23 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2071 Chaitra

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

Subject: - Electrical Engineering Material *(EE502)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Assume suitable data if necessary.*
- ✓ ***Values of commonly used constants are given below.***
- ✓ ***Mass of electron ,m_e=9.1*10^{-31}kg; 1ev=1.6*10^{-19}J***
- ✓ ***h=6.65*10^{-34}Js; k=1.38*10^{-23}J/k;***
- ✓ ***Permittivity of silicon=$\varepsilon_0\varepsilon_r$=11.9*8.85*10^{-12}F/m***
- ✓ ***n_{i0}=1.45*10^{10}/cm^3 for silicon; μ_n=1350cm^2/v.s(at 300K)***
- ✓ ***μ_h=450 cm^2/v.s(at 300K); N_A=6.022*10^{23}/mol***

1. a) What is Thermionic emission and work function? Derive the Richardson's expression for the thermionic emission for Schottky effect. [8]

   b) Consider two copper wires separated only by their surface oxide layer (CuO) of thickness 3 nm. The surface oxide layer offer potential barrier of height 10eV to the conduction electrons in copper. What is the transmission probability for conduction electrons in copper, which have kinetic energy of about 7eV? [4]

2. a) Define lattice and basis of a crystal and draw a neat diagram of body centered cubic structure of chromium and determine its packing density and state its co-ordination number. [2+4]

   b) What is an effective mass of a free electron? Show that effective mass of a free electron is equal to mass of free electron in vacuum. [1+3]

3. a) What are the different types of polarization mechanism in di-electric medium? [6]

   b) Describe how thermal breakdown and electromechanical breakdown results in dielectric breakdown in solids. [4]

4. a) Explain deperming method of demagnetization. If you place graphite in a non-uniform magnetic field what will happen? [3+3]

   b) What are magnetic domains? Explain the behavior of magnetic domains in presence of external magnetic field. [1+3]

5. a) What is Meissner effect? Explain in brief about type-I and type-II superconductor. [8]

   b) Differentiate Non-Degenerate and Degenerate semiconductors. [4]

6. a) In doped semiconductors, carrier concentration and drift mobility both are highly dependent on temperature, justify. [6]

   b) Compute the intrinsic concentration and intrinsic resistivity of silicon at 27°C. Given that: $m_e^* = 1.08m_e$ $\mu_e = 1350\ cm^2/V.s$ $m_h^* = 0.6m_e$ $\mu_h = 450\ cm^2/V.s$ [6]
   Where, m_e^* and m_h^* are effective masses of electron and holes respectively and μ_e and μ_h are electron and hole drift mobility's respectively. The band gap of Silicon = 1.1 eV

7. a) Find the resistance of 1 cm^3 silicon crystal doped with arsenic, the doping density is such that every Arsenic atom sites every 10^9 silicon atoms. Atomic concentration of silicon is $5\times10^{22}\ cm^{-3}$, $n_i = 1\times10^{10}\ cm^{-3}$, $\mu_e = 1350\ cm^2V^{-1}s^{-1}$ and $\mu_h = 450\ cm^2V^{-1}s^{-1}$. Find the resistance if the above silicon sample is further doped with Boron, the doping density is such that every Boron atom sites every 10^6 silicon atoms. [8]

   b) Prove that the position of Fermi level is near the middle of band gap in pure silicon semiconductor. [6]

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23 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2070 Chaitra

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

Subject: - Electrical Engineering Material *(EE502)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Assume suitable data if necessary.*
- ✓ ***Values of commonly used constants are given below.***
- ✓ ***Mass of electron*** $m_e=9.1*10^{-31}kg$; $1ev=1.6*10^{-19}J$
- ✓ $h=6.65*10^{-34}Js$; $k=1.38*10^{-23}J/k$;
- ✓ ***Permittivity of silicon*** $=\varepsilon_0\varepsilon_r=11.9*8.85*10^{-12}F/m$
- ✓ $n_{i0}=1.45*10^{10}/cm^3$ *for silicon;* $\mu_n=1350cm^2/v.s$*(at 300K)*
- ✓ $\mu_h=450\ cm^2/v.s$*(at 300K);* $N_A=6.022*10^{23}/mol$

1. a) From free electron theory of metal, show that E-K diagram is parabolic. Also show the energy of electron in a linear metal is quantized. [4+4]
   b) Find the wavelength of an electron accelerated by 100V. [4]
2. a) Explain with neat diagram how energy levels are filled and different energy bands are formed when N numbers of Lithium atoms are brought together. [6]
   b) Calculate the lattice constants, face diagonal, body diagonal and packing density of body centered cube (BCC) crystal unit cell. [4]
3. a) What are the different types of dielectric breakdown? Explain any two of them. [4]
   b) Explain mathematically how relative permittivity is related with electronic polarizability using Clausius Massoti equation. [6]
4. a) A crystal of iron created magnetic field around it but a piece of iron doesn't why? [6]
   b) How hysteresis loop plays an important role in classifying magnetic materials? Explain. [4]
5. a) Define Critical magnetic field and Critical current in a super-conductor with mathematical relation involved. [8]
   b) What is reverse saturation current in pn junction semiconductor? [4]
6. a) Derive the Einstein relationship showing the relation between electron diffusion co-efficient in n-type semiconductor and electron mobility. [8]
   b) Explain how PN junction is formed when n-type and p-type semiconductor are brought together. Derive the relation of built-in-potential of a PN junction. [6]
7. a) Calculate the resistance of pure silicon cubic crystal of 1 cm^3 at room temperature. What will be the resistance of the cube when it is doped with1arsenic in 10^9 silicon atoms and 1 boron atom per million silicon atoms? Atomic concentration of silicon is $5*10^{22}$ cm^{-3}. Use other required data from above given list. [8]
   b) An n-type semiconductor doped with $10^{16}cm^{-3}$ phosphorus atoms has been doped with $10^{16}cm^{-3}$ boron atoms. Calculate the electron concentration in the semiconductor. [4]

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24 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2068 Baishakh

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

Subject: - Electrical Engineering Material

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt All questions.*
- ✓ *The figures in the margin indicate Full Marks.*
- ✓ *Assume suitable data if necessary.*
- ✓ $h = 6.624 \times 10^{-34}$ JS; $1\ ev = 1.6 \times 10^{-19} J$
- ✓ $k = 1.38 \times 10^{-23} JK$; $n_i = 1.45 \times 10^{10}/cm^3$ for s;
- ✓ $\mu_n = 1350 cm^2 v^{-1}s^{-1}$ (at 300K); $\mu_h = 450 cm^2 v^{-1}s^{-1}$ (at 300K)
- ✓ $\varepsilon = \varepsilon_0\varepsilon_r = 11.9 \times 8.85 \times 10^{-12}$ F/m; $Eg = 1.1ev$
- ✓ $N_A = 6.624 \times 10^{-23}$ /mol $e = 1.602 \times 10^{-19} C$
- ✓ $M_{at} = 16g/mol$ (oxygen) Mass of photon $= 1.673 \times 10^{-27} kg$
- ✓ Velocity of light $= 3 \times 10^8$ m/s

1. a) From the expression $E_h = \frac{h^2}{8ml^2}(h_x^2 + h_y^2 + h_z^2)$, define number of states and density of states functions in quantum mechanics. Derive appropriate expressions for them. [6]

   b) The mean speed of conduction electrons in copper is 1.5×10^6 m/s. The cross sectional area of scattering is $3.9 \times 10^{-22} m^2$. Estimate the drift mobility of electrons and conductivity of copper. Given density of copper is $8.96 g/cm^3$ and the atomic mass is 63.56 g/mole. [6]

2. a) Show that effective mass of an electron inside the crystal is inversely proportional to the curvature of energy with respect to wave number space. [6]

   b) Copper has FCC (Face- centered - cubic) structure. Find the packing density and atomic concentration for copper if radius of copper atom is 0.128nm. [4]

3. a) Define local field in relation to polarization. Derive the Clausius-Massotti Equation for ionic polarization, relating polarizability with the permittivity. [10]

   b) Classify the magnetic materials based on magnetization and explain each of them briefly. [10]

4. a) What is superconductor? Differentiate between Type-I and Type-II superconductor. [3+5]

   b) Explain how donor dopants contribute electrons in conduction band in n-type extrinsic semiconductor. Also prove that conductivity $\sigma \simeq e\ n\ \mu_e$; where symbols have their usual meanings. [10]

5. a) A pn-junction is formed at 300k. The acceptor and donor concentration in p-side and n-side are 10^{16} cm^{-3} and 10^{17} cm^{-3} respectively. Find :

   i) Built-in potential [2.5]
   ii) Width of deplection layer [2.5]
   iii) Maximum electric field [1]
   iv) Width in n and p sides [2]
   v) Fermi level n and p sides [2]

   b) Explain the diffusion process in semiconductor and derive Einstein relation for diffusion process. [10]

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INSTITUTE OF ENGINEERING
Examination Control Division
2068 Chaitra

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

Subject: - Electrical Engineering Material *(EE 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.*
- ✓ *Mass of electron me = 9.1 $\times 10^{-31}$kg; k= 1.38 $\times 10^{-23}$J/K; h =6.65 $\times 10^{-34}$JS; 1eV = 1.6 $\times 10^{-19}$ J; ni = 1.45 $\times 10^{10}$/cm^3 for Si;*
- ✓ *μ_h = 450cm^{2}v^{-1}S^{-1} (at 300K); μ_e = 1350cm^{2}V^{-1}S^{-1}(at 300K);*
- ✓ *N_A = 6.022 $\times 10^{23}$/mol;*

1. a) What do you mean by barrier penetration? How the wave function of particle is given when the particle penetrates the barrier? [8]

   b) A transmitter type vacuum tube has a cylindrical cathode, which is 4m long and 2mm diameter. Estimate the saturation current if the tube is operated at 160°C. The emission constant $A_0 = 3 \times 10^4$ Am^{-2}K^{-2}, work function ϕ= 2.6eV. [4]

   c) Conduction electrons with drift mobility of 53cm^{2}V^{-1}S^{-1} and mean speed of 2.2×10^6ms^{-1} collides. Calculate the mean free path of electrons between collision. [4]

2. a) Explain, how energy bands are formed in solids taking the example of N number of Lithium atoms for the explanation. [6]

   b) What is electric dipole moment? Derive the Clausius- Masotti equation for electronic polarization, relating polarizability with the permittivity. [3+7]

3. a) What is the significance of Hysteresis loop? Explain. [4]

   b) Explain the domain theory of magnetism. [6]

   c) A p-n junction is made by silicon doped with 10^{17} donor atoms per cm^3 with silicon doped 10^{16} acceptor atoms per cm^3 at room temperature. Calculate built in potential across the junction and diffusion co-efficient in both parts. [6]

4. a) A pn junction is formed at 300k. The acceptor and donor concentration in p-side and n-side are 10^{18} cm^{-3} and 10^{16}cm^{-3} respectively. Calculate: [8]

      i) Built in potential
      ii) Width of deplection layer
      iii) Maximum value of electric field

   b) What is Meisner effect? Explain the difference between type I and type II superconductors. [2+6]

5. a) Explain about intrinsic Fermi level of a pure semiconductor and derive a relationship of the intrinsic Fermi level assuming that intrinsic carrier concentration is known. [2+4]

   b) Explain how carrier concentration of a semi-conductor depends on temperature with necessary diagrams and graphs. [6]

   c) What do you understand by diffusion of charge carriers in semiconductor? How does diffusion contribute to conductivity of a semiconductor? [4]

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 types of 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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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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25 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: - 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. List out the name of universal gates and why they are called universal gate? Relise Ex-OR Gate using only NAND gates. [2+2]
2. Explain Excess 3 code with suitable examples. [6]
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 convert the result into standard minterm. [3+5]
4. Design a 32 to 1 multiplexer using 16 to 1 and 2 to 1 multiplexers. [5]
5. Design a 3-bit even parity generator and 4-bit even parity checker circuit. [5]
6. Draw the block diagram of n-bit full adder and explain its operation. [8]
7. Write down the drawbacks of SR flip flop. Explain the operation of data flip flop with timing diagram and truth table. [1+7]
8. With clear circuit and timing diagram, explain the operation of Serial in - Serial out shift register. [4]
9. Define ripple counter. Explain the operation of mode-10 ripple counter with timing diagram. [1+7]
10. 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 1010. [12]
11. Describe the voltage profile of TTL. Explain the operation of TTL to CMOS interface. [2+6]
12. What is frequency counter? Explain with block diagram. [4]

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26 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: - Digital Logic

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

1. Draw the general input output voltage profile for TTL gates and also mention the noise margin. What do you mean by Gray code? [3+1+2]
2. Why NAND and NOR gates are called Universal gates? Illustrate with examples. [4]
3. What do you mean by HDL? Design a 2 to 4 line decoder circuit using HDL. [2+3]
4. Simplify $\pi(0, 4, 5, 8, 9, 11, 15)$ using K-Map and write its standard SOP expression. [4+2]
5. Draw the circuit of 4 bit RCA (Ripple Carry Adder), using only block diagrams. What are the problems associated with RCA. Explain how these problems can be eliminated. [4+2+2]
6. Draw the schematic diagram of TTL NOR gate. Discuss the characteristics of TTL 74XX series gates. [6]
7. Draw the circuit diagram of edge triggred JK flip flop and explain it. [5]
8. What is a shift register? With clear timing diagram, describe the operation of a 4-bit parallel - in serial - out (PISO) shift register. [2+6]
9. What is a counter? Design a MOD - 6 synchronous counter. Draw its timing diagram.
10. Design a synchronous state machine with the following specification: [12]
    a) No. of input:1
    b) No. of output:1
    c) The output of the machine is to be set high when the data in the input is 110 in sequence, starting from the MSB (Use SR flip - flop).
11. With an example, state and explain the problems associated in the design of asynchronous sequential circuit. [6]
12. Design a two bit magnitude comparator. [6]

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24 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2067 Ashadh

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

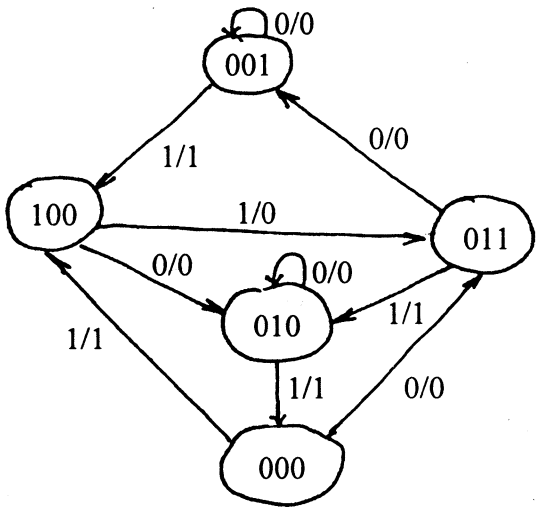
Subject: - Logic Circuits

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

1. Convert the following numbers from the given base to the bases indicated: [1×6]
   a) Octal 623.77 to decimal, binary and hexadecimal
   b) Hexadecimal 2AC5.D to decimal, octal and binary
2. Perform the subtraction with the following decimal and binary numbers using 9's and 1's complement respectively. [2+2]
   a) 3570-2100 (Using 9's complement)
   b) 10010-10011 (Using 1's complement)
3. Prove the following Boolean expression: [4+4+2]

