int_C \frac{e^z}{(z+1)(z-2)} dz$ where C is the circle $|z-1|=3$. [1+4]
- b) State and Prove Taylor's series for function of complex variable. [5]
3. a) Define an isolated pole. Using Cauchy's residue theorem evaluate $\int_C \frac{z-1}{(z+1)^2(z-2)} dz$ where C is the circle $|z-i|=2$. [5]
- b) Evaluate the integral by contour integration: [5]
$$\int_{-\infty}^{\infty} \frac{x^2}{(1+x^2)(x^2+4)} dx$$
4. a) Obtain the z-transform of $(1-e^{-at})$, $a > 0$ and hence evaluate $x(\infty)$ by using final value theorem. [2+3]
- b) Obtain the inverse z-transform of: [5]
$$X(z) = \frac{2z^3 + z}{(z-2)^2(z-1)}$$

 - by using partial fraction method.

5. a) Define z-transform of function $f(t)$. Find the z-transform of following sequences: [1+2+2]
 - (i) $f(k) = \left\{ \begin{matrix} 15, 10, 7, 4, 1, -1, 3, 6 \\ \uparrow \quad \downarrow \end{matrix} \right\}$
 - (ii) $f(k) = \begin{cases} 5^k & ; k < 0 \\ 2^k & ; k \geq 0 \end{cases}$
- b) Solve the difference equation by the application of z-transform:
 $x(k+2) + 3x(k+1) + 2x(k) = 0$ with conditions $x(0) = 0, x(1) = 1$. [5]

6. a) A tightly stretched string with fixed ends at $x = 0$ and $x = l$ is initially at rest in its equilibrium position. Find the deflection $u(x, t)$ if it is set vibrating by giving to each of its points a velocity $3(lx-x^2)$. [10]

b) Derive two dimensional heat equation. [10]

7. a) Obtain the Fourier sine integral representation of $e^{-x} \cos x$ and hence show that

$$\int_0^\infty \frac{\omega^3 \sin \omega x}{\omega^4 + 4} d\omega = \frac{\pi}{2} e^{-x} \cos x, \quad x > 0. \quad [5]$$

- b) Find the Fourier Cosine transform of $f(x) = e^{-x}$, $x > 0$ and hence by Parseval's identity, show that

$$\int_0^\infty \frac{1}{(1+x^2)^2} dx = \frac{\pi}{4}.$$

14 TRIBHUVAN UNIVERSITY
 INSTITUTE OF ENGINEERING
Examination Control Division
 2074 Bhadra

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

Subject: - Applied Mathematics (SH551)

- ✓ 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 an analytic function for a function of complex variable. Derive Cauchy Riemann equations in Cartesian form. [1+4]
- b) Define linear fractional mapping. Find bilinear mapping which maps the points $z = 0, 1, -1$ to $w = 1, 2, 4$. [1+4]
2. a) State and Prove Cauchy integral theorem.
 b) Point out difference between Taylor's series and Laurent's series. Find Laurent's series of function $f(z) = \frac{\sin z}{z^6}$, $0 < |z| < \infty$ [5]
3. a) Define pole of order m. Using Cauchy's residue theorem evaluate $\int_C \cot z dz$; where C is $|z|=1$. [1+4]
- b) Using Counter integration evaluate, $\int_{-\infty}^{\infty} \frac{dx}{(1+x^2)^2}$. [5]
4. a) Find the z-transform of:
 (i) $\cos at$ (ii) $t e^{-at}$ [2+3]
- b) State final value theorem. If $x(t) = 0$ for $t < 0$ and $Z[x(t)] = X(z)$ for $t \geq 0$ then prove that: $Z[x(t+nT)] = z^n \left[X(z) - \sum_{k=0}^{n-1} x(kT)z^k \right]$. [1+4]
5. a) Obtain inverse Z-transform of $\frac{z(3z^2 - 6z + 4)}{(z-1)^2(z-2)}$. [5]
- b) Solve the difference equation by the application of z-transform:
 $x(k+2) - 4x(k+1) + 4x(k) = 0$; with conditions $x(0) = 1$; $x(1) = 0$. [5]
6. a) Derive one dimensional wave equation and solve it completely.
 b) A uniform rod of length ℓ has its end maintained at a temperature 0°C and the initial temperature of the rod is:

$$u(x,0) = 3 \sin \frac{\pi x}{\ell} \quad \text{for } 0 < x < \ell.$$

 Find the temperature $u(x, t)$. [10]
7. a) Find Fourier integral of the function

$$f(x) = \begin{cases} 1 & \text{if } |x| < 1 \\ 0 & \text{if } |x| > 1 \end{cases}$$
 [5]
- b) Verify the convolution theorem for Fourier transform for the functions $f(x) = g(x) = e^{-x^2}$. [5]

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

Subject: - Applied Mathematics (SH551)

- ✓ 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 analytical function of complex-variable. Determine the analytic function $f(z) = u + iv$ if $u = \log \sqrt{x^2 + y^2}$. [1+4]
 - b) Express Cauchy-Riemann equations $U_x = V_y$ and $U_y = -V_x$ into polar form. [5]
 2. a) Define bilinear transformation. Obtain the linear transformation which maps points $z_1 = -i, z_2 = 0, z_3 = i$ into $w_1 = -1, w_2 = i, w_3 = 1$ [1+4]
 - b) Evaluate $\int_C \frac{e^{2z}}{z^2 - 3z + 2} dz$ in the circle $|z| = 3$ by using Cauchy integral formula. [5]
 3. a) State Laurent's Theorem. Obtain the Taylor's series expansion of $f(z) = \frac{1}{z^2 + 4}$ about the point $z = i$. [1+4]
 - b) Define residue at poles. Evaluate $\oint_C \frac{\sin z}{z^6} dz$, $C: |z| = 1$ by residue method. [1+4]
- OR**
- Evaluate real integral $\int_0^{2\pi} \frac{\cos 3\theta}{5 - 4\cos \theta} d\theta$ by contour integration in the complex plane. [5]
 4. a) Define Z-transform and its region of convergence. Find the Z-transform of [1+1+1.5+1.5]
 - $t^2 e^{-at}$
 - $\sin at$
 - b) State and prove final value theorem for Z-transform. [1+4]
 5. a) Find the inverse Z-transform of $f(z) = \frac{z-4}{(z-1)(z-2)^2}$ by partial fraction method. [5]
 - b) Use the method of Z-transform to solve the difference equation. [5]

$$x(k+2) + 2x(k+1) + 3x(k) = 0 : x(0) = 0, x(1) = 2$$
 6. Derive one dimensional wave equation and solve it completely. [10]
 7. Solve completely the Laplace equation $\frac{\partial^2 u}{\partial x^2} + \frac{\partial^2 u}{\partial y^2} = 0$ under the conditions: [10]

$$u(0, y) = u(l, y) = u(x, 0) = 0, u(x, \infty) = \sin\left(\frac{n\pi x}{l}\right)$$
 8. a) Define Fourier transform of a function. How does it differ from Fourier series? Support your answer with suitable example. [1.5+1.5+2]
 - b) Find the Fourier Sine transform of e^{-x} , $x \geq 0$ and hence show that

$$\int_0^{\infty} \frac{x^2}{(1+x^2)^2} dx = \frac{\pi}{4} \quad [5]$$

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

Subject: - Applied Mathematics (SH551)

- ✓ 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 harmonic function of complex variable. Determine the analytical function

$$f(z) = u + iv \text{ if } u = y^3 - 3x^2y$$

[1+4]

- b) Derive Cauchy-Riemann equations if function of complex variable $f(z) = u + iv$ is analytic in cartesian form. [5]

2. a) What do you mean by conformal mapping? Find the linear transformation which maps points $z_1 = 1, z_2 = i, z_3 = -1$ into the points $w_1 = 0, w_2 = 1, w_3 = \infty$. [1+4]

- b) State and prove Cauchy's integral formula. [5]

3. a) State Taylor's theorem. Find the Laurent's series representation of the function

$$f(z) = \frac{z}{(z+1)(z+2)} \text{ in the annular region between } |z|=1 \text{ and } |z|=2.$$

[1+4]

- b) Define zero of order m of function of complex variable. Determine the poles and residue at poles of the functions $f(z) = \frac{1+z}{(z+2)(1-z)^2}$. [1+4]

OR

Evaluate the real integral $\int_{-\infty}^{\infty} \frac{x^2}{(1+x^2)^3} dx$ by contour integration in the complex plane. [5]

4. a) Define z-transform. How does it differ from Fourier transform? Obtain z-transform of

- (i) $t^2 a^t$ (ii) cosat [1+1+1.5+1.5]

- b) State initial value theorem for z transform. Find the initial value $x(0)$ and $x(1)$ for the function. [1+4]

$$X(z) = \frac{(1-e^{-T})z^{-1}}{(1-z^{-1})(1-e^{-T}z^{-1})}$$

5. a) Obtain the inverse z-transform of $X(z) = \frac{3z^3 + 2z}{(z-3)^2(z-2)}$ by using inversion integral method. [5]

- b) Apply method of z-transform to solve the difference equation [5]

$$x(k+2) - 4x(k+1) + 4x(k) = 0; x(0) = 0, x(1) = 1$$

6. Solve completely one-dimensional wave equation $\frac{\partial^2 u}{\partial t^2} = c^2 \frac{\partial^2 u}{\partial x^2}$ under the conditions: [10]

$$u(0, t) = 0, u(l, t) = 0, u(x, 0) = 0 \text{ and } \left(\frac{\partial u}{\partial t}\right)_{\text{at } t=0} = 3(lx - x^2)$$

7. Derive one dimensional heat equation and solve it completely. [10]

8. a) State convolution theorem for Fourier transform. Give its importance with suitable example. [2+3]

- b) Find the Fourier cosine integral of the function $f(x) = e^{-kx}$ ($x > 0, k > 0$) and hence

$$\text{show that } \int_0^\infty \frac{\cos \omega x d\omega}{k^2 + \omega^2} = \frac{\pi}{2k} e^{-kx}, x > 0, k > 0$$

[5]

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

Subject: - Applied Mathematics (SH551)

- ✓ 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) If $u = (x-1)^3 - 3xy^2 + 3y^2$, determine V so that $u + iv$ is an analytic function of $x+iy$. [5]
- b) Define an analytic function. Express Cauchy Riemann equations $u_x = v_y$ and $u_y = -v_x$ in polar form. [5]
2. a) Find the bilinear transformation which maps points $z_1 = 1, z_2 = i, z_3 = -1$ into the points $w_1 = i, w_2 = -1, w_3 = -i$ respectively. [5]
- b) Evaluate $\int_0^{1+i} (x^2 + iy) dz$ along the path $y = x^2$. [5]
3. a) Express $f(z) = \frac{1}{(z^2 - 3z + 2)}$ as Laurent's series in the region $1 < |z| < 2$. [5]
- b) Evaluate $\int_0^{2\pi} \frac{1}{5 - 4\sin\theta} d\theta$ by contour integration method in complex plane. [5]
4. a) Find z-transform of
 - te^{-at}
 - $\sin at$
 b) State and prove final value theorem for z- transform. [5]
5. a) Find the inverse z-transform of $\frac{2z^2 - 5z}{(z-2)(z-3)}$ by using partial fraction method. [5]
- b) Solve difference equation $x(k+2) - 3x(k+1) + 2x(k) = 4^k$ for $x(0) = 0$ and $x(1) = 1$. [5]
6. Derive one dimensional wave equation and obtain its solution. [10]
7. Solve one dimensional heat equation:

$$\frac{\partial u}{\partial t} = c^2 \frac{\partial^2 u}{\partial x^2} \text{ under the conditions:}$$
 - u is not infinite as $t \rightarrow \infty$
 - $\frac{\partial u}{\partial x} = 0$ for $x = 0$ and $x = l$
 - $u(x,0) = lx - x^2$ for $t = 0$; between $x = 0$ and $x = l$
 8. a) Find Fourier integral representation of $f(x) = e^{-x}, x > 0$ and hence evaluate $\int_0^\infty \frac{\cos(sx)}{s^2 + 1} ds$ [5]
- b) Find the Fourier cosine transform of $f(x) = e^{-|x|}$ and hence, by Parseval's identity, shown that $\int_0^\infty \frac{1}{(1+x^2)^2} dx = \frac{\pi}{4}$ [5]

