TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2079 Bhadra

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

Subject: - Digital Logic *(EX 502)*

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

1. What is a Gray code? How is it different than binary code? Convert $(10110)_2$ to Gray code? [2+2+2]
2. State and prove De-Morgan's theorems with necessary diagrams and prove that positive NAND equivalent is equal to negative NOR. [2+4]
3. Simplify the following Boolean function using K-map and draw the circuit of simplified expression using NOR gates only. [6]

   $F = \Sigma m (7, 9, 12, 13, 14, 15) + \text{don't care } (0, 2, 3, 5)$.
4. Implementations the following Boolean function using a single 8:1 multiplexer. $F(A, B, C, D) = \Sigma m (2, 4, 5, 7, 10, 14)$. [5]
5. Realize a full-substractor logic circuit using a single 1:4 demultiplexer and necessary logic gates. [5]
6. How do you eliminate the switch contacts bounds circuits? Explain the operation of negative edge triggered RS flip-flop along with excitation table. [3+5]
7. Explain the working function of PISO register with timing diagram of 1010 data input. [6]
8. What is an asynchronous counter? Design a synchronous counter with counting sequence: 000, 001, 011, 111, 110, 100, 000, ... using JK flip-flop. [3+6]
9. Modify SR flip-flop into JK flip-flop by helping corresponding excitation table. [6]
10. Design a sequential machine that has one serial input X and output Z. The machine is required to have an output Z = 1 when the input X contains the serial message 1010. [12]
11. Explain the operation of three input TTL NAND gate. What is the significance of totem-pole output in it? [6]
12. How does a multiplexing display function? Explain with necessary diagrams. [5]

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TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2079 Baishakh

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

Subject: - Digital Logic (*EX 502*)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
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1. Define Digital and analog Signal, Explain Gray and Excess 3 code with example. [6]
2. Define positive and negative logic and prove that positive X-OR is equivalent to negative X-NOR. [6]
3. Simplify the function using K-map $F=\sum(1,2,3,8,9,10,11,14)$ and $D = \sum(0,4,12)$. Also realize the simplified circuit using NAND Gates. [3+3]
4. a) Design the logic circuit for 4:2 Priority Encoder. [6]
   b) Design 8:1 Multiplexer using 4:1 Multiplexer and 2:1 Multiplexer. [6]
5. Differentiate between combinational and sequential circuits. Explain the operation of asynchronous mod-12 counter with timing diagrams. [2+4]
6. Explain the operation of 4 bit serial in parallel out (SIPO) register with timing diagram. [4]
7. Convert D flip-flop into JK flip-flop and JK flip-flop into D flip-flop. [4+2]
8. Define Synchronous and Asynchronous counter. Design a MOD-10 synchronous counter and draw its timing diagram. [2+6]
9. Define CMOS parameters shortly and explain logic operation of CMOS 2-input NAND gate circuit with its truth table. [3+5]
10. Design a sequential machine that has a single input 'x' and single output 'z'. The machine is required to give high output when it detects the serial sequence of 001 message. Use JK flip-flops only. [12]
11. With the help of block diagram explain the operation of time measurement circuit. [6]

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TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2078 Bhadra

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

Subject: - Digital Logic *(EX 502)*

- ✓ Candidates are required to give their answers in 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 BCD code? List the advantages and disadvantages of BCD code. [1+3]
2. State and prove De-Morgan's theorems with necessary diagrams. Construct XOR gate using minimum number of NAND gates. [2+4]
3. Obtain the minimal SOP form of $F(A, B, C, D) = \sum m(3, 4, 6, 8, 10, 15) + d(0, 2, 7, 14)$ using K-map and implement the simplified result using NOR gate only. [3+3]
4. Design a circuit that compares two 2-bit numbers, A and B, to check if they are equal. The circuit has one output x, so that $x = 1$ if $A = B$ and $x = 0$ is $A \neq B$. [5]
5. Design full adder circuit using a 2×4 decoder and gates. [4]
6. Design a 5x32 line decoder using 3x8 line decoder and necessary logic gates. [5]
7. Explain the operation of 4 bit serial in serial out (SISO) register with timing diagram of 1011 data input. [3+3]
8. Explain the operation of positive edge trigger S-R flip-flop with excitation table. Also derive its characteristic equation and state diagram. [3+2+2]
9. Define synchronous sequential circuits. Explain the operation of asynchronous decade counter with timing diagrams and circuit diagram. [1+6]
10. Define parallel counter. Design a mod-6 synchronous up counter using JK flip flop. [1+7]
11. Explain the characteristics of CMOS logic families. Draw the schematic diagram of TTL 2-input AND gate and explain with necessary diagrams. [3+4]
12. Design a sequential machine that has one serial input X and one output Z. The machine is required to give an output $z = 1$ when the input X contains the message 1001. Use S-R flip-flop. [10]
13. With the help of block diagram explain the operation of frequency counter circuit. [5]

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TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2078 Kartik

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

Subject: - Digital Logic *(EX 502)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
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1. a) Explain Excess-3 code with suitable examples. [3]
   b) Perform the following code conversions: [2+2+2]
   (i) $(41.8125)_{10} = (?)_2$
   (ii) $(1000)_2 = (?)_{BCD}$
   (iii) $(19)_{10} = (?)_{Ex\text{-}3code}$
2. Realize full adder circuit using decoder and gates. Subtract $(43)_{10}$ from $(57)_{10}$ using 2's complement method. [3+3]
3. Realize a following logic expression using a 4:1 multiplexer and standard logic gates.
   $Y(A, B, C) = \prod M(0, 2, 6, 7)$ [6]
4. What is a priority encoder? Design an octal priority encoder. [2+6]
5. Show logic diagram, characteristics table of JK Flip flop and derive its characteristics equation and excitation table. [7]
6. Draw the circuit diagram of Serial In Serial Out and Serial In Parallel Out shift register and explain one of them. [3+4]
7. Construct asynchronous T flip-flopped mod-12 up-counter and use positive edge triggered clock. [7]
8. A sequential machine which has one input, A and one output, Y. The machine is required to give the output high when the input contains a serial message of 1001, use only D flip-flops for realizing the design. [12]
9. a) Draw the CMOS logic level profile for both input and output. [3]
   b) Explain the operation of a CMOS inverter with a circuit diagram. [4]
10. What is a method of multiplexing display? Explain with suitable diagrams. [5]
11. Explain TTL NOR gate with circuit diagram and truth table. What is a propagation delay? [4+2]

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TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2076 Chaitra

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

Subject: - Digital Logic *(EX 502)*

- ✓ Candidates are required to give their answers in 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 Gray code with suitable examples. [3]
2. State and prove the De-margin's theorem and perform the addition (-47+27) by using 2' complement method. [3+3]
3. Simplify the function using K-map F=Σ (1,2,3,8,9,10,11,14) and D = Σ (0,4,12). Also realize the simplified circuit using NAND Gates. [4+2]
4. Describe the importance of parity bits in communication system. Explain 3 bits even parity generator circuit clearly. [2+4]
5. Realize a full subtractor circuit by combining only one 1:4 demultiplexer and standard gates. [5]
6. Explain the operation of 8:1 multiplexer with necessary diagrams. Construct 32:1 MUX using only 8:1 MUXs. [3+3]
7. Explain the serial in parallel-out (SIPO) shift register with timing diagram of 1101 data input. [6]
8. Explain the operation of edge triggered J-K Flip-Flop with necessary diagram and excitation table. [6]
9. Differentiate between combinational and sequential logic circuits. Construct and explain mod-12 asynchronous down counter with negative edge clock triggering system. Use JK flip-flops and necessary logic gates. [2+6]
10. Design the synchronous decade counter using T flip-flop and also show its timing diagram. [8]
11. Explain the operation of TTL two input OR gate with schematic diagram and also define the propagation delay time and power dissipation. [4+2]
12. With the help of block diagram, explain the operation of digital frequency counter. [4]
13. Consider a sequential detector that receives binary data stream at its input 'X' and signals when a serial sequence '1011' arrives at the input by making its output'Y' high, otherwise output remains low. Design a sequence detector state machine using positive edge triggered T flip flops. [10]

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TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2076 Ashwin

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

Subject: - Digital Logic *(EX 502)*

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

1. a) What is a gray code? Compare with binary numbers. [3]
   b) List the advantages of digital signal over analog signal. [3]
2. Describe De' Morgan's laws with examples. Construct XOR gate using only 3-inputs NAND gates. [2+3]
3. What is a decoder? Realize a 2-to-4 line decoder as a full adder circuit. [1+5]
4. Simplify the following function using K-map. And also draw reduced circuit using NOR gate y(A, B, C, D) = ΠM (0,2,3,8,10,11,12,15) and d=ΠM(7,13,14). [5+2]
5. a) Explain the operation of two 4-bit parallel adder with neat diagram. [5]
   b) Realize the logic circuit of 1×16 DMUX using 1×4 DMUX and gates if necessary. [3]
6. Differentiate between combination and sequential circuit. Explain briefly how latch can be used as bounce eliminator. [2+4]
7. Explain how 1001 data can be stored and retrieve n PISO shift register with neat diagram and truth table. [7]
8. Construct a mod-12 asynchronous up counter with positive clock edge triggering Implement only T flip-flops. [5]
9. Design BCD synchronous counter with circuit diagram, truth table and timing waveform. Use T flip-flop. [7]
10. Draw the schematic diagram of 2-input TTL NAND gate and explain about CMOS characteristics. [4+2]
11. Design a sequential machine with one input x and one output z which gives output z=1 when serial input containts 1011 message. Use J-K flip-flop. [12]
12. With the help of block diagram explain the operation of frequency counter. [5]

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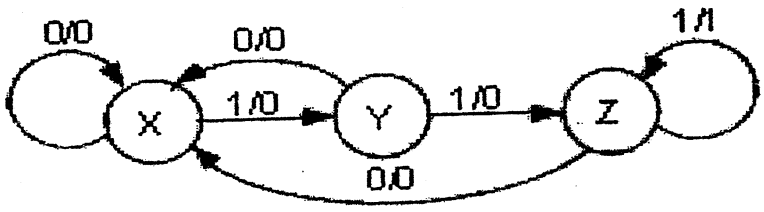
17 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2075 Ashwin

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

Subject: - Digital Logic *(EX502)*

- ✓ Candidates are required to give their answers in 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 in your own words the characteristics of an analog and a digital signal. Convert A2.64H into its octal and decimal equivalents. [2+4]
2. Explain BCD code with suitable examples. [5]
3. Simplify the function using K-map $F=\sum(0, 1, 4, 8, 10, 11, 12)$ and $D=\sum(2, 3, 6, 9, 15)$. Also realize the simplified circuit using NOR Gates. [4+2]
4. Explain the operation of octal to binary encoder with necessary diagrams. Convert A+B'C in to canonical form. [3+3]
5. Describe the importance of parity bits in communication system. Explain 3 bits odd parity generator circuit clearly. [3+3]
6. Realize the circuit diagram for BCD decoder. Explain 1's and 2's complements with examples? [3+3]
7. Explain the operation of edge triggered S-R Flip-Flop with timing diagram and truth table. [6]
8. Design half subtractor circuit using HDL. [4]
9. Define synchronous sequential circuits. Explain the operation of asynchronous mod-12 counter with necessary diagrams. [1+5]
10. Design a synchronous sequential machine from the state diagram given below. Use S-R Flip-Flop. [10]



11. Explain the operation of 4 bit serial in parallel out (SIPO) register with timing diagram. [4]
12. What is the role of hazards in asynchronous circuit design? Explain two bit magnitude comparator with necessary diagrams. [2+4]
13. Draw the schematic diagram of TTL NAND gate and explain about the transistor switch. [2+3]
14. With the help of block diagram explain the operation of Time measuring circuit. [4]

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17 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2074 Chaitra

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

Subject: - Digital Logic *(EX502)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
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1. a) Define TTL IC Signal levels for Input and Output logic with example. [3]
   b) Convert 37.432 decimal number to binary. [3]
2. a) State and prove De-Morgan's theorems with necessary diagrams. Prove that negative logic OR Gate is equivalent to positive logic AND Gate. [4+2]
   b) What is Gray code? Explain with example. [2]
3. a) Minize the expression and implement the reduced expression by using NAND gates. [4+2]
   $F = \overline{A}BC\overline{D} + \overline{A}B\overline{C}D + \overline{A}BCD + \overline{A}BC\overline{D} + A\overline{B}CD + A\overline{B}C\overline{D} + AB\overline{C}\overline{D} + AB\overline{C}D + ABC\overline{D}$
   b) What do you mean by Max term? Explain with example. [3]
4. Design the 32:1 Multiplexer using 4:1 multiplexers tree concept and implement the function $F = \sum(0,1,3,8,9,13)$ using suitable Multiplexer. [4+2]
5. a) Explain the operation of 3 bit magnitude comparator with truth table and draw the circuit. [5]
   b) Draw the circuit to add following bits 1011 and 1100. [3]
6. a) Write down the drawback of SR Flip-Flop. Explain the operation of edge triggered JK Flip-Flop with timing diagram and truth table. [2+4]
   b) Explain the operation of 4 bit serial in serial out (SISO) register with timing diagram. [5]
7. Explain the operation of 3 bit Asynchronous up/down counter with timing diagram. [6]
8. Design a synchronous sequential machine such that it gives output Z = 1 if input contains the message 110 and it retains in its own state for other condition giving output zero. Use J-K Flip-Flop. [10]
9. What do you mean by static and dynamic hazards? Give example of static hazards and explain how do you eliminate such hazards? [4+2]
10. With the help of block diagram explain the operation of frequency counter. [4]
11. Draw the schematic diagram of TTL NOR gate and explain about totem pole. [6]

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27 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2074 Ashwin

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

Subject: - Digital Logic *(EX502)*

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1. a) Explain digital wave form based on TTL compatible logic. (Both for input and output) [3]
   b) What is the importance of De-morgan's laws? Show how a two-input NOR gate can be constructed from a two-input NAND gate. [4]
2. Convert decimal 39 into binary and hexadecimal. Use 2'S complement method to perform the following addition (-28+17) [2+3]
3. Simplify the function using K-map $F = \sum(0,1,4,8,10,11,12)$ and $D = \sum(2,3,6,9,15)$. Also realize the simplified logic circuit. [6]
4. a) What is an encoder? Draw the logic circuit of an encoder that converts Octal number into binary. [1+4]
   b) What is a multiplexer tree? Design the 16 to 1 multiplexer using 4 to 1 multiplexer. [1+4]
5. What is the Setup time and hold time of a flip-flop? With the help of excitation table and K-map, convert R-S flip flop into D and J-K flip flops. [2+6]
6. Describe the operation of 4 bit serial in Serial Out shift register, with timing diagram. Consider the input 1011 to be entered into the register. [6]
7. List the advantages and disadvantages of a synchronous counter over asynchronous counter. Design a 3 bit synchronous counter which follow gray code sequence. [2+6]
8. Design a sequential machine that produces output Y = 1 when it detects the serial input X = 100. [10]
9. Define fan-in and fan-out with reference to TTL. With a circuit diagram explain the operation of 2-bit TTL NAND gate. [2+6]
10. Draw the block diagram with decoders to show hour, minute and second. [6]
11. Write short notes on: (any two) [2×3]
    i) Static and dynamic hazzard
    ii) ROM
    iii) DE-MUX tree

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27 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2073 Chaitra

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

Subject: - Digital Logic *(EX502)*

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1. a) Define the positive logic and negative logic with examples. [2]
   b) Prove that NOR Gate is an universal gate. Realize EX-OR gate using only NAND gate. [6]
2. Convert the decimal number 73 into gray code and perform the addition (-5+13) by using 2's complement method. [2+3]
3. Simplify the following function using K-map and implement the result using suitable gates. [4+2]

   $F(A,B,C,D) = \Sigma m\,(7,9,12,13,14,15) + d\,(0,2,3,5)$
4. a) Design a circuit that compares two 4-bit numbers, A and B, to check if they are equal. The circuit has one output x, so that x = 1 if A = B and x = 0 if A≠ B. [5]
   b) Implement the following function with a Multiplexer: [4]

   $F(A,B,C,D) = \Sigma\,(0,1,3,4,8,9,15)$
5. Define Flip-Flop. Explain the operation of positive edge trigger J-k Flip Flop with excitation table. Also derive its characteristic equation and draw state diagram. [1+3+2+2]
6. What is the difference between Asynchronous and Synchronous counter? Design Mod-13 synchronous counter using J-K flip flop and also draw its timing diagram. [2+6]
7. Explain the different types of registers with suitable block diagram. [3]
8. Explain the operation of 4-bit serial in serial out (SISO) shift left register with timing diagram. [6]
9. Design a synchronous sequential machine such that it gives output Z = 1 if it detects input message 011. Use D-Flip-Flop. [10]
10. What do you mean by static and dynamic hazards? Give example of static hazards and explain how do you eliminate such hazards? [2+4]
11. Draw the schematic diagram of TTL NAND gate and explain the propagation delay time. [6]
12. With the help of block diagram, explain the operation of digital frequency counter. [5]

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24 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2073 Shrawan

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

Subject: - Digital Logic *(EX502)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
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1. a) Perform the following code conversions. [3+2]
   i) $(1110)_{gray} = (?)_{BCD}$
   ii) $(1430)_{10} = (?)_{Excess\text{-}3}$
   b) Construct two input XOR gate using minimum number of 2-input NAND gates only. [5]
2. Implement a full adder circuit using 4:1 Multiplexers. [5]
3. Draw the circuit diagram and explain the working principle of 4-bit parallel in serial out (PISO) shift register. [7]
4. Simplify $\sum 1,2,3,8,10,13 + d(0,4,5,6,7,9,12)$ by using K-Map and write its standard SOP expression. [6]
5. Design 1:32 dimultiplexer tree using 1:8 DEMUXS and 1:2 DEMUXS only. [6]
6. Draw the schematic diagram of TTL Inverter. Explain the working principle of circuit. [3+4]
7. Derive characteristic equation of a JK flip flop. How do you make it a toggle flip flop? Draw the input and output wave form of JK flip flop. [3+2+2]
8. Differentiate between combinational and sequential circuits. Explain BCD-to-Decimal decoder circuit with suitable diagram. [2+6]
9. Design a synchronous MOD-5 counter along with block diagram and timing diagrams. Also write the applications of counters and shift registers. [6]
10. Sketch block diagram of digital frequency counter and describe its operation. [8]
11. A sequential machine has to detect serial input sequance of 101, the machine output will be high. The machine contains two JK flip flops, A and B. Assume: single input, x and single output Y. [12]

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27 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2072 Kartik

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

Subject: - Digital Logic *(EX502)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
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1. What are the major difference between Binary code and BCD code? [2]
2. Explain the operation of gated D flip-flop with timing diagram and truth table. [4]
3. What are the major differences between asynchronous and synchronous counter? Design a Mod-6 synchronous up binary counter using S-R flip flops and draw its timing diagram. [2+6]
4. What are the applications of shift registers? Explain any one of the application with working circuit diagram. [6]
5. Construct MOD-12 asynchronous up-counter with negative edge triggering system in clock. [5]
6. Draw the circuit diagram for 2-input CMOS NAND gate. What is Totem pole output? Explain. [3+3]
7. Convert the decimal number 168 into hexadecimal and gray code by first converting it into binary and perform the following addition using 2's complement 11+15 [2+2+3]
8. Write the minterms of ACD+AB and simplify $\Sigma 1,2,3,8,9,10,11,13,14+d(0,4,12)$ by using K-Map and write its standard product of sum (POS) expression. [4+6]
9. Differentiate between synchronous and asynchronous inputs of a flip flop with suitable diagram. Derive characteristic equation of a JK flip flop. How do you make it a toggle flip flop? Explain with diagram. [3+5]
10. Draw the schematic diagram of TTL NOR gate. Explain the operation of CMOS to TTL interface. [2+2]
11. Explain with block diagram to build the digital watch from a power supply system. Show second, minute and hour display using decoder. [8]
12. Suppose you have given the following word specification describing the sequential operation of some machine. This machine has a control input X and the clock and two state variables A and B and one output. If the input, is high the machine will change state otherwise this machine is supposed to hold its present state. It also gives output when the sequence is 101. Derive state table and state diagram. Use only T flip-flops and necessary logic gates. [4+8]

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27 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2072 Chaitra

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

Subject: - Digital Logic *(EX502)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
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1. Perform the following as indicated in the brackets: [2×4]
   a. $(10.0101)_2 = (?)_{16}$
   b. $(101001001)_{binary} = (?)_{Gray}$
   c. $(93)_{10} = (?)_{Excess\text{-}3}$
   d. $(10.001)_2 - (11.101)_2$ using ***2's complement method.***
2. a) Describe commutative and associative laws of Boolean algebra with examples and simplify A+A'B=A+B. [2+2]
   b) Implement Excusive OR gate by using NAND gates only. [4]
3. Simplify $\sum 1,2,3,8,9,10,11,13,14 + d(0,4,7,12)$ by using K-Map and write its standard product of sum (POS) expression. [4+3]
4. How do you design 32:1 Mux by using multiplexer tree? Implement logic function $Y = \sum m(0,1,3,8,9,13,15)$ by using suitable multiplexer. [4+3]
5. Realize a full-subtractor using suitable demultiplexer and standard getes. [6]
6. Design a simplest logic circuit for 'b' segment of the BCD to 7 segment decoder. [7]
7. Design and draw the circuit diagram of a 3 bit gray code synchronous counter. [7]
8. Draw ripple decade counter and sketch its timing diagram. [5+2]
9. Draw 2-input TTL NAND gate and explain its working principle. [5]
10. How does second section of a digital clock work? Explain its working principle using block diagram. [6]
11. Design a sequential machine that has a single input 'x' and single output 'z'. The machine is required to give high output when it detects the serial sequence of 011 message. Use JK flip-flops only. [12]

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24 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2071 Shawan

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

Subject: - Digital Logic *(EX502)*

- ✓ Candidates are required to give their answers in 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 digital operations. What is Excess-3 Code explain with example. [2+4]
2. Define universal Gate with example. Realise Ex-OR Gate using NAND gate only. [1+4]
3. Simplify the following using K-map and realize the simplified result with NAND gates only. [3+3]
   $$\sum_m(2,5,7,8,10,13)+d(0,6,14,15)$$
4. Implement following combinational circuit with multiplexer. [4]
   $$F(A,B,C,D)=\sum_m(1,3,4,11,12,13,14,15)$$
5. Using seven segment display decoder realize the logic circuit for segment 'b', 'c' and'd'. [5]
6. With neat and clean diagram explain the operation of adder-subtractor circuit. [4]
7. Explain the operation of positive edge triggered RS flip-flop with circuit diagram, trust table and excitation table. [2+8]
8. With clear circuit and timing diagram, explain the operation of parallel in Serial out shift register. [8]
9. Design Synchronous MOD-12 counter using T-flip-flop. [8]
10. Design a sequential machine that can go through 2-bit gray code combination of states. The machine changes its state when serial input is one and remains in same state when input is zero. The machine produces output one when it passes through all states and finally goes back to initial state. (use JK flip flop) [10]
11. What are the characteristics of TTL circuit for logic high and low level? Explain the operation of TTL NAND gate. [2+6]
12. Describe the operation of Digital Clock with block diagram. [6]

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25 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2070 Ashad

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

Subject: - Digital Logic *(EX502)*

- ✓ Candidates are required to give their answers in 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 the different logical operations? Explain. [3]
   b) Explain different coding system used to represent data. [3]
2. Explain the operation of NAND, NOR, XOR and NOT gates with Boolean expression and truth table. [4]
3. Simplify the Boolean function in both SOP and POS and the implement using basic gates only: $F(A, B, C, D) = \sum (0, 1, 3, 4, 8, 9, 15)$ [8]
4. a) Design 8- to -3 line priority encoder. [4]
   b) Design a combinational logic that produces square of 3 bit number using ROM. [6]
5. a) Implement the full adder using two half adders. [3]
   b) Explain the working principle of binary multiplication. [5]
6. Explain the operation of RS flip flop showing it's logic diagram, characteristic table and then derive its characteristics equation and excitation table. [8]
7. With clear circuit diagram, explain the operation of parallel in-Serial out shift register. [4]
8. What do you mean by Presettable Counter? Design a modulo - 12 counter using T-Flip flop. [1+7]
9. Design a sequential machine that takes the one bit of serial data x as input and gives the one bit of data as output z. The machine gives an output z = 1 when the input sequence of x contains the message 0100. [12]
10. What are the parameters of TTL? Explain the operation of 74C00 CMOS. [2+6]
11. Explain the operation of digital clock with neat and clean diagram. [4]

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25 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2069 Chaitra

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

Subject: - Digital Logic *(EX502)*

- ✓ Candidates are required to give their answers in 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 digital IC signal levels. What is Gray Code? Explain with example. [3+3]
2. Construct the given Boolean function: F = (A+B) (C+D) E using NOR gates only. [4]
3. Simplify F (A,B,C,D) = π (0,2,5,8,10) + d(7,15). Write its standard SOP and implement the simplified circuit using NOR gates only. [4+4]
4. a) What is priority Encoder? Design octal to binary priority encoder. [2+4]
   b) Design a 2 bit magnitude comparator. [4]
5. Design a combinational logic that performs multiplication between two 4 bit numbers using binary parallel adder and other gates. [8]
6. Draw the circuit diagram and explain the operation of positive edge triggered JK flip-flop. What are the drawbacks of JK flip-flop? [7+1]
7. Explain the Serial in Serial out (SISO) shift register with timing diagram. [4]
8. Design the synchronous decade counter and also show the timing diagram. [8]
9. Design a sequential machine that detects three consecutive zeros from an input data stream X by making output, Y = 1. [12]
10. Draw the schematic circuit for CMOS NAND gates. What do you mean by totem-pole output? [4+4]
11. Describe the operation of a frequency counter. [4]

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24RE TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2070 Chaitra

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

Subject: - Digital Logic *(EX502)*

- ✓ Candidates are required to give their answers in 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 digital signal and explain Gray code with example. [1+5]
2. Prove that positive X-OR is equivalent to negative X-NOR. [5]
3. a) Convert the following term into standard min term. A+B'C. [3]
   b) Use K-map method to implement the following function and also draw the reduced circuit using NOR gate. [5]

   $F(A, B, C, D) = \Sigma_m (0, 2, 4, 6, 8, 10, 15)$ and

   $d = \Sigma_m (3, 11, 14)$
4. a) Realize the logic circuit of the following using 8:1 MUX. [4]

   $F(W, X, Y, Z) = \Sigma_m (1, 2, 5, 7, 8, 10, 12, 13, 15)$

   b) When FF_H is ANDed with CO_H what will be the resulting number? Subtract (26) 10 from (16) 10 using 2's complement binary method. [2+2]
5. a) Differentiate between level and Edge triggering? [3]
   b) Explain the operation of two bit magnitude comparator with truth table and circuit diagram. [5]
6. a) Describe different typesof registers with diagram. [8]
   b) Illustrate how 1011 data can be stored and retrieve in parallel in serial out shift register with neat timing diagram and truth table. [8]
7. Differentiate synchronous and asynchronous sequential circuits. Explain the operation of mod-12 synchronous counter with timing diagram. [2+6]
8. a) Define state diagram and state table with example. [2]
   b) Design a sequential machine that has one serial input and one output z. The machine is required to give an output z = 1 when the input X contains the message 110. [8]
9. Draw the schematic diagram of TTL two input NOR Gate. [6]
10. Explain briefly the block diagram of an instrument to measure frequency. [5]

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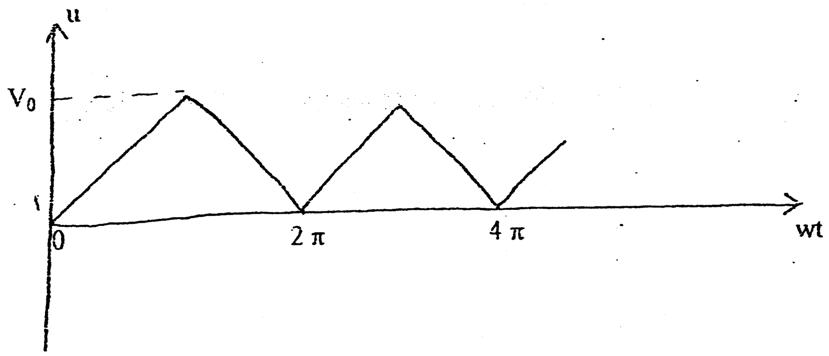
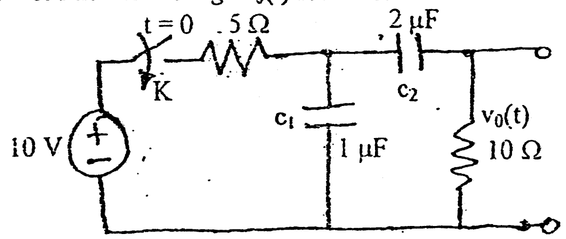
b) Find the trigonometric form of Fourier Series and plot the line spectrum for the following wave form. [8]



5. a) Plot the asymptotic Bode-diagram for the transfer function: [6]

function $G(S) = \dfrac{20(s+1)}{s(s^2+2s+10)(s+5)}$

b) In figure below, the capacitors C_1 and C_2 are initially discharged. The switch K is closed at $t = 0$. Find the voltage $v_0(t)$ for $t > 0$. [4]



c) Find the expression for Equivalent T-parameter equation if three two-port networks are connected in cascade. [6]

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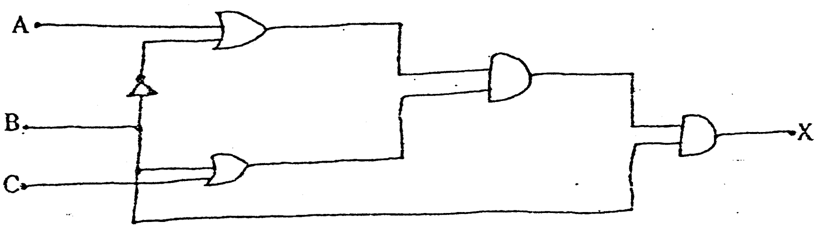
24 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2070 Chaitra

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

Subject: - Logic Circuit *(EG533EX)*

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

1. Typical digital thermometer use BCD to drive their digital displays. [2]
   a) How many BCD bits are required to drive a 3 digit thermometer display?
   b) What happens when 12 bits are sent to display for a temperature of 157°C.
2. What are the next four numbers in the hexadecimal counting sequence D9A, D9B, D9C, D9D......,......,.......,..... [2]
3. Sketch for the following Boolean equation, using only NAND logic gates. $y = A\overline{B} + AC + BD$. [5]
4. Determine the Boolean expression for the output, X of logic circuit shown in figure.



   Also minimize the Boolean expression for the output X using Boolean Algebra to AB. [4]
5. Simplify the following using Karnaugh map $F = \overline{ABC} + \overline{B}C + A\overline{B}$. [4]
6. Design a combinational circuit with three inputs A, B, C and three outputs x, y, z. When the binary input is 0, 1, 2, 3 the binary output is one greater than the input. When the binary input is 4,5, 6, 7 the binary output is one less than the input. [6]
7. Design a combinational circuit that takes decimal digit as input and output lines that generates the 9's complement of the corresponding input digit. [7]
8. What is data selector? How can a decoder be used as a de-multiplexer? Implement the following function with MUX. $F(A,B,C,D) = \Sigma(0,1,3,4,8,9,15)$. [1+2+5]
9. Differentiate between combinational circuit and sequential circuit with suitable examples. [5]
10. A sequential circuit has two D flip flops A and B, two inputs x and y, and one output z. The flip flop input equations and the circuit output are as follows: [3+4]

$DA = \overline{x}y + xA$

$DB = \overline{x}B + xA$

$Z = B$

a) Draw the logic diagram of the circuit.
b) Tabulate the state table.

11. Design a 2-bit count-down counter. This is a sequential circuit with two flip-flops and one input x. When x = 0, the state of the flip flops does not change. When x = 1, the state sequence is 11, 10, 01, 00, 11 and repeats. [10]

12. Construct common bus with tristate logic and explain the use of common bus. [7]

13. Draw the block diagram of a 4 bit shift register using D flipflops. If initially all the flip-flops output are in zero state, prepare the state table when the input sequence is 1,1,0,1,0. Draw the above shift register using J-K flip-flops only. [2+2+2]

14. Construct a 12 hours digital clock using counters and explain its working principle. [7]

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TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2079 Bhadra

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

Subject: - Electro-magnetics *(EX 503)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt All questions.*
- ✓ *The figures in the margin indicate Full Marks.*
- ✓ *Necessary formula sheet are attached herewith.*
- ✓ $\vec{A}$ represent a vector and $\hat{a}_{subscript}$ denotes a unit vector along the direction given by the subscript.
- ✓ *Assume suitable data if necessary.*

1. Transform the vector $\vec{F}$ into the cylindrical co-ordinate system.
$\vec{F} = 10\vec{a_x} - 8\vec{a_y} + 6\vec{a_z}$ at point P(x = 10, y = -8, z = 6) [5]
2. Define electric dipole moment. Two uniform line charges, 8 nC/m each, are located at x = 1, z = 2 and at x = -1, y = 2 in free space. If the potential at the origin is 100 V, find V at P(4, 1, 3). [2+6]
3. State Gauss's Law. The region y < 0 contains a dielectric material for which $\varepsilon_{r1} = 2.5$, while the region y > 0 is characterized by $\varepsilon_{r2} = 4$. Let $\vec{E}_1 = -30\hat{a}_x + 50\hat{a}_y + 70\hat{a}_z$ V/m, find the electric field intensities, flux densities in region 2 and the angle θ_1, which is the angle made by normal component of $\vec{E}$ or $\vec{D}$ with total $\vec{E}$ or $\vec{D}$. [2+3+2+1]
4. Derive Poisson's equation. Assuming that the potential V in the cylindrical coordinate system is the function of ρ only, solve the Laplacian equation by integration method and derive the expression for the capacitance of co-axial capacitor using the same solution of V. [2+5]
5. State Stoke's theorem. Evaluate both sides of Stroke's theorem for the field $\vec{H} = 8xy\hat{a}_x - 5y^2\hat{a}_y$A/m and the rectangular path around the region $2 \le x \le 5$, $-1 \le y \le 1$, z = 0. Let the positive direction of $\vec{dS}$ be $\hat{a}_z$. [1+7]
6. Define Ampere's Circuital law. Determine H at $P_2(0.4, 0.3, 0)$ in the field of an 8 A filamentary current directed inward from infinity to the origin on the positive x axis, and then outward to infinity along the y axis. [2+6]
7. Explain motional induction with necessary derivations. Correct the equation $\nabla \times \vec{H} = \vec{J}$ with necessary arguments and derivation for time varying fields. [3+4]
8. Derive the expression for electric and magnetic fields for a uniform plane wave propagating in a dissipative medium. [4+3]
9. A uniform plane wave in free space is given by $\vec{H}_S = (250\angle 30°)e^{-j350z}\hat{a}_x$ V/m. Determine phase constant, frequency of the wave, intrinsic impedance, $\vec{E}_S$ at z = 25 mm and t = 4ps. [1+2+1+2]
10. Define the secondary parameters of a transmission line. A lossless transmission line with Zo = 50 ohm has a length of 0.4λ. The operating frequency is 300 MHz and it is terminated with a load $Z_L = 40 + j30$. Find: [2+1+2+3]
    a) Reflection Coefficient
    b) Standing wave ratio on the line (SWR)
    c) Input impedance (Zin)
11. Differentiate between TE and TM modes. Consider a rectangular waveguide with $\varepsilon_r = 4$, $\mu = \mu_0$ with dimensions a = 2.08 cm, b = 0.54 cm. Find the cutoff frequency for TM_{11} mode and the dominant mode. [3+3]
12. Write short note on antenna and its types. [2]

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Divergence

$$\text{Cartesian}: \nabla \cdot \bar{D} = \frac{\partial D_x}{\partial x} + \frac{\partial D_y}{\partial y} + \frac{\partial D_z}{\partial z}$$

$$\text{Cylindrical}: \nabla \cdot \bar{D} = \frac{1}{\rho}\frac{\partial (\rho D_\rho)}{\partial \rho} + \frac{1}{\rho}\frac{\partial D_\phi}{\partial \phi} + \frac{\partial D_z}{\partial z}$$

$$\text{Sphecrical}: \nabla \cdot \bar{D} = \frac{1}{r^2}\frac{\partial (r^2 D_r)}{\partial r} + \frac{1}{r\sin\theta}\frac{\partial (D_\theta \sin\theta)}{\partial \theta} + \frac{1}{r\sin\theta}\frac{\partial D_\phi}{\partial \phi}$$

Gradient

$$\text{Cartesian}: \nabla V = \frac{\partial V}{\partial x}\hat{a}_x + \frac{\partial V}{\partial y}\hat{a}_y + \frac{\partial V}{\partial z}\hat{a}_z$$

$$\text{Cylindrical}: \nabla V = \frac{\partial V}{\partial \rho}\hat{a}_\rho + \frac{1}{\rho}\frac{\partial V}{\partial \phi}\hat{a}_\phi + \frac{\partial V}{\partial z}\hat{a}_z$$

$$\text{Spherical}: \nabla V = \frac{\partial V}{\partial r}\hat{a}_r + \frac{1}{r}\frac{\partial V}{\partial \theta}\hat{a}_\theta + \frac{1}{r\sin\theta}\frac{\partial V}{\partial \phi}\hat{a}_\phi$$

Curl

$$\text{Cartesian}: \nabla \times \bar{H} = \left(\frac{\partial H_z}{\partial y} - \frac{\partial H_y}{\partial z}\right)\hat{a}_x + \left(\frac{\partial H_x}{\partial z} - \frac{\partial H_z}{\partial x}\right)\hat{a}_y + \left(\frac{\partial H_y}{\partial x} - \frac{\partial H_x}{\partial y}\right)\hat{a}_z$$

$$\text{Cylindrical}: \nabla \times \bar{H} = \left(\frac{1}{\rho}\frac{\partial H_z}{\partial \phi} - \frac{\partial H_\phi}{\partial z}\right)\hat{a}_\rho + \left(\frac{\partial H_\rho}{\partial z} - \frac{\partial H_z}{\partial \rho}\right)\hat{a}_\phi + \frac{1}{\rho}\left(\frac{\partial (\rho H_\phi}{\partial \rho} - \frac{\partial H_\rho}{\partial \phi}\right)\hat{a}_z$$

$$\text{Spherical}: \nabla \times \bar{H} = \frac{1}{r\sin\theta}\left(\frac{\partial (H_\phi \sin\theta)}{\partial \theta} - \frac{\partial H_\theta}{\partial \phi}\right)\hat{a}_r + \frac{1}{r}\left(\frac{1}{r\sin\theta}\frac{\partial H_r}{\partial \phi} - \frac{\partial (rH_\phi)}{\partial r}\right)\hat{a}_\theta + \frac{1}{r}\left(\frac{\partial (rH_\theta}{\partial r} - \frac{\partial H_r}{\partial \theta}\right)\hat{a}_\phi$$

Laplacian:

$$\text{Cartesian}: \nabla^2 V = \frac{\partial^2 V}{\partial x^2} + \frac{\partial^2 V}{\partial y^2} + \frac{\partial^2 V}{\partial z^2}$$

$$\text{Cylindrical}: \nabla^2 V = \frac{1}{\rho}\frac{\partial}{\partial \rho}\left(\rho \frac{\partial V}{\partial \rho}\right) + \frac{1}{\rho^2}\frac{\partial^2 V}{\partial \phi^2} + \frac{\partial^2 V}{\partial z^2}$$

$$\text{Spherical}: \nabla^2 V = \frac{1}{r^2}\frac{\partial}{\partial r}\left(r^2 \frac{\partial V}{\partial r}\right) + \frac{1}{r^2 \sin\theta}\frac{\partial}{\partial \theta}\left(\sin\theta \frac{\partial V}{\partial \theta}\right) + \frac{1}{r^2 \sin^2\theta}\frac{\partial^2 V}{\partial \phi^2}$$

TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2079 Baishakh

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

Subject: - Electromagnetics (*EX 503*)

- ✓ Candidates are required to give their answers in 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 vector field A = (x-y) a_y in cylindrical and spherical coordinate systems. [5]
2. Find the total charge inside the volume indicated:

   $\rho_v = 4xyz^2,\ 0 \le \rho \le 2, 0 \le \phi \le \frac{\pi}{2}, 0 \le z \le 3.$ [4]
3. Obtain the equation of the streamline that passes through the point P (-2,7,10) in the field:

   $\vec{E} = 2(y-1)\hat{a}_x + 2x\,\hat{a}_y.$ [4]
4. Given the potential field in cylindrical coordinates, $V = [100/(z^2+1)]\rho\cos\phi V$, and point P at $\rho = 3$ m, $\phi = 60°$, $z = 2$ m, find values at P for (a) V; (b) E; (c) E; (d) dV/dN; (e) a_N; (f) ρ_v in free space. [6]
5. Define gradient and laplacian function. A point charge of 16nC is located at Q (2,3,5) in free space and a uniform line charge of 5nC/m is at the intersection of the plane x=2 and y=4. If the potential at the origin is 100V, Find V at P (4,1,3). [2+6]
6. Define curl and its significance in Electromagnetics. Evaluate both sides of stokes theorem for the field H=6xy a_x - $3y^2$ a_y A/m and the rectangular path around the region $2 \le x \le 5, -1 \le y \le 1, z = 0$, let the positive direction of ds be a_z. [2+6]
7. Justify the Maxwell's equation: $\oint_S \vec{B}.\vec{dS} = 0$ with necessary remarks. Derive an expression of magnetic field intensity for an infinite filament carrying a direct current using vector magnetic potential. [2+6]
8. Write down the Maxwell equation in phasor form. Derive the equation for electric field for a uniform plane wave travelling in air. [2+6]
9. A uniform plane wave in free space in given by Electric field intensity $\vec{E}$ in phasor form as:

   $\vec{E}_s = 200 \angle 30° e^{-j250z}\,\hat{a}_x$ V/m Find :

   a) Angular frequency (ω)

   b) Wavelength (λ) and intrinsic impedance (η)

   c) Magnetic field intensity $\vec{H}(x,y,z,t)$ at z = 8 mm and t = 6pS. [2+2+4]

10. Define Faraday's law. A conductor with cross-sectional area of 10 cm^2 carries conduction current $\vec{J} = 0.2\sin 10^9 t\, \hat{a}_z$ mA. Given that σ = 2.5 $\times 10^6$ S/m, and ε_r = 6. Calculate the value of the displacement current. [2+4]

11. A lossless transmission line is 80 cm long and operates at a frequency of 600 MHz. The line parameters are L= 0.25 μH/m and C = 100pF/m. Find the characteristic impedance, the phase constant, the phase velocity on the line, and the input impedance for Z_L=100Ω. [8]

12. Define dominant mode. A standard air-filled rectangular waveguide with dimensions 8.636 cm × 4.318 cm is fed by a 8 GHz carrier from a coaxial cable. Determine if a TE_{10} mode will be propagating or not. [1+4]

13. Write short notes on antenna and its parameters. [2]

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TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2078 Bhadra

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

Subject: - Electro-magnetics *(EX 503)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt <u>All</u> questions.*
- ✓ *The figures in the margin indicate <u>Full Marks</u>.*
- ✓ *<u>Necessary data are attached herewith.</u>*
- ✓ $\vec{A}$ represent a vector and $\vec{a}_{subscript}$ denotes a unit vector along the direction given by the subscript.
- ✓ *Assume suitable data if necessary.*

1. Given a point P (-2, 6, 3) and vector field $\vec{A} = y\vec{a_x} + (xy + z)\vec{a_y}$, express P and $\vec{A}$ in spherical co-ordinate system. [5]
2. A point charge of 6μc located at origin, uniform line charge density of 180nc/m lies along x-axis and uniform sheet charge of 25 c/m^2 lies on z = 0 plane. Find $\vec{D}$ at point (1, 2, 4). [7]
3. Derive the expression for an electric field intensity due to an infinitely long line charge with charge density ρ_L by using Gauss's law. Find the volume charge density that is associated with the field $\vec{D} = xy^2\vec{a}_x + x^2y\vec{a}_y + z\vec{a}_z\ C/m^2$. [4+3]
4. State continuity equation. Given the vector current density $\vec{j} = 10\rho^2 z\vec{a}_\rho - 4\rho\sin^2\phi\vec{a}_\phi\ mA/m^2$. Determine the current following outward the circular band $\rho = 5,\ 0 < \phi < 2\pi, 2 < z < 2.8$. [2+4]
5. Differentiate between scalar magnetic potential and vector magnetic potential. If a vector magnetic potential is $\vec{A} = -(\rho^2/4)\vec{a}_z wb/m$, calculate total magnetic flux crossing the surface $\phi = \pi/2$, $1 \le \rho \le 2$ m and $0 \le z \le 5$ m. [4+4]
6. The region y < 0 (region 1) is air and y > 0 (region 2) has $\mu_r = 10$. If there is a uniform magnetic field $\vec{H} = 5\hat{a}_x + 6\hat{a}_y + 7\hat{a}_z$ A/m in region 1, find $\vec{B}$ and $\vec{H}$ in region 2. [8]
7. Correct the equation $\nabla \times \vec{E} = 0$ for time varying field with necessary derivation. Also modify the equation $\nabla \times \vec{H} = \sigma\vec{E}$ with necessary arguments and derivation for time varying field. [3+4]
8. A uniform plane wave in free space is given by $\vec{H_S} = (250\angle 30°)e^{-j350z}\vec{a}_x\ V/m$. Determine phase constant, frequency of the wave, intrinsic impedance, $\vec{E_S}$ and the magnitude $\vec{H}$ of at z = 25 mm and t = 4ps. [1+1+2+2+2]
9. Derive the expression for electric and magnetic fields for a uniform plane wave propagating in a free space. [8]
10. A lossless transmission line is 80 cm long and operates at a frequency 1 GHz. The line parameters are L = 0.5 μH/m and C = 200 pF/m. Find the characteristics impedance, the phase constant, the velocity on the line, and the input impedance for $Z_L = 100\Omega$. [2+2+2+2]
11. Write short notes on TE and TM modes of rectangular waveguide. An air filled rectangular waveguide has cross-section of 2.3 cm × 1.02 cm. Calculate the cutoff frequency of the dominant mode (TE_{10}). [3+3]
12. Write short notes about antenna and its parameters. [2]

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Divergence

$$\text{Cartesian}: \nabla \cdot \bar{D} = \frac{\partial D_x}{\partial x} + \frac{\partial D_y}{\partial y} + \frac{\partial D_z}{\partial z}$$

$$\text{Cylindrical}: \nabla \cdot \bar{D} = \frac{1}{\rho}\frac{\partial (\rho D_\rho)}{\partial \rho} + \frac{1}{\rho}\frac{\partial D_\phi}{\partial \phi} + \frac{\partial D_z}{\partial z}$$

$$\text{Sphecrical}: \nabla \cdot \bar{D} = \frac{1}{r^2}\frac{\partial (r^2 D_r)}{\partial r} + \frac{1}{r\sin\theta}\frac{\partial (D_\theta \sin\theta)}{\partial \theta} + \frac{1}{r\sin\theta}\frac{\partial D_\phi}{\partial \phi}$$

Gradient

$$\text{Cartesian}: \nabla V = \frac{\partial V}{\partial x}\hat{a}_x + \frac{\partial V}{\partial y}\hat{a}_y + \frac{\partial V}{\partial z}\hat{a}_z$$

$$\text{Cylindrical}: \nabla V = \frac{\partial V}{\partial \rho}\hat{a}_\rho + \frac{1}{\rho}\frac{\partial V}{\partial \phi}\hat{a}_\phi + \frac{\partial V}{\partial z}\hat{a}_z$$

$$\text{Spherical}: \nabla V = \frac{\partial V}{\partial r}\hat{a}_r + \frac{1}{r}\frac{\partial V}{\partial \theta}\hat{a}_\theta + \frac{1}{r\sin\theta}\frac{\partial V}{\partial \phi}\hat{a}_\phi$$

Curl

$$\text{Cartesian}: \nabla \times \bar{H} = \left(\frac{\partial H_z}{\partial y} - \frac{\partial H_y}{\partial z}\right)\hat{a}_x + \left(\frac{\partial H_x}{\partial z} - \frac{\partial H_z}{\partial x}\right)\hat{a}_y + \left(\frac{\partial H_y}{\partial x} - \frac{\partial H_x}{\partial y}\right)\hat{a}_z$$

$$\text{Cylindrical}: \nabla \times \bar{H} = \left(\frac{1}{\rho}\frac{\partial H_z}{\partial \phi} - \frac{\partial H_\phi}{\partial z}\right)\hat{a}_\rho + \left(\frac{\partial H_\rho}{\partial z} - \frac{\partial H_z}{\partial \rho}\right)\hat{a}_\phi + \frac{1}{\rho}\left(\frac{\partial (\rho H_\phi}{\partial \rho} - \frac{\partial H_\rho}{\partial \phi}\right)\hat{a}_z$$

$$\text{Spherical}: \nabla \times \bar{H} = \frac{1}{r\sin\theta}\left(\frac{\partial (H_\phi \sin\theta)}{\partial \theta} - \frac{\partial H_\theta}{\partial \phi}\right)\hat{a}_r + \frac{1}{r}\left(\frac{1}{r\sin\theta}\frac{\partial H_r}{\partial \phi} - \frac{\partial (rH_\phi)}{\partial r}\right)\hat{a}_\theta + \frac{1}{r}\left(\frac{\partial (rH_\theta}{\partial r} - \frac{\partial H_r}{\partial \theta}\right)\hat{a}_\phi$$

Laplacian:

$$\text{Cartesian}: \nabla^2 V = \frac{\partial^2 V}{\partial x^2} + \frac{\partial^2 V}{\partial y^2} + \frac{\partial^2 V}{\partial z^2}$$

$$\text{Cylindrical}: \nabla^2 V = \frac{1}{\rho}\frac{\partial}{\partial \rho}\left(\rho \frac{\partial V}{\partial \rho}\right) + \frac{1}{\rho^2}\frac{\partial^2 V}{\partial \phi^2} + \frac{\partial^2 V}{\partial z^2}$$

$$\text{Spherical}: \nabla^2 V = \frac{1}{r^2}\frac{\partial}{\partial r}\left(r^2 \frac{\partial V}{\partial r}\right) + \frac{1}{r^2 \sin\theta}\frac{\partial}{\partial \theta}\left(\sin\theta \frac{\partial V}{\partial \theta}\right) + \frac{1}{r^2 \sin^2\theta}\frac{\partial^2 V}{\partial \phi^2}$$

TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2078 Kartik

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

Subject: - Electromagnetics *(EX 503)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ ***Necessary data are attached herewith.***
- ✓ $\vec{A}$ represent a vector and $\vec{a}_{subscript}$ denotes a unit vector along the direction given by the subscript.
- ✓ *Assume suitable data if necessary.*

1. Transform a vector field $\vec{A} = 4\vec{a_x} - 2\vec{a_y} - 4\vec{a_z}$ into cylindrical coordinate system at a point P (2, 3, 5). [5]
2. A plane x = 2 carry a surface charge density 10 nC/m^2, a line x = 0 and z = 3 carry a line charge density 10 nC/m and a point charge of 10nC is at origin. Calculate $\vec{E}$ at (1, 1, -1) due to these charge configurations. [7]
3. Evaluate the both sides of divergence theorem for the field $\vec{D} = 2xy\vec{a}_x + x^2\vec{a}_y C/m^2$ and the rectangular parallelopiped formed by the planes x = 0 and 1, y = 0 and 2, and z = 0 and 3. [7]
4. If potential field in free space is $V = \frac{10}{r^2}\sin\theta\cos\phi$ V and point P is located at (2, 90°, 0°). Find: (a) $\vec{E}$ (b) direction of $\vec{E}$ at P (c) energy density at P. [2+2+2]
5. Find the vector magnetic field intensity $\vec{H}$ in Cartesian coordinates at P (2, 1, 3) caused filament of 12 Ampere(A) in a $\vec{a_z}$ direction on the z-axis and extending from z = 0 to z = 4. [8]
6. Consider a boundary at z = 0 which carries current $\vec{K} = \left(\frac{1}{\mu_0}\right)\vec{a_y}$ mAm. Medium 1 (z < 0) is filled with material whose $\mu_r = 6$ and medium 2 (z > 0) is filled with material whose $\mu_r = 4$. If $\vec{B_2} = 5\vec{a_x} + 8\vec{a_z}$ mT, find $\vec{B_1}$. [8]
7. Define Poynting vector. Using this deduce the time average power density for a dissipative medium. [2+5]
8. A uniform plane wave has a magnetic field component $\vec{H} = 15\cos(2\times10^8 t + \beta x)\vec{a_y}$ A/m in a medium characterized by $\sigma = 0$, $\varepsilon = 4\varepsilon_0$, $\mu = \mu_0$. Find [5+1+2]
   a) direction of propagation, phase constant β, wavelength λ, velocity v_p, intrinsic impedance η
   b) Magnitude of $\vec{H}$
   c) $\vec{E}$
9. A uniform plane wave in air partially reflects from the surface of a material whose properties are unknown. Measurements of the electric field in the region in front of the interface yield a 1.5 m spacing between maxima, with the first maximum occurring 0.75 m from the interface. A standing wave ratio (SWR) of 5 is measured. Determine the intrinsic impedance of the unknown material. [8]

10. A 50 Ω lossless transmission line is 0.4 λ long. The line is terminated with a load $Z_L = 40 + j30\ \Omega$. If the operating frequency is 300 MHz, find [2+2+4]
    a) reflection coefficient (Γ)
    b) standing wave ratio (s) and
    c) input impedance (Z_{in})
11. Explain why TEM wave doesn't exist in a rectangular waveguide? A rectangular waveguide has dimensions a = 1 cm, b = 2 cm. The medium within the waveguides has $\varepsilon_r = 1$, $\mu_r = 1$, $\sigma = 1$. Find whether or not the signal with the frequency of 500 MHz will be transmitted in the $TE_{1,0}$ mode. [2+4]
12. What are the parameters of antenna? List out the different types of antenna you have studied. [1+1]

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Divergence

$$\text{Cartesian}: \nabla \cdot \bar{D} = \frac{\partial D_x}{\partial x} + \frac{\partial D_y}{\partial y} + \frac{\partial D_z}{\partial z}$$

$$\text{Cylindrical}: \nabla \cdot \bar{D} = \frac{1}{\rho}\frac{\partial(\rho D_\rho)}{\partial \rho} + \frac{1}{\rho}\frac{\partial D_\phi}{\partial \phi} + \frac{\partial D_z}{\partial z}$$

$$\text{Spherical}: \nabla \cdot \bar{D} = \frac{1}{r^2}\frac{\partial(r^2 D_r)}{\partial r} + \frac{1}{r\sin\theta}\frac{\partial(D_\theta \sin\theta)}{\partial \theta} + \frac{1}{r\sin\theta}\frac{\partial D_\phi}{\partial \phi}$$

Gradient

$$\text{Cartesian}: \nabla V = \frac{\partial V}{\partial x}\hat{a}_x + \frac{\partial V}{\partial y}\hat{a}_y + \frac{\partial V}{\partial z}\hat{a}_z$$

$$\text{Cylindrical}: \nabla V = \frac{\partial V}{\partial \rho}\hat{a}_\rho + \frac{1}{\rho}\frac{\partial V}{\partial \phi}\hat{a}_\phi + \frac{\partial V}{\partial z}\hat{a}_z$$

$$\text{Spherical}: \nabla V = \frac{\partial V}{\partial r}\hat{a}_r + \frac{1}{r}\frac{\partial V}{\partial \theta}\hat{a}_\theta + \frac{1}{r\sin\theta}\frac{\partial V}{\partial \phi}\hat{a}_\phi$$

Curl

$$\text{Cartesian}: \nabla \times \bar{H} = \left(\frac{\partial H_z}{\partial y} - \frac{\partial H_y}{\partial z}\right)\hat{a}_x + \left(\frac{\partial H_x}{\partial z} - \frac{\partial H_z}{\partial x}\right)\hat{a}_y + \left(\frac{\partial H_y}{\partial x} - \frac{\partial H_x}{\partial y}\right)\hat{a}_z$$

$$\text{Cylindrical}: \nabla \times \bar{H} = \left(\frac{1}{\rho}\frac{\partial H_z}{\partial \phi} - \frac{\partial H_\phi}{\partial z}\right)\hat{a}_\rho + \left(\frac{\partial H_\rho}{\partial z} - \frac{\partial H_z}{\partial \rho}\right)\hat{a}_\phi + \frac{1}{\rho}\left(\frac{\partial(\rho H_\phi)}{\partial \rho} - \frac{\partial H_\rho}{\partial \phi}\right)\hat{a}_z$$

$$\text{Spherical}: \nabla \times \bar{H} = \frac{1}{r\sin\theta}\left(\frac{\partial(H_\phi \sin\theta)}{\partial \theta} - \frac{\partial H_\theta}{\partial \phi}\right)\hat{a}_r + \frac{1}{r}\left(\frac{1}{r\sin\theta}\frac{\partial H_r}{\partial \phi} - \frac{\partial(rH_\phi)}{\partial r}\right)\hat{a}_\theta + \frac{1}{r}\left(\frac{\partial(rH_\theta)}{\partial r} - \frac{\partial H_r}{\partial \theta}\right)\hat{a}_\phi$$

Laplacian:

$$\text{Cartesian}: \nabla^2 V = \frac{\partial^2 V}{\partial x^2} + \frac{\partial^2 V}{\partial y^2} + \frac{\partial^2 V}{\partial z^2}$$

$$\text{Cylindrical}: \nabla^2 V = \frac{1}{\rho}\frac{\partial}{\partial \rho}\left(\rho\frac{\partial V}{\partial \rho}\right) + \frac{1}{\rho^2}\frac{\partial^2 V}{\partial \phi^2} + \frac{\partial^2 V}{\partial z^2}$$

$$\text{Spherical}: \nabla^2 V = \frac{1}{r^2}\frac{\partial}{\partial r}\left(r^2\frac{\partial V}{\partial r}\right) + \frac{1}{r^2\sin\theta}\frac{\partial}{\partial \theta}\left(\sin\theta\frac{\partial V}{\partial \theta}\right) + \frac{1}{r^2\sin^2\theta}\frac{\partial^2 V}{\partial \phi^2}$$

TRIBHUVAN UNIVERSITY
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Examination Control Division
2076 Chaitra

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

Subject: - Electromagnetics *(EX 503)*

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

1. Transform the vector $\vec{A} = 4\hat{a}_x - 2\hat{a}_y - 4\hat{a}_z$ into spherical co-ordinates at a point P(x = -2, y = -3, z = 4). [5]
2. An infinite uniform line charge ρL = 2nC/m lies along the x-axis in free space, while point charges of 8nC each are located at (0, 0, 1) and (0, 0, -1). (a) Find $\vec{D}$ at (2, 3, -4). [6]
3. Define uniqueness theorem. Find the energy stored in free space for the region 2mm< r< 3mm, 0<θ<90°, 0<ϕ<90°, given the potential field V = : [2+6]

   a) $\frac{200}{r}$V and b) $\frac{300}{r^2}\cos\theta$V
4. Using the continuity equation elaborate the concept of Relaxation Time Constant (RTC) with necessary derivations. Let $\vec{J} = \frac{e^{-10^4 t}}{\rho^2}\hat{a}_\rho$ A/m^2 be the current density in a given region. At t = 10ms, calculate the amount of current passing through surface ρ = 2m, $0 \le z \le 3$m, $0 \le \phi \le 2\pi$. [4+4]
5. State and prove the Stoke's Theorem. Calculate the value of the vector current density: In cylindrical coordinates at $P_B(1.5,90°,0.5)$ if $\vec{H} = \frac{2}{\rho}(\cos 0.2\phi)\hat{a}_\rho$. [5+3]
6. Define scalar magnetic potential. The region y<0 (region 1) is air and y>0 (region 2) has $\mu_r = 10$. If there is a uniform magnetic field $\vec{H} = 5\hat{a}_x + 6\hat{a}_y + 7\hat{a}_z$ A/m in region 2, find $\vec{B}$ and $\vec{H}$ in region 2. [2+6]
7. List out the Maxwell equations phasor form for time varying case in free space. A conducting bar can slide freely over two conducting rails placed at x = 0 and x = 10cm. Calculate the induced voltage in the bar if the bar slides at a velocity $\vec{V} = 10a\hat{y}$ m/s and $\vec{B} = 3\hat{a}_z$ mWb/m^2. [2+3]

8. A uniform plane wave in free space is given by $\vec{H}_S = (250\angle 30°)e^{-j350z}\hat{a}_x V/m$.

   Determine phase constant, frequency of the wave, intrinsic impedance, $\vec{E}_S$ and the magnitude $\vec{H}$ of at z = 25mm and t = 4ps. [1+2+1+2+2]

9. Within a certain regicn, $\varepsilon = 10^{-11} F/m$ and $\mu = 10^{-5} H/m$. If $B_x = 2\times10^{-4} \cos 10^5 t \sin 10^{-3} y$ T find: [3+3+2]

   a) Find $\vec{E}$
   b) Find the total magnetic flux passing through the surface x = 0, 0 < y < 40m, 0 < z < 2m at t = 1 μs
   c) Find the value of the closed line integral of $\vec{E}$ around the perimeter of the given surface.

