Electrical

II/I

Question BanK

TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2080 Bhadra

Exam.		Regular	
Level	BE	Full Marks	80
Programme	BEL	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**.*
- ✓ ***Values of commonly used constants are given below:***
- ✓ *Assume suitable data if necessary.*

Mass of electron, $m_e = 9.1 \times 10^{-31}$ kg
$h = 6.626 \times 10^{-34}$ Js
Permittivity of Silicon, $\varepsilon = \varepsilon_r \varepsilon_o = 11.9 \times 8.85 \times 10^{-12}$ F/m
$n_i = 1.45 \times 10^{10}$ cm^{-3} for silicon
$\mu_h = 450$ cm^2/V.s (at 300 K)

$1 \text{ eV} = 1.6 \times 10^{-19}$ J
$k = 1.38 \times 10^{-23}$ J/K
$\mu_e = 1350$ cm^2/V.s (at 300 K)
$N_A = 6.022 \times 10^{23}$ / mol

1. a) What is tunneling in quantum mechanics? With necessary mathematical expression, explain the nature of wave function in different regions in case of tunneling. [8]

   b) Estimate the probability of transmission that a ball weighing 0.5 g released at a height of 5 m at rest will reach a barrier height of 8 m with barrier width of 1.5 m. [4]

2. a) What is bonding and anti-bonding molecular orbitals? The formation of H_3 molecule is not stable, justify on the basis of molecular orbital bonding theory. [2+6]

   b) The drift mobility of electron is 43 cm^2 V^{-1} S^{-1} and the mean speed is 2×10^7 m/s. Calculate the relaxation time and mean free path of electrons between collisions. [4]

3. a) How does thermal and electromechanical breakdown result in dielectric breakdown in solids? Explain. How do electronic polarization differ from orientational polarization? [4+4]

   b) Determine electronic polarizability due to valence electrons per Si-atoms. If the sample is supplied by a voltage on its electrode, by how much is the local field greater than the applied field? Also determine the resonant frequency.

   Take $\varepsilon r = 11.9$ and number of Si-atoms per unit volume = 5×10^{22} cm^{-3} [6]

4. a) Define ferromagnetism , para-magnetism and diamagnetism with examples. [6]

   b) What are closure domains? Explain demagnetization of a magnetic material on the basis of magnetic domain formation. [6]

   c) Explain Meissner effect. Explain the difference between type I and type II superconductors with suitable examples and necessary figures. [3+5]

5. a) Differentiate between non-degenerate and degenerate semiconductor. Compare between Si and GaAs semiconductor with their respective E- K curves. [8]

   b) Find the resistance of a cubic pure Si- Crystals at 300K. If this silicon sample is doped with Sb (one Sb in 10^9 Si –atoms), what will be the new change in its resistance?

   Take atomic concentration = 5×10^{22} cm^{-3}. [8]

   c) An n-type Si wafer has been doped uniformly with 10^{15} Arsenic atoms per cm^3. Calculate the position of the Fermi energy level with respect to the intrinsic Fermi energy level E_{Fi} at 27 °C. If this sample is further doped with 2×10^{16} Boron atoms per cm^3, where will the Fermi level be shifted? [6]

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TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2081 Baishakh

Exam.	Back		
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Programme	BEL, BEX	Pass Marks	32
Year / Part	II / I	Time	3 hrs.

Subject: - Electrical Engineering Material *(EE 502)*

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$\mu_e = 1350$ cm^2/V.s (at 300 K)
$N_A = 6.022 \times 10^{23}$ / mol

1. a) What do you mean by quantum mechanics? Evaluate the wavelength of 50 gram golf ball travelling at a velocity of 20 ms^{-1}. [4]
   b) What do you understand by number of states and density of states in quantum mechanics? Derive appropriate expressions for them. [8]
2. a) What are drift velocity, mobility and conductivity for the electrons in metals? [6]
   b) Copper has FCC structure unit cell, atomic mass = 63.55 gm/mol and radius (R) = 0.13nm. Calculate (i) Packing density (ii) Density of copper(iii) Atomic concentration (iv) Fermi energy [2+2+2+2]
3. a) A pure Si crystal that has $\varepsilon_r = 11.9$. [6]
   (i) What is the electronic polarizability due to valence electrons per Si atom?
   (ii) Suppose a voltage is applied across Si crystal sample, by how much is the local field greater than the applied field. Given that the density of Si atoms; $N = 5 \times 10^{28}$ atoms per m^3, $\varepsilon_0 = 8.85 \times 10^{-12}$ Fm^{-1}.
   b) What is loss tangent? Show that the power loss in dielectric material per unit volume is the function of frequency of the applied field and loss tangent. [6]
4. a) Why hard magnetic material is preferred for making permanent magnet? Explain the differences between diamagnetic, paramagnetic and ferromagnetic materials with their suitable examples. [2+6]
   b) What is Meisner effect? Explain the difference between type-I and type-II superconductor. [8]
5. a) Explain the diffusion process in semiconductor and derive the Einstein relationship. [8]
   b) An n-type Si wafer has been doped uniformly with 10^{15} Arsenic atoms per cm^3. Calculate its resistance and the position of the Fermi energy with respect to the intrinsic Fermi energy level E_{Fi} at 27°C. If this sample is further doped with 10^{22} Boron atoms per cm^3, what will be change in its resistance? [6]
6. a) What is the width of the depletion region for pn junction Si diode that has been doped with 10^{18} acceptor atoms cm^{-3} on the p-side and 10^{16}cm^{-3} doner atoms on the n-side? (T = 300k). Also calculate width of the depletion region in each side. [6]
   b) Derive the Einstein relationship showing the relation between electron diffusion co-efficient in n-type semiconductor and electron mobility. [6]

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260

Mass of electron, $m_e = 9.1 \times 10^{-31}$ kg
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$\mu_h = 450$ cm^2/V.s (at 300 K)
$1\ eV = 1.6 \times 10^{-19}$ J
$k = 1.38 \times 10^{-23}$ J/K
$\mu_e = 1350$ cm^2/V.s (at 300 K)
$N_A = 6.022 \times 10^{23}$ / mol

1. a) Prove that the energy of a particle confined in an infinite potential well is quantized. Find also the expression for normalized wave function and draw graph for Ψ and $|\psi|^2$. [8]

   b) Evaluate the probability that an energy state 3KT above the Fermi level will be occupied by an electron. [4]

2. a) What do you understand by infinite effective mass? Derive the expression for effective mass of electron and show that it can be positive as well as negative, explain with the help of E-k diagram. [8]

   b) Calculate the Fermi energy at 0 K for copper. Given its density as 8.96 g/cc and atomic mass as 63.5 g/mol. [4]

3. a) Define electric dipole moment and local electric field. Derive the Clausius-Mossotti equation for electronic polarization, relating polarizability with permittivity. [8]

   b) What is loss tangent? Show that power loss in a dielectric material per unit volume is the function of frequency of the applied field and loss tangent. [6]

4. a) How does a superconductor expel magnetic field? Differentiate between type I and type II superconductors. [8]

   b) Explain demagnetization of magnetic materials with the help of magnetic domain formation. What is deperming method of demagnetization? [8]

   c) Classify different type magnetic materials and explain any two of them. [6]

5. a) Differentiate between non-degenerate and degenerate semiconductor. [4]

   b) An n-type silicon wafer is uniformly doped with 10^{17} antimoney per cm^3. Where will the Fermi level compared to its intrinsic Fermi level? Where will the Fermi level be shifted if the sample is further doped with 2×10^{16} atoms per cm^3? [8]

   c) A heavily doped N-side with donor concentration of 10^{17} cm^{-3} and P-side with acceptor concentration of 10^{16} cm^{-3} are connected. Find [8]

   (i) Built in potential (V_o)

   (ii) Depletion width (W_o, Wn and W_p)

   (iii) Electric field at metallurgical junction (E_o)

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TRIBHUVAN UNIVERSITY
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2079 Bhadra

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$1\ eV = 1.6 \times 10^{-19}$ J
$h = 6.626 \times 10^{-34}$ Js
$k = 1.38 \times 10^{-23}$ J/K
Permittivity of Silicon, $\varepsilon = \varepsilon_r\ \varepsilon_o = 11.9 \times 8.85 \times 10^{-12}$ F/m
$\mu_e = 1350\ cm^2/V.s$ (at 300 K)
$n_i = 1.45 \times 10^{10}\ cm^{-3}$ for silicon
$N_A = 6.022 \times 10^{23}$ / mol
$\mu_h = 450\ cm^2/V.s$ (at 300 K)

1. a) Starting from the suitable equation, prove that energy of an electron in infinite potential well of width L is quantized and also derive the wave function for that electron. [8]

   b) A transmitter type vacuum tube operated at 1500°C has a cylindrical Thorium coated Tungsten cathode which is 5 cm long with diameter of 1.5 mm. Determine the saturation current of vacuum tube if the cathode has emission coefficient constant of $3 \times 10^4\ Am^{-2}K^{-2}$ and work function of 2.6 eV. [4]

   c) If electric conductivity of potassium is 1.39×10^5 Sm/cm, calculate the drift mobility of electron at room temperature. Molar mass and density of potassium are 39.5 and 0.91 gm/cc. [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) Define local field inside a solids and hence derive the Clausis-Massoti Equation for the solids. [6]

   c) Graphically explain frequency dependency of polarizability. [5]

3. a) What is a magnetic domain? Explain the behavior of magnetic domains in presence of external field. [8]

   b) How strong magnetic fields effect the superconductor? Derive the relation of critical current in superconductor with necessary diagram. [8]

4. a) Given that the density of states related effective masses of electrons and holes in Si are approximately $1.08m_e$ and $0.60m_e$ respectively and the electron and hole drift mobilities at room temperature are 1350 and 450 $cm^2V^{-1}S^{-1}$ respectively. Calculate the intrinsic concentration and intrinsic resistivity of Si. The energy band gap for Si is 1.10eV. (T = 300K) [6]

   b) Explain the diffusion process in semiconductor and derive the Einstein relation for diffusion process. [8]

5. a) Calculate the resistance of pure silicone cubic crystal of 8 cm^3 at room temperature. What will be the resistance of the cube when it is doped with 1 arsenic in 5×10^9 Si atom? Take atomic concentration of Si is $5 \times 10^{22}\ cm^{-3}$. [6]

   b) Explain how does temperature affects the formation of carrier concentration in semiconductor. [6]

   c) What is fermi energy? Explain its importance in semiconductor. [5]

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$m_e = 9.1 \times 10^{-31}$kg; $h = 6.65 \times 10^{-34}$J/s;
μ_h=450 cm^2/v.s at 300k; $k = 1.38 \times 10^{-23}$J/K;
μ_n=1350 cm^2/v.s at 300k; $\varepsilon_o = 8.85 \times 10^{-12}$
$n_i = 1.45 \times 10^{10}$/cm^3 for Silicon; mass of electron(m_e)=9.1×10^{-31}kg
$N_a = 6.02 \times 10^{23}$mol^{-1}
μ_e=1350 cm^{2}v^{-1}(at 300k)
ε_r=11.9 for Si
$1_{ev} = 1.6 \times 10^{-19}$J

1. a) Define Fermi Energy. What is the probability that an electron having energy less that Fermi energy will occupy an energy level at absolute zero temperature? Show the radiation between population density N(E) and Fermi energy (E_F). [8]

   b) A 30 A° thick oxide layer of CuO separates two copper conductors providing a barrier height 10eV for the conduction of electrons in copper. Determine the transmission coefficient if the energy of electron in 5eV. What will be the new transmission coefficient if the thickness of CuO was reduced to 10A°. [4]

2. a) Explain the formation of H_2 molecule using molecular orbital bonding theory. Draw the necessary diagram also. [6]

   b) What is effective mass? How does it come into play? Derive the expression for effective mass of electron and show that it can be positive as well as negative, explain with the help of E-k diagram. [6]

3. a) Explain, how thermal breakdown and electromechanical breakdown results in dielectric breakdown in solids? [4]

   b) What is electric dipole moment? Derive the Claisius-Mossotti equation for electronic polarization, relating polarizability with permittivity. [6]

   c) Explain the application of superconductors. What are the limiting factors for a superconductor to remain in its superconducting state? [4+4]

4. a) Define magnetic domains and Domain wall. Explain the behavior of magnetic domains in the presence of external magnetic field with necessary diagram. [2+4]

   b) Why hard magnetic material is preferred for making permanent magnet while soft magnetic material is used for high frequency appliances. Explain with B-H curves. [6]

   c) An n-type silicon wafer is uniformly doped with 10^{15} antimony (Sb) atoms per cm^{-3}. Where will be the fermi level compared to its intrinsic fermi level? Where will be position of fermi level if the sample is further doped with 2×10^{16} boron atoms per cm^{-3}. [6]

5. a) Write short notes on: [4+4]

   i) Degenerate and Non-degenerate semiconductor
   ii) Direct and indirect band gap semiconductors

   b) Explain the diffusion process in semiconductor and derive the Einstein relation for diffusion process. [8]

   c) Calculate the resistance of pure silicone cubic crystal of 1 cm^3 at room temperature. What will be the resistance of the cube when it is doped with 1 arsenic in 10^9 Si atom? Take atomic concentration of Si is 5×10^{22} cm^{-3}. [4]

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TRIBHUVAN UNIVERSITY
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2078 Kartik

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$k = 1.38 \times 10^{-23}$ J/K
$\mu_e = 1350$ cm^2/V.s (at 300 K)
$N_A = 6.022 \times 10^{23}$ / mol

1. a) Differentiate between classical and quantum mechanics with examples. [4]
   b) Define Degenerate state and Fermi energy. Derive an expression showing the relationship between density of states and energy. [8]
   c) A vacuum tube with a cylindrical Thorium coated Tungsten cathode is 5 cm long and 3 mm in diameter. Estimate the saturation current if the tube is operated at 1400°C. Given, the Emission constant is 3 Acm^{-2}K^{-2} and work function for Thorium coated Tungsten is 2.6 eV. [4]
2. a) What is linear combination of atomic orbitals (LCAO)? With the help of LCAO, justify that the "Formation of H_2 molecule is energetically stable". [8]
   b) What is effective mass? Show that the effective mass is same as mass of electron in vacuum. [4]
   c) Differentiate between a normal conductor and a superconductor. [4]
3. a) What are the different limiting factors for a superconductor to remain in its superconducting state? Write some applications where superconductors are used. [4]
   b) What are the different types of polarization mechanisms? Explain briefly about each of them. [8]
   c) How does thermal and electromechanical breakdown process lead to dielectric breakdown in solid dielectrics? [4]
4. a) Define magnetic dipole moment and atomic magnetic moment. Differentiate between ferromagnetic material and ferrimegnetic material. [2+4]
   b) Justify that, "magnetization of a magnetic material occurs due to the growth of magnetic domains along the direction of applied field". [4]
   c) In an n-type semiconductor, the Fermi level lies 0.5eV below the conduction band at 300 K, if the temperature is increased to 310 K, find the new position of Fermi level. [6]
5. a) In doped semiconductors, show that the carrier concentration and drift mobility both are highly dependent on temperature with necessary diagrams. [6]
   b) Find the resistance of a cubic pure silicon crystal. Find the resistance when the Si-crystal is doped with one Arsenic atom in 10^9 Silicon atoms. If the sample is further doped with 10^{14} Boron atoms what will be the new resistance? [6]
   c) Differentiate between direct and indirect band gap semiconductors with examples. [4]

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2078/06/04

TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2078 Bhadra

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$\mu_e = 1350$ cm^2/V.s (at 300 K)
$N_A = 6.022\times10^{23}$ / mol

1. a) What is Thermionic emission and work function? Derive the Richardson's expression for the thermionic emission for Schottky effect. [8]
   b) Calculate the Fermi energy level in copper at 0K, if its density is 8.96 gm.cm^{-3} and atomic weight is 63.5 gm.mol^{-1}. What will be its new Fermi energy at 15°C? [4]
   c) "The effective mass of electron in Gold is 1.1 times the mass of electron". Justify. [4]
2. a) Define lattice and basis of a crystal structure. Draw the face entered cubic (FCC) unit cell and find the body diagonal and parking density. [2+6]
   b) What is Meissner effect? Explain the difference between type I and type II superconductors. [2+6]
3. a) What are different types of polarization in dielectric medium? How do electronic polarization differ from orientational polarization? [4+4]
   b) How can you demagnetize a magnetic material? Explain with the help of its B-H curve. What type of magnetic material would you chose for electronic storage of digital data? Justify. [4+4]
4. a) Derive the relation for built in potential and depletion layer of a p-n junction. [4+4]
   b) Given that the density of states related effective masses of electrons and holes in Si are approximately $1.08m_e$ and $0.60m_e$ respectively, and the electron and hole drift mobilities at room temperature are 1350 and 450 cm^{2}V^{-1}S^{-1} respectively. Calculate the intrinsic concentration and intrinsic resistivity of Si. The energy band gap for Silicon is 1.10eV, T = 300K [8]
5. a) In a pure germanium of 50g, 5μg of Arsenic is thoroughly mixed in molten form. The density of germanium is 5.46 gcm^{-3} and atomic weight of Arsenic is 74.92 gmol^{-1}. Find the total resistance of a wire of such n-type material having length of 1cm and cross-sectional area of 2.25×10^{-4}cm^2. Take mobility of electrons in germanium = 3600 cm^{2}V^{-1}s^{-1}. [8]
   b) What are degenerate and non-degenerate semiconductors? Explain. [4]
   c) What is minority charge suppression in extrinsic semiconductor? [4]

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TRIBHUVAN UNIVERSITY
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2076 Chaitra

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$n_i = 1.45\times10^{10}\ cm^{-3}$ for silicon
$N_A = 6.022\times10^{23}$ / mol
$\mu_h = 450\ cm^2/V.s$ (at 300 K)

1. a) Explain the significance of operators in quantum mechanics. How do you calculate the expected energy value of a particle represented by $\psi(x,t)$ confined at a boundary of 0 to L? [4+4]
   b) Explain the thermionic emission in metal. Using image charge method, derive an expression of emission current density for Schottky effect. [2+6]
2. a) Calculate the lattice constant, face diagonal, body diagonal and packing density of body centered cubic (BCC) crystal unit cell. [4]
   b) Drift mobility of conduction electron is 43 $cm^2V^{-1}s^{-1}$ and mean speed is $1.2\times10^6 ms^{-1}$. Calculate the mean free path of electrons between collisions. [4]
   c) How does a superconductor expel all the magnetic lines of force at T<Tc? [4]
   d) How does Meissner effect help to differentiate superconductor as type-I and type-II? Explain in brief. [4]
3. a) Explain how? [4×2]
      (i) If the spacing between parallel plates of a capacitor is less, the dielectric breakdown will occur soon.
      (ii) Average dipole moment in dipolar polarization depends on temperature.
   b) Distinguish between ferromagnetic and anti-ferromagnetic materials. Give an example for each class of material. [4+1]
   c) Explain about the applications of soft magnetic materials. [3]
4. a) The density of states related effective masses of electrons and holes in silicon are approximately $1.08m_e$ and $0.6m_e$ respectively. The electron and hole drift mobilities at room temperature are 1350 and 450 $cm^2V^{-1}s^{-1}$ respectively. Calculate intrinsic concentration and intrinsic resistivity of silicon at T = 300K. The energy band gap for silicon is 1.1eV. [8]
   b) Explain how does the band bends in semiconductor. [4]
   c) Describe the Direct and indirect recombination process between an electron and hole in semiconductor with necessary diagrams. [4]
5. a) What is PN junction? Derive the relation for built in potential and depletion layer of a PN junction. [8]
   b) Find the resistance of p-n junction Germanium diode if temperature is 27°C and $I_o = 1\mu A$ for an applied forward bias of 0.2 Volt. [4]
   c) Explain the importance of Fermi energy level in semiconductor. [4]

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TRIBHUVAN UNIVERSITY
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2076 Ashwin

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$n_i=1.45*10^{10}$ /cm³ for Si)
$\mu_h = 450$ cm²/v.s. at 300 K
$N_A = 6.022*10^{23}$ /mol

1. a) What is tunneling in quantum mechanics? Explain with necessary mathematical expression, the nature of wave function in different regions in case of tunneling. [8]
   b) Calculate the Fermi energy level at absolute zero for the copper having electron concentration of $8.43\times10^{28}m^{-3}$. [4]
   c) X-rays of wavelength 0.9 A° fall on a metal plate having work function of 2 eV. Find the wavelength associated with emitted photoelectrons. [4]
2. a) Drift mobility of conduction electron is 43 $cm^2/V.s$ and mean speed is 1.2×10^6 m/s. Calculate mean free path of electrons between collisions. [4]
   b) What is Meisner effect? Explain the difference between type I and type II super conductors. [2+6]
   c) For silver with E_{F0}=5.5ev and ∅=4.5 ev, calculate the toal number of status per unit volume and compare this with atomic concentration of silver. Density and atomic mass of silver are 10.5 g/cm^3 and 107.9 g/mol respectively. [4]
3. a) Define magnetic domain and domain walls in magnetic materials. Explain in brief about losses that would occur in magnetic materials. [2+4+2]
   b) Define local field in relation to polarization. Derive the Clausius-Massoti Equation for ionic polarization, relating polarizability with the permittivity. [8]
4. a) An n-type silicon wafer is uniformly doped with 10^{16} antimony atoms per cm^3. Where will be the Fermi level compared to its intrinsic Fermi level? [6]
   b) Explain the diffusion process in semiconductor and derive the Einstein relation for diffusion process. [10]
5. a) Define p-type semiconductor. Derive an expression for minority carrier suppression and hence prove that the conductivity in p-type semiconductor is mainly due to the hole. [8]
   b) If it is desired to raise Fermi level to 0.7 eV above the intrinsic Fermi level at room temperature, what type of dopant is to be used? Also determine its doping level if the used intrinsic semiconductor is silicon. [4]
   c) An n-type semiconductor doped with 10^{16} cm^{-3} phosphorus atoms has been doped with $10^{17}cm^{-3}$ boron atoms. Calculate the electron and hole concentrations in the semiconductor. [4]