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

Subject: - Applied Mathematics (SH551)

- ✓ 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 analytic function of complex variable. Show that $f(z) = \frac{1}{z^n}$ is analytic except at origin. [5]
- b) Show that $u(x,y) = \sin x \cdot \cosh y$ is a harmonic function. Also find its harmonic conjugate $v(x,y)$ such that $u + iv$ is analytic. [5]
2. a) Obtain bilinear transformation which maps $-i, 0, i$ to $-1, i, 1$. [5]
- b) Evaluate $\int_C \frac{e^z}{(z-1)(z-3)} dz$, where $C: |z| = 2$; using Cauchy integral formula. [5]
3. a) Obtain Laurent's series which represents the function $f(z) = \frac{1}{(z+1)(z+2)}$ when $1 < |z| < 2$. [5]
- b) Determine the residue at poles of the function $f(z) = \frac{z^2 - 2z}{(z+1)^2(z^2+1)}$. [5]
4. a) Find z-transform of:
 - i) t^2
 - ii) $\cos wt$
 b) Find inverse z-transform of:
 - i) $\frac{1}{(z-2)(z-3)}$
 - ii) $\frac{z}{(z+1)^3}$
5. a) State and prove convolution theorem for z-transform. [5]
- b) Solve the difference equation,
 $x(k+2) + 5x(k+1) + 6x(k) = 2^k$, given that $x(0) = 0, x(1) = 1$ by using z-transform. [5]
6. A tightly stretched string of length l fixed at both ends is initially at rest. The initial deflection being $u(x,0) = \begin{cases} x & \text{for } 0 < x < l/2 \\ l-x & \text{for } l/2 < x < l \end{cases}$ [10]

If the string is suddenly released, find the displacement $u(x,t)$

7. Derive one dimensional heat equation along a metallic rod of finite length and solve it completely. [10]
8. a) Obtain the Fourier integral of the function [5]

$$f(x) = \begin{cases} 1 & \text{for } 0 < x < \pi \\ 0 & \text{for } x > \pi \end{cases}$$
 b) Verify Convolution theorem for Fourier transform for $f(x) = g(x) = e^{-x^2}$ [5]

Examination Control Division

2071 Bhadra

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

Subject: - Applied Mathematics (SH551)

- ✓ 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. Determine the analytic function $f(z) = u + iv$ if $u = \log\sqrt{x^2 + y^2}$.

2. State and prove Cauchy's integral formula.

3. Find the Taylor's series of $f(z) = \frac{1}{1-z}$ about $z = 3i$.4. Evaluate the integral: $\oint_C \frac{z^2 dz}{(z+1)(z+3)}$ where $C: |z| = 4$, using residue theorem.5. Define conformal mapping, show that $w = \frac{az+b}{cz+d}$ is invariant to

$$\left(\frac{w-w_1}{w-w_3}\right) \times \left(\frac{w_2-w_3}{w_2-w_1}\right) = \left(\frac{z-z_1}{z-z_3}\right) \times \left(\frac{z_2-z_3}{z_2-z_1}\right)$$

6. Using contour integration, evaluate real integral: $\int_{-\infty}^{+\infty} \frac{x^2 dx}{(x^2 + a^2)(x^2 + b^2)}$ 7. Find the z-transform of $x(z) = \cosh t \sinh t$.

8. State and prove "final value theorem" for the z-transform.

9. Find the inverse z-transform of $x(z) = \frac{z}{z^2 + 7z + 10}$.

10. Using z-transform solve the difference equation:

$$x(K+2) + 6x(K+1) + 9x(K) = 2^K; \quad x_0 = x_1 = 0.$$

11. Derive one-dimensional heat equation.

12. Solve the wave equation for a tightly stretched string of length 'l' fixed at both ends if the initial deflection in $y(x, 0) = lx - x^2$ and the initial velocity is zero.13. Solve $\frac{\partial^2 u}{\partial x^2} + \frac{\partial^2 u}{\partial y^2} = 0$ under the conditions $u(0, y) = u(l, y) = u(x, 0) = 0$, $u(x, a) = \sin\left(\frac{n\pi x}{l}\right)$

14. Derive the wave equation (vibrating of a string).

15. Find the Fourier cosine transform of $f(x) = e^{-\beta|x|}$ and hence show that $\int_0^{\infty} \frac{\cos py}{y^2 + \beta^2} dy = \frac{\pi}{2\beta} e^{-\beta p}$.16. Find the Fourier integral representation of the function $f(x) = e^{-x}$, $x \geq 0$ with $f(-x) = f(x)$.

Hence evaluate $\int_0^{\infty} \frac{\cos(sx)}{s^2 + 1} ds$.

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

Subject: - Applied Mathematics (SH551)

- ✓ 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) Determine the analytic function $f(z) = u + iv$ if $u = 3x^2y - y^3$. [5]
- b) Find the linear transformation which maps the points $z = 0, 1, \infty$ into the points $w = -3, -1, 1$ respectively. Find also fixed points of the transformation. [5]
2. a) State and prove Cauchy's integral formula. [5]
- b) Evaluate $\int_C \frac{e^{2z}}{(z-1)(z-2)} dz$ where C is the circle $|z| = 3$. [5]
3. a) Find the first four terms of the Taylor's series expansion of the complex function $f(z) = \frac{z+1}{(z-3)(z-4)}$ about the centre $z = 2$. [5]
- b) Evaluate $\int_C \frac{4-3z}{z(z-1)(z-2)} dz$ where C is the circle $|z| = \frac{3}{2}$. [5]

OR

Evaluate $\int_0^{2\pi} \frac{1}{\cos \theta + 2} d\theta$ by contour integration in the complex plane.

4. Derive one dimensional heat equation $u_t = c^2 u_{xx}$ and solve it completely. [10]
5. Find all possible solution of Laplace equation $u_{xx} + u_{yy} = 0$. Using this, hence solve $u_{xx} + u_{yy} = 0$, under the conditions $u(0, y) = 0$, $u(x, y) = 0$ when $y \rightarrow \infty$ and $u(x, 0) = \sin x$. [10]
6. a) Find the z-transform of $\sin K\theta$. Use it to find the $z[a^K \sin K\theta]$. [5]

b) If $z[x(K)] = \frac{2z^2 + 3z + 12}{(z-1)^4}$, find the value of $x(2)$ and $x(3)$. [5]

7. a) Find the inverse z-transform of $x(z) = \frac{3z^3 + 2z}{(z-3)^2(z-2)}$ by using inversion integral method. [5]
- b) Using z-transform solve the difference equation $x(K+2) - 4x(K+1) + 4x(K) = 2^K$ given that $x(0) = 0$, $x(1) = 1$. [5]

8. a) Find the Fourier sine integral of the function $f(x) = e^{-Kx}$ and hence show that [5]

$$\int_0^\infty \frac{\lambda \sin \lambda x}{\lambda^2 + \beta^2} d\lambda = \frac{\pi}{2} e^{-Kx}, \quad x > 0, K > 0$$

- b) Find the Fourier sine transform of e^{-x} , $x \geq 0$ and hence show that [5]

$$\int_0^\infty \frac{x \sin mx}{x^2 + 1} dx = \frac{\pi}{2} e^{-m}, \quad m > 0$$

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

Subject: - Applied Mathematics (SH551)

- ✓ 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. Show that $u(x, y) = x^2 + 2xy - y^2$ is a harmonic function and determine $v(x, y)$ in such a way that $f(z) = u(x, y) + iv(x, y)$ is analytic. [5]
2. Define complex integral. State and prove Cauchy integral formula. [5]

OR

Obtain bilinear transformation which maps $-i, 0, i$ to $-1, i, 1$. [5]

3. Evaluate $\int_C \frac{e^{2z}}{(z-1)(z-2)} dz$ where C is $|z| = 3$ using Cauchy's integral formula. [5]
4. Obtain the Laurent series which represents the function $f(z) = \frac{z^2 - 1}{(z+2)(z+3)}$ $2 < |z| < 3$. [5]
5. Find the Laurent series of $f(z) = \frac{1}{4+z^2}$ about the point $z = i$. [5]
6. State and prove Taylor series of a function f(z). [5]
7. Derive one dimensional wave equation $u_{tt} = c^2 u_{xx}$ and solve it completely. [10]
8. Solve one dimensional heat equation $\frac{\partial u}{\partial t} = c^2 \frac{\partial^2 u}{\partial x^2}$ under the boundary condition $\frac{\partial u}{\partial x} = 0$ when $x = 0$ and $x = L$ and initial condition $u(x, 0) = x$ for $0 < x < L$. [10]
9. Find Z transform of (a) te^{-at} and (b) $\sin at$. [5]
10. Find the inverse z-transform (a) $\frac{z-4}{(z-1)(z-2)^2}$ (b) $\frac{z}{z^2 - 3z + 2}$. [5]
11. Obtain the Z transform of $x(t) = (1 - e^{-at})$, $a > 0$ and hence evaluate $x(\infty)$ by using final value theorem. [5]
12. Solve using z-transform the difference equation $x(K+2) + 2x(K+1) + 3x(K) = 0$. [5]
13. Find the Fourier sine transform of $f(x) = e^{-x}$, $x \geq 0$ and hence evaluate $\int_0^\infty \frac{x \sin x}{(1+x^2)} dx$. [5]
14. State and prove convolution theorem of Fourier transform. [5]

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

Subject: - Applied Mathematics (SH551)

- ✓ 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 analytic function. Show that the function $f(z) = \frac{1}{z^4}$ is analytic except $z = 0$ [5]

2. Define complex integral. Evaluate $\int_C \log z dz; C: |z| = 1$ [5]

OR

Obtain a bilinear transformation which maps $-i, 0, i$ to $-1, i, 1$.

3. Evaluate $\int_0^{1+i} (x^2 + iy) dz$ along the path $y = x$. [5]

4. Find the Taylor series of $f(z) = \frac{1}{4+z^2}$ about the point $z = i$. [5]

5. Evaluate the integrals by residue theorem $\int_C \frac{1-\cos z}{z^3} dz$ [5]

6. State Cauchy's Residue theorem and use it to evaluate $\int_C \frac{z^2}{3+4z+z^2} dz$ where C is $|z| = 2$ [5]

OR

Evaluate $\int_0^{2\pi} \frac{d\theta}{\cos \theta + 2}$ by contour integration in complex plane.