10. A transmission line operating at 120MHz has R = 20Ω/m, L = 0.3μH/m, C = 63pF/m and G = 4.2ms/m. Find [3+3+2]

    a) Propagation coefficient (γ)
    b) Velocity of wave propagation on the line (v)
    c) Characteristic impedance (Z_o)

11. A rectangular waveguide has dimension a = 4cm and b = 2 cm. Determine the cut-off frequency and range of frequencies over with the guide will operate single mode. [6]

12. Write short notes on antenna and its types. [2]

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TRIBHUVAN UNIVERSITY
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2076 Ashwin

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

Subject: - Electromagnetics *(EX 503)*

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

1. Given points A ($\rho = 5, \varphi = 70^\circ, z = -3$) and B ($\rho = 2, \varphi = -30^\circ, z = 1$),find: (a) a unit vector in cartesian coordinates at A directed toward B; (b) a unit vector in cylindrical coordinates at A directed toward B. [5]
2. Two uniform line charges, each 20 nC/m, are located at $y = 1, z = \pm 1$ m. Find the total electric flux leaving the surface of a sphere having a radius of 2 m, if it is centered at A (3, 1, 0). [6]
3. Derive Energy Density in electrostatic field. [7]
4. The conducting planes $2x + 3y = 12$ and $2x + 3y = 18$ are at potentials of 100 V and 0, respectively. Let $\varepsilon = \varepsilon_0$ and find: a) V at P (5, 2, 6); b) E at P(5,2,6). [7]
5. Let a filamentary current of 5 mA be directed from infinity to the origin on the positive z axis and then back out to infinity on the positive x axis. Find H at P (0, 1, 0). [8]
6. State Ampere's circuital law. Let the permittivity be 5 μH/m in region A where $x < 0$, and 20 μH/m in region B where $x > 0$. If there is a surface current density $K = 150a_y - 200a_z$ A/m at $x = 0$,and if $H_A = 300a_x - 400a_y + 500a_z$ A/m, find: (a) $|H_{LA}|$; (b) $|H_{NA}|$; (c) $|H_{LB}|$; (d) $|H_{NB}|$. [10]
7. State and explain the Maxwell's equation in differential and integral form. Also define the displacement current and depth of penetration. [10]
8. Establish the relation for Helmholtz's equation for electromagnetic wave propagation. [5]
9. State and prove Poynting's theorem. [6]
10. A load $Z_l = 80 + j100\Omega$ is located at $z = 0$ on a lossless 50-Ω line. The operating frequency is 200 MHz and the wavelength on the line is 2 m. (a) If the line is 0.8 m in length, use the Smith chart to find the input impedance. (b) What is s? (c) What is the distance from the load to the nearest voltage maximum? [7]
11. An air-filled rectangular waveguide has dimensions a = 2 cm and b = 1 cm. Determine the range of frequencies over which the guide will operate single mode (TE_{10}). [3]
12. Write short notes on:. [3x2]
    a) TE mode and TM mode
    b) Antenna Properties

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DIVERGENCE

CARTESIAN $$\nabla \cdot \mathbf{D} = \frac{\partial D_x}{\partial x} + \frac{\partial D_y}{\partial y} + \frac{\partial D_z}{\partial z}$$

CYLINDRICAL $$\nabla \cdot \mathbf{D} = \frac{1}{\rho}\frac{\partial}{\partial \rho}(\rho D_\rho) + \frac{1}{\rho}\frac{\partial D_\phi}{\partial \phi} + \frac{\partial D_z}{\partial z}$$

SPHERICAL $$\nabla \cdot \mathbf{D} = \frac{1}{r^2}\frac{\partial}{\partial r}(r^2 D_r) + \frac{1}{r\sin\theta}\frac{\partial}{\partial \theta}(D_\theta \sin\theta) + \frac{1}{r\sin\theta}\frac{\partial D_\phi}{\partial \phi}$$

GRADIENT

CARTESIAN $$\nabla V = \frac{\partial V}{\partial x}\mathbf{a}_x + \frac{\partial V}{\partial y}\mathbf{a}_y + \frac{\partial V}{\partial z}\mathbf{a}_z$$

CYLINDRICAL $$\nabla V = \frac{\partial V}{\partial \rho}\mathbf{a}_\rho + \frac{1}{\rho}\frac{\partial V}{\partial \phi}\mathbf{a}_\phi + \frac{\partial V}{\partial z}\mathbf{a}_z$$

SPHERICAL $$\nabla V = \frac{\partial V}{\partial r}\mathbf{a}_r + \frac{1}{r}\frac{\partial V}{\partial \theta}\mathbf{a}_\theta + \frac{1}{r\sin\theta}\frac{\partial V}{\partial \phi}\mathbf{a}_\phi$$

CURL

CARTESIAN $$\nabla \times \mathbf{H} = \left(\frac{\partial H_z}{\partial y} - \frac{\partial H_y}{\partial z}\right)\mathbf{a}_x + \left(\frac{\partial H_x}{\partial z} - \frac{\partial H_z}{\partial x}\right)\mathbf{a}_y + \left(\frac{\partial H_y}{\partial x} - \frac{\partial H_x}{\partial y}\right)\mathbf{a}_z$$

CYLINDRICAL $$\nabla \times \mathbf{H} = \left(\frac{1}{\rho}\frac{\partial H_z}{\partial \phi} - \frac{\partial H_\phi}{\partial z}\right)\mathbf{a}_\rho + \left(\frac{\partial H_\rho}{\partial z} - \frac{\partial H_z}{\partial \rho}\right)\mathbf{a}_\phi + \frac{1}{\rho}\left[\frac{\partial(\rho H_\phi)}{\partial \rho} - \frac{\partial H_\rho}{\partial \phi}\right]\mathbf{a}_z$$

SPHERICAL $$\nabla \times \mathbf{H} = \frac{1}{r\sin\theta}\left[\frac{\partial(H_\phi \sin\theta)}{\partial \theta} - \frac{\partial H_\theta}{\partial \phi}\right]\mathbf{a}_r + \frac{1}{r}\left[\frac{1}{\sin\theta}\frac{\partial H_r}{\partial \phi} - \frac{\partial(rH_\phi)}{\partial r}\right]\mathbf{a}_\theta + \frac{1}{r}\left[\frac{\partial(rH_\theta)}{\partial r} - \frac{\partial H_r}{\partial \theta}\right]\mathbf{a}_\phi$$

LAPLACIAN

CARTESIAN $$\nabla^2 V = \frac{\partial^2 V}{\partial x^2} + \frac{\partial^2 V}{\partial y^2} + \frac{\partial^2 V}{\partial z^2}$$

CYLINDRICAL $$\nabla^2 V = \frac{1}{\rho}\frac{\partial}{\partial \rho}\left(\rho\frac{\partial V}{\partial \rho}\right) + \frac{1}{\rho^2}\frac{\partial^2 V}{\partial \phi^2} + \frac{\partial^2 V}{\partial z^2}$$

SPHERICAL $$\nabla^2 V = \frac{1}{r^2}\frac{\partial}{\partial r}\left(r^2\frac{\partial V}{\partial r}\right) + \frac{1}{r^2\sin\theta}\frac{\partial}{\partial \theta}\left(\sin\theta\frac{\partial V}{\partial \theta}\right) + \frac{1}{r^2\sin^2\theta}\frac{\partial^2 V}{\partial \phi^2}$$

TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
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2075 Chaitra

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

Subject: - Electromagnetics *(EX 503)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt All questions.*
- ✓ *The figures in the margin indicate Full Marks.*
- ✓ *Necessary figures are attached herewith.*
- ✓ *Assume suitable data if necessary.*
- ✓ *Assume that the Bold Faced letter represents a vector and* $a_{subscript}$ represents a unit vector.

1. Find the vector that extends from A(-3,-4,6) to B(-5,2,-8) and express it in cylindrical coordinate system. [1+4]
2. A point charge of 12nC is located at the origin. Four uniform line charges are located in the x=0 plane as follow: 80nc/m at y=-1 and -5m, -50 nC/m at y=-2 and -4 m. Find the electric flux density **D** at P(0,-3,2). [7]
3. Let the region z<0 be composed of a uniform dielectric material for which $\varepsilon_{R1}=3.2$, while the region z>0 is characterized by $\varepsilon_{R2}=2$. Let $\mathbf{D}_1=-30\mathbf{a}_x+50\mathbf{a}_y+70\mathbf{a}_z$ nC/m^2 and find:- [7]
   a) $\mathbf{D}_{t1}$ (Tangential component of **D** in Region 1);
   b) Polarization ($\mathbf{P}_1$);
   c) $\mathbf{E}_{n2}$ (Normal component of **E** in Region 2)
   d) $\mathbf{E}_{t2}$ (Tangential component of **E** in Region 2)
4. Derive the Possion's and Laplace's equations. Assuming that the potential V in the cylindrical coordinate system is the function of 'r' only, solve the Laplace's equation by Integration Method an derive the expression for the capacitance of the Spherical Capacitor using the same solution of V. [2+5]
5. Derive the equation for magnetic field intensity in different regions due to a co-axial cable carrying a uniformly distributed dc current I in the inner conductor and –I in the outer conductor. [6]
6. Find the vector magnetic field intensity **H** in Cartesian coordinate at P(-1.5, -4, 3) caused by a current filament of 12A in the $\mathbf{a}_z$ direction on the z-axis and extending from z=-3 to z=3. [6]
7. Define Curl and give the physical interpretation of the Curl with a suitable example. [1+3]
8. A uniform plane wave in free space is propagating in the $-\mathbf{a}_y$ direction at a frequency of 5 MHz. If $\mathbf{E}=200\cos(\omega t+\beta y)\,\mathbf{a}_z$ V/m, write the expressions for electric and magnetic fields, i.e., $\mathbf{E}_s(x,y,z)$ and $\mathbf{H}_s(x, y, z)$ respectively in phasor forms. [3+5]
9. Derive an expression for Standing Wave Ratio (SWR) indicating where on the z-axis you'll get the maximum and minimum value of electric field intensity E. Assume that the boundary is at z=0, the region z<0 is a perfect dielectricand the region z>0 may be of any material. [8]

10. Find the amplitude of the displacement current density in an air space within a large power transformer where $\mathbf{H}=10^6 \cos(377t+1.2566 \times 10^{-6}z)\, \mathbf{a}_y$ A/m. [6]

11. A lossless 50-Ω line is 1.5λ long and is terminated with a pure resistance of 100Ω. The load voltage is $40\underline{/60^\circ}$V. Find: (a) the average power delivered to the load; (b) the magnitude of the minimum voltage on the line. [4+4]

12. What are the advantages and disadvantages of waveguides when you compare it with transmission lines? Explain the transverse electric (TE) and transverse magnetic (TM) modes used in rectangular waveguides. [3+3]

13. Give the definition of an antenna and explain the properties of any one type of antenna that you have studied during your electromagnetics course. [1+1]

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TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2075 Ashwin

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

Subject: - Electromagnetics *(EX503)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt All questions.*
- ✓ *The figures in the margin indicate Full Marks.*
- ✓ *The $\xrightarrow[\text{subscript}]{}$ denotes a unit vector along the direction of subscript.*
- ✓ *Necessary formulas are attached herewith.*
- ✓ *Assume suitable data if necessary.*

1. Expres in cartesian components: (a) the vector at A($\rho = 4$, $\Phi = 40°$, $z = -2$) that extends to B($\rho = 5$, $\Phi = -110°$, $z = 2$); (b) a unit vector at B directed toward A. [3+2]

2. Derive an Electric Field Intensity ($\vec{E}$) in between the two co-axial cylindrical conductors, the inner of radius 'a' and outer of radius 'b', each infinite in extent and assuming a surface charge density ρ_s on the outer surface of the inner conductor. An infinite uniform line charge $\rho_L = 2$ nC/m lies along the x-axis in free space, while the point charge of 8nC each are located at (0, 0, 1). Find $\vec{E}$ at (2, 3, -4) [4+4]

3. Derive the integral and point forms of continuity equation. In a certain region, $\vec{j} = 3r^2\cos\theta\vec{a}_r - r^2\sin\theta\vec{a}_\theta\ A/m^2$. Find the current crossing the surface defined by $\theta = 30°$, $0 < \phi < 2\pi$, $0 < r < 2$. [5+3]

4. Given the field, $\vec{D} = \frac{5\sin(\theta)\cos(\phi)}{r}a_r C/m^2$, find: (a) the volume charge density; (b) the total charge contained in the region $r < 2$ m; (c) the value of D at the surface $r = 2$. [2+2+2]

5. Differentiate between scalar and vector magnetic potential. Derive the expression for magnetic boundary conditions. [3+5]

6. State Stroke's theorem. Evaluate both sides of Stroke's theorem for the field $\vec{G} = 10\sin\theta\hat{a}_\phi$ and the surface $r = 3$, $0 \le \theta \le 2\pi$, $0 \le \phi \le 90°$. Let the surface have the $\hat{a}_r$ direction. [1+7]

7. Find the capacitance of a spherical capacitor using Laplace's equation. [6]

8. Write point form of all the Maxwell's Equations in phasor domain, for perfect dielectric material. Use these equations to derive the magnetic field component of a uniform plan wave travelling in the perfect dielectric medium. [2+6]

9. Let $\vec{E}(z,t) = 1800\cos(10^7\pi t - \beta z)\vec{a}_x\ V/m$ and $\vec{H}(z,t) = 3.8\cos(10^7\pi t - \beta z)\vec{a}_y\ A/m$ represents a uniform plane wave propagating at a velocity of 1.4×10^8 m/s in perfect dielectic. Find a) β b) λ c) η d) μ_r e) ε_r. [2+1+2+2+1]

10. The velocity of propagation in a lossless transmission line 2.5×10^8 m/s. If the capacitance of the line is 30 pf/m, find: [2+2+2+2]

a) Inductance of the line
b) Characteristic impedance
c) Phase constant at 100 MHZ
d) Reflection coefficient if the line is terminated with a resistive load of 50Ω

11. What are the advantages of waveguides over transmission lines? A rectangular waveguide has a cross-section of 2.5 cm × 1.2 cm. Find the cut-off frequencies at dominant mode and TE (1,1) [1+4]

12. Write short notes on: Antenna properties [2]

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DIVERGENCE

Cartesian: $\nabla . \vec{D} = \frac{\partial D_x}{\partial x} + \frac{\partial D_y}{\partial y} + \frac{\partial D_z}{\partial z}$

Cylindrical: $\nabla . \vec{D} = \frac{1}{\rho}\frac{\partial (\rho D_\rho)}{\partial \rho} + \frac{1}{\rho}\frac{\partial D_\phi}{\partial \phi} + \frac{\partial D_z}{\partial z}$

Spherical: $\nabla . \vec{D} = \frac{1}{r^2}\frac{\partial (r^2 D_r)}{\partial r} + \frac{1}{r \sin\theta}\frac{\partial (D_\theta \sin\theta)}{\partial \theta} + \frac{1}{r \sin\theta}\frac{\partial D_\phi}{\partial \phi}$

GRADIENT

Cartesian: $\nabla v = \frac{\partial v}{\partial x}\vec{a_x} + \frac{\partial v}{\partial y}\vec{a_y} + \frac{\partial V}{\partial z}\vec{a_z}$

Cylindrical: $\nabla v = \frac{\partial v}{\partial \rho}\vec{a_\rho} + \frac{1}{\rho}\frac{\partial v}{\partial \phi}\vec{a_\phi} + \frac{\partial v}{\partial z}\vec{a_z}$

Spherical: $\nabla v = \frac{\partial v}{\partial r}\vec{a_r} + \frac{1}{r}\frac{\partial v}{\partial \theta}\vec{a_\theta} + \frac{1}{r \sin\theta}\frac{\partial v}{\partial \phi}\vec{a_\phi}$

LAPLACIAN

Cartesian: $\nabla^2 v = \frac{\partial^2 v}{\partial x^2} + \frac{\partial^2 v}{\partial y^2} + \frac{\partial^2 v}{\partial z^2}$

Cylindrical: $\nabla^2 v = \frac{1}{\rho}\frac{\partial}{\partial \rho}\left(\rho \frac{\partial v}{\partial \rho}\right) + \frac{1}{\rho^2}\frac{\partial^2 v}{\partial \phi^2} + \frac{\partial^2 v}{\partial z^2}$

Spherical: $\nabla^2 v = \frac{1}{r^2}\frac{\partial}{\partial r}\left(r^2 \frac{\partial v}{\partial r}\right) + \frac{1}{r^2 \sin\theta}\frac{\partial}{\partial \theta}\left(\sin\theta \frac{\partial v}{\partial \theta}\right) + \frac{1}{r^2 \sin^2\theta}\frac{\partial^2 v}{\partial \phi^2}$

CURL

Cartesian: $\nabla \times \vec{H} = \left(\frac{\partial H_z}{\partial y} - \frac{\partial H_y}{\partial z}\right)\vec{a_x} + \left(\frac{\partial H_x}{\partial z} - \frac{\partial H_z}{\partial x}\right)\vec{a_y} + \left(\frac{\partial H_y}{\partial x} - \frac{\partial H_x}{\partial y}\right)\vec{a_z}$

Cylindrical: $\nabla \times \vec{H} = \left(\frac{1}{\rho}\frac{\partial H_z}{\partial \phi} - \frac{\partial H_\phi}{\partial z}\right)\vec{a_\rho} + \left(\frac{\partial H_\rho}{\partial z} - \frac{\partial H_z}{\partial \rho}\right)\vec{a_\phi} + \frac{1}{\rho}\left(\frac{\partial (\rho H_\phi)}{\partial \rho} - \frac{\partial H_\rho}{\partial \phi}\right)\vec{a_z}$

Spherical: $\nabla \times \vec{H} == \frac{1}{r \sin\theta}\left(\frac{\partial (H_\phi \sin\theta)}{\partial \theta} - \frac{\partial H_\theta}{\partial \phi}\right)\vec{a_r} + \frac{1}{r}\left(\frac{1}{\sin\theta}\frac{\partial H_r}{\partial \phi} - \frac{\partial (r H_\phi)}{\partial r}\right)\vec{a_\theta} + \frac{1}{r}\left(\frac{\partial (r H_\theta)}{\partial r} - \frac{\partial H_r}{\partial \theta}\right)\vec{a_\phi}$

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12 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2074 Chaitra

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

Subject: - Electromagnetics *(EX503)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt All questions.*
- ✓ *The figures in the margin indicate Full Marks.*
- ✓ *The $\xrightarrow[\text{subscript}]{}$ denotes a unit vector along the direction of subscript.*
- ✓ *Necessary formulas are attached herewith.*
- ✓ *Assume suitable data if necessary.*

1. An uniform Electric Field Intensity in certain region is given by $\vec{E} = y\vec{a}_x - xy\vec{a}_y + z\vec{a}_z$. Transform this field vector into cylindrical co-ordinate at a point P(2, 45°, 3). [5]
2. A uniform line charge density of 150 μC/m lies at x = 2, z = -4 and a uniform sheet of charge equal to 25 nC/m^2 is placed at z = 5 plane. Find $\vec{D}$ at point (1, 2, 4) and convert it to the spherical coordinate system. [5+3]
3. Given the potential function $V = \frac{20\cos\theta}{r^2}$ V in free space and point P is located at r = 3m, θ = 60°, φ = 30° find: a) $\vec{E}_p$ b) $\frac{dV}{dN}$ at P c) unit normal vector at P d) ρ_v at P. [2+1+1+2]
4. Define Relaxation time Constant (RTC). Derive an expression for RTC. Given the vector current density $\vec{J} = 10\rho^2 z\vec{a}_\rho - 4\rho\cos^2\phi\vec{a}_\phi$ mA/m^2. Find the current flowing outward through the circular band ρ = 3, 0 < φ < 2π, 2 < z < 2.8. [1+3+4]
5. Show that the vector magnetic potential can be defined in both the regions where $\vec{J}$ is equal or non-equal to zero. Use the concept of vector magnetic potential to derive the Magnetic Field Intensity due to an infinite current carrying filament carrying DC current I. [3+5]
6. State Stoke's theorem. Given the field $\vec{H} = \frac{1}{2}\cos\left(\frac{\phi}{2}\right)\vec{a}_\rho - \sin\left(\frac{\phi}{2}\right)\vec{a}_\Phi$ A/m, evaluate both sides of Stroke's theorem for the path formed by the intersection of the cylinder ρ = 3 and the plane z = 2, and for the surface defined by ρ = 3, 0 ≤ z ≤ 2, and z = 0, 0 ≤ ρ ≤ 3. [1+7]
7. State Faradays Law. Correct the equation $\nabla \times \vec{H} = \vec{J}$ with necessary arguments and derivation for time varying field. [2+4]
8. Derive the expressions for reflection coefficient and transmission coefficient for the reflection of uniform waves at normal incidence. [8]

9. At 50 MHz, a lossy dielectric material is characterized by $\epsilon = 3.6\epsilon_0$, $\mu = 2.1\mu_0$ and $\sigma = 0.08$ S/m. If $\vec{E}_s = 6e^{-\gamma x}\vec{a}_z$ V/m, Compute: [2+2+4]

   a) Propagation Constant
   b) Wavelength
   c) $\vec{H}_s$

10. State the condition for lossless transmission line. A lossless transmission line is 80 cm long and operates at a frequency of 600 MHZ. The line parameters are L = 0.25μH/m and C = 100 pF/m. Find a) characteristics impedance b) phase constant c) phase velocity. [1+2+3+2]

11. Differentiate between Transmission line and waveguide. Consider a rectangular waveguide with $\epsilon_r = 2$, $\mu_r = 1$ with dimensions a = 1.07 cm, b = 0.43 cm find the cut off frequency for TM_{11} mode and the dominant mode. [1+4]

12. Write short notes on antenna and its parameters. [2]

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P.T.O

22 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2074 Ashwin

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

Subject: - Electromagnetics *(EX503)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attemp* *t All questions.*
- ✓ *The figures in the margin indicate Full Marks.*
- ✓ *Necessary formula is attached herewith.*
- ✓ $\vec{A}$ *represents a vector and* $\vec{a}_{subscript}$ *denotes a unit vector along the direction given by the subscript.*
- ✓ *Assume suitable data if necessary.*

1. Convert the vector $\vec{F} = F_x \vec{a}_x + F_y \vec{a}_y + F_z \vec{a}_z$ to both spherical coordinate system. [5]
2. Find the electric field intensity in all three regions due to an infinite sheet parallel plate capacitor having surface charge density ρ_s c/m^2 and $-\rho_s$ c/m^2 and placed at y = 0 and y = b respectively. Let a uniform line charge density, 3 nC/m, at y = 3; uniform surface charge density, 0.2 nC/m^2 at x = 2. Find $\vec{E}$ at the origin. [4+4]
3. What is dipole? Derive the equation for potential and electric field due to dipole at a distant point P. [1+6]
4. Derive Poisson's equation. By solving Laplace's equation, find the capacitance of a parallel plate capacitor with potential difference between the plates equals V_o. [1+5]
5. Verify stoke's theorem for the field $\vec{H} = \left(\frac{3r^2}{\sin\theta}\right)\vec{a}_\theta + 54r\cos\theta\,\vec{a}_\phi$ A/m in free space for the conical surface defined by $\theta = 20°$, $0 \le \phi \le 2\pi$, $0 \le r \le 5$. Let the positive direction of $\vec{ds}$ be $\vec{a}_\theta$. [8]
6. Consider a boundary at z = 0 for which $\vec{B}_1 = 2\vec{a}_x - 3\vec{a}_y + \vec{a}_z$ mT, μ_1 = 4 μH/m (z > 0), μ_2 = 7 μH/m (z < 0) and $\vec{K} = 80\vec{a}_x$ A/m at z = 0. Find $\vec{B}_2$ [8]
7. Explain how Ampere's law conflict with continuity equation and how it is corrected? Derive conduction and displacement current in a capacitor. [4+3]
8. Derive the expression for electric and magnetic fields for a uniform plane wave propagating in a perfect dielectric medium. [5+3]
9. A 9.4 GHz uniform plane wave is propagating in a medium with ϵ_r = 2.25 an μ_r = 1. If the magnetic field intensity is 7 mA/m and the material is loss less, find [1+1+1+2+2]
   i) Velocity of propagation
   ii) The wave length
   iii) Phase constant
   iv) Intrinsic impedance
   v) Magnitude of electric field intensity

10. A lossless line having an air dielectric has a characteristics impedance of 400 Ω. The line is operating at 200 MHz and $z_{in} = 200 - j200\,\Omega$. Find (a) SWR (b) Z_L, if the line is 1 m long; (c) the distance from the load to the nearest voltage maximum. [2+4+2]

11. Differentiate between transmission line and waveguide. A rectangular waveguide having cross-section of 2 cm× 1 cm is filled with a lossless medium characterized by $\varepsilon = 4\varepsilon_0$ and $\mu_r = 1$. Calculate the cut-off frequency of the dominant mode. [4+2]

12. Write short notes on antenna and its properties. [2]

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DIVERGENCE

CARTESIAN $\nabla \cdot \bar{D} = \frac{\partial D_x}{\partial x} + \frac{\partial D_y}{\partial y} + \frac{\partial D_z}{\partial z}$

CYLINDRICAL $\nabla \cdot \bar{D} = \frac{1}{\rho}\frac{\partial}{\partial \rho}(\rho D_\rho) + \frac{1}{\rho}\frac{\partial D_\phi}{\partial \phi} + \frac{\partial D_z}{\partial z}$

SPHERICAL $\nabla \cdot \bar{D} = \frac{1}{r^2}\frac{\partial}{\partial r}(r^2 D_r) + \frac{1}{r\sin\theta}\frac{\partial(\sin\theta D_\theta)}{\partial \theta} + \frac{1}{r\sin\theta}\frac{\partial D_\phi}{\partial \phi}$

GRADIENT

CARTESIAN $\nabla V = \frac{\partial V}{\partial x}\hat{a}_x + \frac{\partial V}{\partial y}\hat{a}_y + \frac{\partial V}{\partial z}\hat{a}_z$

CYLINDRICAL $\nabla V = \frac{\partial V}{\partial \rho}\hat{a}_\rho + \frac{1}{\rho}\frac{\partial V}{\partial \phi}\hat{a}_\phi + \frac{\partial V}{\partial z}\hat{a}_z$

SPHERICAL $\nabla V = \frac{\partial V}{\partial r}\hat{a}_r + \frac{1}{r}\frac{\partial V}{\partial \theta}\hat{a}_\theta + \frac{1}{r\sin\theta}\frac{\partial V}{\partial \phi}\hat{a}_\phi$

CURL

CARTESIAN $\nabla \times \bar{H} = \left(\frac{\partial H_z}{\partial y} - \frac{\partial H_y}{\partial z}\right)\hat{a}_x + \left(\frac{\partial H_x}{\partial z} - \frac{\partial H_z}{\partial x}\right)\hat{a}_y + \left(\frac{\partial H_y}{\partial x} - \frac{\partial H_x}{\partial y}\right)\hat{a}_z$

CYLINDRICAL $\nabla \times \bar{H} = \left(\frac{1}{\rho}\frac{\partial H_z}{\partial \phi} - \frac{\partial H_\phi}{\partial z}\right)\hat{a}_\rho + \left(\frac{\partial H_\rho}{\partial z} - \frac{\partial H_z}{\partial \rho}\right)\hat{a}_\phi + \frac{1}{\rho}\left(\frac{\partial(\rho H_\phi)}{\partial \rho} - \frac{\partial H_\rho}{\partial \phi}\right)\hat{a}_z$

SPHERICAL $\nabla \times \bar{H} = \frac{1}{r\sin\theta}\left(\frac{\partial(H_\phi \sin\theta)}{\partial \theta} - \frac{\partial H_\theta}{\partial \phi}\right)\hat{a}_r + \frac{1}{r}\left(\frac{1}{\sin\theta}\frac{\partial H_r}{\partial \phi} - \frac{\partial(rH_\phi)}{\partial r}\right)\hat{a}_\theta + \frac{1}{r}\left(\frac{\partial(rH_\theta)}{\partial r} - \frac{\partial H_r}{\partial \theta}\right)\hat{a}_\phi$

LAPLACIAN

CARTESIAN $\nabla^2 V = \frac{\partial^2 V}{\partial x^2} + \frac{\partial^2 V}{\partial y^2} + \frac{\partial^2 V}{\partial z^2}$

CYLINDRICAL $\nabla^2 V = \frac{1}{\rho}\frac{\partial}{\partial \rho}\left(\rho\frac{\partial V}{\partial \rho}\right) + \frac{1}{\rho^2}\frac{\partial^2 V}{\partial \phi^2} + \frac{\partial^2 V}{\partial z^2}$

SPHERICAL $\nabla^2 V = \frac{1}{r^2}\frac{\partial}{\partial r}\left(r^2\frac{\partial V}{\partial r}\right) + \frac{1}{r^2\sin\theta}\frac{\partial}{\partial \theta}\left(\sin\theta\frac{\partial V}{\partial \theta}\right) + \frac{1}{r^2\sin^2\theta}\frac{\partial^2 V}{\partial \phi^2}$

22 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2073 Chaitra

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

Subject: - Electromagnetics *(EX503)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ ***Necessary formula is attached herewith.***
- ✓ *$\vec{A}$ represents a vector and $\vec{a}_{subscript}$ denotes a unit vector along the direction given by the subscript.*
- ✓ *Assume suitable data if necessary.*

1. Express a scalar potential field $V = x^2 + 2y^2 + 3z^2$ in spherical coordinates. Find value of V at a point P(2,60°,90°). [3+2]
2. Derive the expression of Electric field intensity due to a line charge using Gauss Law. Find Electric flux density at point P(5,4,3) due to a uniform line charge of 2 nC/m at x = 5, y =3, point charge 12 nC at Q(2,0,6) and uniform surface charge density of 0.2 nC/m^2 at x = 2. [4+4]
3. State the physical significance of divergence. Derive the Divergence theorem. Given the potential $V = \frac{10}{r^2}\sin\theta\cos\phi$; find the electric flux density $\vec{D}$ at $\left(2, \frac{\pi}{2}, 0\right)$. [2+2+3]
4. Derive Laplace's equation. Find the capacitance of a co-axial cable using Laplace's equation. [1+5]
5. State Ampere's circuital law. By using Biot Savart's law, derive an expression for magnetic field intensity $\left(\vec{H}\right)$ due to an infinite length filament carrying a direct current I. [2+6]
6. Flux density at medium with $\mu_1 = 15$ is $\vec{B}_1 = 1.2a_x + 8a_y + 4a_z T$. Find $\vec{B}, \vec{H}$ and the angles between the field vectors and tangent to the interface at second medium, if second medium has $\mu_2 = 1$, and interface plane is z = 0. [3+2+3]
7. State and derive the expression of motional emf (electromotive force). Consider two parallel conductors placed at x =0 and x = 5 cm in a magnetic field $\vec{B} = 6\vec{a}_z \text{ mWb/m}^2$. A high resistance voltmeter is connected at one end and a conducting bar is sliding at other end with velocity $\vec{v} = 18\vec{a}_y \text{ m/s}$. Calculate the induced voltage and show the polarity of induced voltage across the voltmeter. [1+3+3]
8. What is standing wave? Derive the equation of Electric field and Magnetic field and SWR of standing wave? [1+7]

9. An EM wave travels in free space with the electric field component $\vec{E} = \left(15\vec{a}_y - 5\vec{a}_z\right)$ $\cos(\omega t - 3y + 5z)V/m$. Find (a) ω and λ (b) the magnetic field component. [2+2+3]

10. A 50Ω lossless transmission line is 30 m long and is terminated with a load $Z_L = 60 + j40\Omega$. The operating frequency is 20 MHz and velocity on the line is 2.5×10^8 m/s. Find [2+2+4]

    i) Reflection coefficient
    ii) Standing wave ratio
    iii) Input impedance

11. Explain TE and TM modes? Consider a rectangular waveguide with $\varepsilon_r = 2.25$ and $\mu_r = 1$ with dimensions a = 1.07, b = 0.43. Find the cut-off frequency for TM_{11} mode and dominant mode. [2+4]

12. Write short notes on antenna and its type. [2]

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26 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2073 Shrawan

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

Subject: - Electromagnetics *(EX503)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ ***Necessary tables are attached herewith.***
- ✓ $\vec{A}$ *represent a vector and* $\hat{a}_{\text{subscript}}$ *and* $\vec{a}_{\text{subscript}}$ *denotes a unit vector along the direction given by the subscript.*
- ✓ *Assume suitable data if necessary.*

1. Define a vector field. A field vector is given by an expression $\vec{A}=\frac{1}{\sqrt{x^2+y^2+z^2}}\left(X\vec{a}_x+y\vec{a}_y+z\vec{a}_z\right)$, transform this vector in cylindrical coordinate system at point (2, 30°, 6) [2+3]

2. Given the flux density $\vec{D}=(2\cos\theta/r^3)\vec{a}_r+(\sin\theta/r^3)\vec{a}_\theta\,C/m^2$, evaluate both sides of the divergence theorem for the region defined by $1<r<2, 0<\theta<\frac{\pi}{2}, 0<\phi<\frac{\pi}{2}$. [8]

3. Define electric dipole and polarization. The region $z < 0$ contains a dielectric material for which $\varepsilon_{r1}=2.5$ while the region $z > 0$ is characterized by $\varepsilon_{r2}=4$. Let $\vec{E}_1=-30\hat{a}_x+50\hat{a}_y+70\hat{a}_z\,V/m$. Find: (a) $\vec{E}_2$ (b) $\vec{D}_2$ (c) polarization in region 2 $\left(\vec{P}_2\right)$. [2+2+2+1+1]

4. State the uniqueness theorem and prove this theorem for Laplace's equation. [1+5]

5. A current density in certain region is given as: $\vec{J}=20\sin\theta\cos\phi\,\vec{a}_r+\frac{1}{r}\vec{a}_\phi\,A/m^2$, Find: [5+3]
   i) The average value of J_r over the surface $r=1, 0<\theta<\pi/2, 0<\phi<\pi/2$
   ii) $\frac{\delta\rho_v}{\partial t}$

6. Show that $\nabla\times\vec{E}=0$ for static electric field. The region y<0 (Region 1) is air and y>0 (Region 2) has μ_r = 10. If there is a uniform magnetic field $\vec{H}=5\vec{a}_x+6\vec{a}_y+7\vec{a}_z\,A/m$ in region 1, find $\vec{B}$ and $\vec{H}$ in region 2. [2+3+3]

7. Find the amplitude of the displacement current density in a metallic conductor at 60 Hz, if $\varepsilon=\varepsilon_0, \mu=\mu_0, \sigma=5.8\times10^7\,S/m$, and $\vec{J}=\sin(377t-117.1z)\vec{a}_x\,MA/m^2$. [5]

8. Explain the phenomena when a plane wave is incident normally on the interface between two different Medias. Derive the expression for reflection and transmission coefficient. [8]

9. A uniform plane wave in non-magnetic medium has $\vec{E} = 50\cos(10^8 t + 2z)\hat{a}_y \, V/m$. Find:

   i) The direction of propagation
   ii) Phase constant β, wavelength λ, velocity v_p, relative permittivity ε_r, intrinsic impedance η
   iii) $\vec{H}$ [1+5+2]

10. Determine the primary constants (R, L, C and G) on the transmission line when the measurement on the line at 1 KHz gave the following results: $z_0 = 710\angle -16°$, $\alpha = 0.01$ neper/m and $\beta = 0.035$ rad/m. [8]

11. Explain the modes supported by a rectangular waveguide. Calculate the cut off frequencies of the first four propagating modes for an air filled copper waveguide with dimension $a = 2.5\,cm$, $b = 1.2\,cm$. [2+4]

12. Write short notes on antenna and its types. [2]

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22 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2072 Chaitra

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

Subject: - Electromagnetics *(EX503)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ ***Necessary tables are attached herewith.***
- ✓ *$\vec{A}$ represent a vector and $\hat{a}_{subscript}$ and $\vec{a}_{subscript}$ denotes a unit vector along the direction given by the subscript.*
- ✓ *Assume suitable data if necessary.*

1. Express the uniform vector field $\vec{F} = 5\vec{a}_x$ in (a) cylindrical components (b) spherical components. [2+3]
2. Derive the expression for the electric field intensity due to an infinitely long line charge with uniform charge density ρ_L by using Gauss's law. A uniform line charge density of 20 nC/m is located at $y = 3$ and $z = 5$. Find $\vec{E}$ at P(5,6,1) [4+4]
3. Derive an expression to calculate the potential due to a dipole in terms of the dipole moment $\left(\vec{p}\right)$. A dipole for which $\vec{p} = 3\vec{a}_x - 5\vec{a}_y + 10\vec{a}_z$ nC.m is located at the point (1,2,-4). Find $\vec{E}$ at P. [4+4]
4. Assuming that the potential V in the cylindrical coordinate system is function of ρ only, solve the Lapplace's equation and derive the expression for the capacitance of coaxial capacitor of length L using the same solution of V. Assume the inner conductor of radius a is at potential V_0 with respect to the conductor of radius b. [6]
5. State and derive expression for Stoke's theorem. Evaluate the closed line integral of $\vec{H}$ from $P_1(5,4,1)$ to $P_2(5,6,1)$ to $P_3(0,6,1)$ to $P_4(0,4,1)$ to P_1 using straight line segments, if $\vec{H} = 0.1y^3\vec{a}_x + 0.4x\vec{a}_z$ A/m. [1+3+4]
6. Define scalar magnetic potential and show that it satisfies the Laplace's equation. Given the vector magnetic potential $\vec{A} = -(\rho^2/4)\hat{a}_z$ Wb/m, calculate the total magnetic flux crossing the surface $\phi = \pi/2$, $1 \le \rho \le 2$ m and $0 \le z \le 5$ m. [1+2+5]
7. How does $\nabla \times \vec{H} = \vec{J}$ conflict with continuity equation in time varying fields. How is this conflict rectified in such fields? [2+3]
8. Derive the expression for electric and magnetic fields for a uniform plane wave propagating in a perfect dielectric space. [5+3]
9. A lossless dielectric material has $\sigma = 0, \mu_r = 1, \varepsilon_r = 4$. An electromagnetic wave has magnetic field expressed as $\vec{H} = -0.1\cos(\omega t - z)\vec{a}_x + 0.5\sin\cos(\omega t - z)\vec{a}_y$ A/m. Find: [2+2+4]
   a) Angular frequency (ω)
   b) Wave impedance (η)
   c) $\vec{E}$

10. Consider a two-wire 40 Ω line ($Z_0 = 40\Omega$) connecting the source of 80 V, 400 kHz with series resistance 10 Ω to the load of $Z_L = 60\Omega$. The line is 75 m long and the velocity on the line is 2.5×10^8 m/s. Find the voltage $V_{in,s}$ at input end and $V_{L,s}$ at output end of the transmission line. [8]

11. Why does a hollow rectangular waveguide not support TEM mode? A rectangular air-filled waveguide has a cross-section of 45×90 mm. Find the cut-off frequencies of the first four propagating modes. [2+4]

12. Write short notes on antenna and its types. [2]

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DIVERGENCE

CARTESIAN $\nabla\cdot\bar{D} = \frac{\partial D_x}{\partial x} + \frac{\partial D_y}{\partial y} + \frac{\partial D_z}{\partial z}$

CYLINDRICAL $\nabla\cdot\bar{D} = \frac{1}{\rho}\frac{\partial}{\partial\rho}(\rho D_\rho) + \frac{1}{\rho}\frac{\partial D_\phi}{\partial\phi} + \frac{\partial D_z}{\partial z}$

SPHERICAL $\nabla\cdot\bar{D} = \frac{1}{r^2}\frac{\partial}{\partial r}(r^2 D_r) + \frac{1}{r\sin\theta}\frac{\partial(\sin\theta D_\theta)}{\partial\theta} + \frac{1}{r\sin\theta}\frac{\partial D_\phi}{\partial\phi}$

GRADIENT

CARTESIAN $\nabla V = \frac{\partial V}{\partial x}\hat{a}_x + \frac{\partial V}{\partial y}\hat{a}_y + \frac{\partial V}{\partial z}\hat{a}_z$

CYLINDRICAL $\nabla V = \frac{\partial V}{\partial\rho}\hat{a}_\rho + \frac{1}{\rho}\frac{\partial V}{\partial\phi}\hat{a}_\phi + \frac{\partial V}{\partial z}\hat{a}_z$

SPHERICAL $\nabla V = \frac{\partial V}{\partial r}\hat{a}_r + \frac{1}{r}\frac{\partial V}{\partial\theta}\hat{a}_\theta + \frac{1}{r\sin\theta}\frac{\partial V}{\partial\phi}\hat{a}_\phi$

CURL

CARTESIAN $\nabla\times\bar{H} = \left(\frac{\partial H_z}{\partial y} - \frac{\partial H_y}{\partial z}\right)\hat{a}_x + \left(\frac{\partial H_x}{\partial z} - \frac{\partial H_z}{\partial x}\right)\hat{a}_y + \left(\frac{\partial H_y}{\partial x} - \frac{\partial H_x}{\partial y}\right)\hat{a}_z$

CYLINDRICAL $\nabla\times\bar{H} = \left(\frac{1}{\rho}\frac{\partial H_z}{\partial\phi} - \frac{\partial H_\phi}{\partial z}\right)\hat{a}_\rho + \left(\frac{\partial H_\rho}{\partial z} - \frac{\partial H_z}{\partial\rho}\right)\hat{a}_\phi + \frac{1}{\rho}\left(\frac{\partial(\rho H_\phi)}{\partial\rho} - \frac{\partial H_\rho}{\partial\phi}\right)\hat{a}_z$

SPHERICAL $\nabla\times\bar{H} = \frac{1}{r\sin\theta}\left(\frac{\partial(H_\phi\sin\theta)}{\partial\theta} - \frac{\partial H_\theta}{\partial\phi}\right)\hat{a}_r + \frac{1}{r}\left(\frac{1}{\sin\theta}\frac{\partial H_r}{\partial\phi} - \frac{\partial(rH_\phi)}{\partial r}\right)\hat{a}_\theta + \frac{1}{r}\left(\frac{\partial(rH_\theta)}{\partial r} - \frac{\partial H_r}{\partial\theta}\right)\hat{a}_\phi$

LAPLACIAN

CARTESIAN $\nabla^2 V = \frac{\partial^2 V}{\partial x^2} + \frac{\partial^2 V}{\partial y^2} + \frac{\partial^2 V}{\partial z^2}$

CYLINDRICAL $\nabla^2 V = \frac{1}{\rho}\frac{\partial}{\partial\rho}\left(\rho\frac{\partial V}{\partial\rho}\right) + \frac{1}{\rho^2}\frac{\partial^2 V}{\partial\phi^2} + \frac{\partial^2 V}{\partial z^2}$

SPHERICAL $\nabla^2 V = \frac{1}{r^2}\frac{\partial}{\partial r}\left(r^2\frac{\partial V}{\partial r}\right) + \frac{1}{r^2\sin\theta}\frac{\partial}{\partial\theta}\left(\sin\theta\frac{\partial V}{\partial\theta}\right) + \frac{1}{r^2\sin^2\theta}\frac{\partial^2 V}{\partial\phi^2}$

22 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2072 Kartik

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

Subject: - Electromagnetics *(EX503)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ ***Necessary formula sheet is attached herewith.***
- ✓ $\vec{a}_{subscript}$ *denote a unit vector along the direction given by the subscript.*
- ✓ *Assume suitable data if necessary.*

1. Transform $\vec{A} = 10\vec{a}_x - 8\vec{a}_y + 6\vec{a}_z$; at point p(10,-8,6) to cylindrical coordinate system. [5]
2. A line charge of 8nC/m is located at x = -1, y = 2, a point charge of 6mC at y = -4 and a surface charge of 30 pC/m^2 at z = 0. If the potential at origin is 100V, find the potential at P (4,1,3). [7]
3. Explain the Continuity equation. The current density in certain region is approximated by $\vec{J} = \left(\frac{0.1}{r}\right)e^{-10^6 t}\vec{a}_r A/m^2$ in spherical coordinates. (a) How much current is crossing the surface r = 50cm at t = 1μS? (b) Find ρ_v (r,t) assuming that $\rho_v \to 0$ as $t \to \infty$. [2+6]
4. Find the equation for Energy Density in the electrostatic field. [6]
5. Differentiate between scalar and vector magnetic potential. Derive an expression for the magnetic field intensity $\left(\vec{H}\right)$ at a point due to an infinite filament carrying a direct current I, placed on z-axis using ampere's circuital law. [2+6]
6. State and prove Stoke's theorem. Given $\vec{H} = 10\sin\theta\vec{a}_r$ in free space. Find the current in $\vec{a}_r$ direction having $r = 3, 0 \le \theta \le 90°, 0 \le \phi \le 90°$. [3+5]
7. Within a certain region, $\varepsilon = 10^{-11}$ F/m and $\mu = 10^{-5}$ H/m.

   If $\vec{B}_x = 2\times10^{-4}\cos10^5 t\sin10^{-3} y\vec{a}_x$ T: (a) Use $\nabla\times\vec{H} = \varepsilon\frac{\partial\vec{E}}{\partial t}$ to find $\vec{E}$; (b) Find the total magnetic flux passing through the surface $x = 0, 0 \le y \le 40m, 0 \le z \le 2m$, at t = 1μS. [4+4]
8. Derive an expression for standing wave ratio of uniform plane wave in terms of reflection coefficient. Find the reflection coefficient for the interface between air and fresh water ($\epsilon = 81\epsilon_0, \sigma \cong 0$), in case of normal incidence. [5+3]

9. The magnetic field intensity $\left(\vec{H}\right)$ in free space is given as,

$\vec{H}(x,t) = 10\cos(10^8 t + \beta x)\vec{a}_y$ A/m find: [2+1+3]

a) Phase constant (β)
b) Wavelength
c) $\left|\vec{E}(x,t)\right|$ at P (0.1,0.2,0.3) at t = 1nS

10. A 300 Ω transmission line is lossless, 0.25λ long, and is terminated in Z_L = 500 Ω . The line has a generator with 90 ∠0°V in series with 100 Ω connected to the input. Find (a) the load voltage (b) voltage at the midpoint of the line. [4+4]

11. Determine the cut-off frequency for an air filled rectangular waveguide with a = 2.5 cm and b = 1.25 cm for TE_{11} mode. [4]

12. Write short notes on: [2+2]

a) Loss tangent
b) Antenna types and properties

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B.C.T
II/I

26 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2071 Shawan

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

Subject: - Electromagnetics (EX503)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ ***Necessary formulas are attached herewith.***
- ✓ *Assume suitable data if necessary.*
- √ Assume that the **Bold Faced** letter represents a vector and $\mathbf{a}_{subscipt}$ represents a unit vector.

(1) Express the vector field, $\mathbf{G} = (x^2+y^2)^{-1}(x\mathbf{a}_x + y\mathbf{a}_y)$ in cylindrical components and cylindrical variables. [5]

(2) Find **D** at the point (-3, 4, 2) if the following charge distributions are present in free space: point charge, 12 nC, at P (2, 0, 6); uniform line charge density, 3 nC/m, at x = -2, y = 3; uniform surface charge density, 0.2 nC/m^2 at x = 2. [7]

(3) Two uniform line charges, 8 nC/m each, are located at x = 1, z = 2, and at x = -1, y = 2 in free space. If the potential at the origin is 100V, find V at P (4, 1, 3). [7]

(4) State the Uniqueness theorem and prove that the solution of Poisson's equation is unique. [1+6]

(5) Write the equation of the Vector Magnetic Potential in differential form. Using the same equation, derive the equation for magnetic field intensity at a point due to an infinite filament carrying a uniformly distributed dc current I. [1+5]

(6) Calculate the value of the vector current density: (a) in cylindrical coordinates at P_1 (ρ=1.5, ϕ=90°, z=0.5) if $\mathbf{H} = \frac{2}{\rho}(\cos 0.2\phi)\ \mathbf{a}_\rho$. [3+3]

(b) in spherical coordinates at P_2 (r=2, θ=30°, ϕ=20°) if $\mathbf{H} = \frac{1}{\sin\theta}\ \mathbf{a}_\theta$.