   $AB + A\bar{B}C + \bar{A}BC = AB + AC + BC$

   And simplify Σ1,2,3,8,9,10,11,14) and d(0,4,12) by using K-map and write its standard product of sum (POS) expression.
4. Construct a 5×32 decoder using 3 to 8 decoders and standard logic gate if necessary. Define the term 'decoder'. [8]
5. State De-Morgan's theorem. Why NAND and NOR gates are called an universal logic gates. [3+6]
6. Explain about JK-flip-flop along with their truth table and characteristic equation. [6]
7. Design a mod-10 synchronous counter showing its state circuit diagram and output waveforms. [6]
8. Describe briefly the operation of a 4-bit serial in-parallel out register with a clear circuit diagram. [5]
9. A sequential circuit has one input and one output. The state diagram is shown in figure. Design the sequential circuit with RS-flip-flops. [10]



10. Explain with wave diagram how can you display a letter E in a CRT under 5×7 matrix format. [6]
11. Write short notes on: (any two) [5×2]
    a) Multiplexing and demultiplexing
    b) Gray code
    c) Fan-in and fan-out, propagation delay
    d) Parity generator

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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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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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22 TRIBHUVAN UNIVERSITY
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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.*
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- ✓ *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
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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23 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2068 Chaitra

Exam.	Regular		
Level	BE	Full Marks	80
Programme	SEL, BEX, BCT	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 is encapsulation? What are its advantages? How can encapsulation be enforced in C++? Write a program to create a class LandMeasure that reads Ropani, Ana, Paisa and Dam as data members. Write a function to pass two objects of type Land Measure and return their sum. (16 Ana = 1 Ropani, 4 Paisa = 1 Ana, 4 Dam = 1 Paisa) [1+1+2+6]
2. What is function overloading? Use new and delect operators to store *n* numbers dynamically and find their average using casting operator. What are the things we should remember while using default argument. Explain with an example. [2+5+3]
3. What do you mean by friend function and friend class? Do friends violate encapsulation? Write a program that can store Department ID and Department name with constructor. Also write destructor in the same class and show that objects are destroyed in reverse order of creation with suitable message. [2+3+5]
4. List the operators which cannot be overloaded. Why does the overloading of binary operator with member function requires only one argument? Create a class having an array as member. Overload index operator ([ ]) to input and display the elements in the array. [2+2+6]
5. How do you access overridden members of the base class from a member function in the derived class? What is the problem faced when using multipath inheritance and how is it solved? Explain with an example the order of constructor and destructor invocation during multiple inheritance. [2+3+5]
6. What are the primary trade offs between static and dynamic binding? What is pure virtual function? Write a function template for the function power( ) which has two parameters base and exp and returns $base^{exp}$. The type of base is the parameter to the template and exp is int. If the exp is negative, then it must be converted to its positive equivalent. For example 2^3 and 2^{-3} must both return 8. [2+2+6]
7. What is a file stream? Write a class student with roll, name, address, marks as member variables. Use a member function to write records of students in a binary file and another member function to read records from file. Write a program to search a specific record of student using roll number as key from user input. [2+8]
8. What are the advantages of Exception Handling over Conventional Error Handling mechanism? Explain the constructs for Exception Handling in C++ with an example. Write a meaningful program illustrating the use of both Exception with argument and Exception Specification for function. [3+3+4]

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26 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2067 Ashadh

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

Subject: - Computer Programming II

- ✓ Candidates are required to give their answers in 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 advantage does object oriented programming offer over traditional programming? Discuss various features of object oriented programming with necessary example. Write a program that will represent time measurement in 12 hour system with object oriented approach. The program should have conversion functions to convert to 12 hour and 24 hour system. [2+3+5]
2. How is pass by reference with alias variables different than the pass by reference with pointer variables. Give example to illustrate each. Write a program with function that takes two arguments as reference and assign the average of the two arguments to the smaller one and return that by reference. Call this function by assigning value to the function and display the value of both arguments and call this function without assigning the value and display the value of both the arguments. What will be the output? [4+6]
3. What do you mean by const member function of a class? How are const_cast operator and mutable members used with const member functions? Write a meaningful program to illustrate the use of const member functions and const data member. [2+3+5]
4. What is the significance of operator overloading? What are the points to remember when overloading operators? Write a program to convert object of a class that represents weight of gold in *tola* to object of class that represent weight in grams. (1 *tola* = 11.664 gm) [2+2+6]
5. What do you mean by access specifiers? Explain how different access specifiers can be used in inheriting features of base class members. Write a program with a class cricketer that has data members to represent name, age and no of matched played. From this class cricketer derive two classes, bowler and batsman. The bowler class should have no of wickets as data members and the batsman class should have no of runs and no of centuries as data members. Use appropriate member functions in all classes to make the program meaningful. [1+3+6]
6. What are standard manipulators? Explain the parameterized and non parameterized manipulator. Write an interactive program to maintain student database. The information to be stored in the database is registration number, name, program, contact number and address. The user must be able to access all detail about a student by entering the registration number. [1+3+6]
7. What do you understand by class template? Write down the syntax and use of class template. Write a program for a stack class that can handle any data type. The stack class can be made with array member and the access to the elements of array can be done from only one point. The data element that is stored at last must be accessed first. You should not access other elements of array member except the top element. [1+3+6]
8. Discuss the advantage of exception handling over traditional error handling? Explain the exception handling mechanism in C++? Write a meaningful program that can handle multiple exceptions. [2+2+6]

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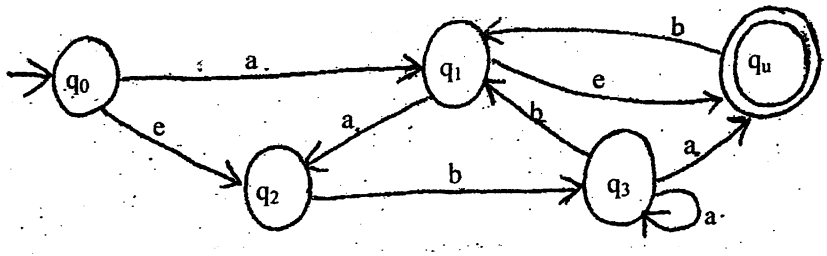
43 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2071 Chaitra

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, Σ, R, S), where
   V = {S, A, B, a, b}
   Σ = {a, b}
   R = {S → aAb | Ba | A, A → SS| e, B → 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 → SS,
   S → 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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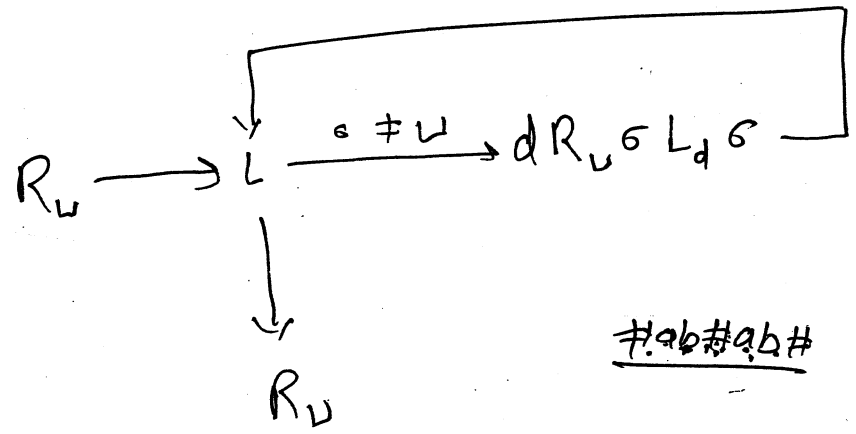

#ab#ab#

$5 \cdot k^k - 1$ $\quad 5(5^{k-1}+1)-1$

$5 \cdot 5^k - 5 + 4$ $\quad 5(5^k - 1) + 5 - 1$

$5(5^k - 1) + 4$ $\quad + 4$

43 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
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. [5]

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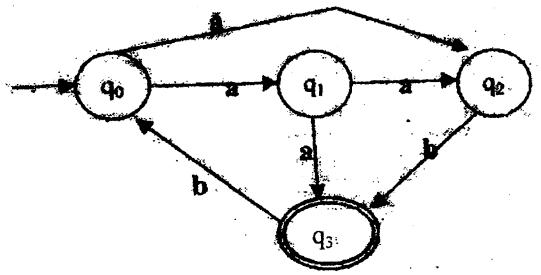
INSTITUTE OF ENGINEERING
Examination Control Division
2068 Chaitra

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. What are the differences between reflexive relation and reflexive closure? Use mathematical induction to show that $2^n < n!$ for any positive integer $n \geq 4$. [2+5]
2. Design DFA that accepts the language L = { W∈{0, 1}*: W is the multiple of five.} Check your design for 1010. [7]
3. Convert the following NDFA into equivalent DFA. [7]



4. Show that $L = \{a^{2n} ba^n : n \geq 1\}$ is not regular by using Pumping Lemma for regular language. Test all possible cases. [7]
5. What is CFG? Design CFG for the language $L(G) = \{WW^R: W \in \{0, 1\}^*\}$. [2+5]
6. Convert following CFG into CNF. G = (V, Σ, R, S), where [7]

   V = {S, A, B, C, a, b, c},
   Σ = {a, b, c},
   R = {S→ABA|abA|BC, A→aA|∈, B→baB|c, C→aC}.
7. Design a Nondeterministic PDA to accept the language L(G) = {W ε{0, 1}*: W has equal number of 0's and 1's}. Check your design for 001110. [7]
8. Design a turning machine that scans to left to find at least two a's. Machine should print "yes" if at least two a's are present otherwise it must print "no" and then halts. Hence test your design for Δ#b#ab#ba# to Δ#yes#ab#ba#. Where Δ and # represent left end and blank symbols respectively with Σ = { Δ, #, a, b}. [9]
9. Explain about Unrestricted Grammar. Design a Turing Machine that accepts the language $L = \{a^n b^n : n \geq 0\}$. Show all configuration of TM for aabb. [2+6]
10. Define universal turning machine and explain its encoding technique in detail with suitable example. List undecidable problems about turning machine and grammar. [5+4]
11. Explain class-P and class-NP, with examples. [5]

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44 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2068 Baishakh

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

Subject: - Theory of Computation

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

1. Let N be a set of natural numbers and R be any relation defined as R = {(a, b): a ≤ b}. Now test whether R is an equivalence relation or not. Prove that the function $f(x) = x^5 + 5x^3 + 16x + 5$ cannot have more than one real root by using proof by contradiction technique. [3+4]
2. How finite automata are useful in various fields? Design a DFA that accepts the language given by (M) = {w∈{0, 1}*: w does not contain four consecutive 0's}. Hence test your design for 01010001. [1+5]
3. Minimize the following DFA (Draw initial diagram first). Specify performed operations in each step. [5]

δ/Σ	0	1
→q_0	q_1	q_2
*q_1	q_1	q_3
*q_2	q_2	q_2
*q_3	q_5	q_2
*q_4	q_4	q_2
*q_5	q_4	q_2
q_6	q_5	q_6
q_7	q_5	q_6

4. Check whether L = {$a^{n!}$: n ≥ 0} is regular or not by using Pumping Lemma for regular language. [5]
5. State closure properties of regular language and explain diagrams. [5]
6. What is ambigious grammar? Write Context Free Grammar for the language given by L = {w∈{(,)}*}: each string in w has balanced parentheses}. Use same to derive leftmost and rightmost derivations for (()) (). Hence also draw parse tree. [1+2+4+1]
7. What are the importance of CNF? Convert following CFG into CNF with explanation of each steps. [1+6]

   G = (V, Σ, R, S), where
   V = {S, A, B, a, b}
   Σ = {a, b}
   R = {S→bA/ Ba/ AaA,
   A→S/e,
   B→aB/ab}

8. Design a Non deterministic PDA for the language given by $L(M) = \{a^n b^n : n > 0\}$. Hence explain how it processes strings like aabb? [4+2]

9. What is Turing-decidable language? Design a Turing machine that recognizes the language given by $L = \{a^n b^n c^n : n \geq 0\}$. Hence test your design for #aabbcc. [1+5+2]

10. List three criteria that should be satisfied by a Turing machine. How unrestricted grammar differ from context free grammar? Design a Turing machine that recognizes the strings of matched parenthesis. [2+2+5]

11. State and explain halting problem with suitable example. Why Church's Turing thesis can not be a theorem? List unsolvable problems about grammar? [5+2+2]

12. State computational complexity theory. Explain class NP with suitable example. [1+4]

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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 ρ_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 ε_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 ρ = 2, π/4 < φ < π/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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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. [1+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) = 3×10^8m/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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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 $\vec{D}_1 = -30\vec{a}_x + 50\vec{a}_y + 70\vec{a}_z \text{ nC/m}^2$ 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]

***

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

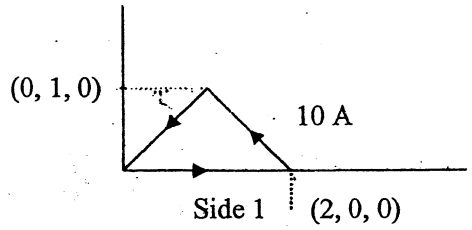
27 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2068 Baishakh

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

Subject: - Electromagnetics

- ✓ Candidates are 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 Smith Chart is attached herewith.***
- ✓ *Assume that the **bold faced** letter represents a vector and $a_{subscript}$ represents a unit vector.*
- ✓ *Assume suitable data if necessary.*

1. Express the vector field $\mathbf{W} = (x-y)\,\mathbf{a}_y$ in cylindrical and spherical co - ordinates. [5]
2. Find the equations for energy density in electrostatic field. [8]
3. A uniform sheet of charge $\rho_s = 40\varepsilon_0$ C/m^2 is located in the plane x = 0 in free space. A uniform line charge $\rho_L = 0.6$ nC/m lies along the line x = 9, y = 4 in free space. find the potential at point P (6, 8, –3) if V = 10V at A (2, 9, 3). [8]
4. What is physical significance of div **D**? Explain the importance of potential in the electro static field. [4]
5. What are the differences between curl and divergence? [4]
6. The condition triangle loop (shown in figure below) carries a current of 10A. Find **H** at (0, 0, 5) due to side 1 of the loop. [8]



7. State Maxwell's fourth equation. [2]
8. State and prove the Stokes theorem. [3]
9. For a non-magnetic materials having $\varepsilon_r = 2.25$ and $\sigma = 10^{-4}$ mho/m, find the numeric values at 5MHz for : [8]
   a) The loss tangent
   b) The attenuation constant
   c) The phase constant
   d) The intrinsic impedance
10. A load of 100 + j 150 Ohm is connected to a 75 ohm lossless line. Find using Smith Chart: [10]
    a) Reflection coefficient
    b) VSWR
    c) The load admittance
    d) Z_{in} at 0.4λ from the load
    e) Z_{in} at generator if line is 0.6λ long
11. Distinguish between conduction and displacement currents. [4]
12. Explain the term skin depth. Using pointing vector, deduce the time average power density for a dissipative medium. [7]
13. Write short notes on: [3×3]
    a) Antenna and its type
    b) TEM
    c) Waveguides