7. Derive the one dimensional wave equation. [10]

8. A rod of length L has its ends A and B maintained at 0° and 100° respectively until steady state prevails. If the changes are made by reducing the temperature of end B to 85° and increasing that of end A to 15° , then find the temperature distribution in the rod at a time t . [10]

9. Find the z-transform of (i) $e^{-at} \sin wt$ (ii) $\cos at$ [5]

10. Obtain inverse Z-transform of (i) $\frac{z+2}{(z-2)(z-3)}$, (ii) $\frac{z}{(z-2)(z-1)}$ [5]

11. If $x(k) = 0$ for $k < 0$ and $Z\{x(k)\} = X(z)$ for $k > 0$ then prove that $Z\{x(k+n)\} = z^n X(z) - z^n \sum_{k=0}^{n-1} x(k) z^{-k}$ where $n = 0, 1, 2, \dots$ [5]

12. Solve the difference equation $x(k+2) - 4x(k+1) + 4x(k) = 0$ with conditions, $x(0) = 0, x(1) = 1$ [5]

13. Find the cosine transform of $f(x) = e^{-mx}$ $m > 0$ show that $\int_0^\infty \frac{\cos pr}{r^2 + B^2} = \frac{\Pi}{2B} e^{-PB}$ [5]

14. Find the Fourier transform of $g(x) = \begin{cases} 1-x^2 & \text{if } -1 < x < 1; \\ 0, & \text{otherwise.} \end{cases}$ [5]

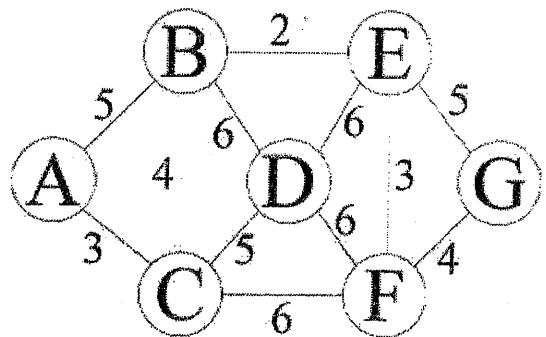
and hence use it to evaluate $\int_0^\infty \left(\frac{x \cos x - \sin x}{x^3} \right) \cos(x/2) dx$

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

Subject: - Discrete Structure (CT 551)

- ✓ 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. Using rules of inference, derive the conclusion to the given hypothesis: Hypothesis: "Doug, a student in this class, knows how to write programs in Python. Everyone who knows how to write programs in Python can get a high-paying job". Conclusion: "Someone in this class can get a high-paying job". Show each step and give reasons for those steps. [8]
2. State the converse, contrapositive and inverse for the conditional statement, "I will not get a degree if I do not pass in Discrete Structure." Differentiate between formal and informal proof. Use proof by contraposition to prove "If x^2 is odd then x is also odd". [3+2+3]
3. Use mathematical induction to show that $1 + 2 + 2^2 + \dots + 2^n = 2^{n+1} - 1$ for all nonnegative integers n. [8]
4. Construct a DFA for the set of string over {a, b} such that length of the string |w| is divisible by 3. Define language for regular expression $(a+b)^* \cdot a$ [6+2]
5. Consider a Regular grammar defined by (Set of Non-Terminals: N={S,A}, Set of Terminals: T={a,b}, Production Rule: {S→bS ,S→aA, A→bA, A→b}, S=Starting Symbol). Design a Finite State Automaton and convert to Deterministic Finite Automaton if it is Non-Deterministic Finite Automaton. [8]
6. Find all the solutions of recurrence relation: $a_n = 3a_{n-1} - 4a_{n-2} + 3^n$ with initial the conditions $a_0 = 1$ and $a_1 = 2$. [8]
7. Define planar graph. Is $K_{3,3}$ a planar graph? Use Handshaking theorem to find the edges of the graph which consists of 10 vertices each of degree 6. [2+3+3]
8. What do you mean by Euler graph? What is the condition to know whether it is Euler graph or not? What is the chromatic number of k_n graph? Draw Q_n graph for n=3 bit. [2+2+2+2]
9. Define Binary Tree, M-ary tree and Spanning tree. Find the minimal spanning tree from the graph given below. [3+5]



10. Write short Notes on: [2×4]
 - Shortest Path Algorithm
 - Hamilton graph with its application.

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

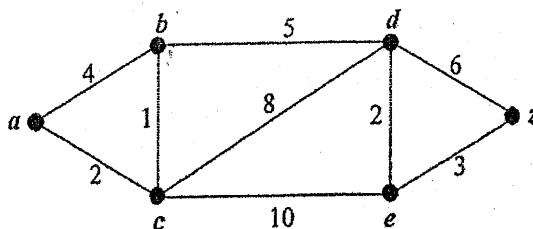
Subject: - Discrete Structure (CT 551)

- ✓ 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. Using rules of inference derive the conclusion to the given hypothesis: "Everyone in the sports training likes football. Someone in the sports training has never seen academy stadium". Conclusion: "Someone who likes football has never seen academy stadium". Show each step and give reasons for those steps. [8]
2. Use induction to show that $n! \geq 2^{n-1} f$ for all $n \geq 1$. [8]
3. State Converse, Contrapositive and Inverse for the conditional statement: "If you don't give up, you will succeed." [3]
4. Use Tableau method to check the validity of following argument: [5]

$$\begin{array}{l} \neg P \wedge \neg Q \\ \neg P \rightarrow Q \vee R \\ \therefore R \end{array}$$
5. Differentiate Finite State Machine and Finite State Automata. Design a DFSA that accepts precisely those strings over $\{a, b\}$ that contain an odd number of b's. Include the proper definition, transition table and transition diagram of your design. [2+6]
6. Consider a regular grammar $G = (N, T, P, \sigma)$, where N = set of non - terminals symbols = $\{\sigma, A\}$, T = set of terminal symbols = $\{0, 1\}$, P is the production rules = $\{\sigma \rightarrow 1A, \sigma \rightarrow 0, \sigma \rightarrow \lambda, A \rightarrow 0A, A \rightarrow 1A, A \rightarrow 1\}$. And σ being the starting symbol. Construct a non - deterministic finite automaton equivalent to the given regular grammar and convert to Deterministic Finite Automata. [4+4]
7. Find all solutions of recurrence relation [8]

$$a_n = 4a_{n-1} - 3a_{n-2} + n$$
 with initial conditions: $a_0 = 1, a_1 = 2$
8. Use Dijkstra's algorithm to find the length of the shortest path between the vertices a and z in the weighted graph displayed below: [8]



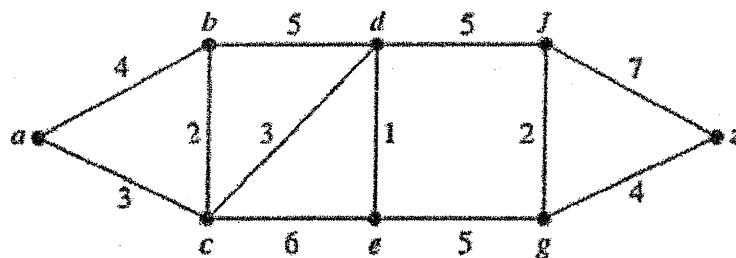
9. How many edges are there in a graph with 10 vertices each of degree six? Draw Q_3 graph for 3 bit and state whether it is planar or not with figure. [2+2+2]
10. What do you mean by Euler graph? What is condition to know whether it is Euler graph or not? What is the chromatic number of K_n graph? Explain Hamiltonian circuit. [2+2+2+3]
11. Write short notes on: [3×3]
 - Max Flow and Min cut theorem
 - Cutssets and cutvertices
 - Handshaking theorem

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

Subject: - Discrete Structure (CT 551).

- ✓ 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.

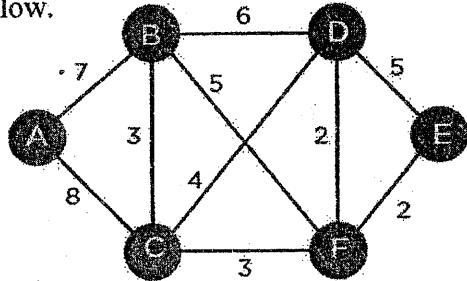
1. Using rules of inference, derive the conclusion to the given hypothesis: Hypothesis: "If today is Sunday then I will have a test in Discrete Structure and Microprocessor. If my Microprocessor instructor is busy then I will not have a test in Microprocessor. Today is Sunday and my Microprocessor instructor is busy". Conclusion: "I will have a test in Discrete Structure" Show each step and give reasons for those steps. [8]
2. What do you mean by tautology, contradiction and contingency? Let $Q(x)$ be the statement " $x < 2$." What is the truth value of the quantification $\forall x Q(x)$, where the domain consists of all real numbers? Prove that $\sqrt{2}$ is irrational using proof by contradiction. [3+2+3]
3. Use mathematical induction to show that $1^2 + 2^2 + \dots + n^2 = \frac{n(n+1)(2n+1)}{6}$ where n is a positive integer. [8]
4. Define Non-Deterministic Finite State Automata. Draw a transition diagram for Deterministic and Non-deterministic finite automata which accept a string containing "ing" at the end of a string in a string of {a-z}, e.g., "anything" but not "anywhere". [2+6]
5. Consider the regular grammar defined by $T = \{a, b\}$, $N = \{S, A\}$ with production rule:
 $S \rightarrow bS,$
 $S \rightarrow aA,$
 $A \rightarrow bA,$
 $A \rightarrow b.$
 Where T is Set of Terminals, N is Set of Non-Terminals and S is a starting symbol. Construct a Non-deterministic Finite Automata equivalent to the above given regular grammar and convert it into Deterministic Finite Automata. [4+4]
6. Find all the solution of recurrence relation: $a_n = 8a_{n-2} - 16a_{n-4}$ with initial conditions $a_0 = 1, a_1 = 4, a_2 = 28$ and $a_3 = 32$. [8]
7. Use Dijkstra's algorithm to find the cost of shortest path from a to z and also find the shortest path. [8]



8. Explain the Euler circuit and Hamilton circuit with an example. State if there is/are any necessary and the sufficient conditions for a graph to have Euler's and Hamilton's paths and circuits. [2+2+2+2]

9. Define Binary Tree, M-ary tree and Spanning tree. Find the minimal spanning tree from the graph given below.

[3+5]



10. Write short notes on:

[2×4]

- a) Max-flow min-cut theorem
- b) Graph Coloring

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

Subject: - Discrete Structure (CT 551)

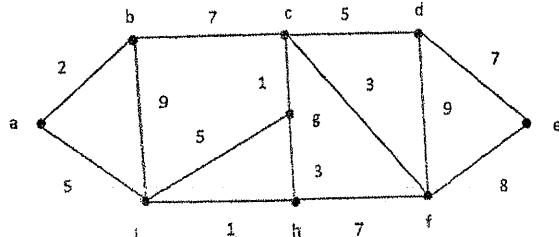
- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

1. Construct an argument using rules of inference to show that the hypotheses "if it does not rain or if it is not foggy, then the sailing race will be held and the lifesaving demonstration will go on, " "If the sailing race is held, then the trophy will be awarded" and "The trophy was not awarded" imply the conclusion "It rained". You are required to show each step and give reasons for those steps before you come to the desired conclusion from the hypotheses. [8]
2. Use mathematical induction to prove that $7^{n+2} + 8^{2n+1}$ is divisible by 57 for every nonnegative integer n. [8]
3. State the converse, contrapositive, and inverse of the statement, "The automated reply cannot be sent when the file system is full. [4]
4. Let $P(x, y)$ be the propositional function $x \geq y$. The domain of discourse is set of all the positive integers. Now tell whether the proposition is true or fall with reasoning. [2+2]
 - (a) $\exists y \forall x P(x, y)$ (b) $\forall y \exists x P(x, y)$
5. a) Design a Finite State automata that accepts precisely those strings over {a, b} that contains the substring "bba". Your design should include the proper definition of the finite-state automation, transition table and the transition diagram. [6]
 - b) Give regular expressions for following language [2]

$$L = \{ W \in \{a, b\}^*: \text{contains at-most 2 'a'} \}$$
6. Given a grammar make NDFA and convert it to equivalent DFA:

$$A \rightarrow sA, A \rightarrow bB, A \rightarrow b, P \rightarrow sP, P \rightarrow bA, P \rightarrow s$$
 [2+6]
7. Find all solutions of the recurrence relation:

$$a_n = 2a_{n-1} + 2n^2$$
 with initial condition $a_1 = 4$. [8]
8. Use Dijkstra's algorithm to find the length of shortest path from vertex a to vertex e in the following weighted graph. Also highlight the shortest path/path in graph. [8]



9. Draw clear and labeled diagrams of Complete graph with 6 Vertices (K_6) and 3-dimensional Hypercube (Q_3). Also write their Chromatic Numbers. Are the graphs K_6 and Q_3 planar? Give proof for your answer. [4+2+4]
10. Define Spanning Tree with example. What are the conditions for Euler's circuit and path in a graph? [2+3]
11. Write short notes on:
 a) Max Flow and Min cut Theroem
 b) Hamiltonian path and circuit
 c) Cut sets and cut vertices [3×3]