(7) State and derive the Stoke's theorem. [1+3]

(8) What is an input intrinsic impedance? Derive an expression for the input intrinsic impedance using the concept of reflection of uniform plane waves. [2+6]

(9) The electric field amplitude of a uniform plane wave propagating in the free space in $\mathbf{a}_z$ direction is 250 V/m. If $\mathbf{E} = E_x\,\mathbf{a}_x$ and ω = 1.00 Mrad/s, find: (a) the frequency; (b) the wavelength; (c) the period; (d) the amplitude of H. [2+2+1+3]

(10) Find the amplitude of the displacement current density inside a typical metallic conductor where f = 1 kHz, Conductivity $\sigma = 5 \times 10^7$ mho/m, dielectric constant $\varepsilon_R = 1$; and the conduction current density $\mathbf{J} = 10^7 \sin(6283\,t - 444\,z)\,\mathbf{a}_x$ A/m^2. [6]

(11) A 50-Ω lossless line has a length of 0.4λ. The operating frequency is 300 MHz. A load $Z_L = 40 + j30\ \Omega$ is connected at z = 0, and the Thevenin equivalent source at z = -l is $12\angle 0^\circ$ in series with $Z_{Th} = 50 + j0\ \Omega$. Find: (a) The Reflection Coefficient Γ (b) The Voltage Standing Wave Ratio (VSWR) and (c) The input Impedance Z_{in}. [2+2+4]

(12) Explain why is it not possible to use waveguides at lower frequencies? Explain the transverse electric (TE) and transverse magnetic (TM) modes used in rectangular waveguides. [2+4]

(13) Give the definition of an antenna. Explain the properties of any one type of antenna that you have studied during your electromagnetics course. [1+1]

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26 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2070 Chaitra

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

Subject: - Electromagnetics *(EX503)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt __All__ questions.*
- ✓ *The figures in the margin indicate __Full Marks__.*
- ✓ *__Necessary formula are attached herewith.__*
- ✓ *Assume suitable data if necessary.*

1. Transform the Vector $\vec{A} = y\vec{a}_x + x\vec{a}_y + z\vec{a}_z$ into cylindrical co-ordinates at a point p(2,45°,5) [5]

2. Along the z-axis there is a uniform line of charge with $\rho_L = 4\pi$ Cm^{-1} and in the x = 1 plane there is a surface charge with $\rho_s = 20$ Cm^{-2}. Find the Electric Flux Density at (0.5, 0, 0) [6]

3. Define Uniqueness theorem. Assuming that the potential V in the cylindrical coordinate system is the function of 'ρ' only, solve the Laplacian Equation by integration method and derive the expression for the Capacitance of the co-axial capacitor using the same solution of V. [2+5]

4. Define Electric Dipole and Polarization. Consider the region y < 0 be composed of a uniform dielectric material for which the relative permittivity (ε_r) is 3.2 while the region y > 0 is characterized by $\varepsilon_r = 2$. Let the flux density in region 1 be [2+3+3]
   $\vec{D}_1 = -30\vec{a}_x + 50\vec{a}_y + 70\vec{a}_z\ nC/m^2$.
   Find:
   a) Magnitude of Flux density and Electric fields intensity at region 2.
   b) Polarization $(\vec{P})$ in region 1 and region 2

5. State Ampere's circuital law and stoke's theorem. Derive an expression for magnetic field intensity $(\vec{H})$ due to infinite current carrying filament using Biot Savart's Law. [1+2+5]

6. Differentiate between scalar and vector magnetic potential. The magnetic field intensity in a certain region of space is given as $\vec{H} = (2\rho + z)\vec{a}_\rho + \frac{2}{z}\vec{a}_z$ A/m. Find the total current passing through the surface $\rho = 2$, $\pi/4 < \varphi < \pi/2$, $3 < z < 5$, in the $\vec{a}_\rho$ direction. [3+5]

7. State Faraday's law and correct the equation $\nabla \times \vec{E} = 0$ for time varying field with necessary derivation. Also modify the equation $\nabla \times \vec{H} = \vec{J}$ with necessary derivations for time varying field. [1+3+4]

8. Derive an expression for input intrinsic impendence using the concept of reflection of uniform plane waves. [6]

9. Find the amplitude of displacement current density inside a typical metallic conductor where $f = 1KHz$, $\sigma = 5\times10^7$ mho/m, $\varepsilon_r = 1$ and the conduction current density is $\vec{J} = 10^7 \sin(6283t - 444z)\hat{a}_y\ A/m^2$ [4]

10. Write all the Maxwell equations for the time varying field point form as well as integral form. [4]

11. A lossless transmission line with $Z_0 = 50\ \Omega$ with length 1.5 m connects a voltage $V_g = 60\angle V$ source to a terminal load of $Z_L = (50+j50)\ \Omega$. If the operating frequency $f = 100$ MHz, generator impedence $Z_g = 50\ \Omega$ and speed of wave equal to the speed of the light. Find the distance of the first voltage maximum from the load. What is the power delivered to the load? [4+4]

12. What are the techniques that can be taken to match the transmission line with mismatched load? Explain any one. [2]

13. Write short notes on: [2×3]

a) Modes in rectangular wave guide
b) Antenna and its types

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TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division

2069 Chaitra

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

Subject: - Electromagnetics *(EX503)*

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

1. Given a point P(-3, 4, 5), express the vector that extends from P to Q(2, 0, -1) in (a) Rectangular coordinates (b) Cylindrical coordinates (c) Spherical coordinates. [5]
2. Verify the divergence theorem (evaluate both sides of the divergence theorem) for the function $\vec{A} = r^2 \vec{a}_r + r\sin\theta\cos\phi \vec{a}_\theta$, over the surface of quarter of a hemisphere defined by: $0 < r < 3$, $0 < \phi < \pi/2$, $0 < \theta < \pi/2$. [6]
3. Given the potential field $V = 100xz/(x^2+4)$ volts in free space: [7]
   a) Find $\vec{D}$ at the surface, z=0
   b) Show that the z=0 surface is an equipotential surface
   c) Assume that the z=0 surface is a conductor and find the total charge on that portion of the conductor defined by $0 < x < 2$, $-3 < y < 0$
4. State the uniqueness theorem and prove this theorem using Poisson's equation. [2+6]
5. State Amperes circuital law with relevant examples. The magnetic field intensity is given in a certain region of space as $\vec{H} = \frac{x+2y}{z^2}\vec{a}_y + \frac{2}{z}\vec{a}_z$ A/m. Find the total current passing through the surface $z = 4$, $1 < x < 2$, $3 < y < 5$, in the a_z direction. [3+5]
6. Define scalar and vector magnetic potential. Derive the expression for the magnetic field intensity at a point due to an infinite filament carrying a dc current I, placed on the z-axis, using the concept of vector magnetic potential. [3+5]
7. Define displacement current. Assume that dry soil has conductivity equal to 10^{-4} S/m, $\varepsilon = 3\varepsilon_0$ and $\mu = \mu_0$. Determine the frequency at which the ratio of the magnitudes of the conduction current density and displacement current density is unity. [2+5]
8. Derive the expression for electric field for a uniform plane wave propagating in a free space. [7]
9. State Poynting's theorem. An EM wave travels in free space with the electric field component $\vec{E} = (10\vec{a}_y + 5\vec{a}_z)\cos(\omega t + 2y - 4z)$ [V/m]. Find (a) ω and λ (b) the magnetic field component (c) the time average power in the wave. [2+2+2+2]
10. A lossless transmission line with $Z_0 = 50\Omega$ is 30m long and operates at 2 MHz. The line is terminated with a load $Z_L = (60+j40)\ \Omega$. If velocity (v) = 3×10^8 m/s on the line. Find (a) the reflection coefficient, (b) the standing wave ratio and the input impedance. [2+2+3]
11. Explain the modes supported by Rectangular waveguide. Define cutoff frequency and dominant mode for rectangular waveguide. [2+2+2]
12. Write short notes on: [2+2]
    a) Antenna types and properties
    b) Quarter wave transformer

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25 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division

2069 Chaitra

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

Subject: - Digital Logic *(EX502)*

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

1. Define digital IC signal levels. What is Gray Code? Explain with example. [3+3]
2. Construct the given Boolean function: F = (A+B) (C+D) E using NOR gates only. [4]
3. Simplify F (A,B,C,D) = π (0,2,5,8,10) + d(7,15). Write its standard SOP and implement the simplified circuit using NOR gates only. [4+4]
4. a) What is priority Encoder? Design octal to binary priority encoder. [2+4]
   b) Design a 2 bit magnitude comparator. [4]
5. Design a combinational logic that performs multiplication between two 4 bit numbers using binary parallel adder and other gates. [8]
6. Draw the circuit diagram and explain the operation of positive edge triggered JK flip-flop. What are the drawbacks of JK flip-flop? [7+1]
7. Explain the Serial in Serial out (SISO) shift register with timing diagram. [4]
8. Design the synchronous decade counter and also show the timing diagram. [8]
9. Design a sequential machine that detects three consecutive zeros from an input data stream X by making output, Y = 1. [12]
10. Draw the schematic circuit for CMOS NAND gates. What do you mean by totem-pole output? [4+4]
11. Describe the operation of a frequency counter. [4]

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27 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2069 Ashad

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

Subject: - Electromagnetics *(EX 503)*

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

1. Given a vector field $\vec{D} = \frac{x\vec{a}_x + y\vec{a}_y}{x^2 + y^2}$, evaluate D at the point where $\rho=2$, $\Phi=0.2\pi$, and $Z=5$ in both cylindrical and Cartesian components. [5]
2. Define Gauss's law. A co-axial cable has inner conductors of radius r_1, outer conductor of radius r_2. Surface charge density on the surface of inner conductors is ρ_s. Use Gauss's law to derive an expression for electric field intensity in the region $r_1 \le r \le r_2$. [2+5]
3. Define potential field. Assuming that the potential V in the spherical coordinate system is function of r only, solve the laplacian equation and derive the expression for the capacitance of a spherical capacitor using the same solution of V. [1+6]
4. Use boundary condition to find $\vec{E}_2$ in the medium 2 with boundary located at plane Z=0. Medium 1 is perfect dielectric characterized by $\varepsilon_{r1}=2.5$, medium 2 is perfect dielectric characterized by $\varepsilon_{r2}=5$, electric field in medium 1 is $\vec{E}_1 = \hat{a}_x + 3\hat{a}_y + 3\hat{a}_z$ v/m. [7]
5. Given the magnetic vector potential $\vec{A} = -\frac{\rho^2}{4}\vec{a}_z$ Wb/m, Calculate the total magnetic flux crossing the surface $\Phi=\pi/2$, $1 \le \rho \le 2$m, $0 \le Z \le 5$m. [6]
6. Find the boundary condition for H and B at the interface between two isotropic homogeneous linear materials with permeabilities μ_1 and μ_2. [6]
7. For magnetic vector potential given in cylindrical co-ordinate system as $\bar{A} = 5r^3\hat{a}_z$ Wb/m in free space, find the magnetic field intensity, $\bar{H}$. [4]
8. Derive the equations to show that the electric field and the magnetic field compone[illegible]e in same phase for the wave propagation in perfect dielectric medium. [8]
9. Derive expressions for reflection co-efficient and transmission co-efficient for the case of normal incidence at boundary between two dielectric media where medium 1 is characterized by permittivity ε_1, permeability μ_1 and medium 2 is characterized by permittivity ε_2, permeability μ_2. Also explain why the concept of reflection is necessary. [5+3]
10. Write down the Maxwell's equations in point and phasor form for time varying fields. Define the pointing vector. [4+2]
11. A load impedance of $(40+j70)\Omega$ terminates a 100Ω transmission line that is 0.3λ long. Find the reflection coefficient at the load and the voltage at the input of the line. [2+4]
12. Define transverse electric and transverse magnetic mode of wave propagation in wave guide. A rectangular wave guide has dimensions a = 4.5cm, b=2.5cm. The medium within wave guide has relative permittivity $\varepsilon_r=1$, relative permeability $u_r=1$, conductivity $\sigma=0$ and conducting walls of wave guide are perfect conductors. Determine the cut off frequency for the modes $TE_{(1,0)}$, and $TM_{(1,1)}$. [2+2+2+2]
13. Write short notes on antenna and its properties. [2]

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Divergence

Cartesian: $\nabla.\bar{A} = \frac{\partial A_x}{\partial x} + \frac{\partial A_y}{\partial y} + \frac{\partial A_z}{\partial z}$

Cylindrical: $\nabla.\bar{A} = \frac{1}{r}\frac{\partial}{\partial r}(rA_r) + \frac{1}{r}\frac{\partial A_\phi}{\partial \phi} + \frac{\partial A_z}{\partial z}$

Spherical: $\nabla.\bar{A} = \frac{1}{R^2}\frac{\partial}{\partial R}(R^2 A_R) + \frac{1}{R\sin\theta}\frac{\partial}{\partial \theta}(A_\theta \sin\theta) + \frac{1}{R\sin\theta}\frac{\partial A_\phi}{\partial \phi}$

Gradient

Cartesian: $\nabla A = \frac{\partial A}{\partial x}\hat{a}_x + \frac{\partial A}{\partial y}\hat{a}_y + \frac{\partial A}{\partial z}\hat{a}_z$

Cylindrical: $\nabla A = \frac{\partial A}{\partial r}\hat{a}_r + \frac{1}{r}\frac{\partial A}{\partial \phi}\hat{a}_\phi + \frac{\partial A}{\partial z}\hat{a}_z$

Spherical: $\nabla A = \frac{\partial A}{\partial R}\hat{a}_R + \frac{1}{R}\frac{\partial A}{\partial \theta}\hat{a}_\theta + \frac{1}{R\sin\theta}\frac{\partial A}{\partial \phi}\hat{a}_\phi$

Curl

Cartesian: $\nabla \times \bar{A} = (\frac{\partial A_z}{\partial y} - \frac{\partial A_y}{\partial z})\hat{a}_x + (\frac{\partial A_x}{\partial z} - \frac{\partial A_z}{\partial x})\hat{a}_y + (\frac{\partial A_y}{\partial x} - \frac{\partial A_x}{\partial y})\hat{a}_z$

Cylindrical: $\nabla \times \bar{A} = (\frac{1}{r}\frac{\partial A_z}{\partial \phi} - \frac{\partial A_\phi}{\partial z})\hat{a}_r + (\frac{\partial A_r}{\partial z} - \frac{\partial A_z}{\partial r})\hat{a}_\phi + \frac{1}{r}(\frac{\partial}{\partial r}(rA_\phi) - \frac{\partial A_r}{\partial \phi})\hat{a}_z$

Spherical:

$\nabla \times \bar{A} = \frac{1}{R\sin\theta}(\frac{\partial}{\partial \theta}(A_\phi \sin\theta) - \frac{\partial A_\theta}{\partial \phi})\hat{a}_R + \frac{1}{R}(\frac{1}{\sin\theta}\frac{\partial A_R}{\partial \phi} - \frac{\partial}{\partial R}(RA_\phi))\hat{a}_\theta + \frac{1}{R}(\frac{\partial}{\partial R}(RA_\theta) - \frac{\partial A_R}{\partial \theta})\hat{a}_\phi$

Laplacian

Cartesian: $\nabla^2 A = \frac{\partial^2 A}{\partial x^2} + \frac{\partial^2 A}{\partial y^2} + \frac{\partial^2 A}{\partial z^2}$

Cylindrical: $\nabla^2 A = \frac{1}{r}\frac{\partial}{\partial r}(r\frac{\partial A}{\partial r}) + \frac{1}{r^2}\frac{\partial^2 A}{\partial \phi^2} + \frac{\partial^2 A}{\partial z^2}$

Spherical: $\nabla^2 A = \frac{1}{R^2}\frac{\partial}{\partial R}(R^2\frac{\partial A}{\partial R}) + \frac{1}{R^2\sin\theta}\frac{\partial}{\partial \theta}(\sin\theta\frac{\partial A}{\partial \theta}) + \frac{1}{R^2\sin^2\theta}\frac{\partial^2 A}{\partial \phi^2}$

27 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2068 Chaitra

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

Subject: - Electromagnetics *(EX 503)*

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

1. Transform vector $\vec{A} = \rho \sin\phi \vec{a}_z$ at point (1, 45°, 2) in cylindrical co-ordinate system to a vector in spherical co-ordinate system. [5]
2. The region X<0 is composed of a uniform dielectric material for which $\varepsilon_{r1} = 3.2$, while the region X>0 is characterized by $\varepsilon_{r2} = 2$. The electric flux density at region X<0 is $\vec{D}_1 = -30\vec{a}_x + 50\vec{a}_y + 70\vec{a}_z$ nC/m^2 then find polarization ($\vec{P}$) and electric field intensity ($\vec{E}$) in both regions. [3+3]
3. Define an electric dipole. Derive expression for electric field because of electric dipole at a distance that is large compared to the separation between charges in the dipole. [2+6]
4. Define Relaxation Time Constant and derive an expression for the continuity equation. [3+4]
5. Derive the equations for magnetic field intensity for infinite long coaxial transmission line carrying direct current I and return current -I in positive and negative Z-direction respectively. [7]
6. A current carrying square loop with vertices A(0,–2,2), B(0,2,2), C(0,2,–2) D(0,–2,–2) is carrying a dc current of 20A in the direction along A-B-C-D-A. Find magnetic field intensity $\vec{H}$ at centre of the current carrying loop. [6]
7. Elaborate the significance of a curl of a vector field. [3]
8. Derive the expressions for the electric field $\vec{E}$ and magnetic field $\vec{H}$ for the wave propagation in free space. [8]
9. The phasor component of electric field intensity in free space is given by $\vec{E}_s = (100\angle 45°)e^{-j50z}\,\vec{a}_x$ v/m. Determine frequency of the wave, wave impedance, $\vec{H}_s$, and magnitude of $\vec{E}$ at z = 10mm, t = 20ps. [2+2+2+2]
10. Write short notes on: (a) Loss tangent (b) Skin depth and (c) Displacement current density. [2+2+2]
11. Explain impedance matching using both quarter wave transformer and single stub methods. [3+3]
12. Explain in brief the modes supported by rectangular waveguides. Consider a rectangular waveguide with $\varepsilon_r = 2$, $\mu = \mu_0$ with dimensions a = 1.07cm, b = 0.43cm. Find the cut off frequency for TM_{11} mode and the dominant mode. [4+2+2]
13. Define antenna and list different types of antenna. [2]

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Divergence

Cartesian: $\nabla.\overline{A} = \frac{\partial A_x}{\partial x} + \frac{\partial A_y}{\partial y} + \frac{\partial A_z}{\partial z}$

Cylindrical: $\nabla.\overline{A} = \frac{1}{r}\frac{\partial}{\partial r}(rA_r) + \frac{1}{r}\frac{\partial A_\phi}{\partial \phi} + \frac{\partial A_z}{\partial z}$

Spherical: $\nabla.\overline{A} = \frac{1}{R^2}\frac{\partial}{\partial R}(R^2 A_R) + \frac{1}{R\sin\theta}\frac{\partial}{\partial \theta}(A_\theta \sin\theta) + \frac{1}{R\sin\theta}\frac{\partial A_\phi}{\partial \phi}$

Gradient

Cartesian: $\nabla A = \frac{\partial A}{\partial x}\hat{a}_x + \frac{\partial A}{\partial y}\hat{a}_y + \frac{\partial A}{\partial z}\hat{a}_z$

Cylindrical: $\nabla A = \frac{\partial A}{\partial r}\hat{a}_r + \frac{1}{r}\frac{\partial A}{\partial \phi}\hat{a}_\phi + \frac{\partial A}{\partial z}\hat{a}_z$

Spherical: $\nabla A = \frac{\partial A}{\partial R}\hat{a}_R + \frac{1}{R}\frac{\partial A}{\partial \theta}\hat{a}_\theta + \frac{1}{R\sin\theta}\frac{\partial A}{\partial \phi}\hat{a}_\phi$

Curl

Cartesian: $\nabla \times \overline{A} = (\frac{\partial A_z}{\partial y} - \frac{\partial A_y}{\partial z})\hat{a}_x + (\frac{\partial A_x}{\partial z} - \frac{\partial A_z}{\partial x})\hat{a}_y + (\frac{\partial A_y}{\partial x} - \frac{\partial A_x}{\partial y})\hat{a}_z$

Cylindrical: $\nabla \times \overline{A} = (\frac{1}{r}\frac{\partial A_z}{\partial \phi} - \frac{\partial A_\phi}{\partial z})\hat{a}_r + (\frac{\partial A_r}{\partial z} - \frac{\partial A_z}{\partial r})\hat{a}_\phi + \frac{1}{r}(\frac{\partial}{\partial r}(rA_\phi) - \frac{\partial A_r}{\partial \phi})\hat{a}_z$

Spherical:

$\nabla \times \overline{A} = \frac{1}{R\sin\theta}(\frac{\partial}{\partial \theta}(A_\phi \sin\theta) - \frac{\partial A_\theta}{\partial \phi})\hat{a}_R + \frac{1}{R}(\frac{1}{\sin\theta}\frac{\partial A_R}{\partial \phi} - \frac{\partial}{\partial R}(RA_\phi))\hat{a}_\theta + \frac{1}{R}(\frac{\partial}{\partial R}(RA_\theta) - \frac{\partial A_R}{\partial \theta})\hat{a}_\phi$

Laplacian

Cartesian: $\nabla^2 A = \frac{\partial^2 A}{\partial x^2} + \frac{\partial^2 A}{\partial y^2} + \frac{\partial^2 A}{\partial z^2}$

Cylindrical: $\nabla^2 A = \frac{1}{r}\frac{\partial}{\partial r}(r\frac{\partial A}{\partial r}) + \frac{1}{r^2}\frac{\partial^2 A}{\partial \phi^2} + \frac{\partial^2 A}{\partial z^2}$

Spherical: $\nabla^2 A = \frac{1}{R^2}\frac{\partial}{\partial R}(R^2\frac{\partial A}{\partial R}) + \frac{1}{R^2\sin\theta}\frac{\partial}{\partial \theta}(\sin\theta\frac{\partial A}{\partial \theta}) + \frac{1}{R^2\sin^2\theta}\frac{\partial^2 A}{\partial \phi^2}$

TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division

2079 Bhadra

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

Subject: - Object Oriented Programming *(CT 501)*

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

1. Explain the basic concept of Object Oriented Programming. Compare C with C++. [4+4]
2. Define namespace in C++. What are conditions where inline function may not work? Write a program with function that takes two arguments as reference and assign the average of the two arguments to the greater one and return that by reference. Call this function by assigning value to the function and display the value of both argument. What will be the output? [2+2+4]
3. What do you mean by "this" pointer? Create a class with a constructor and a Destructor and show the operation or working of constructors and destructor using appropriate blocks. [2+6]
4. What are friend class and friend function? WAP to add private data of two different classes using non-member function. [2+6]
5. List down the operators that cannot be overloaded in C++. Explain how a class type (user-defined type) of data can be converted to a basic data (in-built data) type? Write a program to compare two amount in Rupee by overloading greater than (>) operator using the concept of operator overloading. [1+2+5]
6. What is the difference between private and protected access specifier? Explain multi-path inheritance with a suitable example. [2+6]
7. What do you mean by polymorphic class? What are different RTTI mechanisms in C++? Write a program that shows the use of pure virtual function. [2+2+4]
8. What are the advantages of Random access over sequential access of file? Write a program for transaction processing that write and read object randomly to and from a random access file so that user can add and display the account information (account number, last name, firstname, total balance) [2+6]
9. What do you mean by templates? Write down the syntax for function template and class templates. Write a program with a class template to represent array with member function to sort the array elements. [2+2+4]
10. What are the reasons to use the exception handling mechanism? Write a program to handle multiple exception in C++. [3+5]

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TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2079 Baishakh

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

Subject: - Object Oriented Programming (*CT 501*)

- ✓ Candidates are required to give their answers in 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 drawback of procedural programming and advantage of object oriented programming. With a program code differentiate between procedure oriented programming and object oriented programming. [3+5]
2. Explain the order of constructor and destructor invocation with example. When do we use static data member and static function in a class? Explain with example. [4+4]
3. Write down the brief history of C++. Compare C with C++ with example. [4+4]
4. Explain how function selection is done in function overloading? Where can enumerated data types be used in C++ programming. [5+3]
5. How do you convert one class type to another class type? Write a program to overload the relational operators(>and==)to compare two distance objects using non-member function. [3+5]
6. Explain multipath and multiple inheritances. Write a program to demonstrate example of Hierarchical inheritance. [3+5]
7. How can you eliminate member function overriding in virtual function? Consider a book shop which sells both books and video-tapes. Create a class known as media that stores the title and price of a publication. Then create two derived classes, one for storing the number of pages in a book and another for storing the playing time of tape. [2+6]
8. Explain how do you achieve random access to file? Write a program to store and retrieve 'n' records of items (item_ID, name, price, mfd_date, company) in Inventory system. [3+5]
9. What are the use of Function Template? Explain the case when all the template parameters are not used in function arguments. Write a program that illustrates the overloading of two function template. [2+2+4]
10. Explain exception along with exception handling mechanism. Write a program to demonstrate example of rethrowing exception. [3+5]

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TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2078 Bhadra

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

Subject: - Object Oriented Programming *(CT 501)*

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

1. Is Object Oriented Programming is better than Procedure Oriented Programming? If yes support with appropriate statements. Explain the features of object oriented programming in brief. [3+5]
2. Define constructor and destructor. Explain different types of constructor with suitable example. [2+6]
3. How do you compare C and C++? Explain different components (Lexical elements) of C++. [4+4]
4. How does an inline function differ from a pre-processor macro? What is the main advantage of passing argument by reference? Illustrate with a suitable program. [3+5]
5. Explain the rules of operator overloading in C++. Write a program to concatenate two user given string using the concept of operator overloading. [3+5]
6. Explain the need of virtual base class with example. Write a program to show the order of constructor invocation in multiple inheritance. [4+4]
7. Explain the need of virtual function with suitable example. How dynamic cast and typeid operators are used to achieve RTTI? [4+4]
8. Discuss about classes for file stream operator with a suitable block diagram. Write a program to write the information of students in a file. And also display their details in console. [3+5]
9. Explain how default arguments are used in template. Define class template and all of its function members with suitable example. [3+5]
10. How is exception handling better than conventional error handling? Explain how multiple exceptions are handled with a suitable example. [3+5]

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TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division

2078 Kartik

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

Subject: - Object Oriented Programming *(CT 501)*

- ✓ Candidates are required to give their answers in 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 the advantages and disadvantages are of object oriented programming? What are the features of OOP? [4+4]
2. What are the properties of Constructors? What are the differences between copy constructor and assignment operator, explain. "A friend function is not a member of any classes but has full access to the members of class where it is declared as friend", justify this statement with appropriate example. [2+2+4]
3. Explain the need of C++ language. Explain the features of C++ language. [3+4]
4. Define inline function with suitable example. Explain the usage of 'new' and 'delete' operators for dynamic memory allocation. [4+4]
5. Why do we use operator overloading in C++? List the operators that cannot be overloaded. Write a program that converts object of Celsius type to object of Fahrenheit type. [2+2+4]
6. List rules of operator overloading. Write a program to add two time objects using operator overloading. [4+6]
7. Explain virtual function with appropriate example. What do you mean by Run Time type Information? Explain. [4+4]
8. Why use file handling? Write a program in a file of student to add the record, list the record, search by roll number and delete the record. [1+8]
9. Define class templates with example. Write a program to demonstrate example of function overloading with function template and normal function. [2+5]
10. How is exception handling better than conventional error handling? Explain the exception handling mechanism in C++ with example. [3+4]

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TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division

2076 Chaitra

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

Subject: - Object Oriented Programming *(CT 501)*

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

1. What are the limitations of Procedure Oriented Programming? Explain features of C++. Write a program to multiply two complex numbers using Object Oriented Approach. [2+2+4]
2. Can we have more than one constructors in a class? If yes, explain the need for such a situation. Write a program designing a class called midpoint to find mid-point between two points by returning object from member function using this pointer. [3+5]
3. Why is namespace required? Explain how namespace is created and used in program with a suitable example. How is reference variable used for pass by reference? Explain. [1+4+3]
4. Explain how the use of default argument supports the function overloading with suitable example. Define inline function with its merits and demerits. [4+4]
5. Define operator overloading. What are the rules of operator overloading? How do you overload unary operator? Explain with example. [1+2+5]
6. What are the different forms of inheritance? Give an example for each. Write a program which contains a base class that ask the user to enter a complex number and make a derived class that adds the complex number of its own with the base. Finally make third class that is friend of derived and calculate the difference of base complex number and its own complex number. [3+5]
7. Define virtual function with suitable example. Explain how dynamic_cast and typeid operators are used to achieve RTTI. [5+3]
8. Write short notes on file access pointers and their manipulators. Write a program to make simple library management system of a college. Your program should store and retrieve the information (Book Name, Book ID, Number of books and purchase date). [3+5]
9. Briefly explain importance of function template and class template with suitable example. Write a program to create a derive class which is a template from a base class which is also a template with additional template parameters in the derived class than that of the base class. [4+4]
10. What is the advantage of having exception handling in the program? How are multiple exceptions handled? Explain about Catching all exception in exception handling mechanism. [2+3+3]

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TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2076 Ashwin

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

Subject: - Object Oriented Programming *(CT 501)*

- ✓ Candidates are required to give their answers in 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 benefits of object oriented programming over procedural language? Compare C++ with C. List out the features of C++. [4+3+3]
2. What is a constant function? What is its relation with constant object? Write a meaningful function that shows the use of constant object and constant function along with use of const cast operator. [2+2+6]
3. What do you understand by default arguments? How can you relate default argument function with function overloading? Write a program to find volume of different shapes using function overloading. [2+2+6]
4. What do you mean by operator overloading? Write down its syntax. Write a class that represent the distance class and overload ++ and -- operator to increment and decrement distance. [2+2+6]
5. Explain the need inheritance in programming? Explain various forms of inheritance. Write a program to create a derived class by inheriting two base classes with same function names. Your program should be complete and meaningful. [2+2+6]
6. What is the purpose of stream manipulation? Explain different file modes that are used in opening the file. Write a program that will copy the content from one file, change the case of letters to upper case if they are in lower case and store in next file. [2+2+6]
7. What do you mean by polymorphic class? What are different RTTI mechanisms in C++? Write a program that shows the use of pure virtual function. [2+2+6]
8. Why do we need class template? Write a program to create class to represent stack data structure and use exception handling to control empty and full cases. [3+7]

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TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2075 Chaitra

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

Subject: - Object Oriented Programming *(CT 501)*

- ✓ Candidates are required to give their answers in 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 main features of Object Oriented Programming? Would you consider it better than structured programming? If you do, what makes it better? Write down its advantages and disadvantages. [2+3+3]
2. What do mean by constructor and destructor? Explain the necessity of copy constructor with example. Also explain order of invocation of constructor and destructor with example. [2+3+3]
3. What type of language is C++? Explain its features. [2+6]
4. What is function overloading? How is pass by reference done in C++. Explain with suitable example. [2+2+4]
5. Write syntax of operator overloading. Create a class called time that has separate int member data for hours, minutes, and seconds. One constructor should initialize this data to zero (0), and another should initialize it to fixed values. A member function should display it in 10:45:30 format. The final member function should add two objects of type time passed as arguments using operator overloading. [1+7]
6. How the function over-riding differ from function overloading? When do we face ambiguity problem in multiple inheritance? Explain. [4+4]
7. What is pure virtual function? Discuss the role of virtual functions in C++ to cause dynamic polymorphism. Show with example how it is different from the compile time polymorphism. [2+2+4]
8. What are different file access pointers? Write a program to store and retrieve the information of Client(Client_ID, Account_ID, name, address and age) in Bank management system. Also calculate the total number of clients in a bank. [2+6]
9. Explain function template? How do you use function template with multiple template types? Give example. [4+4]
10. What is exception and what is the mechanism of exception handling in C++? Write a program to illustrate the process of handling multiple exceptions. [2+6]

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15 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2075 Ashwin

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

Subject: - Object Oriented Programming *(CT501)*

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

1. Why object oriented programming is necessary in Programming? With suitable example, explain the importance of object as function argument and returning object. [3+5]
2. What do you mean by constructor? Explain different types of constructors. Create a class called 'time' with data member hour, minute, second and day. Initilalize all the data member using constructor. Write a program to add two time object using necessary member functions and display the result. [1+2+5]
3. Compare C and C++. Why do we need dynamic memory management? Explain the operators in C++ that enables dynamic memory management with example. [2+2+4]
4. What is Token, write its details? With example explain function overloading in object oriented programming. [3+5]
5. Explain which operators cannot be overloaded in c++? Explain how a Class type (user-defined type) of data can be converted to a basic data (inbuilt data) type? Write a program to concatenate two user given string by overloading binary plus (+) operator. [1+2+5]
6. Explain why inheritance is important in object oriented programming? With suitable example write details on member function overriding? [3+5]
7. Explain compile-time and run-time binding. Differentiate abstract base class and concrete class. Write an abstract class of your choice and use it in a program. Your program should be meaningful. [1+2+5]
8. Sequential and random access are two methods to access a data file. Which one do you prefer and why? Write a program to show opening, reading objects from file, checking end of file and closing the file. [4+4]
9. Why template is important in C++ programming? Write a program using template to add two numbers. Use the function template to pass integer, float and double. Display the returned result. [3+5]
10. How is exception handling mechanism better than traditional error handling? Explain how the exception is rethrown with a suitable program. [3+5]

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15 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2074 Chaitra

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

Subject: - Object Oriented Programming *(CT501)*

- ✓ Candidates are required to give their answers in 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 advantages of object oriented programming over procedural programming language? Explain the features of object oriented programming. Write a simple program that illustrates the object oriented concept. [2+3+3]
2. Why do we need friend function? Explain how any member function of a class can be friend of other class with a suitable example. [2+6]
3. Explain the features of C^{++}.What is namespace? Explain how memory is allocated and deleted dynamically for normal variable and for array in C^{++} with example program. [2+1+5]
4. Explain why default arguments are used with functions. How can a function with default argument be implemented with function overloading? Explain with example. [3+5]
5. Define operator overloading. Write operator functions as member function of a class to overload arithmetic operator +, logical operator '<=' and stream operator '<<' to operate on the objects of user defined type time (hr, min, sec). [1+7]
6. What is Ambiguity and function Overriding? How they can be resolved? Explain each with a suitable example. [4+4]
7. What is pure virtual function and abstract class? With suitable example explain run time polymorphism. [3+5]
8. Discuss about stream class hierarchy. How a file can be open in C++. Explain with suitable example and syntax. Write a program to write the Information of 10 employee in a file. And also display their details in console. [2+2+4]
9. Explain why do we need template. Explain the function template overloading with suitable example. [3+5]
10. Explain about all Exception Handling constructs. With suitable example explain multiple exceptions handling in C++. [3+5]

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25 TRIBHUVAN UNIVERSITY

INSTITUTE OF ENGINEERING

Examination Control Division

2074 Ashwin

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

Subject: - Object Oriented Programming *(CT501)*

- ✓ Candidates are required to give their answers in 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 advantages of object oriented programming over procedural programming? Describe the characteristics of OOP. [4+6]
2. Explain how the use of default argument supports the function overloading with suitable example. Define namespace with its significance. [5+5]
3. Explain the relation between constant object and constant function with example. When do we use static data member and static function in a class? Exemplify. [5+5]
4. How do you convert user-defined data type to a basic data type? Write a program to overload the relational operators to compare the length (in meter and centimeter) of two objects. [4+6]
5. How the function over-riding differ from function overloading? Explain. Write a program to show the order of constructor invocation in multilevel inheritance. [5+5]
6. Explain abstract class with example. Explain how dynamic cast and typeid operators are used to achieve RTTI. [5+5]
7. What are different ios functions used in stream I/O?How they are different from manipulators? Write a program to store and retrieve the information of patient (Patient_ID, name, address, age and type)in hospital management system. [3+2+5]
8. How do you use class template with multiple template type? How the exception is re-thrown during exception handling? [5+5]

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25 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2073 Chaitra

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

Subject: - Object Oriented Programming *(CT501)*

- ✓ Candidates are required to give their answers in 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 advantages and disadvantages of object oriented programming over procedural programming? Briefly describe the features of C++. [5+5]
2. Define dynamic memory allocation. How do you use it in C++? Explain reference variable with suitable example. Write a program to swap two numbers using pass by reference concept. [1+2+3+4]
3. Define 'this' pointer with its applications. Explain the order in which constructor and destructor are invoked with suitable example. [5+5]
4. Define operator overloading. What are the rules of operator overloading? How do you overload unary operator? Explain in detail with example. [1+2+7]
5. What is function over-riding? How scope resolution is used with over ridden function? Explain the need of virtual base class with suitable example. [2+3+5]
6. Write short notes on the access pointer and their manipulators. Write a program to make simple library management system of a college. Your program should store and retrieve the information (Book Name, Book ID, Number of books and purchase date). [4+6]
7. Explain the need of virtual function with suitable example. Define runtime type information (RTTI). How dynamic cast and typeid operators are used to achieve RTTI? [4+2+4]
8. Explain how default arguments are used with class template with example. How do you throw only specified exception from a function? Exemplify. [5+5]

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22 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2073 Shrawan

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

Subject: - Object Oriented Programming *(CT501)*

- ✓ Candidates are required to give their answers in 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 characteristics of OOP. Write a program to create class "time" with data members hours, minute and second. Then add two "time" objects by taking object as argument and also returning object as argument. [4+6]
2. Why don't you use an object to call the Static Member Function, explain with example? Why do you need to use a reference in the argument to the copy constructor? Write a program to calculate the Perimeter of Triangle using Default and Parameterized constructors. [4+3+3]
3. When inline function may not work? What do you understand by Default Arguments? Write syntax of Default Arguments. Write a program to display N number of characters by using default arguments for both parameters. Assume that the function takes two arguments one character to be printed and other number of characters to be printed. [2+2+2+4]
4. Explain the syntax of operator overloading. Create a class named City that will have two member variables CityName (chart[20]) and DistFromKtm (float). Add member functions to set and retrieve the CityName and DistFromKtm separetely. Add operator overloading to find the distance between the cities (just find the difference of DistFromKtm) and sum of distance of those cities form Kathmandu. In the main function, initialise three city objects. Set the first and second city to be Pokhara and Dhangadi. Display the sum of DistFromKtm of pokhara and Dhangadi and distance between pokhara and Dhangadi. [3+7]
5. What do you mean by function overriding and how can we access every overridden function from the derived class object? Explain with example. Write a program to show the execution order of constructor and destructor in multilevel inheritance. Show your program outputs. [5+5]
6. What are the different ios class functions and flags that are used for formatted I/O operation? Write a program to read and write the information of 10 students in a file. Also modify the student information according to the given roll number. [3+7]
7. What do you mean by Class Template and Function Template? Write down the syntax of Class Template and Function Template. Write a program to read your Date of Birth and display it. Your program should throw multiple exception for day, month and other values not in range using exception class and each exception is handled by separate handler. [2+2+6]
8. Explain different manipulator available in C++. Create class student to store Name, Age and CRN of students. Write a program to write records of N numbers of students into the file. And your program should search complete information of students from file according to CRN entered by user and display it. [4+6]

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25 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2072 Chaitra

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

Subject: - Object Oriented Programming *(CT501)*

- ✓ Candidates are required to give their answers in 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 main characteristics of Object Oriented Programming. Write a program to find the transpose of given Matrix using the concept of Object Oriented Programming. [5+5]
2. Define constructor. Why constructor is needed for a class? Explain about different types of constructor with a suitable program. [1+2+7]
3. Write down the significance of reference variable with suitable example. Define default argument. Write a program to show the relation between default argument and function overloading. [4+2+4]
4. Why do we need operator overloading? What are the non-over loadable operators in C++? Write a program that will convert object from a class Rectangle to object of a class Polar using Casting Operator. [2+2+6]
5. Explain the need of virtual base class with suitable example. Create a derived class manager from two base classes person and employee. Assume suitable data members in each class and display the information. [5+5]
6. Explain about stream class hierarchy by highlighting the different ios flags and their usage. Write a program to make billing system of a department store. Your program should store and retrieve data to/from files. Use manipulators to display the record in proper formats. [3+7]
7. Why do you need Virtual Destructor? Explain with example. Write a program having Polygon as an abstract class with Length and Height as its data member. Create derived class Rectangle and Triangle. Make Area () as pure virtual function and redefined it in derived class to calculate respective area. [4+6]
8. Define function template and class template with respective syntax. Write a program to find the square root of given number. Check the validity of input number and raise the exception as per requirement. [5+5]

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25 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2072 Kartik

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

Subject: - Object Oriented Programming *(CT501)*

- ✓ Candidates are required to give their answers in 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 data abstraction? Compare it with encapsulation in C^{++}. With suitable example, explain the concept of class in C^{++}. [2+2+6]
2. What is the advantage of C^{++} over C? With suitable example explain dynamic memory allocation for object and object array. [4+6]
3. What is a default argument? What are the advantages and disadvantages of using inline function? Write a program to calculate and display the cube of integer, float and double number using function overloading (passing single argument to function). [4+3+3]
4. Write down syntax of operator overloading for various cases. Develop a program using a class to with 3×3 matrix as a data member. Overload the * operators so as multiply two matrices. [3+7]
5. What is difference between overloading and overriding? With suitable example explain hybrid inheritance. [4+6]
6. Discuss about stream class hierarchy. Write a program for transaction processing that write and read object randomly to and from a random access file so that user can add, update, delete and display the account information (accountnumber, lastname, firstname, totalbalance). [3+7]
7. Explain the reason for member function over-riding when using virtual function. Explain RTTI using dynamic cast and typeid operators with suitable example. [5+5]
8. Explain class template with suitable example. How do you handle multiple exceptions in C^{++}? Explain with example. [5+5]

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22 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2071 Shawan

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

Subject: - Object Oriented Programming *(CT501)*

- ✓ Candidates are required to give their answers in 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 Object Oriented Programming? What are the drawbacks of Procedure Oriented Programming? List down the features of C++. Write a program with a class to represent distance with fect and inches members . The class should have member functions to read and display the data members and member functions to add and subtract two distances. [1+2+2+5]
2. What do you mean by namespace and what is its use? Explain about returning a variable from a function by reference with an example. Explain about function overloading with an example. [2+4+4]
3. How do you dynamically allocate objects and object arrays in C++? Explain about constant member function and constant object with an example. Write a meaningful program to illustrate the use of copy constructor and destructor. [1+4+5]
4. List the operators that cannot be overloaded in C++. Explain about explicit constructor with an example. Write a program having a class to represent money. The class should have two integer members to represent rupees and paisa. Overload + and – operators for adding and subtracting the objects. Then, overload >, <, == and != operators for comparing the objects. [1+3+6]
5. What do you understand by protected access specifier? Explain about the different forms of inheritance. Define a class named Course. Derive three classes from this class named: Mathematics, Science and Engineering. Then, derive two classes from Science named: Physics and Chemistry. Define data members and member functions as appropriate. Illustrate the concept of member function overriding and accessing overridden member from the derived class in your program. [1+3+6]
6. List any four formatting flags of ios class with their usage. Explain with an example how a non-parameterized user-defined manipulator can be defined. Write a program for managing a simple library database. The information to be stored in the database are book id, book name, borrower's id, borrower's name, issue date and due date. Your program should have features to add a record, display all the records and display a set of records corresponding to a particular borrower's id or a particular borrower's name. [1+3+6]
7. What are pure virtual function and abstract class? How is dynamic_cast used? Write a meaningful program to illustrate overloading of a function template with both a normal function and a function template. [2+3+5]
8. What are class templates? What do you understand by rethrowing an exception and catching all the exception? Define a class to represent time. It should have a member function to read time from the user and a member function to display the time. The function to read time must raise an exception if the user enters invalid values for hours, minutes or seconds. The exception thrown should contain arguments. The exception should be handled outside of the member function of the class. [1+4+5]

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22 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2070 Chaitra

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

Subject: - Object Oriented Programming *(CT501)*

- ✓ Candidates are required to give their answers in 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 benefits of object oriented programming over procedure oriented programming? Describe the features of object oriented programming. What is the task of *const* keyboard? [4+4+2]
2. List the feature of C^{++}. What are constructors, write their use and explain using an example. [4+6]
3. What is dynamic memory allocation? Write a C^{++} program to join two strings using dynamic constructor concept. [3+7]
4. What is the disadvantage of using operator overloading in C++? Write a program to define a Class Distance with necessary data members and functions. Then overload the relational operators to compare the two objects of Distance class. [2+8]
5. What is a protected access specifier? Write a program with three classes students, test and result by using multilevel inheritance. Assume necessary data members and functions yourself and program with input information, input data and calculate marks total and display result. [3+7]
6. List the features that are used in formatting the output. Explain each with example. [10]
7. Why do we need virtual function? Explain with suitable example. What is pure virtual function? What is the task of reinterpret cast operator? [6+2+2]
8. Explain the importance of function template with suitable example. How default arguments can be used in class template? What are the tasks of try, catch and throw block? [4+3+3]

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23 TRIBHUVAN UNIVERSITY

INSTITUTE OF ENGINEERING

Examination Control Division

2070 Ashad

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

Subject: - Object Oriented Programming *(CT501)*

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

1. Write down the limitations of procedural programming. Compare procedural and object oriented programming. Write program to find prime number in procedural and object oriented ways. [2+2+6]

2. What do you understand by friend functions and classes? Explain with example. Write a program to add members of objects of two different classes. [4+6]

3. What do you mean by namespace? Explain how namespace can be used. Write a program that uses pass by reference to change meter to centimeter using pass by reference along with the namespace. [2+2+6]

4. Explain the binary and unary operator overloading along with their syntax and example. Write a program to add two matrices by overloading the + operator. [4+6]

5. Explain the constructor and destructor invocation order in single and multiple inheritance. Also show how a parameterized base class constructor is called when derived class object are created. Write a program to create classes to represent student, teaching staffs and non-teaching staffs from the base class person. Use proper members in the classes to make your program meaningful. [4+6]

6. What do you mean by manipulators? Explain different manipulators available in C++. Write a program that stores information of a students in a file and display the file's content in descending order according to their marks obtained. [1+3+6]

7. What are virtual functions and pure virtual functions? Explain abstract class and its use. Write a program having student as an abstract class and create derived class such as Engineering, Science and Medical. Show the use of virtual functions in this program. [2+2+6]

8. What do you understand by function template? Write down the syntax and use of function template. Write a program that will find the sum and average of elements in an array using function templates. [2+2+6]

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23 TRIBHUVAN UNIVERSITY

INSTITUTE OF ENGINEERING

Examination Control Division

2070 Ashad

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

Subject: - Object Oriented Programming *(CT501)*

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

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8. What do you understand by function template? Write down the syntax and use of function template. Write a program that will find the sum and average of elements in an array using function templates. [2+2+6]

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23 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2069 Chaitra

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

Subject: - Object Oriented Programming *(CT501)*

- ✓ Candidates are required to give their answers in 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 characteristics of OOP? How does the OOP differ from POP? Using object oriented technique, write a program to create a class vector that reads integer number. Perform vector addition by passing object as argument and returns the object as result. A vector is a class with array as member. [3+2+5]
2. What is the significance of using inline function? Describe with suitable example. What do you mean by default argument? How can you relate default argument with function overloading? Describe with suitable example. [4+2+4]
3. Define constructor and destructor. Write down different types of constructors with syntax. Create a class mdistance to store the values in meter and centimeter and class edistance to store values in feet and inches. Perform addition of object of mdistance and object of edistance by using friend function. [2+2+6]
4. Why do we need operator overloading? How can you overload operators using member function and non member function? Write a program to overload relational operators (==, !=, >, <, >=, <=) to compare complex numbers. [2+3+5]
5. How do different types of derivation affect the members of class? Write down the types of inheritance. What kind of problem is encountered in multipath inheritance? Write down its solution with suitable example. [2+2+2 +4]
6. Write down the different techniques for formatting I/O stream with example. Explain the different errors encountered during file operation. [5+5]
7. Explain the need of virtual function with suitable example. What do you mean by run -time type information (RTTI)? How dynamic cast and typeid operators are used to achieve RTTI? [5+2+3]
8. Define class template and function template with respective syntax. What are the different exception handling techniques in C++? Explain with appropriate example. [5+2+3]

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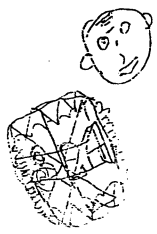

23 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2068 Baishakh

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

Subject: - Object Oriented Programming

- ✓ Candidates are required to give their answers in 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 C and C++. Write down different features of C++ with example for each. [5+5]
2. What do you understand by the static data member and member functions? Explain their use in the program. Write a program that uses static member functions and static data member. [2+2+6]
3. What do you understand by default arguments? Replace the function with default argument with function overloading. Write a program to find the area of triangle (when three sides are given) and area of rectangle using function overloading and default argument. [2+2+6]
4. What are the overloadable operators in C++? Write down the syntax for operator overloading in different cases. Write a program to compare the magnitude of complex numbers by overloading <,> and == operators [2+2+6]
5. Explain different types of access specifiers used in inheritance. Explain the case of ambiguity in inheritance. Write a program that shows ambiguity in multiple inheritance. [2+2+6]
6. What do you mean by stream? Explain different stream class for file input/output. Write a program to display the output in pyramid from as follows: [2+2+6]

A
AB
ABC
ABCD

7. What do you mean by polymorphic class? What are different RTTI mechanisms in C++? Write a program that shows both RTTI mechanisms. [2+2+6]
8. What do you mean by templates? Write down the syntax for function template and class templates. Write a program with a class template to represent array and add member functions to find maximum, minimum and sort the generic array. [2+2+6]

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TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2079 Bhadra

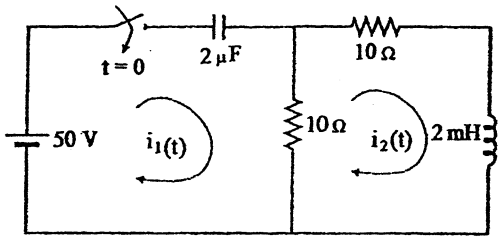
Exam.	Regular		
Level	BE	Full Marks	80
Programme	BEL, BEX, BCT	Pass Marks	32
Year / Part	II / I	Time	3 hrs.

Subject: - Electric Circuit Theory *(EE 501)*

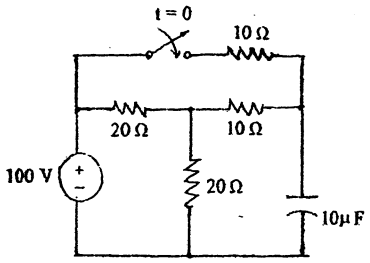
- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt <u>All</u> questions.*
- ✓ *The figures in the margin indicate <u>Full Marks</u>.*
- ✓ *Assume suitable data if necessary.*

1. a) What do you mean by resonance in RLC series circuit? Define half power frequencies and bandwidth in RLC series circuit and obtain expression for them. [4+4]

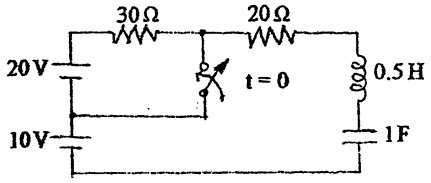
   b) For the circuit shown in the figure below, find i_1, i_2, $\frac{di_1}{dt}$, $\frac{di_2}{dt}$ and $\frac{d^2 i_2}{dt^2}$ at $t = 0^+$. [8]



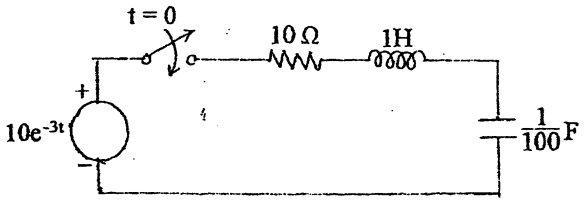
2. a) Using classical method, find current and voltage across capacitor for $t > 0$ in the circuit shown below. [8]



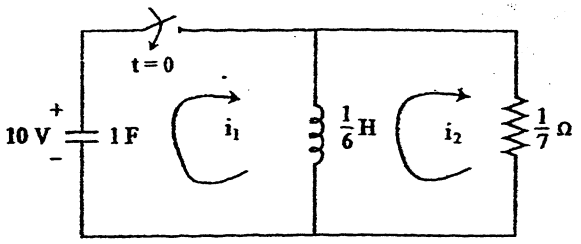
   b) If the switch is closed at $t = 0$, find the expression of current through inductor for $t > 0$. Also calculate the voltage across inductor after 10 ms using classical method. [8]



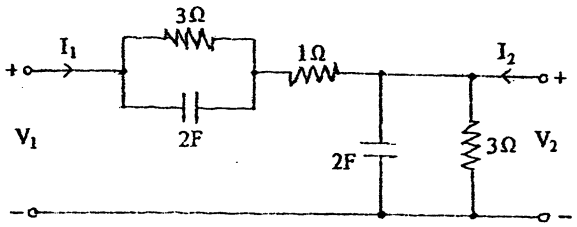
3. a) Using Laplace Transform method find the expression of current and voltage across inductor if the switch is closed at $t = 0$. [8]



b) Using Laplace transform method, find the loop currents i_1 and i_2 for $t > 0$ in the circuit shown in the following figure. [8]



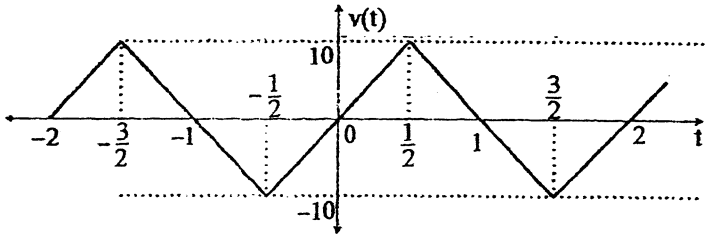
4. a) Find the voltage ratio transfer function of given TPN. [8]



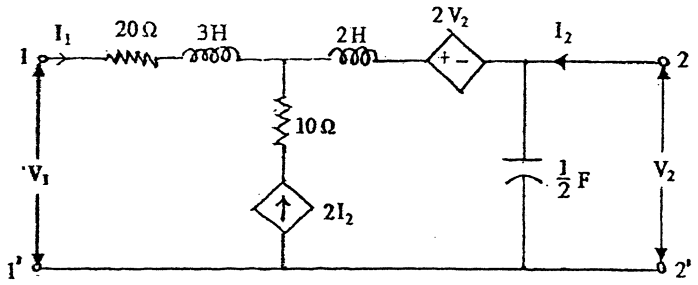
b) For the transfer function below, draw the asymptotic Bode plot. [8]

$$G(s) = \frac{50(s+10)}{s(s+20)(s^2+2s+225)}$$

5. a) Obtain trigonometric Fourier series of voltage waveform shown in figure below and plot the line spectra. [8]



b) Calculate [Y] and [g] parameters of the given circuit and also check whether the network reciprocity and symmetry. [8]



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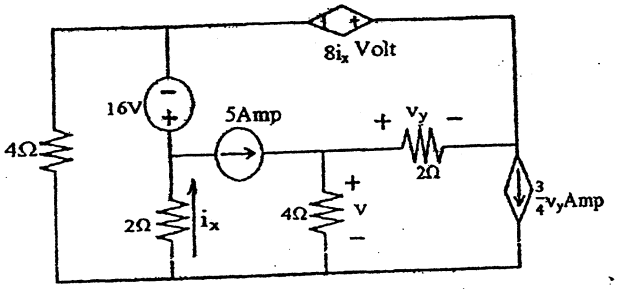
TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2079 Baishakh

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

Subject: - Electric Circuit Theory (*EE 501*)

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

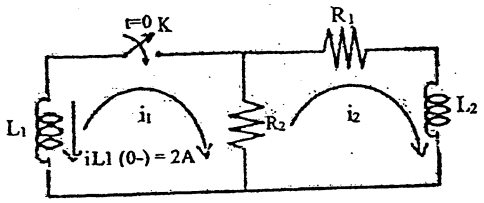
1. a) In the circuit shown in figure below, find the value of "v", using node voltage method. [8]



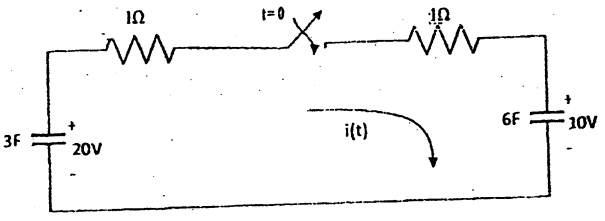
b) In the given network of figure below, inductor L_1 is energized and the switch K is closed at t = 0. When each element has following values.

$R_1 = 10k\Omega$, $R_2 = 5k\Omega$, $L_1 = 2mH$, $L_2 = 6mH$, solve for $i_1, i_2, \frac{di_1}{dt}, \frac{di_2}{dt}$,

$\frac{d^2i_1}{dt^2}, \frac{d^2i_2}{dt^2}$ at $t = 0^+$. [8]

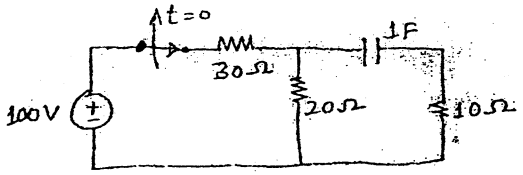


2. a) Solve for i (t) in circuit as shown in figure below in which 3F capacitor is initially charged to 20 volts, 6F capacitor to 10 volts and the switch is closed at t=0. Use classical method. [8]

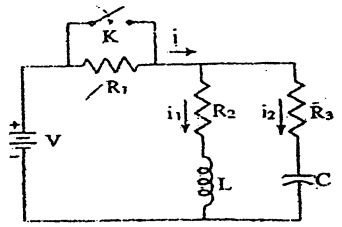


b) An exponential current $i(t) = 20\,e^{-5t}$ Amp is suddenly applied at time t = 0 to a parallel RLC circuit comprising of resistor R = 1/10Ω, inductor L = 10mH and capacitor C = 2.5μF. Obtain the complete particular solution for voltage v(t) across the network, by classical method. Assume zero initial current through inductor and zero initial charge across the capacitor before application of the current. [8]

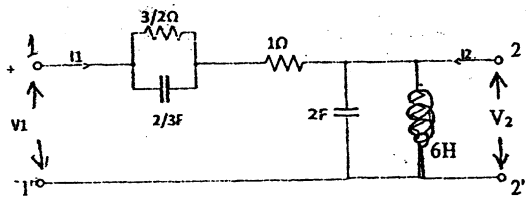
3. a) The circuit below is in the steady state with the switch S closed. The switch is opened at t = 0. Determine the current through capacitor for t > 0 using Laplace's Transform method. [8]



b) In the network shown below, a steady state is reached with the switch K open with V = 100V, R_1 = 10Ω, R_2 = 20Ω, R_3 = 20Ω, L = 1H, and C = 1μF. At time t = 0, the switch is closed. i) Write integrodifferential equation for the network after switch is closed. ii) Evaluate the currents i_1 and i_2, using Laplace transform, for t > 0. [8]



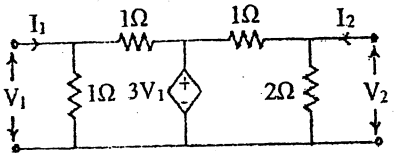
4. a) Find the voltage ratio transfer function of the two port network shown in figure below, if port 2 is terminated with 2H inductor. [8]



b) Define frequency response and explain how frequency response of a system can be obtained. Draw the Bode plot of following transfer function. [8]

$$G(s) = \frac{1}{s(1+0.5s)(1+0.05s)}$$

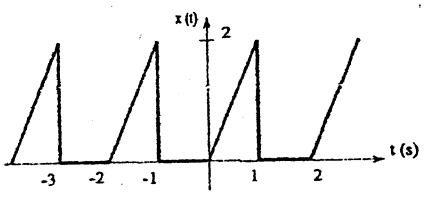
5. a) Find y and g parameters of the network shown in the figure below. Also check its symmetricity and reciprocity. [6]



b) Show that:

The overall ABCD parameter network matrix for cascaded network is the matrix product of a ABCD matrices of individual network. [4]

c) Find the trigonometric fourier series for the waveform shown in figure below. [6]



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2078 Bhadra

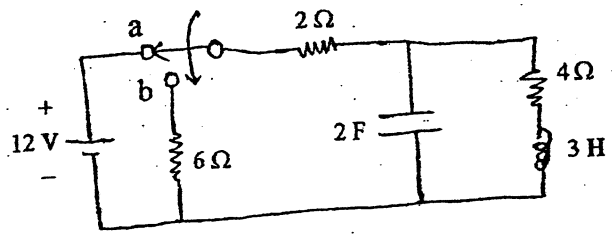
Exam.	Regular		
Level	BE	Full Marks	80
Programme	BEI, BEX, BCT	Pass Marks	32
Year / Part	II / I	Time	3 hrs.