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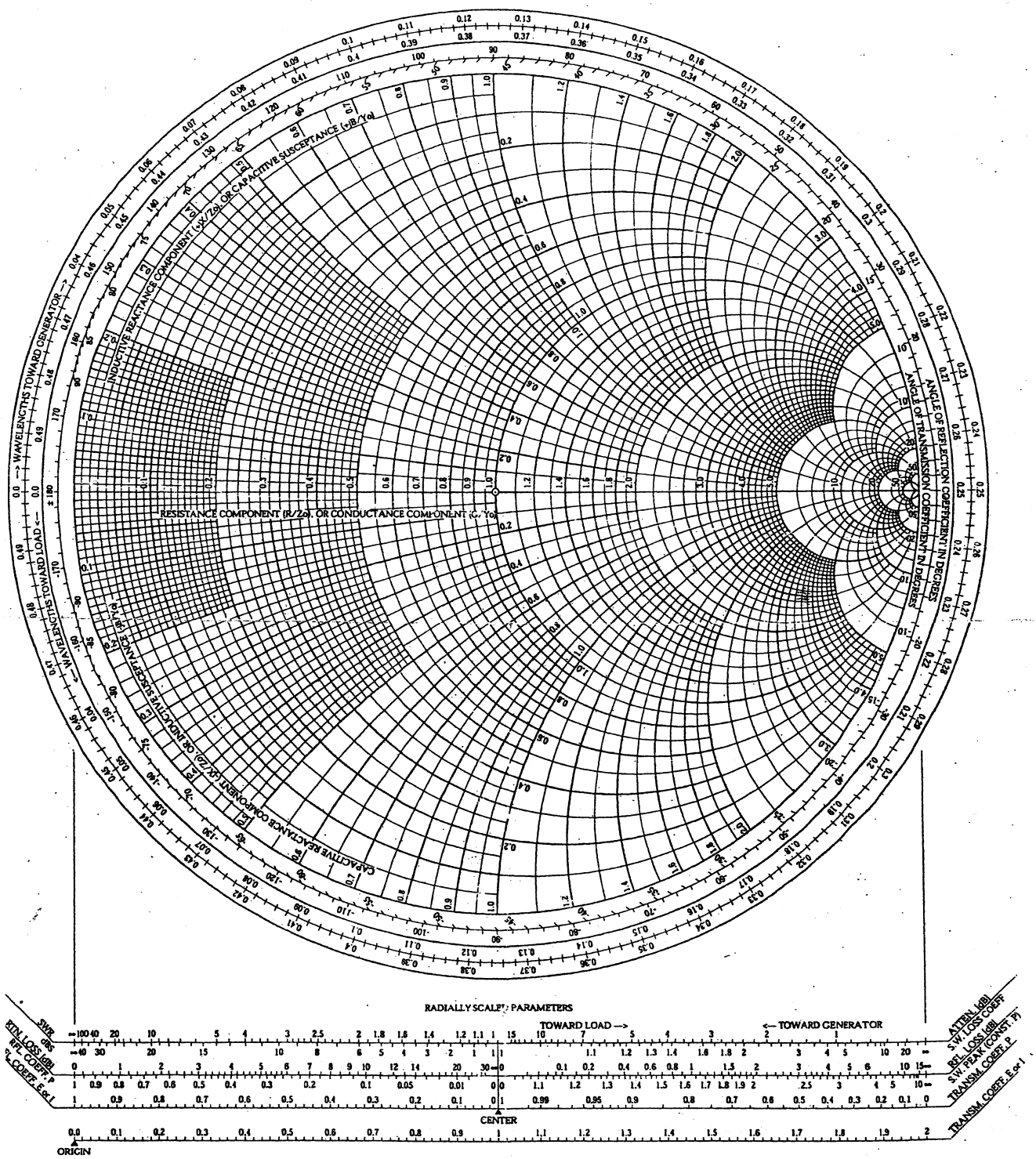
The Complete Smith Chart

Black Magic Design



25 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2067 Mangsir

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

Subject: - Electromagnetics

- ✓ Candidates are 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.***
- ✓ *Assume suitable data if necessary.*

1. Transform $\bar{A}_c = x\hat{a}_x + xy\hat{a}_z$ at point (1,2,3) in Cartesian co-ordinate system to $\bar{A}_{cy}$ in cylindrical co ordinate system. [6]
2. Use Gauss's law to determine electric field intensity because of infinite line charge with uniform charge density ρ_l. [6]
3. Find potential at a point P(2,3,3) due to a 1nC charge located at Q(3,4,4), 1nC/m uniform line charge located at x = 2, y = 1 if potential at (3,4,5) is 0V . [6]
4. Use the boundary condition to find $\bar{E}_2$ in the medium 2 with boundary located at plane y = 0. Medium 1 is perfect dielectric characterized by $\varepsilon_{r1} = 3$, medium 2 is perfect dielectric characterized by $\varepsilon_{r2} = 5$, electric field in medium 1 is $\bar{E}_1 = 3\hat{a}_x + 2\hat{a}_y + \hat{a}_z$. [6]
5. Use two dimensional Laplace equation to determine potential distribution for the following boundary condition: V = 0 at x = 0, V = V_0 at x =a, V = 0 at y = 0 and V = 0 at y = b. [8]
6. State and explain Biot – Savart's law. [4]
7. For a given co – axial cable with inner conductor of radius 'a', outer conductor with inner radius 'b' and outer radius 'c' with current in the inner conductor 'I' and current in the outer conductor - 'I', determine $\nabla \times \bar{H}$ for $0 \le r \le a$, $a \le r \le b$, $b \le r \le c$. [10]
8. Consider a wave propagating in lossy dielectric with propagation consultant, $\gamma = \alpha + j\beta$. Derive expressions for α and β if medium is characterized by permittivity ε, permeability μ and conductivity σ. [8]
9. A uniform plane wave propagating in free space has $\bar{E} = 2\cos(10^7\pi t - \beta z)\hat{a}_x$, determine β and $\bar{H}$. [6]
10. A z-polarized uniform plane wave with frequency 100MHz propagates in air in the positive x-direction and impinges normally on a perfectly conducting plane at x = 0. Assuming the amplitude of the electric field vector to be 3mV/m, determine phasor and instantaneous expressions for [8]
    a) Incident electric and magnetic field vectors
    b) Reflected electric and magnetic field vectors
11. Derive the expression for input impedance of a transmission line with characteristic impedance, Z_0 excited by source, V with source impedance Z_s and terminated in load Z_l. [6]
12. Define transverse magnetic mode. A rectangular waveguide has dimensions, a = 5cm and b = 3cm. The medium within the waveguide has $\varepsilon_r = 1$, $\mu_r = 1$, $\sigma = 0$ and conducting walls of wave guide are perfect conductors. Determine the cutoff frequency for $TM_{1,1}$ mode. [6]

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

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Examination Control Division
2067 Shrawan

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

Subject: - Electromagnetics

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

1. a) Transform a point (x, y, z) in rectangular co-ordinates to a point (r, θ, ϕ) in spherical co-ordinate and vice-versa. [3]

   b) Transform the vector $\vec{B} = y\hat{a}_x - x\hat{a}_y + z\hat{a}_z$ into cylindrical co-ordinates. [4]

2. a) State Coulomb's law with an example. Derive an expression for electric field intensity $(\vec{E})$ at a point due to an infinite line charge having uniform charge density. [1+6]

   b) An infinitely long uniform line charge is located at y = 3, z = 5. If ρ_L = 30 nC/m, find $\vec{E}$ at (i) $P_A(0, 0, 0)$ (ii) $P_B(0, 6, 1)$ (iii) $P_C(5, 6, 1)$. [6]

3. a) State and explain Gauss's law. Define divergence and write down its physical significance as it applies to electric fields. [2+3]

   b) Consider a co-axial cable of length 50cm having inner radius of 1mm and an outer radius of 4mm with the spare between the conductors filled with air. Total charge on the inner conductor is 30 nC. Find (i) the charge density on the inner conductor and outer conductor (ii) $\vec{D}$ (iii) $\vec{E}$. [5]

4. a) Deduce how potential gradient can be used to determine the electric field intensity. What do you understand by electric dipole moment? [5+1]

   b) Given the potential field $V = 2x^2y - 5z$ and a point P(–4, 3, 6), find at P (i) V (ii) $\vec{E}$ (iii) $\hat{a}_E$ (iv) $\vec{D}$ (v) ρ_v. [5]

5. Explain how the conductivity of metals and semi-conductor changes with increase in temperature. Derive the point form of continuity equation. [3+3]

6. a) State Bio-Savart's law. Derive the equation for magnetic field intensity due to a co-axial cable carrying a uniformly distributed dc current I in the inner conductor and –I in the outer conductor. [2+6]

   b) Given $\vec{H} = (3r^2 / \sin\theta)\hat{a}_\theta + 54r\cos\theta\hat{a}_\phi$ A/m in free space. Find the total current in the $\hat{a}_\theta$ direction through the conical surface $\theta = 20°$, $0 \le \phi \le 2\pi$, $0 \le r \le 5$. [6]

7. a) Explain how displacement current differs from conduction current. What do you understand by the term magnetization? What does the relative permeability of a substance indicate? [2+1+1]

   b) A 9.4 GHz uniform plane wave is propagating in polyethylene ($\epsilon_r = 2.25$, $\mu_r = 1$). If the magnitude of the magnetic field intensity is 7 mA/m and the material is lossless, find (i) velocity of propagation (v_p) (ii) the wavelength (λ) (iii) the phase constant (β) (iv) the intrinsic impedance (η) (v) the magnitude of electric field intensity. [6]

8. a) What is a distortionless transmission line? Why are telephone lines required to be distortionless? [2+1]

   b) A radar dish antenna is needed to be covered with a transparent plastic ($\epsilon_r = 2.25$, $\mu_r = 1$) to protect it from weather without any reflection of the signal back to the antenna. What should be the minimum thickness of the plastic cover if the operating frequency of antenna is 10 GHz? [6]

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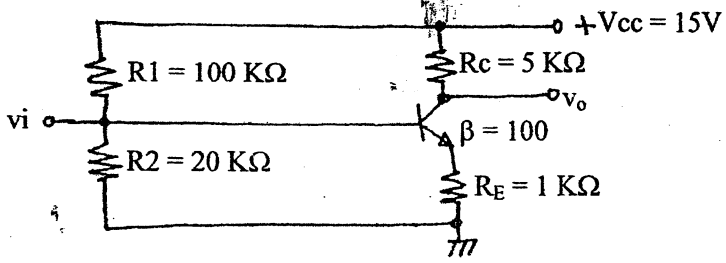
INSTITUTE OF ENGINEERING
Examination Control Division
2069 Chaitra

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

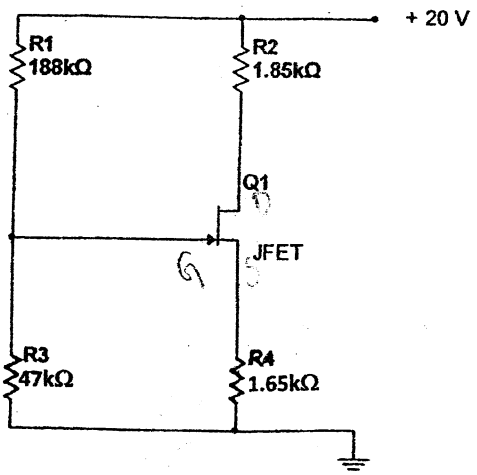
Subject: - Electronic Device and Circuits *(EX501)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *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 $V_P = -5$V. 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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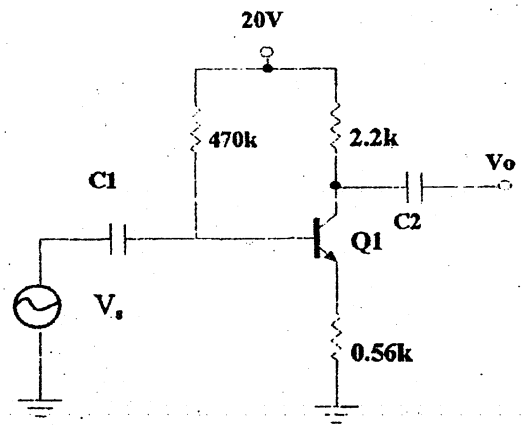
Examination Control Division
2068 Chaitra

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

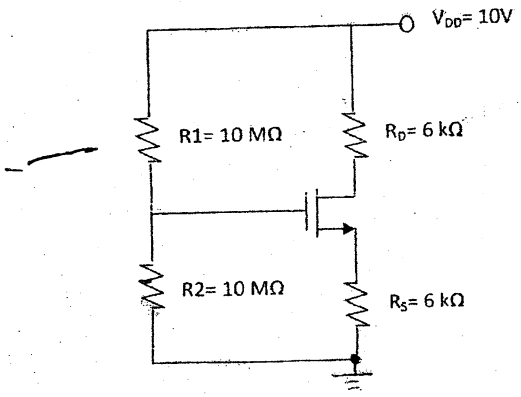
Subject: - Electronic Devices and Circuit *(Ex 501)*

- ✓ 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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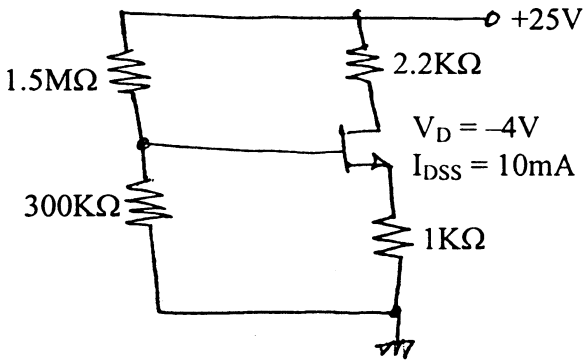
INSTITUTE OF ENGINEERING
Examination Control Division
2068 Baishakh

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

Subject: - Electronic Devices and Circuits

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

1. Draw graphs of IV characteristics of ordinary PN junction diode and zener diode. Draw ac equivalent model for PN junction diode and derive its ac resistance. [7]
2. Define and explain reverse break down effect. [3]
3. Design β-independent type dc biased common collector amplifier, and find its current gain and input resistance. Given parameters are: V_{CC} = 20V, I_C = 2mA, β = 100 and use firm biasing method. [8]
4. Derive an expression to find output resistance for emitter unbypassed common emitter amplifier circuit. [5]
5. Draw Ebers Moll model and ac equivalent T- model for BJT. [4]
6. Describe the principle of operation of EMOSFET with the help of IV characteristic curves and algebraic expressions. Also show its ac equivalent circuit model. [7]
7. Find I_D and V_{DS} for the given circuit. [5]



8. Derive an expression to find the tranconductance for JFET. [2]
9. Draw standard series dc voltage regulator circuit and find its voltage stability factor (S_v). [6]
10. Draw a voltage regulator circuit using IC LM317. [3]
11. Draw a circuit diagram for Bandgap reference voltage source. [3]
12. Define cross over distortion in class B amplifier. Draw quasi-complementary symmetry class AB amplifier. And explain how crossover distortion is eliminated in class AB amplifier. [7]
13. What is the maximum efficiency of class B amplifier? State the condition when it occurs. [4]
14. Why heat sink is necessary in power transistor? Explain with the help of thermal Ohm's law or thermal resistance method. [4]
15. State Barkhausen criteria and explain the principle of oscillation. [4]
16. Draw Wien Bridge Oscillator circuit and write the expression for frequency of Oscillation. [6]
17. Draw crystal oscillator circuit. [2]

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21 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2067 Mangsir

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

Subject: - Electronic Circuits I

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

1. With the aid of $i_D - v_{GS}$ curve, verify that the transconductance g_m of a MOSFET depends upon the dc bias point. [5]
2. State why the resistors and capacitors are minimized in IC fabrication. [5]
3. Explain how the voltage gain of difference amplifier would be larger when a current mirror is used at the load as compared to using only a simple resistance at the load. [6]
4. Draw emitter follower with voltage divider and current mirror dc level shifting circuits and which circuit performs better results and why? [2+2+3]
5. Find the close loop input impedance of non inverting Op-amp. Derive the expression to reduce the effect of input offset current in an Op-amp. [4+3]
6. For a non- inverting op-amp $R_i = 1K\Omega$, $R_f = 20\ K\Omega$, $V_{CC} = \pm 15$volt. The op-amp has a slew rate of 0.5V/μsec, and a saturation dropout voltage of 10%. Find maximum input voltage in RMS value at 10 KHz sine wave. [6]
7. Draw circuit diagram of variable series voltage regulator with transistor error amplifier circuit and derive its voltage regulation factor, S_v. [2+5]
8. Design a regulator circuit diagram to obtain 16 VDC with input voltage of 25 VDC. [5]
9. Draw a circuit diagram of transformer coupled class B push pull amplifier clearly. And determine its maximum efficiency. [3+5]
10. Discuss crossover distortion in push pull amplifier, and state how you can eliminate it. [6]
11. Define Barhausen Criteria for sinusoidal oscillation. Draw a circuit diagram of RC oscillator and derive its frequency of oscillation. [3+1+8]
12. Draw the circuit diagram of triangular wave generator. Explain the operation of square wave generator circuit. [2+4]