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

Subject: - Discrete Structure (CT 551)

- ✓ 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. By using rules of inferences, show that the hypothesis "If you send me an email, then I will finish writing the program", "If you do not send me an e-mail message, then I will go to sleep early", and "If I go to sleep early, then I will wake up feeling refreshed" lead to the conclusion "If I do not finish writing the program, then I will wake up feeling refreshed". [8]
2. Use mathematical induction to prove that $1 + 3 + 6 + 10 + \dots + [n(n+1)]/2 = [n(n+1)(n+2)]/6$ for all positive integers n. State Converse, Contrapositive and Inverse for the conditional statements: "I feel sleepy if I study till late night." [5+3]
3. Proved that $\sqrt{2}$ is an irrational by giving a proof by contradiction. What are the significance of Tableau methods? [5+3]
4. Design a Finite State Automata that accepts precisely those strings over {a, b} that ends with "abb". Your design should include the proper definition of the finite-state automation, transition table and the transition diagram. Give regular expression for following language $L = \{w \in \{a, b\}^*: w \text{ starts and ends with different symbols}\}$ [6+2]
5. Construct a Non-deterministic Finite Automata equivalent to the regular grammar G given below and convert it to the Deterministic Finite Automata. Here the regular grammar G is defined as:
 $G = \{N, T, P, S\}$, where N is non-terminal symbols, T is terminal symbols, P is production rules and S is the starting symbol. [4+4]

N -> {S, A}
 T -> {a, b}
 P -> aAb, aaAb
 A -> ∈ (empty symbol)
6. Find all the solutions of the recurrence relation $a_n = 2a_{n-1} + a_{n-2} + 2^n + 1$ with initial conditions $a_1 = 7$ and $a_2 = 19$. [8]
7. Using Dijkstra's Shortest Path Algorithm to find the shortest path from A to Z in the following weighted graph. Also make highlight the shortest path from source to destination (A-Z). [8]


```

graph LR
    A((A)) -- 4 --> B((B))
    A -- 2 --> C((C))
    B -- 5 --> D((D))
    B -- 1 --> C
    C -- 4 --> C
    C -- 5 --> E((E))
    D -- 2 --> E
    D -- 1 --> Z((Z))
    E -- 3 --> Z
  
```
8. Prove that an undirected graph has even number of vertices of odd degree. Draw cycle with 5 vertices (C_5) and 3-Dimensional Hypercube (Q_3) and write their chromatic numbers. [2+6]
9. Differentiate between Hamiltonian and Euler Circuit with suitable examples. Define planar and regular graphs. [4+2+2]
10. Write short notes about following topics: [2×4]
 - Cut Edges and Cut Vertices
 - MaxFlow and MinCut theorem

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Exam.		Back	1
Level	BE	Full Marks	80
Programme	BEX, BCT	Pass Marks	32
Year / Part	II / II	Time	3 hrs.

Subject: - Discrete Structure (CT 551)

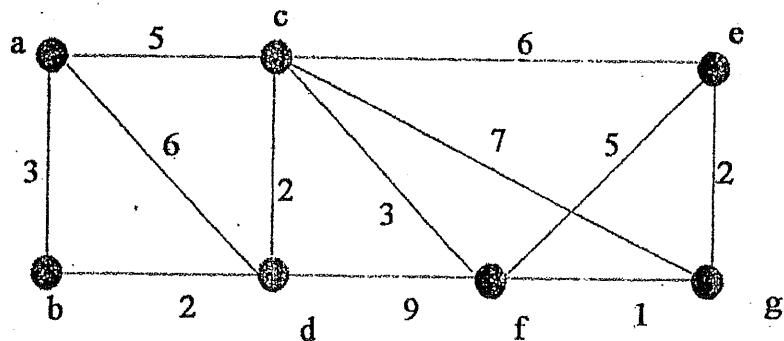
- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

1. Explain inclusive and exclusive disjunction with truth table and examples. [6]
2. Explain De Morgan's law for quantifiers with example. [4]
3. State the converse, contrapositive and inverse for the conditional statement "if any two sides of a triangle have equal length, then the triangle is isosceles" [3]
4. Check whether the following groups of statements are consistent to each other or not using tableaux method. If consistent, give the truth values to the variables for which the system is consistent. [6]

$$\Phi = \{p \rightarrow (r \wedge t), (t \vee s) \rightarrow \neg q, \neg \neg (p \wedge q)\}$$
5. Use mathematical induction to prove that $n < 2^n$ for all positive integers n. [5]
6. Define regular expression with example. Design a DFA that accepts following language
 $L = \{w \mid w \text{ is a binary string such that } w \text{ has both } 01 \text{ and } 10 \text{ as substring}\}$
 Check your design for 10011 and 1101. [2+6]
7. Define Regular grammar. Construct a Non-Deterministic Finite State Automata for following grammar and convert it into its equivalent Deterministic Finite State Automata. [8]

$$G = (N, T, P, S) \text{ where}$$
 - N = set of non-terminals = {S, A, B}
 - T = set of terminals = {a, b}
 - P = productions = {S \rightarrow aA $|$ bB, A \rightarrow a $|$ B \rightarrow a}
 - S = starting non-terminal
8. Find solution of following recurrence relation [8]

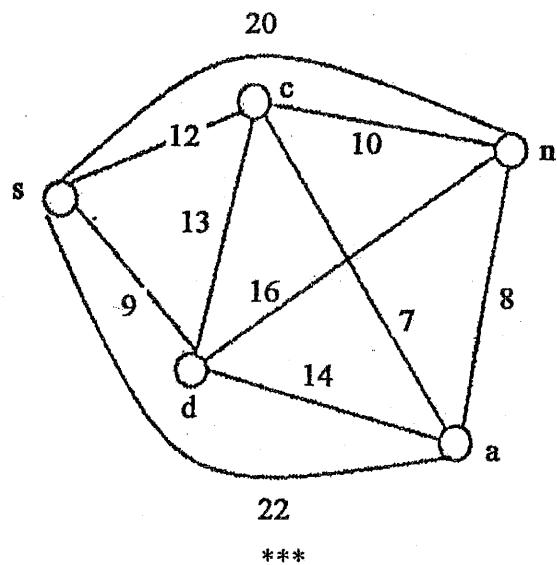
$$a_n = 2a_{n-1} - a_{n-2} + 2^n \text{ for } n \geq 2 \text{ with } a_0 = 1 \text{ and } a_1 = 2$$
9. What is a bipartite graph? Is C_6 bipartite? [2+2]
10. Explain matrix representations of graph with examples. [6]
11. Use Dijkstra's algorithm to find the length of shortest path between vertices a and g in the weighted graph displayed below. [8]



12. How does a tree differ from graph? Define balanced tree with example. [4]

13. Define spanning tree with example. Use Prim's algorithm to find minimum spanning tree of following graph.

[2+8]



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2078 Chaitra

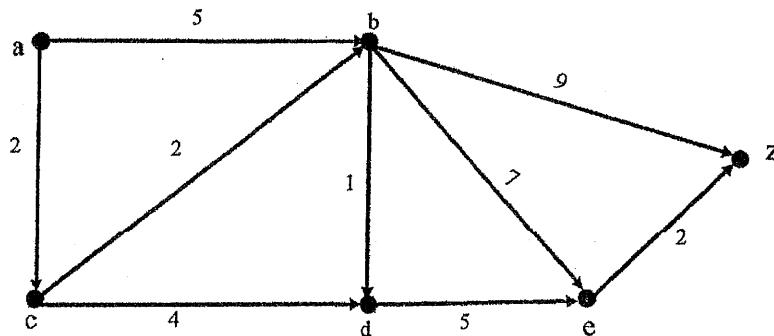
Exam.	Regular
Level	BE
Programme	BEI, BEX, BCT
Year / Part	II / II
Full Marks	80
Pass Marks	32
Time	3 hrs.

Subject: - Discrete Structure (CT 551)

- ✓ 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. Use rules of inference to show that the hypothesis "No humans can fly.", "Tweety is a bird or a human.", "Tweety can fly" implies the conclusion "Tweety is a bird". [8]
2. Write the inverse, covers and contrapositive of the statement "If Covid Spreads then we will have online classes". Use a mathematical induction to prove, if n is non-negative integer, then $(n^5 - n)$ is divisible by 5. [3+5]
3. Define consistency and Completeness of the Logical System. Draw Tableau for formula set:

$$\phi = \{(P \wedge Q) \vee R, P \rightarrow \neg Q, \neg P\}$$
 [2+6]
4. Given a Language $L = \{ W \in \{a,b\}^* : W \text{ ends with 'ba'} \}$. Write a regular expression and design a Finite state automata that accepts the language L. Your design should include proper definition of finite-state automation, transition table and transition diagram. [2+6]
5. Consider the regular grammar
 $G = (N, T, P, \sigma)$ where,
Set of Non-Terminals, $N = \{\sigma, A, B\}$
Set of Terminals, $T = \{a, b\}$
Set of productions, $P = \{\sigma \rightarrow bB, \sigma \rightarrow bA, A \rightarrow a\sigma, B \rightarrow bB, B \rightarrow a, B \rightarrow \lambda\}$
and starting symbol σ .
Construction a Non-Deterministic Finite State Automata equivalent to the above given regular grammar and convert this into DFA.
[4+4]
6. Find all the solution of the recurrence relation: $a_n = 6a_{n-1} - 8a_{n-2} + 3^n$, where the initial conditions: $a_0 = 4$ and $a_1 = 10$. [8]
7. Use Dijkstra's algorithm to find the length of shortest path between vertices 'a' and 'z' in the graphs below. Also highlight the shortest path. [8]



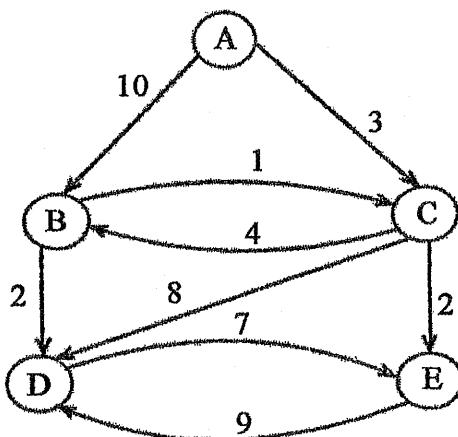
8. State Handshaking Algorithm for directed graph. Define Bipartite graph with a suitable example. Draw a figure for complete bipartite graph $K_{3,5}$ and determine its chromatic number. [2+2+2+2]
9. Define spanning tree with a suitable example. Prove that $K_{3,3}$ is non-planar graph. [3+5]
10. Write short notes on:
 - Breadth First and Depth First Traversal
 - Cut Edges and Cut Vertices

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

Subject: - Discrete Structure (CT 551)

- ✓ 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. Show that the premises. "If the Council approves the funds, then New Atlantic will get the Olympic Games. If New Atlantic gets the Olympic Games, then New Atlantic will build a new stadium. New Atlantic does not build a new stadium. Therefore, the Council does not approve the funds, or the Olympic Games are canceled." [8]
2. Use mathematical induction to prove that $2^n > n^2$ for $n > 4$. [8]
3. Define predicates. State the converse, contrapositive, and inverse of "I come to class whenever there is going to be a quiz." Prove that if n is a positive integer, then n is even if and only if $7n + 4$ is even. [1+3+4]
4. Design a DFA that accepts a language $L(M) = \{w \in \{0, 1\}^*: \text{all bit strings that contain the string } 101\}$. Your design should include proper definition of DFA, transition table and transition diagram. [8]
5. Write the regular expression for set of strings of a's and b's ending with the string either ab or ba. Construct a finite-state machine that gives an output of 1 if and only if last three bits received are all 1s. [4+4]
6. Find all solutions of the recurrence relation $a_n = 2a_{n-1} + 2n^2$ with initial condition $a_1 = 4$. [8]
7. Let G be a connected planar simple graph with e edges and v vertices. Let r be the number of regions in a planar representation of G . Then prove that $r = e - v + 2$. [4]
8. Are C_3 and C_6 bipartite? Justify your answer. Explain about Incidence Matrix technique for graph representation with figure. [4+4]
9. Use Dijkstra's algorithm to find the length of a shortest path from the vertex "A" to other vertices in the graph below. [8]