Subject: - Electric Circuit Theory *(EE 501)*

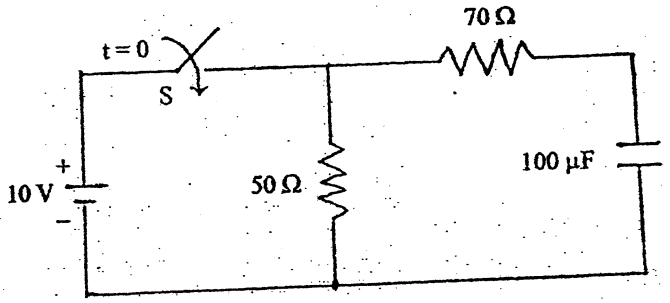
- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ ***Semi-log graph paper is to be provided.***
- ✓ *Assume suitable data if necessary.*

1. a) Explain the phenomenon of resonance in a practical parallel resonant circuit and hence obtain the expression for resonant frequency. How does it differ from an ideal circuit? [8]

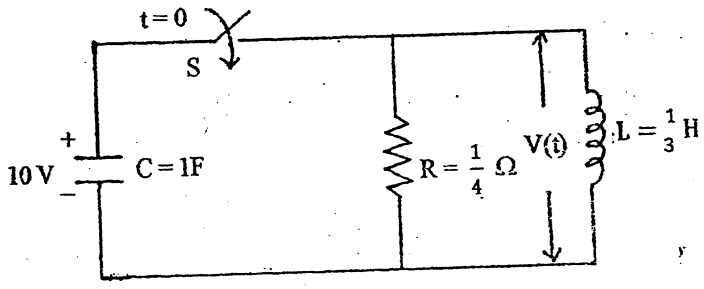
   b) At t = 0 switch changes its position from a to b. Find current and voltage of each element at $t = 0^+$. Also find the initial value of first order derivatives of inductor voltage and inductor current. [8]



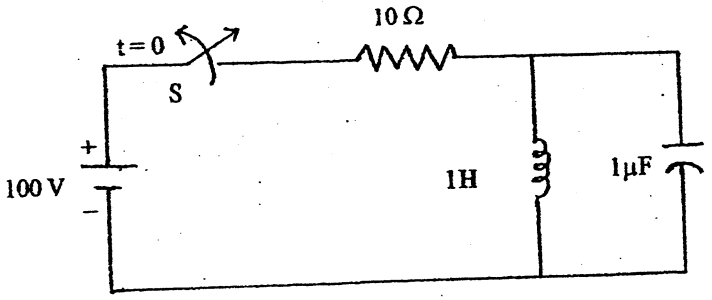
2. a) In the circuit shown in figure below, if the switch is closed at t = 0, find the time when the current from the battery reaches to 500 mA. Use classical method. [8]



   b) In the circuit shown in figure below, capacitor C has an initial voltage $V_c = 10$ volts and at the same instant, current through inductor L is zero. The switch S is closed at time t = 0. Find out the expression for the voltage v(t) across the inductor L using classical method. [8]

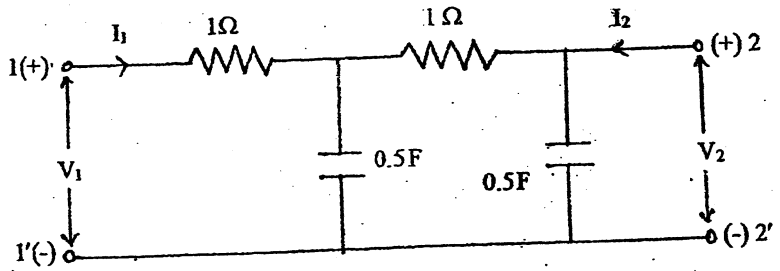


3. a) Using Laplace transform method find the current through the inductor in the network shown in figure below. [8]

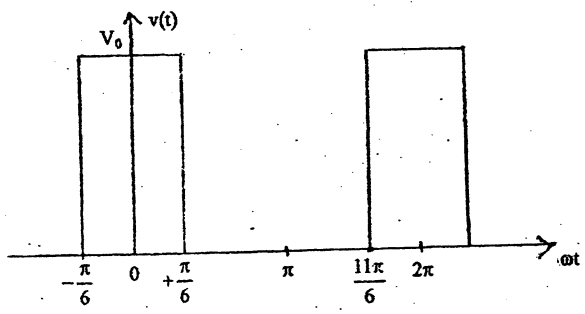


b) A RLC series circuit with R = 4Ω, L = 1H and C = 1/3 F is excited by an exponential source of $20e^{-3t}$. Find the expression of the current in the circuit for t = 0 using Laplace Transform. [8]

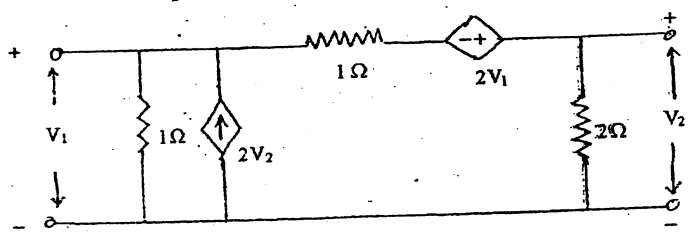
4. a) For the given two port network, determine the driving point impedance and voltage ratio transfer function. [8]



b) Find the trigonometric Fourier series for the rectangular pulse as shown in the following figure. [8]



5. a) Determine the Z and Y parameters of the two port network shown below. [8]



b) For the transfer function below, draw the asymptotic Bode plot. [8]

$$G(S) = \frac{20(s+2)}{s(s+5)(s^2+4s+16)}$$

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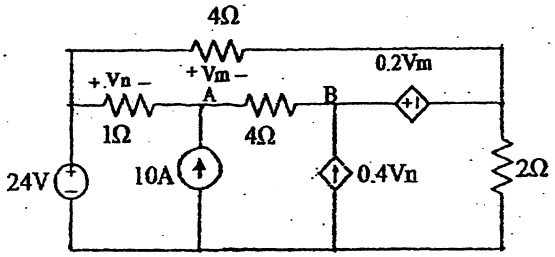
2078 Kartik

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

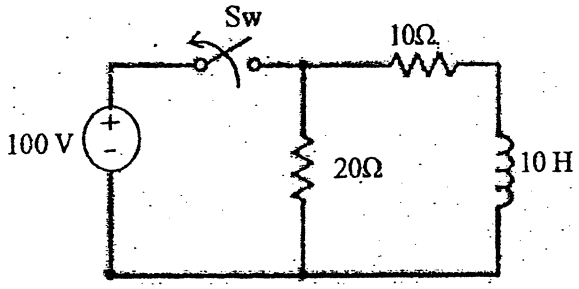
Subject: - Electric Circuit Theory *(EE 501)*

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

1. a) Using nodal analysis, determine the current through 4Ω resistor connected between terminals A and B for the network of following figure. [8]



b) In the circuit shown below, the inductor is suddenly disconnected from the dc supply. Find (i) the initial rate of change of current just after switching (ii) initial voltage across 20Ω (iii) the voltage across the switch at the instant of separation of contacts. [8]

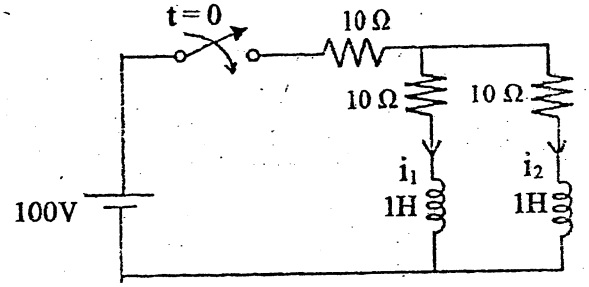


2. a) In a series R-L circuit with R = 1 Ω and L = 1H, the voltage source follows the law $v(t) = Ve^{-\alpha t}$, where α is a constant. The switch is closed at t = 0. [8]

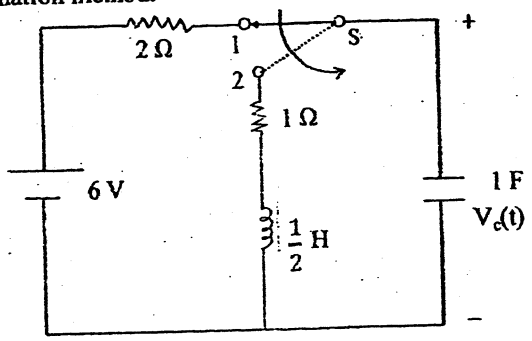
(i) Solve for the current assuming that $\alpha \neq \frac{R}{L}$ and

(ii) Solve for the current when $\alpha = \frac{R}{L}$ using classical method.

b) In the network shown, the switch is closed at t = 0, with the network previously unenergised. For the element values shown on the diagram, find $i_1(t)$ and $i_2(t)$ by classical method for t > 0. [8]

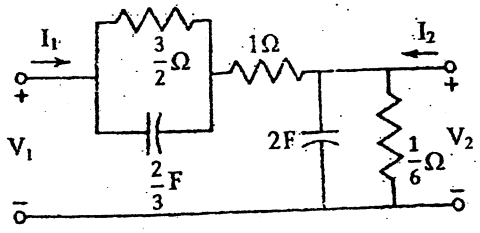


3. a) In the circuit shown in figure below, a switch S is in the position 1 for a long time and moved to position 2 at t = 0. Find the voltage across the capacitor for t > 0. Use Laplace Transformation method. [8]



b) A sinusoidal voltage v(t) = 40 sin (10^6t + π/4) is suddenly applied at time t = 0 to series RC circuit comprising of resistor R = 2Ω and Capacitor C = ¼ F. Obtain the complete particular solution for current through the circuit, by Laplace's Transform method. Assume 3C charge across the capacitor before switching. [8]

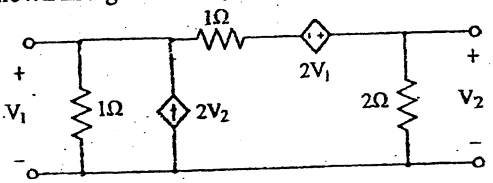
4. a) Find the voltage ratio transfer function of the two port network shown in figure below. If the port 2 is terminated with 2H inductor. Find Z_{11}, α_{21}, Y_{12}. [8]



b) Draw the bode log-magnitude and phase plots for the following system [8]

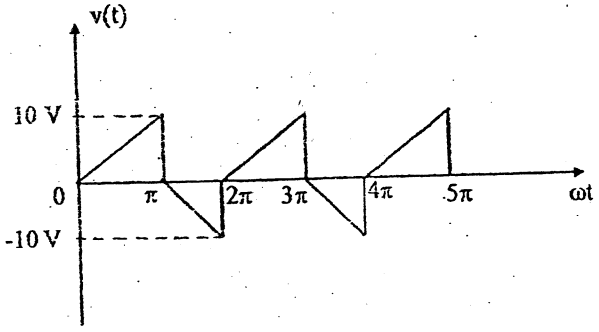
$$G(S) = \frac{s+3}{s(s+1)(s+2)}$$

5. a) For the network shown in figure below, determine Y parameter and T-parameter. [8]



b) Derive the condition for reciprocity in term of inverse transmission parameter in a TPN. [4]

c) Find the trigonometric Fourier Series of the waveform shown in figure below. Also plot the line spectra. [4]



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2076 Chaitra

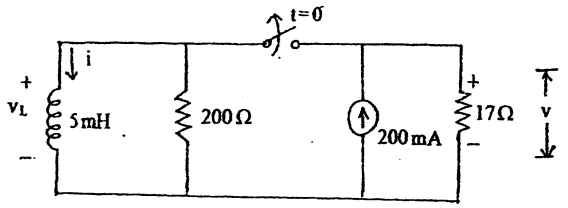
Exam.	Regular		
Level	BE	Full Marks	80
Programme	BEL, BEX, BCT	Pass Marks	32
Year / Part	II / I	Time	3 hrs.

Subject: - Electric Circuit Theory *(EE 501)*

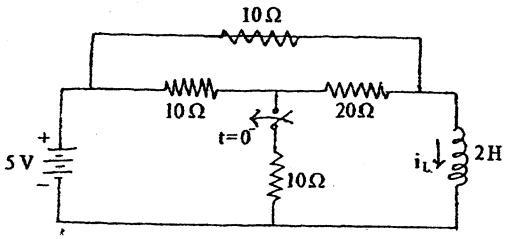
- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ ***Semi-log graph paper is to be provided.***
- ✓ *Assume suitable data if necessary.*

1. a) Explain the phenomenon of resonance in RLC parallel circuit. Also derive the expression for resonance frequency and draw the wave form of instantaneous voltage and current at resonance. [8]

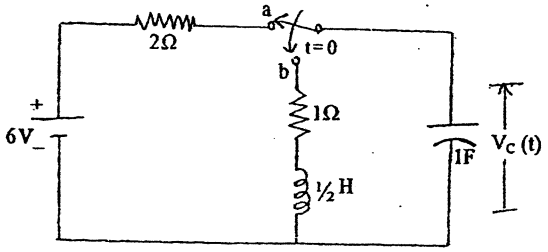
   b) In the circuit shown below, the switch has been closed for a long time and at t = 0 it is opened, determine (i) $i(0^+)$ (ii) $v(0^+)$ (iii) $v_L(0^+)$ and (iv) I and v at t = 20μs. [8]



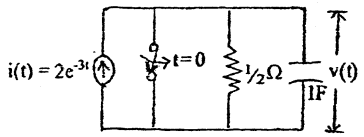
2. a) In the network given below, the switch K is open and the network reaches a steady state. At t = 0, switch K is closed. Find the current in the inductor for t > 0 using classical method. [8]



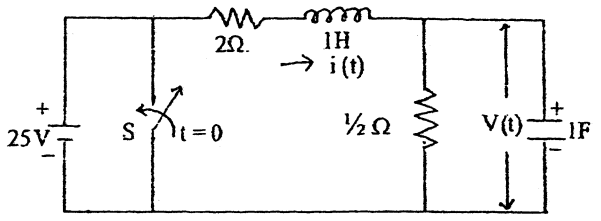
   b) Use Laplace transform approach to find the voltage across the capacitor $V_C(t)$ for t > 0 when the switch is moved to position 'b' at t = 0 which was in position 'a' for a long time prior to switching. [8]



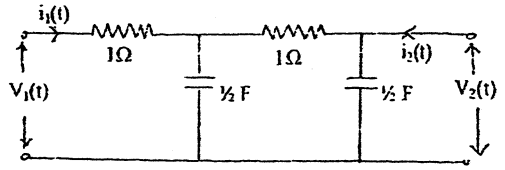
3. a) An exponential current $i(t) = 2e^{-3t}$ is applied at time t = 0 to a parallel R-C circuit shown below. Comprising resistor R = ½ Ω and capacitor C = 1F. Obtain complete solution for v(t). Assume $V_C = 0$ before the application of current. Use Laplace transform method. [8]



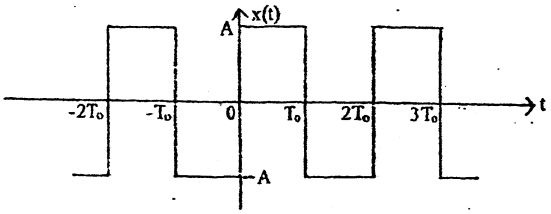
b) In the circuit shown in figure below, steady state is reached with switch S open. Switch S is closed at t = 0. Determine current through inductor i(t) and voltage across the capacitor v(t) for t > 0 using Laplace transform method. [8]



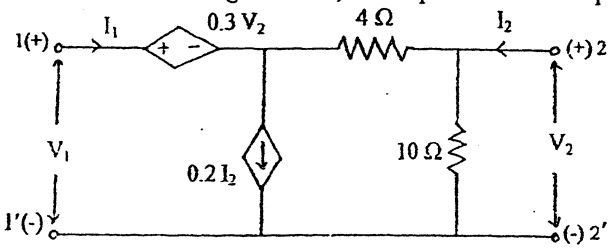
4. a) For the following network determine the voltage ratio transfer function. If this network is terminated at port 2 with a 2Ω resistor, find for this terminated network α_{21} (S) and V_{21}(S) [8]



b) Obtain the trigonometric Fourier-series of the waveform shown in figure below and sketch the line spectra. [8]



5. a) For the two port network shown in figure below, find Z-parameter and T-parameter. [8]



b) Draw the asymptotic Bode plot for the transfer function given below. [8]

$$G(S)=\frac{2(S+5)}{S(S^2+21S+20)(S+10)}$$

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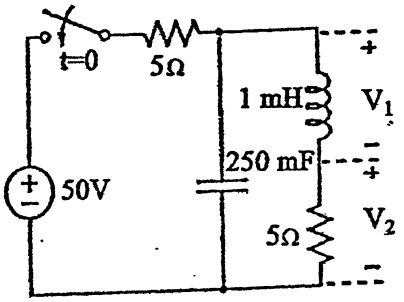
Exam.	Back		
Level	BE	Full Marks	80
Programme	BEL, BEX, BCT	Pass Marks	32
Year / Part	II / I	Time	3 hrs.

Subject: - Electric Circuit Theory *(EE 501)*

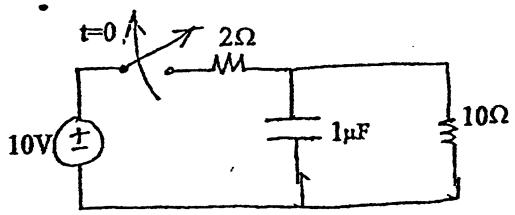
- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt All questions.*
- ✓ *The figures in the margin indicate Full Marks.*
- ✓ *Semi log graph will be provided.*
- ✓ *Assume suitable data if necessary.*

1. a) A 50 μF capacitor, when connected in series with a coil having 40 Ω resistance, resonates at 1000 Hz. Find the inductance of the coil. Also obtain the circuit current if the applied voltage is 100V. Also calculate the voltage across the capacitor and the coil at resonance. [8]

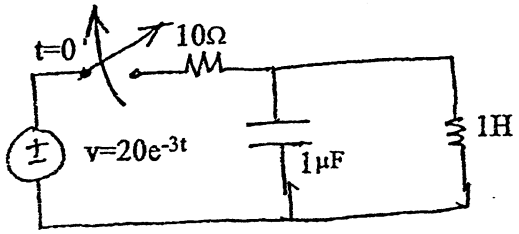
   b) In the circuit shown in figure, switch is closed at t=0 with zero capacitor voltage and zero inductor current, find the following. [8]
   i) v_1 and v_2 at t=0+
   ii) dv_1/dt and dv_2/dt at t=0+
   iii) d^2v_2/dt at t=0+



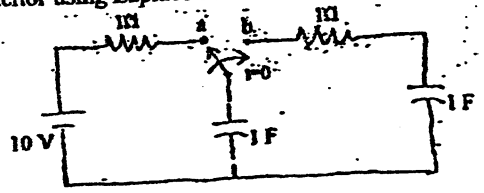
2. a) The circuit shown in figure is in the steady state with the switch S closed. The switch is opened at t=0. Determine current and voltage of all elements for t>0 using classical method. [8]



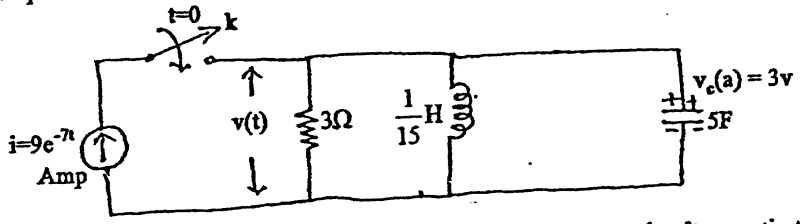
   b) Using Classical method, find the expression for current and voltage of capacitor for t>0 in the circuit shown below. [8]



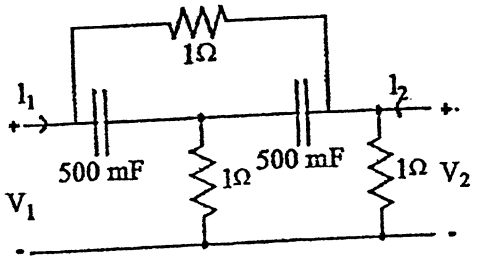
3. a) Keeping the switch at position 'a' for a long time, if the switch is moved to position 'b' at t = 0 in the circuit shown in figure below, find expressions for current through and voltage across capacitor using Laplace transform method. [8]



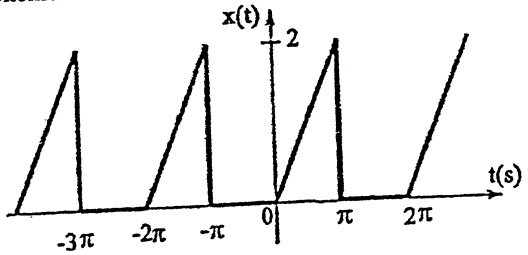
b) In the given network of figure below, both the energy storing elements are initially reached to steady state, before application of current source. The switch K is closed at t=0. Find complete expression for voltage v(t) across the network, for t>0, using Laplace transformation. [8]



4. a) Find the input point driving impedance, transfer impedance, and voltage ratio transfer function for the circuit shown in following figure. [8]



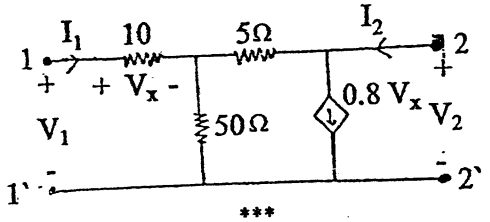
b) Find the trigonometric fourier series for the waveform shown in figure below. [8]



5. a) Draw the asymptotic Bode Plot for the transfer function [8]

$$H(s)=\frac{(s+5)}{s(s^2+21s+20)(s^2+2s+100)}$$

b) For the two port network shown in figure below. Find the Z parameter and T parameter. [8]



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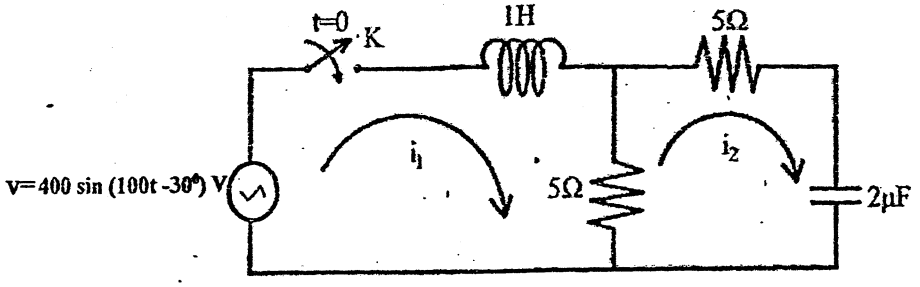
Exam.	Regular / Back		
Level	BE	Full Marks	80
Programme	BEL, BEX, BCT	Pass Marks	32
Year / Part	II / I	Time	3 hrs.

Subject: - Electric Circuit Theory *(EE 501)*

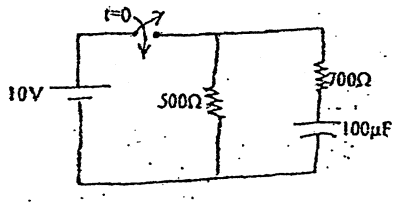
- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt <u>All</u> questions.*
- ✓ *The figures in the margin indicate <u>Full Marks</u>.*
- ✓ ***<u>Semi log graph will be provided.</u>***
- ✓ *Assume suitable data if necessary.*

1. a) Discuss about resonance in a circuit consisting of a practical coil in parallel with a capacitor. Also derive an expression for impedance and current at resonating frequency. [8]

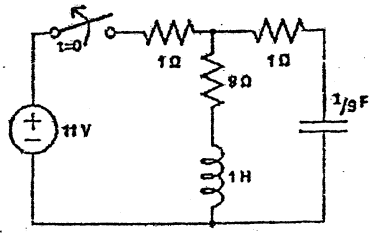
   b) In the given network of figure below, both the energy storing elements are initially relaxed ie. no current is flowing through the inductor and no charge is accumulated across the capacitor before application of voltage. The switch K is closed at t=0. Find the values of i_1, i_2, $\frac{di_1}{dt}, \frac{di_2}{dt}, \frac{d^2i_1}{dt^2}, \frac{d^2i_2}{dt^2}$ at $t=0^+$. [8]



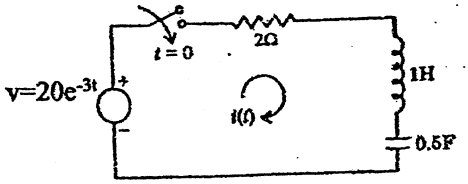
2. a) Using classical method, find the expression for the current supplied by the source in the network shown in figure. Also find the time taken by the source current to reach 25 mA. [8]



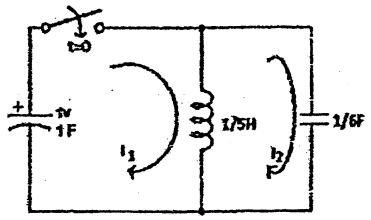
   b) Using classical method, find the expression for the current and voltage of inductor and capacitor respectively for t>0 from the circuit shown in following figure. [8]



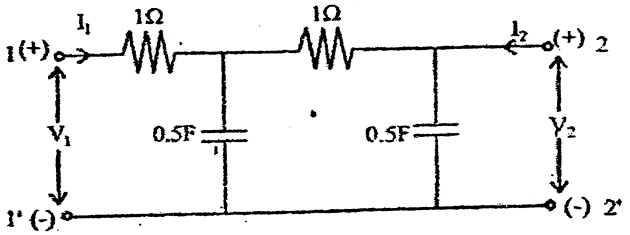
3. a) In the series R-L-C circuit shown in figure, there is no initial charge on the capacitor. If the switch S is closed at t=0, determine expression of current and voltage for all elements for t>0. [8]



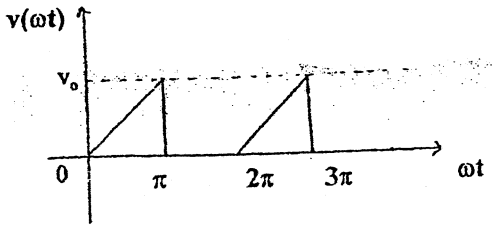
b) Using Laplace transform method, find the loop current i_1 and i_2 for t>0 in the figure shown below. [8]



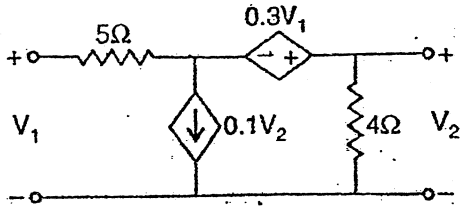
4. a) For the given two port network, determine the driving point impedance. If this network is terminated at port 2 with 1F capacitor, find the following network function for this terminated network, (i) $Z_{21}(s)$ (ii) $Y_{21}(s)$ (iii)$\alpha_{21}(s)$ [8]



b) Find the trigonometric Fourier series for the given waveform shown in figure below. [8]



5. a) For the two port network shown below, find h-parameter and T' parameter. Also Check for reciprocity of network. [8]



b) Draw the asymptotic bode plot for the transfer function given by: [8]

$$G(s) = \frac{64(s+2)}{s(s+0.5)(s^2+3.2s+64)}$$

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14 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2075 Ashwin

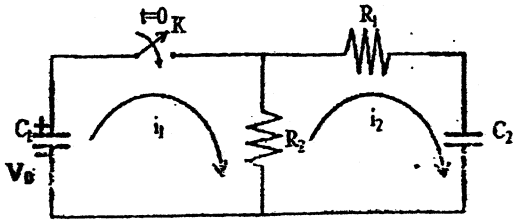
Exam.	Back		
Level	BE	Full Marks	80
Programme	BEL, BEX, BCT	Pass Marks	32
Year / Part	II / I	Time	3 hrs.

Subject: - Electric Circuit Theory *(EE501)*

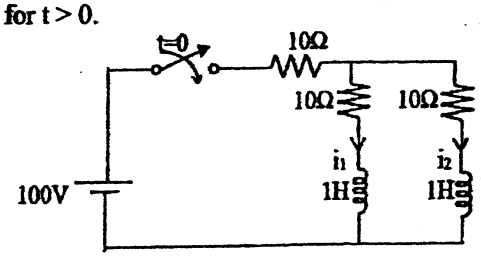
- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ ***Semi log paper should be provided.***
- ✓ *Assume suitable data if necessary.*

1. a) What do you mean by resonance in RLC series circuit? Define half power frequencies and bandwidth in RLC series circuit and also obtain an expression for them. [8]

   b) In the given network, the capacitor C1 is charged to voltage V_0 and switch K is closed at t = 0. When $R_1 = 2M\Omega$, $V_0 = 1000V$, $R_2 = 1\ M\Omega$, $C_1 = 10\mu F$ and $C_2 = 20\mu F$, solve for $i_1, i_2, \frac{di_2}{dt}, \frac{d^2i_2}{dt^2}$ at $t = 0^+$. [8]

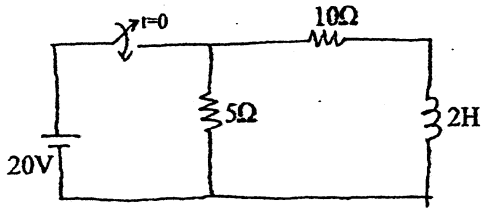


2. a) In the network shown, the switch is closed at t = 0, with the network previously unenergised. For the element values shown on the diagram, find $i_1(t)$ and $i_2(t)$, by classical method for t > 0. [8]



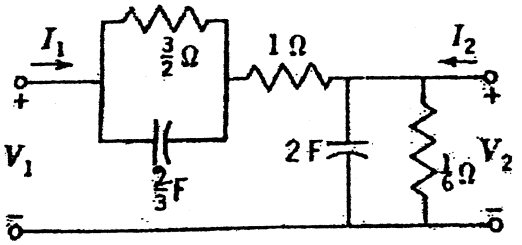
   b) Find the time expression for current for t > 0 in RLC series circuit with R = 10 ohm, L = 1H and $C = \frac{1}{9}F$, if the circuit is supplied by v = 10sint at t = 0. Assume that capacitor and inductor are initially de-energized. Use classical method. [8]

3. a) In the circuit shown in figure below, obtain an expression for voltage across the inductor if the switch is closed at t = 0 using Laplace Transform method. [8]



b) An exponential current $i(t) = 20e^{-4t}$ Amp is suddenly applied at time t = 0 to a parallel RLC circuit comprising of resistor R = 1/10Ω, inductor L = 10mH and capacitor C = 2.5μF. Obtain the complete particular solution for voltage v(t) across the network, by Laplace transform method. Assume zero initial current through inductor and zero initial charge across the capacitor before application of the current. [8]

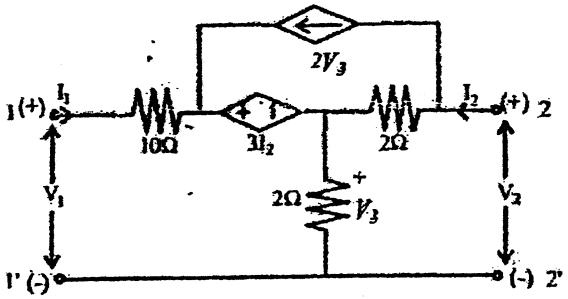
4. a) Find the voltage ratio transfer function of the two port network shown in figure below, if the port 2 is terminated with 2H inductor. [8]



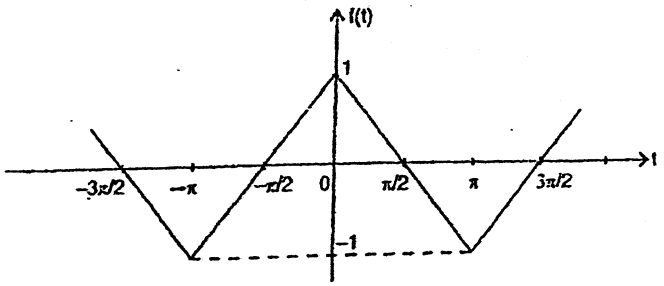
b) Sketch Bode Plot for the following transfer function. [8]

$$H(s) = \frac{40(s+1)}{(2s^2+10s)(s^2+2s+10)}$$

5. a) Find the Z-parameter and hence T' -parameter for the network shown in figure below also check if network is symmetrical. [8]



b) For the given waveform, find the trigonometric form of Fourier series and then plot its line spectrum. [8]



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14 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2074 Chaitra

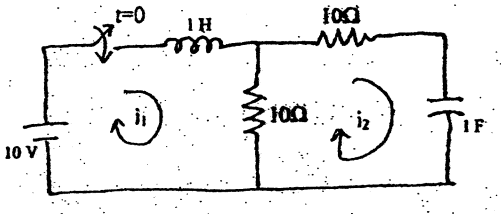
Exam.	Regular		
Level	BE	Full Marks	80
Programme	BEL, BEX, BCT	Pass Marks	32
Year / Part	II / I	Time	3 hrs.

Subject: - Electric Circuit Theory *(EE501)*

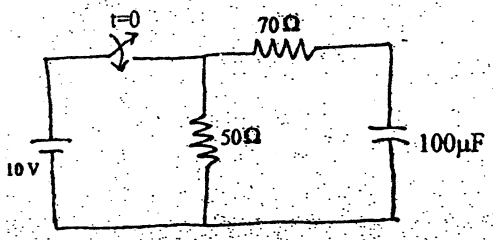
- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ ***Semi log paper should be provided.***
- ✓ *Assume suitable data if necessary.*

1. a) Explain the phenomenon of resonance in RLC parallel circuit. Also derive the expression for resonance frequency and draw the wave form of instantaneous voltage and current at resonance. [8]

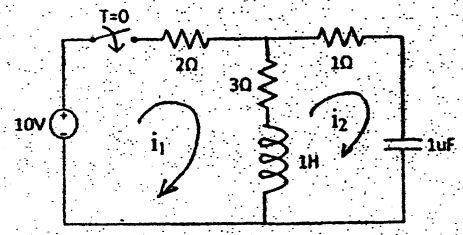
   b) Obtain the value of i_1, i_2, di_1/dt, di_2/dt, d^2i_1/dt and d^2i_2/dt^2 at $t = 0^+$, if the switch is closed at $t = 0$ in the circuit shown in figure below. [8]



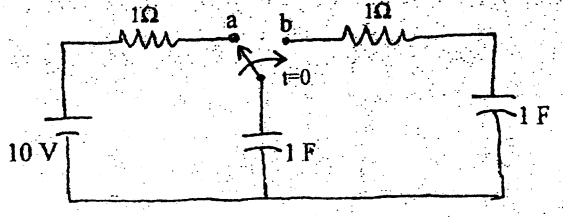
2. a) In the circuit shown in figure below, if the switch is closed at $t = 0$, find the time when the current from the battery reaches to 500mA. Use classical method. [8]



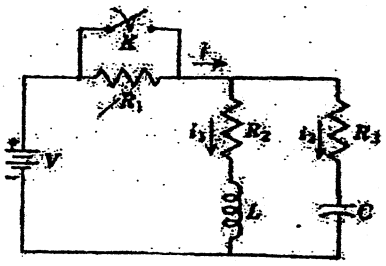
   b) Find the time expression for loop currents for $t > 0$ in the given circuit using classical method. [8]



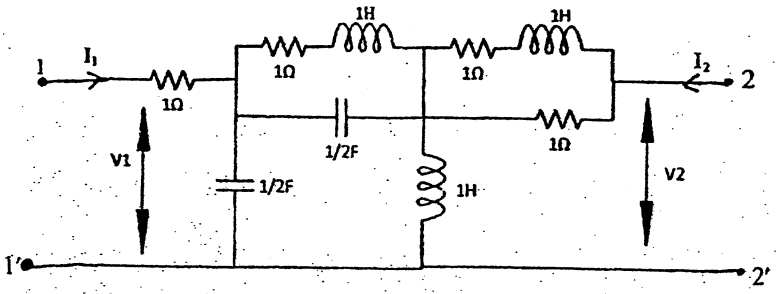
3. a) Keeping the switch at position 'a' for a long time, if the switch is moved to position 'b' at $t = 0$ in the circuit shown in figure below, find expressions for current through and voltage across capacitor using Laplace Transform method. [8]



b) In the network shown below, a steady state is reached with the switch *K* open with V = 100V, $R_1 = 10\Omega$, $R_2 = 20\Omega$, $R_3 = 20\Omega$, L = 1H, and C = 1 μF. at time t = 0, the switch is closed. Evaluate the currents i_1 and i_2, using Laplace transform, for t > 0. [8]



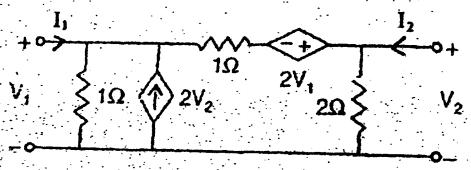
4. a) Find the forward voltage ratio transfer function $G_{21}(s)$ and forward transfer admittance $Y_{21}(s)$ in the following circuit. [8]



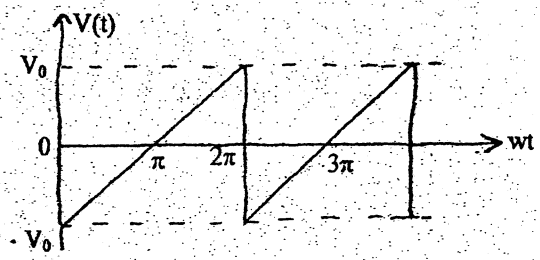
b) Sketch the Bode Plot for the transfer function given by

$H(S) = 64(S+2)/[S(S^2 + 0.5S)(S^2 + 3.2S + 64)]$ [8]

5. a) Find transmission and admittance parameter for the given TPN and check its reciprocity and symmetry. [8]



b) Obtain trigonometric Fourier series of the waveform shown in figure below and sketch the line spectra. [8]



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24 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2074 Ashwin

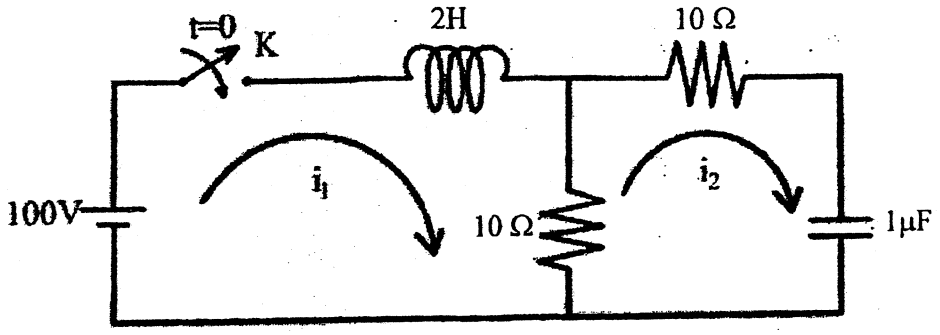
Exam.	Back		
Level	BE	Full Marks	80
Programme	BEL, BEX, BCT	Pass Marks	32
Year / Part	II / I	Time	3 hrs.

Subject: - Electric Circuit Theory *(EE501)*

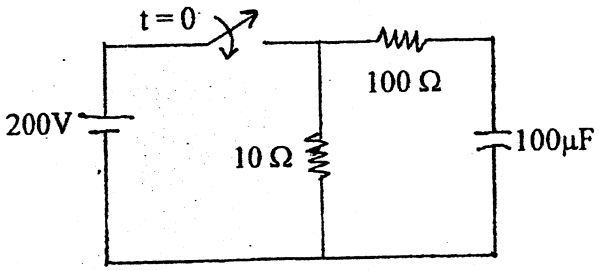
- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Semi log paper will be provided.*
- ✓ *Assume suitable data if necessary.*

1. a) Describe the resonance phenomenon in RLC series circuit. Define half power points and band width for a series RLC circuit and derive expression for them. [8]

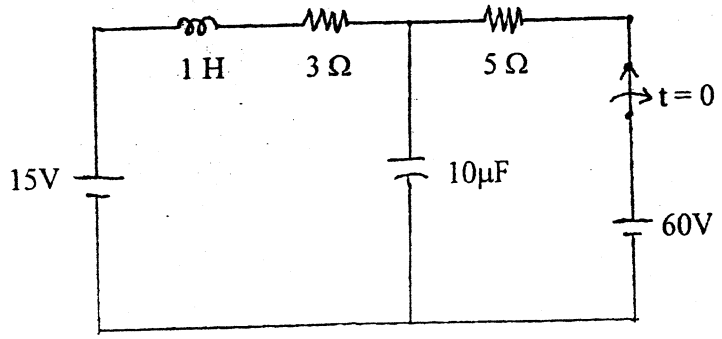
   b) In the given network of figure below, both the energy storing elements are initially relaxed i.e. no current is flowing through the inductor and no charge is accumulated across the capacitor before application of voltage. The switch K is closed at t = 0. Find the values of $i_1, i_2, \frac{di_1}{dt}, \frac{di_2}{dt}, \frac{d^2i_1}{dt^2}, \frac{d^2i_2}{dt^2}$ at $t = 0^+$. [8]



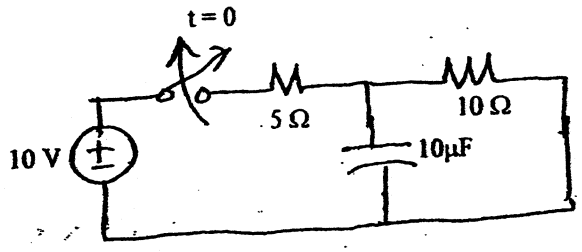
2. a) In the circuit shown in figure below, if the switch is closed at t = 0, find the expression for voltage across capacitor using classical method. [8]



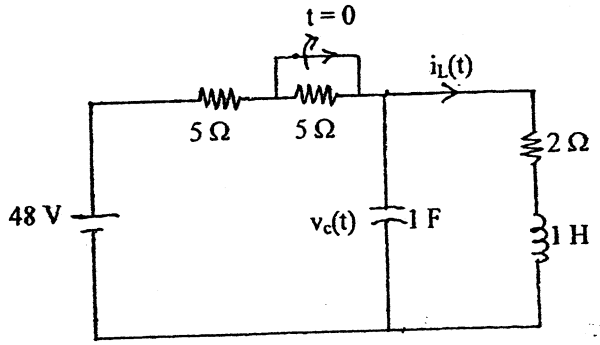
   b) Keeping the switch closed for a long time, if the switch is opened at t = 0 in the circuit shown in figure below, find expression for voltage across capacitor using classical method of solution. [8]



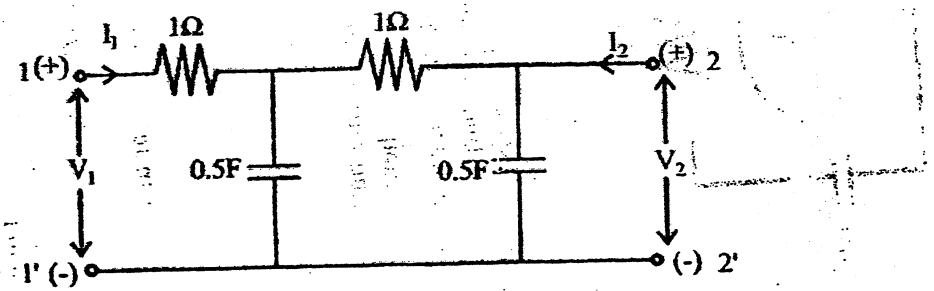
3. a) For the circuit shown in figure below, Find the current and voltage of capacitor for $t > 0$ using Laplace Transform method. [8]



b) After being closed for a long time, if the switch in the circuit shown in figure below is opened at $t = 0$. Obtain the expressions for $i_L(t)$ and $v_c(t)$ for $t > 0$, using Laplace Transform Method. [8]



4. a) For the given two port network, determine the driving point impedance and voltage ratio transfer function. [4]

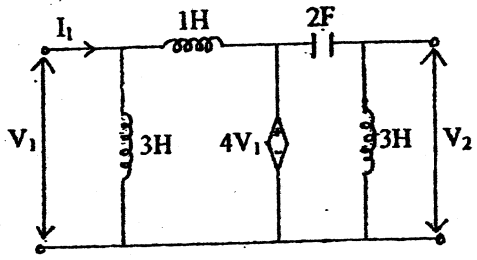


b) Sketch the Bode Plot for the transfer function given by [8]

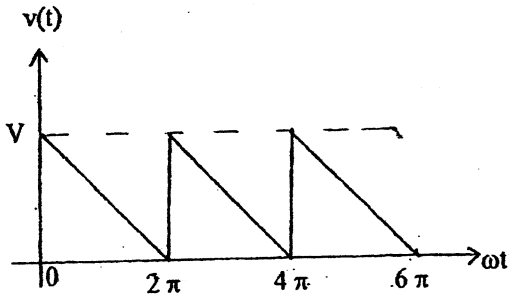
$$H(S) = 200(S+1)/[S(S+5)(S^2+2S+100)]$$

c) Show that all overall transmission parameter matrix for cascaded two 2-port networks is simply the matrix product of transmission parameters for each individual 2-port network in cascade. [4]

5. a) Find the y and g-parameters of the circuit in figure below and also find whether the network is reciprocal or not. [8]



b) Obtain trigonometric Fourier series of the waveform shown in figure below and sketch the line spectra. [8]



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24 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2073 Chaitra

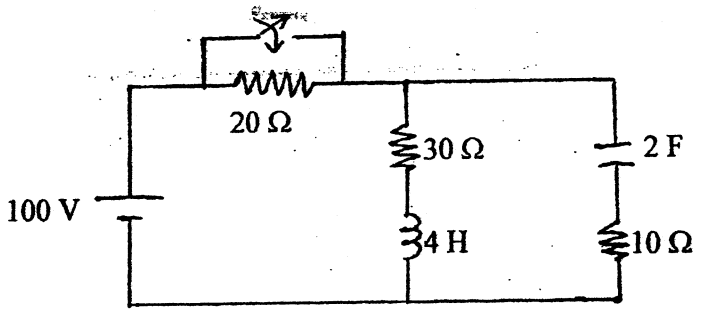
Exam.	Regular		
Level	BE	Full Marks	80
Programme	BEL, BEX, BCT	Pass Marks	32
Year / Part	II / I	Time	3 hrs.

Subject: - Electric Circuit Theory *(EE501)*

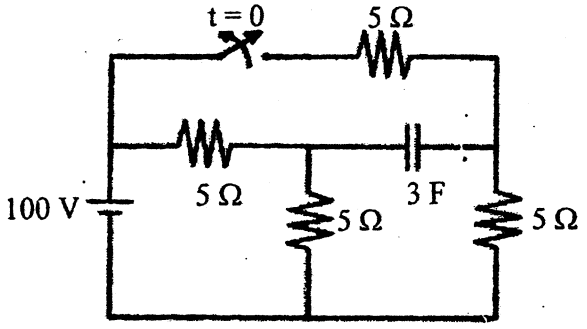
- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Semi log paper will be provided.*
- ✓ *Assume suitable data if necessary.*

1. a) Describe the phenomenon of series RLC circuit. What value of capacitor would procedure resonance in 400 V, 50 Hz source if the resistance and inductance are 20mΩ and 6mH respectively? Also calculate the Q-factor and half power frequencies. [8]

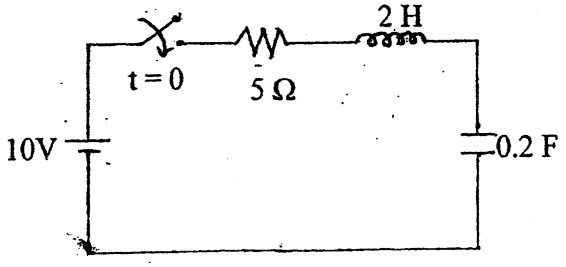
   b) After being open for a long time, if the switch in the circuit shown in figure below is closed at t = 0, find current through inductor, voltage across capacitor, current and voltage across each resistor at $t = 0^+$. [8]



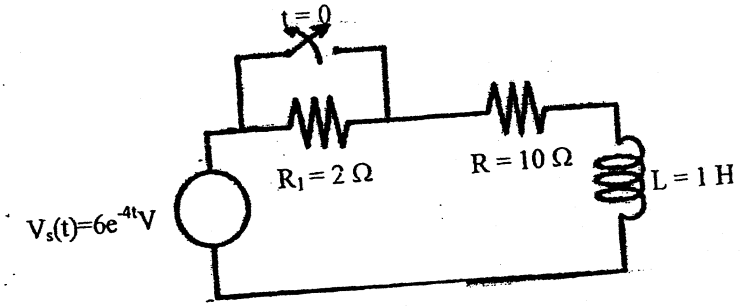
2. a) For the circuit shown in figure below, find the current through and voltage across the capacitor for t > 0. Using Classical approach. [8]



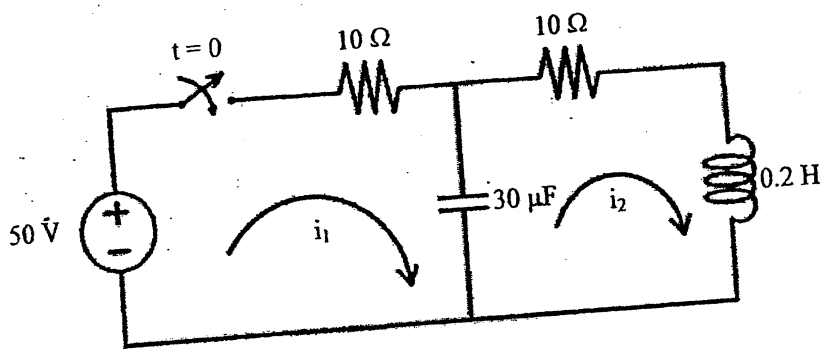
   b) Switch is closed at t = 0, find the expression for circuit i(t), for any time 't', and calculate the value of current at t = 0.1 sec. Also, find the time for current reach maximum value and corresponding maximum value of current. Use Classical method. [8]



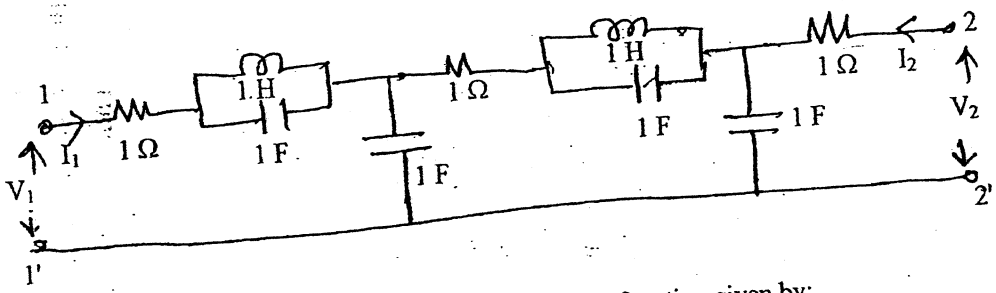
3. a) Find the expression of the current flowing through resistor R of the circuit in following figure and also find the voltage across the inductor for $t > 0$, when the switch is opened at $t = 0$. Use Laplace Transform method. [8]



b) In the network shown in figure below, the switch is closed at $t = 0$, with the network previously unenergised. For the element value given on diagram, find the expression for mesh currents $i_1(t)$ and $i_2(t)$, by Laplace Transformation method. [8]



4. a) For the TPN shown, find voltage ratio transfer function and transform impedance. [4]

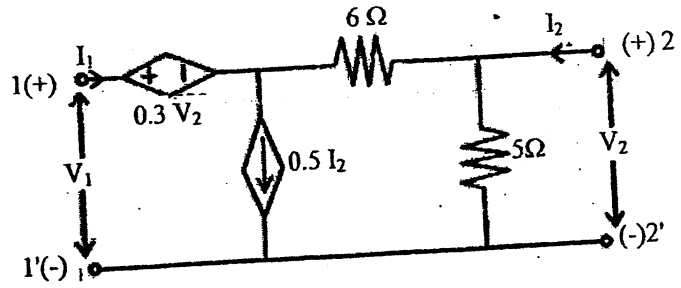


b) Sketch the asymptotic bode plots for the transfer function given by: [8]

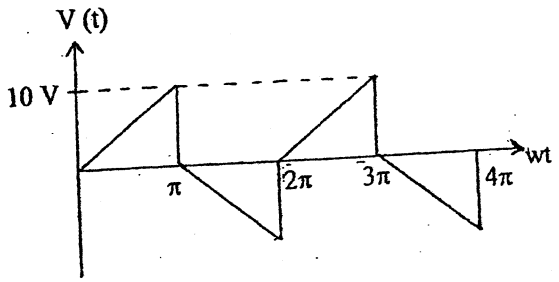
$$G(S) = \frac{5S^2(S+100)}{(S+20)(S^2+20S+100)}$$

c) Find the expression for Equivalent Z-parameter equation if three two-port networks are connected in series. [4]

5. a) For the two port network shown in figure below, find Z-parameter and T-parameter. [8]



b) Find the trigonometric Fourier Series for the wave shown in figure and sketch line spectrum. [8]



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27 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2073 Shrawan

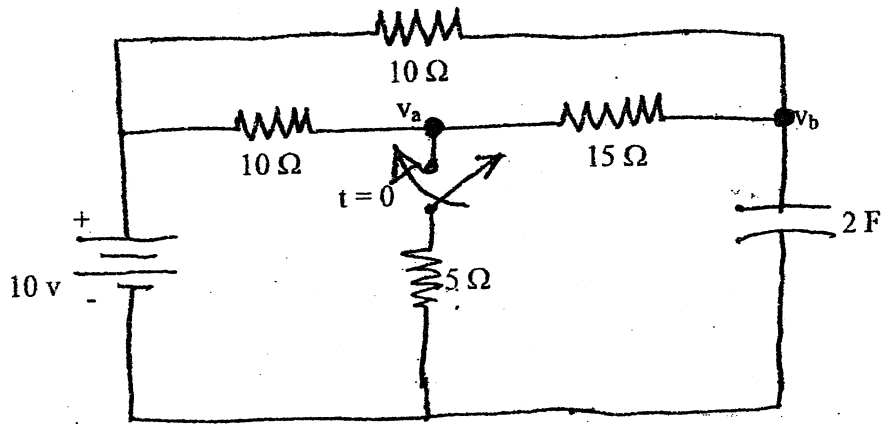
Exam.	New Back (2066 & Later Batch)		
Level	BE	Full Marks	80
Programme	BEL, BEX, BCT	Pass Marks	32
Year / Part	II / I	Time	3 hrs.

Subject: - Electric Circuit Theory *(EE501)*

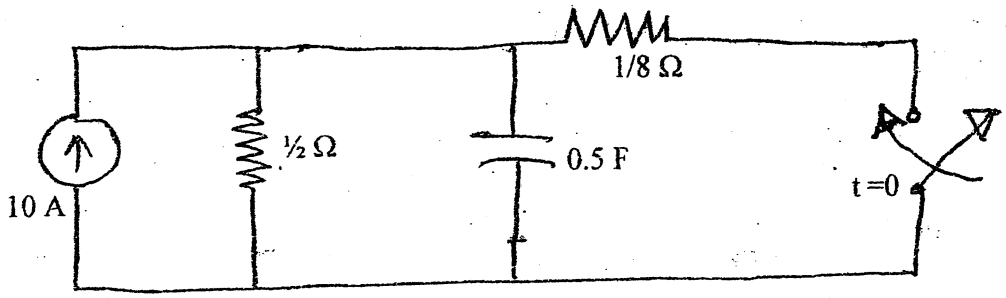
- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ ***All** questions carry equal marks.*
- ✓ ***Necessary Semi-log graph paper is Provided.***
- ✓ *Assume suitable data if necessary.*

1. a) A voltage u(t) = 100Sinωt is applied to a series RLC circuit. At the resonant frequency of the circuit, the maximum Voltage across the capacitor is found to be 400 V. The Bandwidth is known to be 600 rad/sec and impedance at resonance is 100 Ω. Find the resonant frequency and compute the upper and lower limits of the bandwidth. Also determine the value of L and C of the circuit.