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TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2075 Chaitra

Exam.	Regular / Back		
Level	BE	Full Marks	80
Programme	BEL, BEX	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.*
- ✓ *Values of commonly used constants are given below:*

Mass of electron, $m_e = 9.1*10^{-31}$ kg;
$h = 6.624*10^{-34}$ JS;
$\varepsilon_o\varepsilon_r = 11.9*8.85*10^{-12}$ F/m for Si
$\mu_e = 1350$ cm^2/v.s. at 300 K
$e=1.6*10^{-19}$ c
$1ev=1.6*10^{-19}$ J;
$K=1.38*10^{-23}$ J/K;
$n_i=1.45*10^{10}$ /cm^3 for Si)
$\mu_h = 450$ cm^2/v.s. at 300 K
$N_A = 6.022*10^{23}$ /mol

1. a) Starting from the suitable equation, prove that the energy of an electron that is confined in an infinite potential well of width L is quantized. [8]

   b) An electron is confined to an infinite potential well of size 0.1nm. Calculate the ground energy of the electron and radian frequency. How can this electron be put to the third energy level? [4]

2. a) Derive Einstein's relation between mobility and diffusion co-efficient. Also define the terms electron mobility, conductivity and resistivity. [5+3]

   b) Explain the concept of effective mass in crystal with necessary mathematical expression. [6]

3. a) Define polarization. Derive the Clausius-Massoti equation showing the relation between relative permittivity and electronic polarizability. [8]

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

   c) Classify the magnetic material based on magnetization and explain each of them briefly. [8]

4. a) Explain how strong magnetic field effects superconductor. [4]

   b) Describe the phenomenon of generation of electrons and holes, and conduction in semiconductor. Also derive equation for conductivity. [6]

   c) How band bending occurs in semiconductors? Derive Einstein relationship. [10]

5. a) A pn junction semiconductor has resistivity of 5Ω cm. If mobility of holes is 450 cm^2/Vs, and electron mobility is three times the mobility of holes at room temperature, find

   i) Built in potential
   ii) Depletion width that lies in n-region and p-region respectively
   iii) Built in electric field at x=0. [6]

   b) Calculate the resistance of pure silicon cubic crystal of 1cm^3 at room temperature. What will be the resistance of the cubic when it is doped with 1 arsenic in 10^9 silicon atoms and 1 boron atom per billion silicon atoms? Atomic concentration of silicon is $5*10^{22}$cm^{-3}, $n_i=1.45*10^{10}$cm^{-3}. [8]

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13 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2075 Ashwin

Exam.	Back		
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, $m_e = 9.1\times10^{-31}$ kg
$h = 6.626\times10^{-34}$ Js
Permittivity of Silicon, $\varepsilon = \varepsilon_r\,\varepsilon_0 = 11.9\times8.85\times10^{-12}$ F/m
$n_i = 1.45\times10^{10}$ cm^{-3} for silicon
$\mu_h = 450$ cm^2/V.s (at 300 K)
1 eV $= 1.6\times10^{-19}$ J
$k = 1.38\times10^{-23}$ J/K
$\mu_e = 1350$ cm^2/V.s (at 300 K)
$N_A = 6.022\times10^{23}$ / mol

1. a) Derive the time independent Schrodinger's equation, starting with classical wave equation, $y = A\sin 2\pi\left(ft - \frac{x}{\lambda}\right)$, where notations have their usual meanings. [8]

   b) Find the probability that an energy state 5KT above the Fermi level will not occupied by an electron. [4]

2. a) Draw a neat diagram of face centered cubic (FCC) unit cell crystal structure for copper and find
   (i) Number of atoms per unit cell
   (ii) Packing density
   (iii)Atomic concentration if radius of copper atom is 0.128 nm
   (iv)Density of crystal given that atomic mass of Cu is 63.55 g mol^{-1} [8]

   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 is local field in polarization? Derive the Clasuius- Massotti equation for electronic polarization. [8]

   b) Differentiate between Ferro and Piezo electricity. [4]

4. a) Explain the significance of hysteresis loop while selecting materials for preparing magnetic materials. [4]

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

   c) Define superconductor, critical magnetic field, and critical current density. [4]

5. a) Explain how donor dopants contribute electrons in conduction band in n-type extrinsic semiconductor. Also prove that $\sigma = ne\mu_e$ where symbols have their usual meanings. [8]

   b) A silicon wafer is uniformly doped with 10^{16} Boron atoms per cm^3. Where will be the Fermi level compared to its intrinsic Fermi level? Where will be the Fermi level is shifted if the sample is further doped with 10^{17} antimony atom per cm^3? [6]

6. a) Explain the diffusion process in semiconductor and derive the Einstein relation for diffusion process. [8]

   b) Derive an expression of a built-in potential and depletion width of a pn junction with necessary diagram. [8]

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13 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2074 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, $m_e = 9.1\times10^{-31}$ kg
$h = 6.626\times10^{-34}$ Js
Permittivity of Silicon, $\varepsilon = \varepsilon_r\,\varepsilon_o = 11.9\times8.85\times10^{-12}$ F/m
$n_i = 1.45\times10^{10}$ cm^{-3} for silicon
$\mu_h = 450$ cm^2/V.s (at 300 K)
1 eV $= 1.6\times10^{-19}$ J
$k = 1.38\times10^{-23}$ J/K
$\mu_e = 1350$ cm^2/V.s (at 300 K)
$N_A = 6.022\times10^{23}$ / mol

1. a) Calculate the temperature at which there is 98% probability that a state 0.3 ev below the fermi energy level will be occupied by an electron. [4]
   b) Prove that the energy of a particle confined in an infinite potential well is quantized. Also find the expression for normalized wave function. [8]
2. a) Draw face centered cubic (FCC) unit cell and find body diagonal and packing density. [6]
   b) The conductivity and drift mobility of copper conductor is $63.5*10^6$ s/m and 43 cm^2/v/s. Calculate Fermi level for copper conductor. [4]
3. a) Show that the dielectric loss per unit volume is a function of frequency of the applied field and the loss tangent. [6]
   b) What do you mean by piezo-electric materials? Explain piezoelectric effect in terms of polarization. [4]
4. a) On the basis of magnetic vector, explain the ferromagnetism, ferrimagnetism and antiferromagnetism. [4+2]
   b) What is Meissner effect? Explain the difference between type I and type II superconductors. Type II superconductor is also called hard superconductor, why? [2+4+2]
5. a) Differentiate between non-degenerate and degenerate semiconductors. [6]
   b) What is Built-in potential and depletion width? Derive the expression of these with necessary diagram. [6]
   c) 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 with 1 arsenic in 10^9 silicon atoms and 1 boron atom per billion silicon atoms? Atomic concentration of silicon is $5*10^{22}$ cm^{-3}, ni = $1.45*10^{10}$ cm-3. [8]
6. a) Calculate the diffusion coefficient of electrons at 300K in n-type silicon semiconductor. Also find current density if electron concentration gradient is 10^3 electrons per centimeter. [4]
   b) Obtain the expression to evaluate built in potential and width of depletion layer of p-n junction with necessary diagrams. [10]

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23 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2074 Ahswin

Exam.	Back		
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**.*
- ✓ ***Necessary Graph is attached herewith.***
- ✓ *Assume suitable data if necessary.*
- ✓ *Value of commonly used constants are given below:*

Mass of electron, $m_e = 9.1 \times 10^{-31}$ kg
$1\ eV = 1.6 \times 10^{-19}$ J
$h = 6.626 \times 10^{-34}$ Js
$k = 1.38 \times 10^{-23}$ J/K
Permittivity of Silicon, $\varepsilon = \varepsilon_r \varepsilon_0 = 11.9 \times 8.85 \times 10^{-12}$ F/m
$\mu_e = 1350\ cm^2/V.s$ (at 300K)
$n_i = 1.45 \times 10^{10}\ cm^{-3}$ for silicon
$N_A = 6.022 \times 10^{23}$ / mol
$\mu_h = 450\ cm^2/V.s$ (at 300K)

1. a) Explain the importance of quantum mechanics. Differentiate between classical and quantum mechanics with suitable examples. [8]

   b) In the photoelectric experiment, green light, with a wavelength of 522 nm is the longest wavelength radiation that can cause photoemission of electron from a clean sodium surface. Calculate the work function of sodium. If ultraviolet radiation with a wavelength 250 nm is incident to the sodium surface, what will be the kinetic energy of the photo-emitted electrons? [4]

2. a) What happen when inter-atomic separation between two helium atoms is very less? Describe on the basis of formation of bonding and antibonding molecular orbital. [6]

   b) Prove that for a simple cubic structure, the lattice constant: $a = \left[\frac{NM}{\rho N_A}\right]^{1/3}$ where, N is the number of atoms per unit cell, M is atomic weight, N_A is Avogadro's number and ρ is density of crystal material. [4]

3. a) Define local electric field and derive clausius-massotti equation. [6]

   b) The number of electrons per unit volume of Silicon is $6 \times 10^{22} cm^{-3}$. Calculate: [4]

      i) Electronic polarizability due to valence electrons per Silicon atom.

      ii) If the Silicon crystal sample is electrode on opposite faces, by how many times the local field is greater than the applied field?

4. a) What is a domain wall? How does a domain wall motion occur? [6]

   b) Explain about the applications of soft magnetic materials. [4]

5. a) A superconductor in its superconducting state expels all the magnetic lines of forces, justify. [6]

   b) Explain how carrier concentration of an n-type extrinsic semiconductor depends on temperature with necessary diagram and graphs. [6]

   c) Four micrograms of antimony are thoroughly mixed in molten form with 100 gms of pure germanium. Find the density of antimony atoms, density of donated electrons and the total resistance of a bar of such n-type material of 2 cm long, 0.012×0.012 cm in cross-section. Take, density of Ge = 5.46 gm/cm^3 and atomic weight of Sb = 121.76. [8]

6. a) The current density in semiconductor devices is affected both by diffusion and drifting of electrons and holes, justify. [6]

   b) Sample of silicon wafer is doped with 10^{15} Antinomy atoms/cm^3. Find the carrier concentrations, its resistance and the shift in Fermi level from its intrinsic Fermi level at 27°C. If this sample is further doped with 10^{22} Boron atoms/cm^3, what will be the change in its resistance. [6]

   c) Show that in n-type semiconductor minority carries concentrations are suppressed. [6]

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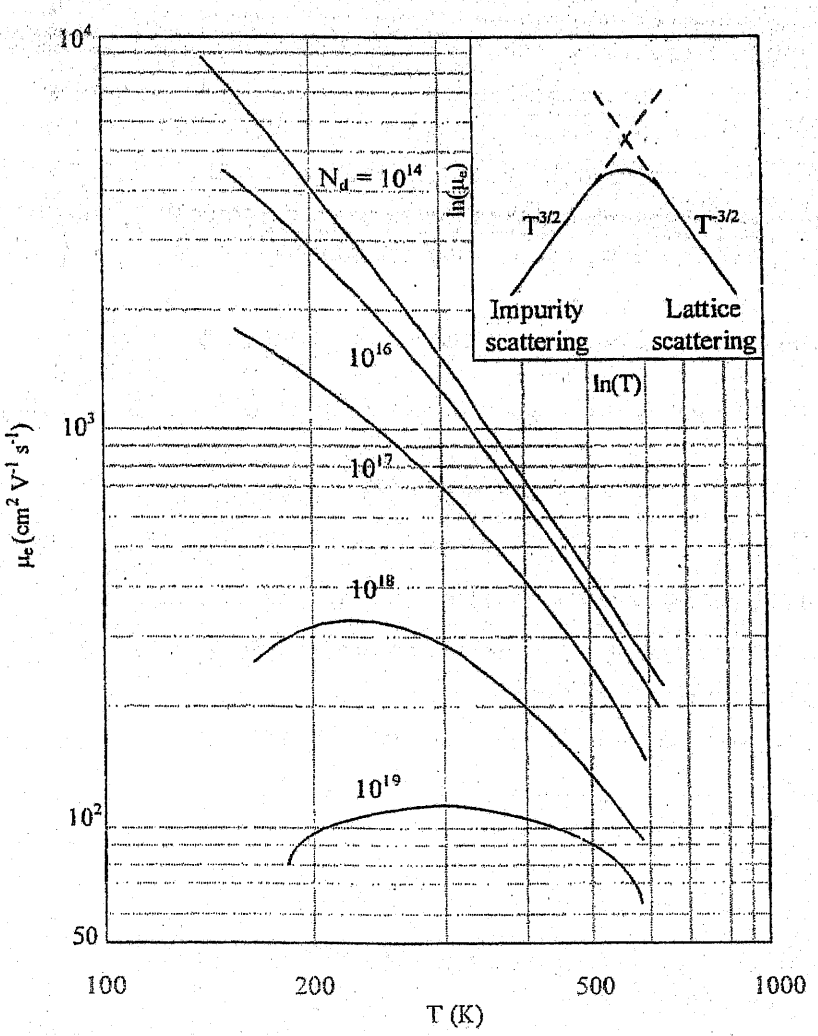

Figure: log-log plot of drift mobility versus temperature for n-type Silicon sample.

23 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2073 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**.*
- ✓ ***Necessary Graph is attached herewith.***
- ✓ *Assume suitable data if necessary.*
- ✓ *Values of commonly used constants are given below:*

Mass of electron, $m_e = 9.1\times10^{-31}$ kg
$h = 6.626\times10^{-34}$ Js
Permittivity of Silicon, $\varepsilon = \varepsilon_r\,\varepsilon_o = 11.9\times8.85\times10^{-12}$ F/m
$n_i = 1.45\times10^{10}$ cm^{-3} for silicon
$\mu_h = 450$ cm^2/V.s (at 300K)
1 eV $= 1.6\times10^{-19}$ J
$k = 1.38\times10^{-23}$ J/K
$\mu_e = 1350$ cm^2/V.s (at 300K)
$N_A = 6.022\times10^{23}$ / mol

1. a) Define population density. Prove that fermi energy in a metal is independent of temperature and depends only in its electron concentration. [2+6]

   b) Consider a Al-Cu thermocouple pair, Estimate the potential difference available from this thermo-couple if one junctions is held at 0°C and other at 100°C. [4]

Metal	Fermi Energy, EF (eV)	Constant (x)
Al	11.6	2.78
Cu	7.0	-1.79

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

   b) Drift mobility of conduction electron is 43cm^{2}V^{-1}S^{-1} and mean speed is 1.2*10^6 ms^{-1}. Calculate the mean free path of electrons between collisions. [4]

3. a) Show that dipolar polarization is a temperature dependent parameter. [6]

   b) Determine electronic polarizability due to valence electrons per Si-atoms. If the sample is supplied by a voltage on its electrode by how much is the local field greater than the applied field? Take ϵ_r = 11.9 and number of Si-atoms per unit volume = 5×10^{28} m^{-3}. [4]

4. a) Differentiate between ferrimagnetic and ferromagnetic materials. [6]

   b) What is Meissner effect? Differentiate between type I and type II superconductors. [4]

5. a) Explain how donor dopants contribute electrons in conduction band in n-type extrinsic semiconductor. Also prove that $\sigma = ne\mu_e$ where symbols have their usual meanings. [6]

   Describe the importance of determining Fermi energy in semiconductor materials. [6]

   The density of states related effective masses of electrons and holes in silicon are approximately 1.08m_e and 0.56m_e respectively. The electron and hole drift mobilities at room temperature are 1350 and 450cm^{2}V^{-1}S^{-1} respectively. Calculate intrinsic concentration and intrinsic resistivity of silicon. The energy band gap for silicon is 1.1ev. [8]

6. a) An n-type semiconductor doped with 10^{16}cm^{-3} phosphorus atoms has been doped with 10^{17}cm^{-3} boron atoms. Calculate the electron and hole concentrations and conductivity. [6]

   b) Explain how does the temperature affect the formation of carrier concentration in semiconductor? [6]

   c) Differentiate between si and GaAs with their respective E-k curve. [6]

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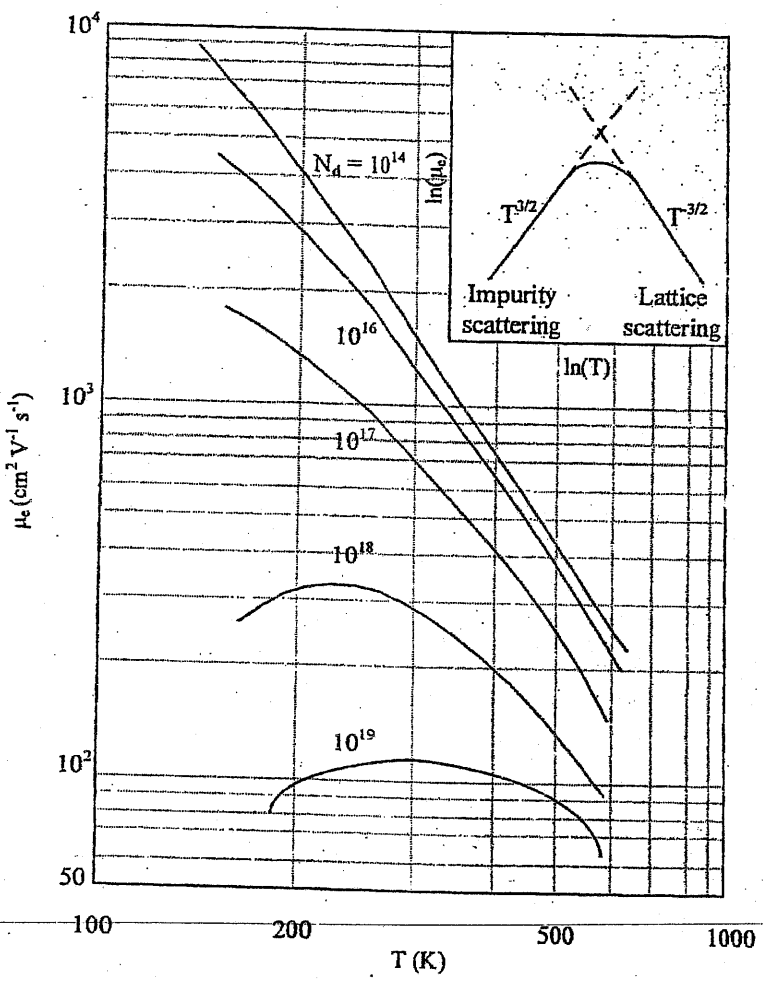

Figure: log-log plot of drift mobility versus temperature for n-type Silicon sample.