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21 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2067 Shrawan

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

Subject: - Electronic Circuits I

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

1. List out the advantages of monolithic IC as compared with discrete components. 4
2. Draw hybrid-π model of BJT as a) voltage controlled current source, b) current controlled current source. 3+3=6
3. Draw a simple current mirror and describe its operation. What are the reasons for the output current of a simple current mirror not being exactly equal to the reference current? 2+4+4=10
4. Discuss the importance of active load and level shifting circuit in op-amps. 5+5=10
5. Define slew rate of an op-amp. A 10mV-10 kHz sine wave is input to an op-amp with a gain of 1000. Calculate the minimum slew rate that is required for the op-amp to produce an output without any distortion. (The sine wave and slew rate are related with the expression $SR=2\Pi fA$) 3+4=7
6. For an inverting op amp, R_i = 1k, R_f = 10k, V_{cc}= ± 15 V. The op amp has a slew rate of 0.5 V / μS, a saturation dropout voltage of 10% and gain bandwidth product of 1 MHz. Plot the gain and phase response of the circuit, and also show the output waveform when a 5 V peak to peak sine wave of 1 kHz frequency is used as the input to this circuit. 2+2+2=6
7. Define loading effect in unregulated power supply. Draw a series transistor zener diode voltage regulator, and state how this problem is taken care of by this circuit. 2+6=8
8. Compare zener diode with bandgap voltage reference. 4
9. How does cross over distortion occur in class B push pull amplifier? Discuss the change in effects of cross over distortion when the magnitude of the input signal is reduced, and when the frequency is decreased. What will you do to eliminate cross-over distortion? Discuss the impact of this remedy in terms of power dissipation. 3+2+2+3+2=12
10. Describe "Barkhausen Criteria" for oscillation. Write down the general expression for the gain of a feedback amplifier, and state the condition for oscillation. 5
11. Draw and explain the operation of CMOS inverter relaxation oscillator. 8

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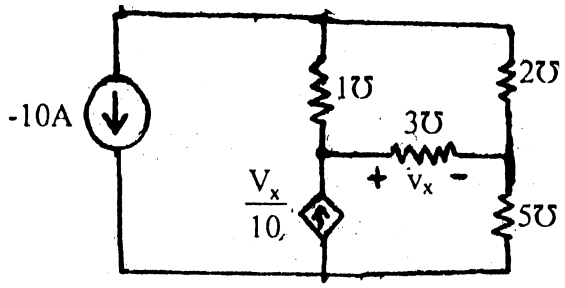
27 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2070 Chaitra

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)*

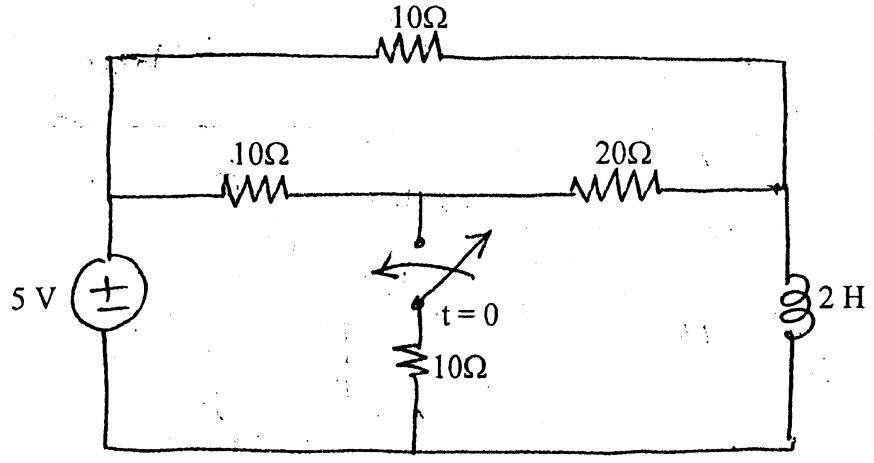
- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Semilog graph paper will be provided.*
- ✓ *Assume suitable data if necessary.*

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

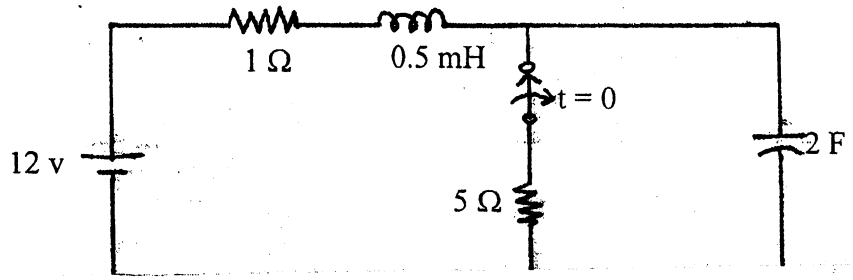


b) With the help of phasor diagram, explain the phenomenon of resonance of a parallel ac circuit and also derive the expression for the resonant frequency. [4]

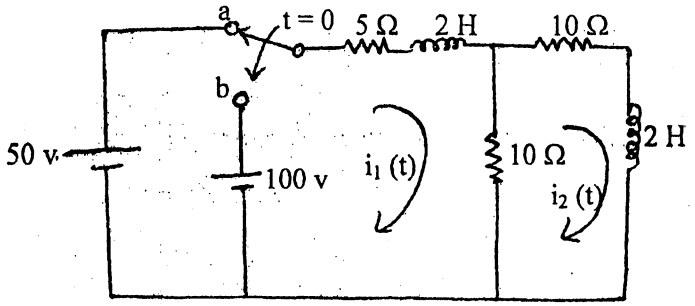
c) Find the voltage and current of each element at t = 0+ in the network of the following figure. [6]



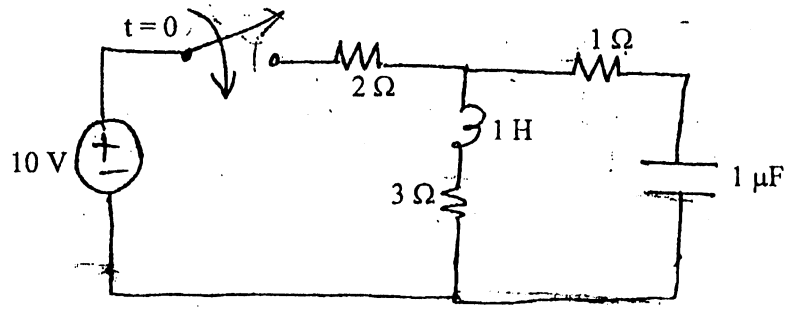
2. a) If the switch is opened at t = 0, find expression for voltage across capacitor in the circuit shown below using classical method. [8]



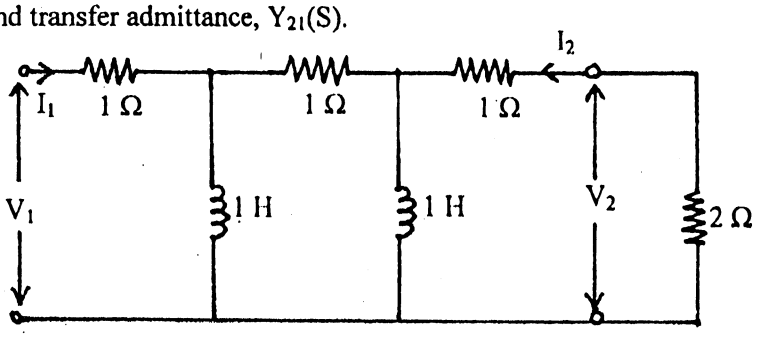
b) In the circuit shown, switch is changed from position "a" to "b" at t = 0. Find the expression for current $i_1(t)$ and $i_2(t)$ using Laplace transformation method. [8]



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

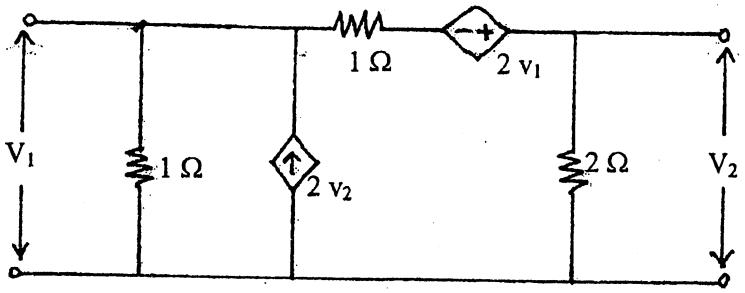


b) For the 2-port network shown in figure below, find voltage ratio transfer function, $G_{21}(S)$ and transfer admittance, $Y_{21}(S)$. [6]

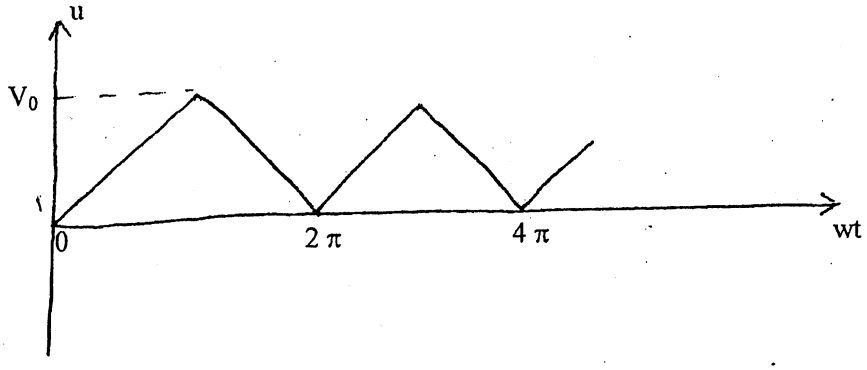


c) Express transmission (ABCD) parameters of the Two port Network in terms of Z parameters. [4]

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



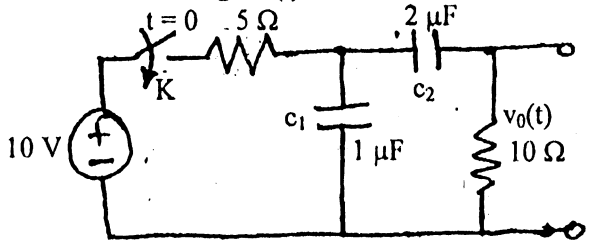
b) Find the trigonometric form of Fourier Series and plot the line spectrum for the following wave form. [8]



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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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.

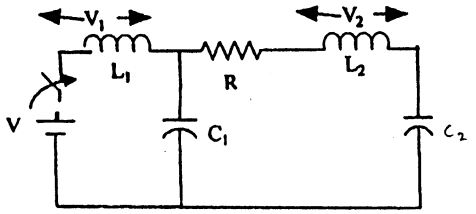
Subject: - Electrical Circuit Theory *(EE501)*

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

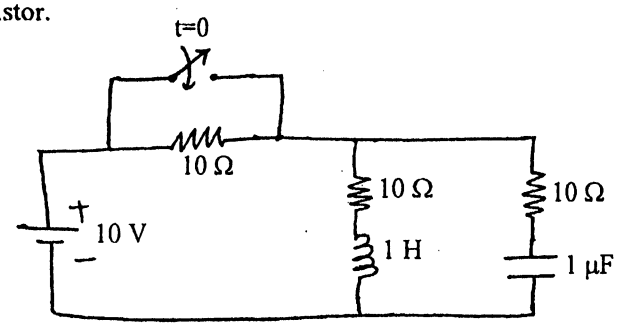
1. a) How resonance occurs in electrical RLC series circuit? Also show that bandwidth of circuit is independent of capacitor value. [6]

   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]

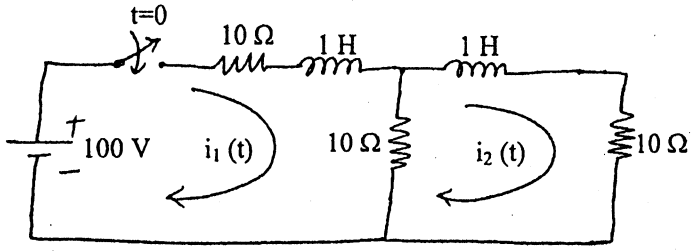
   c) Discuss the behavior of inductor and Capacitor at initial and final condition for dc excitation. Determine V_1, V_2, dV_1/dt, dV_2/dt at $t = 0+$ when switch is closed at $t = 0$. [2+4]



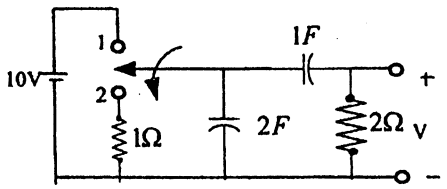
2. a) Circuit given in figure below was under steady state before the switch is closed at $t = 0$. At $t = 0^+$, find current through inductor, voltage across capacitor and current through each resistor. [8]



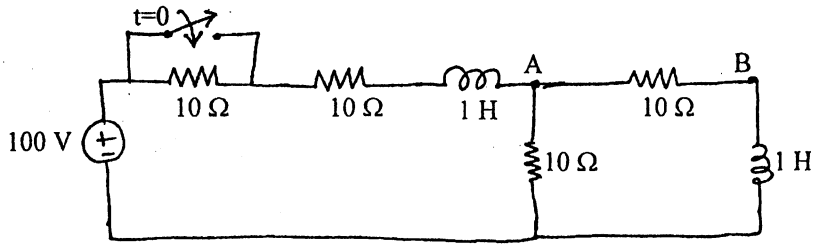
   b) In the circuit shown in figure below the switch is closed at $t = 0$, find the expression for $i_1(t)$ and $i_2(t)$ using Laplace transform method, if the circuit is unenergised before the switch is closed. [8]



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]

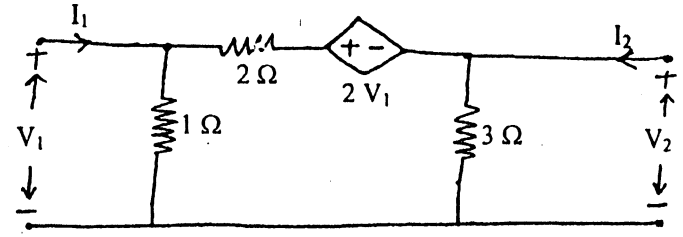


b) The network shown in figure below is under steady state condition. The switch is closed at t = 0. Determine the current through 10 Ω resistor connected between terminals AB. [use classical method] [6]

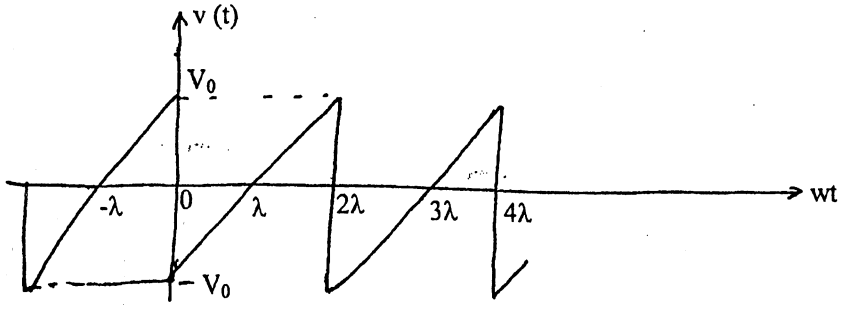


c) Express Transmission (ABCD) parameters of the two-port network in term of Y-parameters. [4]