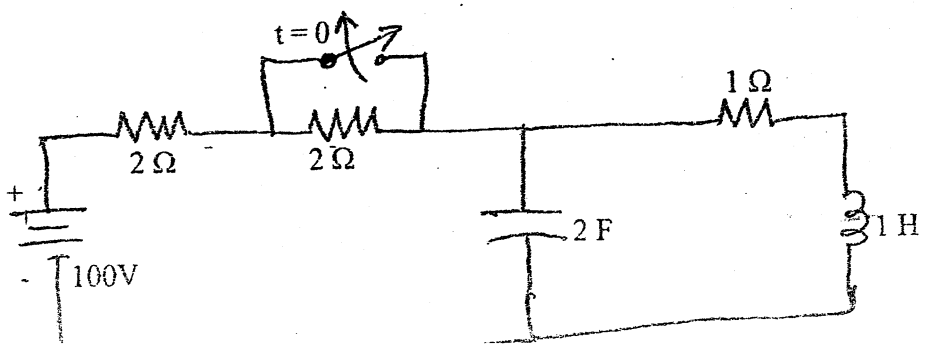
   b) In the network shown in figure below a steady state is reached with the switch open. At t = 0, the switch is closed. Determine the value of $u_a(0^-)$ and $u_a(0^+)$.



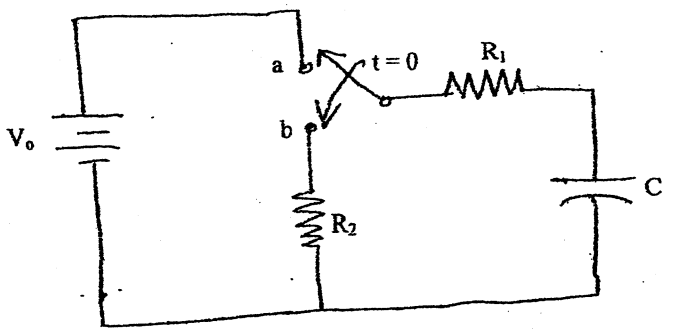
2. a) Using classical method in the circuit shown in figure below. Find the voltage across capacitor for t > 0.



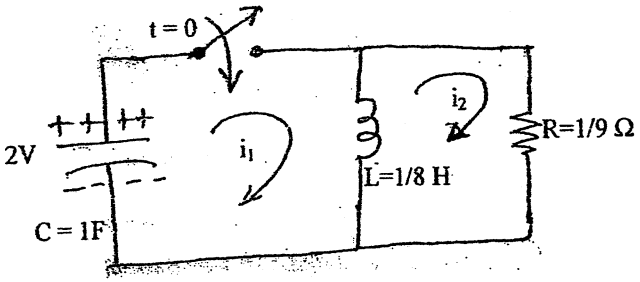
   b) Using classical method, in the circuit shown in figure below. Find the current through inductor and voltage across capacitor for t > 0



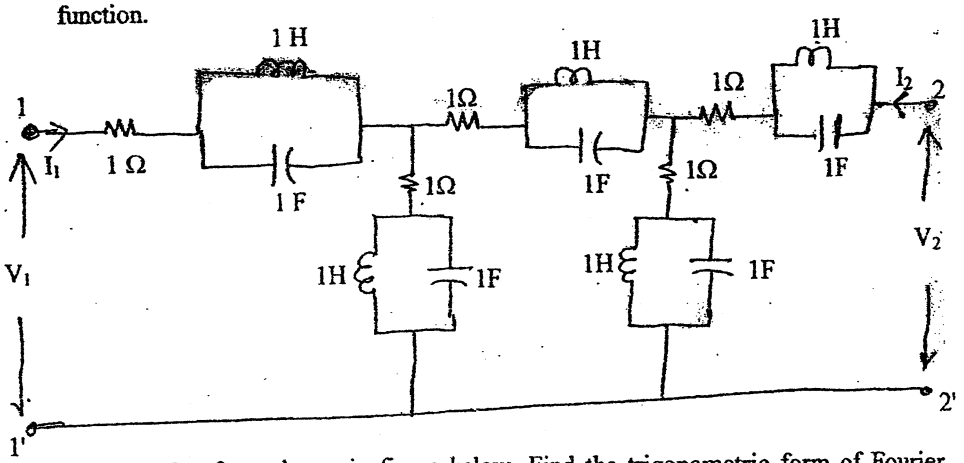
3. a) Using Laplace Transform method in the circuit shown in figure below find the voltage and current of capacitor for $t > 0$



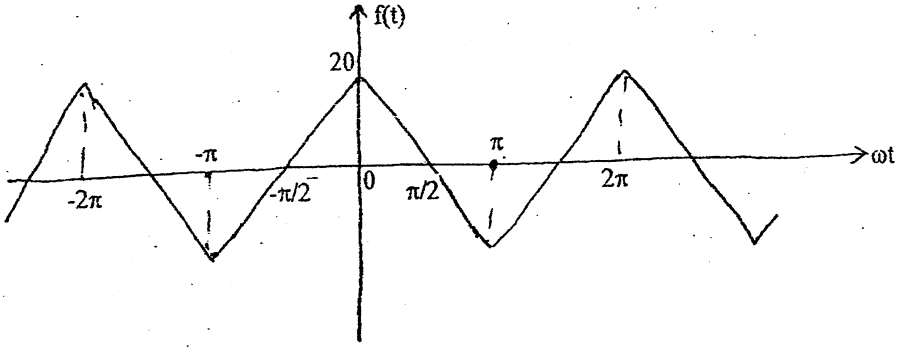
b) Using Laplace Transform method in the circuit shown in figure below. Find the current i_1 and i_2 for $t > 0$.



4. a) For the Two-Port network shown in figure below. Find the voltage ratio transfer function.



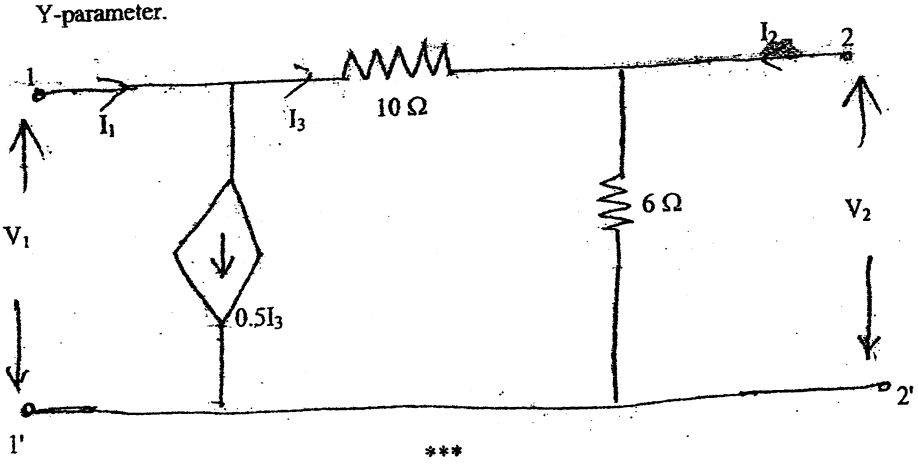
b) For the Waveform shown in figure below. Find the trigonometric form of Fourier Series and plot the line spectrum.



5. a) For the network function given below, plot the asymptotic Bode diagram

$$H(S)=\frac{20(s+1)}{s(s+5)(s^2+2s+10)}$$

b) For the Two Port network shown in figure find Transmission parameter and Y-parameter.



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24 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2072 Chaitra

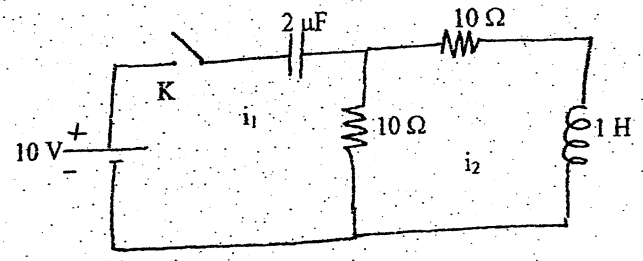
Exam.	Regular		
Level	BE	Full Marks	80
Programme	BEL, BEX, BCT	Pass Marks	32
Year / Part	II / I	Time	3 hrs.

Subject: - Electric Circuit Theory *(EE501)*

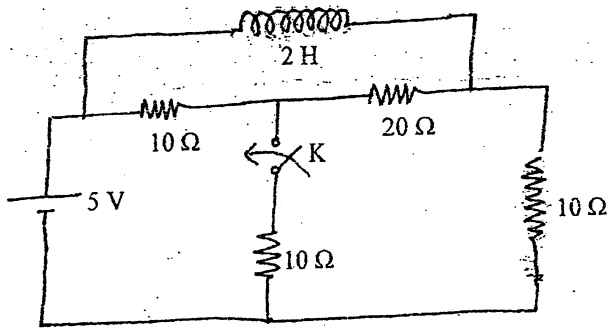
- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Assume suitable data if necessary.*

1. a) What do you understand by the bandwidth of a series resonant circuit? Explain with the help of resource curve and also derive its expression both in terms of ω and f. [8]

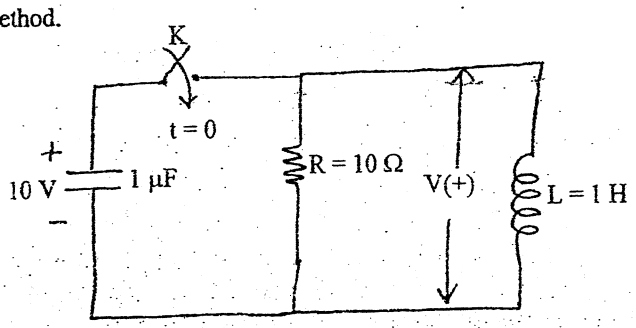
   b) In the circuit shown in figure below, switch K is closed at time t = 0. Find the values of i_1, i_2, di_1/dt, di_2/dt, d^2i_1/dt^2, d^2i_2/dt^2 at t =0+. [8]



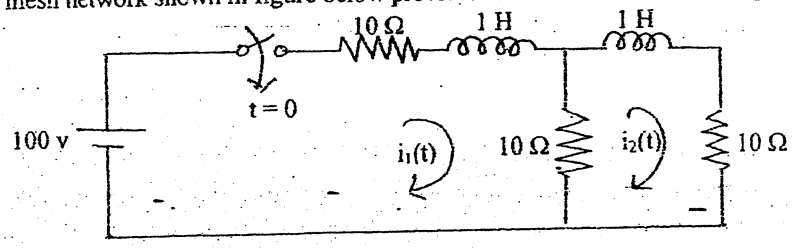
2. a) In the circuit of the figure below, the switch K is open and the circuit reaches a steady state. At t = 0, K is closed. Find the current in the inductor t > 0. Use classical method. [8]



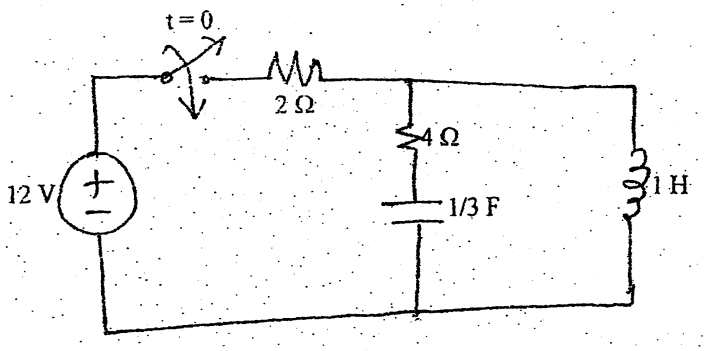
   b) In the circuit shown in figure below capacitor C has an initial voltage V_C = 10 volts and at the same instant, current through the inductor L is zero. The switch K is closed at t = 0. Find out the expression for the voltage V(t) across the inductor L using classical method. [8]



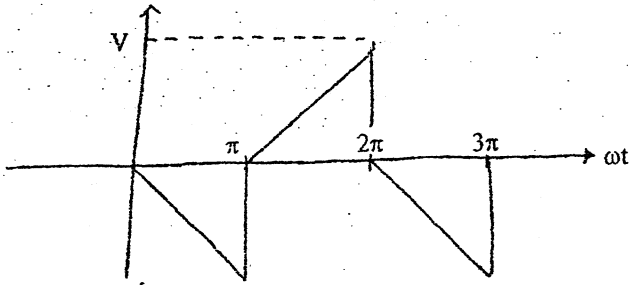
3. a) Using Laplace transform method find the expressions for $i_1(t)$ and $i_2(t)$ in the given two mesh network shown in figure below provided that the network is unenergised. [8]



b) Using Laplace Transform method, find the current of inductor and capacitor for $t > 0$ in the circuit shown in figure below. [8]



4. a) Find the trigonometric Fourier series for the waveform shown in figure below and plot the line spectrum. [8]

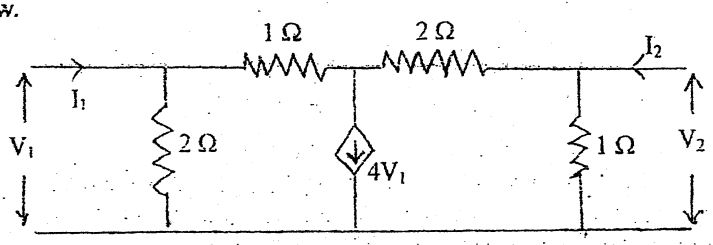


b) For the network shown in figure below find the voltage ratio transfer function and transfer impedance. [8]

5. a) Sketch the bode plot for the transfer function given by [6]

$$G(S) = 20(S+1)/(S^2+4S+2)(S^2+5S)$$

b) Find Z-parameters and hence the T-parameters for the 2 port network shown in figure below. [6]



c) What do you understand by reciprocal two-port network? Also derive the condition for the same in terms of T parameters. [4]

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24 TRIBHUVAN UNIVERSITY
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2072 Kartik

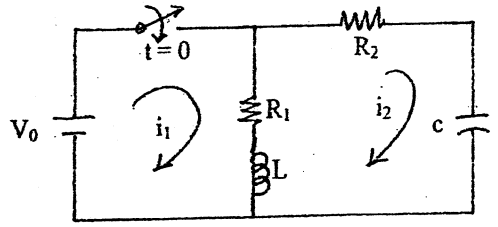
Exam.	New Back (2066 & Later Batch)		
Level	BE	Full Marks	80
Programme	BEL, BEX, BCT	Pass Marks	32
Year / Part	II / I	Time	3 hrs.

Subject: - Electric Circuit Theory *(EE501)*

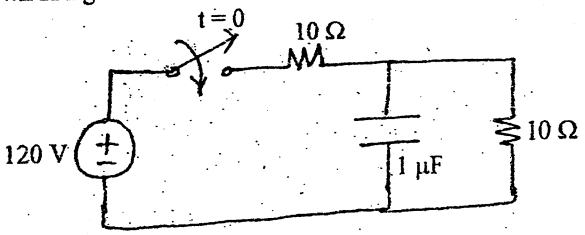
- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Assume suitable data if necessary.*

1. a) How does the resonance occurs in RLC series circuit? Define the half power frequencies and bandwidth for RLC series circuit and also obtain the expression for them. [8]

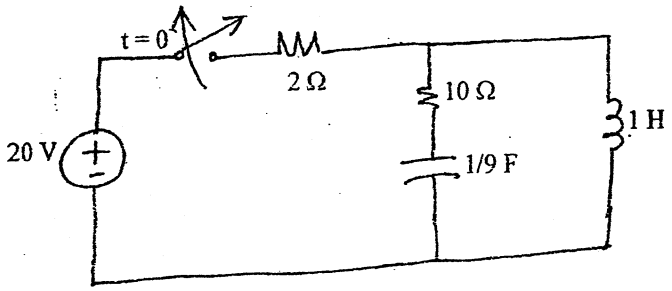
   b) If the switch is closed at t = 0 in the circuit shown in figure below, Obtain the value of $i_1, i_2, di_1/dt, di_2/dt, d^2i_1/dt^2$ and d^2i_2/dt^2 at $t = 0^+$ [8]



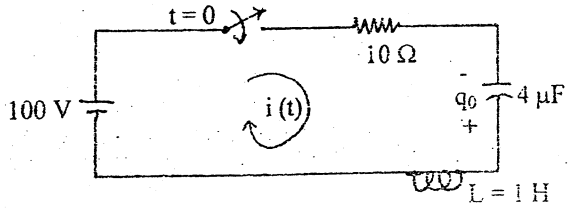
2. a) Using classical method, Find the current and voltage of capacitor for t > 0 in the circuit shown in figure. [8]



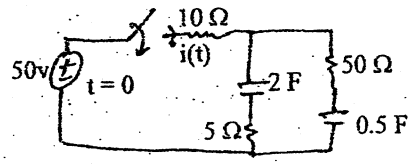
   b) Using classical method, find the current and voltage of inductor and capacitor for t > 0 in the circuit shown in following figure. [8]



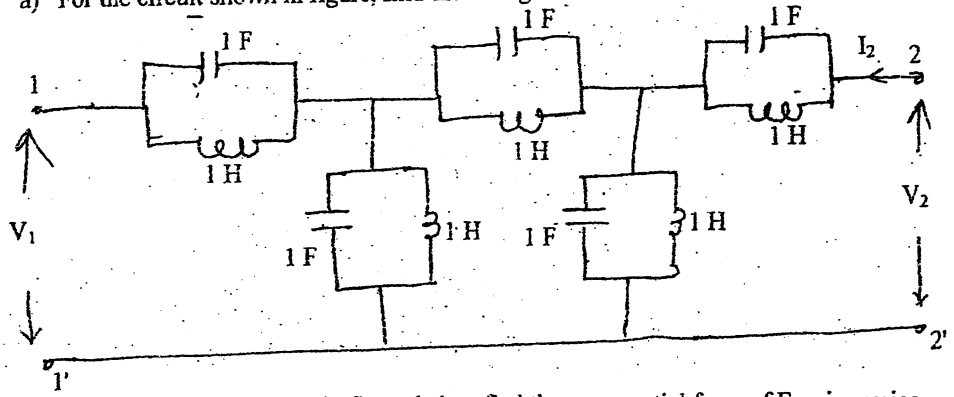
3. a) In the circuit shown in figure below, the capacitor has an initial charge of $q_0 = 800\ \mu C$ with polarity shown in the figure. Find current i(t) if the switch is closed at t = 0 using Laplace Transform method. [8]



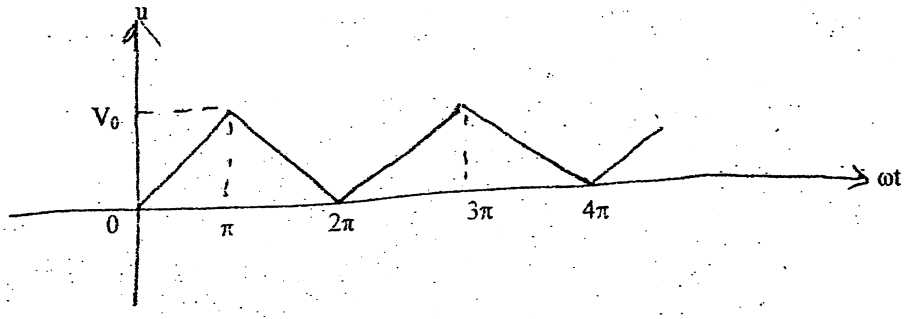
b) Solve for i(t) for t > 0 by using Laplace transformation. The switch closes time t = 0. Assume zero initial charge across the capacitors. [8]



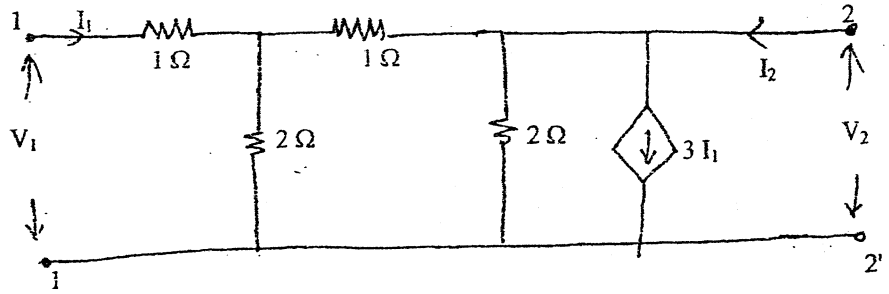
4. a) For the circuit shown in figure, find the voltage ratio transfer function G_{21}. [5]



b) For the waveform shown in figure below find the exponential form of Fourier series. [6]



c) For the two-port network shown in figure below. Find Z parameter. [5]



5. a) Draw the asymptotic Bode Plot for the transfer function. [8]

$$H(S) = \frac{(S+5)}{S(S^2+21S+20)(S^2+2S+10)}$$

b) What do you understand by reciprocity of two port network? Express the z-parameters and y-parameters in terms of ABCD parameters. Also derive condition for reciprocity in terms of transmission parameter. [8]

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24 TRIBHUVAN UNIVERSITY
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Examination Control Division
2071 Chaitra

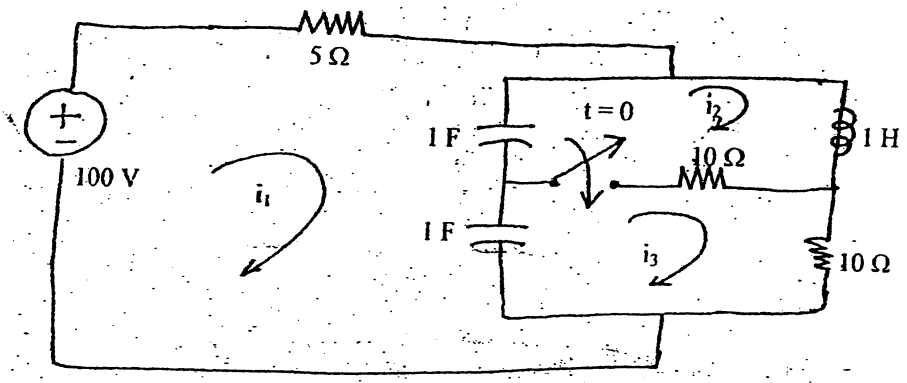
Exam.	Regular		
Level	BE	Full Marks	80
Programme	BEL, BEX, BCT	Pass Marks	32
Year / Part	II / I	Time	3 hrs.

Subject: - Electric Circuit Theory *(EE501)*

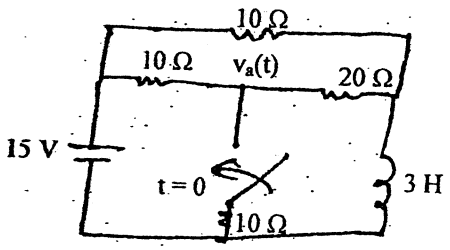
- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt <u>All</u> questions.*
- ✓ *The figures in the margin indicate <u>Full Marks</u>.*
- ✓ *Assume suitable data if necessary.*

1. a) Explain the phenomenon of Resonance in parallel RLC circuit and derive expression for resonance frequency. [8]

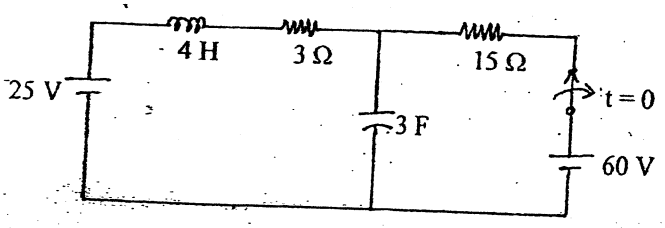
   b) In the circuit shown in following figure, find the loop currents i_1, i_2, i_3 at $t = 0^+$. [8]



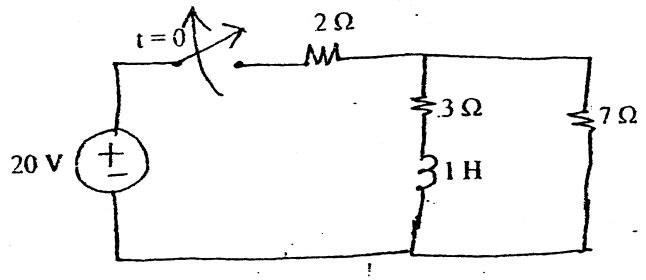
2. a) Find $v_a(t)$ for $t > 0$ in the figure below using classical method. [8]



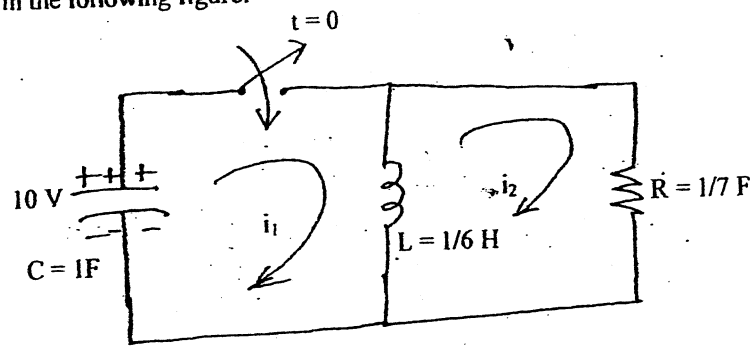
   b) Keeping the switch closed for a long time, if the switch is opened at $t = 0$ in the circuit shown in figure below, find expression for voltage across capacitor in the circuit shown in below using classical method of solution. [8]



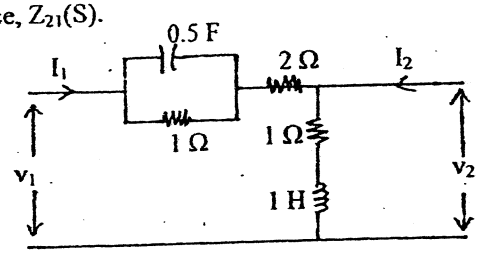
3. a) Using Laplace Transform method, find the current and voltage across inductor for $t > 0$ in the circuit shown in figure below. [8]



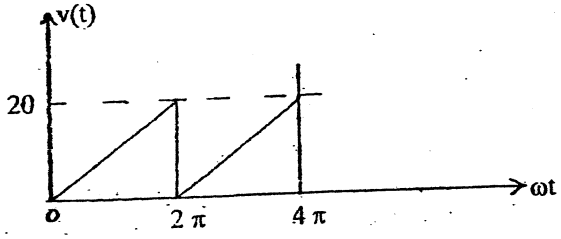
b) Using Laplace transform method, find he loop currents i_1 and i_2 for $t > 0$ in the circuit shown in the following figure. [8]



4. a) For the 2-port network shown in figure below, find voltage ratio transfer function, $G_{21}(S)$ and transfer admittance, $Z_{21}(S)$. [8]



b) Obtain trigonometric Fourier series of the waveform in figure below and sketch the line spectra. [8]



5. a) For the transfer function below, draw the asymptotic Bode plot [8]

$$G(s)=\frac{20(s+5)}{S(s+20)(s^2+80s+200)}$$

b) The Y-parameters of two TPNS are given as: [8]

$\begin{bmatrix} 1/4 & -5/4 \\ -1/4 & -3/4 \end{bmatrix}$ and $\begin{bmatrix} 1/3 & -1/3 \\ -1/3 & 1/3 \end{bmatrix}$. If these two TPNS are connected in series. What will be the equivalent Transmission parameter of the combination?

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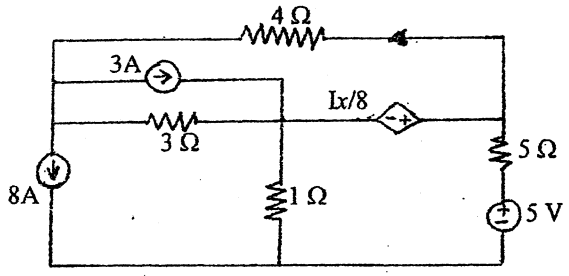
27 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2071 Shawan

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

Subject: - Electric Circuit Theory *(EE501)*

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

1. a) Using node voltage method, find I_x in the circuit shown in figure below. [6]

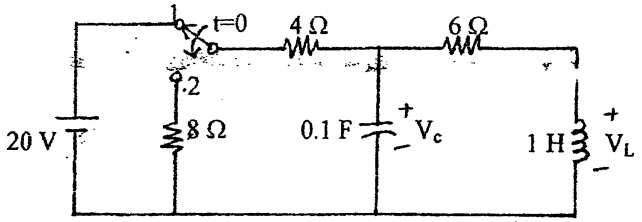


b) A 10Ω resistor is placed in series with a coil of self resistance R_L and inductance L a pure capacitor 'C' across a 50 V variable frequency supply. The current is maximum and has value of 1 A when the frequency is 500 HZ, At this frequency, voltage across the capacitor is 300 Volts, Calculate (i) capacitance of capacitor (ii) resistance and inductance of coil (iii) Power consumed in the circuit (iv) Voltage across the resistor and coil. [6]

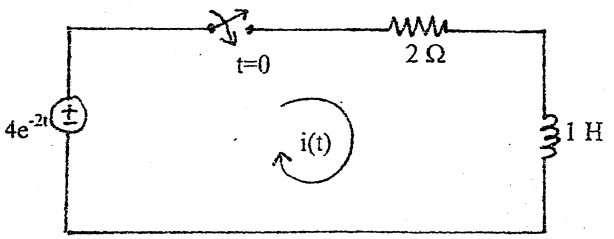
c) Define bandwidth of a series RLC circuit. How the quality factor changes with the change of R. [2+2]

2. a) With mathematical support show that current through inductor and voltage across capacitor do not change instantaneously. [2+2]

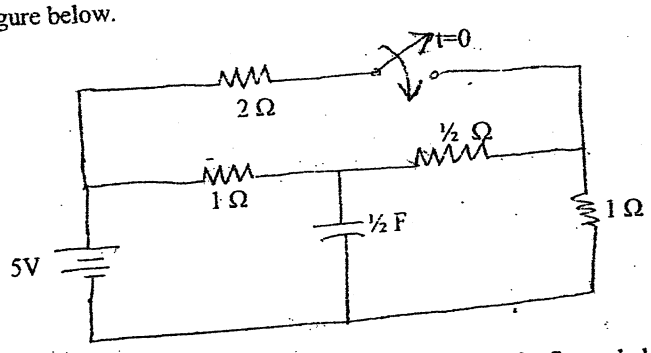
b) Keeping the switch at position 1 for a long time in the network shown in figure below, if it is changed to position 2 at t=0, find i_1, i_2, V_L, V_C, di_1/dt and dv_c/dt at $t=0^+$. [6]



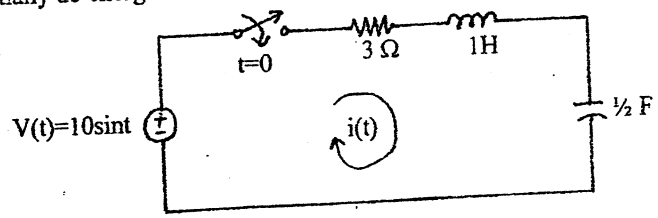
c) In a series RL circuit shown in figure below, if the switch is closed at t = 0, find particular solution for i(t) using classical method. [6]



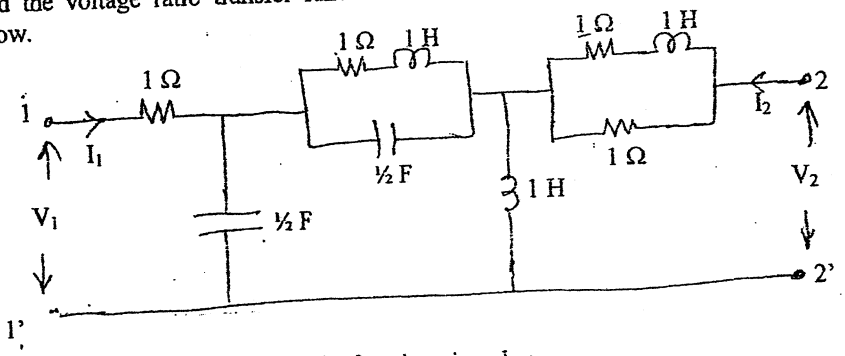
3. a) Using classical method, find the current through capacitor for $t > 0$ in the network shown in figure below. [8]



b) If the voltage source is applied at t=0 in the circuit shown in figure below, find the expression for current i(t) using transform method. Assume inductor and capacitor are initially de-energized. [8]



4. a) Find the voltage ratio transfer function of the two-port network shown in figure below. [6]

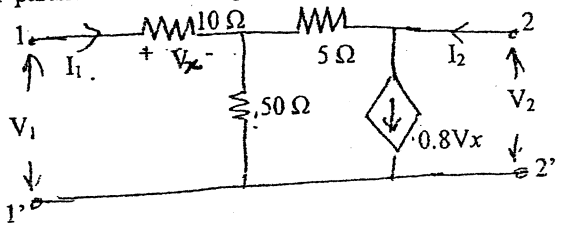


b) Sketch the Bode Plot for the transfer function given by:

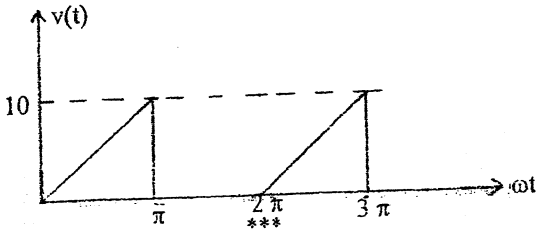
$H(S) = 80(S+20)/[(S^2+5S)(S^2+20S+1600)]$. [10

5. a) Explain poles and zero of the network function and its application in circuit analysis. [4]

b) Find Z and T-parameter of the two port network shown in figure below. [6]



c) Obtain trigonometric Fourier series of the waveform shown in figure below and sketch the line spectra. [6]



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21 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2070 Ashad

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

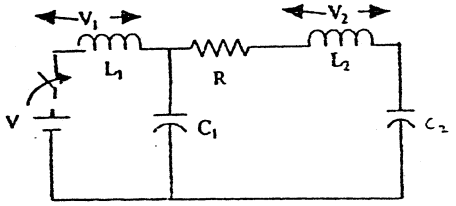
Subject: - Electrical Circuit Theory *(EE501)*

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

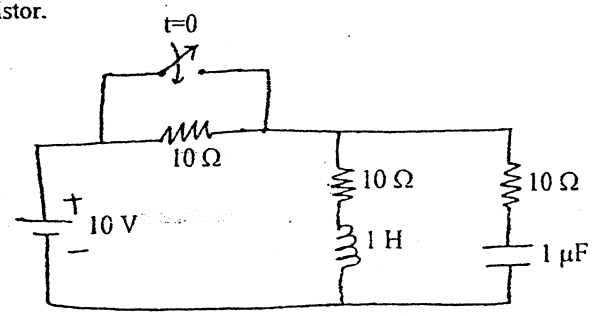
1. a) How resonance occurs in electrical RLC series circuit? Also show that bandwidth of circuit is independent of capacitor value. [6]

   b) A 220 V, 100 Hz source supplies a series R-L-C circuit. What value of capacitor would produce resonance at 100 Hz if the resistance and inductance of the circuit are 50 mΩ and 5 mH respectively? Also calculate the Q-factor and half - power frequencies of the circuit. [4]

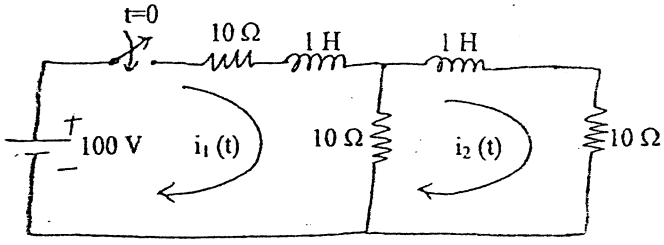
   c) Discuss the behavior of inductor and Capacitor at initial and final condition for dc excitation. Determine V_1, V_2, dV_1/dt, dV_2/dt at $t = 0+$ when switch is closed at $t = 0$. [2+4]



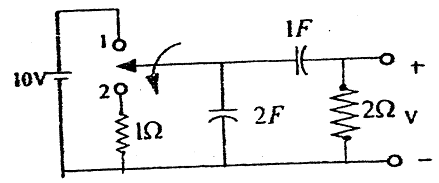
2. a) Circuit given in figure below was under steady state before the switch is closed at $t = 0$. At $t = 0^+$, find current through inductor, voltage across capacitor and current through each resistor. [8]



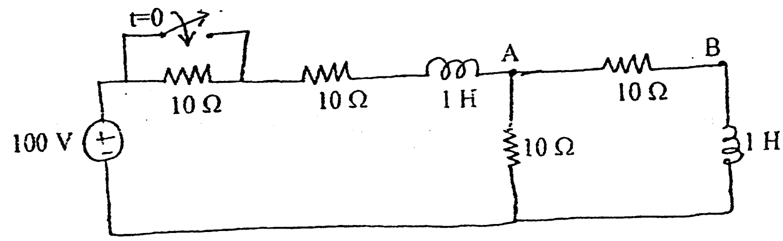
   b) In the circuit shown in figure below the switch is closed at $t = 0$, find the expression for $i_1(t)$ and $i_2(t)$ using Laplace transform method, if the circuit is unenergised before the switch is closed. [8]



3. a) Find the expression of output voltage V when the switch moved from position 1 to 2 after long time by using Laplace method. [6]

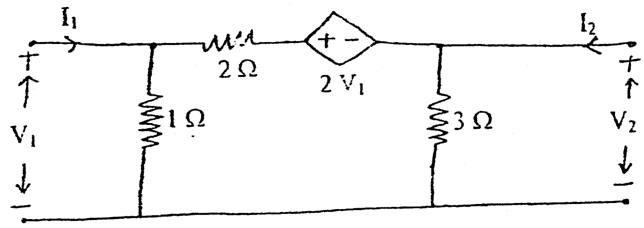


b) The network shown in figure below is under steady state condition. The switch is closed at t = 0. Determine the current through 10 Ω resistor connected between terminals AB. [use classical method] [6]

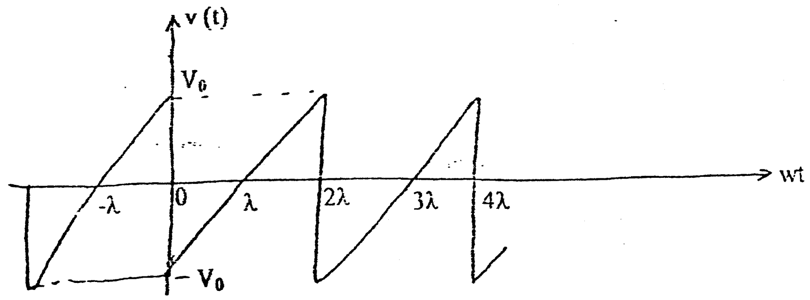


c) Express Transmission (ABCD) parameters of the two-port network in term of Y-parameters. [4]

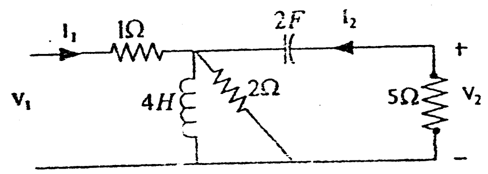
4. a) Find the Z-parameters of the circuit shown in figure below and also find whether the network is reciprocal or not. [8]



b) Find the trigonometric Fourier series for the Sawtooth Wave shown in figure below and also plot the line spectrum. [8]



5. a) In the given network determine $G_{21}(S)$, $Z_{11}(S)$ and $\alpha_{21}(S)$ [8]



b) For the network function given below draw the asymptotic Bode-plot. [8]

$$N(S) = \frac{210(S^2 + 45S + 200)}{S(S+20)(S^2 + 80S + 700)}$$

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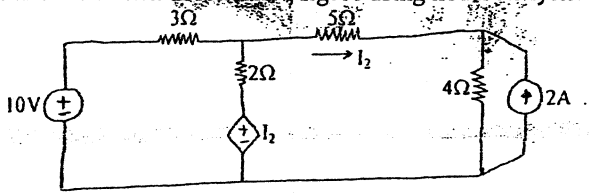
25 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2070 Ashad

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

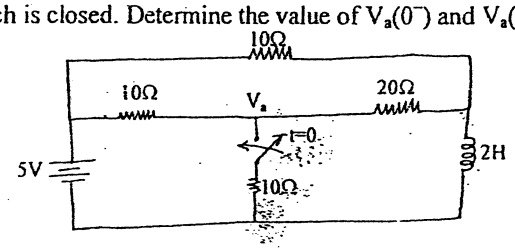
Subject: - Electric Circuit II (EG527EE)

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

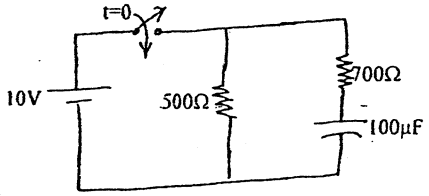
1. a) Find the current in each branch of following figure using nodal analysis. [8]



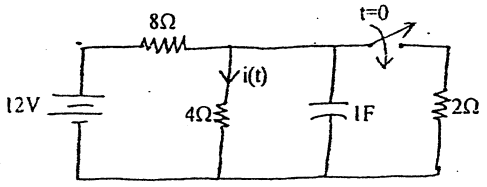
b) In the network shown in figure below, a steady state is reached with switch open. At t = 0, the switch is closed. Determine the value of $V_a(0^-)$ and $V_a(0^+)$. [8]



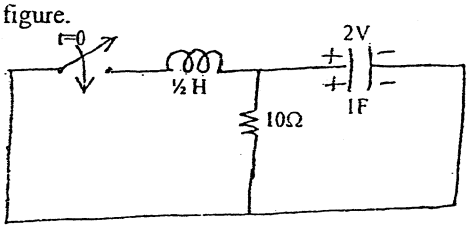
2. a) Using classical method, find the expression for the current supplied by the source in the network shown in figure. Also find the time taken by the source current to reach 25mA? [8]



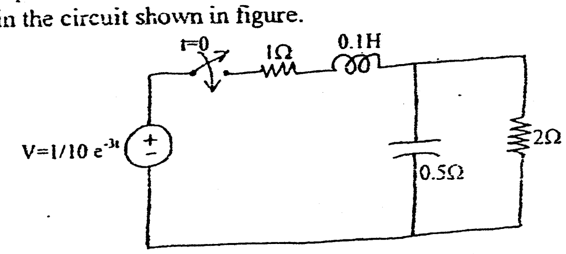
b) Using Laplace transform method, find the current i(t) for t>0 in the circuit shown in the figure below. [8]



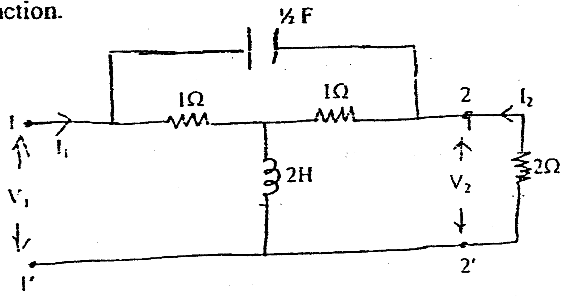
3. a) Using classical method find the expression for current through the inductor for t>0 in the circuit shown in figure. [8]



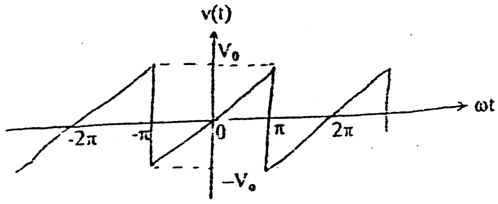
b) Using Laplace transform method, find the expression for current through 2Ω resistor for t>0 in the circuit shown in figure. [8]



4. a) For the two-port network, find the current ratio transfer function as well as voltage ratio transfer function. [8]



b) Find the trigonometric Fourier series for the waveform shown and also sketch the line spectrum. [8]

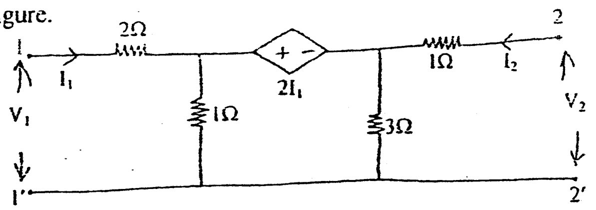


5. a) Sketch the asymptotic Bode-plot for the transfer function given by: [10]

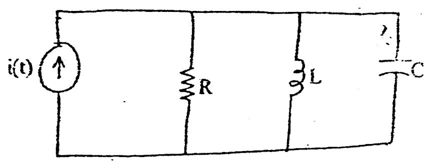
$$T(s) = \frac{10(S+10)}{S(S^2+5S+4)(S+40)}$$

b) Express transmission line parameters in terms of Y-parameter. [6]

6. a) Find the Z-parameter and T-parameter for the two-port network given in the following figure. [8]



b) Obtain the state model of the network shown in following figure. [8]



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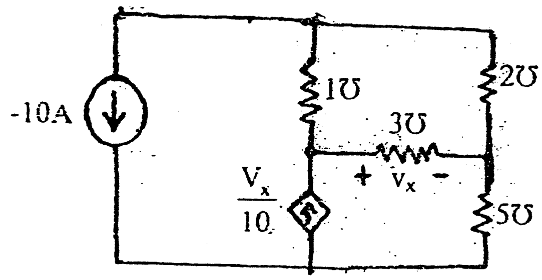
27 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2070 Chaitra

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

Subject: - Electric Circuit Theory *(EE501)*

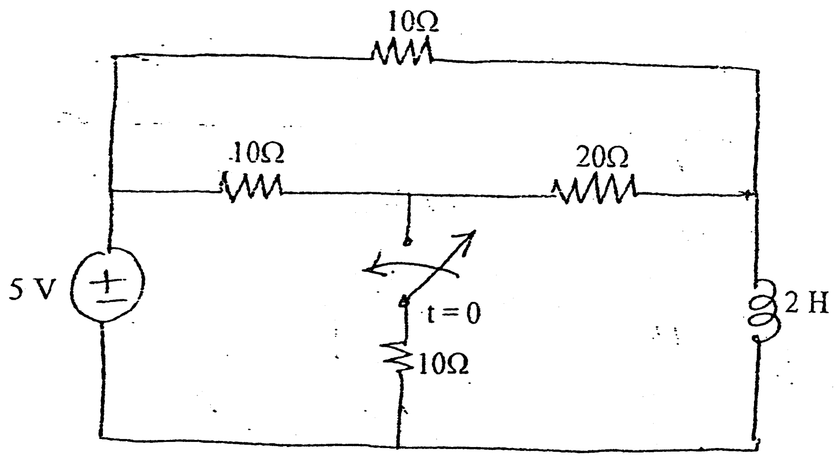
- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Semilog graph paper will be provided.*
- ✓ *Assume suitable data if necessary.*

1. a) In the network shown, find current through each resistor using nodal analysis. [6]

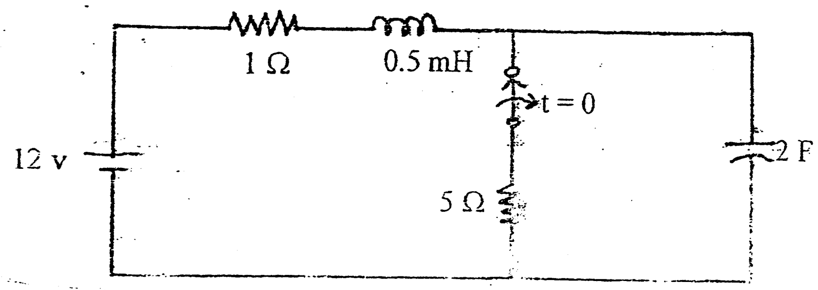


b) With the help of phasor diagram, explain the phenomenon of resonance of a parallel ac circuit and also derive the expression for the resonant frequency. [4]

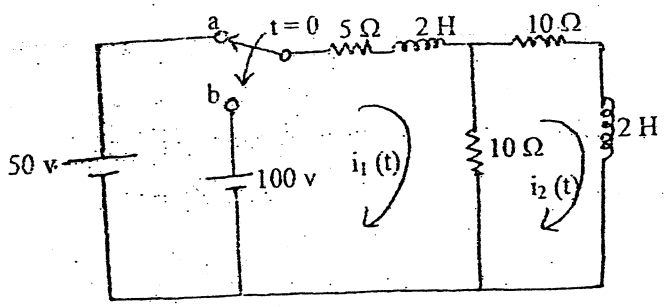
c) Find the voltage and current of each element at t = 0+ in the network of the following figure. [6]



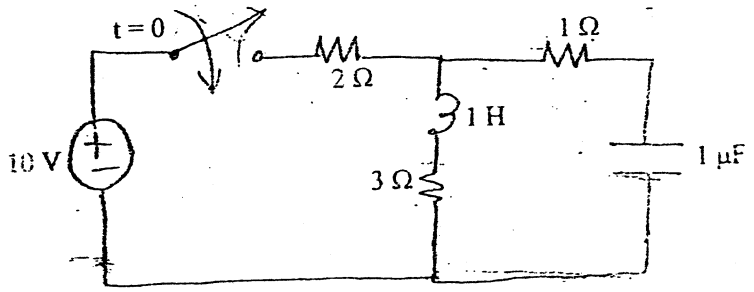
2. a) If the switch is opened at t = 0, find expression for voltage across capacitor in the circuit shown below using classical method. [8]



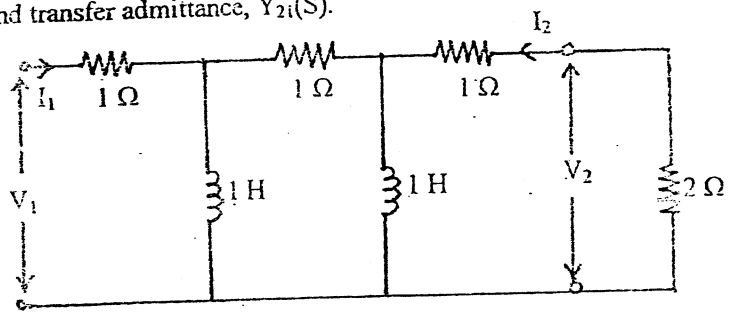
b) In the circuit shown, switch is changed from position "a" to "b" at t = 0. Find the expression for current $i_1(t)$ and $i_2(t)$ using Laplace transformation method. [8]



3. a) Using Laplace transform method find the current through inductor in the network shown in figure below. [6]

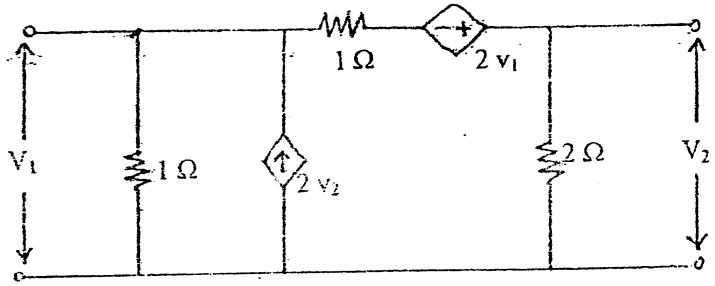


b) For the 2-port network shown in figure below, find voltage ratio transfer function. $G_{21}(S)$ and transfer admittance, $Y_{21}(S)$. [6]



c) Express transmission (ABCD) parameters of the Two port Network in terms of Z parameters. [4]

4. a) Determine Y-parameters of the 2-port network shown in figure below. [8]



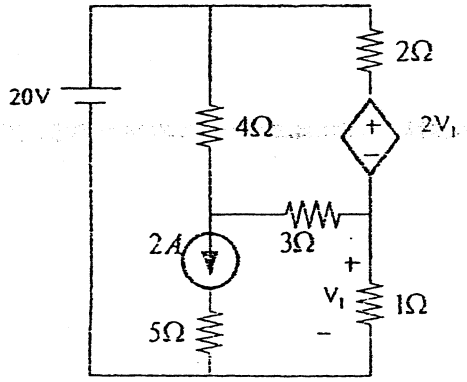
21 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2069 Chaitra

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

Subject: - Electrical Circuit Theory *(EE501)*

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

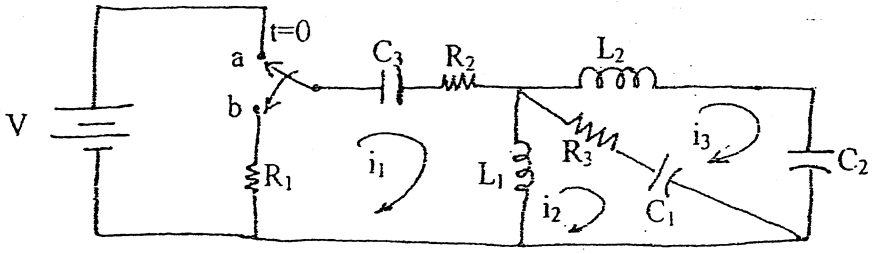
1. a) In the given circuit determine voltage across 1Ω resistor using mesh analysis method. [6]



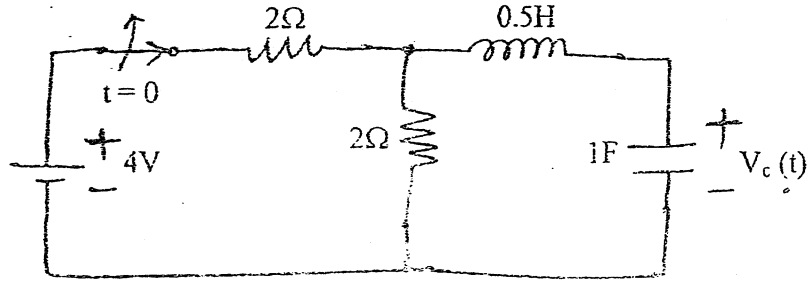
b) Explain the phenomenon of resonance in RLC series circuit. Derive the expression for resonant frequency, bandwidth, half power frequencies and quality factor. [6]

c) Derive an expression with necessary diagrams for resonance frequency of a circuit consisting of a coil in parallel with a capacitor excited by a sinusoidal AC voltage. [4]

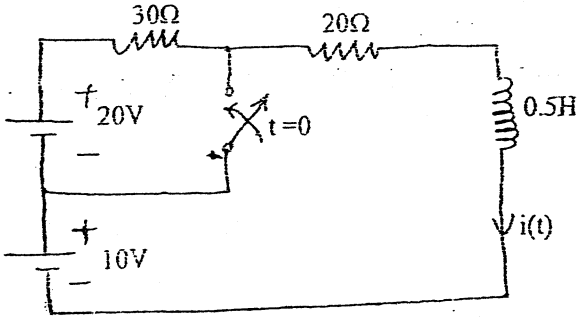
2. a) In the network shown in figure below the switch is changed from a to b at t = 0. Show that at $t = 0^+$ $i_1 = i_2 = -\dfrac{V}{R_1 + R_2 + R_3}$ and $i_3 = 0$. Also find the voltage across C_1, C_2, C_3, L_1 and L_2 at $t = 0^+$ [8]



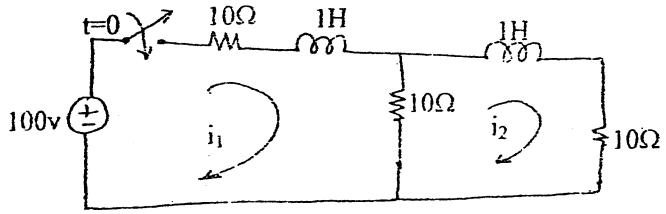
b) Switch in the circuit is suddenly opened at t = 0 after steady state has been reached in the closed position of the switch. Use classical method to determine the expression for voltage across capacitor for t > 0. [8]



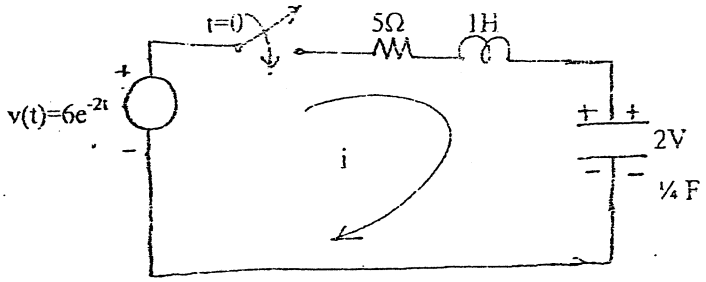
3. a) In the circuit shown switch is opened for a long time and then it is suddenly closed at t = 0. Obtain the expression for current through inductor for t > 0. Also calculate the voltage across inductor after 10mSec. [Use classical method] [8]



b) Using Laplace transform method, find the current i_1 and i_2 for t > 0 in the circuit of figure below. [8]

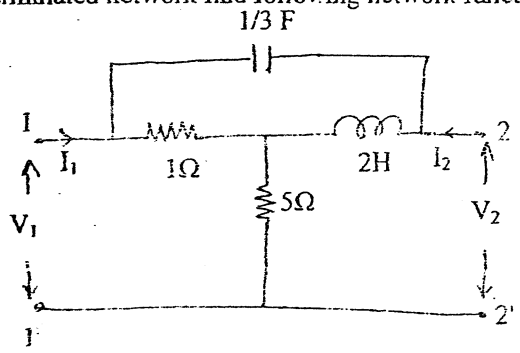


4. a) In a series RLC, as shown in figure below find the value of current for t > 0, also find the voltage across capacitor for t > 0, using Laplace transform method. [6]



b) With necessary circuit diagram, obtain the equivalent Y-parameter if three two-port networks are connected in parallel. [4]

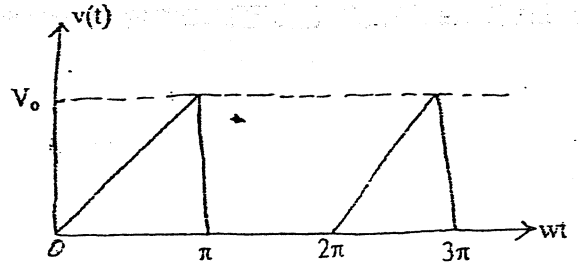
c) If the two port network, shown in figure below is terminated with a 2Ω resistor at port 2 then for this terminated network find following network function. (i) G_{21} (ii) α_{21} [6]



5. a) Sketch the asymptotic bode plots for the transfer function given by [8]

$$N(S) = \frac{10(S+10)}{S(S^2+5S+4)(S+40)}$$

b) Find the trigonometric Fourier series for the given waveform shown and also sketch the line spectrum. [8]



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21 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2068 Chaitra

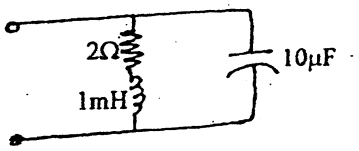
Exam.	Regular		
Level	BE	Full Marks	80
Programme	BEL, BEX, BCT	Pass Marks	32
Year / Part	II / I	Time	3 hrs.