23 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2073 Shrawan

Exam.	New Back (2066 & Later Batch)		
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 do you understand by number of states and density of states in quantum mechanics? Derive appropriate expressions for them. [8]

   b) A transmitter type vacuum tube operated at 1500°C has a cylindrical Thorium coated Tungsten cathode which is 5 cm long with diameter of 1.5 mm. Determine the saturation current of vacuum tube if the cathode has emission constant of 3×10^4 Am^{-2}k^{-2} and work function of 2.6eV. [4]

2. a) Define and explain the effective mass of electron within a crystal. How do you understand negative and infinite mass of electron? [6]

   b) For silver with E_{FO} = 5.5ev and ϕ = 4.5 ev, calculate the total number of states per unit volume and compare this with atomic concentration of silver. Density and atomic mass of silver are 10.5g/cm^3 and 107.9g/mol respectively. [4]

3. a) Define local field in relation to polarization. Derive the Clausius-Massotti equation for ionic polarization, relating polarizability with the permittivity. [6]

   b) Name the field of application of different types of dielectric materials. [4]

4. a) Classify the magnetic material based on magnetization. [6]

   b) What type of magnetic material would you chose for electromagnetic relays? Justify. [6]

5. a) For a specimen of V_3Ga, the critical fields are 0.176T and 0.528T for 14K and 13K respectively. Calculate the critical temperature. Also calculate critical fields at 0K and 4.2K. [6]

   b) What is diffusion? Derive Einstein relationship for an n-type semiconductor. [6]

   c) A silicon ingot is doped with 10^{16} arsenic atoms/cm^3. Find the carrier concentrations conductivity of the sample and the shift in Fermi level from its intrinsic Fermi level at 27°C. [6]

6. a) Suppose a P-N junction is created on silicon wafer at room temperature. If the donor level on N-side is10^{17} cm^{-3} and acceptor level on P-Side is 10^{16} cm^{-3} calculate built in potential (V_o) and depletion width (W_o). [6]

   b) 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 with 1 arsenic in 10^9 silicon atoms and 1 boron atom per billion silicon atoms? Atomic concentration of silicon is $5*10^{22}$cm^{-3}, $n_i = 1.45*10^{10}$cm^{-3}. [6]

   c) What are energy bands? Distinguish between a conductor, an insulator and a semiconductor on the basis of energy diagram. Write two characteristic features to distinguish between n-type and p-type semiconductors. [6]

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23 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2072 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) Define Fermi Energy. What is the probability that an electron having energy less than Fermi energy will occupy an energy level at absolute zero temperature? Determine the expectation value for any property of a particle described by a wave function Ψ. [8]

   b) An electron is confined to an infinite potential well of size 0.1 nm. Calculate the ground energy of the electron and radian frequency. How this electron can be put to the third energy level? [4]

2. a) What is effective mass? The electron at the top of valence band is said to have negative effective mass. Explain with the help of E-k diagram. [2+4]

   b) Formation of H_2 molecule is more stable than the formation of H_3 molecule. Justify with the help of electron energy versus inter-atomic separation between H-atoms. [6]

3. a) Show that the dielectric loss per unit volume is a function of frequency of the applied field and the loss tangent. [6]

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

   c) Based on magnetization vector, explain the diamagnetism, ferromagnetism and ferrimagnetisms. [8]

4. a) Explain how strong magnetic field effects superconductor. Derive the relation of critical current in superconductor with necessary diagram. [8]

   b) How band bending occurs in semiconductors? Derive Einstein relationship. [10]

   c) If it is desired that the Fermi-level is to be raised to 0.1 eV above intrinsic Fermi-level at room temperature, what type of dopant is to be used? Determine its doping level. [6]

5. a) Present a comparison between Si and GaAs semiconductors with the help of their basic properties and E-k diagram. [6]

   b) Derive the expression of a built-in potential and depletion width of a pn junction with necessary diagrams. [8]

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23 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2072 Kartik

Exam.	New Back (2066 & Later Batch)		
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 density of states? Describe any statistical tool used in quantum mechanics to predict number of energy states being occupied by an electron. [1+4]

   b) A 3nm thick oxide layer of CuO separates two copper conductors providing a barrier height of 10eV for the conduction of electrons in copper. Determine the transmission coefficient if the energy of electron is 5eV. What will be the new transmission coefficient if the thickness of CuO was reduced to 1nm. [6]

2. a) If electrical conductivity of potassium is 1.39×10^5 Sm/cm, calculate the drift mobility of electron at room temperature. Molar mass and density of potassium are 39.95 and 0.91 gm/cc. [4]

   b) Taking the reference of formation of Lithium (Li) solid from N Lithium atoms explain clearly how the continuous energy band are formed in the solid metal. [6]

3. a) Derive the mathematical relation showing the relation between ionic polarization and relative permittivity, using Clausis-Massotti equation. [6]

   b) What is ferroelectricity and piezoelectricity? Write their similarities and differences. [4]

4. a) Classify magnetic materials based on their magnetic susceptibilities. What is the basic difference between ferromagnetic and ferrimagnetic material? [8]

   b) Explain how strong magnetic field effects superconductor. Derive the relation of critical current in superconductor with necessary diagram. [8]

   c) Describe briefly about domain theory of magnetism. [4]

5. a) Describe the importance of Fermi energy. Also differentiate between a degenerate and a non-degenerate semiconductor. [3+4]

   b) What is PN junction? Derive the relation for built in potential and depletion layer of a PN junction. [10]

6. a) Calculate the diffusion coefficient of electrons at 30°C in silicon doped with 10^{15} Arsenic atoms cm^{-3}. Given that the drift mobility of electron with 10^{15} cm^{-3} dopants is 1300 cm^{2}V^{-1}s^{-1}. [4]

   b) The effective density of states at conduction band and valence band are $2.9*10^{19}$ cm^{-3} and $1.1*10^{19}$ cm^{-3} respectively. Calculate the intrinsic concentration and intrinsic resistivity of silicon at 300 K temperature. [8]

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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
2071 Shawan

Exam.	New Back (2066 & Later Batch)		
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) Derive the relation of energy level inside a potential well of width L. Show mathematically that energy level in a copper wire of length L is quantized similar to energy level inside a potential well. [8]
   b) An electron is confined in an infinite potential well. The length of confinement is 0.01 nm. Find the energy and wave function of electron at third energy level. [4]

2. a) Derive the expression for effective mass of electron and show that it can be positive as well as negative. [8]
   b) The width of energy band is typically 10ev calculate: [4]
      i) The density of states at the center of the band
      ii) The number of states per unit volume within a small energy range KT above the center.

3. a) Derive Clausis Massoti equally showing the relation between electronic polarization and relative permittivity. [6]
   b) Derive the relation for average dipole energy of Hcl molecule when it is applied with electric fied of magnitude E. [4]
   c) Calculate the intrinsic conductivity and resistivity of Ga As at room temperature. The intrinsic concentration electron mobility and hole mobility of QaAs are 1.8×10^6 per cm^{-3}, 8500 $cm^2\ v^{-1}s^{-1}$ and 400 $cm^2\ v^{-1}s^{-1}$ respectively at 300K. [4]

4. a) Based on magnetization, differentiate between feromagnetism, ferrimagnetism, antiferrimagnetism and paramagnetism. [4]
   b) Explain the significance of hysteresis loop while selecting materials for preparing magnetic materials. [4]

5. a) What is critical current? Prove that the critical current decreases linearly with the increase in applied field for a wire. [8]
   b) A pn juction semiconductor has resistivity of 5Ω-cm. If mobility of hole is 450 $cm^2V^{-1}s^{-1}$ and electron mobility is three times the mobility of hole. At room temperature , find (i) Built in potential (ii) deletion width that lies in n-region and p-region and (iii) Built in electric field at x = 0 (Given $n_i = 1.45*10^{10}$ cm^{-3} at T=300K, $\varepsilon_r = 11.9$ for si). [8]

6. a) What is minority carrier suppression? Prove electron concentration and conduction in n-type semiconductor is defined by impurity donor. [8]
   b) Derive the relation for finding the concentration of electron in an extrinsic semi-conductor. [6]
   c) What is minority charge suppression in extrinsic semi-conductor? [4]

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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; 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) 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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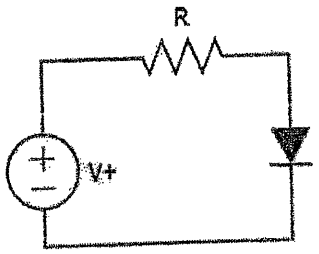
TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2080 Bhadra

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

Subject: - Electronics Device 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. Consider the circuit below for which R = 10kΩ. The power supply V^+ has a dc value of 10V on which is superimposed a 60 Hz sinusoid of 1-V peak amplitude. Calculate both the dc voltage of the diode and the amplitude of the sine wave signal appearing across it. Assume the diode to have a 0.7V drop at 1 mA current and n=2. [4]



2. What is Zener breakdown? Describe the Zener diode as a voltage regulator with circuit diagram and IV characteristics curve. [5]
3. What is dc load line in diode? Write its significance. [3]
4. Describe in brief the operation of BJT as a switch with necessary diagrams. [4]
5. Why voltage divider biasing is called β independent? Design a voltage divider type DC biased CE amplifier to obtain β independent biasing. Use appropriate guidelines to support your design. Given parameters are: V_{CC} = 24V, I_C= 1.5mA and β = 150. [2+6]
6. Draw the ac equivalent circuit for a CE amplifier (emitter resistor unbypassed) and derive the expressions for voltage gain, input impedance. [4]
7. Describe the construction and working principal of DMOSFET with the help of drain characteristics curve, transfer characteristics curve and mathematical expression. [8]
8. A JFET amplifier with a voltage divider biasing circuit, has the following parameters: V_p = -2V, IDSS = 4mA, RD = 910Ω, Rs = 3kΩ, R1 = 12 MΩ, R2 = 8.75 MΩ and VDD = 24 V. Calculate ID and VGS, VDS. [8]
9. Draw the circuit diagram of transformer coupled class B push pull amplifier and its corresponding characteristics graph. And, show that the maximum efficiency is 25π%. [2+2+4]
10. Draw the circuit diagram of tuned amplifier and derive the expression for the 3dB bandwidth of the amplifier. Write its applications. [6+2]
11. Explain the working principal of Wien bridge oscillator with necessary expressions and circuit diagram. [4]
12. How can we use astable multivibrator for the generation of square wave? [4]
13. Design a 5V to 20V variable dc voltage regulator using LM317. [4]
14. Draw a standard series DC voltage regulator circuit and find its voltage stability factor (Sv). [2+6]

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TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division

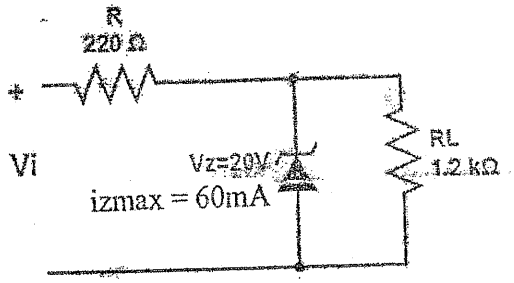
2081 Baishakh

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

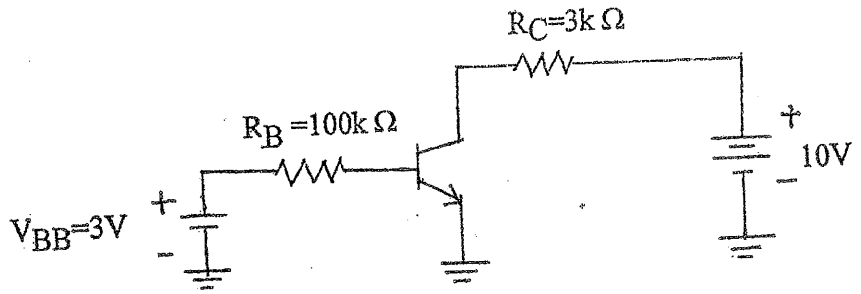
Subject: - Electronic Devices and Circuits *(EX 501)*

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

1. A diode conducts 1mA at 20°C. If it is operated at 100°C, What will be its current? Given data are $\eta = 1.6$ and negative temperature coefficient value = -2.2mV/°C. [6]
2. Determine the range of values of Vi that will maintain the Zener diode of the figure below in ON state. [6]

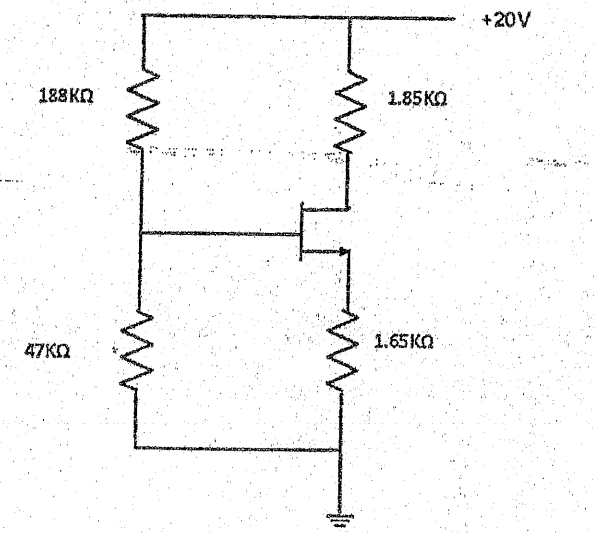


3. Draw the small signal model of CE amplifier and derive the expression for voltage gain and input resistance for CE amplifier using emitter bypass capacitor. [2+3+3]
4. Explain Transistor as a Switch in cutoff and saturation region. [4]
5. Determine the dc collector current I_{CQ} and collector emitter voltage V_{CEQ} for the following circuit. Given B = 100. [4]



6. Describe the construction and working principle of n-channel Enhancement MOSFET with the help of necessary diagram and characteristics curve. [8]

7. The n-channel JFET in the figure below has I_{DSS} = 18mA and Vp = -5V. Determine the values of I_D and V_{DS}. [8]



8. How can we solve the cross-over distortion in Class B amplifier? Calculate the general efficiency of class B push-pull Amplifier. [2+4]
9. Explain the classIfication of amplifiers according to operating region. [4]
10. Draw the circuit diagram of LRC class A tuned amplifier and its frequency response graph. And show that Bandwidth = 1/RC. [3+3]
11. Explain the working principle of RC phase shift oscillator with necessary expressions and circuit diagram. [6]
12. Draw the circuit diagram of precision rectifier circuit. [2]
13. Describe the working of transistor series voltage regulator with current limiting circuit. [7]
14. Design a voltage regulator to give output voltage from 7V to 21V using LM317. [5]

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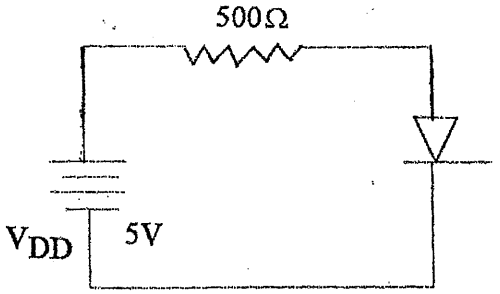
TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2080 Baishakh

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

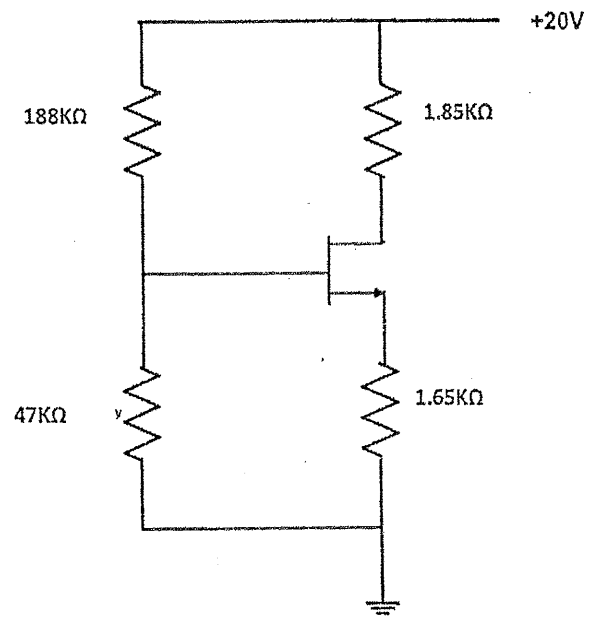
Subject: - Electronic Devices and Circuits *(EX 501)*

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

1. What is Zener breakdown? Describe the Zener diode as a voltage regulator with circuit diagram and IV characteristic curve. [5]
2. In the given circuit the diode used has its $\eta = 1.74$ and it conducts 1mA at forward bias voltage of 0.7 V. Find the current flow in the circuit. [5]



3. Design CC amplifier using β independent voltage divider biasing circuit using appropriate guideline. Given: $V_{CC} = 20V$, $I_{CQ} = 2mA$ and $\beta = 100$. Use firm biasing. Derive its voltage gain. [8+2]
4. Draw Hybrid π and T model. Derive the relationship between r_π and r_e. [3+3]
5. Describe the construction and working principle of EMOSFET with the help of drain characteristics curve and mathematical expressions. [8]
6. Find the drain current(I_D) and drain to source voltage (V_{DS}) for the following circuit. Given parameters are : $V_t = 1$ V and $k = 0.5mA/V^2$. [8]



7. Draw the circuit diagram of transformer coupled class B push- pull amplifier. And show that the maximum efficiency is 25π %. [2+4]
8. What are the applications of tuned amplifiers? Determine its 3 dB Bandwidth, Resonance frequency and Quality factor. [2+6]
9. Explain the operation of RC Phase shift oscillator and derive the condition for the sustained oscillation. [3+4]
10. Draw the circuit diagram of colpitts oscillator. Derive its frequency of oscillation. [2+4]
11. Describe the band gap voltage reference source with the help of a relevant circuit. Compare band gap voltage reference source with Zener diode. [4+2]
12. Design a voltage regulator to give output voltage from 7 V to 21 V using LM317. [5]

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TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division

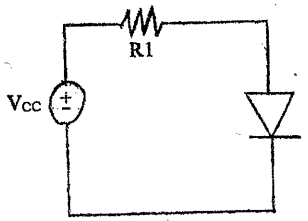
2079 Bhadra

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

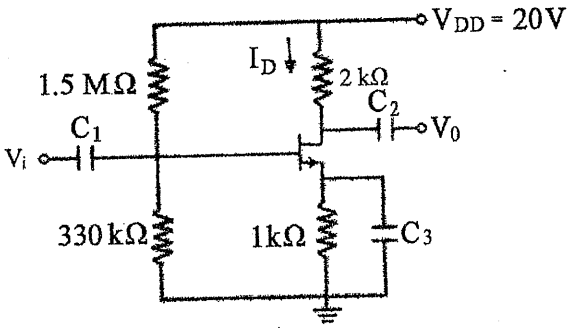
Subject: - Electronic Devices and Circuits *(EX 501)*

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

1. What is Dc load line? Find operating point for the diode circuit graphically using load line method. [1+4]
2. In the circuit given below the DC power supply V_{CC} = 10 V is superimposed with 60 Hz sinusoid of 1 V peak to peak amplitude. Calculate the amplitude of the sine wave signal appearing across the diode for the case R1 = 10 KΩ. Assume the constant voltage drop of 0.7 V in the diode. [5]



3. Why voltage divider biasing called β independent? Design common emitter Amplifier using β independent dc biasing method with appropriate guideline. Given parameters: V_{CC} = 24 VDC, I_C = 1.5 mA, β = 150. [1+4+2+2]
4. What is the significance of bypass capacitor in CE amplifier? Draw the small signal model of voltage divider bias for emitter bypassed capacitor CE amplifier circuit and find its input impedance, output impedance and voltage gain. [2+6]
5. Explain construction and working principle of N channel Depletion type MOSFET with the help of drain characteristics and transfer characteristics. [8]
6. Find I_D and V_{DS} for the given circuit. Given data are V_P = - 5.5 V, I_{DSS} = 10 mA and assume all the capacitors are ideal and check whether transistor is operating in pinch off region or not? [8]



7. Draw the circuit diagram of class B push-pull amplifier. Derive its general efficiency and maximum efficiency. [8]
8. Draw the circuit diagram of class A series fed amplifier and its corresponding characteristic graph. And, find its general efficiency. [3+4]
9. Draw the circuit diagram of op-amp Wein Bridge oscillator. Derive its frequency of oscillation. [2+4]
10. Draw the circuit diagram of Hartley oscillator. Derive its frequency of oscillation. [6]
11. Design DC voltage regulator using LM 317 to get 6-15V output. [6]
12. Draw standard series DC voltage regulator circuit and find its voltage stability factor (S_v). [4]

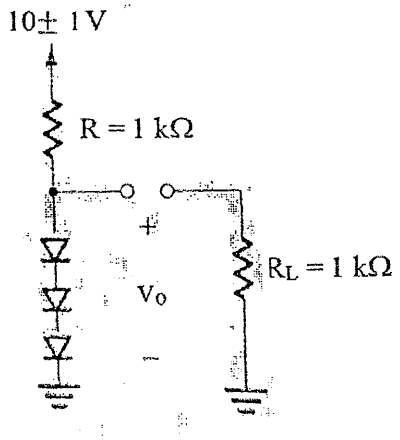
TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2079 Baishakh

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

Subject: - Electronics Devices and Circuits (*EX 501*)

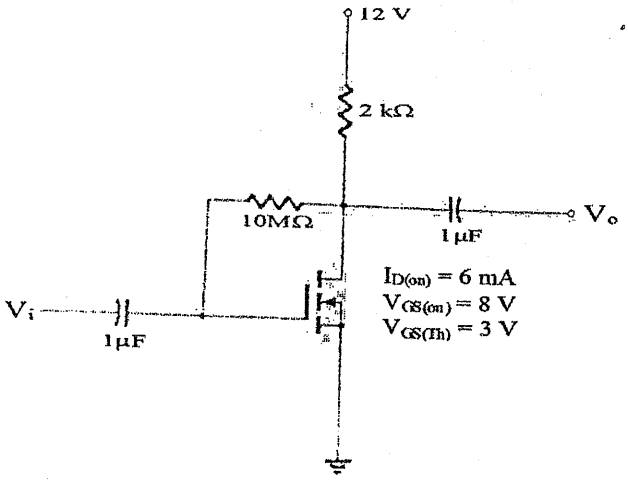
- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Assume suitable data if necessary.*

1. A string of three diodes is used to provide a constant voltage of about 2.1 v. Calculate the change in this regulated voltage caused by (i) a ±10% change in the power supply voltage; (ii) connection of a 1K Ω load resistance. Assume η = 2. [3+2]