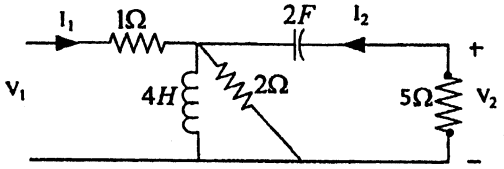
4. a) Find the Z-parameters of the circuit shown in figure below and also find whether the network is reciprocal or not. [8]



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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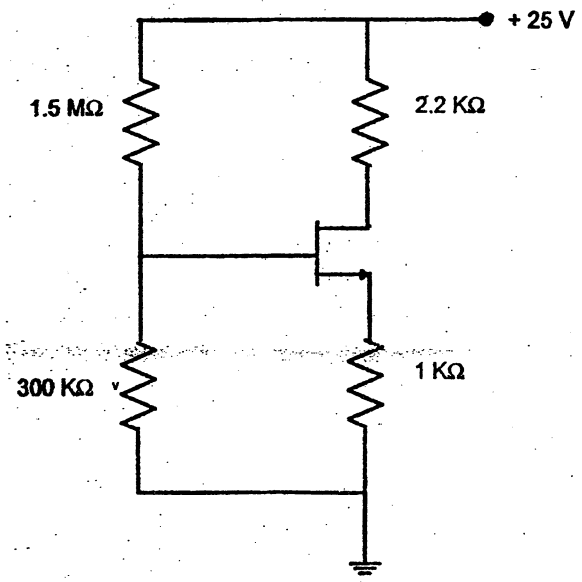
25 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2070 Chaitra

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= (10×10^{-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 JFFT. [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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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.*

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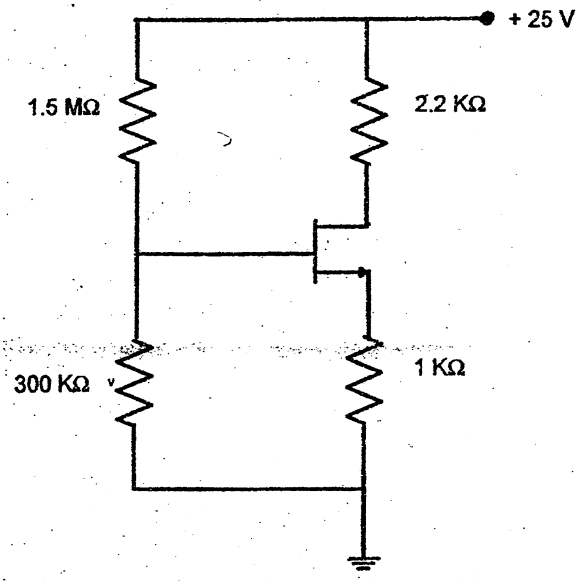

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17. Find voltage stability factor of series dc voltage regulator. [5]

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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
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 **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *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.

OR [5]

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 $\vec{F} = (2x - y)\vec{i} - yz^2\vec{j} - y^2z\vec{k}$ 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

$$\sum \frac{1}{x^2} = \frac{1}{1^2} + \frac{1}{2^2} + \frac{1}{3^2} \ldots\ldots = \frac{\pi^2}{6}$$ [5]

13. Obtain half range sine series for $f(x) = \pi x - x^2$ in $(0, \pi)$ [5]

14. Graphically minimize $z = 4x_1 + 3x_2 + x_3$ [5]

Subject to $x_1 + 2x_2 + 4x_3 \geq 12$

$3x_1 + 2x_2 + x_3 \geq 8$ and $x_1, x_2, x_3 \geq 0$

15. Minimize $z = 8x_1 + 9x_2$ [10]

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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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) $\dfrac{e^{at}-\cos 6t}{t}$ [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 $\iint_S \vec{F}.\hat{n}\,ds$ 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 $\iint_S \vec{F}.\hat{n}\,ds$ 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]

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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) $\dfrac{\cos at - \cos bt}{t}$

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

$$\sum\frac{1}{n^2}=\frac{1}{1^2}+\frac{1}{2^2}+\frac{1}{3^2}+\ldots\ldots=\frac{\pi^2}{6}$$ [5]

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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02 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division

2068 Chaitra

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BCE, BEL, BEX, BCT, BME, BIE, B. AGRI.	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: $\begin{vmatrix} a & b & c \\ b & c & a \\ c & a & b \end{vmatrix}^2 = \begin{vmatrix} 2bc-a^2 & c^2 & b^2 \\ c^2 & 2ac-b^2 & a^2 \\ b^2 & a^2 & 2ab-c^2 \end{vmatrix} = (a^3+b^3+c^3-3abc)^2$. [5]

2. Define Hermition and Skew Hermition matrix. Show that every square matrix can be uniquely expressed as the sum of a Hermition and a skew Hermition. [5]

3. For what value of λ the equation $x + y + z = 1$, $x + 4y + 10z = \lambda^2$ and $x + 2y + 4z = \lambda$ have a solution? Solve them completely in each case. [5]

4. Find the eigen values and eigen vectors of $A = \begin{vmatrix} 3 & -4 & 4 \\ 1 & -2 & 4 \\ 1 & -1 & 3 \end{vmatrix}$. [5]

5. Evaluate $\int_C \vec{F}.\vec{dr}$, Where C: $x^2 = y$ and $y^2 = x$ and $\vec{F} = (x-y)\vec{i} + (x+y)\vec{j}$. [5]

6. State and prove Green theorem in a plane. [5]

7. Verify Guess divergence theorem for $\vec{F} = x^2\vec{i} + 3\vec{j} + yz\vec{k}$. Taken over the cube bounded by $x = 0$, $x = 1$, $y = 0$, $y = 1$, $z = 0$, $z = 1$. [5]

8. Find the Laplace transform of the given function (i) $t^2 \sin t$ (ii) $\cos at \sinh at$. [5]

9. Evaluate $\iint_s \vec{F}.\hat{n}ds$ where $\vec{F} = 3\vec{i} + x\vec{j} - yz\vec{k}$ and s is the surface of the cylinder $x^2 + y^2 = 9$ included in the first octant between the plane $z = 0$, $z = 4$. [5]

10. Find the inverse Laplace transform: (a) $\frac{1}{(S-2)(S+4)}$ (b) $\log\left(\frac{s^2+a^2}{s^2}\right)$ [5]

11. Solve the equation using Laplace transform $y'' + 4y' + 3y = t$, $t>0$ $y(0) = 0$, $y'(0) = 1$. [5]

13

12. Obtain a Fourier series to represent the function f(x) = /x/ for $-\pi \le x \le \pi$ and hence deduce $\frac{\pi^2}{8} = \frac{1}{1^2} + \frac{1}{3^2} + \frac{1}{5^2} + \ldots\ldots$ [5]

13. Obtain the half Range Sine Series f(x) = ex in 0<x<1. [5]

OR

Obtain the Fourier series for $f(x) = x - x^2$ where $-1 < x < 1$ as a Fourier series of period 2.

14. Solve the following by using the simplex method: [7.5]

Maximize $P = 15x_1 + 10x_2$,
Subject to
$2x_1 + x_2 \le 10$,
$x_1 + 3x_2 \le 10$,
$x_1, x_2 \ge 0$.

15. Solve by using the dual method: [7.5]

Minimize $C = 21x_1 + 50x_2$,
Subject to $2x_1 + 5x_2 \le 12$,
$3x_1 + 7x_2 \le 17$,
$x_1, x_2 \ge 0$.

OR

Solve the following LPP by using the big M-method:

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
2068 Baishakh

Exam.	Regular / 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

- ✓ Candidates are required to give their answers in 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 of determinant prove that: [5]

$$\begin{vmatrix} x & 1 & y & 1 \\ 1 & y & 1 & x \\ 1 & x & 1 & y \\ y & 1 & x & 1 \end{vmatrix} = (x+y+2)(x-y)^2(x+y-2)$$

2. If A and B are two non singular matrices of the same order, prove that $(AB)^{-1} = B^{-1}.A^{-1}$. [5]

3. Find the rank of the following matrix reducing to normal form $\begin{bmatrix} 1 & 2 & 1 & 2 \\ 1 & 3 & 2 & 2 \\ 2 & 4 & 3 & 4 \\ 3 & 7 & 4 & 6 \end{bmatrix}$. [5]

4. Find the eigen values and eigen vectors of the matrix $\begin{bmatrix} 2 & -2 & 2 \\ 1 & 1 & 1 \\ 1 & 3 & -1 \end{bmatrix}$. [5]

5. Find the Laplace transform of the following functions: [5]

   a) $te^{-3t}\cos 2t$ b) $\frac{e^{at} - \cos 6t}{t}$

6. Find the inverse Laplace transform of the following functions: [5]

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

7. Solve using Laplace transform $(D^2 + 4D + 3)x = e^{-t}$, where $x(0) = x'(0) = 1$. [5]

8. Obtain a Fourier series for $f(x) = x^3$ in the interval $-\pi \le x \le \pi$. [5]

9. Find the half range sine series for the function $f(x) = x - x^2$ in the interval $0 < x < 1$. [5]

10. Maximize $Z = x_1 + 1.5\, x_2$ subject to constraints [5]

    $2x_1 + 2x_2 \le 160$
    $x_1 + 2x_2 \le 120$
    $4x_1 + 2x_2 \le 280$
    $x_1 \ge 0$ and $x_2 \ge 0$ graphically.

11. Solve the following linear programming problems by simplex method [10]

Maximize $Z = 15x_1 + 10x_2$
Subject to $2x_1 + 2x_2 \leq 10$
$x_1 + 3x_2 \leq 10$ and $x_1, x_2 \geq 0$

12. Show that the vector field $\vec{F} = (x^2 - yz)\hat{i} + (y^2 - zx)\hat{j} + (z^2 - xy)\hat{k}$ is irrotational. Find the sector function $\varphi(x, y, z)$ such that $\vec{F} = \nabla\varphi$. [5]

13. If S be the part of the surface $Z = 9 - x^2 - y^2$ with $Z \geq 0$ and $\vec{F} = 3x\,\vec{i} + 3y\vec{j} + Z\vec{k}$, find the flux of F through S. [5]

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

15. Evaluate by Stoke's theorem: [5]

$$\int_c (e^x dx + 2ydy - dz)$$

Where c is the curve: $x^2 + y^2 = 4$, $z = 2$.

OR

Verify Gauss divergence theorem for the vector function $\vec{F} = x^2\hat{i} + z\hat{j} + yzk$, taken over the unit cube bounded by the planes: $x = 0, x = 1, y = 0, y = 1, z = 0, z = 1$.

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05 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2067 Ashadh

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

Subject: - Mathematics III

- ✓ 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 determinant prove:

$$\begin{vmatrix} a^2+1 & ba & ca & da \\ ab & b^2+1 & cb & db \\ ac & bc & c^2+1 & dc \\ ad & bd & cd & d^2+1 \end{vmatrix} = a^2+b^2+c^2+d^2+1$$

2. Show that every square matrix can be uniquely expressed as the sum of hermitian and a skew-hermitian matrix.
3. Reduce to normal form and find the rank of the matrix:

$$\begin{bmatrix} 2 & -2 & 0 & 6 \\ 4 & 2 & 0 & 2 \\ 1 & -1 & 0 & 3 \\ 1 & -2 & 1 & 2 \end{bmatrix}$$

4. Find the eigen values and eigne vectors of the matrix

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

5. Find the Laplace transform of:

   a) coshat sin at b) $\frac{\cos 2t - \cos 3t}{t}$

6. Find the inverse Laplace transform of:

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

7. State and prove the integral theorem of the Laplace transform.
8. Solve the following differential equation using the Laplace transform.

   $y''' + 2y'' - y' - 2y = 0$ where $y(0) = y'(0) = 0$ and $y''(0) = 6$

9. Find a Fourier series to represent $x - x^2$ f[illegible] Hence show that

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

10. Express $f(x) = x$ as a cosine half range series in $0 < x < 2$.

11. The acceleration of a moving particle at any time t is given by $\frac{d^2\vec{r}}{dt^2} = 12\cos 2t\hat{i} - 8\sin 2t\hat{j} + 16t\hat{k}$. Find the velocity $\vec{v}$ and displacement $\vec{r}$ at anytime t if

$t = 0$, $\vec{v} = 0$ and $\vec{r} = 0$.

12. Find the angle between the normals to the surface $xy = z^2$ at the points (1,4,2) and (–3,–3,3)

13. Find the work done in moving a particle once round the circle $x^2 + y^2 = 9$, $z = 0$ under the force field $\vec{F}$ given by $\vec{F} = (2x - y + z)\vec{i} + (x + y - z^2)\vec{j} + (3x - 2y + 4z)\vec{k}$.

14. Evaluate $\iint_S \vec{F}.\vec{n}\, ds$ where s is the upper side of triangle with vertices (1,0,0), (0,1,0), (0,0,1) where $\vec{F} = (x - 2z)\vec{i} + (x + 3y + z)\vec{j} + (5x + y)\vec{k}$.

15. State Green's theorem in a plane. Using Green's theorem find the area of $x^{2/3} + y^{2/3} = a^{2/3}$.

16. Verify Stoke's theorem for $\vec{F} = (2x - y)\vec{i} - yz^2\vec{j} - y^2z\vec{k}$ where s is the upper part of the sphere $x^2 + y^2 + z^2 = a^2$ and c is its boundary.

OR

Verify Gauss theorem for $\vec{F} = y\vec{i} + x\vec{j} + z^2\vec{k}$ over the region bounded by $x^2 + y^2 = a^2$, $z = 0$ and $z = h$.

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04 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2067 Magh

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

Subject: - Mathematics III

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

1. Show that $\begin{vmatrix} a & b & b & b \\ a & b & a & a \\ a & a & b & a \\ b & b & b & a \end{vmatrix} = -(b-a)^4$.

2. If P and Q are two orthogonal matrices of the same order, prove that their product is also orthogonal.

3. Reducing to normal form, find the rank of matrix $\begin{vmatrix} 1 & -1 & 2 & -3 \\ 4 & 1 & 0 & 2 \\ 0 & 3 & 0 & 4 \\ 0 & 1 & 0 & 2 \end{vmatrix}$.

4. Find the eigen values and eigen vectors of the matrix $\begin{vmatrix} 2 & -2 & 2 \\ 1 & 1 & 1 \\ 1 & 3 & -1 \end{vmatrix}$.

5. Find a Fourier series for $f(x) = x^3$, $-\pi < x < \pi$.

6. Find the half range sine series for the function $f(x) = e^x$ for $0 < x < \pi$.

7. Find the Laplace transform of
   a) $t^2 \cos at$
   b) $t^3 e^{-3t}$

8. Find the Inverse Laplace transform of
   a) $\dfrac{s}{(s-3)(s^2+4)}$
   b) $\log \dfrac{s(s+1)}{(s^2+4)}$

9. If $L\{f(t)\} = F(s)$, then prove $L\{e^{at} f(t)\} = F(s-a)$.

10. Use the Laplace transform to solve $\frac{d^2y}{dt^2}+4\frac{dy}{dt}+3y=e^{-t}$, $y(0)=y^1(0)=1$.

11. The position vector of a moving particle at any time t is given by $\vec{r}=(t^2+1)\vec{i}+(4t-3)\vec{j}+(2t^2-6)\vec{k}$. Find the velocity and acceleration at t = 1. Also find their magnitudes.