Subject: - Electric Circuit Theory ***(EE 501)***

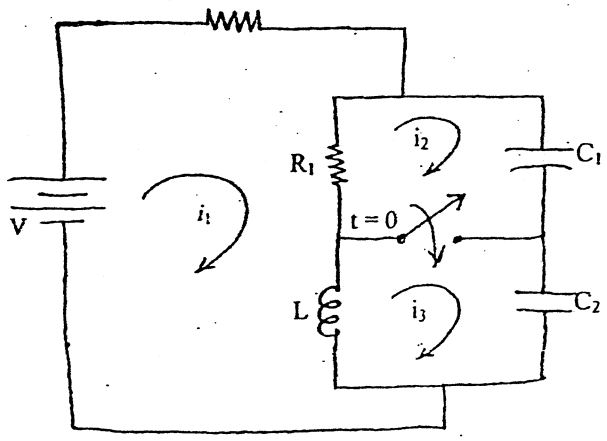
- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt any <u>All</u> questions.*
- ✓ *The figures in the margin indicate <u>Full Marks</u>.*
- ✓ *Assume suitable data if necessary.*

1. a) How does resonance occur in RLC series circuit? Define half power points and bandwidth for a series RLC circuit and derive the expression for them. [8]

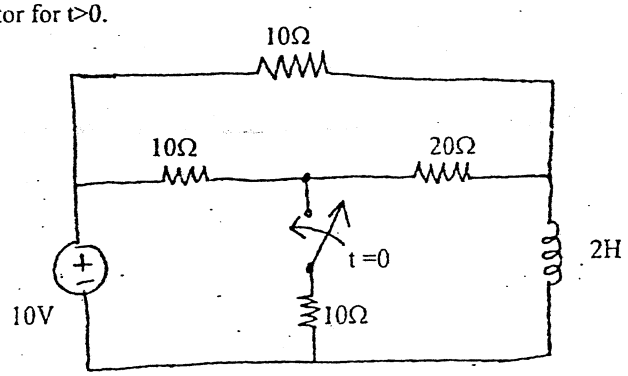
   b) In the parallel resonant circuit as shown in the figure below, find resonance frequency, Q factor and band width. [8]



2. a) For the circuit shown in following figure, find the current i_1, i_2, i_3 at $t = 0^+$. [8]

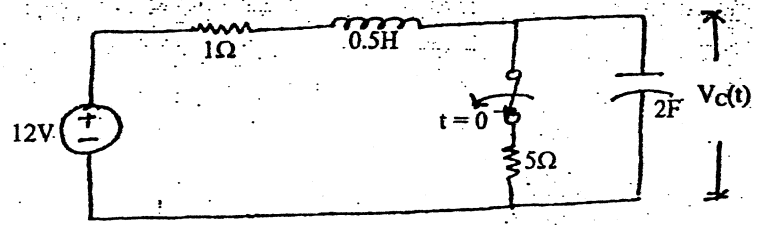


   b) For the circuit shown in following figure, use classical method to find the current in the inductor for t>0. [8]

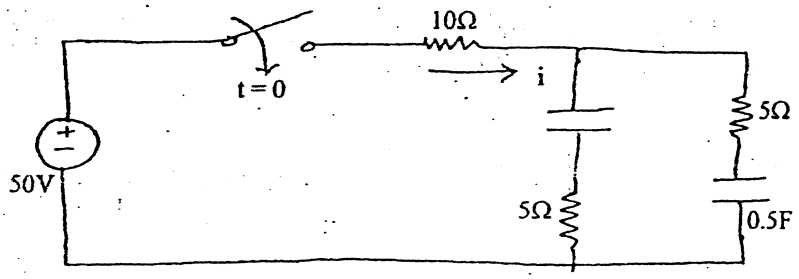


3. a) An exponential voltage $v(t) = 2e^{-4t}$ is applied at time t = 0 to a series R-L circuit comprising a resistor R = 1Ω and a inductor L = 0.25H. Obtain the particular solution for current i(t) through the circuit. Assume zero initial current through the inductor. Use classical approach. [8]

b) In the following network the switch was closed for a long time before it is being opened at t = 0. Find the expression for V_C (t) for t > 0. (Use classical method). [8]

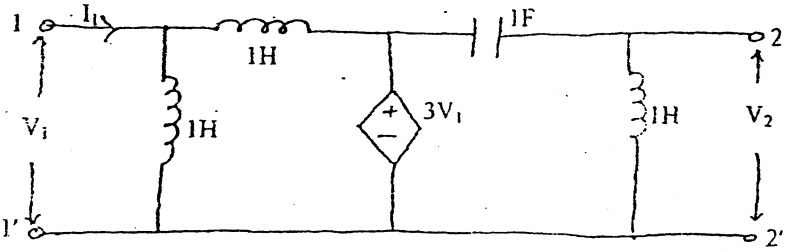


4. a) Using laplace transformation technique, find the expression for current i(t) in the network shown below for t > 0 when the switch is closed at t = 0. Assume zero initial charge across the capacitors. [6]



b) What do you understand by a reciprocal two port network? Derive the condition for reciprocity in terms of y-parameters. [4]

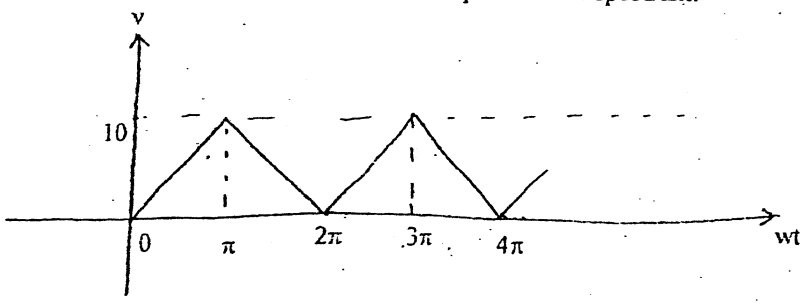
c) Find the Z-parameters in the network shown below and also check for its reciprocity and symmetricity. [6]



5. a) Sketch the asymptotic bode plots for the transfer function given by:

$$N(S) = \frac{2s^2(S+5)}{(S^2+22S+40)(S+10)}.$$ [8]

b) The following figure shows a voltage waveform in the form of a train of isosceles triangles. Determine the Fourier series and plot the line spectrum. [8]



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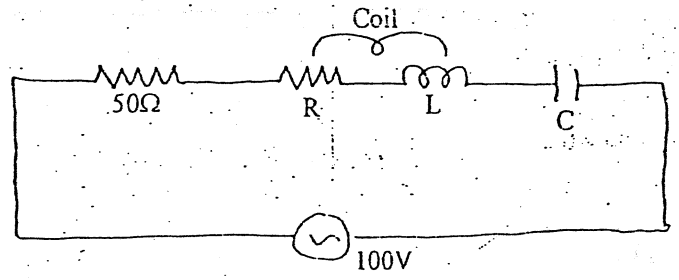
21 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2068 Baishakh

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

Subject: - Electric Circuit Theory

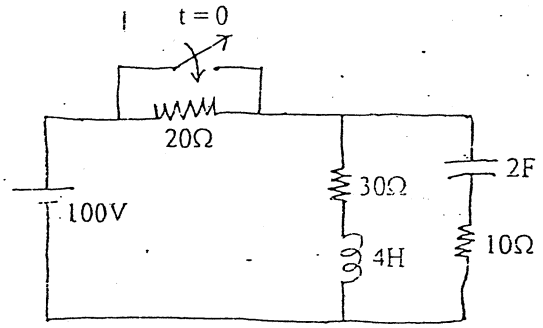
- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt All questions.*
- ✓ *The figures in the margin indicate Full Marks.*
- ✓ *Semilog graph paper is attached herewith.*
- ✓ *Assume suitable data if necessary.*

1. a) A 50Ω resistor is connected in series with a coil having resistance R and inductance L, a capacitor "C" and 100V variable frequency supply as shown in figure below. At a frequency of 200Hz, the maximum current of 0.7Amp flows through the circuit and voltage across the capacitor is 200V. Determine the value of R, L, and C. [6]

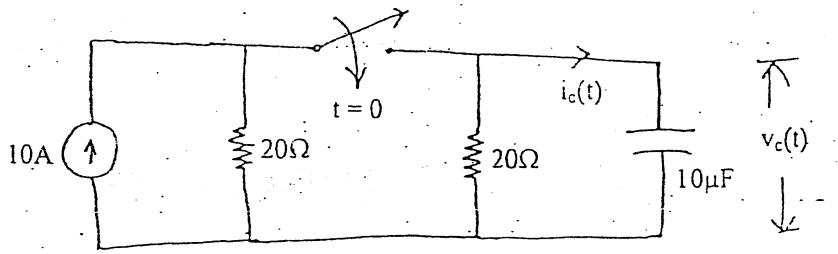


b) Explain the phenomenon of resonance of a parallel ac circuit and hence derive the expression for the resonant frequency. [6]

2. a) The switch has been opened for a long time as shown in figure below. At time t = 0, it is suddenly closed. At $t = 0^+$, find current through inductor, voltage across capacitor, charge across capacitor, current and voltage across each resistor. [8]

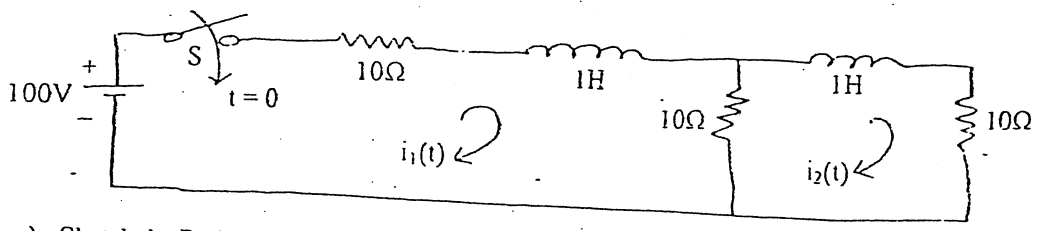


b) At t = 0, switch is closed in the circuit of figure below. Find the $V_c(t)$ and $i_c(t)$ using classical method. [8]



3. a) In a series R-L circuit the applied voltage is $v(t) = 10 \sin(10^6 t + \frac{\pi}{6})$ with R = 2Ω, L = 0.01H. v(t) is applied at t = 0. Obtain the particular solution for current i(t) through the circuit. Assume zero initial current through the inductor. [Use classical method]. [8]

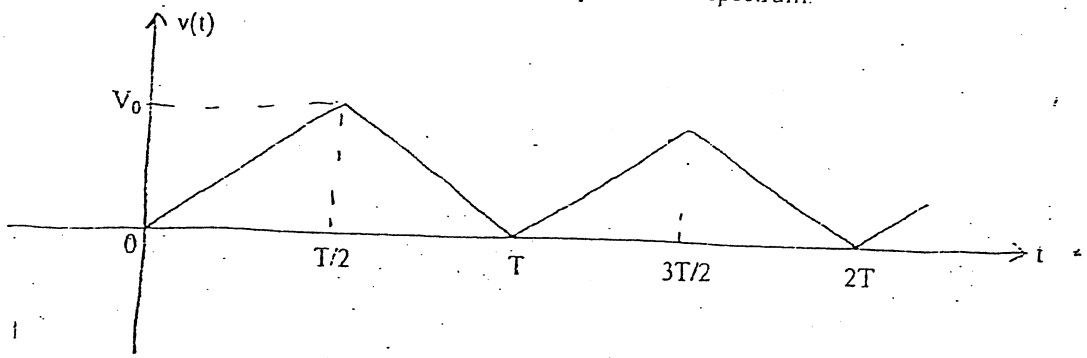
b) In the network shown below, the switch is closed at t = 0. With the network parameter values given, find the expression for $i_1(t)$ and $i_2(t)$ using Laplace transform method. The network is in energized before the switch is closed. [8]



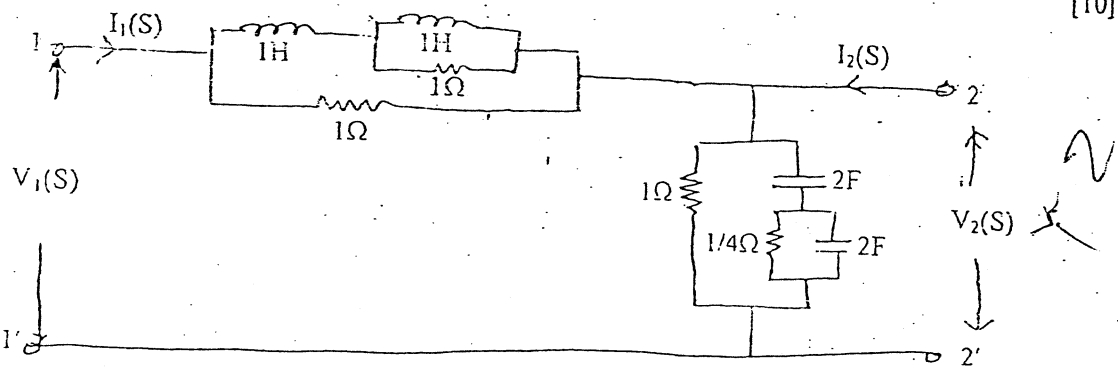
4. a) Sketch the Bode plots for the transfer function given by

$$N(S) = \frac{10(S+10)}{(S^2+40S)(S^2+5S+4)}$$ [8]

b) The given figure shows a voltage waveform in the form of a train of isosceles triangles. Determine the Fourier series and plot the line spectrum. [8]



5. a) For the two port network shown below, find the driving point impedance of port one and the voltage ratio transfer function. [10]



b) What do you understand by frequency response of networks and hence highlight the role of complex frequency in studying the frequency response. [6]

c) With necessary circuit diagram, obtain the equivalent Z - parameter if three two port networks are connected in series. [4]

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TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2079 Bhadra

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

Subject: - Engineering Mathematics III *(SH 501)*

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

1. Prove that $\begin{vmatrix} a^3 & 3a^2 & 3a & 1 \\ a^2 & a^2+2a & 2a+1 & 1 \\ a & 2a+1 & a+2 & 1 \\ 1 & 3 & 3 & 1 \end{vmatrix} = (a-1)^6$ by using properties of determinate. [5]

2. Define transpose of a matrix. Prove that the transpose of the product of two matrices is the product of their transpose taken in reverse order. [1+4]

3. Find the rank of the matrix $\begin{bmatrix} 1 & 0 & -5 & 6 \\ 3 & -2 & 1 & 2 \\ 3 & -2 & -9 & 14 \\ 4 & -2 & -4 & 8 \end{bmatrix}$ by reducing it into normal form. [5]

4. State Cayley-Hamilton Theorem. Use it to find the inverse of the matrix: [1+4]

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

5. Prove that the line integral $\int_c \vec{F}.d\vec{r}$ of a continuous vector function $\vec{F}$ defined in a region R is independent of the path C joining any two points in R if and only if there exists a single valued scalar function ϕ, having first order partial derivatives such that $\vec{F} = \nabla\phi$. [5]

6. Evaluate $\iint_S \vec{F}.\vec{n}\, ds$ where $\vec{F} = y^2z^2\vec{i} + z^2x^2\vec{j} + x^2y^2\vec{k}$ and S is the surface of the sphere $x^2 + y^2 + z^2 = 1$ above the xy-plane. [5]

7. Apply Green's theorem in plane to evaluate, $\int_c \vec{F}.d\vec{r}$ where $\vec{F} = (x^2 - xy^3)\vec{i} + (y^2 - 2xy)\vec{j}$ and C is a square with vertices (0, 0), (2, 0), (2, 2), (0, 2). [5]

8. Verify the stroke's theorem for $\vec{F} = (x^2 + y^2)\vec{i} - 2xy\vec{j}$ taken round the rectangle bounded by the lines $x = \pm a$, $y = 0$, $y = b$. [5]

9. Define Laplace transform of function f(t). Find the Laplace transform of [1+2+2]

a) $te^{-4t}\sin 3t$ b) $\frac{1-e^t}{t}$

10. Find the inverse Laplace transform of: [2+3]

a) $\frac{s^2}{(s+2)^3}$ b) $\tan^{-1}\frac{2}{s}$

11. Solve the following initial value problem by using Laplace transform

$y'' + 2y' - 3y = \sin t$, $y(0) = y'(0) = 0$. [5]

12. Find the Fourier series of the function $f(x) = \frac{(\pi - x)^2}{4}$ in the interval $0 \le x \le 2\pi$. [5]

13. Obtain the half-range Fourier cosine series of sinx in the interval $0 \le x \le \pi$. [5]

14. Solve the linear programming problem maximize by simplex method [7]

Maximize: $Z = 10x_1 + x_2 + 2x_3$
Subject to: $x_1 + x_2 - 2x_3 \le 10$
$4x_1 + x_2 + x_3 \le 20$
and $x_1, x_2, x_3 \ge 0$.

15. Solve the linear programming problem by simplex method using two phase method: [8]

Maximize $Z = 3x_1 - x_2$
Subject to $2x_1 + x_2 \ge 2$
$x_1 + 3x_2 \le 2$
$x_2 \le 4$; $x_1, x_2 \ge 0$.

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TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2079 Baishakh

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

Subject: - Engineering Mathematics III (*SH 501*)

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

1. Applying properties of determinant, prove that $\begin{vmatrix} a & b & a & a \\ a & b & b & b \\ b & b & b & a \\ a & a & b & a \end{vmatrix} = -(b-a)^4$. [5]

2. Prove that every square matrix can be uniquely expressed as the sum of symmetric and skew-symmetric matrices. [5]

3. Find the rank of the augmented matrix and test the consistency of the system of linear equations $x+9y-z = 27$, $x-8y+16z = 10$, $2x+y+15z = 37$. Also find the solution if the system is consistent. [5]

4. State Cayley-Hamilton theorem and use it to find the inverse of the matrix: [5]
$$\begin{bmatrix} -2 & 2 & -3 \\ 2 & 1 & -6 \\ -1 & -2 & 0 \end{bmatrix}$$

5. If $\vec{F} = 3x^2yz^2\vec{i} + x^3z^2\vec{j} + 2x^3yz\vec{k}$, show that $\int_C \vec{F}.d\vec{r}$ is independent of the path of integration. Hence evaluate the integral on any path C from P: (0,0,0) to Q: (1,2,3). [3+2]

6. Evaluate the flux of $\vec{F} = (x+y^2)\hat{i} - 2x\hat{j} + 2yz\hat{k}$ over the surface of the plane $2x + y + 2z = 6$ lying in the first octant. [5]

7. State and prove the Green's theorem in plane. [5]

8. State stoke's theorem. Apply it to evauate $\iint_S (\nabla \times \vec{F})\vec{n}\, ds$ where $\vec{F} = (2x-y)\vec{i} - yz^2\vec{j} - y^2z\vec{k}$, S is the upper half surface of the sphere $x^2+y^2+z^2 = a^2$ and C is its boundary. [1+4]

9. Find the Laplace transform of: (i) Sinhat Cosbt (ii) $\frac{e^{-at} - e^{-bt}}{t}$ [5]

10. What do you mean by convolution of two functions f (t) and g(t)? Hence or otherwise find the inverse Laplace transform of $\frac{s^2}{(s^2+4)(s^2+9)}$ [1+4]

11. Using laplace transform, solve the initial value problem:
$y'' + 2y' + 2y = 5\sin x$, $y(0) = y'(0) = 0$. [5]

12. Find the Fourier series to represent $f(x) = x - x^2$ from $-\pi$ to π and deduce that: [5]

$$\frac{\pi^2}{12} = \frac{1}{1^2} - \frac{1}{2^2} + \frac{1}{3^2} - \frac{1}{4^2} + \cdots$$

13. Find half range sine as well as cosine series for $f(x) = e^x$ in (0,2). [2+3]

14. Solve the following LPP by the simplex method: [7]

Maximize, $P = -x_1+2x_2$

Subject to :

$$-x_1 + x_2 \leq 2$$
$$-x_1 + 3x_2 \leq 12$$
$$x_1 - 4x_2 \leq 4$$
$$x_1 \geq 0, x_2 \geq 0$$

15. Solve the following LPP by Big-M, method: [8]

Maximize, $P = 2x_1+5x_2$

Subject to :

$$x_1 + 2x_2 \leq 18$$
$$2x_1 + x_2 \leq 21$$
$$x_1 + x_2 \geq 10$$
$$x_1 \geq 0, x_2 \geq 0$$

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TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2078 Bhadra

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

Subject: - Engineering Mathematics III *(SH 501)*

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

1. Use the Properties of determinant to show that:
$$\begin{vmatrix} (a+b)^2 & ca & bc \\ ca & (b+c)^2 & ab \\ bc & ab & (c+a)^2 \end{vmatrix} = 2abc\,(a+b+c)^3$$ [5]

2. Define Hermitian and Skew-Hermitian of a square complex matrix. If A is any square matrix, prove that $A + A^*$ is Hermitian and $A - A^*$ is Skew – Hermitian matrix. [5]

3. Test the consistency of the system by matrix rank method and solve it completely if consistent: [5]
$x+2y-z=0,\ 2x+3y+z=10,\ 3x-y-7z=1$

4. Find the eigenvalues of the matrix $A=\begin{bmatrix} 1 & 0 & -1 \\ 1 & 2 & 1 \\ 2 & 2 & 3 \end{bmatrix}$ and use them to compute

(i) eigenvalues of A-1
(ii) determinant of A
(iii)eigenvalues of adj A [2+1+1+1]

5. Evaluate $\int_C \vec{F}.d\vec{r}$ where $\vec{F}=\sin y\,\vec{i}+x(1+\cos y)\vec{j}$ and C is the circular path given by $x^2 + y^2 = a^2, z = 0$. [5]

6. Evaluate $\iint_S \vec{F}.\vec{n}\,ds$ where $\vec{F}=yz\,\vec{i}+zx\,\vec{j}+xy\,\vec{k}$ where S is the surface of the sphere $x^2+y^2+z^2=1$ in the first octant. [5]

7. Apply Green's Theorem in plane to compute the area of the curve $\left(\frac{x}{a}\right)^{2/3}+\left(\frac{y}{b}\right)^{2/3}=1$. [5]

8. State Gauss divergence theorem in vector calculus. Apply it to evaluate $\iint_s \left[(x^3-yz)\vec{i}-2x^2y\vec{j}+2\vec{k}\right].\vec{n}\,ds$ where S denote the surface of the cube bounded by the planes $x=0, x=a, y=0, y=a, z=0, z=a$. [1+4]

9. State the condition for existence property of Laplace transform. Find the Laplace transform of: (a) $\frac{1}{\sqrt{t}}$ (b) $\frac{1-\cos 2t}{t}$ [1+2+2]

10. State the convolution theorem for inverse Laplace transform and use it to find the inverse Laplace transform of $\frac{s}{(s^2+1)(s^2+4)}$. [5]

11. Solve the initial value problem by applying Laplace transform: [5]

$y'' - 10y' + 9y = 5t$, $y(0) = -1$, $y'(0) = 2$.

12. Obtain the Fourier series of $f(x) = x + x^2$ in $-\pi \le x \le \pi$. [5]

13. Express $f(x) = x^2$ as a half-range sine series in $0 < x < 3$. [5]

14. Solve following LPP by the Simplex method: [7]

Maximize, $P = x_1 + x_2$

Subject to : $2x_1 + x_2 \le 16$

$x_1 \le 6$

$x_2 \le 10$

$x_1 \ge 0,\ x_2 \ge 0$

15. Solve following LPP by the Dual Method: [8]

Minimize, $C = 21x_1 + 50x_2$

Subject to : $2x_1 + 5x_2 \ge 12$

$3x_1 + 7x_2 \ge 17$

$x_1 \ge 0,\ x_2 \ge 0$

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TRIBHUVAN UNIVERSITY
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Examination Control Division
2078 Kartik

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

Subject: - Engineering Mathematics III *(SH 501)*

- ✓ Candidates are required to give their answers in 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 $\begin{vmatrix} a & a^2 & a^3-1 \\ b & b^2 & b^3-1 \\ c & c^2 & c^3-1 \end{vmatrix} = 0$; where $a \neq b \neq c$, apply the properties of determinants to show abc = 1. [5]
2. Define an orthogonal matrix. Prove that the product of two orthogonal matrices of the same order is also orthogonal. [5]
3. For the matrix $= \begin{bmatrix} 5 & 4 \\ 1 & 2 \end{bmatrix}$, find the modal matrix and the corresponding diagonal matrix. [5]
4. State Cayley-Hamilton theorem and verify the theorem for the square matrix $A = \begin{bmatrix} 1 & 3 & 7 \\ 4 & 2 & 3 \\ 1 & 2 & 1 \end{bmatrix}$. [5]
5. Prove that "for any simple closed curve C, the line integral $\int_A^B \vec{F}.d\vec{r}$ is independent of the path joining the points A and B in the region if and only if $\int_C \vec{F}.d\vec{r} = 0$. [5]
6. State Green's theorem in the plane. Using Green's theorem find the area of the hypocycloid $\left(\frac{x}{a}\right)^{2/3} + \left(\frac{y}{b}\right)^{2/3} = 1$. [5]
7. Evaluate $\iint_S \vec{F}.\vec{n}\,ds$ by Gauss' divergence theorem, where $\vec{F} = x\,\vec{i} - y\,\vec{j} + (z^2-1)\,\vec{k}$ and S is the cylinder formed by the surfaces $x^2 + y^2 = 4$, $z = 0$, $z = 1$. [5]
8. Verify Stoke's theorem for $\vec{F} = (x^2 - y^2)\vec{i} + 2xy\vec{j}$ taken over the rectangular bounded by the lines $x = 0$, $x = a$, $y = 0$, $y = b$. [5]
9. Define Laplace transform of f(t). Find the Laplace transform of:

   a) $t\,e^{-t}\cosh t$ b) $\frac{\sin t \sin 5t}{t}$ [1+1.5+2.5]
10. Find the inverse Laplace transform of:

    a) $\log\frac{s}{s+1}$ b) $\frac{1}{(s-2)(s^2+1)}$ [2.5+2.5]
11. Solve the initial value problem $y'' + 4y' + 3y = 0$, $y(0) = 3$, $y'(0) = 1$ by using Laplace transform. [5]
12. Find the Fourier series of $f(x) = 2x - x^2$ in (0, 2). [5]
13. Obtain the half range sine series for $f(x) = e^x$ in $0 < x < 1$. [5]
14. Use Simplex method to solve following LPP: [7]

    Maximize, $P = 50x_1 + 80x_2$
    Subject to : $x_1 + 2x_2 \leq 32$
    $3x_1 + 4x_2 \leq 84$
    $x_1, x_2 \geq 0$
15. Solve the following LPP by using big M method: [8]

    Maximize, $P = 2x + y$
    Subject to: $x + y \leq 10$
    $-x + y \geq 2$
    $x, y \geq 0$

TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2076 Chaitra

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

Subject: - Engineering Mathematics III *(SH 501)*

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

1. Prove that $\begin{vmatrix} 1+a^2-b^2 & 2ab & -2b \\ 2ab & 1-a^2+b^2 & 2a \\ 2b & -2a & 1-a^2-b^2 \end{vmatrix} = (1+a^2+b^2)^3$ by using the properties of determinants. [5]

2. Prove that every square complex matrix can uniquely be expressed as a sum of a Hermitian and a skew-Hermitian matrix. [5]

3. Reduce the matrix $\begin{bmatrix} 1 & 0 & -5 & 6 \\ 3 & -2 & 1 & 2 \\ 5 & -2 & -9 & 14 \\ 4 & -2 & -4 & 8 \end{bmatrix}$ into normal form and hence find its rank. [5]

4. Find the eigen values and eigen vectors of the matrix $\begin{bmatrix} 2 & 0 & 1 \\ 0 & 2 & -1 \\ 0 & 0 & 2 \end{bmatrix}$ and also fnd its modal matrix. [5]

5. If $\vec{F} = 3x^2yz^2\,\vec{i} + x^3z^2\,\vec{j} + 2x^3yz\,\vec{k}$, show that $\int_c \vec{F}.d\vec{r}$ is independent of the path of integration. Hence evaluate the integral on any path C from (0, 0, 0) to (1, 2, 3). [5]

6. Verify Green's Theorem in plane for $\int_c [(x-y)\,dx + (x+y)\,dy]$ where c is the boundary of the region enclosed by $y^2 = x$ and $x^2 = y$. [5]

7. Evaluate $\iint_s \vec{F}.\vec{n}\,ds$ where $\vec{F} = 4x\,\vec{i} - 2y^2\,\vec{j} + z^2\,\vec{k}$ taken over the region bounded by the cylinder $x^2 + y^2 = 4$ and the planes $z = 0, z = 3$. [5]

8. Evaluate $\int_c \vec{F}.d\vec{r}$, where c is the rectangle bounded by the lines $x = \pm a, y = 0, y = n$ and $\vec{F} = (x^2+y^2)\,\vec{i} - 2xy\,\vec{j}$. [5]

9. State the condition for existence of Laplace transform. Obtain the Laplace transform of:

   a) $\cos^3 2t$ (b) $\frac{\cos at - \cos bt}{t}$ [1+1.5+2.5]

10. Find the inverse Laplace transform of:

a) $\frac{s+3}{(s^2+6s+13)^2}$ b) $\frac{e^{-2s}}{(s+1)(s^2+2s+2)}$ [2+3]

11. Solve the differential equation $y''+2y'-3y=\sin t$ under the conditions $y(0)=y'(0)=0$ by using Laplace transform. [5]

12. Obtain the Fourier series to represent the function $f(x)=e^x$ for $-\pi \le x \le \pi$. [5]

13. Obtain the half range cosine series for the function $f(x)=x\sin x$ in the interval $(0, \pi)$. [5]

14. Use Simplex method to solve following LPP:

Maximize, $P = 30x_1 + x_2$

Subject to : $2x_1 + x_2 \le 10$
$x_1 + 3x_2 \le 10$
$x_1, x_2 \ge 0$ [7]

15. Use Big M method to solve following LPP:

16. Minimize, $Z = 4x_1 + 2x_2$

Subject to : $3x_1 + x_2 \ge 27$
$-x_1 - x_2 \le -21$
$x_1 + 2x_2 \ge 30$
$x_1, x_2 \ge 0$ [8]

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TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2076 Ashwin

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

Subject: - Engineering Mathematics III *(SH 501)*

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

1. Prove that: $\begin{vmatrix} (b+c)^2 & c^2 & b^2 \\ c^2 & (c+a)^2 & a^2 \\ b^2 & a^2 & (a+b)^2 \end{vmatrix} = 2(ab+bc+ca)^2$ [5]

2. Prove that the necessary and sufficient condition for a square matrix A to possess an inverse is that $|A| \neq 0$. [5]

3. Find the rank of the matrix $\begin{bmatrix} 2 & -2 & 0 & 6 \\ 4 & 2 & 0 & 2 \\ 1 & -1 & 0 & 3 \\ 1 & -2 & 1 & 2 \end{bmatrix}$ by reducing it to normal form. [5]

4. State any two properties of eigen values of a matrix. Obtain eigen values and eigen vectors of the matrix $\begin{bmatrix} -2 & 2 & -3 \\ 2 & 1 & -6 \\ -1 & -2 & 0 \end{bmatrix}$ [1+4]

5. Prove that the line integral $\int_A^B \vec{F}.d\vec{r}$ is independent of path joining any two points A and B in the region if and only if $\int_C \vec{F}.d\vec{r} = 0$ for any simple closed curve C in the region. [5]

6. State Green's Theorem and use it to find the area of the curve $\left(\frac{x}{a}\right)^{2/3} + \left(\frac{y}{b}\right)^{2/3} = 1$. [1+4]

7. Use Gauss' divergence theorem to evaluate $\iint_S \vec{F}.\hat{n}ds$ where $\vec{F} = (2xy+z)\vec{i} + y^2\vec{j} - (x+3y)\vec{k}$ and S is the surface bounded by the plane 2x+3y+z=6, x=0, y=0, z=0. [5]

8. Verify Stoke's Theorem for the vector field $\vec{F} = (2x-y)\vec{i} - yz^2\vec{j} - y^2z\vec{k}$ over the upper half of the sphere $x^2+y^2+z^2=1$ bounded by its projection on xy-plane. [5]

9. Find the Laplace transform of: [2+3]

   i) $t^2\cos at$

   ii) $\frac{1-\cosh(at)}{t}$

10. Find the inverse Laplace transform of : [2+3]

i) $\frac{e^{-\pi s}(s+1)}{s^2+2s+2}$

ii) $\tan^{-1}\frac{2}{s}$

11. Solve the differential equation $y''+3y'+2y=e^{-t}$, $y(0)=y'(0)=0$ by applying Laplace transform. [5]

12. Find the Fourier Series of the function $f(x)=|\sin x|$ for $-\pi \le x \le \pi$. [5]

13. If $f(x) = lx-x^2$ in $(0,1)$, show that the half range sine series for $f(x)$ is $\frac{8l^2}{\pi^3}\sum_{n=0}^{\infty}\frac{1}{(2n+1)^3}\sin(2n+1)\frac{\pi x}{l}$. [5]

14. Find the maximum and minimum values of the function $z=20x+10y$ subject to: $x+2y\le 40$, $3x+y\ge 30$, $4x+3y \ge 60$, $x,y\ge 0$ by graphical method. [5]

15. Solve the following linear programming problem using big M method:

Maximize $P=2x_1+5x_2$

subject to : $x_1+2x_2 \le 18$

$2x_1+x_2 \ge 21$

$x_1, x_2 \ge 0$. [10]

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TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2075 Chaitra

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

Subject: - Engineering Math III *(SH 501)*

- ✓ Candidates are required to give their answers in 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 $\begin{vmatrix} a & a^2 & a^3-1 \\ b & b^2 & b^3-1 \\ c & c^2 & c^3-1 \end{vmatrix} = 0$, where $a \neq b \neq c$ show that abc=1. [5]

2. If A is a square matrix of order n, prove that A(adj. A) = (adj. A)A = $|A|I_n$, where I_n is a unit matrix having same order as A. [5]

3. Test the consistency of the system by matrix rank method and solve completely if found consistent: x+2y-z=3, 2x+3y+z=10, 3x-y-7z=1 [5]

4. State Cayley-Hemilton Thorem and verify it for the matrix $A=\begin{bmatrix} 1 & 0 & -1 \\ 1 & 2 & 1 \\ 2 & 2 & 3 \end{bmatrix}$ [1+4]

5. A vector field is given by $\vec{F} = \sin y\vec{i} + x(1+\cos y)\vec{j}$. Evaluate the line integral $\int_c \vec{F}.d\vec{r}$ over the circular path c given by $x^2+y^2=a^2$, z=0. [5]

6. State and prove Green's Theorem in plane. [1+4]

7. Evaluate $\iint_S \vec{F}.\vec{n}\,ds$ for $\vec{F} = yz\vec{i} + zx\vec{j} + xy\vec{k}$ where S is the surface of the sphere $x^2+y^2+z^2=1$ in the first octant. [5]

8. State Stoke's theorem. Evaluate $\oint_c (xydx + xy^2dy)$ by Stoke's theorem taking c to be a square in the xy-plane with vertices (1,0),(-1,0),(0,1) and (0,-1). [1+4]

9. Find the Laplace transform of : [2+3]
   i) $te^{-t}\sin t$
   ii) $\dfrac{\cos 2t - \cos 3t}{t}$

10. Find the inverse Laplace transform of : [2+3]
   i) $\dfrac{s+2}{(s+1)^4}$
   ii) $\cot^{-1}(s+1)$

11. Solve the differential equation y"+y=sin3t, y(0)=y'(0)=0 by using Laplace transform. [5]

12. Define Fourier Series for a function f(x). Obtain Fourier series for $f(x)=x^3$; $-\pi \le x \le \pi$. [5]

13. Express $f(x)=e^x$ as the half range Fourier Sine series in $0<x<1$. [5]

14. Find the maximum and minimum values of the function $z = 50x_1 + 80x_2$ subject to: $x_1 + 2x_2 \le 32$, $3x_1 + 4x_2 \le 84$, $x_1x_2 \ge 0$; by graphical method. [5]

15. Solve the following Linear Programming problem using big M method: [10]
   Maximize $P= 2x_1+x_2$
   Subject to : $x_1+x_2 \le 10$
   $-x_1+x_2 \ge 2$
   $x_1, x_2 \ge 0$

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02 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2075 Ashwin

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

Subject: - Engineering Mathematics III *(SH501)*

- ✓ Candidates are required to give their answers in 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 determinant as a function and using its properties. Show that

$$\begin{vmatrix} b+c & c+a & a+b \\ q+r & r+p & p+q \\ y+z & z+x & x+y \end{vmatrix} = 2\begin{vmatrix} a & p & x \\ b & q & y \\ c & r & z \end{vmatrix}$$ [5]

2. If A and B are orthogonal matrices of same order, prove that the product AB is also orthogonal. [5]
3. Test the consistency of the system $x-2y+2z=4$, $3x+y+4z=6$ and $x+y+z=1$ and solve completely if found consistent. [5]
4. For a matrix $A=\begin{pmatrix} 5 & 4 \\ 1 & 2 \end{pmatrix}$, find the modal matrix and the corresponding diagonal matrix. [5]
5. Prove that line integral $\int_A^B \vec{F}.d\vec{r}$ is independent of path joining any two points A and B in the region if and only if $\int_C \vec{F}.d\vec{r}=0$ for any simple closed curve C in the region. [5]
6. Verify Green's theorem in the plane for $\int_C [(3x^2-8y^2)dx+(4y-6xy)dy]$ where C is region bounded by $y=x^2$ and $x=y^2$. [5]
7. Evaluate $\iint_S \vec{F}.\vec{n}\,ds$ where $\vec{F}=6z\vec{i}-4\vec{j}+y\vec{k}$ and S is the region of the plane $2x+3y+6z=12$ bounded in the first octant. [5]
8. Evaluate using Gauss divergence theorem, $\iint_S \vec{F}.\vec{n}\,ds$ where $\vec{F}=x^2y\vec{i}+xy^2\vec{j}+2xyz\vec{k}$ and S is the surface bounded by the planes $x=0, y=0, z=0, x+2y+z=2$. [5]
9. Obtain the Fourier Series to represent $f(x)=x-x^2$ from $x=-\pi$ to $x=\pi$ and deduce that

$$\frac{\pi^2}{12}=\frac{1}{1^2}-\frac{1}{2^2}+\frac{1}{3^2}-\frac{1}{4^2}+\ldots\ldots$$ [5]

10. Obtain the half range Fourier Sine Series for $f(x)=\pi-x$ in the range $0<x<\pi$. [5]
11. State the conditions for existence of Laplace transform. Obtain the Laplace transform of:

(i) $e^{2t}\cos^3 2t$ (ii) $\frac{\cos 2t-\cos 3t}{t}$ [1+2+2]

12. Find the inverse Laplace transform of: [2.5+2.5]

(i) $\frac{1}{(S-2)(S^2+1)}$ (ii) $\cot^{-1}(S+1)$

13. Solve the following intial value problem by using Laplace transform: [5]

$y'' + 4y' + 3y = e^t$, $y(0) = 0; y'(0) = 2$

14. Graphically maximize $Z = 7x_1 + 10x_2$

Subject to constraints: [5]

$$3x_1 + x_2 \leq 9$$
$$x_1 + 2x_2 \leq 8$$
$$x_1, x_2 \geq 0.$$

15. Solve the following linear Programming Problem by simple method:

Maximize: $Z = 3x_1 + 5x_2$

Subject to: [10]

$$3x_1 + 2x_2 \leq 18$$
$$x_1 \leq 4,\ x_2 \leq 6$$
$$x_1, x_2 \geq 0.$$

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01 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2074 Chaitra

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

Subject: - Engineering Mathematics III *(SH501)*

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

1. If $\begin{vmatrix} a & a^2 & a^3-1 \\ b & b^2 & b^3-1 \\ c & c^2 & c^3-1 \end{vmatrix} = 0$ where $a \neq b \neq c$; apply properties of determinant to show abc = 1. [5]

2. If A be an n × n matrix, prove that

   Adj (A) . A = A . (AdjA) = $|A|I$ where I is an n × n unit matrix. [5]

3. Find the rank of the following matrix by reducing it into normal form:

$$\begin{pmatrix} 3 & 1 & 4 \\ 0 & 5 & 8 \\ -3 & 4 & 4 \\ 1 & 2 & 4 \end{pmatrix}$$ [5]

4. Find the modal matrix for the matrix

$$A = \begin{pmatrix} 2 & 1 & 1 \\ -2 & 1 & 3 \\ 2 & 1 & -1 \end{pmatrix}$$ [5]

5. State and prove Green's theorem in plane. [5]

6. Find the total work done in moving the particle in a force field given by $\vec{F} = \sin y\,\vec{i} + x(1+\cos y)\,\vec{j}$ over the circular path $x^2 + y^2 = a^2,\ z = 0$. [5]

7. Evaluate $\iint_S \vec{F}.d\vec{s}$ where $\vec{F} = x\,\vec{i} - y\,\vec{j} + z\,\vec{k}$ and s is the surface of the cylinder $x^2 + y^2 = a^2, 0 < z < b$. [5]

8. Verify Stoke's theorem for $\vec{F} = (x^2 + y^2)\,\vec{i} - 2xy\,\vec{j}$ taken round the rectangle bounded by the lines $x = \pm a, y = 0, y = b$. [5]

9. Obtain Fourier series for $f(x) = x^3$ in the interval $-\pi \leq x \leq \pi$. [5]

10. Express $f(x) = e^x$ as a half range Fourier Cosine Series in $0 < x < 1$. [5]

11. State existence theorem for Laplace Transform. Obtain the Laplace transform of

    a) $te^{-t}\sin t$ b) $\frac{e^{-at} - e^{-bt}}{t}$ 1+2+2]

12. Find the inverse Laplace transform of:

a) $\frac{1}{s^2-5s+6}$ b) $\tan^{-1}\frac{2}{s}$ [2+5.+2.5]

13. By using Laplace transform, solve the initial value problem:

$y'' + 2y = r(t)$, $y(0) = y'(0) = 0$
Where $r(t) = 1, 0 < t < 1$
$= 0$, otherwise [5]

14. Graphically maximize $Z = 5x_1 + 3x_2$ Subject to constraints

$x_1 + 2x_2 \leq 50$
$2x_1 + x_2 \leq 40.$
$x_1, x_2 \geq 0$ [5]

15. Solve the following Linear Programming Problem by simple method:

Maximize : $Z = 4x + 3y$

Subject to : $2x + 3y \leq 6$
$-x + 2y \leq 3$
$2y \leq 5$
$2x + y \leq 4$
$x, y \geq 0.$ [10]

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01 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2074 Ashwin

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

Subject: - Engineering Mathematics III *(SH501)*

- ✓ Candidates are required to give their answers in 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 properties of determinant to show [5]

$$\begin{vmatrix} x^2 & x^2-(y-z)^2 & yz \\ y^2 & y^2-(z-x)^2 & zx \\ z^2 & z^2-(x-y)^2 & xy \end{vmatrix} = (x-y)(y-z)(z-x)(x+y+z)(x^2+y^2+z^2)$$

2. Prove that every square matrix can be uniquely expressed as the sum of symmetric and a skew symmetric matrix. [5]
3. Define eigen values and eigen vectors in terms of linear transformation with matrices as operator. Find eigen values of the matrix. [2+3]

$$\begin{pmatrix} -2 & 2 & -3 \\ 2 & 1 & -6 \\ -1 & -2 & 0 \end{pmatrix}$$

4. Test the consistency of the system $x+y+z=3,\ x+2y+3z=4,\ 2x+3y+4z=7$ by using rank of matrix method and solve if consistent. [5]
5. If $\vec{F}$ is the gradient of some scalar point functions ϕ i.e $\vec{F}=\nabla\phi$, prove that the line integral is independent of the path joining any two points in the region and conversely. [5]
6. Evaluate $\iint_S \vec{F}.\vec{n}\,ds$, where $\vec{F}=xy\,\vec{i}-x^2\,\vec{j}+(x+z)\vec{K}$ and S is the region of the plane $2x+2y+z=6$ bounded in the first quadrant. [5]
7. State and prove Green's theorem in plane. [5]
8. Apply Gauss' divergence theorem to evaluate $\iint_S \left[(x^3-yz)\vec{i}-2x^2y\,\vec{j}+2\vec{K}\right].\vec{n}\,ds$, where S is the surface of the cube bounded by the planes x = 0, x = a, y = 0, y = a, z = 0, z = a. [5]
9. Expand $f(x) = x \sin x$ as a Fourier series in $-\pi \le x \le \pi$. [5]
10. Obtain half range cosine series for $f(x) = x$ in the interval $0 \le x \le \pi$. [5]
11. Find the Laplace transform of: [3+2]
    i) $t^2 \cos at$
    ii) $\frac{\sin t}{t}$

12. State convolution theorem for inverse Laplace transform and use it to find the inverse Laplace transform of $\frac{S}{(S^2+4)(S^2+9)}$ [1+4]

13. Solve the following initial value problem by using Laplace transform: [5]

$y''+2y'-3y=\sin t,\ y(0)=y'(0)=0$

14. Graphically maximize [5]

$Z=7x_1+10x_2$

Subject to constraints,

$3x_1+x_2\leq 9$

$x_1+2x_2\leq 8$

$x_1,x_2\geq 0$

15. Solve the following LPP by simplex method using duality of: [10]

Minimize $Z=20x+50y$

Subject to:

$2x+5y\geq 12$

$3x+7y\geq 17$

$x,y\geq 0$

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01 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2073 Chaitra

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

Subject: - Engineering Mathematics III *(SH501)*

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

1. Distinguish a matrix and a determinant. Use property of determinant to prove: [5]

$$\begin{vmatrix} a+b+2c & a & b \\ c & b+c+2a & b \\ c & a & c+a+2b \end{vmatrix} = 2(a+b+c)^3$$

2. Prove that the necessary and sufficient condition for a square matrix to posses an inverse is that it is non singular. [5]

3. Find the rank of the matrix: [5]

$$\begin{pmatrix} 1 & 0 & -5 & 6 \\ 3 & -2 & 1 & 2 \\ 3 & -2 & -9 & 14 \\ 4 & -2 & -4 & 8 \end{pmatrix}$$ by reducing it to normal form.