10. What is Huffman coding? Why do you need it? Show that K_n has Hamilton circuit whenever $n \geq 3$. What is the chromatic number of C_n for $n \geq 3$? [2+3+3]
11. Explain S-T cut theorem with example. [4]

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

Subject: - Discrete Structure (CT 551)

- ✓ 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. Use rules of inference to show that the hypothesis "Buddha will go to Lumbini or Pokhara", "He will not visit Mayadevi Temple if he goes to Pokhara", "He will not visit Mayadevi Temple only if he visits Sarangkot.", "If he visit Sarangkot, he will do paragliding.", "He will not do paragliding" imply the conclusion "He will go to Lumbini". [8]

2. Conjecture a formula for $\frac{1}{2} + \frac{1}{4} + \frac{1}{8} + \dots + \frac{1}{2^n}$ and prove the formula you conjectured using mathematical induction. [2+6]

3. a) State Converse, Contrapositive and Inverse for the conditional statement:

"I won't get a degree if I do not pass in Discrete Structure."

b) Define soundness and completeness of a proof system. Draw Tableau for formula sets: $\Phi = \{P \rightarrow Q \vee R, P \wedge \neg Q, \neg(\neg P \wedge R)\}$ [3]

4. Design a DFA that accepts a language $L(M) = \{w \in \{0,1\}^*: \text{Every 0 in } w \text{ has 1 immediately to its right}\}$. Your design should include proper definition of DFA, transition table and transition diagram. [8]

5. Consider the regular grammar, $G = (N, T, P, \sigma)$ where

Set of Non-terminals, $N = \{\sigma, A, B\}$

Set of Terminals, $T = \{a, b\}$

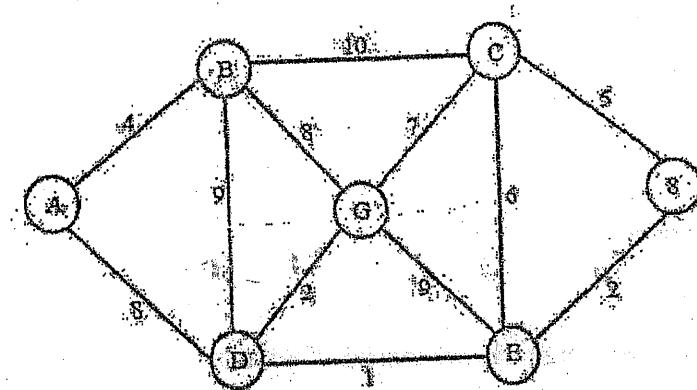
Set of productions, $P = \{\sigma \rightarrow aA, \sigma \rightarrow aB, \sigma \rightarrow bA, A \rightarrow bA, A \rightarrow \lambda, B \rightarrow b\}$
 and starting symbol σ .

Construct a Non-deterministic Finite State Automata equivalent to the above given regular grammar and convert this into equivalent DFA.

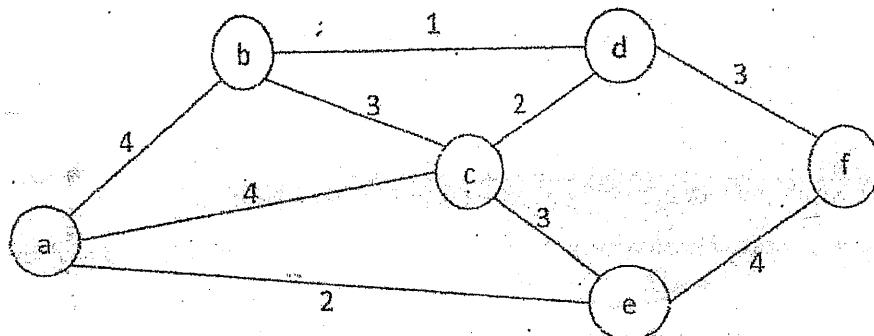
6. Find all solutions of the recurrence relation $a_n = 7a_{n-1} - 16a_{n-2} + 12a_{n-3} + n4^n$ with $a_0 = -2$, $a_1 = 0$, and $a_2 = 5$. [8]

7. Use handshaking theorem to find the number of edges of the graph which consists of 12 vertices each of degree five. Define "Chromatic Number". Draw the figure of complete bipartite graph $K_{3,4}$ and cycle with 5 vertices C_5 . Also write their chromatic numbers. [2+2+2+2]

8. Use Dijkstra's algorithm to find the length of a shortest path from the vertex "A" to other vertices in the graph below. [8]



9. Define Spanning Tree with example. Find the Minimum Spanning Tree from the graph given below. [2+5]



10. Write short notes on: [3x3]

- a) Hamilton graph
- b) Max flow and Min cut theorem
- c) Planar Graph

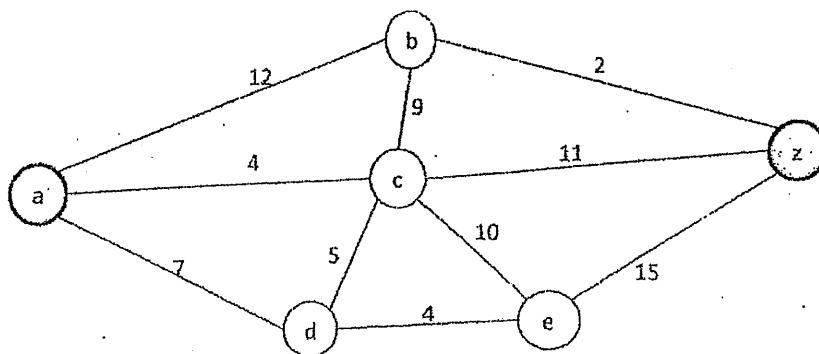
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Exam.	Regular		
Level	BE	Full Marks	80
Programme	BEI, BEX, BCT	Pass Marks	32
Year / Part	II / II	Time	3 hrs.

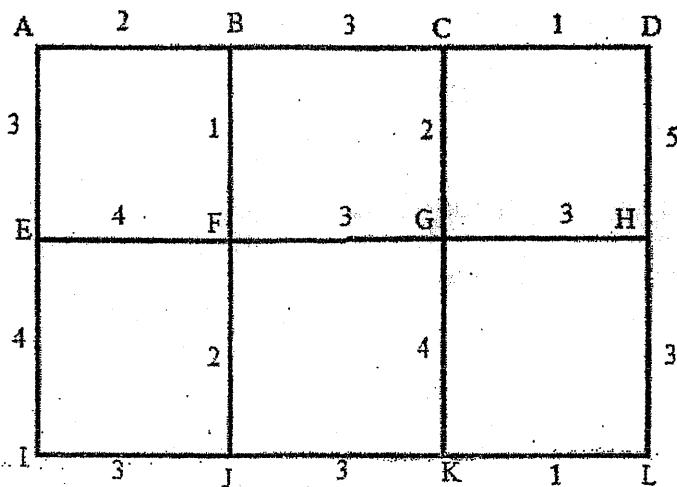
Subject: - Discrete Structure (CT 551)

- ✓ 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 Valid Argument in Logic. "Somebody in this class enjoys whale watching. Every person who enjoys whale watching cares about ocean pollution. Therefore, there is a person in this class who cares about ocean pollution." Show whether the given argument is valid or not using rules of inference. [2+6]
2. What are "Counterexamples", explain with example. Use mathematical induction to prove: $1^3 + 2^3 + 3^3 + \dots + n^3 = n^2(n+1)^4/4$ for all positive integer n. [2+6]
3. Prove that if $n=ab$, where a and b are positive integers, then $a \leq \sqrt{n}$ or $b \leq \sqrt{n}$. Determine whether the given expression is consistent or inconsistent using method of Tableaux: $(P \wedge Q \rightarrow R) \wedge (\neg P \rightarrow S) \wedge Q \wedge \neg R \wedge \neg S$ [3+5]
4. Define Finite state machine with example. Design a Finite State Automata that accepts precisely those strings over {a,b} that does not end with the substring "abb". Your design should include the proper definition of the finite-state automation, transition table and the transition diagram. [2+6]
5. Consider the regular grammar defined by $T=\{a,b\}$, $N=\{S, A\}$ with productions $S \rightarrow bS$, $S \rightarrow aA$, $A \rightarrow bA$, $A \rightarrow b$ and starting symbol S. [4+4]
 - Construct a NDF A equivalent to the above given regular grammar.
 - Convert the NDF A into equivalent DFA.
6. Find all solutions of recurrence relation: $a_n = 4a_{n-1} - 4a_{n-2} + 3^n$. Also, find the solution with initial conditions: $a_0=1$ and $a_1=2$. [8]
7. State and describe briefly the chromatic number of complete bipartite graph $K_{3,4}$ and cycle C_5 . Define Planar graph and show that K_5 is not a planar graph. [4+4]
8. Use Dijkstra's algorithm to find the length of shortest path from vertex 'a' to vertex 'z' in the following weighted graph. Also highlight the shortest path in the graph. [8]



9. Define Spanning Tree and Minimum Spanning Tree. Find the minimum spanning tree from the given graph below. [1+1+5]



10. Write short notes on: [3x3]

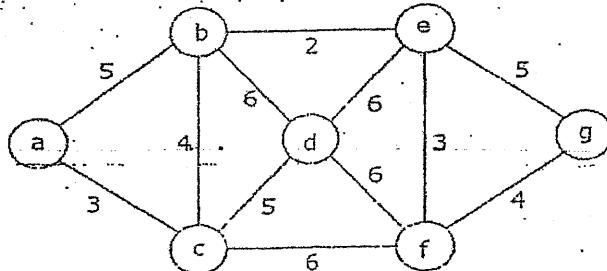
- a) Max flow and Min cut theorem
- b) Cut edges and Cut vertices
- c) Euler graph.

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 2076 Baisakh

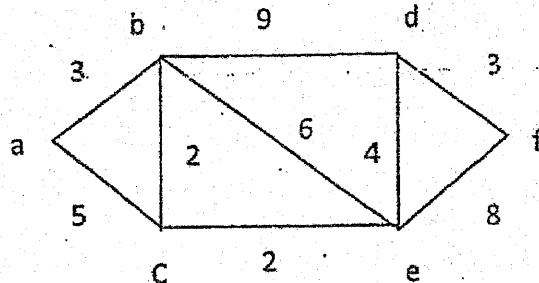
Exam.	Back		
Level	BE	Full Marks	80
Programme	BCT, BEX	Pass Marks	32
Year / Part	II / II	Time	3 hrs.