2. A zener diode exhibits a constant voltage of 5.6 V for currents greater than five times the knee current. I_{zk} is specified to be 1mA. The zener is to be used in the design of a shunt regulator fed from a 15V supply. The load current varies over the range of 0 mA to 15 mA. Find a suitable value for the resistor R. What is the maximum power dissipation of the zener diode? [3+2]
3. Design voltage divider CE amplifier (without emitter by pass capacitor). Given: Transistor BC 547B having β = 295, I_c = 1.5 mA and Vcc = +9V.
   a) Is this the best Q point? Why?
   b) Calculate its input impedance and voltage gain.
   c) What is the maximum peak voltage of the signal that can be applied to the input of this amplifier to ensure the transistor is always in active region? [5+2+3+2]
4. Draw Ebers- Moll (EM) model of BJT and write expression of collector current for active region. [5]

5. Find Q point and show it graphically. [6+2]



6. Explain the working of n channel DMOSFET with characteristics curves. Derive an expression for JFET transconductance. [6+3]
7. It is required to design a class B power Amplifier to deliver an average power of 20 W to an 8 Ω load. The power supply is to be selected such that Vcc is about 5 V greater than the peak output voltage. This avoide transistor saturation and associated nonlinear distortion, and allows for including short circuit protection circuitry. Determine the supply voltage required, the peak current drawn from each supply, the total supply power, and the power conversion efficiency. Also determine the maximum power that each transistor must be able to dissipate safely. [1+1+2+2]
8. Derive general efficiency of series fed Class A power amplifier. [6]
9. Explain the working principle of crystal oscillator with diagrams operating in both parallel and series resonance mode. [4+2+2]
10. State Barkhausen Criteria for sinusoidal oscillation. Is it possible to obtain 50% duty cycle square wave from 555 timer Astable Multivibrator? How? [2+3]
11. Explain the working of transistor series voltage regulator with current limiting element. [6]
12. Design variable DC voltage regulator using LM 317 to get (5-9) volts output. [5]

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TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division

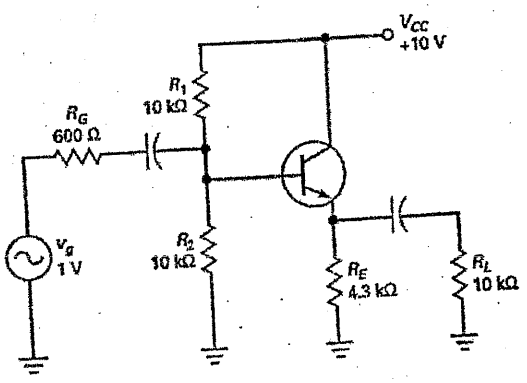
2078 Bhadra

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

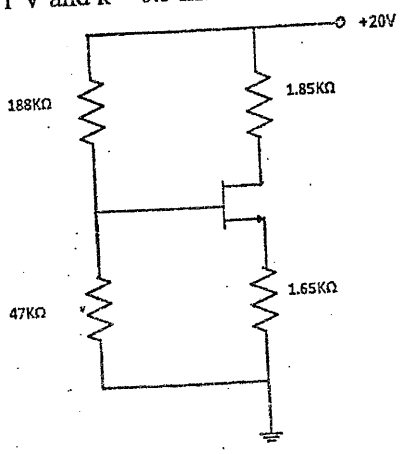
Subject: - Electronic Devices and Circuits *(EX 501)*

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

1. Explain the reverse break down region in zener diode. "Zener diode acts as a voltage reference element" Justify the statement from IV characteristic curve. [5]
2. A diode conducts 1mA at 20°C. If it is operated at 100°C, what will be its current? Given data are $\eta = 1.6$ and negative temperature coefficient value = -2.2 mV/°C. [5]
3. Show the importance of transistor bias stabilization. Design voltage divider bias (common collector configuration) to get $I_{CQ} = 1.5$ mA. Assume power supply voltage VCC = 15V and beta of transistor is 110. [3+5]
4. Why BJT is called bipolar and FET is called unipolar device? Derive mathematically the transconductance of MOSFET. [2+3]
5. The bipolar junction transistor parameters for the circuit in figure below are $\beta = 200$ and $V_A = \infty$. Determine the input resistance, output resistance and overall voltage gain of the circuit. [8]



6. Describe the physical structure of N-channel JFET and explain its working principal and characteristics clearly marking the various regions of operation. [2+6]
7. Find the drain current (I_D) and drain to source voltage (V_{DS}) for the following circuit. Given parameters are: $V_t = 1$ V and $k = 0.5$ mA/V^2. [8]



8. Draw the circuit diagram of transformer coupled class B push-pull amplifier stage. And find its maximum efficiency. Define cross over distortion in class B amplifier. [2+4+2]

9. Draw the circuit diagram of Quasi complementary-symmetry class AB amplifier using diodes. [3]

10. When are tuned amplifiers used? Draw the circuit diagram of class-A tuned amplifier and its frequency response graph. [2+3]

11. Draw Wien Bridge oscillator circuit and derive the expression for frequency of oscillation and gain of amplifier circuit. [1+3+2]

12. Describe the operation of precision half wave rectifier with circuit diagram. [4]

13. Why transistor series regulator has lower efficiency? Explain the operation of voltage regulator using band gap voltage reference. [2+5]

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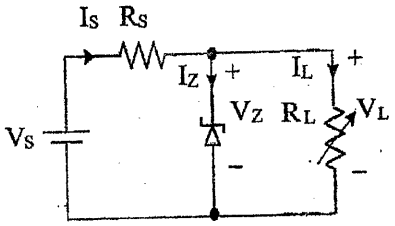
TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2078 Kartik

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

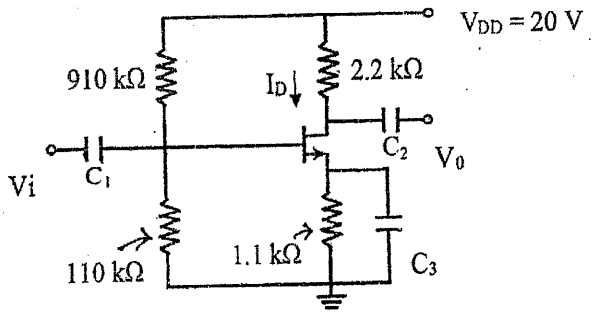
Subject: - Electronic Devices and Circuits *(EX 501)*

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

1. Explain the small signal model of PN junction diode and derive the expression for its dynamic resistance. [5]
2. Determine the Range of load R_L that will maintain the zener diode load voltage V_L at 5V. Given $V_S = 10$ V, $R_S = 100\ \Omega$, $I_{ZM} = 30$ mA. [5]



3. Design a voltage divider type dc biased CE amplifier to obtain β independent biasing. Use appropriate guidelines to support your design. Given $V_{CC} = 12$ V DC, $I_C = 2$mA and $\beta = 150$. [7]
4. Derive the expression for R_{in}, R_{out}, A_v and A_i in CE capacitor bypassed amplifier. [8]
5. Describe the construction and working principle of EMOSFET with the help of drain characteristics curve and mathematical expressions. [8]
6. Find I_D and V_{DS} for the given circuit. Given data are $V_P = -3.5$V, $I_{DSS} = 10$ mA and assume all the capacitors are ideal and check whether transistor is operating in pinch off region or not? [7]



7. Draw the circuit diagram of transformer coupled class B push-pull amplifier and show that the maximum efficiency is 25π %. [7]
8. When are tuned amplifiers used? Draw class A tuned amplifier circuit and find its 3 dB bandwidth. [7]
9. Explain working of RC phase shift oscillators and derive the frequency of its oscillation. [6]
10. Draw standard series DC voltage regulator circuit and find its voltage stability factor (Sv). [6]
11. Design a voltage regulator to give output voltage from 7V to 21V using LM317. [5]
12. Write short notes on: [3×3]
    a) Ebers Moll model
    b) Transconductance of JFET
    c) Crossover distortion

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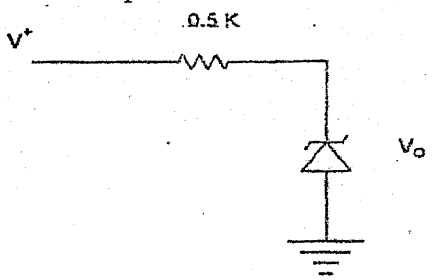
TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2076 Chaitra

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

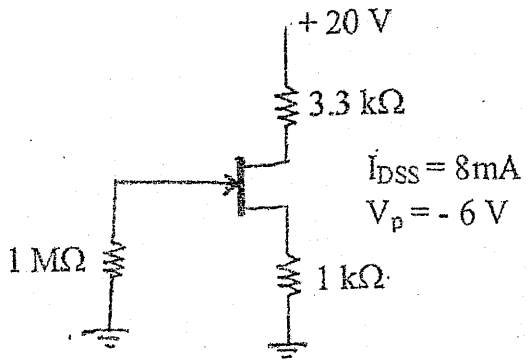
Subject: - Electronic Devices and Circuits *(EX 501)*

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

1. Define Q-point in pn junction diode operation. Show it graphically with necessary derivations. Differentiate between avalanche and zener break down. [3+2]
2. The 6.8 V zener diode is specified to have V_Z = 6.8 V at I_Z = 5 mA, r_Z = 20Ω and I_{ZK} = 0.2 mA. The supply voltage V^+ is nominally 10V but can vary by ± 1V. Find V_0 with no load and with V^+ at its nominal value. Find the change in V_0 resulting from connecting a load resistance RL that draws a current I_L = 1 mA. What is the minimum value of R_L for which the diode still operates in the breakdown region? [2+1+2]



3. Design β independent type dc biased common collector amplifier, and find its current gain and input resistance. Given parameters: V_{CC} = 20 VDC, I_C = 2mA and β = 100 and use firm biasing method. [8]
4. Draw common emitter transistor amplifier circuit (emitter bias with unbypassed emitter capacitor) and find its output impedance and voltage gain. Write application of common base amplifier. [4+3+1]
5. Describe the working principle of N-channel Depletion type MOSFET with the help of I_D V_S V_{DS} characteristics and transfer characteristics curves. Find the condition and expression for it to operate in active mode of operation and write the expression for drain current. [5+2+1]
6. Write about JFET as a voltage controlled resistor with practical application. [4]
7. Find I_{DQ} and V_{GSQ} from the following circuit. [5]



8. Draw the circuit diagram of class A series fed amplifier and its corresponding characteristic graph. And, find its general efficiency. [3+3]
9. Draw the circuit diagram of Complementary-Symmetry class-AB amplifier using Darlington pair transistors. [3]
10. Describe about tuned amplifier and derive the expression for the 3dB bandwidth of the amplifier. [5]
11. Differentiate between synchronous and stagger turned amplifier. [3]
12. Draw voltage controlled oscillator circuit using IC 555 and derive expression for frequency of oscillation. [6]
13. Among Hartley and Colpitts LC oscillator, which one do you choose to implement in FM stations to generate carrier wave signal? Why? Draw its circuit diagram. [5]
14. Draw the standard series DC voltage regulator circuit and find its voltage stability factor(S_v). [5]
15. Design a 5V to 20V variable dc voltage regulator using IC LM317. [4]

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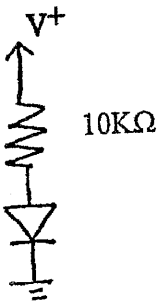
TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2076 Ashwin

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

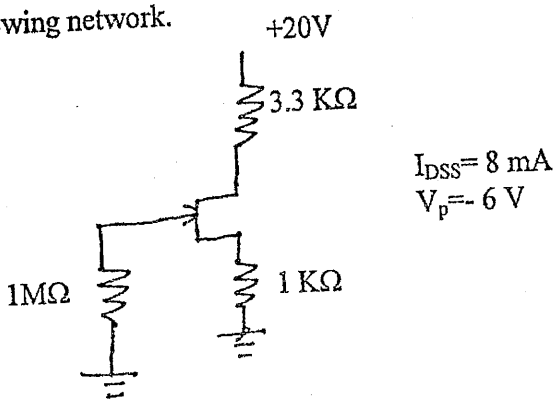
Subject: - Electronic Devices and Circuits *(EX 501)*

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

1. Differentiate between avalanche and zener breakdown. Draw V-I characteristic curve of zener diode and briefly explain about it. [3+2]
2. In the given circuit, the power supply V^+ has a dc value of 10V on which is super imposed a 50 Hz sinusoid of 1V peak amplitude. Calculate both the dc voltage of the diode and amplitude of the sine-wave signal appearing across it. Assume the diode to have a 0.7V at 1 mA current and η=2. [5]



3. Design β independent type of dc biased common collector amplifier, and find its voltage gain and input resistance. Given parameters: V_{cc}= 20 VDC, I_c=2mA and β=100 and use firm biasing method. [8]
4. Describe in brief the operation of BJT as a switch in cut off and saturation region. [4]
5. Explain about working principle of N-channel DMOSFET with its construction, characteristics curves and characteristic equation. [7]
6. For the faithful amplification of signal, selection of operating point is utmost importance. Justify the above statement. Derive transconductance of bipolar junction transistor. [3+4]
7. Determine Q point for the following network. [7]



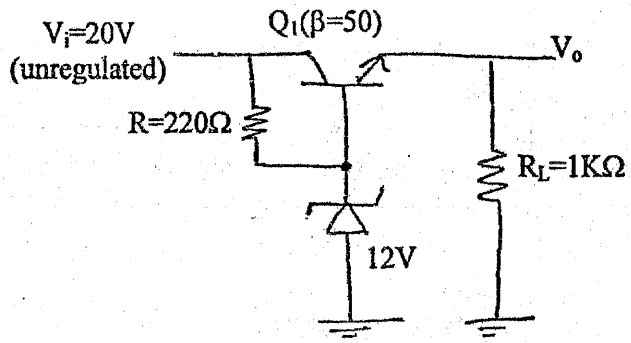
8. Draw the circuit diagram of the Hartley Oscillator and derive its frequency of oscillation. [6]

9. Draw the circuit diagram of class A series fed amplifier and its corresponding characteristics graph. And find its general efficiency. [3+3]

10. Explain about the operation of voltage controlled oscillator (VCO) using 555 timer IC and derive its frequency of oscillation. [8]

11. Draw the circuit diagram of Complementary-Symmetry Class-AB amplifier using Darlington pair transistors. [3]

12. Calculate the output voltage and the zener current in the regular circuit as shown in figure below for R_L=1 KΩ and R=220Ω. V_Z=12V. [5]



13. Draw series voltage regulator with current limiting circuit and explain how this protection circuit works? [6]

14. Briefly explain about Precision half wave rectifier with circuit diagram. [3]

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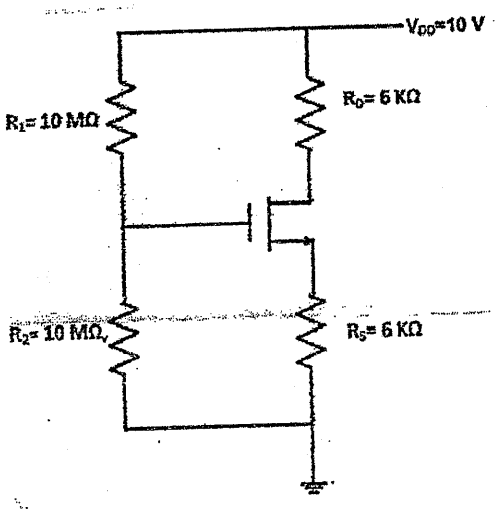
TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2075 Chaitra

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

Subject: - Electronic Devices and Circuits *(EX 501)*

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

1. Find the operating point of the diode circuit graphically using load line method. [5]
2. Design DC voltage regulator for 6V output. Given data are V_Z=6V at I_Z=20mA, I_{ZK}=2mA, P_{Zmax}=500mW and rz=10Ω. The nominal input voltage is 15V+30% DC. Find the maximum current it can deliver to the load. [5]
3. Design a common base amplifier circuit using β independent method. Given parameters are V_{CC}=15V, I_E=1.5mA, β=100 and input and output impedances are comparatively large. Use appropriate guideline to support your design. [7]
4. Why common collector amplifier is known as emitter follower? Draw its ac equivalent circuit to find its input resistance and voltage gain. [1+6]
5. Draw and describe the Ebers Moll model for BJT. [4]
6. Draw the cirucuit diagram of the Colpitts Oscillator and derive its frequency of Oscillation. [6]
7. Find the drain current (I_D) and drain to source voltage (V_{DS}) for the following circuit. Given parameters are: V_t=1 V and k=0.5 mA/V^2. [7]



8. Describe the construction and working principal of N-channel JFET with the help of characteristics curve and mathematical expression. [7]

9. Define crossover distortion in class B amplifier. Draw quasi-complementary symmetry class AB amplifier. And explain how crossover distortion is eliminated in class AB amplifier. [7]

10. Draw the circuit diagram of Class A tuned amplifier and determine the range of frequency in which it gives maximum gain within 3 dB range? [6]

11. Design a DC voltage regulator for 3V to 12V output using LM317. [5]

12. Define the term multivibrator. Explain the operation of op-amp based astable multivibrator for square wave with the help of circuit diagram and waveforms and also determine its frequency of oscillation. [8]

13. Draw the standard series DC voltage regulator circuit and find its voltage stability factor(S_v). [6]

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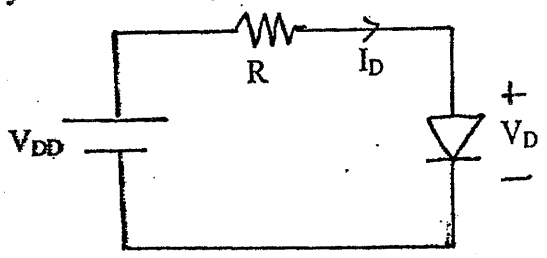
16 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2075 Ashwin

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

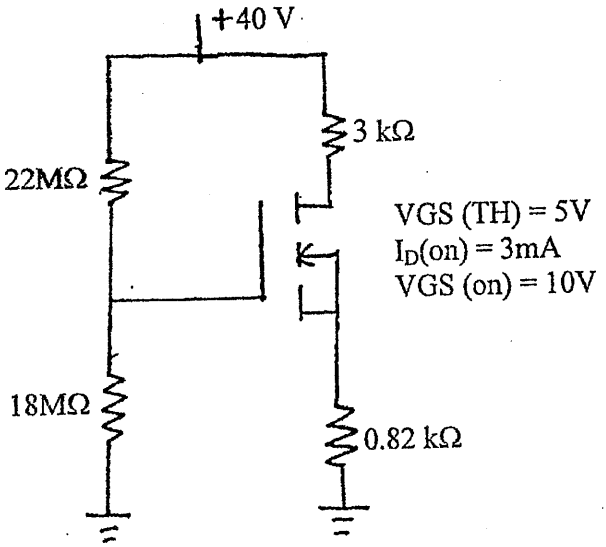
Subject: - Electronic Devices and Circuits *(EX501)*

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

1. Derive the **expression** for dynamic resistance of pn junction diode. [5]
2. Determine **the current** I_D and the diode voltage V_D with V_{DD}=5 V and R= 1KΩ. Assume that the **diode has a** current of 1 mA at a voltage of 0.7 V and that its voltage drop changes by **0.1 V for** every decade change in current. [5]



3. Design **voltage divider** biased common emitter BJT amplifier to get voltage gain of -90. Assume β= **100 and** Vcc=+12V. [8]
4. Derive **input impedance,** output impedance and voltage gain of common collector BJT amplifier . [8]
5. Explain the **construction** and operation of E-MOSFET with characteristics curve and mathematical **expression.** [7]
6. Derive **mathematical** definition of JEFET transconductance. [4]
7. Find I_{DQ} and V_{DSQ} from the following circuit. Show Q point graphically. [5+3]



8. Derive general efficiency of class B amplifier. [5]
9. Draw the circuit diagram of Darlington complementary-symmetry class AB amplifier using diodes. [3]
10. Derive maximum efficiency of transformer coupled class A amplifier. [5]
11. Draw astable multivibrator circuit using IC 555 and derive expression for frequency of oscillation. [6]
12. Explain working principle of RC phase shift oscillator with necessary expressions and circuit diagram. [6]
13. Explain the operation of voltage regulator using band gap voltage reference. [6]
14. Design a (5-15)V variable dc voltage regulator using LM 317 IC. [4]

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16 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2074 Chaitra

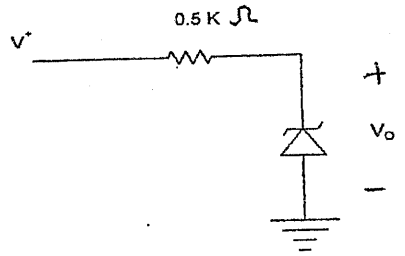
Exam.	Regular		
Level	BE	Full Marks	80
Programme	BEL, BEX, BCT	Pass Marks	32
Year / Part	II / I	Time	3 hrs.