12. Define divergence and curl of $\vec{V}$. Prove that div(Curl $\vec{V}$) = 0.

13. Evaluate $\int_c \vec{F}.\vec{dr}$ where $\vec{F}=Z\vec{i}+x\vec{j}+y\vec{k}$ and C is the arc of curve, $x = t^2+1$, $y = 2t^2$, $z = t^3$ from t = 1 to t = 2.

14. Evaluate $\iint_S \vec{F}.\vec{n}\,ds$ where $\vec{F}=x\vec{i}+y\vec{j}+z\vec{k}$ and S is the outside of the lateral surface of circular cylinder, $x^2+y^2=a^2$ between planes z = 0 and z = 4.

15. Use Green's theorem to find the area of ellipse, $\frac{x^2}{a^2}+\frac{y^2}{b^2}=1$.

16. Verify Stoke's theorem for $\vec{F}=x\vec{i}+z^2\vec{j}+y^2\vec{k}$ over the plane surface x + y + z = 1 lying in first octant.

OR

Verify Gauss's theorem for $\vec{F}=4x\vec{i}-2y^2\vec{j}+z^2\vec{k}$ taken over the region bounded by $x^2+y^2=4$, z =0 and z =3.

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24 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2071 Chaitra

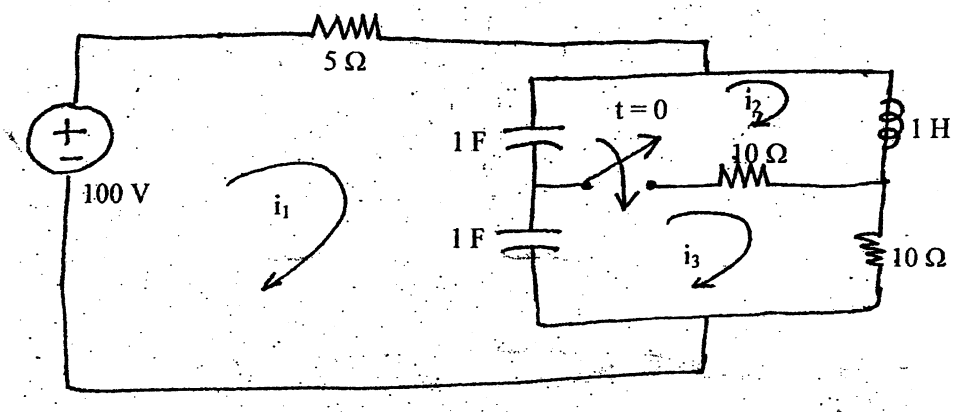
Exam.	Regular		
Level	BE	Full Marks	80
Programme	BEL, BEX, BCT	Pass Marks	32
Year / Part	II / I	Time	3 hrs.

Subject: - Electric Circuit Theory *(EE501)*

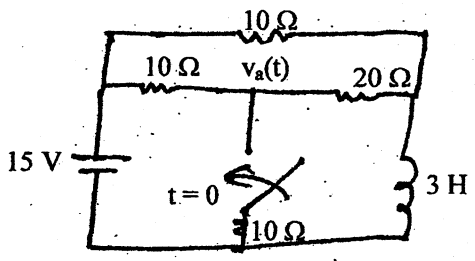
- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Assume suitable data if necessary.*

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

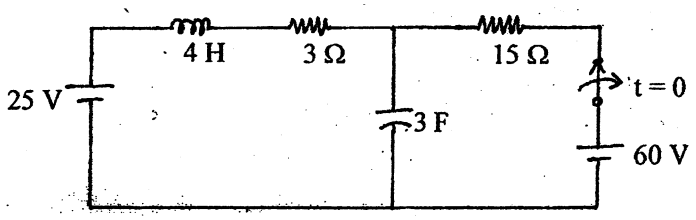
   b) In the circuit shown in following figure, find the loop currents i_1, i_2, i_3 at $t = 0^+$. [8]



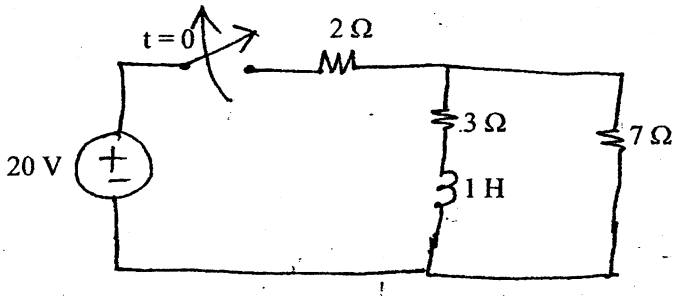
2. a) Find $v_a(t)$ for $t > 0$ in the figure below using classical method. [8]



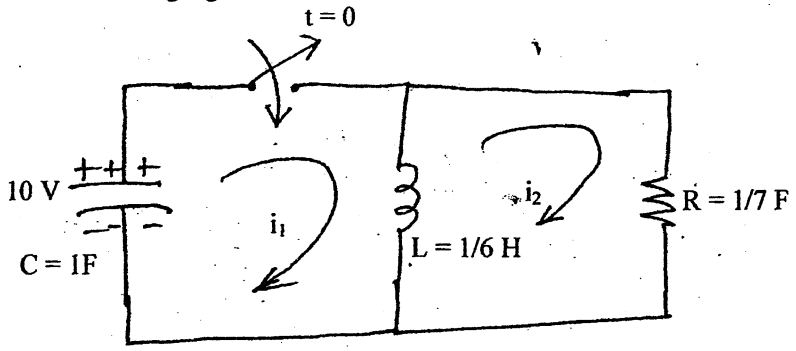
   b) Keeping the switch closed for a long time, if the switch is opened at $t = 0$ in the circuit shown in figure below, find expression for voltage across capacitor in the circuit shown in below using classical method of solution. [8]



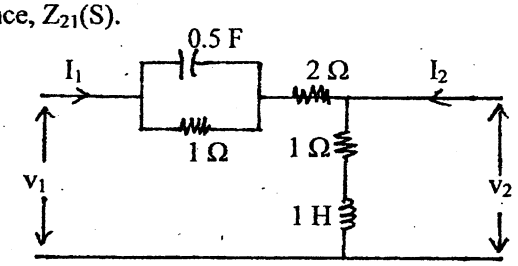
3. a) Using Laplace Transform method, find the current and voltage across inductor for t > 0 in the circuit shown in figure below. [8]



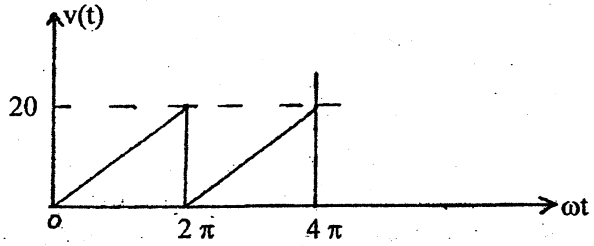
b) Using Laplace transform method, find he loop currents i_1 and i_2 for t > 0 in the circuit shown in the following figure. [8]



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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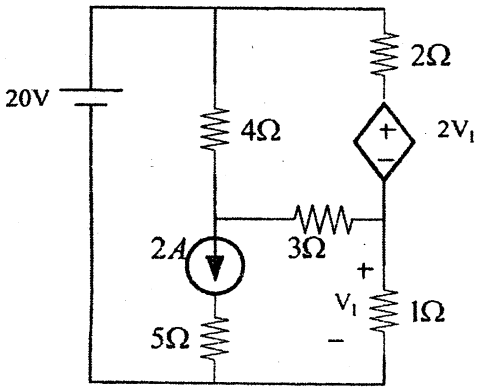
21 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2069 Chaitra

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.*

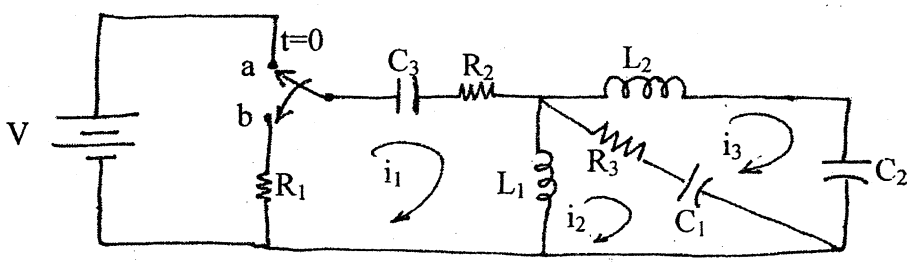
1. a) In the given circuit determine voltage across 1Ω resistor using mesh analysis method. [6]



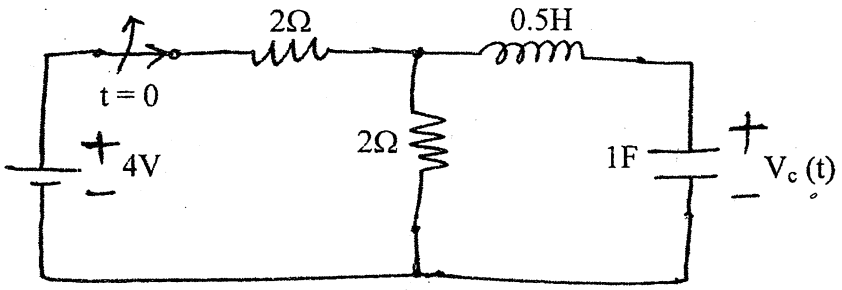
b) Explain the phenomenon of resonance in RLC series circuit. Derive the expression for resonant frequency, bandwidth, half power frequencies and quality factor. [6]

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]

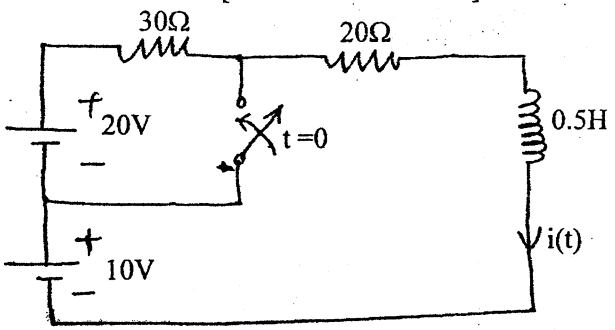
2. a) In the network shown in figure below the switch is changed from a to b at t = 0. Show that at $t = 0^+$ $i_1 = i_2 = -\dfrac{V}{R_1 + R_2 + R_3}$ and $i_3 = 0$. Also find the voltage across C_1, C_2, C_3, L_1 and L_2 at $t = 0^+$ [8]



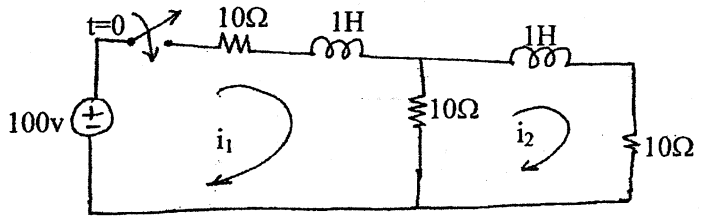
b) Switch in the circuit is suddenly opened at t = 0 after steady state has been reached in the closed position of the switch. Use classical method to determine the expression for voltage across capacitor for t > 0. [8]



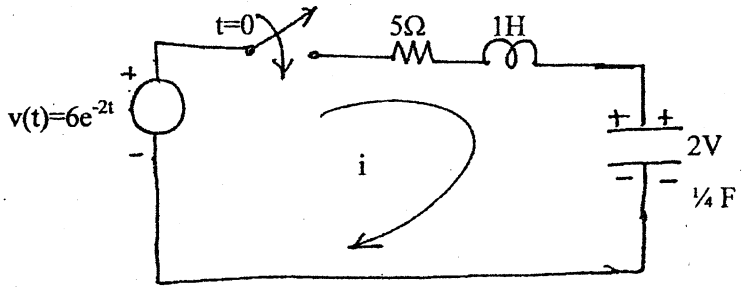
3. a) In the circuit shown switch is opened for a long time and then it is suddenly closed at t = 0. Obtain the expression for current through inductor for t > 0. Also calculate the voltage across inductor after 10mSec. [Use classical method] [8]



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

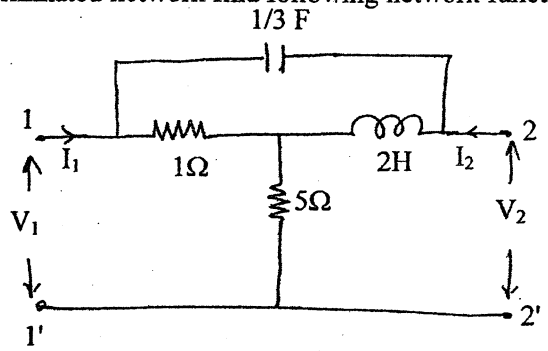


4. a) In a series RLC, as shown in figure below find the value of current for t > 0, also find the voltage across capacitor for t > 0, using Laplace transform method. [6]



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

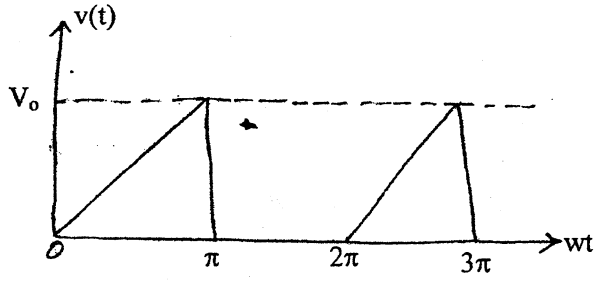
c) If the two port network, shown in figure below is terminated with a 2Ω resistor at port 2 then for this terminated network find following network function. (i) G_{21} (ii) α_{21} [6]



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

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

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



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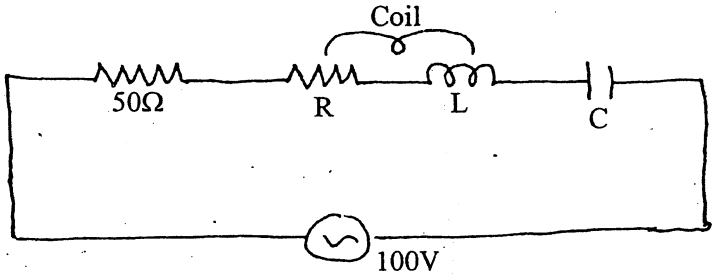
21 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2068 Baishakh

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

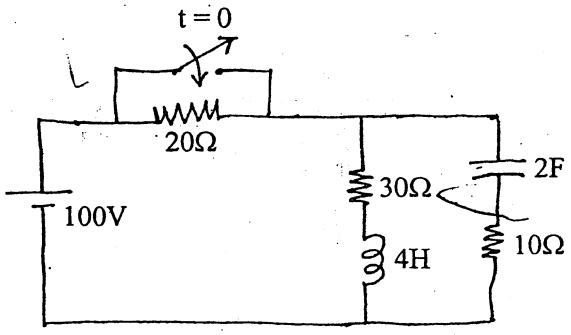
- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ ***Semilog graph paper is attached herewith.***
- ✓ *Assume suitable data if necessary.*

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]