Subject: - Discrete Structure (CT 551)

- ✓ 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 student in this class has not read the book" and "Everyone in this class passed the first exam" implies that conclusion "someone who passed the first exam has not read the book." [5]
 - b) Let $Q(x,y)$ denote $(x+y=0)$. What is truth values of quantification $\exists y \forall x Q(x,y)$ and $\forall x \exists y Q(x,y)$. [3]
 2. Show that $\{A \wedge C, (\neg A \vee B) \wedge (\neg B \vee \neg C)\}$ are unsatisfiability of the given set using method of tableaux. Prove that " If n is an integer and $3n+2$ is odd, then n is odd." [5+3]
 3. Use mathematical induction to prove that $7^{n+2} + 8^{2n+1}$ is divisible by 57 for every non negative integer n. [8]
 4. Design a FSA transition diagram that accepts the given set of string over {a,b},
 - which starts with ab and ends with baa.
 - where every b is followed by a.
[4+4]
 5. Design a Grammar to generate Palindrome for Binary Number. Consider the right linear Grammar $N=\{N, T, P, S\}$, where N=set of non-terminal = {A, B, S}, T=Set of Terminal={a, b, c}, and P consists of the following rules: $\{S \rightarrow abA/bbB/a, A \rightarrow aA/bB/b, B \rightarrow baB/aaaA\}$. Construct the NDFA equivalent to the given grammar. [4+4]
 6. Find all the solutions of recurrence relation:
 $a_n = 3a_{n-1} + 4a_{n-2} + 3^n$ with initial conditions $a_0=1$ and $a_1=2$. [8]
 7. Are C_3 and C_6 bipartite, explain with figures. If G is a connected planar simple graph with E edges and V vertices, where $V \geq 3$, then prove that $E \leq 3V-6$. [4+4]
 8. Define Binary tree, M-ary tree and Spanning tree. Find the minimal spanning tree from the graph given below. [3+5]



9. Use Dijkstra's Algorithm to find the length of shortest path from vertex a to vertex f in the following weighted graph. Also highlight the shortest path/path in graph. [8]



10. Write short notes on:

[4+4]

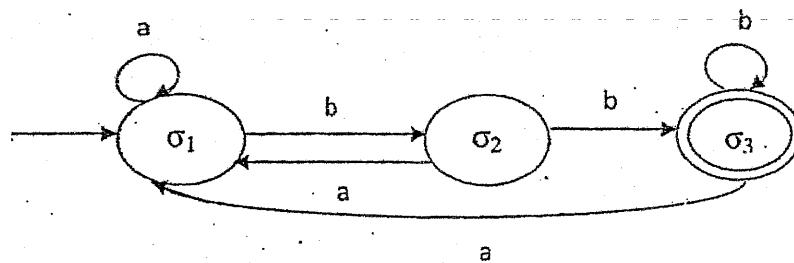
- a) Regular Graph with example.
- b) Max Flow and Min Cut Theorem

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BCT/ BEX	Pass Marks	32
Year / Part	II / II	Time	3 hrs.

Subject: - Discrete Structure (CT551)

- ✓ 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.

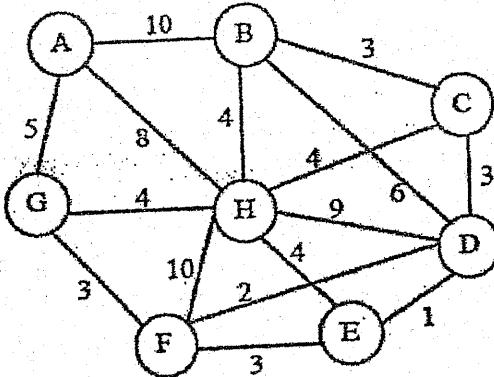
1. Define the terms Tautology, Contradiction and Logical Equivalences. Show that $\neg A \rightarrow \neg B$ and $B \rightarrow A$ are Logically Equivalent. State the converse, contrapositive and inverse of the statement, "A positive integer is prime only if it has no divisors other than 1 and itself". [3+2+3]
 2. Show that the premises "There is someone in this class who has been to Pokhara. Everyone who goes to Pokhara visit the Sarankot. Therefore, someone in this class has visited the Sarankot." [8]
 3. Use mathematical induction to verify: [8]
- $$1^2 - 2^2 + 3^2 - 4^2 + \dots + (-1)^{n+1} n^2 = (-1)^{n+1} n(n+1)/2$$
4. a) State the closure properties of Regular Language. [3]
 - b) Let L be the set of strings accepted by the FSA shown below. Now construct a FSA that accepts the strings $L^R = \{X_n \dots X_1 | X_1, \dots, X_n \in L\}$ [5]



5. i) Find the language $L(G)$ over $\{a,b,c\}$ generated by the grammar G with production: $S \rightarrow aSb, aS \rightarrow Aa, Aab \rightarrow c$. [4+4]
- ii) Write a grammar that generates the string over $\{a,b\}$ not ending with ab.
6. Find the solution of recurrence relation of $a_n = 5a_{n-1} - 6a_{n-2} + 3n + 2^n$, with initial condition $a_0 = 0, a_1 = 1$, and $a_2 = 2$. [8]
7. Prove the theorem, "An undirected graph has an even number of vertices of odd degree." Describe complete graph and bipartite graph. [3+5]
8. What is chromatic number of $K_s, K_{m,n}$ and C_p for $P \geq 3$, explain with suitable figure. How Euler graph is different from Hamilton graph, explain? [5+3]

9. Use Dijkstra's algorithm to find the length of a shortest path from the vertices A to other in the graph below.

[8]



10. Write short notes on:

[4+4]

- i) Max Flow and Min cut Theorem
- ii) Planar Graph

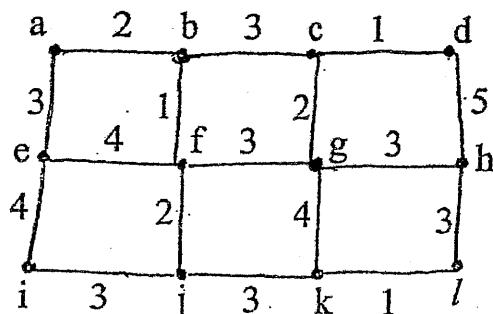
47 TRIBHUVAN UNIVERSITY
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Exam.	Back		
Level	BE	Full Marks	80
Programme	BEX, BCT	Pass Marks	32
Year / Part	II / II	Time	3 hrs.

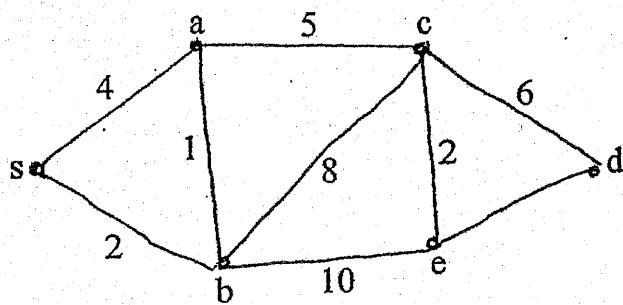
Subject: - Discrete Structure (CT551)

- ✓ 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 proposition. List the various classes of propositions and describe about them. [1+2]
- b) Using rules of inferences show that the hypothesis "It is not rainy today and its hotter than yesterday", "we will go for shopping only if it is rainy", "If we do not go for shopping then we will go for swimming", and "If we go for swimming, then we will be home by sunset" lead to the conclusion "we will be home by sunset". Prove forming the each steps along with their justification. [5]
- c) Prove by mathematical induction
 $"4^{n+1} + 5^{2n-1}$ is divisible by 21 for n as the positive integer". [8]
2. a) Design the finite state machine for the implementation of the S - R - Hip-Hop. Design the NDFSA that recognizes the substring starting with "abb" over the input I = {a, b}. [4+4]
- b) Define the context sensitive, context-free and regular grammar. Formulate the regular grammar for integers. [3+5]
3. a) What is recurrence relation? Solve the R-R given by $a_n = 5a_{n-1} - 6a_{n-2} + 6^n$ giving the all solutions of it. [8]
- b) List out the various proof techniques. Describe about the proof by contradiction and proof by equivalences using the suitable examples. [3+5]
4. a) Define planar graph. Is $K_{3,3}$ a planar graph? Use hand shaking theorem to find the edges of the graph which consists of 10 vertices each of degree six. [2+3+3]
- b) Use Kruskal's algorithm to find the minimum spanning tree for the weighted graph given below. [8]



5. a) Use Dijkstra's algorithm to find the length of the shortest path between the vertices s and d in the weighted graph given below. [8]



- b) Write short notes on: [2x4]

- (i) Eulerian path and circuits
- (ii) Min-cut-Max flow theorem
- (iii) Carapah Coloring
- (iv) Bipartite and Complete bipartite graphs

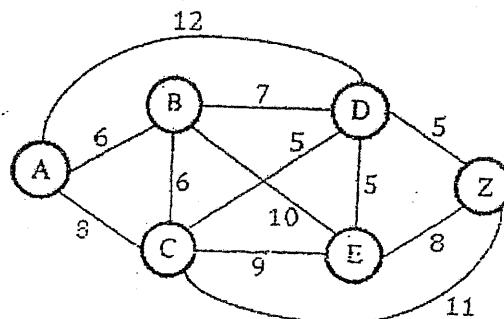
Exam.	Regular		
Level	BE	Full Marks	80
Programme	BEX, BCT	Pass Marks	32
Year / Part	II / II	Time	3 hrs.

Subject: - Discrete Structure (CT551)

- ✓ 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. Use rules of inference to show that the hypothesis "If my cheque book is in office, then I have paid my telephone bill", "I was looking for phone bill at breakfast of I was looking for phone bill in my office", "If I was looking for phone bill at breakfast then my cheque book is on breakfast table", "If I was looking for phone bill in my office then my cheque book is in my office", "I have not paid my phone bill" imply the conclusion "My cheque book is on my breakfast table." [8]
2. Write the inverse, converse and contrapositive of the statement "I visit temple only if it's Saturday". Prove that if n is a positive integer, then n is even if and only if $7n + 4$ is even. [3+5]
3. Define tableau method with its significances? Use mathematical induction to prove the formula for the sum of a finite number of terms of Geometric Progression: [4+4]

$$\sum_{j=0}^n ar^j = a + ar + ar^2 + \dots + ar^k = \frac{ar^{n+1} - a}{r - 1},$$
 when $r \neq 1$, where n is non-negative integer.
4. Given a language, $L = \{w \in \{a, b\}^*: w \text{ contain at-least three 'b' s}\}$
 Write the regular expression for L and design a Finite State Automata that accepts the Language L. Your design should include the proper definition of the finite-state automation, transition table and the transition diagram. [2+6]
5. Consider the regular grammar $G = \{N, T, P, \sigma\}$ where N = set of non-terminal symbols = $\{\sigma, C\}$, T = set of terminal symbols = {a, b}, P is the set of production rules = $\{\sigma \rightarrow b\sigma, \sigma \rightarrow aC, C \rightarrow bC, C \rightarrow b\}$ and σ being the starting symbol. Construct a non-deterministic finite state automaton equivalent to the given regular grammar. Use this non-deterministic finite state automaton to generate equivalent deterministic finite state automaton. [3+5]
6. State linear homogeneous and non-homogeneous recurrence relation with examples. Find all solutions of the recurrence relation: $a_n = 2a_{n-1} + 2n^2$ with initial condition $a_1 = 4$. [3+5]
7. Use Dijkstra's algorithm to find the length of shortest path from vertex A to vertex Z in the following weighted graph. Also highlight the shortest path/path in the graph: [8]



8. State Handshaking Theorem for undirected graph. Define bipartite graph with suitable example. Draw the figure for Complete Bipartite Graph $K_{3,4}$ and determine its chromatic number. [2+2+2+2]
9. How does Hamiltonian circuit differ from Euler circuit? Define Planar and Regular graphs with suitable examples. [4+2+2]
10. Write short notes on: [4+4]
- Tree and its applications
 - Max-flow Min-cut Theorem

47 TRIBHUVAN UNIVERSITY
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Examination Control Division
2073 Bhadra

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

Subject: - Discrete Structure (CT551)

- ✓ 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. Using rules of inference, prove that the hypotheses "If I get my Christmas bonus and my friend are free, I will take a road trip with my friends.", "If my friends don't find a job after Christmas, then they will be free." and "I got my Christmas bonus and my friend did not find a job after Christmas." Lead to the conclusion "I will take a road trip with my friends." [8]

2. State the principle of strong induction. Prove the formula for the sum of a finite number of terms of Geometric Progression: $\sum_{j=0}^n ar^j = a + ar + ar^2 + \dots + ar^k = \frac{ar^{n+1} - a}{r - 1}$ [3+5]

When $r \neq 1$, where n is non-negative integer.