4. State Cayley-Hamilton theorem and use it to find inverse of the matrix $\begin{pmatrix} 4 & 3 & 1 \\ 2 & 1 & -2 \\ 1 & 2 & 1 \end{pmatrix}$ [5]

5. Find the work done by the force $\vec{F} = yz\,\vec{i} + zx\,\vec{j} + xy\,\vec{k}$ in displacement of a particle along the straight segment C from point (1,1,1) to the point (3,3,2). [5]

6. State Gauss divergence theorem and apply it to evaluate $\iint_S \vec{F}.\vec{n}\,ds$, where $\vec{F} = x\,\vec{i} + y\,\vec{j} + z\,\vec{k}$ and S is the surface of the cube bounded by the planes x = 0, x = a, y = 0, y = a, z = 0, z = a. [5]

7. State and prove Green's theorem in plane. [5]

8. Verify stokes theorem for the vector field $\vec{F} = (2x - y)\,\vec{i} - yz^2\,\vec{j} - y^2z\,\vec{k}$ over the upper half of the surface of $x^2 + y^2 + z^2 = 1$ bounded by its projection the xy-plane. [5]

9. Find the Fourier series to represent $f(x) = x - x^2$ from $-\pi$ to π. [5]

10. Find the half range Fourier sine series for $f(x) = e^{2x}$ in $0 < x < \pi$. [5]

11. Define Laplace transform of a function and state criteria of existence of a Laplace transform of a function. Find the Laplace transform of $f(t) = \frac{1-\cos 2t}{t}$ [1+1+3]

12. Find inverse Laplace transform of [2+3]

(i) $\frac{1}{s(s+2)}$ (ii) $\tan^{-1}\left(\frac{1}{s}\right)$

13. Solve the following initial value problem using Laplace transform: [5]

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

14. Use simplex method to solve the following LPP: [10]

Maximum $z=50x_1+80x_2$

Subject to,

$$x_1+2x_2\le 32$$
$$3x_1+4x_2\le 84$$

15. Graphically maximize [5]

$z=7x_1+10x_2$

Subject to,

$$3x_1+x_2\le 9$$
$$x_1+2x_2\le 8$$
$$x_1,x_2\ge 0$$

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01 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2072 Chaitra

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

Subject: - Engineering Mathematics III *(SH501)*

- ✓ Candidates are required to give their answers in 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 properties of determinants to prove: [5]

$$\begin{vmatrix} a^2+1 & ba & ca & da \\ ab & b^2+1 & cb & db \\ ac & bc & c^2+1 & dc \\ ad & bd & cd & d^2+1 \end{vmatrix} = 1+a^2+b^2+c^2+d^2$$

2. Show that every square matrix can be uniquely expressed as the sum of symmetric and Skew-Symmetric matrices. [5]

3. Test the consistency of the system $x+y+z=3, x+2y+3z=4$ and $2x+3y+4z=7$ and solve completely if found consistent. [5]

4. State Cayley-Hamilton theorem and verify it for the matrix; $A=\begin{pmatrix} -2 & 2 & -3 \\ 2 & 1 & -6 \\ -1 & -2 & 0 \end{pmatrix}$ [1+4]

5. Prove that " The line integral $\int_c \vec{F}.d\vec{r}$ of a continuous function $\vec{F}$ defined in a region R is independent of path C joining any two points in R if and only if there exists a single valued scalar function ϕ having first order partial derivatives such that $\vec{F}=\nabla\phi$". [5]

6. State Green's theorem and use it to find the area of astroid $x^{2/3}+y^{2/3}=a^{2/3}$ [5]

7. Evaluate $\iint_s \vec{F}.\vec{n}\, ds$, where $\vec{F}=x^2\vec{i}+y^2\vec{j}+z^2\vec{k}$ and 's' is the surface of the plane $x+y+z=1$ between the co-ordinate planes. [5]

8. Apply Gauss' divergence theorem to evaluate $\iint_s \vec{F}.\vec{n}\, ds$ where

$\vec{F}=(x^3-yz)\vec{i}-2x^2y\vec{j}+2\vec{k}$ and 's' is the surface the cube bounded by the planes $x=0, x=a, y=0, y=a, z=0, z=a$. [5]

9. Find the Laplace transform of: [2+3]

i) $t\sin^2 3t$

ii) $\frac{\sin 2t}{t}$

10. Find the inverse Laplace transform of: [2+3]

i) $\frac{1}{s^2-3s+2}$

ii) $\frac{1}{s(s+1)^3}$

11. Apply Laplace transform to solve the differential equation: [5]

$y''+2y'+5y=e^{-t}\sin t,\quad x(0)=0, x'(0)=1$

12. Find a Fourier series to represent $f(x)=x-x^2$ from $x=-\pi$ to $x=\pi$. Hence show that

$$\frac{1}{1^2}-\frac{1}{2^2}+\frac{1}{3^2}-\frac{1}{4^2}+\ldots\ldots=\frac{\pi^2}{12}$$ [5]

13. Develop $f(x)=\sin\left(\frac{\pi x}{l}\right)$ in half range Cosine Series in the range $0<x<l$. [5]

14. Graphically maximize, [5]

$Z=7x_1+10x_2$

Subject to constraints,

$3x_1+x_2\le 9$

$x_1+2x_2\le 8$

$x_1\ge 0, x_2\ge 0$

15. Solve the following LPP using simplex method. [10]

Maximize: $P=50x_1+80x_2$

Subject to: $x_1+2x_2\le 32$

$3x_1+4x_2\le 84$

$x_1\ge 0, x_2\ge 0$

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01 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2072 Kartik

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

Subject: - Engineering Mathematics III *(SH501)*

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

1. Prove that $\begin{vmatrix} (a+b)^2 & ca & bc \\ ca & (b+c)^2 & ab \\ bc & ab & (c+a)^2 \end{vmatrix} = 2abc(a+b+c)^3$ [5]

2. If A and B are two non singular matrices, then prove that $(AB)^{-1} = B^{-1}A^{-1}$ [5]

3. Find the rank of the matrix: [5]

$$\begin{pmatrix} 1 & -1 & -2 & -4 \\ 2 & 3 & -1 & -1 \\ 3 & 1 & 3 & -2 \\ 6 & 3 & 0 & -7 \end{pmatrix}$$

4. Find the eigen values and eigen vectors of the matrix. [5]

$$\begin{pmatrix} -2 & 2 & -3 \\ 2 & 1 & -6 \\ -1 & -2 & 0 \end{pmatrix}$$

5. Prove that the line integral $\int_A^B \vec{F}.d\vec{r}$ is independent of path joining any two points A and B in the region R, if and only if, $\int_C \vec{F}.d\vec{r} = 0$ for any simple closed path C in R. [5]

6. Evaluate $\iint_S \vec{F}.\vec{n}\,ds$ where $\vec{F} = yz\,\vec{i} + zx\,\vec{j} + xy\,\vec{k}$ where S is the surface of the sphere $x^2 + y^2 + z^2 = 1$ in the first octant. [5]

OR

Apply Stoke's theorem to evaluate $\int_C (x+y)dx + (2x-z)dy + (y+z)dz$ where C is the boundary of the triangle with vertices (2,0,0), (0,3,0) and (0,0,6). [5]

7. State Green's theorem in plane and hence apply it to compute the area of the curve $x^{2/3} + y^{2/3} = a^{2/3}$. [5]

8. Apply Gauss divergence theorem to evaluate $\iint_S \vec{F}.\vec{n}\,ds$ where $\vec{F} = x^2\vec{i} + z\vec{j} + yz\vec{k}$ taken over the cube bounded by $x = 0, x = 1, y = 0, y = 1, z = 0, z = 1$. [5]

9. Find the Laplace transform of the following: [2.5×2]

   a) $\frac{\cos 2t - \cos 3t}{t}$

   b) $\sin^3 2t$

10. Find the inverse Laplace transform of the following: [2+3]

   a) $\frac{1}{s^2 - 5s + 6}$

   b) $\frac{s+2}{(s^2 + 4s + 5)^2}$

11. Solve the initial value problem by using Laplace transform: [5]

   $x'' + 2x' + 5x = e^{-t}\sin t;\ x(0) = 0,\ x'(0) = 1$

12. Obtain Fourier Series for the function $f(x) = x - x^2$ from $-\pi$ to π and hence show that: [5]

   $$\frac{\pi^2}{12} = \frac{1}{1^2} - \frac{1}{2^2} + \frac{1}{3^2} - \frac{1}{4^2} + \ldots\ldots\ldots$$

13. Obtain the half range sine series for the function $f(x) = x^2$ in the interval (0,3). [5]

14. Graphically maximize and minimize [5]

   $Z = 5x_1 + 3x_2$ Subjected to constraints

   $3x_1 + 5x_2 \le 15$

   $5x_1 + 2x_2 \le 10, x_1, x_2 \ge 0$

15. Use simplex method to solve the Linear Programming problem: [10]

   Maximize $Z = 15x_1 + 10x_2$

   Subject to $2x_1 + 2x_2 \le 10$

   $x_1 + 3x_2 \le 10$

   and $x_1, x_2 \ge 0$

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01 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2071 Chaitra

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

Subject: - Engineering Mathematics III *(SH501)*

- ✓ Candidates are required to give their answers in 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 the properties, evaluate the determinant: [5]

$$\begin{vmatrix} 1 & a & a^2 & a^3+bcd \\ 1 & b & b^2 & b^3+cda \\ 1 & c & c^2 & c^3+abd \\ 1 & d & d^2 & d^3+abc \end{vmatrix}$$

2. Prove that every square matrix can uniquely be expressed as the sum of a symmetric and a skew symmetric matrix. [5]
3. Test the consistency of the system: [5]

   $x-6y-z=10,\ 2x-2y+3z=10,\ 3x-8y+2z=20$

   And solve completely, if found consistent.
4. Find the eigen values and eigenvecters of the matrix $\begin{pmatrix} 2 & 2 & 1 \\ 1 & 3 & 1 \\ 1 & 2 & 2 \end{pmatrix}$. [5]
5. Using the line integral, compute the workdone by the force [5]

   $\vec{F}=(2x-y+2z)\vec{i}+(x+y-z)\vec{j}+(3x-2y-5z)\vec{k}$

   when it moves once around a circle $x^2+y^2=4; z=0$
6. State and prove Green's Theorem in plane. [5]
7. Verify Stoke's theorem for $\vec{F}=(x^2+y^2)\vec{i}-2xy\,\vec{j}$ taken around the rectangle bounded by the lines $x=\pm a,\ y=0,\ y=b$. [5]
8. Evaluate $\iint_S \vec{F}.\vec{n}\ ds$ where $\vec{F}=(2xy+z)\vec{i}+y^2\vec{j}-(x+3y)\vec{K}$ by Gauss divergence theorem; where S is surface of the plane $2x+2y+z=6$ in the first octant bounding the volume V. [5]
9. Find the Laplace transform of the following: [2.5×2]
   a) $te^{-2t}\cos t$
   b) Sinhat.cost

10. Find the inverse Laplace transform of : [2.5×2]

a) $\frac{1}{S(S+1)}$

b) $\frac{S^2}{(S^2+b^2)^2}$

11. Solve the differential equation $y''+2y'+5y=e^{-t}\sin t, y(0)=0, y'(0)=1$, by using Laplace transform. [5]

12. Expand the function $f(x)=x\sin x$ as a Fourier series in the interval $-\pi \le x \le \pi$. [5]

13. Obtain half range sine series for the function $f(x)=x-x^2$ for $0<x<1$. [5]

14. Graphically maximize and minimize [5]

$z=9x+40y$ subjected to the constraints

$y-x\ge 1, y-x\le 3, 2\le x\le 5$

15. Solve the following Linear Programming Problem by Simplex method: [10]

Maximize, $P=20x_2-5x_1$

Subjected to, $10x_2-2x_1\le 5$

$2x_1+5x_2\le 10$ and $x_1, x_2\ge 0$

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01 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2071 Shawan

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

Subject: - Mathematics III *(SH501)*

- ✓ Candidates are required to give their answers in 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: $\begin{vmatrix} (b+c)^2 & b^2 & c^2 \\ a^2 & (c+a)^2 & c^2 \\ a^2 & b^2 & (a+b)^2 \end{vmatrix} = 2abc(a+b+c)^3$ [5]

2. Prove that every square matrix can be uniquely written as a sum of Hermitian and Skew-Hermitian matrices. [5]

3. Find the rank of the matrix by changing it into normal form: $\begin{pmatrix} 3 & 1 & 4 \\ 0 & 5 & 8 \\ -3 & 4 & 4 \\ 1 & 2 & 4 \end{pmatrix}$ [5]

4. Find the eigen value and eigen vector of the matrix: $\begin{pmatrix} 2 & 1 & 1 \\ -2 & 1 & 3 \\ 2 & 1 & -1 \end{pmatrix}$ [5]

5. Using Green's theorem, evaluate $\int_C (y^3dx - x^3dy)$ where C is the boundary of the circle $x^2 + y^2 = 4$. [5]

6. Show that $\vec{F}(x,y,z) = y^3\,\vec{i} + (3xy^2 + e^{2z})\,\vec{j} + 2ye^{2z}\,\vec{k}$ is conservative vector field and find its scalar potential function. [5]

7. Find the surface integral $\iint_S \vec{F}.\hat{n}\,ds$ where $\vec{F} = x\,\vec{i} + y\,\vec{j} + z\,\vec{k}$ and S is the upper half of the sphere $x^2 + y^2 + z^2 = 1$. [5]

8. Verify Stoke's theorem for $\vec{F}(x,y,z) = (2x-y)\,\vec{i} - yz^2\,\vec{j} - y^2z\,\vec{k}$ where S is the upper half of the sphere $x^2 + y^2 + z^2 = 4$ and C is its boundary. [5]

OR

Evaluate using Gauss divergence theorem,

$\iint_S \vec{F}.\hat{n}\,ds$ where $\vec{F}(x,y,z) = x^2y\,\vec{i} + xy^2\,\vec{j} + 2xyz\,\vec{k}$ and S is the surface bounded by the planes x = 0, y = 0, z =0 and x+2y+z =2

9. Find the Laplace transform of (i) sin 2t cosh 4t (ii) te^{2t} sin 4t. [5]

10. Using the Convolution theorem, find the inverse Laplace transform of $\frac{3s}{(s^2+4)(s^2+1)}$ [5]

11. Solve the following initial value problem using Laplace transform: [5]

$y''+4y'+3y = e^t, y(0) = 00, y'(0) = 2$

12. Obtain the half range Fourier sine series of $f(x) = \pi - x$ in the range $0 < x < \pi$. [5]

13. Obtain the Fourier series of $f(x) = e^{3x}$ in $0 < x < 2\pi$. [5]

14. Graphically maximum $Z = 5x_1 + 3x_2$ subject to constraints [5]

$x_1 + 2x_2 \leq 50, 2x_1 + x_2 \leq 40$ and $x_1 \geq 0, x_2 \geq 0$

15. Solve the following linear programming problem by simplex method constructing the duality: [10]

Minimize: $P = 21x_1+50x_2$

Subject to $3x_1+7x_2 \geq 17$

$2x_1+5x_2 \geq 12$

$x_1, x_2 \geq 0$

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01 TRIBHUVAN UNIVERSITY

INSTITUTE OF ENGINEERING

Examination Control Division

2070 Chaitra

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

Subject: - Mathematics III *(SH501)*

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

1. Using the properties of determinant prove [5]

$$\begin{vmatrix} (b+c)^2 & a^2 & a^2 \\ b^2 & (c+a)^2 & b^2 \\ c^2 & c^2 & (a+b)^2 \end{vmatrix} = 2abc(a+b+c)^3$$

2. Prove that $(AB)^T = B^T A^T$ where A is the matrix of size m×p and B is the matrix of size p×n [5]

3. Find the rank of the following matrix by reducing normal form. $\begin{bmatrix} 1 & 3 & -2 & 1 \\ 1 & 1 & 1 & 1 \\ 2 & 0 & -3 & 2 \\ 3 & 3 & -3 & 3 \end{bmatrix}$ [5]

4. Find the eigen values and eigen vectors of the following matrix. $\begin{bmatrix} 2 & 0 & 1 \\ 0 & 2 & -1 \\ 0 & 0 & 2 \end{bmatrix}$. [5]

5. Prove that the line intergral $\int_A^B \vec{F}.d\vec{r}$ is independent of the path joining any two points A and B in a region if $\int_c \vec{F}.d\vec{r} = 0$ for any simple closed curve C in the region. [5]

6. Evaluate $\iint_S \vec{F}.\hat{n}\ ds$ where $\vec{F} = x^2\vec{i} + y^2\vec{j} + z^2\vec{k}$ and S is the finite plane x + y + z = 1 between the coordinate planes. [5]

OR

Evaluate $\iint_S \vec{F}.\hat{n}\,ds$ for $\vec{F} = yz\vec{i} + zx\vec{j} + xy\vec{k}$ where S is the surface of sphere $x^2 + y^2 + z^2 = 1$ in the first octant.

7. Evaluate, $\iint_S \vec{F}.\hat{n}\,ds$ for $\vec{F} = x\vec{i} - y\vec{j} + (z^2 - 1)\vec{k}$ where S is the surface bounded by the cylinder $x^2 + y^2 = 4$ and the planes z = 0 and z = 1 [5]

8. Verify the stoke's theorem for $\vec{F} = (2x - y)\vec{i} - yz^2\vec{j} - y^2 z\vec{k}$ where S is the upper part of the sphere $x^2 + y^2 + z^2 = a^2$ C is its boundary. [5]

9. Find the Laplace transform of (a) $t^2 \sin zt$ and (b) $\frac{1 - e^t}{t}$ [2.5×2]

10. Find the inverse Laplace transform of (a) $\frac{2s + 3}{s^2 + 5s - 6}$ (b) $\frac{s^3}{s^4 - a^4}$ [2.5×2]

11. Solve the following differential equation by using Laplace transform [5]

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

12. Obtain the Fourior series for $f(x) = x^2$ in the interval $-\pi < x < \pi$ and hence prove that [5]

$$\sum \frac{1}{x^2} = \frac{1}{1^2} + \frac{1}{2^2} + \frac{1}{3^2} \dots\dots\dots = \frac{\pi^2}{6}$$

[5]

13. Obtain half range sine series for $f(x) = \pi x - x^2$ in $(0, \pi)$ [5]

14. Graphically minimize $z = 4x_1 + 3x_2 + x_3$

    Subject to $x_1 + 2x_2 + 4x_3 \geq 12$

    $3x_1 + 2x_2 + x_3 \geq 8$ and $x_1, x_2, x_3 \geq 0$ [10]

15. Minimize $z = 8x_1 + 9x_2$

    Subject to $x_1 + 3x_2 \geq 4$

    $2x_1 + x_2 \geq 5$ with $x_1, x_2 \geq 0$

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04 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2070 Chaitra

Exam.	Old Back (2065 & Earlier Batch)		
Level	BE	Full Marks	80
Programme	All (Except B. Arch)	Pass Marks	32
Year / Part	II / I	Time	3 hrs.

Subject: - Mathematics III *(EG501SH)*

- ✓ 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. Using the properties of the determinant prove that: $\begin{vmatrix} x & a & a & a \\ a & x & a & a \\ a & a & x & a \\ a & a & a & x \end{vmatrix} = (x+3a)(x-a)^3$.

2. If A and B are square matrices of same order n, then show that B^TAB is symmetric or skew-symmetric according as A is symmetric or skew-symmetric.

3. Solve the following system of equation by Gauss elimination method:

$$2x+3y+4z=20$$
$$3x+4y+5z=26$$
$$3x+5y+6z=31$$

4. State prove Cayley - Hamilton theorem.

5. Find the Laplace transforms of the following functions: (i) $\frac{\sin^2 2t}{t}$ (ii) tsin2tcos3t.

6. Find the inverse Laplace transforms of the following functions:

   (i) $\frac{4s+15}{s^2-25}$ (ii) $\frac{1}{s^2-5s+6}$

7. Prove the second shifting theorem. If $L[f(t)] = F(s)$, then $L[f(t-a)\,u(t-a)] = e^{-as}F(s)$.

8. Solve the following differential equation using Laplace transform:

   $\frac{d^2y}{dt^2} + y = \sin 3t; y(0) = 0, y'(0) = 0.$

9. Find the velocity and acceleration of a particle which moves along the curve $x = 2\sin 3t$, $y = 2\cos 3t$, $z = 8t$ at any time $t=\pi/3$. And hence find their magnitudes.

10. If $\vec{V} = \text{grad}\,(x^3+y^3+z^3-3xyz)$, find div $\vec{V}$ and curl $\vec{V}$.

11. Evaluate $\int_c \vec{F}\cdot d\vec{r}$ if $\vec{F} = x^2\hat{i} + y^3\hat{j}$ and C is the arc of the parabola $y = x^2$ in the xy-plane from (0,0) to (1,1).

12. Verify Green's theorem in the plane for $\int_C (xy+y^2)dx + x^2dy$ where C is the closed curve of the region bounded by the straight line $y = x$ and parabola $y = x^2$.

13. Evaluate $\iint_S \vec{F}.\vec{n}\,ds$ where $\vec{F} = yz\hat{i} + zx\hat{j} + xy\hat{k}$ and S is the surface of the sphere $x^2+y^2+z^2=1$ in the first octant.

14. Evaluate $\iiint_V (\nabla.\ \vec{F})dv$ where $\vec{F} = x\hat{i} - y\hat{j} + (z^2 - 1)\hat{k}$ for the square region in the xy plane bounded by the lines $x = 0$, $y = 0$, $x = a$ and $y = a$.

OR

Verify Stokes theorem for $\vec{F} = (2x-y)\hat{i} - yz^2\hat{j} - y^2z\hat{k}$ where S is the upper part of the sphere $x^2+y^2+z^2=a^2$ and C is its boundary.

15. Obtain the Fourier series to represent $f(x) = \dfrac{\pi - x}{2}$ in the interval $0 \le x \le 2\pi$.

16. Obtain the half range sine series for the function $f(x) = x^2$ in the interval$0 \le x \le \pi$.

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02 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division

2069 Chaitra

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

Subject: - Engineering Mathematics III *(SH501)*

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

1. Find the value of the determinant $\begin{vmatrix} a^2 & a^2-(b-c)^2 & bc \\ b^2 & b^2-(c-a)^2 & ca \\ c^2 & c^2-(a-b)^2 & ab \end{vmatrix}$ [5]

2. Show that the matrix $B^\theta AB$ is Hermitian or skew-Hermittian according as A is Hermitian and skew- Hermitian. [5]

3. Find the rank of the matrix $\begin{bmatrix} 6 & 1 & 3 & 8 \\ 4 & 2 & 6 & -1 \\ 10 & 3 & 9 & 7 \\ 16 & 4 & 12 & 15 \end{bmatrix}$ reducing this into the triangular form. [5]

4. Obtain the characteristic equation of the matrix $A = \begin{bmatrix} 1 & 0 & 2 \\ 0 & 2 & 1 \\ 2 & 0 & 3 \end{bmatrix}$ and verify that it is satisfied by A. [5]

5. Evaluate $\int_c \vec{F}.d\vec{r}$, where $\vec{F} = (x-y)\vec{i} + (x+y)\vec{j}$ along the closed curve C bounded by $y^2 = x$ and $x^2 = y$ [5]

6. Find the value of the normal surface integral $\iint_S \vec{F}.\vec{n}\,ds$ for $\vec{F} = x\vec{i} - y\vec{j} + (z^2-1)\vec{k}$, where S is the surface bounded by the cylinder $x^2 + y^2 = 4$ between the planes $Z = 0$ and $Z = 1$. [5]

7. Using Green's theorem, find the area of the astroid $x^{\frac{2}{3}} + y^{\frac{2}{3}} = a^{\frac{2}{3}}$ [5]

8. Verify stoke's theorem for $\vec{F} = 2y\vec{i} + 3x\vec{j} - z^2\vec{k}$ where S is the upper half of the sphere $x^2 + y^2 + z^2 = 9$ and C is its boundary. [5]

OR

Evaluate the volume intergral $\iiint_V \vec{F}\,dv$, where V is the region bounded by the surface $x = 0, y = 0, y = 6, z = x^2, z = 4$ and $\vec{F} = 2xz\vec{i} - x\vec{j} + y^2\vec{k}$

9. Find the Laplace transforms of the following functions [2.5×2]
   a) $t\,e^{-4t}\sin 3t$
   b) $\frac{\cos at - \cos bt}{t}$

10. State and prove the second shifting theorem of the Laplace transform. [5]

11. Solve the following differential equation using Laplace transform. [5]

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

12. Obtain the Fourier series for $f(x) = x^2$ in the interval $-\pi < x < \pi$ and hence show that [5]

$$\sum\frac{1}{n^2}=\frac{1}{1^2}+\frac{1}{2^2}+\frac{1}{3^2}+\ldots\ldots=\frac{\pi^2}{6}$$

13. Express $f(x) = x$ as a half-range sine series in $0 < x < 2$ [5]

14. Maximize $Z = 4x_1+5x_2$ subject to constraints [5]

$2x_1 + 5x_2 \le 25$
$6x_1 + 5x_2 \le 45$
$x_1 \ge 0$ and $x_2 \ge 0$

graphically

15. Solve the following linear programming problem using the simplex method. [10]

Maximize $P = 50x_1+80x_2$
Subject to $x_1+ 2x_2 \le 32$
$3x_1 + 4x_2 \le 84$
$x_1, x_2 \ge 0$

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62 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division.
2069 Ashad

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

Subject: - Engineering Mathematics III *(SH 501)*

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

1. Find the value of the determinant: [5]

$$\begin{vmatrix} 1 & a & a^2 & a^3+bcd \\ 1 & b & b^2 & b^3+cda \\ 1 & c & c^2 & c^3+dab \\ 1 & d & d^2 & d^3+abc \end{vmatrix}$$

2. Prove that every square matrix can be uniquely expressed as the sum of a symmetric and a skew-symmetric matrices. [5]

3. Find the rank of matrix: $\begin{bmatrix} 1 & 3 & -2 & 1 \\ 1 & 1 & 1 & 1 \\ 2 & 0 & -3 & 2 \\ 3 & 3 & -3 & 3 \end{bmatrix}$ reducing to echelon form. [5]

4. Verify Cayley-flamiltan theorem for the matrix: $\begin{bmatrix} 1 & 3 & 7 \\ 4 & 2 & 3 \\ 1 & 2 & 1 \end{bmatrix}$. [5]

5. Find the Laplace transforms of: (a) $te^{-t}\sin t$ (b) $\frac{e^{at}-\cos 6t}{t}$ [5]

6. If $L[f(t)]=F(s)$, then prove that $L[f'(t)]=SF(s)-f(o)$. [5]

7. Use Laplace transform to solve: $x''+2x'+5x=e^{-t}\sin t$ given $x(0)=0$; $x'(0)=1$. [5]

8. Obtain the Fourier series for $f(x)=x^3$ in the interval $-\pi \le x \le \pi$. [5]

9. Obtain half-range sine series for e^x in (0, 1). [5]

10. Maximize $z=2x_1+3x_2$ subject to constraints $x_1-x_2 \le 2$, $x_1+x_2 \ge 4$ and $x_1, x_2 \ge 0$ graphically. [5]

11. Solve the linear programming problems by simplex method constructing the duality [10]

Minimize $Z = 3x_1+2x_2$
Subject to $2x_1+4x_2 \ge 10$
$4x_1+2x_2 \ge 10$
$x_2 \ge 4$ and $x_1, x_2 \ge 0$

12. Prove that $\vec{F} = (2xz^3 + 6y)\vec{i} + (6x - 2yz)\vec{j} + (3x^2z^2 - y^2)\vec{k}$ is conservative vector field and find its scalar potential function. [5]

13. Evaluate $\iint_S \vec{F}\cdot\hat{n}\,ds$ where $\vec{F} = x^2\vec{i} + y^2\vec{j} + z^2\vec{k}$ and S is the finite plane $x+y+z=1$ between the co-ordinate planes. [5]

14. Using Green's theorem, find the area of the hypocycloid $\frac{x^{2/3}}{a^{2/3}} + \frac{y^{2/3}}{b^{2/3}} = 1$. [5]

15. Evaluate $\iint_S \vec{F}\cdot\hat{n}\,ds$ where $\vec{F} = 2x\vec{i} + 3y\vec{j} + 4z\vec{k}$ and S is the surface of sphere $x^2+y^2+z^2=1$ by Gauss divergence theorem. [5]

OR

Verify Stoke's theorem for $\vec{F} = 2y\vec{i} + 3x\vec{j} - z^2\vec{k}$ where S is the upper half of the sphere $x^2+y^2+z^2=9$ and 'C' is its boundary. [5]

$\iint \vec{F}\cdot\hat{n}\,ds = \iint F\cdot\hat{n}\,\frac{dx\,dy}{|\vec{k}\cdot\hat{n}|}$ *** $\hat{n}$ = normal to the given surface

$\therefore \vec{n}$ = grad of S

$= \frac{\partial}{\partial x}x^2\vec{i} + \frac{\partial}{\partial y}y^2 + \frac{\partial}{\partial z}z^2 -$

$= 2x\vec{i} + 2y\vec{j} + 2z\vec{k}$

$\therefore \hat{n} = \frac{2}{\sqrt{12}} = \frac{1}{\sqrt{3}}(x\vec{i} + y\vec{j} + z\vec{k})$

TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division

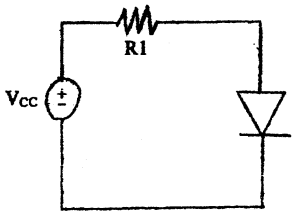
2079 Bhadra

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

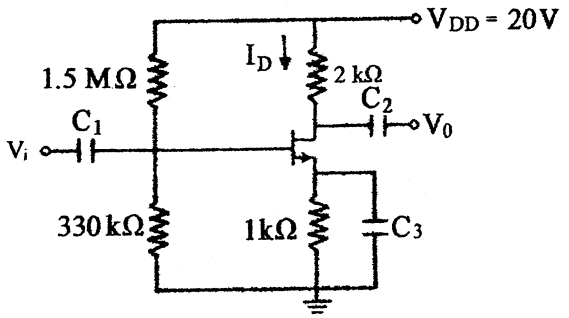
Subject: - Electronic Devices and Circuits *(EX 501)*

- ✓ Candidates are required to give their answers in 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 Dc load line? Find operating point for the diode circuit graphically using load line method. [1+4]
2. In the circuit given below the DC power supply V_{CC} = 10 V is superimposed with 60 Hz sinusoid of 1 V peak to peak amplitude. Calculate the amplitude of the sine wave signal appearing across the diode for the case R1 = 10 KΩ. Assume the constant voltage drop of 0.7 V in the diode. [5]



3. Why voltage divider biasing called β independent? Design common emitter Amplifier using β independent dc biasing method with appropriate guideline. Given parameters: V_{CC} = 24 VDC, I_C = 1.5 mA, β = 150. [1+4+2+2]
4. What is the significance of bypass capacitor in CE amplifier? Draw the small signal model of voltage divider bias for emitter bypassed capacitor CE amplifier circuit and find its input impedance, output impedance and voltage gain. [2+6]
5. Explain construction and working principle of N channel Depletion type MOSFET with the help of drain characteristics and transfer characteristics. [8]
6. Find I_D and V_{DS} for the given circuit. Given data are V_P = - 5.5 V, I_{DSS} = 10 mA and assume all the capacitors are ideal and check whether transistor is operating in pinch off region or not? [8]



7. Draw the circuit diagram of class B push-pull amplifier. Derive its general efficiency and maximum efficiency. [8]
8. Draw the circuit diagram of class A series fed amplifier and its corresponding characteristic graph. And, find its general efficiency. [3+4]
9. Draw the circuit diagram of op-amp Wein Bridge oscillator. Derive its frequency of oscillation. [2+4]
10. Draw the circuit diagram of Hartley oscillator. Derive its frequency of oscillation. [6]
11. Design DC voltage regulator using LM 317 to get 6-15V output. [6]
12. Draw standard series DC voltage regulator circuit and find its voltage stability factor (S_v). [4]

TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division

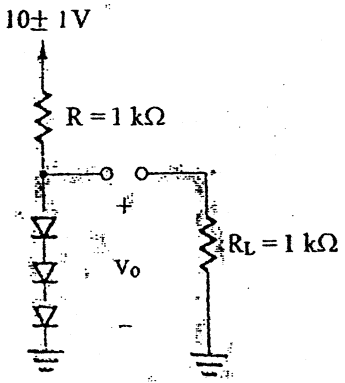
2079 Baishakh

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

Subject: - Electronics Devices and Circuits (*EX 501*)

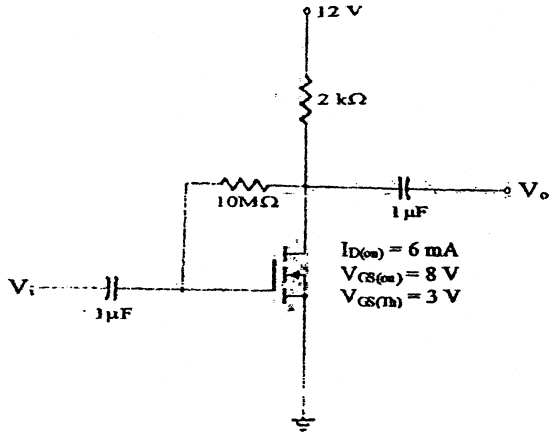
- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Assume suitable data if necessary.*

1. A string of three diodes is used to provide a constant voltage of about 2.1 v. Calculate the change in this regulated voltage caused by (i) a ±10% change in the power supply voltage; (ii) connection of a 1K Ω load resistance. Assume η = 2. [3+2]



2. A zener diode exhibits a constant voltage of 5.6 V for currents greater than five times the knee current. I_{zk} is specified to be 1mA. The zener is to be used in the design of a shunt regulator fed from a 15V supply. The load current varies over the range of 0 mA to 15 mA. Find a suitable value for the resistor R. What is the maximum power dissipation of the zener diode? [3+2]
3. Design voltage divider CE amplifier (without emitter by pass capacitor). Given: Transistor BC 547B having β = 295, I_c = 1.5 mA and Vcc = +9V.
   a) Is this the best Q point? Why?
   b) Calculate its input impedance and voltage gain.
   c) What is the maximum peak voltage of the signal that can be applied to the input of this amplifier to ensure the transistor is always in active region? [5+2+3+2]
4. Draw Ebers- Moll (EM) model of BJT and write expression of collector current for active region. [5]

5. Find Q point and show it graphically. [6+2]



6. Explain the working of n channel DMOSFET with characteristics curves. Derive an expression for JFET transconductance. [6+3]
7. It is required to design a class B power Amplifier to deliver an average power of 20 W to an 8 Ω load. The power supply is to be selected such that Vcc is about 5 V greater than the peak output voltage. This avoide transistor saturation and associated nonlinear distortion, and allows for including short circuit protection circuitry. Determine the supply voltage required, the peak current drawn from each supply, the total supply power, and the power conversion efficiency. Also determine the maximum power that each transistor must be able to dissipate safely. [1+1+2+2]
8. Derive general efficiency of series fed Class A power amplifier. [6]
9. Explain the working principle of crystal oscillator with diagrams operating in both parallel and series resonance mode. [4+2+2]
10. State Barkhausen Criteria for sinusoidal oscillation. Is it possible to obtain 50% duty cycle square wave from 555 timer Astable Multivibrator? How? [2+3]
11. Explain the working of transistor series voltage regulator with current limiting element. [6]
12. Design variable DC voltage regulator using LM 317 to get (5-9) volts output. [5]

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TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division

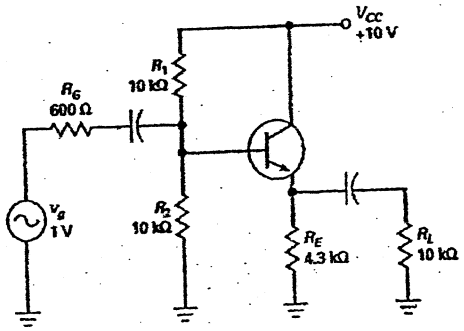
2078 Bhadra

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

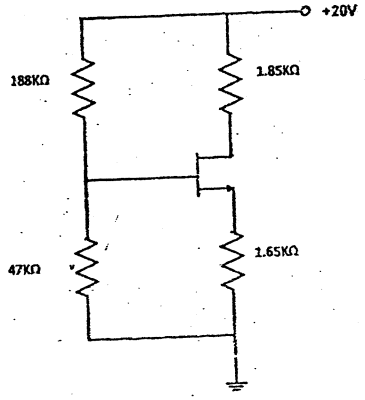
Subject: - Electronic Devices and Circuits *(EX 501)*

- ✓ Candidates are required to give their answers in 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 reverse break down region in zener diode. "Zener diode acts as a voltage reference element" Justify the statement from IV characteristic curve. [5]
2. A diode conducts 1mA at 20°C. If it is operated at 100°C, what will be its current? Given data are $\eta = 1.6$ and negative temperature coefficient value = -2.2 mV/°C. [5]
3. Show the importance of transistor bias stabilization. Design voltage divider bias (common collector configuration) to get $I_{CQ} = 1.5$ mA. Assume power supply voltage VCC = 15V and beta of transistor is 110. [3+5]
4. Why BJT is called bipolar and FET is called unipolar device? Derive mathematically the transconductance of MOSFET. [2+3]
5. The bipolar junction transistor parameters for the circuit in figure below are $\beta = 200$ and $V_A = \infty$. Determine the input resistance, output resistance and overall voltage gain of the circuit. [8]



6. Describe the physical structure of N-channel JFET and explain its working principal and characteristics clearly marking the various regions of operation. [2+6]
7. Find the drain current (I_D) and drain to source voltage (V_{DS}) for the following circuit. Given parameters are: $V_t = 1$ V and $k = 0.5$ mA/V^2. [8]



8. Draw the circuit diagram of transformer coupled class B push-pull amplifier stage. And find its maximum efficiency. Define cross over distortion in class B amplifier. [2+4+2]

9. Draw the circuit diagram of Quasi complementary-symmetry class AB amplifier using diodes. [3]

10. When are tuned amplifiers used? Draw the circuit diagram of class-A tuned amplifier and its frequency response graph. [2+3]

11. Draw Wien Bridge oscillator circuit and derive the expression for frequency of oscillation and gain of amplifier circuit. [1+3+2]

12. Describe the operation of precision half wave rectifier with circuit diagram. [4]

13. Why transistor series regulator has lower efficiency? Explain the operation of voltage regulator using band gap voltage reference. [2+5]

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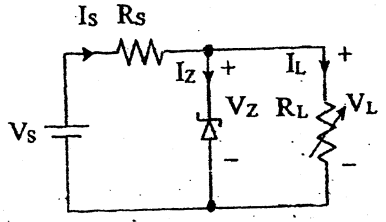
TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2078 Kartik

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

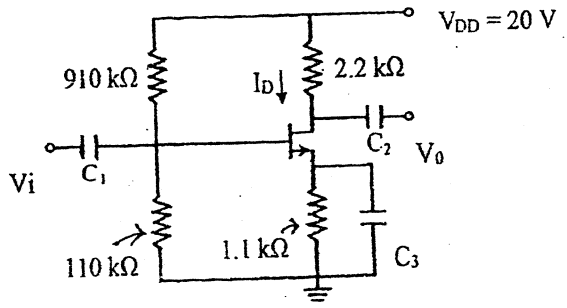
Subject: - Electronic Devices and Circuits *(EX 501)*

- ✓ Candidates are required to give their answers in 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 small signal model of PN junction diode and derive the expression for its dynamic resistance. [5]
2. Determine the Range of load R_L that will maintain the zener diode load voltage V_L at 5V. Given $V_S = 10$ V, $R_S = 100\ \Omega$, $I_{ZM} = 30$ mA. [5]



3. Design a voltage divider type dc biased CE amplifier to obtain β independent biasing. Use appropriate guidelines to support your design. Given $V_{CC} = 12$ V DC, $I_C = 2$mA and $\beta = 150$. [7]
4. Derive the expression for R_{in}, R_{out}, A_v and A_i in CE capacitor bypassed amplifier. [8]
5. Describe the construction and working principle of EMOSFET with the help of drain characteristics curve and mathematical expressions. [8]
6. Find I_D and V_{DS} for the given circuit. Given data are $V_P = -3.5$V, $I_{DSS} = 10$ mA and assume all the capacitors are ideal and check whether transistor is operating in pinch off region or not? [7]



7. Draw the circuit diagram of transformer coupled class B push-pull amplifier and show that the maximum efficiency is 25π %. [7]
8. When are tuned amplifiers used? Draw class A tuned amplifier circuit and find its 3 dB bandwidth. [7]
9. Explain working of RC phase shift oscillators and derive the frequency of its oscillation. [6]
10. Draw standard series DC voltage regulator circuit and find its voltage stability factor (Sv). [6]
11. Design a voltage regulator to give output voltage from 7V to 21V using LM317. [5]
12. Write short notes on: [3×3]
    a) Ebers Moll model
    b) Transconductance of JFET
    c) Crossover distortion

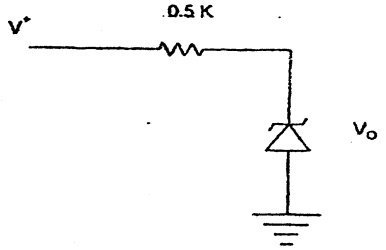
TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2076 Chaitra

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

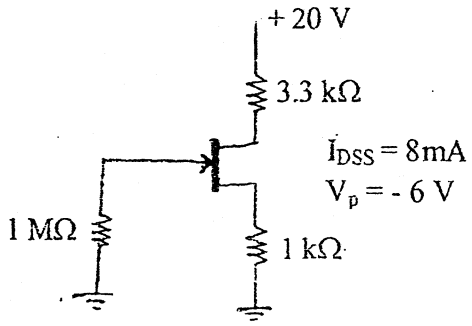
Subject: - Electronic Devices and Circuits *(EX 501)*

- ✓ Candidates are required to give their answers in 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 Q-point in pn junction diode operation. Show it graphically with necessary derivations. Differentiate between avalanche and zener break down. [3+2]
2. The 6.8 V zener diode is specified to have Vz = 6.8 V at Iz = 5 mA, rz = 20Ω and Izk = 0.2 mA. The supply voltage V^+ is nominally 10V but can vary by ± 1V. Find V_0 with no load and with V^+ at its nominal value. Find the change in V_0 resulting from connecting a load resistance RL that draws a current I_L = 1 mA. What is the minimum value of R_L for which the diode still operates in the breakdown region? [2+1+2]



3. Design β independent type dc biased common collector amplifier, and find its current gain and input resistance. Given parameters: V_{CC} = 20 VDC, I_C = 2mA and β = 100 and use firm biasing method. [8]
4. Draw common emitter transistor amplifier circuit (emitter bias with unbypassed emitter capacitor) and find its output impedance and voltage gain. Write application of common base amplifier. [4+3+1]
5. Describe the working principle of N-channel Depletion type MOSFET with the help of I_D V_S V_{DS} characteristics and transfer characteristics curves. Find the condition and expression for it to operate in active mode of operation and write the expression for drain current. [5+2+1]
6. Write about JFET as a voltage controlled resistor with practical application. [4]
7. Find I_{DQ} and V_{GSQ} from the following circuit. [5]



8. Draw the circuit diagram of class A series fed amplifier and its corresponding characteristic graph. And, find its general efficiency. [3+3]
9. Draw the circuit diagram of Complementary-Symmetry class-AB amplifier using Darlington pair transistors. [3]
10. Describe about tuned amplifier and derive the expression for the 3dB bandwidth of the amplifier. [5]
11. Differentiate between synchronous and stagger turned amplifier. [3]
12. Draw voltage controlled oscillator circuit using IC 555 and derive expression for frequency of oscillation. [6]
13. Among Hartley and Colpitts LC oscillator, which one do you choose to implement in FM stations to generate carrier wave signal? Why? Draw its circuit diagram. [5]
14. Draw the standard series DC voltage regulator circuit and find its voltage stability factor(S_v). [5]
15. Design a 5V to 20V variable dc voltage regulator using IC LM317. [4]

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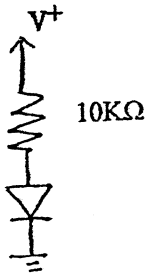
TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2076 Ashwin

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

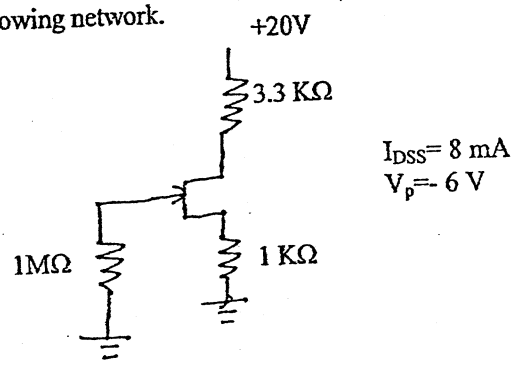
Subject: - Electronic Devices and Circuits *(EX 501)*

- ✓ Candidates are required to give their answers in 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 avalanche and zener breakdown. Draw V-I characteristic curve of zener diode and briefly explain about it. [3+2]
2. In the given circuit, the power supply V^+ has a dc value of 10V on which is super imposed a 50 Hz sinusoid of 1V peak amplitude. Calculate both the dc voltage of the diode and amplitude of the sine-wave signal appearing across it. Assume the diode to have a 0.7V at 1 mA current and η=2. [5]



3. Design β independent type of dc biased common collector amplifier, and find its voltage gain and input resistance. Given parameters: V_{cc}= 20 VDC, I_c=2mA and β=100 and use firm biasing method. [8]
4. Describe in brief the operation of BJT as a switch in cut off and saturation region. [4]
5. Explain about working principle of N-channel DMOSFET with its construction, characteristics curves and characteristic equation. [7]
6. For the faithful amplification of signal, selection of operating point is utmost importance. Justify the above statement. Derive transconductance of bipolar junction transistor. [3+4]
7. Determine Q point for the following network. [7]



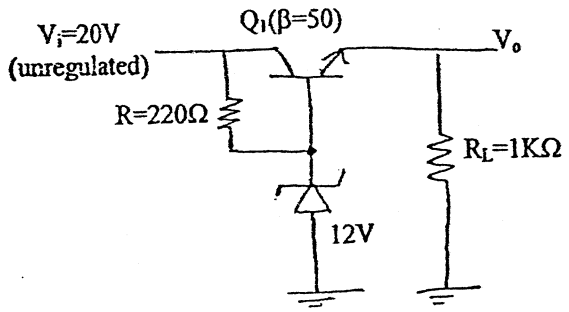
8. Draw the circuit diagram of the Hartley Oscillator and derive its frequency of oscillation. [6]

9. Draw the circuit diagram of class A series fed amplifier and its corresponding characteristics graph. And find its general efficiency. [3+3]

10. Explain about the operation of voltage controlled oscillator (VCO) using 555 timer IC and derive its frequency of oscillation. [8]

11. Draw the circuit diagram of Complementary-Symmetry Class-AB amplifier using Darlington pair transistors. [3]

12. Calculate the output voltage and the zener current in the regular circuit as shown in figure below for R_L=1 KΩ and R=220Ω. V_Z=12V. [5]



13. Draw series voltage regulator with current limiting circuit and explain how this protection circuit works? [6]

14. Briefly explain about Precision half wave rectifier with circuit diagram. [3]

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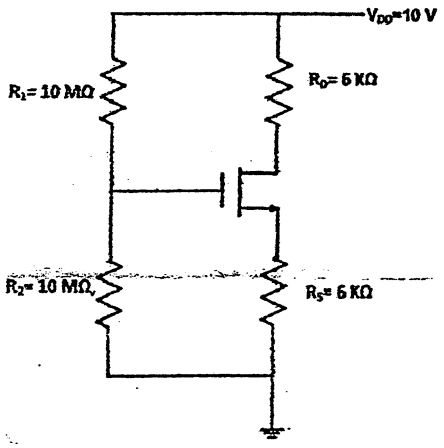
TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2075 Chaitra

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

Subject: - Electronic Devices and Circuits *(EX 501)*

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

1. Find the operating point of the diode circuit graphically using load line method. [5]
2. Design DC voltage regulator for 6V output. Given data are V_2=6V at I_z=20mA, I_{zx}=2mA, P_{zmax}=500mW and rz=10Ω. The nominal input voltage is 15V+30% DC. Find the maximum current it can deliver to the load. [5]
3. Design a common base amplifier circuit using β independent method. Given parameters are V_{cc}=15V, I_E=1.5mA, β=100 and input and output impedances are comparatively large. Use appropriate guideline to support your design. [7]
4. Why common collector amplifier is known as emitter follower? Draw its ac equivalent circuit to find its input resistance and voltage gain. [1+6]
5. Draw and describe the Ebers Moll model for BJT. [4]
6. Draw the cirucuit diagram of the Colpitts Oscillator and derive its frequency of Oscillation. [6]
7. Find the drain current (I_D) and drain to source voltage (V_{DS}) for the following circuit. Given parameters are: V_t=1 V and k=0.5 mA/V^2. [7]



8. Describe the construction and working principal of N-channel JFET with the help of characteristics curve and mathematical expression. [7]

9. Define crossover distortion in class B amplifier. Draw quasi-complementary symmetry class AB amplifier. And explain how crossover distortion is eliminated in class AB amplifier. [7]

10. Draw the circuit diagram of Class A tuned amplifier and determine the range of frequency in which it gives maximum gain within 3 dB range? [6]

11. Design a DC voltage regulator for 3V to 12V output using LM317. [5]

12. Define the term multivibrator. Explain the operation of op-amp based astable multivibrator for square wave with the help of circuit diagram and waveforms and also determine its frequency of oscillation. [8]

13. Draw the standard series DC voltage regulator circuit and find its voltage stability factor(S_v). [6]

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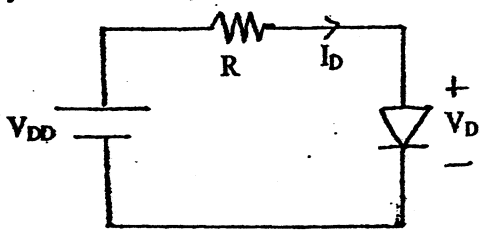
16 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2075 Ashwin

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

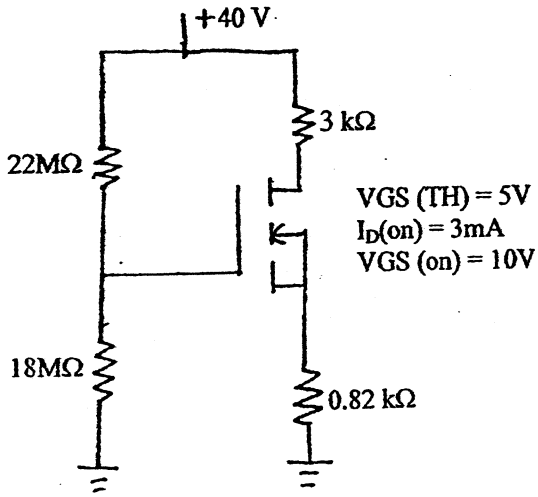
Subject: - Electronic Devices and Circuits *(EX501)*

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

1. Derive the expression for dynamic resistance of pn junction diode. [5]
2. Determine the current I_D and the diode voltage V_D with V_{DD}=5 V and R= 1KΩ. Assume that the diode has a current of 1 mA at a voltage of 0.7 V and that its voltage drop changes by 0.1 V for every decade change in current. [5]



3. Design voltage divider biased common emitter BJT amplifier to get voltage gain of -90. Assume β= 100 and Vcc=+12V. [8]
4. Derive input impedance, output impedance and voltage gain of common collector BJT amplifier. [8]
5. Explain the construction and operation of E-MOSFET with characteristics curve and mathematical expression. [7]
6. Derive mathematical definition of JEFET transconductance. [4]
7. Find I_{DQ} and V_{DSQ} from the following circuit. Show Q point graphically. [5+3]



8. Derive general efficiency of class B amplifier. [5]
9. Draw the circuit diagram of Darlington complementary-symmetry class AB amplifier using diodes. [3]
10. Derive maximum efficiency of transformer coupled class A amplifier. [5]
11. Draw astable multivibrator circuit using IC 555 and derive expression for frequency of oscillation. [6]
12. Explain working principle of RC phase shift oscillator with necessary expressions and circuit diagram. [6]
13. Explain the operation of voltage regulator using band gap voltage reference. [6]
14. Design a (5-15)V variable dc voltage regulator using LM 317 IC. [4]

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16 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2074 Chaitra

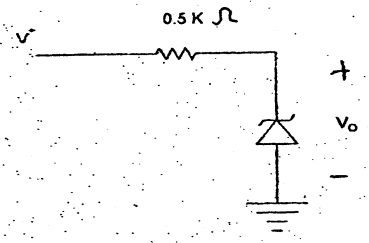
Exam.	Regular		
Level	BE	Full Marks	80
Programme	BEL, BEX, BCT	Pass Marks	32
Year / Part	II / I	Time	3 hrs.

Subject: - Electronic Devices and Circuits *(EX501)*

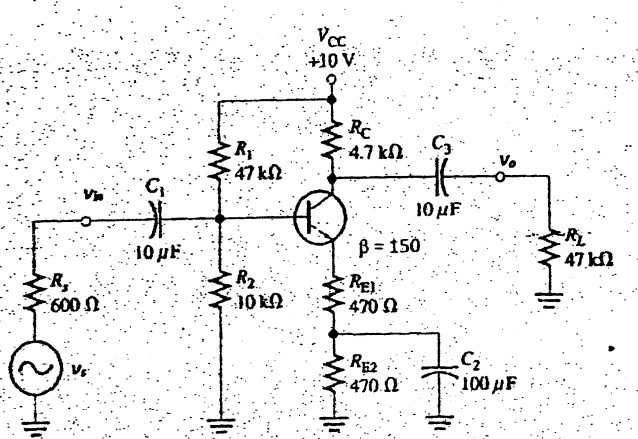
- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Assume suitable data if necessary.*

1. The leakage current of a silicon diode is $I_S = 10^{-9}$ A at 25°C, and the emission coefficient is $\eta = 1.6$. The operating junction temperature is $T_j = 60°C$. Determine (i) the leakage current I_S and (ii) the diode current I_D at $V_D = 0.8$ V. [4]

2. The 6.8V zener diode is specified to have Vz = 6.8 V at Iz = 5 mA, $r_z = 20\ \Omega$ and $I_{zk} = 0.2$ mA. The supply Voltage V^+ is nominally 10 V but can vary by ± 1V. Find V_0 with no load and with V^+ at its nominal value. Find the change in V_0 resulting from connecting a load resistance R_L that draws a current $I_L = 1$ mA. What is the minimum value of R_L for which the diode still operates in the breakdown region? [2+2+2]



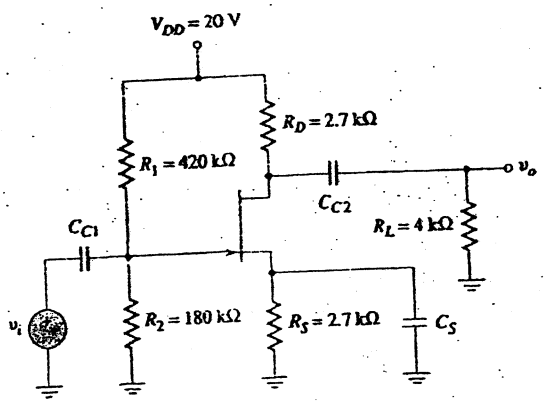
3. Determine the input resistance, output resistance and overall voltage gain of the circuit given below: [8]



4. Find terminal currents of BJT using Ebers-Moll Model. Write applications of different BJT configurations. [5+3]

5. Explain the construction and operation of D-MOSFET with characteristics curve and mathematical expression. [8]

6. Find the DC operating point of JFET circuit given below. Given parameters I_{DSS} = 12 mA and V_P = -4V. [8]



7. Derive maximum efficiency of series fed class A amplifier. [6]
8. Derive bandwidth of tuned amplifier. Write its applications. [6]
9. For a class B amplifier providing a 14V peak signal to 16 Ω load and a power supply of V_{cc} = 24V, determine input power, output power and circuit efficiency. [4]
10. Draw voltage controlled oscillator circuit using IC 555 and derive expression for frequency of oscillation. [6]
11. Draw the circuit diagram of half wave precision rectifier and explain the operation. [4]
12. Define voltage regulator. Explain the series voltage regulator with current limiting element. [1+5]
13. Explain working principle of WIEN BRIDGE oscillator with necessary expressions and circuit diagram. [6]

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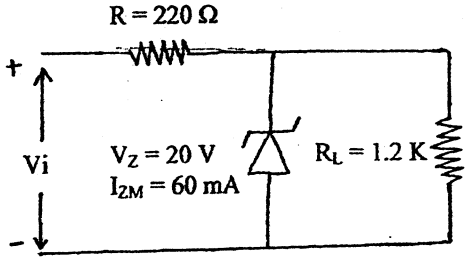
26 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2074 Ashwin

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

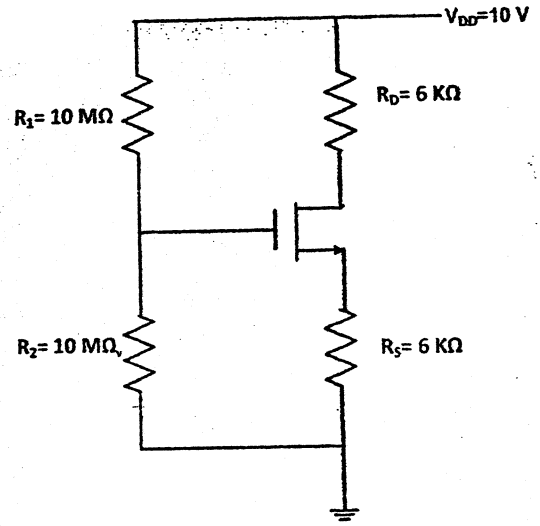
Subject: - Electronic Device and Circuits *(EX501)*

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

1. Explain the small signal model of PN junction diode and drive its dynamic resistance. [2+4]
2. Determine the range of values of V_i that will maintain the Zener diode of figure below in ON state. [5]



3. Design β independent type DC biased common emitter amplifier with emitter resistance bypassed and find its voltage gain and input resistance. Given parameters V_{cc} = 24, I_C = 2 mA, β = 90. Use appropriate guideline to have high input resistance. [8]
4. Describe in brief the operation of BJT as a switch in cut off and saturation region. [6]
5. Define transconductance (g_m). Derive g_m for BJT. [1+3]
6. Explain the construction and operation of N channel enhancement type MOSFET with the help of drain characteristics and transfer characteristics. [8]
7. Find the drain current (I_D) and drain to source voltage (V_{DS}) for the following circuit. Given parameters are: V_t = 1 V and k = 0.5mA/V^2. [6]



8. State the difference between BJT and FET. [2]

9. What is crossover distortion? Explain how it can be eliminated with necessary diagram. [2+4]

10. Draw the circuit diagram of tuned amplifier and derive the expression for the 3dB bandwidth of the amplifier. [6]

11. Define Barkhausen criteria for sinusoidal oscillation. Draw the circuit diagram of wien bridge oscillator and determine its frequency of oscillation. [2+6]

12. Describe Colpitt's oscillator with necessary circuit diagram. [5]

13. Draw the standard series DC voltage regulator circuit and find its voltage stability factor (S_V). [6]

14. Design a 3.7 to 9V variable dc voltage regulator using IC LM317. [4]

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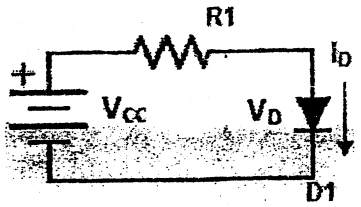
TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2073 Chaitra

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

Subject: - Electronic Device and Circuits *(EX501)*

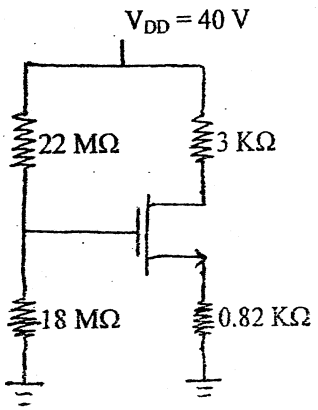
- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Scientific calculator is allowed.*
- ✓ *Assume suitable data if necessary.*

1. In the circuit given below, the DC power supply V_{cc} = 10 V is superimposed with 60 Hz sinusoid of 1 V_{pp} amplitude. Calculate the amplitude of the sine wave signal appearing across the diode for the case R1 = 10 KΩ. Assume the constant voltage drop of 0.7 V in the diode. [5]



2. Define and explain reverse breakdown effect. Describe how Zener diode works as a voltage regulator. [2+3]
3. Why voltage divider biasing is called β independent? Design CE amplifier using β independent dc biasing method with appropriate guideline. [3+5]

   Given: V_{CC} = 24 V, I_{BQ} = 10μA and β = 100
4. What is the significance of bypass capacitor in CE amplifier? Draw the small signal model for capacitor bypassed CE amplifier circuit and find its input impedance, output impedance and voltage gain. [2+6]
5. Describe the principle of operation of operation of N channel Depletion type MOSFET with the help of mathematical expression and drain characteristics graphs. [8]
6. Determine I_D and V_{DS} for the given circuit and find the region of its operation. Given: k = 0.12mA/V^2 and V_t = 5 V. [6+2]



7. Explain the operation of transformer coupled class B push-pull amplifier with the proper circuit diagram and characteristics curve. Also determine its maximum efficiency. [4+4]
8. Explain why class A amplifier is cooler with load than without load. [6]
9. State Barkhausen criteria. Draw the circuit diagram of RC phase shift oscillator and derive the expression for its frequency of oscillation. [2+5]
10. Describe the operation of precision half wave rectifier with circuit diagram. [5]
11. Describe the operation of a series voltage regulator with current limiting circuit. [7]
12. Design a 5.2 V to 13 V variable DC voltage regulator using IC LM 317. [5]

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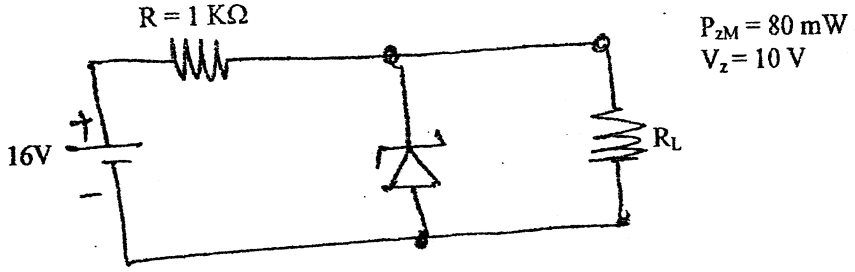
25 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2073 Shrawan

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

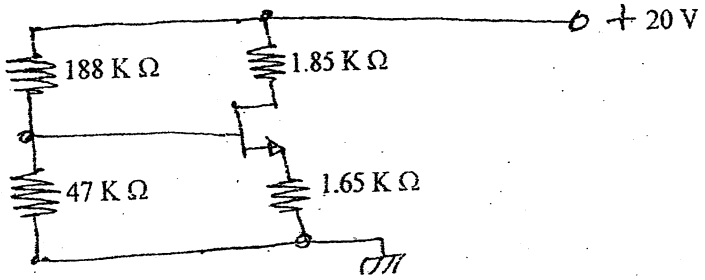
Subject: - Electronic Devices and Circuits *(EX501)*

- ✓ Candidates are required to give their answers in 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 operating point for the diode circuit graphically using load line method. [4]
2. Find the zener current form the given circuit if (i) $R_L = 1.2\ K\Omega$ (ii) $R_L = 3\ K\Omega$ [4]



3. Determine the input resistance and output resistance of CC BJT amplifier circuit. Why common collector configuration is used in amplifier circuit design. [2+2+2+2]
4. Describe the operation of BJT as switch with the help of Non-gate circuit. [4]
5. Derive expressions to obtain transconductance for BJT, JFET and MOSFET. Also prove that $\gamma_\pi = (\beta+1)\gamma_e$ [8]
6. The n-channel JFET in the figure below has I_{DSS} = 18 mA and V_p = -5V. Determine the values of I_D and V_{DS}. [8]



7. Describe the working principle of N-channel EMOSFET with the help of its drain characteristics curve and necessary mathematical expressions. [6]

8. Determine the general efficiency of transformer coupled class B push pull amplifier. Draw the circuit diagram and its graph. [4+4]
9. Explain how class AB amplifier eliminates the cross over distortion. [3]
10. Draw the circuit diagram of LRC tuned class A amplifier and its frequency response graph and show that Bandwidth $= \frac{1}{RC}$. [3+3]
11. Explain the operation of AMV using 555 timer IC and derive its frequency of oscillation. [6]
12. Draw the circuit diagram of Hartley oscillator. [3]
13. Draw standard dcV regulator circuit and find its voltage stability factor. [4+4]
14. Design a DCV regulator for 3.7 V to 12 V output using LM317. [4]

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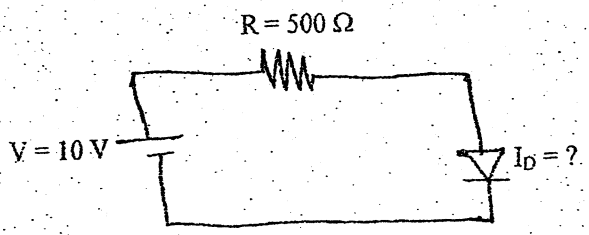
20 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2072 Chaitra

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

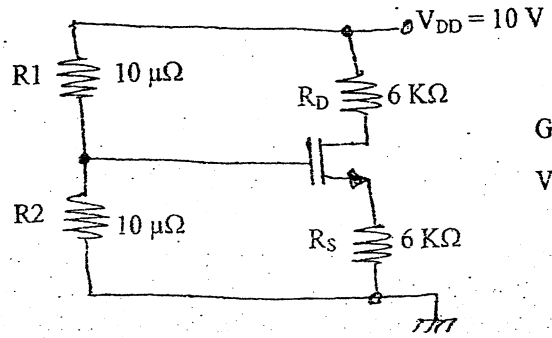
Subject: - Electronic Devices and Circuits *(EX501)*

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

1. In the given circuit, the diode used has its n = 1.74 and it conducts 1mA at forward bias voltage of 0.7 V. Find the current flow in the circuit. [4]



2. Design DC voltage regulator for 6V output. Given data are V_z = 6 V at I_Z = 20 mA, I_{2k} = 2mA, P_{Zmax} = 500 mw and r_Z = 10Ω. The nominal input voltage is 15V ± 30% DC. Find maximum current it can delivers to the load. [4]
3. Design β independent type dc biased common collector amplifier and find its current gain and input resistance. Given parameters are: V_{CC} == 20 V, I_C = 2 mA and β = 100. Use firm biasing method. [8]
4. Draw the small signal model circuit for capacitor unbypassed CE amplifier and find its voltage gain and current gain. [8]
5. Describe the construction and working principle of N-channel JFET with the help of its drain characteristics curve and necessary mathematical expressions. [6]
6. For the circuit given below, find I_D and V_{DS}. Also determine its region of operation and small signal ac equivalent circuit. [3+3+2+2]



Given data are:
$V_t = 1\ V, k = 0.5 \frac{mA}{V^2}$

7. Draw the circuit diagram of transformer coupled class B push pull amplifier and its corresponding characteristic graph. And from graph prove that maximum efficiency is equal to 78.5%. Also find the condition when it has maximum loss. [3+3+3+3]

8. Draw the circuit diagram and its frequency response graph of LRC tuned class A amplifier. State its resonance frequency and band width (3dB). [1+1+1+1]

9. State Barkhausen criteria for sinusoidal oscillator. Is this principle applicable to RC oscillator using op-Amp? Why? If yes, determine the frequency of oscillations and the gain of the amplifier of the circuit. [2+1+4]

10. Explain the operation of AMV using555 IC and derive its frequency of oscillation. [6]

11. Describe the bandgap voltage reference source with the help of a relevant circuit. Compare bandgap voltage reference source with zener diode. [4+2]

12. Draw the series dc voltage regulator with current limiting element and explain how it works. [5]

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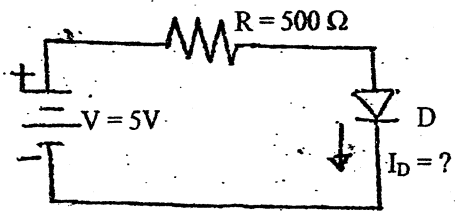
26 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2072 Kartik

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

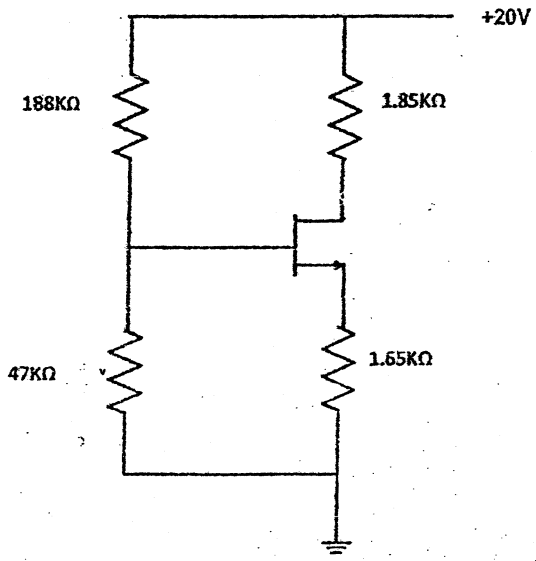
Subject: - Electronic Devices and Circuits *(EX501)*.