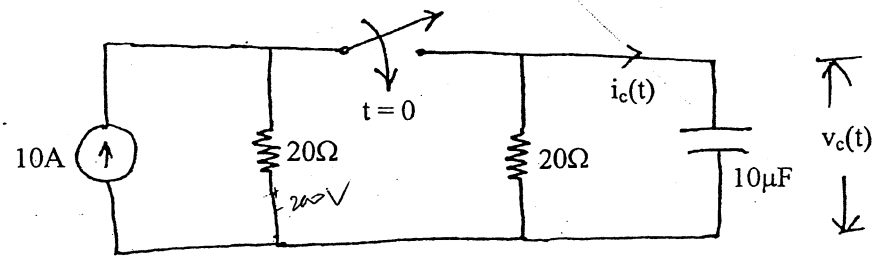


b) Explain the phenomenon of resonance of a parallel ac circuit and hence derive the expression for the resonant frequency. [6]

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]

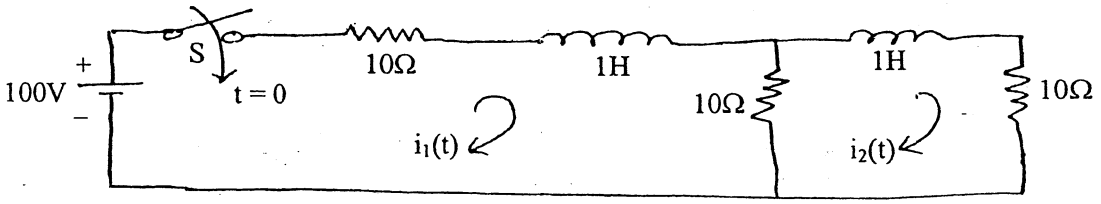


b) At t = 0, switch is closed in the circuit of figure below. Find the $V_c(t)$ and $i_c(t)$ using classical method. [8]



3. a) In a series R-L circuit the applied voltage is $v(t) = 10 \sin (10^4 t + \frac{\pi}{6})$ 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]

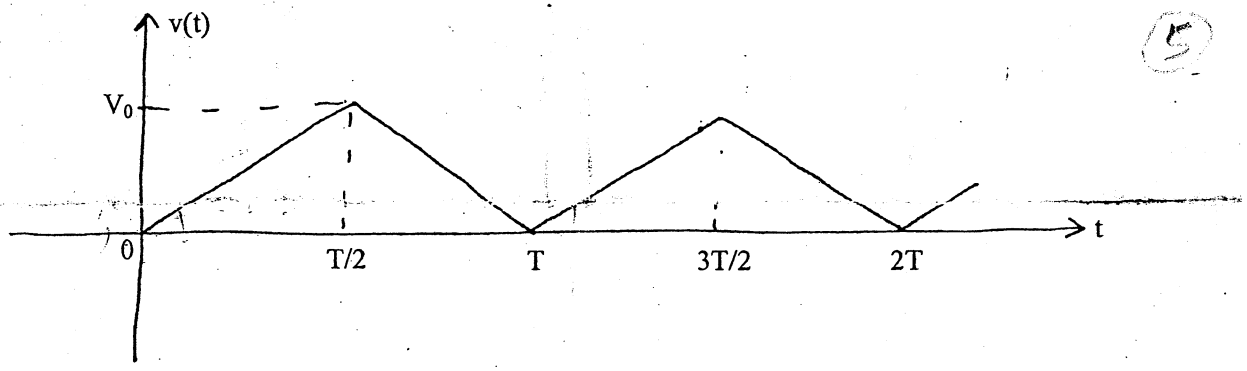
b) In the network shown below, the switch is closed at t = 0. With the network parameter values given, find the expression for $i_1(t)$ and $i_2(t)$ using Laplace transform method. The network is in energized before the switch is closed. [8]



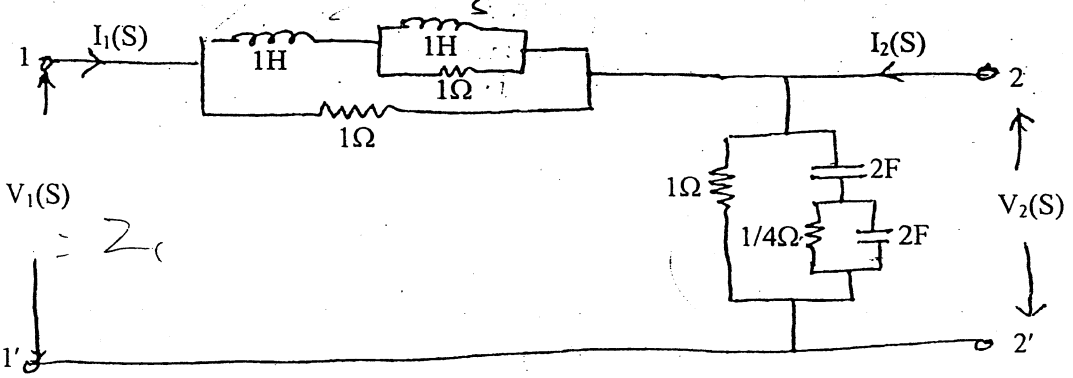
4. a) Sketch the Bode plots for the transfer function given by

$$N(S) = \frac{10(S+10)}{(S^2+40S)(S^2+5S+4)}.$$ [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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21 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2068 Chaitra

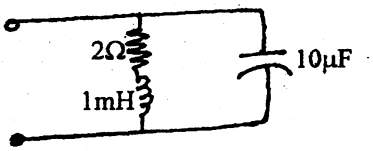
Exam.	Regular		
Level	BE	Full Marks	80
Programme	BEL, BEX, BCT	Pass Marks	32
Year / Part	II / I	Time	3 hrs.

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

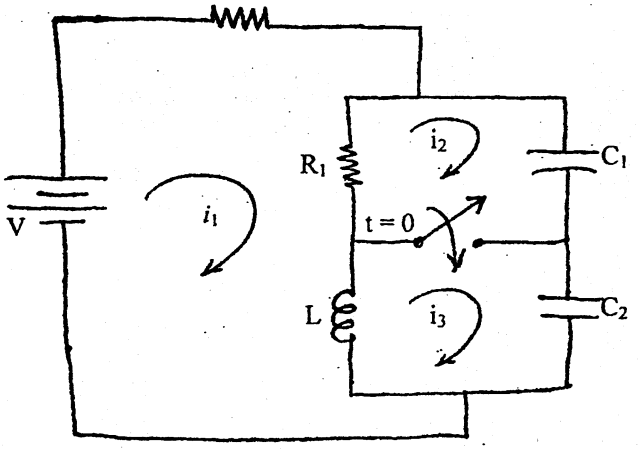
- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt any **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Assume suitable data if necessary.*

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]

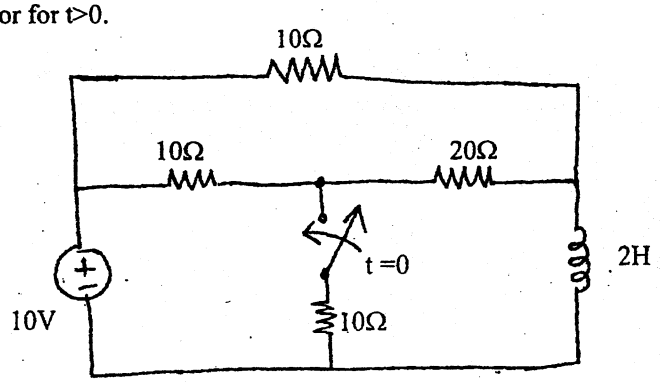
   b) In the parallel resonant circuit as shown in the figure below, find resonance frequency, Q factor and band width. [8]



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

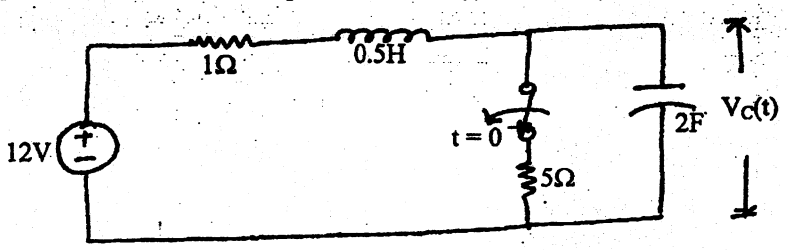


   b) For the circuit shown in following figure, use classical method to find the current in the inductor for t>0. [8]

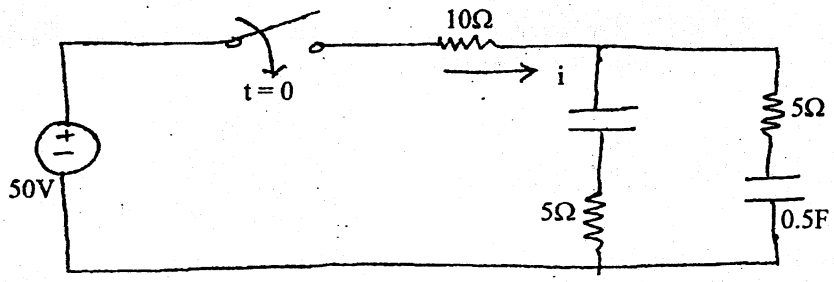


3. a) An exponential voltage $v(t) = 2e^{-4t}$ is applied at time t = 0 to a series R-L circuit comprising a resistor R = 1Ω and a inductor L = 0.25H. Obtain the particular solution for current i(t) through the circuit. Assume zero initial current through the inductor. Use classical approach. [8]

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]

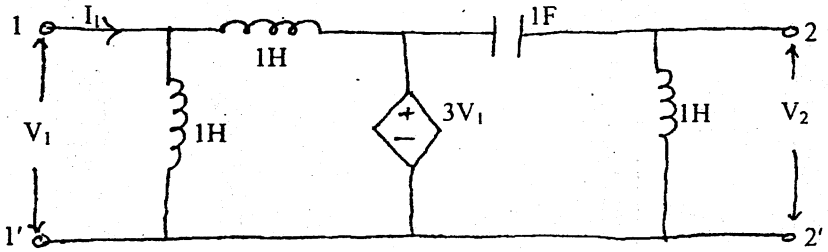


4. a) Using laplace transformation technique, find the expression for current i(t) in the network shown below for t > 0 when the switch is closed at t = 0. Assume zero initial charge across the capacitors. [6]



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

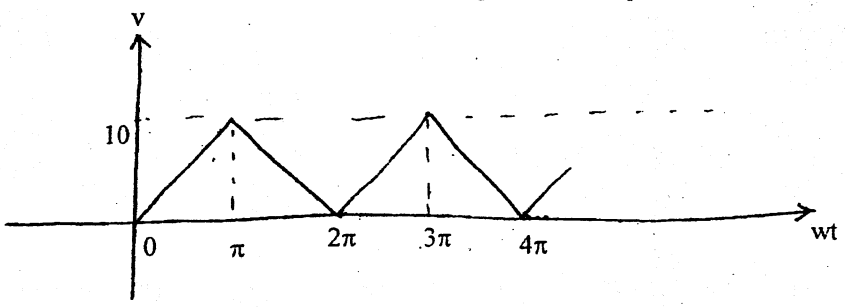
c) Find the Z-parameters in the network shown below and also check for its reciprocity and symmetricity. [6]



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 Shrawan

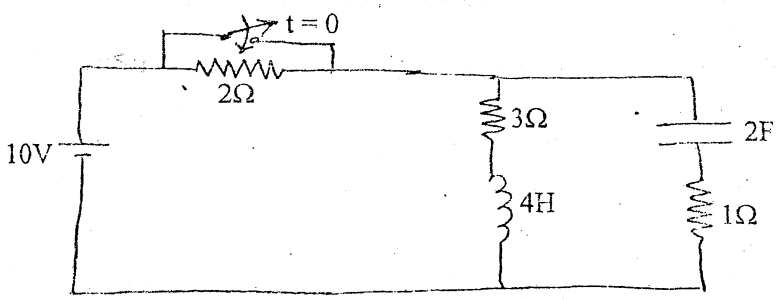
Exam.	New Back (2066 Batch)		
Level	BE	Full Marks	80
Programme	BEL, BEX, BCT	Pass Marks	32
Year / Part	II / I	Time	3 hrs.

Subject: - Electric Circuit Theory

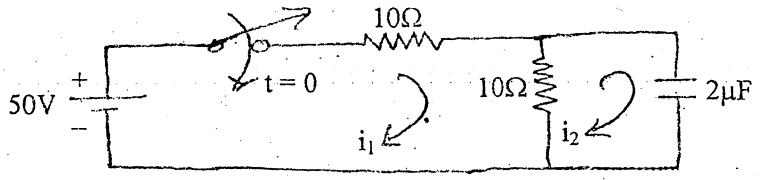
- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt any **Five** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ ***Semilog graph paper will be provided.***
- ✓ *Assume suitable data if necessary.*

1. a) Define half power points and bandwidth for a series RLC circuit and derive the expression for them. How is the bandwidth affected by quality factor of the circuit? [8]

   b) The switch has been open for a long long time in the circuit shown below and at t = 0 it is suddenly closed. Find i_L, v_C, q_C, $i_{2\Omega}$, $i_{3\Omega}$, $i_{1\Omega}$, i_C, v_L, $v_{3\Omega}$, $v_{1\Omega}$, $v_{2\Omega}$ at $t = 0^+$. [8]

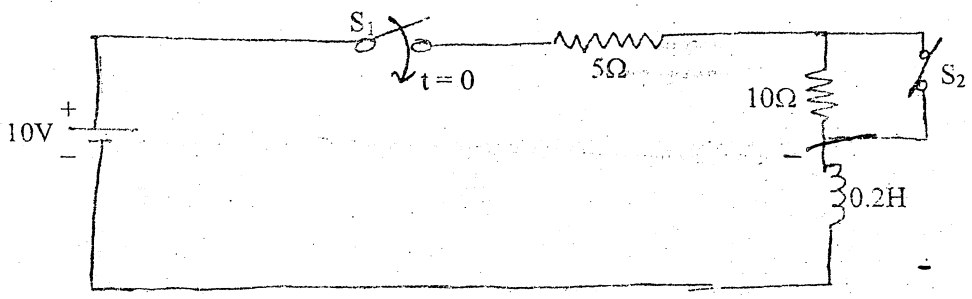


2. a) In the two mesh network shown in the figure below, the switch is closed at t = 0. Find the mesh currents $i_1(t)$ and $i_2(t)$ as shown, and the capacitor voltage $v_C(t)$. [Use classical approach]. [8]

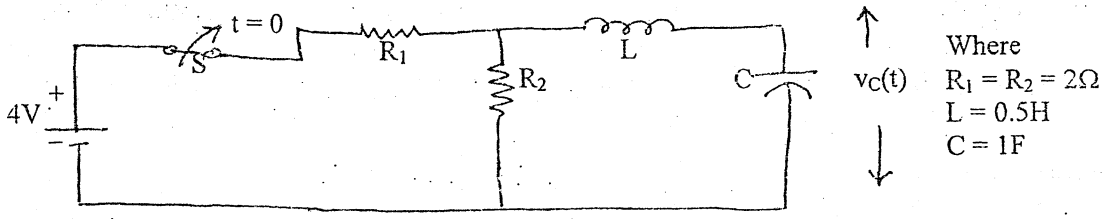


   b) An exponential voltage $v(t) = 20e^{-4t}$ is suddenly applied at time t = 0 to a series RC circuit with R = 1Ω, C = 0.25F. Obtain the particular solution i(t) in the circuit. Assume zero initial charge across capacitor. [Use classical method.] [8]