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

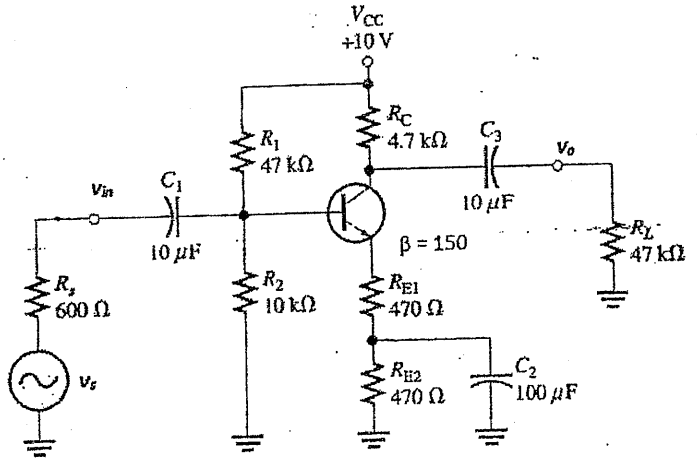
- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Assume suitable data if necessary.*

1. The leakage current of a silicon diode is $I_S = 10^{-9}$ A at 25°C, and the emission coefficient is $\eta = 1.6$. The operating junction temperature is $T_j = 60°C$. Determine (i) the leakage current I_S and (ii) the diode current I_D at $V_D = 0.8$ V. [4]

2. The 6.8V zener diode is specified to have Vz = 6.8 V at Iz = 5 mA, $r_z = 20\ \Omega$ and $I_{zk} = 0.2$ mA. The supply Voltage V^+ is nominally 10 V but can vary by ± 1V. Find V_0 with no load and with V^+ at its nominal value. Find the change in V_0 resulting from connecting a load resistance R_L that draws a current $I_L = 1$ mA. What is the minimum value of R_L for which the diode still operates in the breakdown region? [2+2+2]



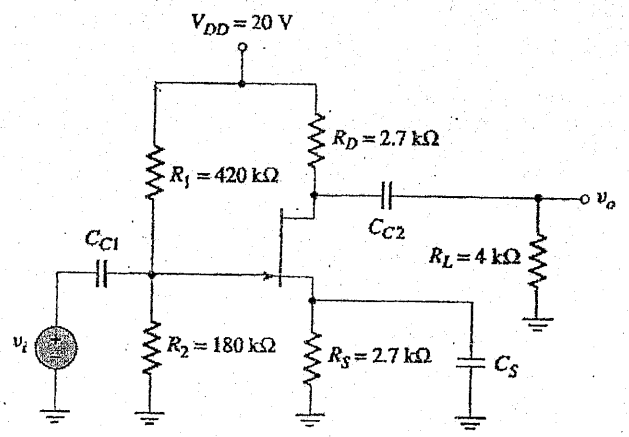
3. Determine the input resistance, output resistance and overall voltage gain of the circuit given below: [8]



4. Find terminal currents of BJT using Ebers-Moll Model. Write applications of different BJT configurations. [5+3]

5. Explain the construction and operation of D-MOSFET with characteristics curve and mathematical expression. [8]

6. Find the DC operating point of JFET circuit given below. Given parameters I_{DSS} = 12 mA and V_P = -4V. [8]



7. Derive maximum efficiency of series fed class A amplifier. [6]
8. Derive bandwidth of tuned amplifier. Write its applications. [6]
9. For a class B amplifier providing a 14V peak signal to 16 Ω load and a power supply of V_{cc} = 24V, determine input power, output power and circuit efficiency. [4]
10. Draw voltage controlled oscillator circuit using IC 555 and derive expression for frequency of oscillation. [6]
11. Draw the circuit diagram of half wave precision rectifier and explain the operation. [4]
12. Define voltage regulator. Explain the series voltage regulator with current limiting element. [1+5]
13. Explain working principle of WIEN BRIDGE oscillator with necessary expressions and circuit diagram. [6]

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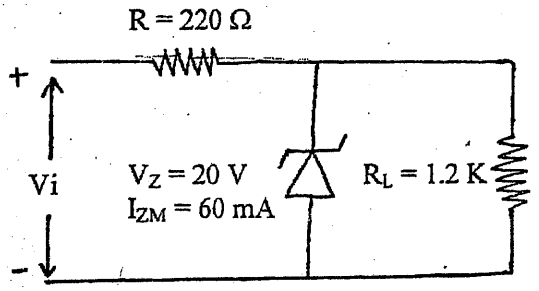
26 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2074 Ashwin

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

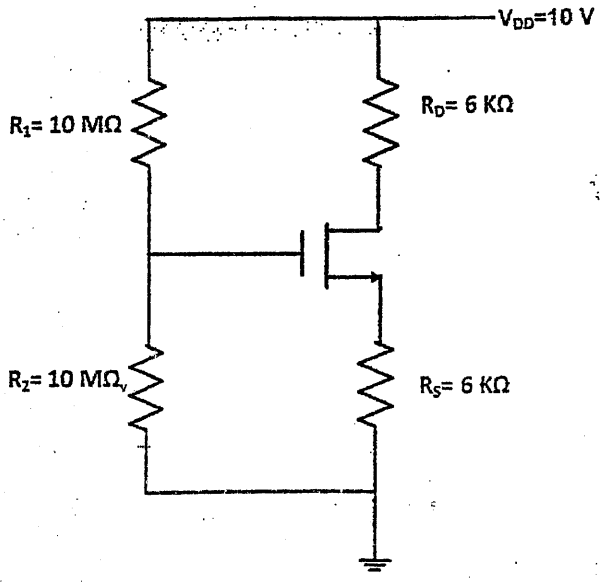
Subject: - Electronic Device and Circuits *(EX501)*

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

1. Explain the small signal model of PN junction diode and drive its dynamic resistance. [2+4]
2. Determine the range of values of V_i that will maintain the Zener diode of figure below in ON state. [5]



3. Design β independent type DC biased common emitter amplifier with emitter resistance bypassed and find its voltage gain and input resistance. Given parameters V_{cc} = 24, I_C = 2 mA, β = 90. Use appropriate guideline to have high input resistance. [8]
4. Describe in brief the operation of BJT as a switch in cut off and saturation region. [6]
5. Define transconductance (g_m). Derive g_m for BJT. [1+3]
6. Explain the construction and operation of N channel enhancement type MOSFET with the help of drain characteristics and transfer characteristics. [8]
7. Find the drain current (I_D) and drain to source voltage (V_{DS}) for the following circuit. Given parameters are: V_t = 1 V and k = 0.5mA/V^2. [6]



8. State the difference between BJT and FET. [2]
9. What is crossover distortion? Explain how it can be eliminated with necessary diagram. [2+4]
10. Draw the circuit diagram of tuned amplifier and derive the expression for the 3dB bandwidth of the amplifier. [6]
11. Define Barkhausen criteria for sinusoidal oscillation. Draw the circuit diagram of wien bridge oscillator and determine its frequency of oscillation. [2+6]
12. Describe Colpitt's oscillator with necessary circuit diagram. [5]
13. Draw the standard series DC voltage regulator circuit and find its voltage stability factor (S_V). [6]
14. Design a 3.7 to 9V variable dc voltage regulator using IC LM317. [4]

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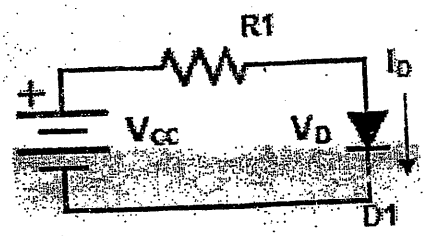
26 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2073 Chaitra

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

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

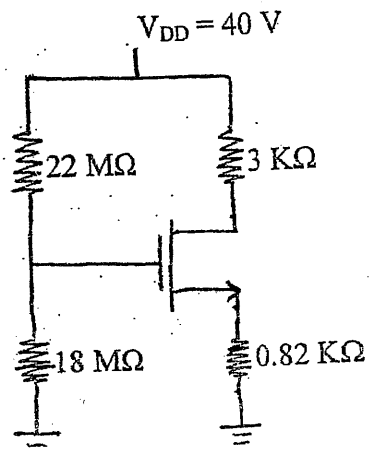
- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Scientific calculator is allowed.*
- ✓ *Assume suitable data if necessary.*

1. In the circuit given below, the DC power supply V_{cc} = 10 V is superimposed with 60 Hz sinusoid of 1 V_{pp} amplitude. Calculate the amplitude of the sine wave signal appearing across the diode for the case R1 = 10 KΩ. Assume the constant voltage drop of 0.7 V in the diode. [5]



2. Define and explain reverse breakdown effect. Describe how Zener diode works as a voltage regulator. [2+3]
3. Why voltage divider biasing is called β independent? Design CE amplifier using β independent dc biasing method with appropriate guideline. [3+5]

   Given: V_{CC} = 24 V, I_{BQ} = 10μA and β = 100
4. What is the significance of bypass capacitor in CE amplifier? Draw the small signal model for capacitor bypassed CE amplifier circuit and find its input impedance, output impedance and voltage gain. [2+6]
5. Describe the principle of operation of operation of N channel Depletion type MOSFET with the help of mathematical expression and drain characteristics graphs. [8]
6. Determine I_D and V_{DS} for the given circuit and find the region of its operation. Given: $k = 0.12mA/V^2$ and V_t = 5 V. [6+2]



7. Explain the operation of transformer coupled class B push-pull amplifier with the proper circuit diagram and characteristics curve. Also determine its maximum efficiency. [4+4]
8. Explain why class A amplifier is cooler with load than without load. [6]
9. State Barkhausen criteria. Draw the circuit diagram of RC phase shift oscillator and derive the expression for its frequency of oscillation. [2+5]
10. Describe the operation of precision half wave rectifier with circuit diagram. [5]
11. Describe the operation of a series voltage regulator with current limiting circuit. [7]
12. Design a 5.1 V to 12 V variable DC voltage regulator using IC LM 317. [5]

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TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division

2080 Bhadra

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

Subject: - Electromagnetics (*EX 503*)

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

1. Express a scaler potential field $V=x^2+2y^2+3z^2$ in spherical coordinates. Find the value of P at a point $(2,60^0,90^0)$. [4+1]
2. Derive the expression for an electric field intensity due to an infinite line charge using Gauss's Law. Find electric flux density at point P(6, 5, 4) due to a uniform line charge of 6nC/m at x = 4, y = 2, point charge 10nC at Q(3, 2, 4) and uniform surface charge density of 0.4nC/m^2 at x = 3. [3+5]
3. Two uniform charges 8 nC/m are located at x = 1, z = 2 and x = -1, y = 2 in free space respectively. If the potential at origin is 100 V. Find V at P (4, 1, 3). [6]
4. Derive Poisson Equation. Find the capacitance of parallel plate capacitor by solving Laplace equation with potential difference between the plates as V_o. [3+4]
5. Evaluate both sides of Stokes's theorem for the field $\vec{H} = 12\sin\theta\hat{a}_\phi$ and the surface $r=4, 0\le\theta\le 90°, 0\le\phi\le 90°$. Let the surface have the $\hat{a}_r$ direction [6]
6. Differentiate Scalar Magnetic Potential and Vector Magnetic Potential. Given magnetic vector potential $\vec{A} = -\frac{\rho^2}{4}\hat{a}_z$ Wb/m. Calculate the total magnetic flux crossing the surface $\phi = \frac{\pi}{2}, 1\le\rho\le 2, 0\le z\le 5$. [2+6]
7. List out point form of Maxwell's equations in phasor form for time varying case. Using these equations, derive the electric field component of a uniform plane wave travelling in the perfect dielectric medium. [2+6]
8. A 9.375 GHz uniform plane wave is propagating in polythene (ε_r=2.26, μ_r=1). If the amplitude of the electric field intensity is 500 V/m and the material is assumed to be lossless: Find the phase constant, wavelength, velocity of propagation and intrinsic impedance. [2+2+2+2]
9. Explain the term Skin Depth. Using Poynting Vector deduce the time- average power density for a perfect dielectric. [4+4]
10. A lossless 60 Ω line is 1.8λ long and is terminated with pure resistance of 80 Ω. The load voltage is $15\angle 30^0$ V.(i) Average power delivered to load (ii) Magnitude of minimum voltage on the line. [4+4]
11. What are the advantages of waveguides over transmission line? Consider a rectangular waveguide of dimension a=1.07 cm, b=0.43 cm. Find the cutoff frequency for TM_{11} mode. (E_r=2, $\mu=\mu_0$) [2+4]
12. Write short notes about antenna and its parameters. [2]

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DIVERGENCE

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

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

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

GRADIENT

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

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

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

CURL

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

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

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

LAPLACIAN

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

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

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

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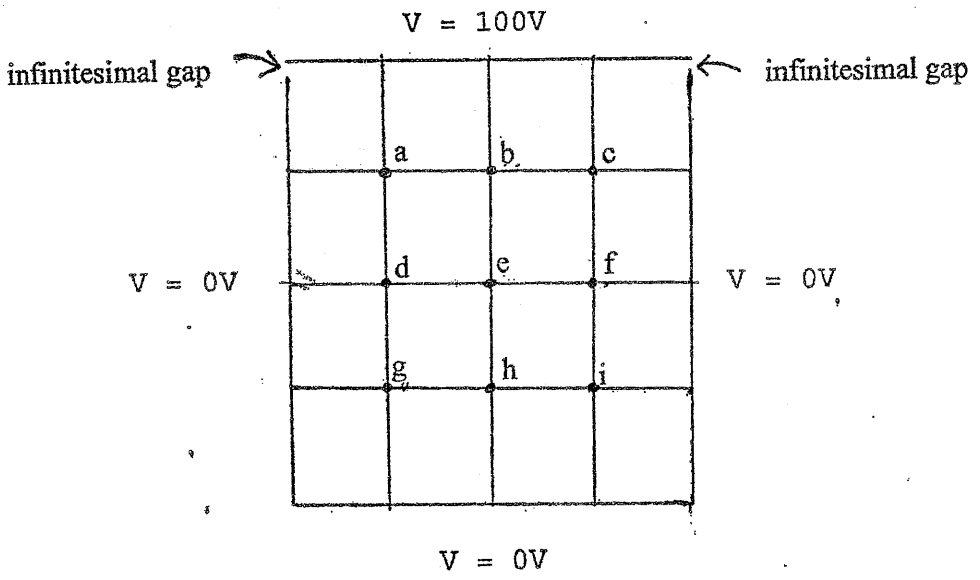
2081 Baishakh

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

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

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

1. The Magnetic field Intensity in a certain region is given as $\vec{H} = 20\hat{a}_\rho - 10\hat{a}_\phi + 3\hat{a}_z A/m$. Transform this field vector into Cartesian co-ordinate at P(x=5, y=2, z=-1). [5]
2. A point charge of 6μc located at origin, uniform line charge density of 180nc/m lies along x-axis and uniform sheet charge of $25c/m^2$ lies on z=0 plane. Find $\vec{D}$ at point (1,2,4). [6]
3. Differentiate between divergence and gradient. Let $V = \frac{\cos 2\phi}{\rho}$ in free space.(i) Find the volume charge density at point A (0.5,60°,1). (ii) Find the surface charge density on a conductor surface passing through the point B(2,30°,1). [2+3+3]
4. Define curvilinear square method for calculating capacitance. A square grid shown in figure below within a given potential. Find the potential at point a, b, c, d, e, f, g, h and i using iteration method. Complete it using single iteration only. [4+4]



5. Justify the maxwell's equation: $\oint_S \vec{B}.d\vec{S} = 0$ with necessary remarks. Derive an expression of magnetic field intensity for an infinite filament carrying a direct current using vector magnetic potential. [2+6]

6. Define Biot savart's law. Let the permittivity be 5μH/m in region A where x<0, and 20μH/m in region B where x>0. If there is a surface current density , $\vec{K} = 150\hat{a}_y - 200\hat{a}_z A/m$ at $x = 0$ and if $\vec{H} = 300\hat{a}_x - 400\hat{a}_y + 500\hat{a}_z A/m$, find $|\vec{H}_{tA}|$, $|\vec{H}_{NA}|$, $|\vec{H}_{tB}|$ and $|\vec{H}_{NB}|$ [2+6]

7. Define poynting vector. Using this deduce the time average power density for a dissipative medium. [2+6]

8. A conductor with cross-sectional area of $10cm^2$ carries conduction current $\vec{J} = 0.2\sin 10^9 t\hat{a}_z mA$. Given that $\sigma = 2.5\times10^6 S/m$, and $\epsilon_r = 6$. Calculate the magnitude of the displacement current density. [5]

9. A uniform plane wave in free space is given by Magnetic field intensity $\vec{H}$ in phasor form as: $\vec{H}_s = 400\angle 30° e^{-j250z}\hat{a}_y A/m$ Find:
   a) Angular frequency (ω).
   b) Wavelength (λ) and intrinsic impedance (η).
   c) Electric field intensity $\vec{E}(x,y,z,t)$ at z=50mm and t= 4pS. [2+2+4]

10. The parameters of a certain transmission line operating at 6×10^8 rad/s are L = 0.4μH/m, C = 40pF/m, G = 80mS/m, and R = 20Ω/m. Find γ, λ and Z_0 (characteristic impedance). [3+3+2]

11. A standard air-filled rectangular waveguide with dimensions 8.636cm×4.318cm is fed by a 4GHz carrier from a coaxial cable. Determine if a TE_{10} mode will be propagating or not. [6]

12. What are the parameters of antenna? List out the types of Antenna. [2]

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

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

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

1. Transform the vector $\vec{A} = y\vec{a}_x - (x+y)\vec{a}_y + z\vec{a}_z$ at point P (-3,4,5) in cylindrical coordinate system. [5]

2. Define electric flux density. Given the field $\vec{D} = \frac{20}{\rho^2}(-\sin^2\phi\hat{a}_\rho + \sin 2\phi\hat{a}_\phi)$, evaluate both sides of the divergence theorem for the region bounded by $1 < \rho < 2, 0 < \phi < 90°, 0 < z < 1$. [1+7]

3. State Divergence's Theorem. A current density in certain region is given as $\vec{j} = \frac{400\sin\theta.\vec{ar}}{r^2} A/m^2$.

   Find the total current flowing through that portion of the spherical surface r = 0.8 bounded by $0.1\pi < \theta < 0.3\pi, 0 < \phi < 2\pi$. [2+6]

4. Find the equation for Energy Density in the electrostatic field. [7]

5. Define curl. Evaluate both side of Stoke's Theorem for $\vec{H} = 8z\vec{a}_x - 4x^3\vec{a}_z A/m$ and rectangular path P(2,3,4) to Q(4,3,4) to R (2,3,1) to S(2,3,1) to P. [1+7]

6. State Biot-Savart's law. A filamentary current of 10A is directed in from infinity to the orgin on the positive x-axis and then block out to infinity along the positive z-axis. Use the Biot-Savart's law to determine $\vec{H}$ at P(0,1,0). [2+6]

7. State Faraday's law of electromagnetic induction. Explain motional induction and transformer induction with necessary expressions. [1+3+3]

8. Derive an expression for electric field and magnetic field for a uniform plane wave propagating in a free space. [7]

9. Determine skin depth, propagation constant and velocity of wave at 1 MHz in good conductor with conductivity of 1.9×10^7 mho per meter. [2+2+2]

10. A 200Ω transmission line is lossless, 0.25 λ long and is terminated in Z_L = 400Ω. The line has the generator with 80 < 0° V in series with 100Ω connected to the input. (a) Find the load voltage (b) Find the voltage at the midpoint of the line. [4+4]

11. Explain the different modes of propagation supported by waveguides. A rectangular waveguide has a cross-section of 2.5 cm × 1.2 cm. Determine if the signal of 5 GHz propagates in the dominant mode. [2+4]

12. What are the parameters of antenna? List out the types of Antenna. [2]

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Divergence

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

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

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

Gradient

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

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

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

Curl

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

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

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

Laplacian:

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

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

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

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

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

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

1. Transform the vector $\vec{F}$ into the cylindrical co-ordinate system.
$\vec{F} = 10\vec{a_x} - 8\vec{a_y} + 6\vec{a_z}$ at point P(x = 10, y = -8, z = 6) [5]

2. Define electric dipole moment. Two uniform line charges, 8 nC/m each, are located at x = 1, z = 2 and at x = -1, y = 2 in free space. If the potential at the origin is 100 V, find V at P(4, 1, 3). [2+6]

3. State Gauss's Law. The region y < 0 contains a dielectric material for which $\varepsilon_{r1} = 2.5$, while the region y > 0 is characterized by $\varepsilon_{r2} = 4$. Let $\vec{E}_1 = -30\hat{a}_x + 50\hat{a}_y + 70\hat{a}_z \text{ V/m}$, find the electric field intensities, flux densities in region 2 and the angle θ_1, which is the angle made by normal component of $\vec{E}$ or $\vec{D}$ with total $\vec{E}$ or $\vec{D}$. [2+3+2+1]

4. Derive Poisson's equation. Assuming that the potential V in the cylindrical coordinate system is the function of ρ only, solve the Laplacian equation by integration method and derive the expression for the capacitance of co-axial capacitor using the same solution of V. [2+5]

5. State Stoke's theorem. Evaluate both sides of Stroke's theorem for the field $\vec{H} = 8xy\hat{a}_x - 5y^2\hat{a}_y \text{A/m}$ and the rectangular path around the region $2 \le x \le 5, -1 \le y \le 1, z = 0$. Let the positive direction of $\vec{dS}$ be $\hat{a}_z$. [1+7]

6. Define Ampere's Circuital law. Determine H at $P_2(0.4, 0.3, 0)$ in the field of an 8 A filamentary current directed inward from infinity to the origin on the positive x axis, and then outward to infinity along the y axis. [2+6]