3. Explain the validity of arguments with suitable example. Use direct proof to prove "if x is odd then x^2 is also odd". [4+4]

4. How do you define a Finite State Automation (FSA)? Design a finite state automation that accepts precisely those strings over {a,b} that end with substring aa. Your design should include the proper definition of the finite state automation, transition table and the transition diagram. [2+6]

5. Write a grammar that generates the string having the given property. [4+4]

- String over {a,b} ending with ba
- String over {a,b} starting with a

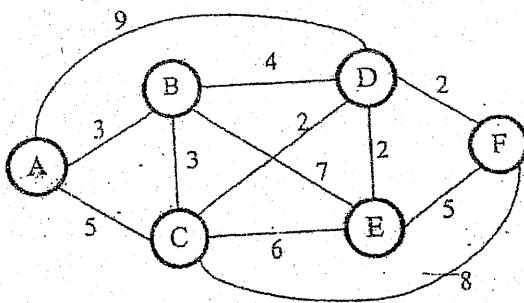
6. Find all the solutions of recurrence relation: [8]

$$a_n = 7a_{n-1} - 12a_{n-2} + 3^n \text{ with initial conditions } a_0 = 1 \text{ and } a_1 = 4$$

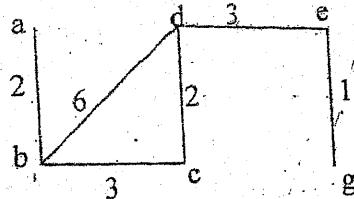
7. Draw the figure for the complete graph with 5 vertices (This is usually denoted by K_5). Define the term graph coloring and the chromatic number of a graph in graph coloring. What is the chromatic number of the complete graph K_5 and complete bipartite graph $K_{3,3}$? [2+1+1+2+2]

113

8. Use Dijkstra's algorithm to find the length of shortest path from vertex A to vertex F in the following weighted graph. Also highlight the shortest path/path in the graph. [8]



9. Prove that $K_{3,3}$ is not a planar graph. The labeled graph has 3 spanning trees. [4+4]



Find the two spanning trees of given Graph

10. Write short notes on:

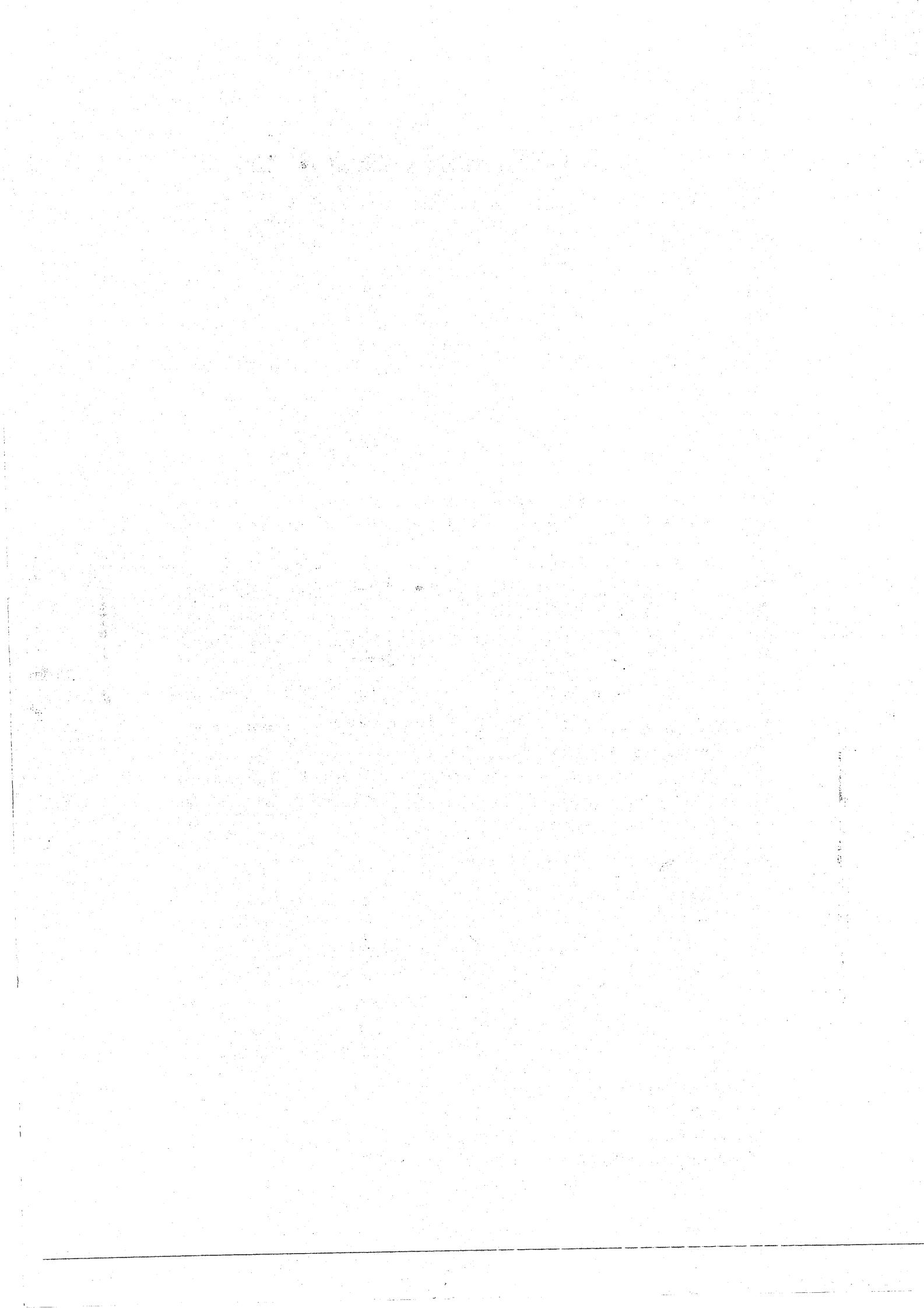
- i) MaxFlowMinCut Theorem
- ii) Cutsets and Cutvertices

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

Subject: - Discrete Structure (CT5)

- ✓ 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. Hypothesis: "If today is Sunday then I will have a test in MFC and IT. If my IT teacher is sick then I will not have a test in IT. Today is Sunday and my IT teacher is sick." Conclusion: "I will have a test in MFC." Use rule of inference to prove it. [8]
 2. What do you mean by weak principle of mathematical induction? Prove that $5^n - 1$ is divisible by 4 for all $n \geq 1$ using Induction method. [3+5]
 3. What are the central ideas of formal and informal proofs? Prove that $\sqrt{2}$ is irrational. [4+4]
 4. Define Non-Deterministic Finite State Automata. Design a finite-state automation that accepts only those set of strings over $\{a,b\}$ which ends with aba . Precisely, only those strings which end with aba should be accepted and other strings over $\{a,b\}$ should be rejected. Your design should include the proper definition of the finite-state automation, transition table and the transition diagram. [2+6]
 5. Consider the regular grammar $G = (N, T, P, \sigma)$ where N = set of non-terminal symbols = $\{\sigma, C\}$, T = set of terminal symbols = $\{a, b\}$, P is the set of production rules = $\{a \rightarrow b\sigma, \sigma \rightarrow aC, C \rightarrow bC, C \rightarrow b\}$ and σ being the starting symbol. Construct a non-deterministic finite state automaton equivalent to the given regular grammar. Use this non-deterministic finite state automaton to generate equivalent deterministic finite state automaton. [4+4]
 6. What do you understand by recurrence relation? Explain in brief. Setup a recurrence relation for the sequence representing the number of moves needed to solve Hanoi Tower puzzle. [3+5]
 7. Draw neat and clean graphs of: W_6 (a wheel with 6 peripheral vertices), K_6 (a complete graph with 6 vertices), Q_3 (a 3 dimensional hypercube) and $K_{2,5}$ (complete bipartite graph). Use graph coloring technique to color each of these graphs and state their respective chromatic numbers. [4+4]
 8. Find the shortest path from vertex a to vertex Z Highlight the shortest paths in the graph. [6+2]
-
9. Explain the Euler circuit and Hamilton circuit with example. State the necessary and the sufficient conditions for them. [2+2+2+2]
 10. Write short notes on:
 - Spanning Trees
 - Max-flow min-cut theorem



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

Subject: - Discrete Structure (CT551)

- ✓ 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.

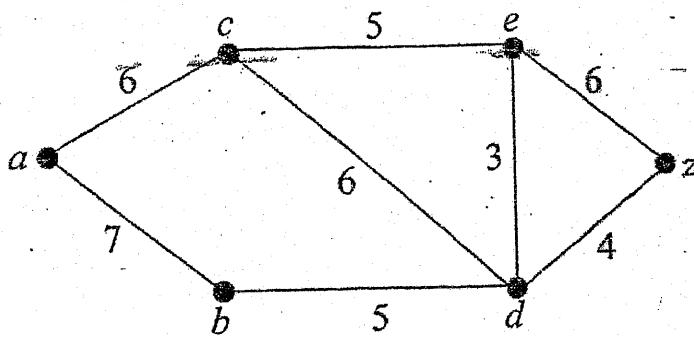
- (1) We are given the following hypotheses: [8]
- If the Chargers get a good linebacker then the Chargers can beat the Broncos
- If the Chargers can beat the Broncos, then the Chargers can beat the Jets.
- If the Chargers can beat the Broncos, then the Chargers can beat the Dolphins.
- The Chargers get a good linebacker.
- Show using the rules of inference that the conclusion, the Chargers beat the Jets and the Chargers can beat the Dolphins, follows from the hypotheses.
- (2) Use mathematical induction to prove that [8]
- $$2 - 2 \cdot 7 + 2 \cdot 7^2 - \dots + 2(-7)^n = (1 - (-7)^{n+1})/4 \text{ whenever } n \text{ is a non negative integer}$$
- (3) Prove that $\sqrt{2}$ is irrational by giving a proof by contradiction. [3]
- (4) Draw the tableau for the formula set [5]
- $$\Phi = \{p \rightarrow (r \wedge t), (t \vee s) \rightarrow \neg q, \neg \neg(p \wedge q)\}$$
- where \neg denotes the negation of a variable, \vee denotes the disjunction of variables, \wedge denotes the conjunction of variables and \rightarrow denotes the implication.
- (5) Differentiate between Deterministic Finite State Automata and Non-Deterministic Finite State Automata. Design a Finite State Automata that accepts precisely those strings over $\{a, b\}$ that contain an odd number of b's. Your design should include the proper definition of the finite-state automaton, transition table and the transition diagram. [2+6]
- (6) Consider the regular grammar $G = (N, T, P, \sigma)$ where N = Set of Non-Terminals = $\{\sigma, A, B\}$, T = Set of Terminals = $\{a, b\}$ with productions $\sigma \rightarrow a, \sigma \rightarrow bB, A \rightarrow bA, A \rightarrow aB, A \rightarrow b, A \rightarrow a, B \rightarrow b$ and starting symbol σ . [4 + 4]
- Construct a Non-Deterministic Finite State Automata equivalent to the above given regular grammar and convert this into equivalent Deterministic Finite State Automata.

- (7) Find all solutions of the recurrence relation
 $a_n = 7a_{n-1} - 16a_{n-2} + 12a_{n-3} + n4^n$
with initial condition $a_0 = -2$, $a_1 = 0$ and $a_2 = 5$.

[8]

- (8) Use Dijkstra's algorithm to find the length of the shortest path between the vertices a and z in the weighted graph displayed below.

[8]



- (9) In a round-robin tournament the Tigers beat the Blue Jays, the Tigers beat the Cardinals, the Tigers beat the Orioles, the Blue Jays beat the Cardinals, the Blue Jays beat the Orioles, and the Cardinals beat the Orioles. Model this outcome with a directed graph.

[4]

- (10) Draw the figure for the complete bipartite graph $K_{4,5}$ and the cycle graph with 6 vertices (This is usually denoted by C_6). What is the chromatic number of the drawn complete bipartite graph $K_{4,5}$ and the cycle graph C_6 .