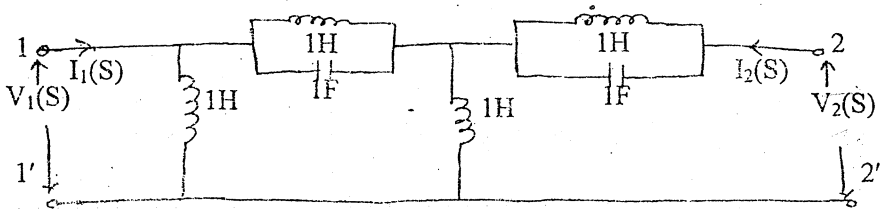
3. a) In the given circuit below, switch S_1 is closed at t = 0 and after 8ms, the switch S_2 is opened. Find the complete expression for current in the interval 0 < t < 8ms and t > 8ms. Use Laplace Transform approach. [8]



b) The circuit shown below is in steady state with switch 'S' closed. The switch is opened at t = 0. Using Laplace Transform method, find $i_L(t)$ in the circuit. [8]



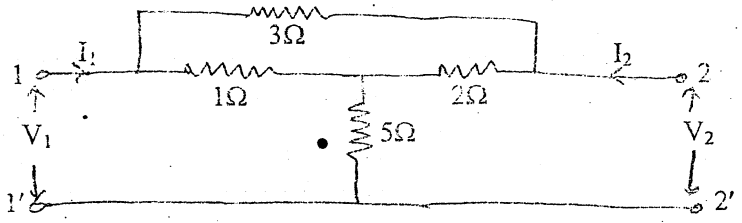
4. a) For the given 2-port network shown in figure below, find the voltage ratio transfer function. [8]



b) What do you understand by poles and zeros of a network function? State their significance in analyzing the time domain response of a network. [4]

c) Determine the equivalent Y-parameter if two port Networks are connected in parallel. [4]

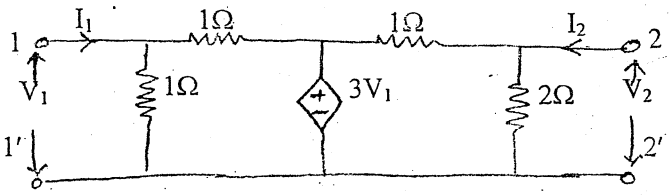
5. a) Obtain the T and Y parameters of the given 2-port network shown in following figure. Also check for the symmetry and/or reciprocity of the network. [8]



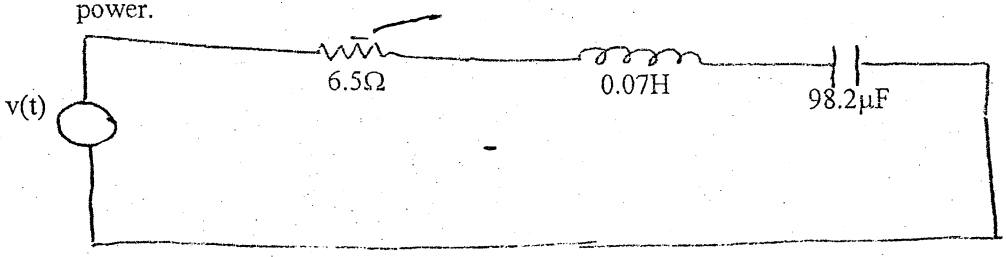
b) Sketch the asymptotic Bode plots for the transfer function given by [8]

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

6. a) For the network shown below, find the Z and g parameters and show that the network is neither reciprocal nor symmetrical. [8]



b) The network of figure shown below has an applied voltage of v(t) = (40 sin ωt + 80 sin 3ωt) volts where ω = 500 rad/s. Find the current response and hence the average power. [8]



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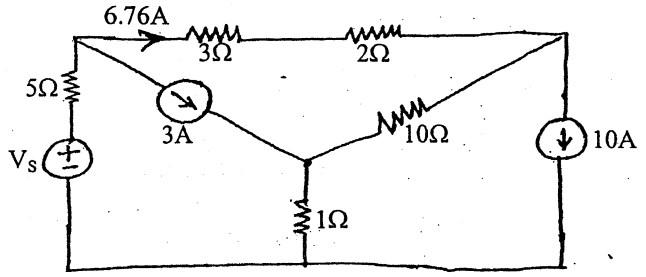
22 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2067 Ashadh

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

Subject: - Electric Circuits II

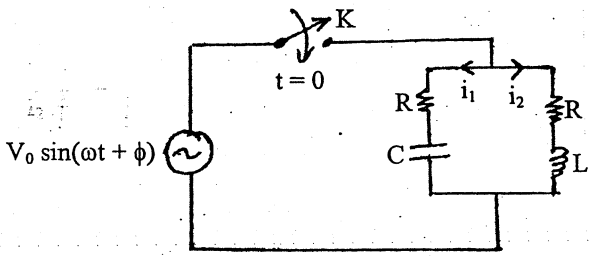
- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt any **Five** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ ***Semilog graph paper will be provided.***
- ✓ *Assume suitable data if necessary.*

1. a) Using mesh analysis, determine the value of V_S so that the current through 3Ω resistor is 6.76 Amp as shown in the following figure. [8]

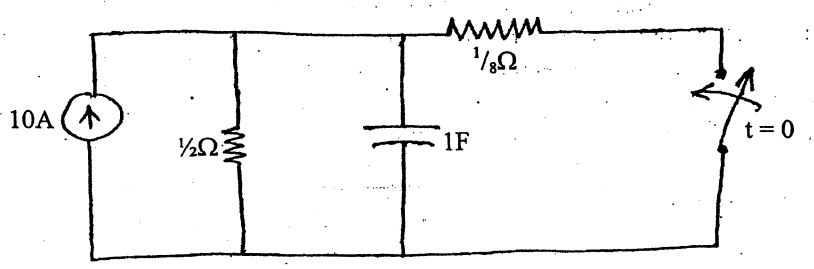


b) Mention the importance of initial conditions in the circuit analysis. Draw the equivalent circuit showing the initial and final condition for inductor and capacitor. [4]

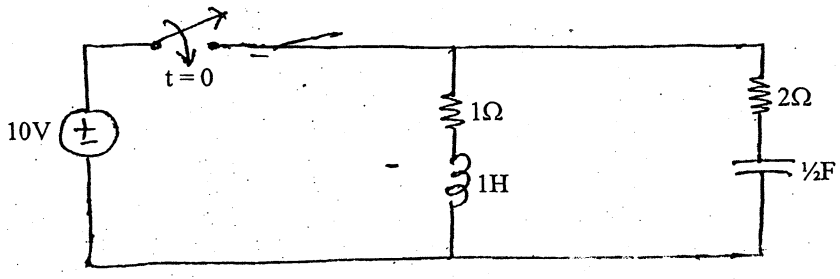
c) In the given circuit, switch K is closed at time t = 0. Find $i_1(0^+)$, $i_2(0^+)$, $\frac{di_1(0^+)}{dt}$ and $\frac{di_2(0^+)}{dt}$. [4]



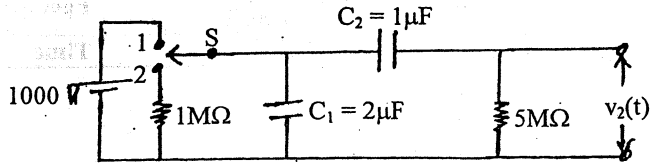
2. a) In the given circuit, after the switch has been in the open position for a long time, it is closed at t = 0. Find the voltage across the capacitor using classical method. [8]



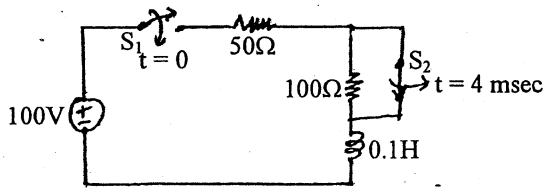
b) In the network shown, the switch is closed at t = 0. Find the current supplied by the source using Laplace transform method. [8]



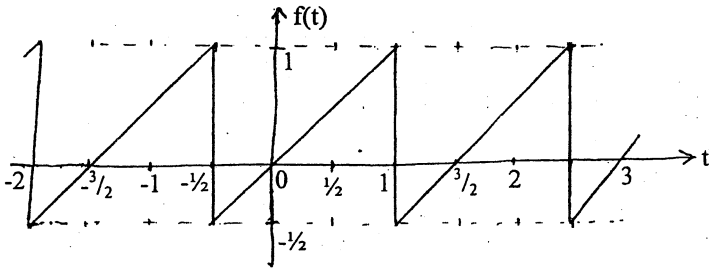
3. a) With the switch S in position 1, the circuit shown below attains equilibrium. At time t = 0, the switch is moved to position 2. Find the voltage across 5MΩ resistor. (Use Laplace transform method) [8]



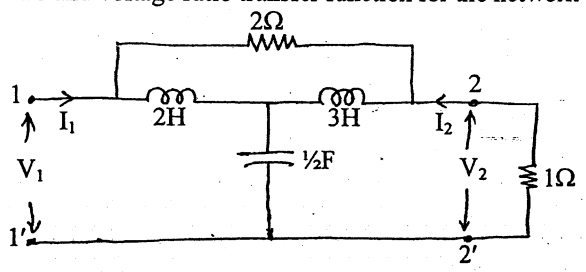
b) In the circuit shown below, switch S_1 is closed at t = 0 and S_2 is opened at t = 4 msec. Determine i(t) for t > 0. Assume that inductor is initially de-energized. (Use Laplace method) [8]



4. a) Find the exponential form of Fourier series for the given Saw-tooth wave. [8]



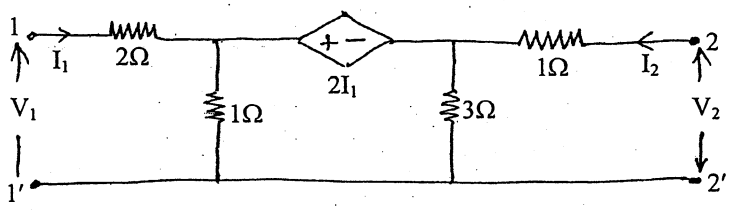
b) Find the current ratio and voltage ratio transfer function for the network given. [8]



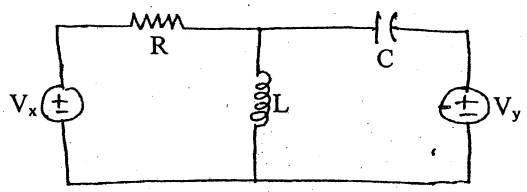
5. a) Sketch Bode-plot for the transfer function given by $G(S) = 10\dfrac{S(S+3)}{(S+1)(S^2+2S+16)}$. [8]

b) With a suitable example prove that the forced response of a network depends upon the nature of input excitation while the natural response never depends upon the input excitation. [8]

6. a) Find the transmission and y-parameter of the two port network given in the following figure and also prove that the network is neither reciprocal nor symmetrical. [8]



b) Write the state variable formulation of the circuit shown. [8]



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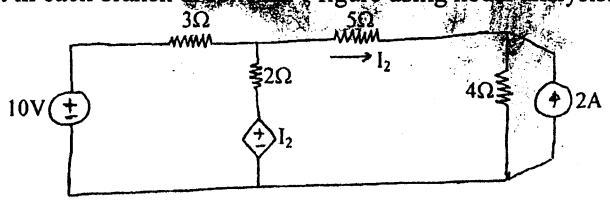
25 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2070 Ashad

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.

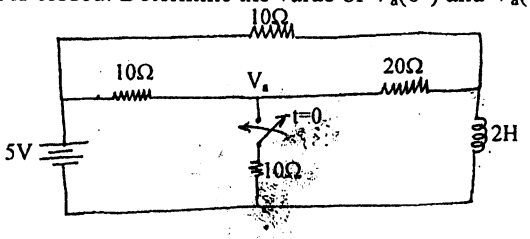
Subject: - Electric Circuit II (EG527EE)

- ✓ 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.*

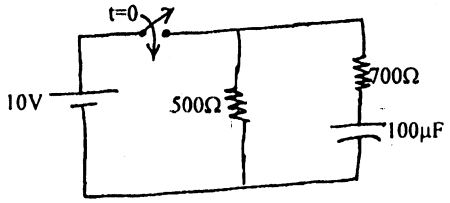
1. a) Find the current in each branch of following figure using nodal analysis. [8]



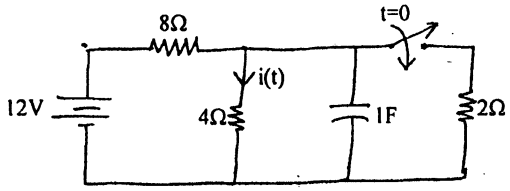
b) In the network shown in figure below, a steady state is reached with switch open. At t = 0, the switch is closed. Determine the value of $V_a(0^-)$ and $V_a(0^+)$. [8]



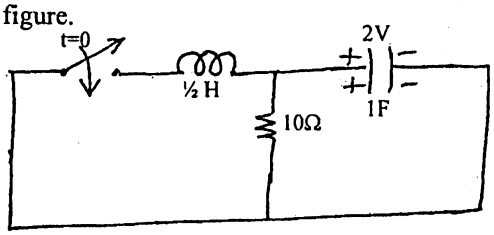
2. a) Using classical method, find the expression for the current supplied by the source in the network shown in figure. Also find the time taken by the source current to reach 25mA? [8]



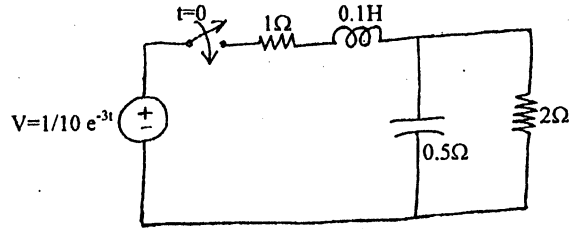
b) Using Laplace transform method, find the current i(t) for t>0 in the circuit shown in the figure below. [8]



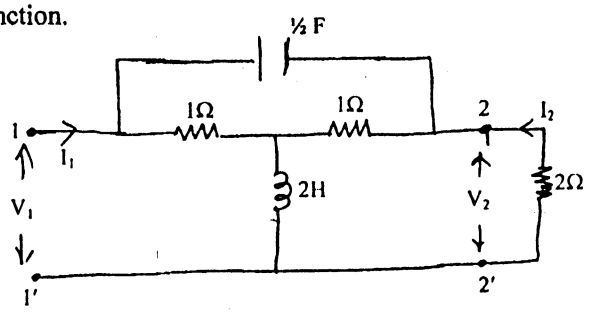
3. a) Using classical method find the expression for current through the inductor for t>0 in the circuit shown in figure. [8]



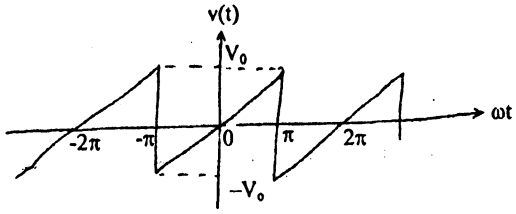
b) Using Laplace transform method, find the expression for current through 2Ω resistor for t>0 in the circuit shown in figure. [8]



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]

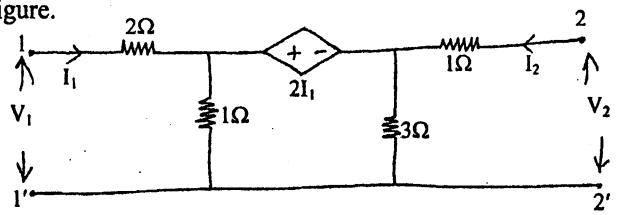


5. a) Sketch the asymptotic Bode-plot for the transfer function given by: [10]

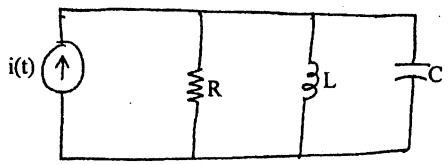
$$T(s) = \frac{10(S+10)}{S(S^2+5S+4)(S+40)}$$

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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