7. Explain motional induction with necessary derivations. Correct the equation $\nabla \times \vec{H} = \vec{J}$ with necessary arguments and derivation for time varying fields. [3+4]

8. Derive the expression for electric and magnetic fields for a uniform plane wave propagating in a dissipative medium. [4+3]

9. A uniform plane wave in free space is given by $\vec{H}_S = (250\angle 30°)e^{-j350Z}\hat{a}_x \text{ V/m}$. Determine phase constant, frequency of the wave, intrinsic impedance, $\vec{E}_S$ at z = 25 mm and t = 4ps. [1+2+1+2]

10. Define the secondary parameters of a transmission line. A lossless transmission line with Zo = 50 ohm has a length of 0.4λ. The operating frequency is 300 MHz and it is terminated with a load $Z_L = 40 + j30$. Find: [2+1+2+3]
    a) Reflection Coefficient
    b) Standing wave ratio on the line (SWR)
    c) Input impedance (Zin)

11. Differentiate between TE and TM modes. Consider a rectangular waveguide with $\varepsilon_r = 4$, $\mu = \mu_0$ with dimensions a = 2.08 cm, b = 0.54 cm. Find the cutoff frequency for TM_{11} mode and the dominant mode. [3+3]

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

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Divergence

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

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

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

Gradient

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

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

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

Curl

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

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

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

Laplacian:

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

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

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

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

Subject: - Electromagnetics (*EX 503*)

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

1. Express the vector field $A = (x\text{-}y)\, a_y$ in cylindrical and spherical coordinate systems. [5]
2. Find the total charge inside the volume indicated:

$$\rho_v = 4xyz^2,\ 0 \le \rho \le 2,\ 0 \le \phi \le \frac{\pi}{2},\ 0 \le z \le 3.$$ [4]

3. Obtain the equation of the streamline that passes through the point P (-2,7,10) in the field:

$$\vec{E} = 2(y-1)\hat{a}_x + 2x\,\hat{a}_y.$$ [4]

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

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

   a) Angular frequency (ω)
   b) Wavelength (λ) and intrinsic impedance (η)
   c) Magnetic field intensity $\vec{H}(x,y,z,t)$ at $z = 8$ mm and $t = 6$pS. [2+2+4]

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

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

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

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

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2078 Bhadra

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

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

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

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

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Divergence

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

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

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

Gradient

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

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

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

Curl

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

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

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

Laplacian:

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

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

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

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2078 Kartik

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

Subject: - Electromagnetics *(EX 503)*

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

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

10. A 50 Ω lossless transmission line is 0.4 λ long. The line is terminated with a load $Z_L = 40 + j30\ \Omega$. If the operating frequency is 300 MHz, find [2+2+4]
    a) reflection coefficient (Γ)
    b) standing wave ratio (s) and
    c) input impedance (Z_m)

11. Explain why TEM wave doesn't exist in a rectangular waveguide? A rectangular waveguide has dimensions a = 1 cm, b = 2 cm. The medium within the waveguides has $\varepsilon_r = 1$, $\mu_r = 1$, $\sigma = 1$. Find whether or not the signal with the frequency of 500 MHz will be transmitted in the $TE_{1,0}$ mode. [2+4]

12. What are the parameters of antenna? List out the different types of antenna you have studied. [1+1]

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Divergence

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

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

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

Gradient

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

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

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

Curl

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

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

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

Laplacian:

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

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

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

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Examination Control Division
2076 Chaitra

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

Subject: - Electromagnetics *(EX 503)*

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

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

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

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

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

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

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

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

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

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

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

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Examination Control Division
2076 Ashwin

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

Subject: - Electromagnetics *(EX 503)*

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

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

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2075 Chaitra

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

Subject: - Electromagnetics *(EX 503)*

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

1. Find the vector that extends from A(-3,-4,6) to B(-5,2,-8) and express it in cylindrical coordinate system. [1+4]
2. A point charge of 12nC is located at the origin. Four uniform line charges are located in the x=0 plane as follow: 80nc/m at y=-1 and -5m, -50 nC/m at y=-2 and -4 m. Find the electric flux density **D** at P(0,-3,2). [7]
3. Let the region z<0 be composed of a uniform dielectric material for which $\varepsilon_{R1}=3.2$, while the region z>0 is characterized by $\varepsilon_{R2}=2$. Let $\mathbf{D_1}=-30\mathbf{a_x}+50\mathbf{a_y}+70\mathbf{a_z}$ nC/m^2 and find:- [7]
   a) $\mathbf{D_{t1}}$ (Tangential component of **D** in Region 1);
   b) Polarization ($\mathbf{P_1}$);
   c) $\mathbf{E_{n2}}$ (Normal component of **E** in Region 2)
   d) $\mathbf{E_{t2}}$ (Tangential component of **E** in Region 2)
4. Derive the Possion's and Laplace's equations. Assuming that the potential V in the cylindrical coordinate system is the function of 'r' only, solve the Laplace's equation by Integration Method an derive the expression for the capacitance of the Spherical Capacitor using the same solution of V. [2+5]
5. Derive the equation for magnetic field intensity in different regions due to a co-axial cable carrying a uniformly distributed dc current I in the inner conductor and –I in the outer conductor. [6]
6. Find the vector magnetic field intensity **H** in Cartesian coordinate at P(-1.5, -4, 3) caused by a current filament of 12A in the $\mathbf{a_z}$ direction on the z-axis and extending from z=-3 to z=3. [6]
7. Define Curl and give the physical interpretation of the Curl with a suitable example. [1+3]
8. A uniform plane wave in free space is propagating in the $-\mathbf{a_y}$ direction at a frequency of 5 MHz. If $\mathbf{E}=200\cos(\omega t+\beta y)\,\mathbf{a_z}$ V/m, write the expressions for electric and magnetic fields, i.e., $\mathbf{E_s}(x,y,z)$ and $\mathbf{H_s}(x,y,z)$ respectively in phasor forms. [3+5]
9. Derive an expression for Standing Wave Ratio (SWR) indicating where on the z-axis you'll get the maximum and minimum value of electric field intensity E. Assume that the boundary is at z=0, the region z<0 is a perfect dielectricand the region z>0 may be of any material. [8]

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

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

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

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

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2075 Ashwin

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

Subject: - Electromagnetics *(EX503)*

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

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

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

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

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

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

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

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

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

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

10. The velocity of propagation in a lossless transmission line 2.5×10^8 m/s. If the capacitance of the line is 30 pf/m, find: [2+2+2+2]
    a) Inductance of the line
    b) Characteristic impedance
    c) Phase constant at 100 MHZ
    d) Reflection coefficient if the line is terminated with a resistive load of 50Ω
11. What are the advantages of waveguides over transmission lines? A rectangular waveguide has a cross-section of 2.5 cm × 1.2 cm. Find the cut-off frequencies at dominant mode and TE (1,1) [1+4]
12. Write short notes on: Antenna properties [2]

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INSTITUTE OF ENGINEERING
Examination Control Division
2074 Chaitra

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

Subject: - Electromagnetics *(EX503)*

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

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

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

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

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

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

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

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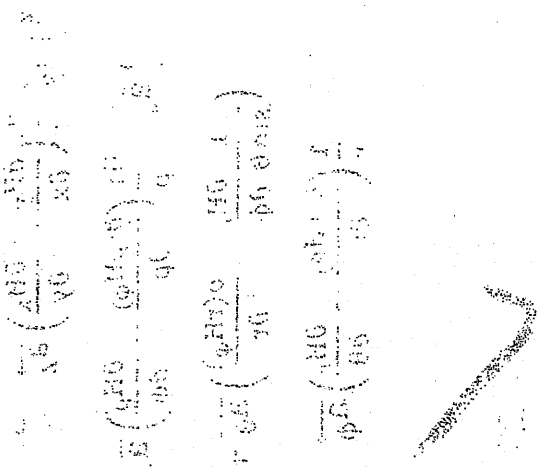

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22 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2074 Ashwin

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

Subject: - Electromagnetics *(EX503)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attemp* *t **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ ***Necessary formula is attached herewith.***

$\vec{A}$ represents a vector and $\vec{a}_{subscript}$ denotes a unit vector along the direction given by the subscript.

- ✓ *Assume suitable data if necessary.*

1. Convert the vector $\vec{F} = F_x \vec{a}_x + F_y \vec{a}_y + F_z \vec{a}_z$ to both spherical coordinate system. [5]
2. Find the electric field intensity in all three regions due to an infinite sheet parallel plate capacitor having surface charge density ρ_s c/m^2 and $-\rho_s$ c/m^2 and placed at y = 0 and y = b respectively. Let a uniform line charge density, 3 nC/m, at y = 3; uniform surface charge density, 0.2 nC/m^2 at x = 2. Find $\vec{E}$ at the origin. [4+4]
3. What is dipole? Derive the equation for potential and electric field due to dipole at a distant point P. [1+6]
4. Derive Poisson's equation. By solving Laplace's equation, find the capacitance of a parallel plate capacitor with potential difference between the plates equals V_0. [1+5]
5. Verify stoke's theorem for the field $\vec{H} = \left(\frac{3r^2}{\sin\theta}\right)\vec{a}_\theta + 54r\cos\theta\,\vec{a}_\phi$ A/m in free space for the conical surface defined by $\theta = 20°$, $0 \le \phi \le 2\pi$, $0 \le r \le 5$. Let the positive direction of $\vec{ds}$ be $\vec{a}_\theta$. [8]
6. Consider a boundary at z = 0 for which $\vec{B}_1 = 2\vec{a}_x - 3\vec{a}_y + \vec{a}_z$ mT, $\mu_1 = 4$ μH/m (z > 0), $\mu_2 = 7$ μH/m (z < 0) and $\vec{K} = 80\vec{a}_x$ A/m at z = 0. Find $\vec{B}_2$ [8]
7. Explain how Ampere's law conflict with continuity equation and how it is corrected? Derive conduction and displacement current in a capacitor. [4+3]
8. Derive the expression for electric and magnetic fields for a uniform plane wave propagating in a perfect dielectric medium. [5+3]
9. A 9.4 GHz uniform plane wave is propagating in a medium with $\epsilon_r = 2.25$ an $\mu_r = 1$. If the magnetic field intensity is 7 mA/m and the material is loss less, find [1+1+1+2+2]
   i) Velocity of propagation
   ii) The wave length
   iii) Phase constant
   iv) Intrinsic impedance
   v) Magnitude of electric field intensity

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

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

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

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DIVERGENCE

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

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

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

GRADIENT

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

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

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

CURL

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

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

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

LAPLACIAN

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

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

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

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INSTITUTE OF ENGINEERING
Examination Control Division
2073 Chaitra

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

Subject: - Electromagnetics *(EX503)*

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

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

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

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

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

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

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

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INSTITUTE OF ENGINEERING
Examination Control Division
2073 Shrawan

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

Subject: - Electromagnetics *(EX503)*

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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22 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2072 Chaitra

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

Subject: - Electromagnetics *(EX503)*

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

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

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

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

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

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DIVERGENCE

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

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

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

GRADIENT

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

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

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

CURL

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

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

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

LAPLACIAN

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

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

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

22 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2072 Kartik

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

Subject: - Electromagnetics *(EX503)*

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

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

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

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

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

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

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

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

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

a) Loss tangent
b) Antenna types and properties

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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: - Electromagnetic (EX503)

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

1. Transform the vector $4\vec{a}_x - 2\vec{a}_y - 4\vec{a}_z$ into spherical coordinates at point P(-2,-3,4) [5]
2. State and write the mathematical equation of Gauss Law. Using the same law, derive an expression for electric field intensity $(\vec{E})$ in between the two co-axial cylindrical conductors having inner radius 'a' and outer radius 'b', each infinite in extent and assuming a surface charge density ρ_s on the outer surface of the inner conductor. [1+6]
3. State the physical significance of potential gradient. Assuming that the potential V in the spherical coordinate system is a function of r only, solve the Laplacian equation and derive the expression for the capacitance of a spherical capacitor using the same solution of V. [2+6]
4. Within the cylinder $\rho = 2$, $0 < z < 1$ the potential given by: $V = 100+50\rho+150\rho\sin\phi V$ find:[2+1+2+1]
   a) Electric Field Intensity $(\vec{E})$ at P (1, 60°, 0.5) in free space
   b) Potential Gradient $\left(\frac{dV}{dN}\right)$
   c) Volume Charge Density (ρ_v) at P(1,60°,0.5) in free space
   d) How much charge lies within the cylinder?
5. State the physical significance of Curl. Evaluate both sides of stokes theorem for the field $\vec{A} = 6xy\,\vec{a}_x - 3y^2\,\vec{a}_y$ A/m and the rectangular path around the region; $2 \le x \le 5$, $-1 \le y \le 1$, $z = 0$. Let the positive direction of $\vec{ds}$ be $\vec{a}_z$. [2+6]
6. Explain the physical significance of the equation $\phi_s \vec{B}.\vec{ds} = 0$. Given the vector magnetic potential $\vec{A} = \rho^2/8\,\vec{a}_z$ Wb/m. Calculate the total magnetic flux crossing the surface $\phi = \pi/4$, $1 \le \rho \le 3$m, $0 \le z \le 5$m. [2+6]

7. Explain motional emf and transformer emf with necessary mathematical derivations. A straight conductor of 0.2m lies along x-axis with one end at the origin. If this conductor is subjected to the magnetic flux density $\vec{B} = 0.08\vec{a}_y$ T and velocity v = 2.5 sin $10^3 t\vec{a}_z$ m/s. Calculate the emf induced in the conductor. [6+2]

8. Define Transverse Electromagnetic (TEM) wave. Derive an expression electric field for a uniform plane wave propagating in a perfect dielectric media. [7+1]

9. A uniform plane wave in free space at a frequency of 12 MHz is given by $\vec{E} = 200\cos(\omega t + 120x + 30°)\vec{a}_y$ V/m, find (a) $|E_{max}|$ (b) $\vec{H}$ at x = 40mm and t = 340ps. [3+3]

10. A lossless transmission line with $Z_0 = 50\Omega$ has a length of 0.4λ. The operating frequency is 300MHz and it is terminated with a load $Z_L = 40+j30\Omega$. Find: [2+2+4]
    a) Reflection coefficient (Γ)
    b) Standing wave ratio on the line (SWR)
    c) Input impedance (Z_{in})

11. Explain Transverse Electric Mode and Transverse Magnetic Mode of a waveguide. [2+2]

12. Write short notes on: [2×2]
    a) Skin depth
    b) Antenna and its types

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Examination Control Division
2080 Bhadra

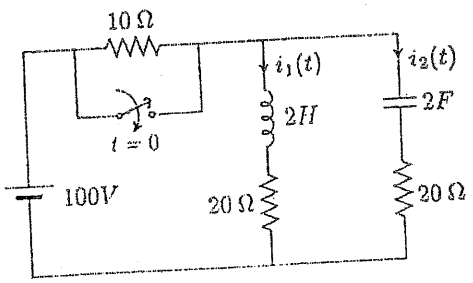
Exam.	Regular		
Level	BE	Full Marks	80
Programme	BEL,BEX, BCT	Pass Marks	32
Year / Part	II / I	Time	3 hrs.

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

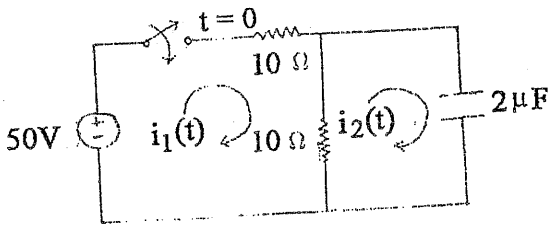
- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ ***Semi-log graph paper is to be provided.***
- ✓ *Assume suitable data if necessary.*

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

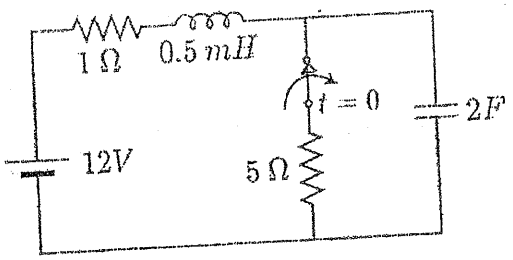
   b) In the circuit shown in figure below, the switch is closed at t = 0. Determine i_1, i_2, i'_1,i'_2 and i''_1 at $t = 0^+$. [8]



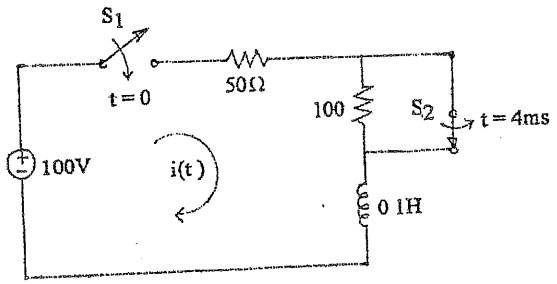
2. a) In the two mesh network, the switch is closed at t=0. Find the mesh currents $i_1(t)$ and $i_2(t)$ using classical method. Also calculate the capacitor voltage. [8]



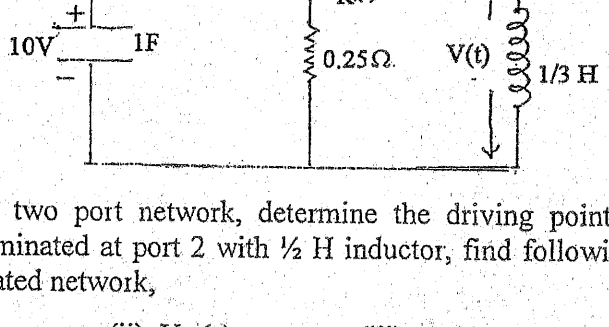
   b) The switch in the circuit shown in figure is closed for long time. It opens at t = 0. Obtain the current through inductor and voltage across capacitor for t > 0. [8]



3. a) In the given circuit s1 is closed at t = 0 and s2 is opened at t = 4msec, determine i(t) for t > 0 using Laplace transform method. Assume inductor is initially de-energized. [8]

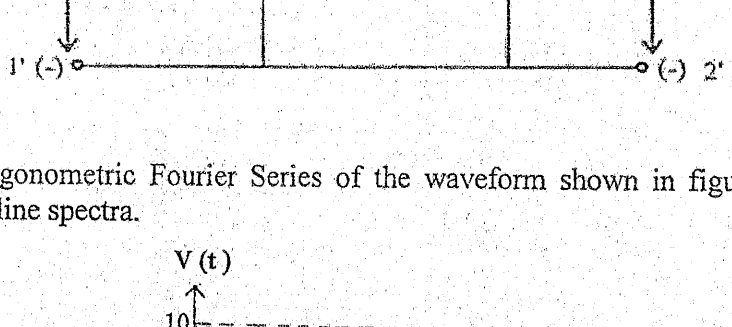


b) Figure below shows a parallel circuit where capacitor has an initial voltage of 10 V with polarity indicated in the figure. The switch is closed at t =0 . Find V(t) for t > 0, using Laplace transform method. [8]

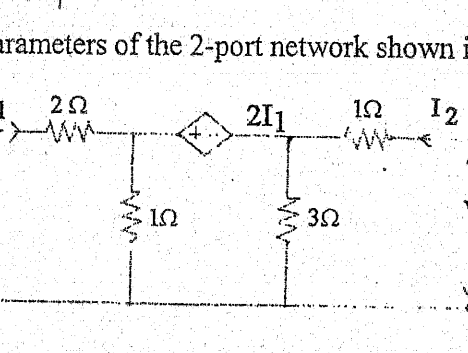


4. a) For the given two port network, determine the driving point impedance. If this network is terminated at port 2 with ½ H inductor, find following network function for this terminated network, [8]

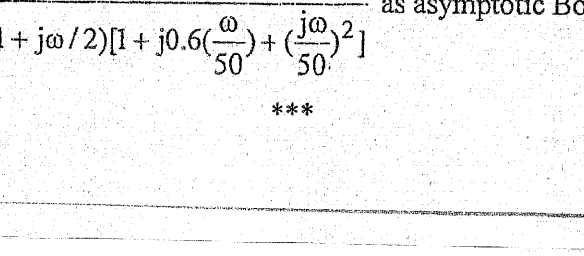
(i) $Z_{21}(s)$ (ii) $Y_{21}(s)$ (iii) $\alpha_{21}(s)$



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



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



b) What is the significance of frequency response study? Plot the frequency response of

$$G(j\omega) = \frac{15(1 + j\omega/10)}{j\omega(1 + j\omega/2)[1 + j0.6(\frac{\omega}{50}) + (\frac{j\omega}{50})^2]}$$ as asymptotic Bode plot. [8]

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Examination Control Division
2081 Baishakh

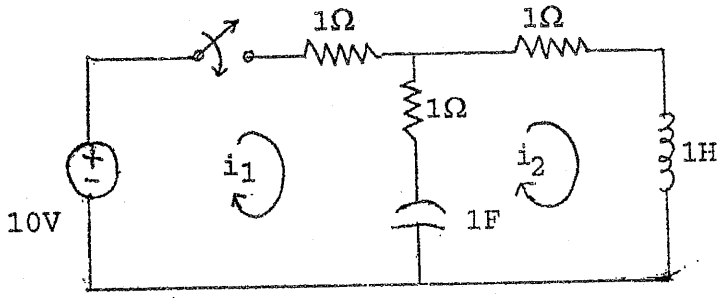
Exam.	Back		
Level	BE	Full Marks	80
Programme	BEL,BEX, BCT	Pass Marks	32
Year / Part	II / I	Time	3 hrs.