[2+2+2+2]

- (11) Explain the Hamiltonian path and Hamiltonian circuit with the help of a diagram.

[3]

- (12) Write short notes on:-
a) Spanning tree
b) Max flow and Min cut theorem
c) Planar graphs

[3+3+3]

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

Subject: - Discrete Structure (CT551)

- ✓ 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. Use resolution to show the hypothesis "It is note raining or Sita has her umbrella," "Sita does not have her umbrella or she does not get wet," and "It is raining or Sita does not get wet" imply that "Sita does not get wet." [8]

2. Use mathematical induction to show that [8]

$$1^3 + 2^3 + \dots + n^3 = [n(n+1)/2]^2$$

whenever n is a positive integer.

3. State the converse, contrapositive and inverse for the conditional statement, "I go to the beach whenever it is a sunny summer day." [3]

4. Why is a tableau method important in propositional logic? Draw the tableau for the formula [2+3]

$$\Phi = (p \wedge \neg q) \rightarrow s$$

Where \neg denotes the negation of a variable, \wedge denotes the conjunction of variables and \rightarrow denotes the implication.

5. Differentiate between Finite State Machines and Finite State Automata. Design a Finite State Automata that accepts precisely those strings over $\{a, b\}$ that contain an odd number of b's. Your design should include the proper definition of the finite-state automation, transition table and the transition diagram. [2+6]

6. Consider the regular grammar $G = (N, T, P, \sigma)$ where $N = \text{Set of Non-Terminals} = \{\sigma, A, B\}$, $T = \text{Set of Terminals} = \{a, b\}$ with productions. [4+4]

$$\sigma \rightarrow aA, \sigma \rightarrow bB, A \rightarrow a, B \rightarrow a$$

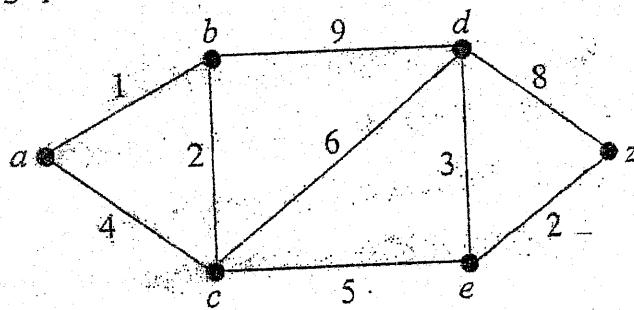
Construct a Non-Deterministic Finite State Automata equivalent to the above given regular grammar and convert this into equivalent Deterministic Finite State Automata.

7. Find all solutions of the recurrence relation [8]

$$a_n = 3a_{n-1} + 2^n$$

with initial condition $a_0 = 5$.

8. Use Dijkstra's algorithm to find the length of the shortest path between the vertices a and z in the weighted graph displayed below. [8]



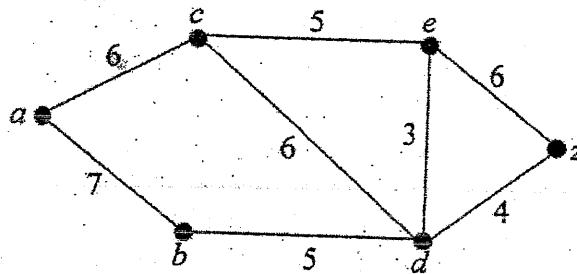
9. Draw the figure for the complete graph with 6 vertices (This is usually denoted by K_6). Define the term graph coloring and the chromatic number of a graph coloring. What is the chromatic number of the complete graph K_6 ? [2+2+2]
10. Explain the Hamiltonian path and Hamiltonian circuit with the help of a diagram. State the necessary and sufficient conditions for Euler circuits and paths. How is Euler circuit different from the Hamiltonian circuit? [3+2+2]
11. Write short notes on:
a) Spanning tree
b) Cutsets and Cutvertices
c) Application of trees

Exam.	New Back (2066x) Paper Batch		
Level	BE	Full Marks	80
Programme	BEX, BCT	Pass Marks	32
Year / Part	II / II	Time	3 hrs.

Subject: - Discrete Structure (CT551)

- ✓ 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 argument using rules of inference to show that the hypothesis "All movies produced by John Sayles are wonderful. John Sayles produced a movie about coal miners imply the conclusion, "There is a wonderful movie about coal miners." You are required to show each step and give reasons for those steps before you come to the desired conclusion from the hypothesis. [8]
2. Use mathematical induction to show that 6 divides $n^3 - n$ whenever n is a nonnegative integer. [8]
3. If $P = F$, $Q = T$, $S = T$, $R = F$, then find truth value of: [4+4]
 - $(S \rightarrow (P \wedge \bar{R})) \wedge ((P \rightarrow (R \vee Q)) \wedge S)$
 - $((P \wedge \bar{Q}) \leftrightarrow (Q \wedge R)) \rightarrow (S \vee \bar{Q})$
4. Define Non-Deterministic Finite State Automata. Design a Finite State Automata that accepts precisely those strings over $\{a, b\}$ that do not contain two consecutive a's. [2+6]
5. Construct the regular grammar to generate integers. Your construction should include the proper definitions of the grammar, which includes properly defined non-terminal symbols, terminal symbols, production rules and starting symbol. [8]
6. Find general solution of $\sqrt{a_n} = \sqrt{a_{n-1}} + 2\sqrt{a_{n-2}}$ with initial condition $a_0 = a_1 = 1$. [8]
7. Use Dijkstra's algorithm to find the length of the shortest path between the vertices a and z in the weighted graph displayed below. [8]



8. In a round-robin tournament the Tigers beat the Blue Jays, the Tigers beat the Cardinals, the Tigers beat the Orioles, the Blue Jays beat the Cardinals, the Blue Jays beat the Orioles, and the Cardinals beat the Orioles. Model this outcome with a directed graph. [4]
9. Draw the figure for the complete bipartite graph $K_{3,4}$ and the cycle graph with 5 vertices (This is usually denoted by C_5). What is the chromatic number of the drawn complete bipartite graph $K_{3,4}$ and the cycle graph C_5 ? [2+2+2+2]
10. State the necessary and sufficient conditions for Euler circuits and paths. [3]
11. Write short notes on: [3+3+3]
 - Hamiltonian path and Hamiltonian circuit
 - Max flow and Min cut theorem
 - Planar graphs

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

Subject: - Discrete Structure (CT551)

- ✓ 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 $P = F, Q = T, S = T, R = F$, then find truth value of:

[4+4]

- $(S \rightarrow (P \wedge \bar{R})) \wedge ((P \rightarrow (R \vee Q)) \wedge S)$
- $((P \wedge \bar{Q}) \leftrightarrow (Q \wedge R)) \rightarrow (S \vee \bar{Q})$

2. Using rules of inferences, show that the hypothesis "It is not rainy today and its hotter than yesterday", "We will go for movie only if it is rainy", "If we do not go for movie, then we will go for shopping", and "If we go for shopping, then we will be home by sunset" lead to the conclusion "We will be home by sunset". You are required to show each steps and give reasons for those steps before you come to desired conclusion from the hypothesis.

[8]

[8]

3. Prove by Mathematical Induction:

$$1.2.3 + 2.3.4 + 3.4.5 + \dots + n(n+1)(n+2) = n(n+1)(n+2)(n+3)/4$$

4. Design a Finite State Machines (FSM) that performs binary serial addition. Define DFA and NDFA. Construct DFA that recognize the language "The set of bit strings that do not contain three consecutive 0's. Show only necessary figures and state diagrams.

[3+2+3]

5. Define and differentiate between context-sensitive, context free and regular grammars with suitable examples. Explain in short the role of regular expressions.

[6+2]

6. What do you understand by recurrence relation? Explain in brief. Derive and solve the recurrence relation for Tower of Hanoi puzzle.

[2+6]

7. Is $K_{3,3}$ graph a planar graph? Explain it with suitable reasons.

[4+4]

8. Define Regular and Bipartite graphs with suitable examples.

[3+3]

9. Define level and height of tree? What is full m-ary tree and balanced tree?

[2+2]

10. State the handshaking theorem for the undirected graph and use it to prove the theorem that an undirected graph has an even number of vertices of odd degree.

[2+4]

11. Write down the short notes on the following:

[4+4]

- Maximum Flow MinCut Theorem
- Graph Coloring

37 TRIBHUVAN UNIVERSITY
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Exam.	New Back (2066 & Later Batch)		
Level	BE	Full Marks	80
Programme	BEX, BCT	Pass Marks	32
Year / Part	II / II	Time	3 hrs.

Subject: - Discrete Structure (CT551)

- ✓ 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 argument using rules of inference to show that the hypotheses "Randy works hard," "If Randy works hard, then he is a dull boy," and "If Randy is a dull boy, then he will not get the job" imply the conclusion "Randy will not get the job." [8]
2. Use mathematical induction to show that

$$1^2 + 2^2 + \dots + n^2 = n(n+1)(2n+1)/6$$
 whenever n is a positive integer. [8]
3. State the converse, contrapositive and inverse for the conditional statement, "A positive integer is a prime only if it has no divisors other than 1 and itself." [3]
4. Define satisfiable and unsatisfiable formulas. Draw the tableau for the formula

$$\Phi = \neg((p \wedge q) \vee r)$$

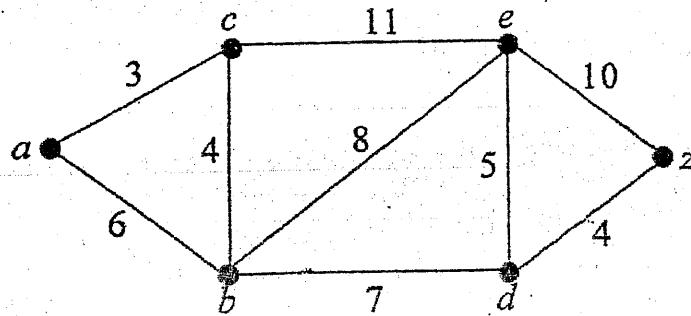
where \neg denotes the negation of a variable, \vee denotes the disjunction of variables and \wedge denotes the conjunction of variables. [2+3]
5. Define Finite State Machines. Design a Finite State Automata that accepts precisely those strings over {a, b} that contain two consecutive a's. Your design should include the proper definition of the finite-state automaton, transition table and the transition diagram. [2+6]
6. Consider the regular grammar $G = (N, T, P, \sigma)$ where N= Set of Non-Terminals = {σ, A, B}, T= Set of Terminals = {a, b} with productions
 $\sigma \rightarrow a, \sigma \rightarrow bB, A \rightarrow bA, A \rightarrow aB, A \rightarrow b, A \rightarrow a, B \rightarrow b$ and starting symbol σ.

Construct a Non-Deterministic Finite State Automata equivalent to the above given regular grammar and convert this into equivalent Deterministic Finite State Automata. [4+4]
7. Find all solutions of the recurrence relation

$$a_n = 2a_{n-1} + 2^n$$

with initial condition $a_0 = 2$. [8]

8. Use Dijkstra's algorithm to find the length of the shortest path between the vertices a and z in the weighted graph displayed below. [8]



9. Draw the figure for the complete graph with 5 vertices (This is usually denoted by K_5). Define the term graph coloring and the chromatic number of a graph in graph coloring. What is the chromatic number of the complete graph K_5 . [2+2+2+2]
10. Construct an influence graph for the board members of a company if the President can influence the Director of Research and Development, the Director of Marketing, and the Director of Operations; the Director of Research and Development can influence the Director of Operations; the Director of Marketing can influence the Director of Operations; and no one can influence, or be influenced by, the Chief Financial Officer. [4]
11. How is Euler circuit different from the Hamiltonian circuit? Explain [3]
12. Write short notes on [3+3+3]
a) Spanning tree and its applications
b) Network Flows
c) Regular graphs