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

1. In the given circuit, the diode used has its n = 1.74 and it conducts 1mA at forward bias voltage of 0.7 V. Find the current flow in the circuit. [6]



2. Draw unregulated dc voltage power supply using bridge rectifier. [2]
3. Describe functions of BJT as amplifier with the help of transfer characteristics (i_c - v_{BE} graph), and find expressions for g_m , r_π and r_e. Also show that $\beta = g_m r_\pi$ and $r_\pi = (\beta+1) r_e$. [6+2]
4. Draw common collector transistor amplifier circuit and find its input impedance, output impedance and voltage gain. [6]
5. Describe the construction and working principal of EMOSFET with the help of drain characteristics curve and mathematical expression. [6]
6. The n-channel JFET in the figure below has I_{DSS} = 18mA and V_P = -5V. Determine the values of I_D and V_{DS}. [8]



7. Describe the operation of class B amplifier and find the maximum efficiency of the amplifier. [4+4]

8. Draw class A tuned amplifier and its corresponding graph. And find its resonant frequency (ω_o) and 3dB band width (B). [6]

9. Describe AMV circuit using IC 555 and state its frequency of oscillation. [6]

10. Draw phase shift oscillator circuit and write its frequency of oscillation (f_o). [5]

11. Why transistor series regulator has lower efficiency? Explain the operation of voltage regulator using band gap voltage reference. [2+4]

12. Design a (5-10)V variable dc voltage regulator using LM 317 IC. [5]

13. Write short notes on: (any two) [2×4]

a) Π-models of BJT and MOSFET
b) ac equivalent circuit of common source amplifier using MOSFET
c) BJT as switch

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25 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2071 Shawan

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

Subject: - Electronic Devices and Circuits *(EX501)*

- ✓ Candidates are required to give their answers in 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 with the help of loadline and IV characteristics of the diode, a simple circuit that uses pn junction diode in forward biased state. [5]
2. Design DC voltage regulator for 6V output. Given data are $V_Z = 6V$ at $I_Z = 20$ mA, $I_{zk} = 2$ mA, $P_{ZMAX} = 500$ mW and $r_z = 20\Omega$. The nominal input voltage is 12v±20% DC. Find its voltage regulation factor and maximum current it can deliver to the load. [5]
3. Design Common Base Amplifier using β-independent dc biasing method. Use appropriate guideline to support your design. Given parameters are: $V_{CC} = 24$VDC, $I_C = 1$ mA and $\beta = 200$. Also find its voltage gain by using its ac equvalent circuit. [5+3]
4. Describe in brief the operation of BJT as switch in cut off and saturation region. [4]
5. Draw Ebers Moll model, low frequency ∏-model and simple T - model for BJT. [2+1+1]
6. Describe the principle of operation of N-channel JEET with the help of drain and transfer characteristics graphs and mathematical expressions. [8]
7. An n-channel JEET has a pinch-off voltage of -4.5V and $I_{DSS} = 9$ mA. At what value of V_{GS} will I_{DS} be equal to 3 mA? What is its g_m at this I_{DS}. [5]
8. Derive an expression to obtain transconductance of MOSFET. [3]
9. What is crossover distortion and how it can be eliminated? [4]
10. Draw a circuit diagram of tuned amplifier. Determine the range of frequency in which it gives maximum gain within -3dB range. [5]
11. Why the efficiency of class-A amplifier is low? Obtain the expression of the general efficiency of series fed class -A power amplifier circuit. [6]
12. Define Barkhausen Criteria for sinusoidal oscillation. Draw the circuit diagram of RC phase shift oscillator and derive its frequency of oscillation. [5]
13. Define the term multivibrator. Explain the operation of op-amp based astable multivibrator with the help of circuit diagram and waveform. [4]
14. Design a regulator circuit to obtain 16 VDC. Choose approximate values of the parameters. Input voltage is 25 VDC. [5]
15. Draw the series voltage regulator with current limiting element and explain how it works. [6]
16. Draw block diagram for IC voltage regulator. [3]

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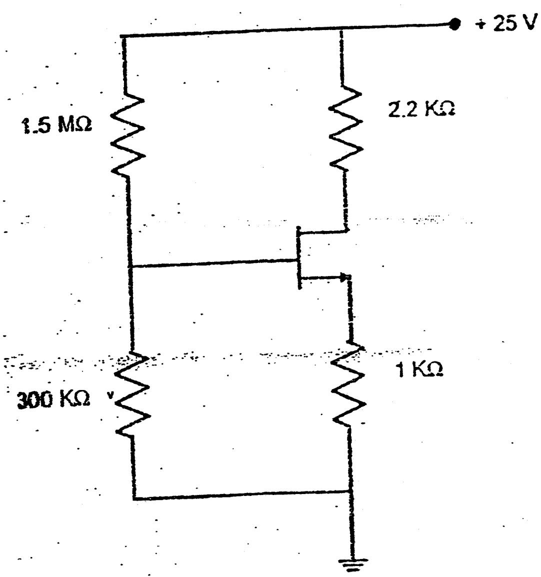
25 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2070 Chaitra

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

Subject: - Electronic Devices and Circuits *(EX501)*

- ✓ Candidates are required to give their answers in 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 p-n junction diode? Explain the large signal models of p-n junction diode. [1+4]
2. Find the value of dynamic resistance if voltage in the diode is 650mv and I_{RS} is 10pA= $(10\times10^{-12}A)$ (Given n = 2 and V_1 = 25 mV) [5]
3. Why common collector amplifier is also called emitter follower? Draw the common collector transistor amplifier circuit and find its input impedance, output impedance and voltage gain. [8]
4. Draw and describe the Ebers Moll model for BJT. [4]
5. Describe in brief the operation of BJT as a switch in cut off and saturation region. [4]
6. Describe the construction and working principle of EMOSFET with help of drain characteristics curve and mathematical expressions. [8]
7. Find I_D and V_{DS} for the given circuit. The given data are V_p = -4V and I_{DSS} = 10mA [5]



8. Derive an expression to obtain the transconductance of JFET. [3]
9. What is the maximum efficiency of class B amplifier? State the condition when it occurs. [4]
10. When are tuned amplifiers used? Draw class A tuned amplifier circuit and find its 3db bandwidth. [2+5]

11. Draw the circuit diagram of Complementary-Symmetry Class-AB amplifier. Using Darlington pair transistors. [3]

12. Write the applications of tuned LC oscillators. Draw the Colpitt's oscillator circuit and derive the expression for frequency of oscillation. [6]

13. Draw AMV circuit using IC 555 or BJT. [4]

14. State Barkhausen Criteria for sine wave oscillator. [2]

15. Design a (10-25) V variable dc series voltage regulator using LM 317 IC. [5]

16. Draw the circuit of current limiting circuit in dc voltage regulator. [2]

17. Find voltage stability factor of series dc voltage regulator. [5]

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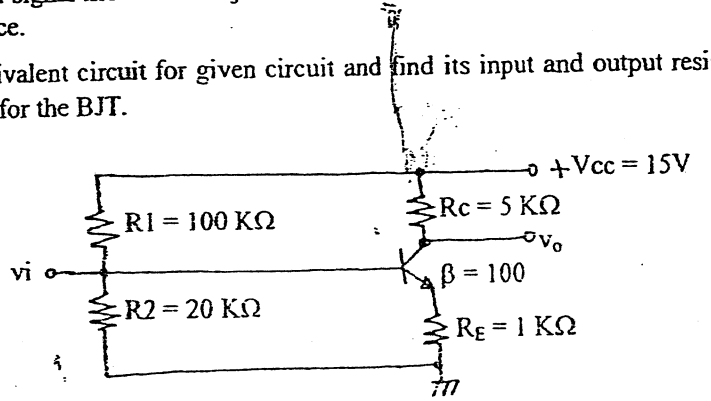
26 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2069 Chaitra

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

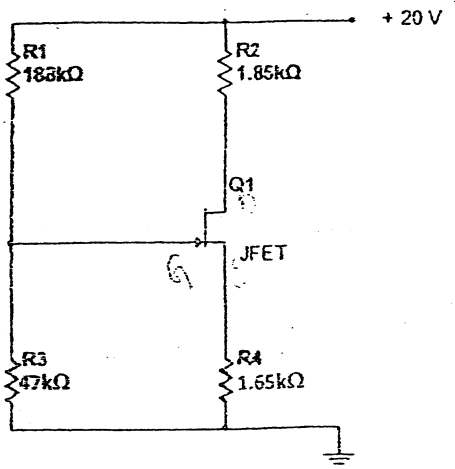
Subject: - Electronic Device and Circuits *(EX501)*

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

1. Draw full wave bridge rectifier circuit with 5 ohm load resistor connected at its output. If input ac voltage is 10V, calculate the power dissipation in the load resistor (Assume diodes operate at forward voltage of 0.7V). [4]
2. Explain the small signal model of PN junction diode and derive the expression for AC or dynamic resistance. [2+4]
3. Draw the ac equivalent circuit for given circuit and find its input and output resistances. Assume $\beta = 100$ for the BJT. [8]



4. Define transconductance (gm). Derive gm for BJT. [2+4]
5. Describe in brief the operation of BJT as a switch. [4]
6. Describe with necessary graphs and expressions the principle of operation of N-channel JFET. [6]
7. The n-channel JEET in the figure below has I_{DSS} = 18 mA and V_P = -5V. Determine the values of I_D and V_{DS}. [8]



8. State the difference between BJT and FET. [4]
9. Determine the general efficiency of Transformer Coupled Class-A power Amplifier. [6]
10. Draw the circuit diagram of Complementary-Symmetry Class-AB Amplifier. [2]
11. Calculate the efficiency of transformer coupled push pull Power Amplifier for a supply voltage of 20V and output of (i) $V_P = 20V$ (ii) $V_P = 16V$. [3+3]
12. Draw Wien Bridge Oscillator circuit and derive the expression for frequency of Oscillation and gain of the amplifier circuit. [2+3+3]
13. Draw standard series dc voltage regulator and find its voltage stability factor (S_v). [6]
14. Design a 4.2 V to 12 V variable dc voltage regulator using IC LM317. [4]
15. Draw the circuit diagram of square wave generator. [2]

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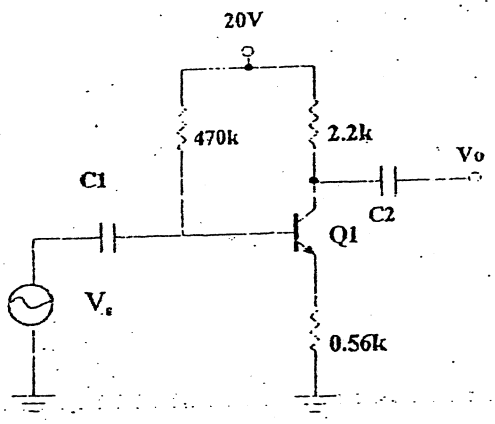
26 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2068 Chaitra

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

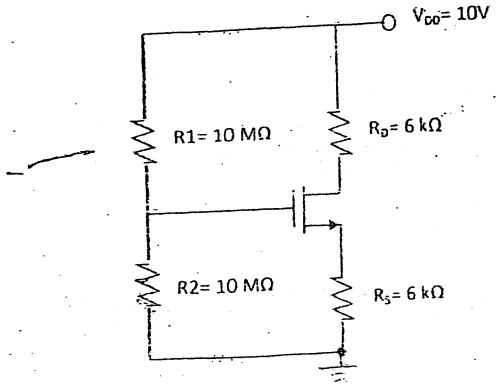
Subject: - Electronic Devices and Circuit *(Ex 501)*

- ✓ Candidates are required to give their answers in 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 large signal models of PN junction diode. [4]
2. A diode conducts 1mA at 20°C. If it is operated at 100°C, what will be its current? Given data are: η=1.8 and negative temperature coefficient value = –1.8mv/°C. [4]
3. For the figure shown below with β = 120 find the a) input impedance (b) Output impedance (c) voltage gain (d) current gain. Use small signal model. [2+2+2+2]



4. Draw ac equivalent circuit of common collector amplifier. Find its input and output resistances. [2+3+3]
5. Describe the physical structural of N-channel JEET and explain its working principle and characteristics clearly marking the various regions of operation. [2+6]
6. Derive the expression to obtain the transconductance of E-MOSFET. [4]
7. Find the drain current (I_D) and drain to source voltage (V_{DS}) for the following circuit. Given parameters are: V_t = 1V and k = 0.5mA/V^2. [4]



8. Draw the circuit diagram of class B push pull amplifier with output transformer and explain how push pull action is achieved. Determine the general efficiency of class B push pull amplifier. [1+3+4]

9. Draw class A tuned amplifier circuit and derive the expression for 3dB bandwidth of the amplifier. [2+6]

10. Describe the operation of IC 555 as square wave oscillator and find its frequency of oscillation. [6+2]

11. Estimate voltage stability factor (S_V) for standard series dc voltage regulator using BJT. Also, explain the operation of overload protection circuit that could be used in series voltage regulator circuit. [5+3]

12. A class B audio amplifier is providing 20V peak sine wave signal to 8Ω speaker with power supply of 25V ($=V_{CC}$). At what efficiency is it operating? [4]

13. Define and explain the reverse breakdown effect in diodes. [4]

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TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2079 Bhadra

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

Subject: - Theory of Computation *(CT 502)*

- ✓ Candidates are required to give their answers in 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 regular expressions? Write a regular expression for the language. L = {w∈{a, b}*: w has even number of 'a's followed by odd number of 'b's}. Prove by mathematical induction that $n < 2^n$ for all positive integers n. [1+2+4]
2. Why is NDFA important although it is equivalent to a DFA? Design a DFA that accepts the language given by L = {w ∈ {0, 1}*: w has neither '00' nor '11' as substring}. Hence test your design for 01011010. [2+5]
3. Convert following Regular Expression to NFA and then to DFA. [7]
   L = b(baa ∪ aba)*
4. State pumping lemma for regular languages. Use it to show $L = \{a^{n!} : n > 0\}$ is not regular. [2+5]
5. What are inherent ambiguity in grammar? Write a CFG for following language.
   L = { w∈ 0, 1, 2}* : $W = 0^i 1^j 2^k$ such that i = j or j = k}. [2+5]
6. Convert following CFG into CNF with explanation of each steps. G = (V, Σ, R, S), where
   V = {S, A, B, a, b},
   Σ = {a, b}
   R = {S → aBb| A, A → aB|bA| AB| e, B → aB} [7]
7. Show that context free languages are not closed under intersection and complementation operation but closed under complementation. [7]
8. Construct a Turing machine to transform ⊔ ω ⊔ into ⊔ω⊔ ω ⊔where ω is a string with no blanks and ⊔ represents a blank symbol. [7]
9. Design a Turing machine that decreases any binary strings by one with Σ = {0, 1, #, ⊳}, where ⊳ is left end symbol and # is the Blank Symbol. Hence test your design for ⊳ #100# to ⊳ # 011#. [7]
10. What is a universal Turing machine? Explain with example. What is Church Turing thesis? [7]
11. State Church Turing Thesis. Prove that if L and its complement are both Recursively Enumerable, then L is recursive. [3+3]
12. What do you mean by Halting Problem? Explain about complexity classes P, NP and NP Complete. [4]

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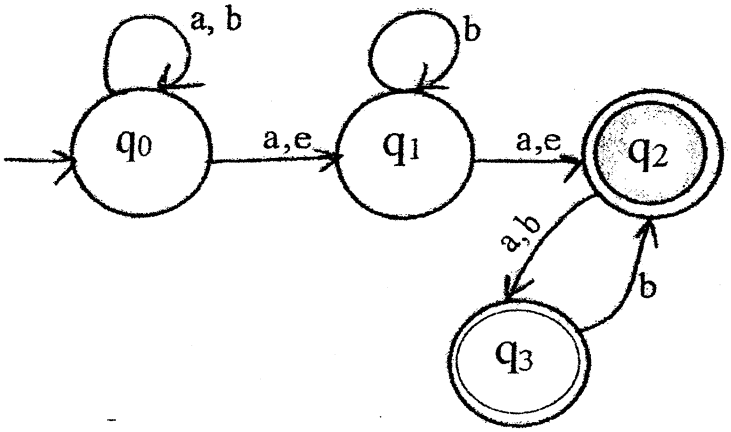
TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2079 Baishakh

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

Subject: - Theory of Computation (*CT 502*)

- ✓ Candidates are required to give their answers in 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 regular expressions? Write a regular expression for the language.
   L = {w∈{a, b}*: w has even number of 'a' s followed by odd number of 'b' s.}. [1+2]
2. Prove by mathematical induction that $n < 2^n$ for all positive integers n. [4]
3. Define finite state Automata with its block diagram. Design a deterministic finite automata accepting strings over {a, b} containing either 'ab' or 'bba' as substring. [2+5]
4. Formally define a non-deterministic finite automata. Using pumping lemma for regular language, show that L = { 0^n: n is prime} is not regular. [2+5]
5. Convert the following e-NFA into DFA. [7]



6. What are inherent ambiguity in grammar? Write a CFG for following language.
   L = {w∈ 0, 1, 2}* : W = $0^i 1^j 2^k$ such that i = j or j = k }. [2+5]
7. Describe the operation of pushdown automata. Design a PDA for language L = { w c w^R : w∈ { a, b}*} and check your design for string w = abacaba. [2+5]
8. State and describe the pumping theorem for context free languages. Show that context free languages are not closed under intersection and complementation operation. [2+5]
9. Construct a Turing machine to transform ⊔w⊔ into ⊔w⊔ w⊔ where w is a string with no blanks and ⊔ represents a blank symbol. [7]
10. How Turing machine works? Explain. Design a Turing machine that computes the function f (m,n) = m+1. [4+6]
11. Explain the significance of church-Turing thesis. What is undecidability? Explain undecidebility problem with example. [2+4]
12. Explain Turing recognizable and Turing decidable languages. [3]
13. How can we define computational complexity of an algorithm? Explain class P problems with example. [2+3]

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TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2078 Bhadra

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

Subject: - Theory of Computation *(CT 502)*

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

1. a) Write regular expressions for the language which generates strings of even length over the alphabet $\Sigma = \{a, b\}$. [3]
   b) Define Induction Principle. Explain Pigeonhole principle with suitable example. [1+3]
2. Design a DFA that accepts a language L(M) = {w∈{0, 1}*: Every 0 in w has 1 immediately to its right. Test your design for 0010111, 1011010111 and also show the steps involved. [7]
3. State the pumping for regular languages. Use pumping lemma for regular languages to show the Language $L = \{a^{n!} : n > 0\}$ is not regular. [2+5]
4. List closure properties of regular language. Show that regular languages are closed under intersection. [2+5]
5. Design a Pushdown Automata (PDA) which accepts all the strings for the language $L = \{a^n b^m a^{n+m} : n, m > 0\}$. Check your design for the string "aabbbaaaaa". [2+5]
6. Convert following CFG into CNF with explanation of each steps. G = (V, Σ, R, S), where
   $V = \{S, A, B, a, b\}$,
   $\Sigma = \{a, b\}$,
   $R = \{S \rightarrow ASA | aB, A \rightarrow B | S, B \rightarrow b | \varepsilon\}$. [7]
7. Design a Context Free Grammar for the language $L = \{a^i b^j c^k \mid i, j, k \geq 0 \text{ and } i + j = k\}$. Derive the string "aabccc" and also draw parse tree for the same. [7]
8. Design a Turing machine that takes binary numbers as input and computes 1's complement operation. Hence test your design for #100# to # 011#. [7]
9. Describe the working of a Turing Machine along with a block diagram. How can we represent configuration of a Turing Machine? State and explain with example Rules for Combining Turing Machine. [3+2+5]
10. Explain undecidable problems about Turing machine and grammar. Show that complement of recursive language is recursive. [3+4]
11. Explain about Halting problem with example. [3]
12. Explain about class-NP problems with examples. [4]

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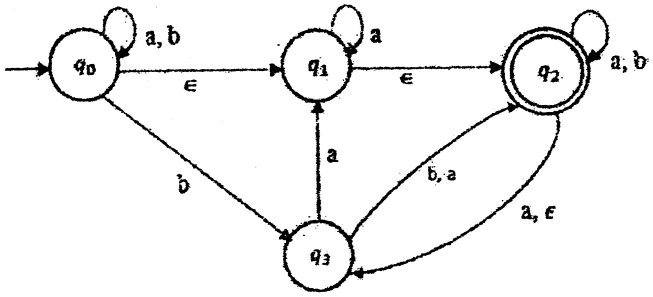
TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2078 Kartik

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

Subject: - Theory of Computation *(CT 502)*

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

1. a) Write a regular expression for the set of strings over {0, 1} with exactly two 0's. [3]
   b) Explain equivalence relations and partial order relations with examples of each. [4]
2. What is configuration of DFA? Design a DFA which accepts the strings of the language defined by the regular expression R = (01 ∪ 010)*. [2+5]
3. How can you prove that some languages are not regular? Prove that the set of regular languages are closed under complementation and intersection operations. [2+5]
4. Define e-NFA formally. Convert the following e-NFA to equivalent DFA. [1+6]



5. Design a Pushdown Automata (PDA) which accepts all the language $L = \{a^m b^n c^{3m} : m, n>0\}$. Check your design for string 'abbccc'. [5+2]
6. What are the decision properties of context free language? Prove that context free languages are closed under union and concatenation operation. [3+4]
7. What is ambiguity in CFG? Design a CFG that generates the strings belongs to the language L = {wcw^R : w is the string of alphabets {a, b} and w^R is the reverse of w}. Verify your design by deriving string abbcbba. [2+5]
8. A single tape Turning Machine consist of sequence of 0's and 1's, design a single tape deterministic Turing Machine which counts numbers of 1s in the given tape. If it contains even number of 1s then it replaces each occurrence of 1 s by 0s and otherwise it should replace each occurrence of 0s by 1s and halts.
   E.g. if input string in tape is #10111# then output should be #00000#, if input string in tape is #11001# then output should be #11111# [7]
9. What is primitive recursive function? How Turing Machine can be used to describe Zero function and Successor function as defined in initial functions? Explain with proper example. [1+4]
10. Describe working mechanism of Multi-tape Turing machine. How it differs from multiple head Turing machine? [3+2]
11. How Universal Turing Machine (UTM) is different from Standard Turing machine? How Universal Turing machine works? Explain with proper example. [1+4]
12. What is undecidability? Describe recursive and recursively enumerable language with suitable examples of each. [4]
13. What is complexity theory? Why it is important to deal with computational problems? Explain NP-Complete problems with suitable examples. [2+3]

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TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2076 Chaitra

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

Subject: - Theory of Computation *(CT 502)*

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

1. Formally define regular expressions. Explain the diagonalization principle with an example. [2+5]
2. Distinguish between deterministic and non-deterministic finite automata. Design a DFA with $\Sigma = \{0, 1\}$ which accepts the strings with an even number of 0's followed by a single 1} [2+5]
3. Construct an NDFA for the language (ba)*U(bab)*. Convert the NDFA into a DFA. [2+5]
4. Define what is a closure property. Prove that regular languages are closed under union, concatenation and kleene star operation. [1+6]
5. Explain ambiguity in CFG with example. Write the CFG for the language $L = \{a^i b^j c^k : i=j$ or $j=k\}$. Generate the strings $a^3 b^4 c^4$ using your grammar. [3+4]
6. Define Chomsky Normal Form. [1+6]

   Convert the following CFG into CNF.

   G = (V, Σ, R, S) where
   V = {S, X, Y}
   Σ = {a, b, c}
   R given by
   $S \rightarrow aXbX$
   $X \rightarrow aY \mid bY \mid \varepsilon$
   $Y \rightarrow X \mid c$
7. Differentiate between Finite Automata and Pushdown Automata. Design a PDA which accepts all the strings of languages $L = \{a^n b\, c^{2n} : n > 1\}$. [2+5]
8. Design a single tape deterministic Turing Machine that accepts
   $L = \{wcw^R : w \in \{0, 1\}^*$ and c is single 0 or 1 or e (empty string). [7]
9. Compare Turing machine with PDA and FA. Explain Chomsky hierarchy of language with suitable diagram and examples. [4+4]
10. Define the term Turing Decidable. Show that Union and Intersection of two recursive languages is recursive. [3+5]
11. What is the significance of a Universal Turing Machine? Explain its working mechanism. [2+3]
12. Explain NP-complete problems with example. [3]

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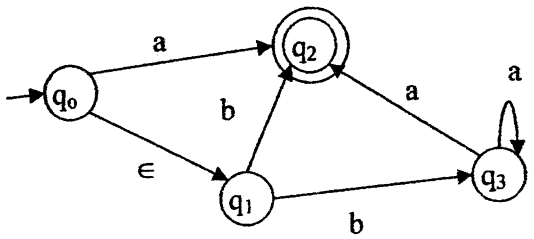
TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2076 Ashwin

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

Subject: - Theory of Computation *(CT 502)*

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

1. Determine Regular Expression for the following Language L={ w ∈ {a, b}* : w contains at-least one 'a' OR at-least one 'b'}. [2]
2. Prove by using Principle of Mathematical Indication: [5]
$$1+2+3+...+n=\frac{n^2+n}{2};\ \text{for } n\geq 0$$
3. Define configuration of DFA. Design a DFA that accepts the language L={w ∈ {a, b}: w has neither 11 nor 00 as substring}. [2+5]
4. Convert following NDFA to DFA. [7]



5. State pumping lemma for regular language. Show that L={ $a^n b a^n$: n>0} is not regular. [2+5]
6. Construct CFG for following language: L={ww^R: w ∈ {a, b}*}
Also, use the grammar to derive the string "abba" and draw parse tree for it. [7]
7. Define Chomsky Normal Form.
Convert the following CFG into CNF.
G= (V,Σ,R,S) where V={S, A, B, a, b}, Σ={a, b}, R given by
s → AB
A→ aAA/e
B→bBB/e [2+5]
8. Design PDA for following language: L={$a^{2n}b^{3n}$: n ≥ 0}
Also test your design for "aabbb". [7]
9. Explain a multi-tape Turning Machine. Design a single tape deterministic Turing Machine which accepts the given string w over alphabet Σ={a, b, c} and w contain equal number of a, b, c. [2+5]
10. Differentiate between Context Free and Unrestricted Grammars. Design a Turing Machine that replaces symbol 'a' with 'b' and 'b' with 'a' for any string w ∈ {a, b}*. Show the processing of machine (configuration transition) for string "ababa". [2+5]
11. What do you mean by Church Turing thesis? Show that the union of two recursively enumerable languages is recursively enumerable. [3+4]
12. What is "Halting Problem"? How can you prove that it is unsolvable? [5]
13. Define polynomial time reduction. Explain P and NP problems with examples. [1+4]

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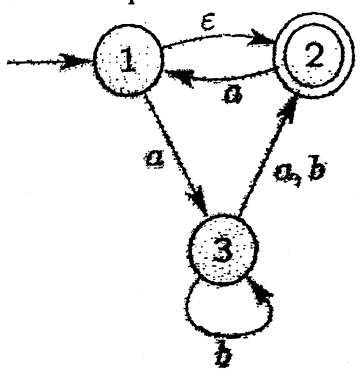
33 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2074 Chaitra

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

Subject: - Theory of Computation *(CT502)*

- ✓ Candidates are required to give their answers in 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 regular expressions? Find the equivalence classes for the set N = {1, 2, 3, 4, 5 ....} corresponding to the equivalence relation R = {(a, b): (a+b) is even number}. [2+5]
2. Explain finite automata with their application. Design a DFA that accepts the language L = {w ε {a, b} : w must have either aaa or bbb as a substring}. [2+5]
3. Convert the following NFA into it's equivalent DFA. [7]



4. State the pumping lemma for the regular languages. Show that the Language $L = \{0^{n2} \mid n >= 1\}$ not regular e.g.
if n = 1, w = 0, n = 2, w = 0000.n = 3, w = 000000000 [2+5]
5. Define context free Grammar (CFG). Show that $L = \{a^n b^{2n} c^{3n} : n > 0\}$ is not context free language by using Pumping lemma for CFL. [2+5]
6. Convert the following CFG into CNF. G = {V, T, P, S} [7]

   Where, V = {S, A, B, C, a, b, c}
   T = {a, b, c}
   P = {S →ABA | ab A | BC, A → aA | ε , B → baB | c, C → aC}
7. Design a push down automaton (PDA) for $L = \{a^n b^{2n} : n \geq 1\}$. Hence test for "aaabbb" and "aabbbb". [5+2]
8. Define Turing Machine. Design a single tape deterministic Turing Machine which reverses the given string w, over alphabet ∑ = {a, b}. [2+5]
9. Explain how unrestricted grammar can be used to generate the language $L = \{a^n b^n c^n : n > 0\}$.
   Is there any difference between CFG and Unrestricted grammar? Explain [4+2]
10. Explain encoding technique of universal Turing machine. Show that complement of recursive language is recursive. [5+4]
11. What do you mean by Church-Turing Thesis? State when a problem is said to be decidable and give an example of an undecidable problem. [2+2]
12. Explain P and NP class of problems. [5]

33 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2075 Ashwin

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

Subject: - Theory of Computation *(CT502)*

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

1. a) Write a regular expression for the language in which strings start and end with different symbol over alphabet $\sum = \{a,b\}$. [3]

   b) Define Diagonalization Principle. Explain Principle of mathematical induction with suitable example. [1+3]

2. What are the components of finite automata? Design a DFA that accepts the strings given by L = {w∈ {a, b}*: w has number of a divisible by 3 and number of b by 2}. [1+6]

3. List closure properties of regular language. If M and N are any two regular languages then show that L = (M∪N) is also regular language. [2+5]

4. Write the statement of Pumping lemma for regular languages. Show that $L = \{a^n b^n, n > 0\}$ is not a regular language by using pumping lemma. [3+4]

5. Write Context Free Grammar for the Language $L = \{a^i b^j c^i : i, j > 0\}$ over the alphabet $\sum = \{a,b,c\}$. Use Leftmost, rightmost derivation to generate strings "aabbbcc". Also draw parse tree for the same. [7]

6. Convert following CFG into CNF with explanation of each steps. G = (V, Σ, R, S), where
   V = {S, X, Y, a, b, c},
   Σ = {a, b, c},
   R = {S→aXbX, X→aY|bY|XY|∈, Y→aX|c}. [7]

7. What is additional feature PDA has when compared with finite automata? Explain. Design a Pushdown Automata (PDA) which accepts all the strings of language $L = \{a^n b^m c^{2n}; n, m > 0\}$. [2+5]

8. Design a Turing machine that increments any binary strings by one with $\sum = \{0,1,\#\}$. Hence test your design for ##11# to #100#. [7]

9. How multi-tape Turing machine is different from multi-track Turing Machine? Does any variation of Turing machine have more computational power than standard Turing machine? Explain. [2+5]

10. Describe in detail about on universal Turing machines with example. [5]

11. Explain the Church Turing thesis. Show that the "halting problem" is undecidable. [3+4]

12. Explain NP hard and NP-Complete Problems with reference to polynomial time reduction. [5]

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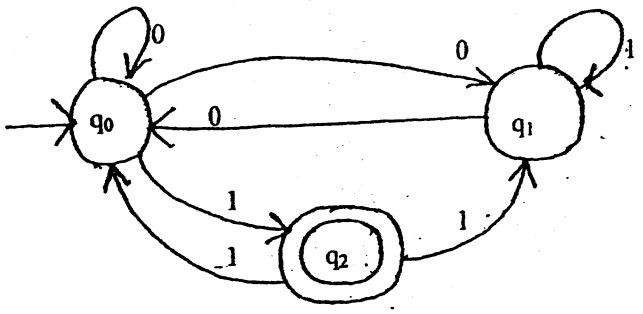
43 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2074 Ashwin

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

Subject: - Theory of Computation *(CT502)*

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

1. State the diagonalizable principle. Use principle of mathematical induction principle to prove $n^4 - 4n^2$ is divisible by 3 for $n \geq 0$. [3+4]
2. What is the significance of finite automata? Design a DFA that accepts the strings over an alphabet $\sum = \{0,1\}$ that either start with 01 or end with 01. Hence test your design for any two strings. [1+6]
3. Differentiate between DFA and NDFA. Convert the following NDFA to its DFA. [2+5]



4. Define Closure properties of Regular Language. Prove that regular Language are closed under Union, Intersection and Complementation operation. [1+6]
5. Define pumping lemma for context free language. Prove that language $L = \{WW | W \in \{1,0\}^*\}$ is not context free. [2+5]
6. Convert following CFG into CNF with explanation of each steps. G=(V,Σ,R.S), where [7]

   V = {S,A,B,a,b},
   Σ = {a,b}
   R = {S→ASB|∈, A→aAS|a, B→AB|b|∈}.
7. Mention role of parse tree in context free grammar. Design a PDA that accepts $L = \{a^n b^{2n+1}, n > 0\}$ and check it for string aabbbbb. [2+5]
8. Design a single tape deterministic Turing machine which accepts all strings defined for the language $L = \{a^n c b^n : n \geq 0\}$ over alphabet $\sum = \{a,b,c\}$. [5]
9. Design a multi-tape Turing machine which act as Copying machine over the alphabets $\sum = \{0,1\}$ that transforms string of the form "#10#" into "#10#10#". [5]

10. Define unrestricted grammar. Explain possible extensions of Turing machine in brief. [1+6]

11. What is universal Turing machine? How Universal Turing machine works? Explain. [5]

12. Explain Halting problem. Is it solvable problem? Discuss. [4]

13. What are two factors affecting the computational complexity of a problem? Explain class NP with suitable example. [1+4]

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43 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2073 Chaitra

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

Subject: - Theory of Computation *(CT502)*

- ✓ Candidates are required to give their answers in 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 dovetailing technique with suitable example. Write a regular expression for even number of 'a' followed by odd number of 'b' over an alphabet $\Sigma = \{a, b\}$. [3+4]
2. Differentiate between NFA and DFA. Design a DFA that accepts the language $L = \{x : x \in \{0,1\}^* \mid 10110$ does not occurs as a substring in x$\}$. Verify your design with supporting examples. [2+5]
3. State Pumping Lemma for Regular Language. Use Pumping Lemma and prove that Language $L = \{w : w \in \{0,1\}^*$, and w has an equal number of 0's and 1's$\}$ is not regular. [2+5]
4. Why is NDFA important although it is equivalent to a DFA? Design NDFA which accepts $L = \{W \mid W \in \{a,b\}^*$ such that W contains either two consecutive a's or two consecutive b's$\}$. [2+5]
5. Define ambiguity in CFG. Write CFG for $L = w \in \{a,b\}^* : w$ is a palindrome$\}$ and also draw parse trees for the derivation of any two strings of length even and odd. [2+5]
6. Define Chomsky Normal Form (CNF). Convert the following CFG into CNF. $G = (V, \Sigma, R, S)$ where $V = \{S, A, B, a, b\}$, $\Sigma = \{a, b\}$ and R is given by

   $\{S \to A, S \to B, A \to aBa, A \to e, B \to bAb, B \to e\}$. Where e is empty symbol? [2+5]
7. Design a PDA that accepts those strings "having total number of 'a' equal to the sum of number of 'b' and 'c' with sequence of a,b,c,(i.e $a^i b^j c^k : i = j + k$). Hence test your design for the string "aaaabbcc". [7]
8. Compare Turing machine with Finite Automata (FA) and Push down Automata (PDA). [5]
9. Design a Turing machine to accept language $L = \{WW^R \mid W \in \{0,1\}^*\}$. Show processing for the string 101101. [5]
10. Explain unrestricted grammar with suitable example. Is unrestricted grammar is superset of Context Free Grammar? Justify your answer. [4+3]
11. What is recursive language? Mention its properties. Prove that "A language is recursive if and only if both it and its complement are recursively enumerable." [2+2+5]
12. Define Computational Complexity and Polynomial Time Reduction. Also explain NP hard and NP-Complete problems. [2+3]

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43 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2073 Shrawan

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

Subject: - Theory of Computation *(CT502)*

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

1. State pigeonhole principle. Prove the following statement by using mathematical induction: $1\times1!+2\times2!+3\times3!+.....+n\times n! = (n+1)!-1$ where $(n\geq1)$. [2+5]
2. Define Configuration of DFA. Design a Deterministic Finite Automata (DFA) for language $L = \{w \varepsilon\{0,1\} : w$ has both 01 and 10 as substrings$\}$. Verify your design by taking one accepted and one rejected strings. [2+5]
3. Construct a NFA for the language (ab*a U b*aa). Provide any two accepted strings and two rejected strings. [7]
4. State pumping lemma for regular language and use this theorem to prove that $L = \{a^n b^{2n} : n \geq 1\}$ is not regular. [7]
5. Construct a PDA which accepts the language $L = \{a^n b^{n+m} c^m : n,m \geq 1\}$. Verify your design by taking s string "abbbcc" as example. [7]
6. What is Chomsky? Normal Form (CNF)? $\{S,L,M,N,a,b,c\}$, $\sum = \{a,b,c\}$,

   $R = \{S \rightarrow MaN|bL|bM, L \rightarrow ab|cN|Ml|\varepsilon, M \rightarrow a|cM, N \rightarrow abN\}$ and S is the start symbol. [2+5]
7. Construct a CFG for the language $L = a^n b^{2n}, n > 0$ and use this grammar to generate the string aabbbb. Also construct the parse tree. [5+2]
8. Design a Turing Machine (TM) which accepts the following language $L = \{W \varepsilon\{x,y,z\}^* : w$ has equal no. of x's,y's and z's$\}$. Verify your design for the string "#xyxyzz#". [6]
9. Design a two tape Turing machine that acts as a binary adder. Assume both the strings are kept at first tape and separated by a semicolon and output is desired at the same tape. [7]
10. Explain Recursive and Recursively Enumerable Languages with suitable examples of each language. [4]
11. Define unrestricted grammar. Explain, how unrestricted grammar can be defined as super set of CFG and Regular Grammar? Explain the church-turing thesis. [2+3+4]
12. Explain class P and NP problems with example. What is NP-complete problem? [5]

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43 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2072 Chaitra

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

Subject: - Theory of Computation *(CT502)*

- ✓ Candidates are required to give their answers in 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 Catesian Product. Use Mathematical Induction to show [1+3]

   $1.1!+2.2!+.....+n.n! = (n+1)!-1$ for $n \geq 1$

   b) Find the regular expression for the language $L = \{W \in \{0, 1\}^*$: has 0101 as substring. [3]

2. Construct a DFA over {a,b} accepting strings having even number of 'a' and odd number of 'b'. [7]

3. Define DFA formally. State and prove closure properties of regular languages. [7]

4. Define pumping lemma for regular language. Use pumping lemma for regular language to show $L = \{a^n b a^n$ for $n = 0,1,2.....\}$ is not regular. [2+5]

5. Define the configuration of PDA. Design a PDA that accepts $L = \{a^{3n}b^n, n > 0\}$ and check the string aaaaaabb. [7]

6. Define context free grammer.Convert the given Context Free Grammar (CFG) into equivalent CNF [2+5]

   $S \rightarrow AB$

   $A \rightarrow aAA \mid e$

   $B \rightarrow bBB \mid e$, Here: e means empty symbol

7. a) Write a CFG for the regular expression $R = 0^*1(OUI)^*$ [4]

   b) Use concept of closure property to prove that intersection of Context Free Languages is not Context Free. [3]

8. Design a Turing machine to compute the function $f(n) = n+1$, where n be a binary string. Show the processing for the string 10111. [6]

9. Define Multitape Turing Machine. With the help of suitable example, explain how Universal Turing machine works. [2+5]

10. State Church Turing thesis. What is a recursive language? [2+2]

11. Show that if a language L and its complement both are recursively enumerable, then L and its complement is recursive. Explain the halting problem. [4+5]

12. Write short notes on: [5]

    a) Computational Complexity
    b) NP hard and NP Complete Problems

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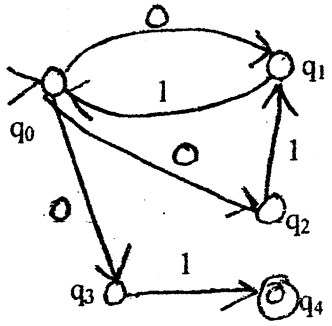
43 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2072 Kartik

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

Subject: - Theory of Computation *(CT502)*

- ✓ Candidates are required to give their answers in 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 what an equivalence relation is. Show by induction that for any $n \geq 0$, $1+2+.....+n = (n^2+n)/2$. [2+3]
2. Let $\Sigma = \{a,b\}$. Write a regular expression for the language with all strings in Σ^* with no more than three a's. [3]
3. Formally define a Deterministic Finite Automation (DFA) [5]
4. Design a DFA accepting strings over the alphabet {0,1} defined by {0 0}* {11}*. [5]
5. Convert the following non-deterministic finite automation to DFA. [5]



6. State the pumping lemma for regular language. Show that the language $L = \{a^n : n \text{ is prime}\}$ is not regular using the pumping lemma. [5]
7. Define Context Free Grammar (CFG) along with an example. [5]
8. Convert the following CFG to Chomsky Normal Form (CNF) [5]

   $G = (V, \Sigma, R, S)$ where $V = \{S, A, B, a, b\}$

   $\Sigma = \{a,b\}$

   $R = \{S \rightarrow aAbB, A \rightarrow aA, A \rightarrow a, B \rightarrow bB\}$
9. Design a pushdown automation to accept $L = \{ww^R; w \in \{a,b\}^*\}$. Show how it accepts the string "abbbba". [5]
10. Using the pumping theorem for context free languages show that $L = \{a^n b^n c^n : n \geq 0\}$ is not context free. [5]
11. What is a Turing machine? Describe its operation. [5]
12. Construct a Turing machine to transform ⊔w⊔ into ⊔⊔w⊔, where w is a string containing no blanks and ⊔ represents blank. [7]
13. Construct a Grammar to accept the language $L = \{a^n b^n c^n : n \geq 1\}$ [5]
14. Explain the Church-Turing thesis. Show that the Halting problem is undecidable. [3+7]
15. Explain what is the class P. Describe the Traveling Salesman Problem. [3+2]

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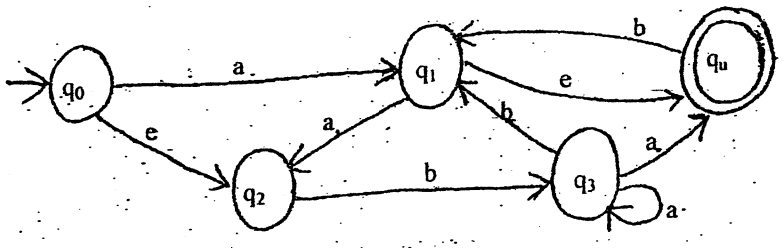
43 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2071 Chaitra

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

Subject: - Theory of Computation *(CT502)*

- ✓ Candidates are required to give their answers in 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 countably infinite and uncountable sets with example. Use principle of mathematical induction to prove $(5^n - 1)$ is divisible by 4 for all integers $n \geq 0$. [3+4]
2. Design a Deterministic Finite Automata (DFA) for the regular expression (a(ab)*b)*. Verify your design by taking one accepted and one rejected strings. [5+2]
3. State pumping lemma for regular language. Use this lemma to prove language, $L = \{a^{n^2} : n \geq 0\}$ is not regular. [2+5]
4. What are the differences between a DFA and a NFA? Convert the following NFA in to its equivalent DFA. [2+5]



5. Construct CFG for language, $L(G) = \{a^m b^n : m,n > 0, m \geq n\}$. Use this grammar to generate string "aaab". And also draw the parse tree. [4+1+1]
6. Convert following CFG to CNF [5]

   $G = (V, \Sigma, R, S)$, where
   $V = \{S, A, B, a, b\}$
   $\Sigma = \{a, b\}$
   $R = \{S \rightarrow aAb \mid Ba \mid A, A \rightarrow SS \mid e, B \rightarrow e\}$
7. Define the term ambiguity and inherent ambiguity in parse tree. For a CFG given by G = (V, Σ, R, S) with V = {S}, Σ = {a} and production rules R is defined as: [4]
   $S \rightarrow SS$,
   $S \rightarrow a$.
   Obtain the language L(G) generated by this grammar.

8. Design a PDA that accepts language, $L = \{a^n b^{3n} : n \geq 1\}$. Test your design for string "abbb".[5+1]

9. Write the differences between CFG and unrestricted grammar with example. Design a Turing machine that reads binary string and doubles the number represented by that string. A binary number is doubled if a '0' is added on the right end of the number. [3+5]

10. Define head shifting and symbol writing Turing Machines. Design a Turing Machine (TM) which computes following function $f(w) = ww^R$, where w^R is the reverse of string and $w \in \{0,1\}^*$. If your input string is #01#then TM should give the output string as #0110#. [3+6]

11. Define class-P and class-NP problems with example. How do they relate to NP-complete problems? [5]

12. What is an "Algorithm" according to Church-Turing Thesis? Why is it called thesis and not a theorem? Prove that if a language 'L' and its complement '$\bar{L}$' both are recursively enumerable, then L is recursive. [2+1+6]

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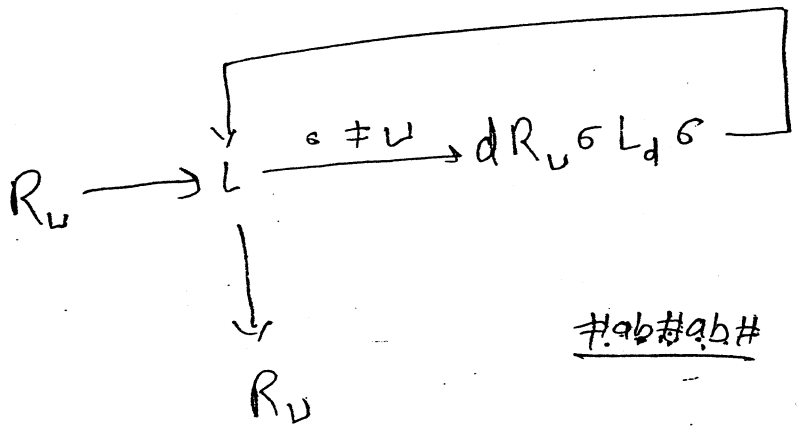

$S^K \cdot S - 1$

$5 \cdot K^K - 1$ $\quad S(B^{1K} - 1 \cdot + 1) - 1$

$5 5^K - 5 + 4$ $\quad 5(5^K - 1) + 5 - 1$

$5(5^K - 1) + 4$ $\quad + 4$

43 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2071 Shawan

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

Subject: - Theory of Computation *(CT502)*

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

1. State and explain pigeon-hole principle with an example. [3]
2. Prove that $\frac{1}{2}+\frac{1}{6}+\frac{1}{12}+.....+\frac{1}{n(n+1)}=\frac{n}{n+1}$ using mathematical Induction Principle. [4]
3. Design a DFA that accepts the language given by L = {w∈ {0, 1}*: w begins with 0 and ends with 10}. Your design should accept strings like 010, 011110, 000010, 01011010 and should not accept strings like 1010, 0011, 01011. [6]
4. Find the regular expression represented by NFA M= (K, Σ, Δ, s, F) where K= {q_0, q_1, q_2, q_3, q_4, q_5}, Σ= {a,b}, s=q_0, F={ q_5} and Δ is given as follows. [5]

δ / Σ	a	b	∈
→q_0	-	-	q_1
q_1	q_2	q_4	-
q_2	-	q_3, q_4	-
q_3	q_3	q_3	q_5
q_4	q_2, q_4	-	-
*q_5	-	-	-

5. Show that L= {w∈ {a, b}*: w has equal number of a's and b's} is not regular by using pumping lemma for regular language. You may use closure properties along with pumping lemma. [5]
6. Explain about decision algorithms for regular language. [5]
7. State and proof the pumping lemma for regular language. [6]
8. Prove that language which contains set of strings of balanced parentheses is not regular. [5]
9. Define a context-free Grammer. Convert the following productions into chomsky Normal form. [2+4]

   S → abAB

   A → bAB/E

   B → BAa/A/E
10. Describe the trausition function of push-down Automata. [4]

11. Design a Turing machine that reads binary strings and counts the number of 1's in the sequence. If there is odd number of 1 in the input string, machine just halts with doing nothing. Otherwise machine should add 1 to the input binary number if it is even number and subtract 1 from the input binary number if it is odd number. For example if input string is #1110#, it just halts after counting odd number of 1's. For #101#, it subtracts 1 to get #100# and for #1010#, it adds 1 to get #1011#. [7]

12. Let M1, M2 and M3 be three Turing machines, can you combine these three Turing machines to get new Turing machine M? If yes, elaborate your idea with required theory and illustration. Explain unrestricted grammar with suitable example. [5+5]

13. What is universal turning machine? Explain with example, how universal turing machine works? [5]

14. What do you mean by Church-Turing Thesis? Explain Turing recognizable languages and Turning decidable language with suitable examples. [2+2]

15. Why computational complexity analysis is required? Define class NP and explain how Travelling Salesman Problem (TSP) is Class NP problem. [1+4]

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43 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2070 Chaitra

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

Subject: - Theory of Computation *(CT502)*

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

1. Justify that "The complement of diagonal set is different from each row sets." with the help of diagonalization principle. Show that if 3n+2 is odd then n is odd by using proof by contradiction technique. [3+4]
2. Design a DFA that accepts the language L = {x ε {1,1}*: x has an even number of 0's and an even number of 1's}. Verify your design for at least two strings that are accepted by this DFA and 2 strings that are rejected. [5+2]
3. Show that for any Regular expression R, there is a NFA that accepts the same language represented by R. Construct a e-NFA for regular expression bb (a U b)*ab [3+3]
4. Use pumping lemma to prove that $L = \{a^n b^{2n} : n \geq 1\}$ is not regular. [4]
5. Consider the **regular grammar** G = (V, Σ, R, S) where [4]
   V = {S,A,B,a,b}, Σ = {a,b}
   R = {S → abA / B / baB / e
   A → bS / a
   B → aS
   }
   Construct a finite automaton M such that L (M) = L (G)
6. Write context free grammars (CFG) for the languages $L1 = \{a^m b^n c^n : m \geq 1, n \geq 1\}$ and $L2 = \{a^n b^n c^m : m \geq 1, n \geq 1\}$. Do you think that $L = (L1 \cap L2)$ is also context free? If not prove that the language thus obtained is not context free by using pumping lemma for context free language. [4+6]
7. Convert following CFG into CNF with explanation of each step. G = (V,Σ,R,S), where [6]
   V = {S, X, Y, Z, a, b, c},
   Σ = {a, b, c}
   R = {S→XYZ|XY|aZ, X→abX|ε, Y→bY|cZ|ab, Z→aXZ}
8. Design a PDA that accepts all the palindromes defined over {a, b}*. Your design should accept strings like ε, a, b, aba, bab, abba, babab etc. [5]
9. Define the term configuration of Turing Machine. Design a Turing machine which accepts the set of all palindromes over alphabets {0,1} [2+5]
10. Is Turing Machine a complete computer, support your answer in reference to different roles of Turing machines? Justify that unrestricted grammar can generate the language $L = \{a^n b^n c^n : n \geq 1\}$ [3+3]
11. Define Multiple tapes Turing machine. With reference to language they accept, compare Multiple tapes Turing machine with single tape Turing machine. [4]
12. "Turing machines is believed to be the ultimate calculating mechanism", elaborate with the help of Church-Turing thesis. How halting problems suffer the computational procedures? Explain with suitable example. [5+4]
13. With reference to Polynomial Time Reducibility, explain NP hard and NP- Complete Problems. [4]

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