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

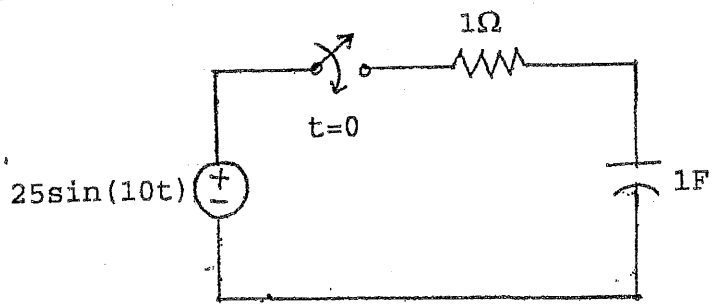
- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ ***Semi-log paper is to be provided.***
- ✓ *Assume suitable data if necessary.*

1. a) Define resonance in parallel R-L-C circuit with the help of phasor diagram. A220V, 100Hz AC source supplies a series circuit with a capacitor and coil. If the coil has 50 mΩ resistance and 5mH inductance, find the value of capacitor to create resonance. Also calculate:(i) voltage across R, L and C, (ii) Quality factor. [8]

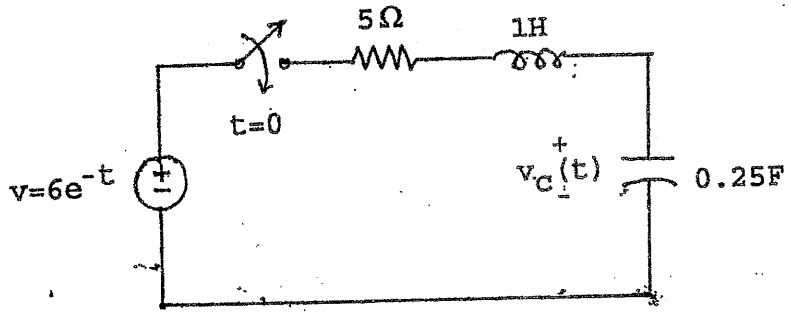
   b) Obtain the value of i_1, i_2,di_1/dt,di_2/dt,d^2i_1/dt^2 and d^2i_2/dt^2 at $t = 0^+$, if the switch is closed at t=0 in the circuit shown in figure below. [8]



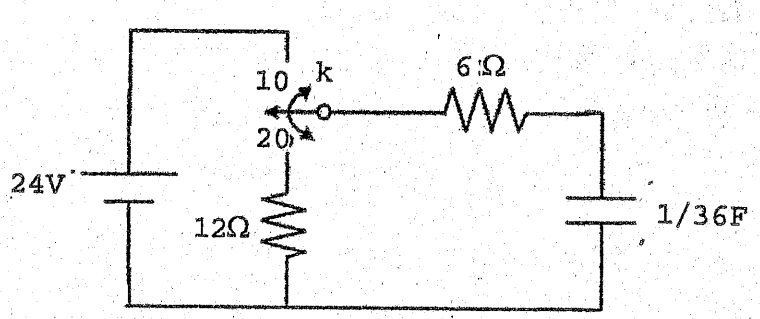
2. a) If the switch is closed at t=0 in the circuit shown in figure below, find expressions for current through and voltage across capacitor using classical method of solution. [8]



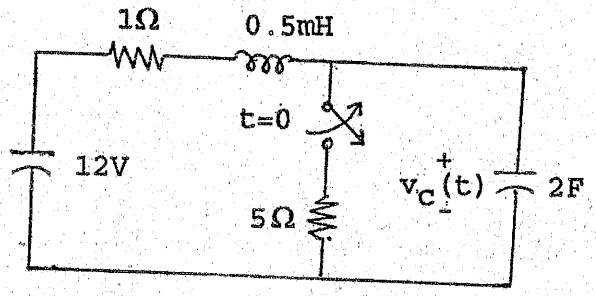
   b) Obtain an expressions for $V_c(t)$, if the switch in the circuit shown in figure below is closed at t=0. Use Classical method. [8]



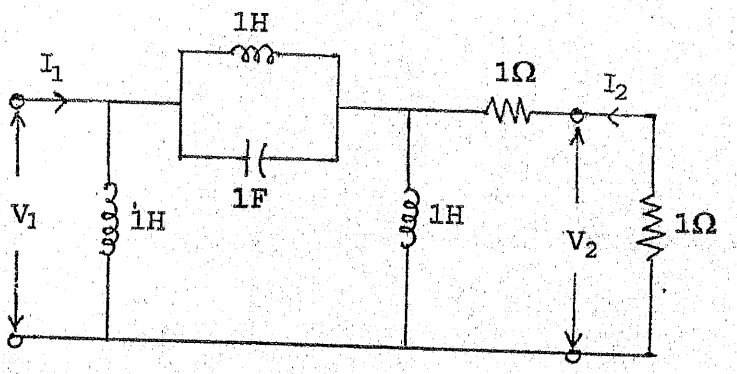
3. a) In the network shown, the switch is moved from 1 to 2 at t=0. For the element value given on diagram, find the expression for voltage and current of capacitor, by Laplace Transformation method. [8]



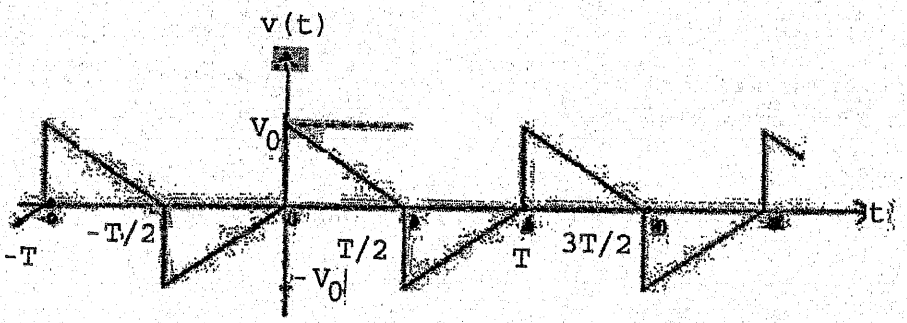
b) In the circuit shown in figure below, if the switch is opened at t= 0, find $V_c(t)$ for t > 0, using Laplace transform method. [8]



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



b) Find the trigonometric form of Fourier series for following wave and also sketch the line spectrum. [8]



5. a) The network shown below is a two port network containing dependent voltage source. Obtain Z-parameters and T-parameters of the network. Also check whether the network is symmetrical or not? [8]

b) Draw the asymptotic bode graph of the given transfer function: [8]

$$G(s) = \frac{1000(s+2)}{s(s^2+21s+20)(s^2+2s+100)}$$

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TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2080 Baishakh

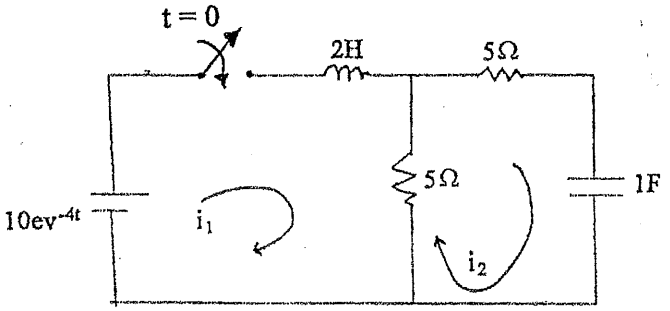
Exam.	Back		
Level	BE	Full Marks	80
Programme	BEL, BEX, BCT	Pass Marks	32
Year / Part	II / I	Time	3 hrs.

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

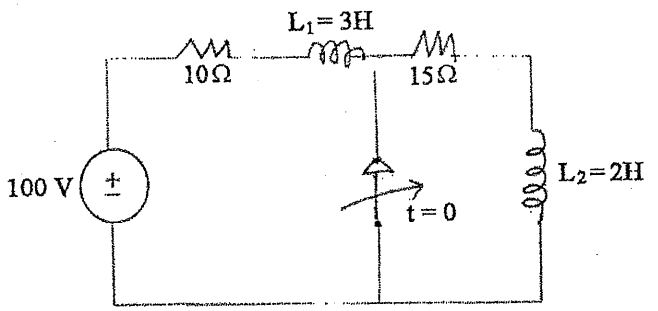
- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ ***All** questions carry equal marks.*
- ✓ ***Semilog graph paper is to be provided.***
- ✓ *Assume suitable data if necessary.*

1. a) A 50 ohms resistor is connected in series with a coil having resistance R, inductance L and capacitor C supplied by 100 V variable frequency supply. At a frequency of 200 Hz, the maximum current of 0.7 A flows through the circuit and voltage across the capacitor is 200 V. Determine the value of R, L and C.

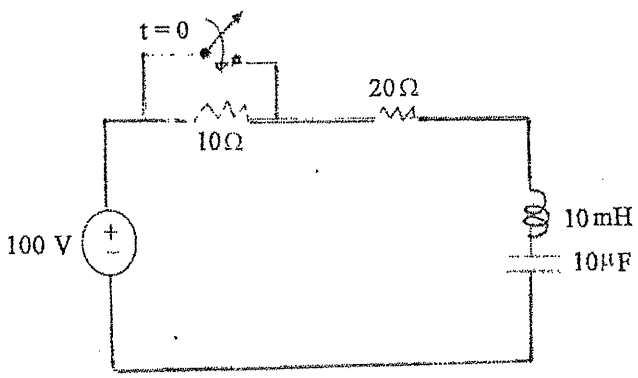
   b) Obtain i_1, i_2, di_1/dt, di_2/dt, d^2i_1/dt^2, d^2i_2/dt^2 at $t = 0^+$, if the switch is closed at $t = 0^+$.



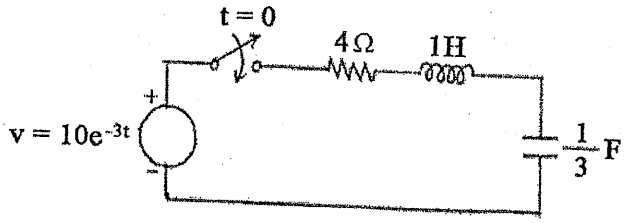
2. a) Using classical method, find the voltage across inductor L_2 in the circuit shown in following figure.



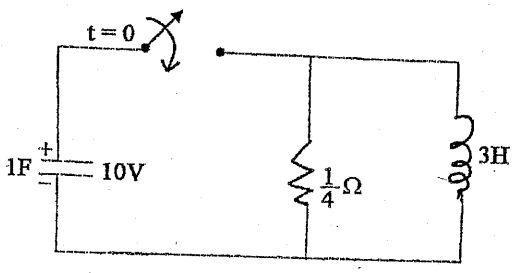
   b) Calculate expression for total current supplied by source for $t > 0$ using classical method in the circuit shown below.



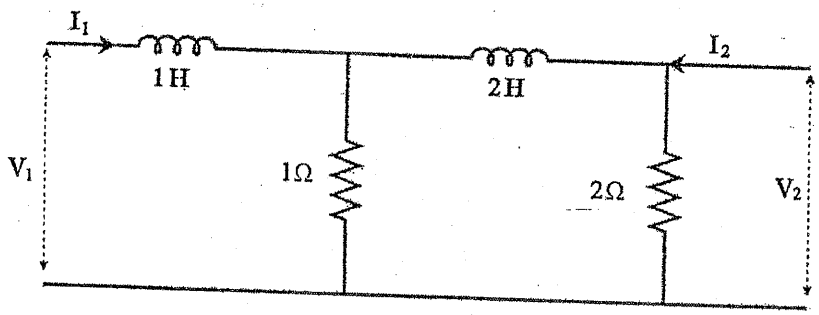
3. a) Using Laplace Transform method, find the current and voltage across capacitor for $t > 0$ in the circuit shown below.



b) Find the expression of v(t) for $t > 0$ using Laplace transform if switch is closed at $t = 0$.



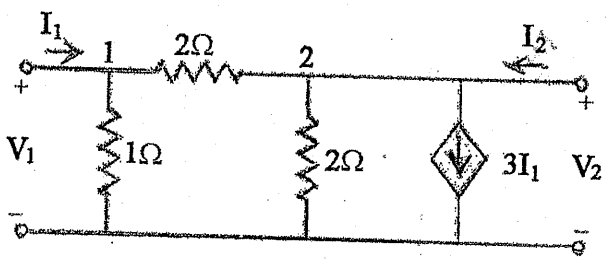
4. a) For the given two port network, determine the driving point impedance and voltage ratio transfer function.



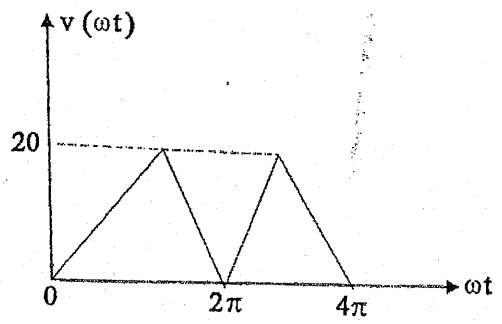
b) Sketch the Bode Plot for the transfer function given by:

$$G(S) = \frac{30(S+10)}{S(S^2+3S+50)}$$

5. a) Find Y and Z parameters for the network shown in figure below.



b) Obtain trigonometric Fourier series of waveform in figure below, also sketch the line spectrum.



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TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2079 Bhadra

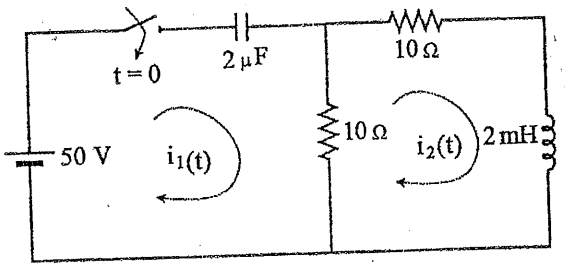
Exam.	Regular		
Level	BE	Full Marks	80
Programme	BEL, BEX, BCT	Pass Marks	32
Year / Part	II / I	Time	3 hrs.

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

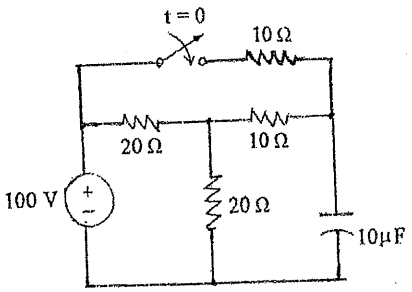
- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Assume suitable data if necessary.*

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

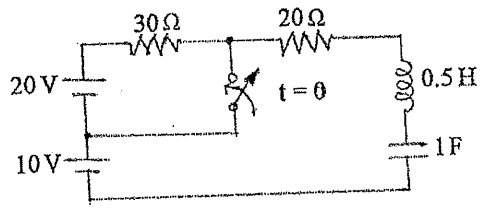
   b) For the circuit shown in the figure below, find i_1, i_2, $\frac{di_1}{dt}$, $\frac{di_2}{dt}$ and $\frac{d^2 i_2}{dt^2}$ at $t = 0^+$. [8]



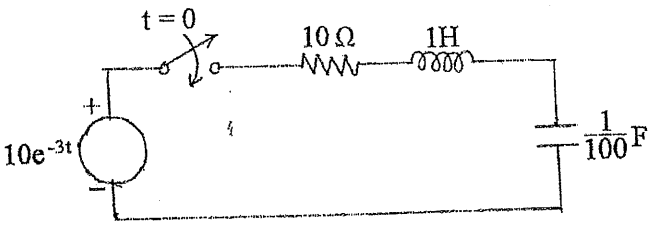
2. a) Using classical method, find current and voltage across capacitor for $t > 0$ in the circuit shown below. [8]



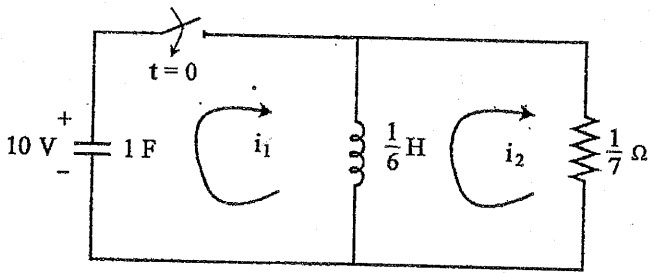
   b) If the switch is closed at $t = 0$, find the expression of current through inductor for $t > 0$. Also calculate the voltage across inductor after 10 ms using classical method. [8]



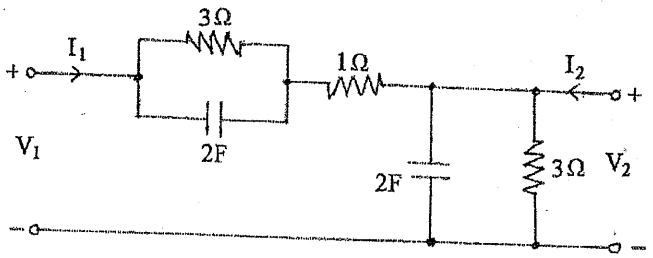
3. a) Using Laplace Transform method find the expression of current and voltage across inductor if the switch is closed at $t = 0$. [8]



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



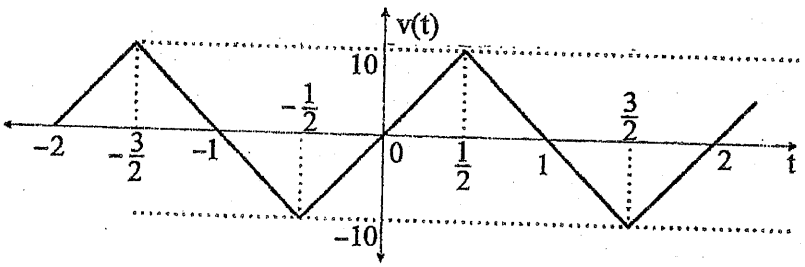
4. a) Find the voltage ratio transfer function of given TPN. [8]



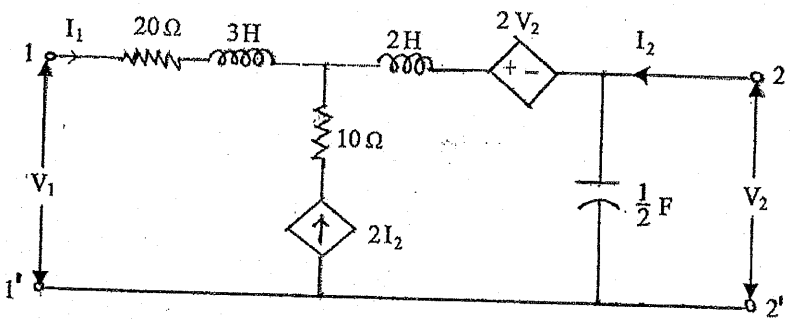
b) For the transfer function below, draw the asymptotic Bode plot. [8]

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

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



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



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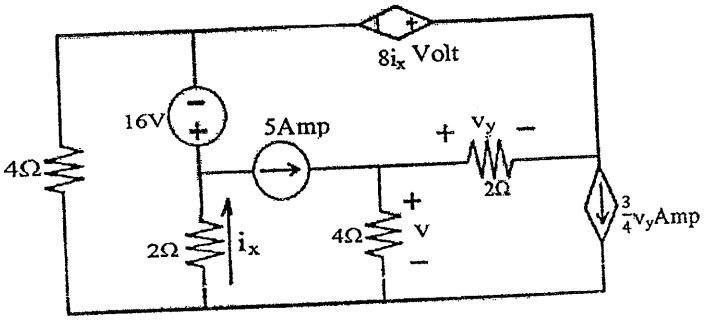
TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2079 Baishakh

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

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

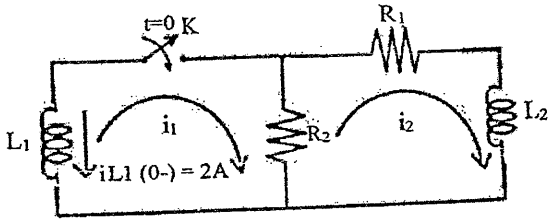
- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Semi log paper will be provided.*
- ✓ *Assume suitable data if necessary.*

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

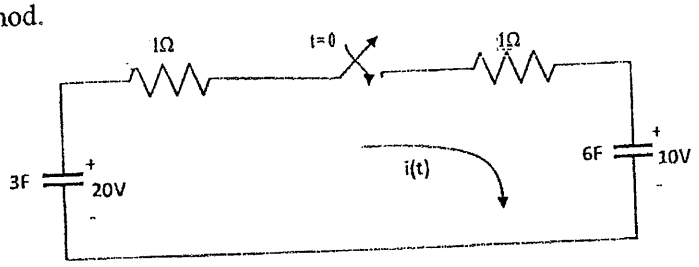


b) In the given network of figure below, inductor L_1 is energized and the switch K is closed at t = 0. When each element has following values.

$R_1 = 10k\Omega$, $R_2 = 5k\Omega$, $L_1 = 2mH$, $L_2 = 6mH$, solve for $i_1, i_2, \frac{di_1}{dt}, \frac{di_2}{dt}$, $\frac{d^2i_1}{dt^2}, \frac{d^2i_2}{dt^2}$ at $t = 0^+$. [8]

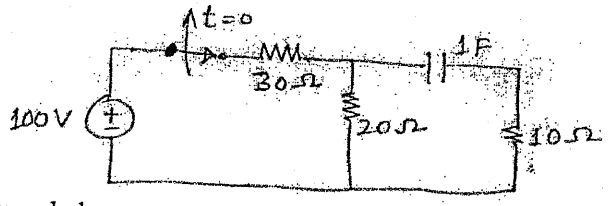


2. a) Solve for i (t) in circuit as shown in figure below in which 3F capacitor is initially charged to 20 volts, 6F capacitor to 10 volts and the switch is closed at t=0. Use classical method. [8]

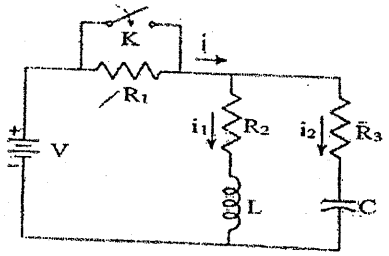


b) An exponential current $i(t) = 20\,e^{-5t}$ Amp is suddenly applied at time t = 0 to a parallel RLC circuit comprising of resistor R = 1/10Ω, inductor L = 10mH and capacitor C = 2.5μF. Obtain the complete particular solution for voltage v(t) across the network, by classical method. Assume zero initial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

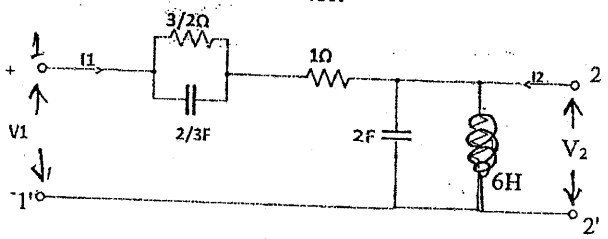
3. a) The circuit below is in the steady state with the switch S closed. The switch is opened at t = 0. Determine the current through capacitor for t > 0 using Laplace's Transform method. [8]



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



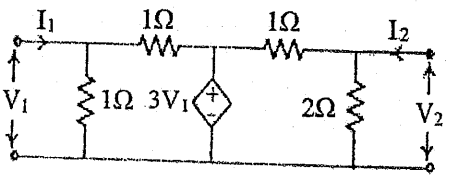
4. a) Find the voltage ratio transfer function of the two port network shown in figure below, if port 2 is terminated with 2H inductor. [8]



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

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

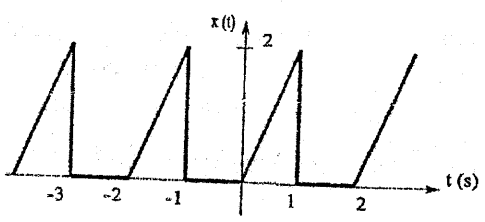
5. a) Find y and g parameters of the network shown in the figure below. Also check its symmetricity and reciprocity. [6]



b) Show that:

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

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



TRIBHUVAN UNIVERSITY
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Examination Control Division
2078 Bhadra

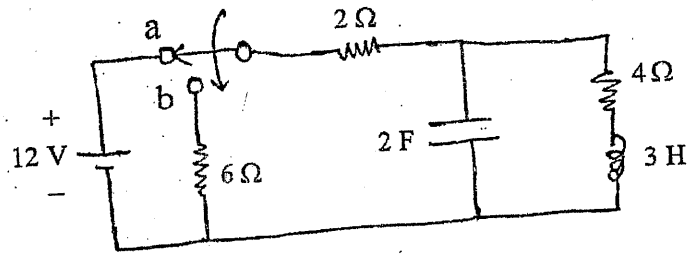
Exam.	Regular		
Level	BE	Full Marks	80
Programme	BEI, BEX, BCT	Pass Marks	32
Year / Part	II / I	Time	3 hrs.

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

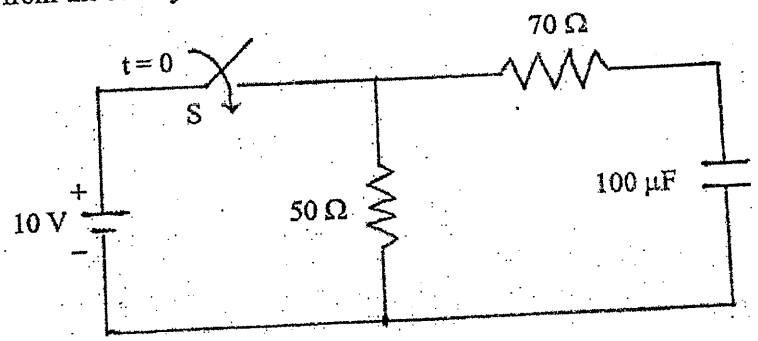
- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ ***Semi-log graph paper is to be provided.***
- ✓ *Assume suitable data if necessary.*

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

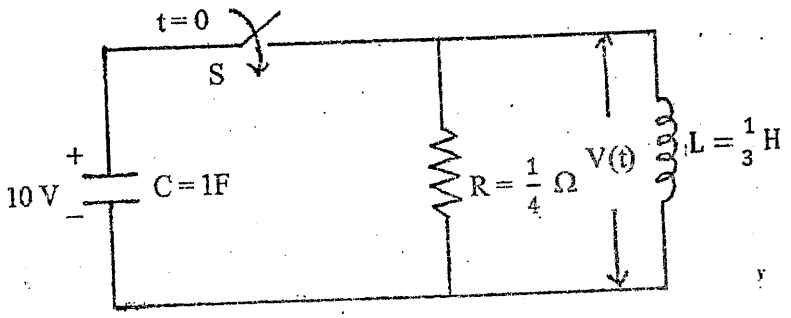
   b) At t = 0 switch changes its position from a to b. Find current and voltage of each element at $t = 0^+$. Also find the initial value of first order derivatives of inductor voltage and inductor current. [8]



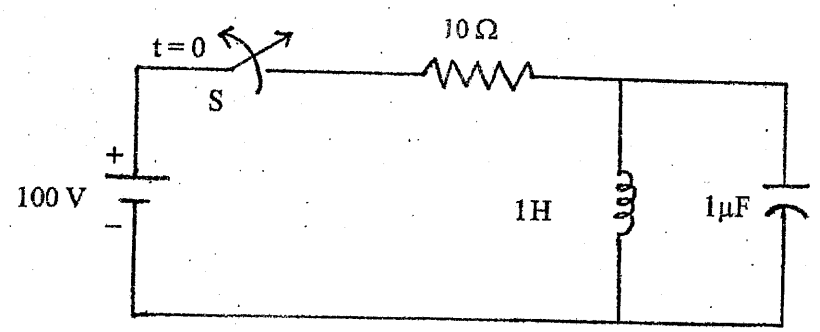
2. a) In the circuit shown in figure below, if the switch is closed at t = 0, find the time when the current from the battery reaches to 500 mA. Use classical method. [8]



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

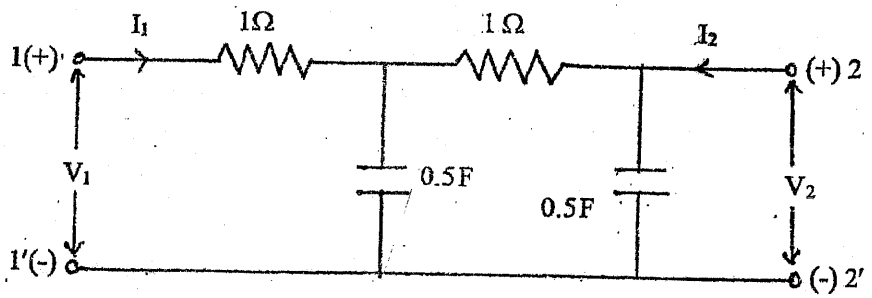


3. a) Using Laplace transform method find the current through the inductor in the network shown in figure below. [8]

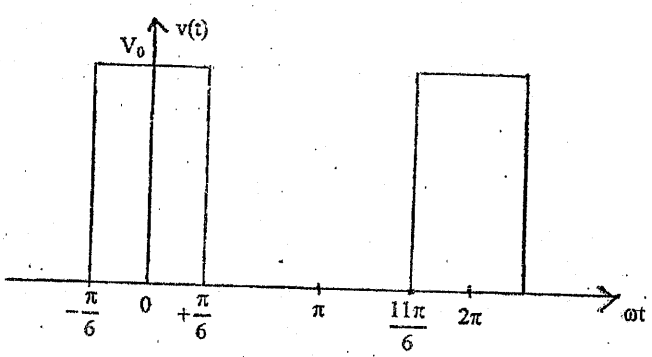


b) A RLC series circuit with R = 4Ω, L = 1H and C = 1/3 F is excited by an exponential source of $20e^{-3t}$. Find the expression of the current in the circuit for t = 0 using Laplace Transform. [8]

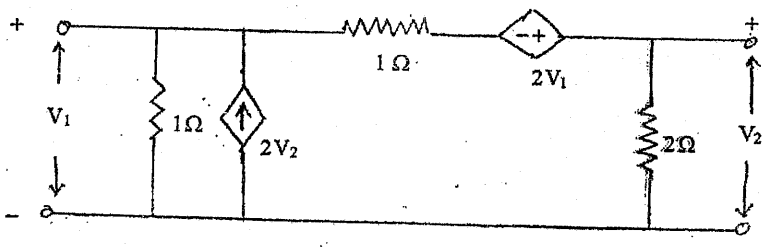
4. a) For the given two port network, determine the driving point impedance and voltage ratio transfer function. [8]



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



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



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

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

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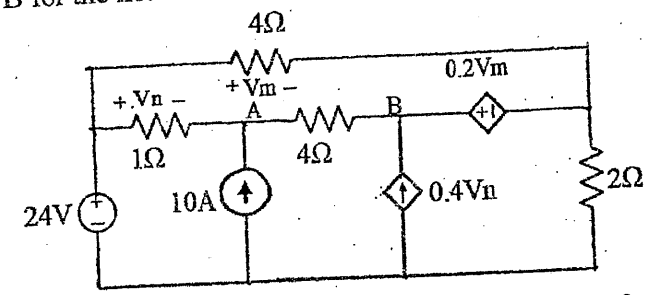
Examination Control Division
2078 Kartik

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

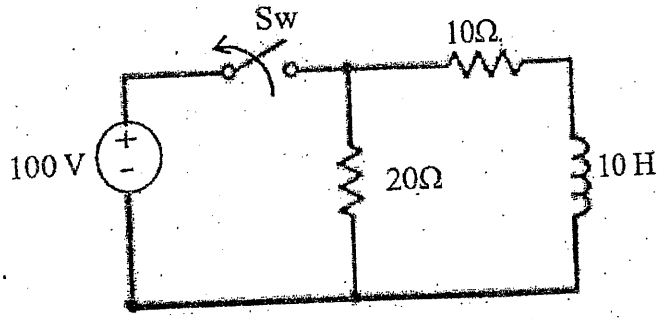
Subject: - Electric Circuit Theory *(EE 501)*

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

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



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

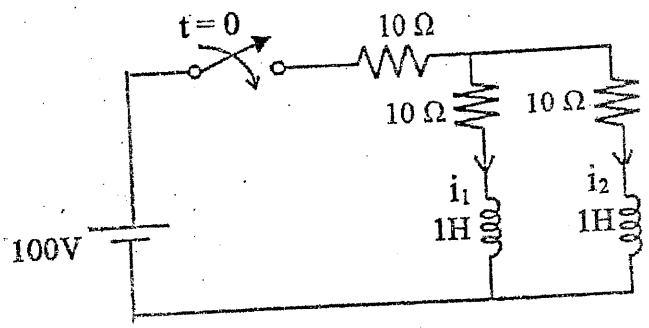


2. a) In a series R-L circuit with R = 1 Ω and L = 1H, the voltage source follows the law $v(t) = Ve^{-\alpha t}$, where α is a constant. The switch is closed at t = 0. [8]

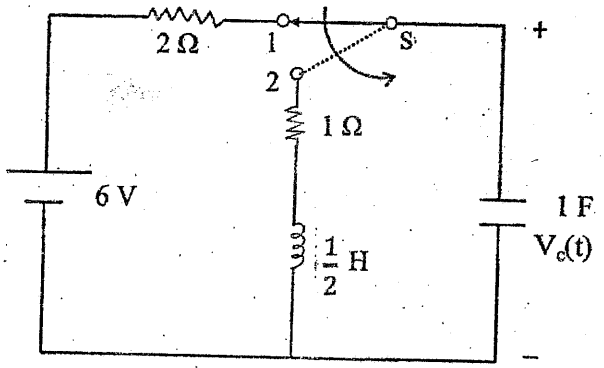
(i) Solve for the current assuming that $\alpha \neq \frac{R}{L}$ and

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

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

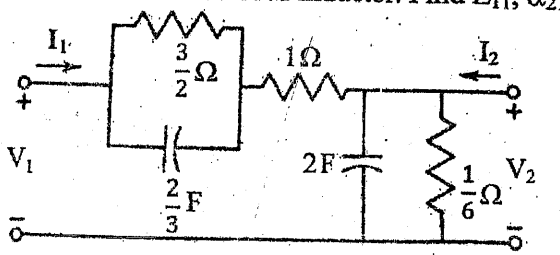


3. a) In the circuit shown in figure below, a switch S is in the position 1 for a long time and moved to position 2 at t = 0. Find the voltage across the capacitor for t > 0. Use Laplace Transformation method. [8]



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

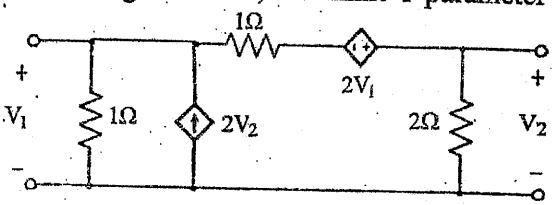
4. a) Find the voltage ratio transfer function of the two port network shown in figure below. If the port 2 is terminated with 2H inductor. Find Z_{11}, α_{21}, Y_{12}. [8]



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

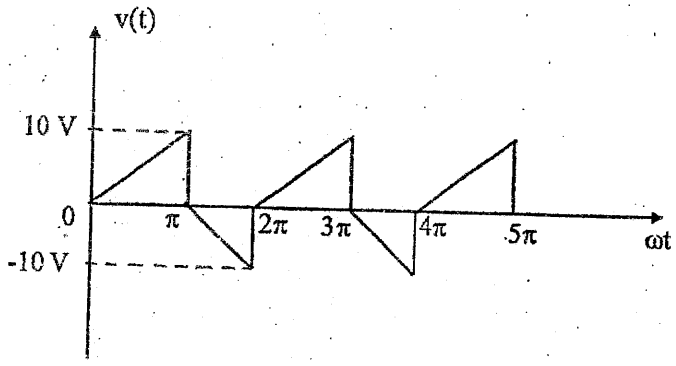
$$G(S) = \frac{s+3}{s(s+1)(s+2)}$$

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



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

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



TRIBHUVAN UNIVERSITY
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Examination Control Division
2076 Chaitra

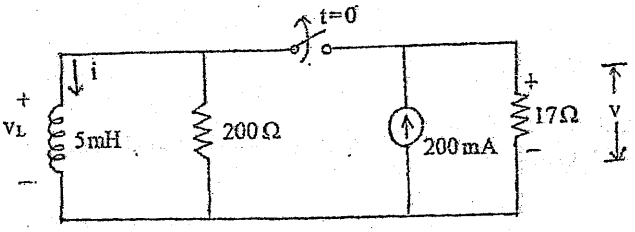
Exam.	Regular		
Level	BE	Full Marks	80
Programme	BEL, BEX, BCT	Pass Marks	32
Year / Part	II / I	Time	3 hrs.

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

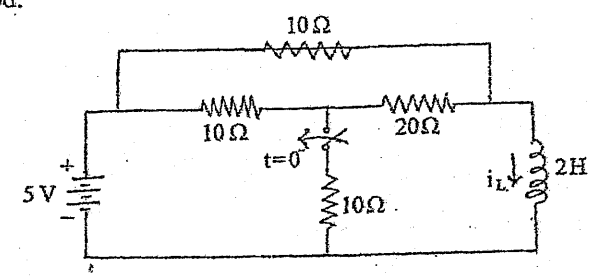
- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt <u>All</u> questions.*
- ✓ *The figures in the margin indicate <u>Full Marks</u>.*
- ✓ ***<u>Semi-log graph paper is to be provided.</u>***
- ✓ *Assume suitable data if necessary.*

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

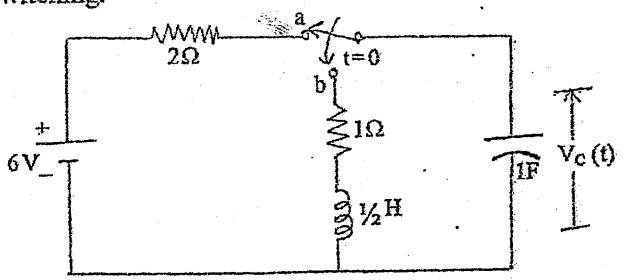
   b) In the circuit shown below, the switch has been closed for a long time and at t = 0 it is opened, determine (i) $i(0^+)$ (ii) $v(0^+)$ (iii) $v_L(0^+)$ and (iv) I and v at t = 20μs. [8]



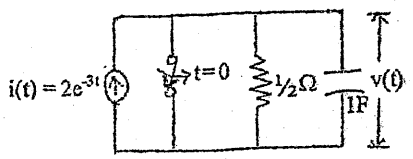
2. a) In the network given below, the switch K is open and the network reaches a steady state. At t = 0, switch K is closed. Find the current in the inductor for t > 0 using classical method. [8]



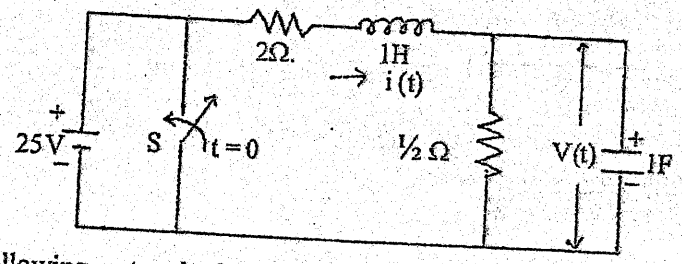
   b) Use Laplace transform approach to find the voltage across the capacitor $V_C(t)$ for t > 0 when the switch is moved to position 'b' at t = 0 which was in position 'a' for a long time prior to switching. [8]



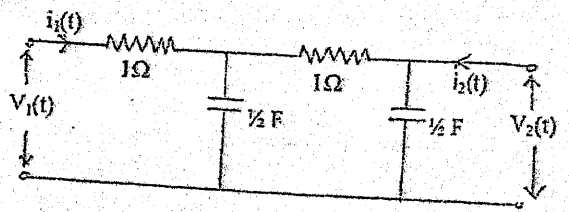
3. a) An exponential current $i(t) = 2e^{-3t}$ is applied at time t = 0 to a parallel R-C circuit shown below. Comprising resistor R = ½ Ω and capacitor C = 1F. Obtain complete solution for v(t). Assume V_C = 0 before the application of current. Use Laplace transform method. [8]



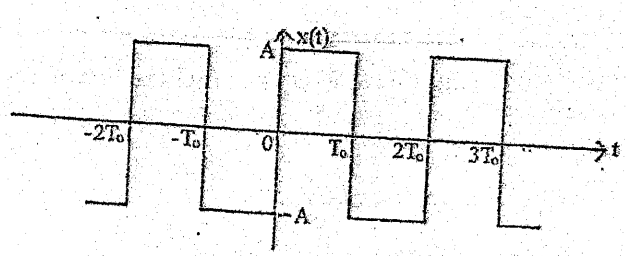
b) In the circuit shown in figure below, steady state is reached with switch S open. Switch S is closed at t = 0. Determine current through inductor i(t) and voltage across the capacitor v(t) for t > 0 using Laplace transform method. [8]



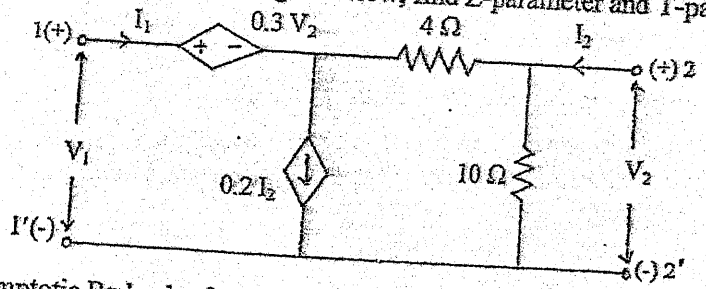
4. a) For the following network determine the voltage ratio transfer function. If this network is terminated at port 2 with a 2Ω resistor, find for this terminated network α_{21} (S) and V_{21}(S) [8]



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



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



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

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

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2076 Ashwin

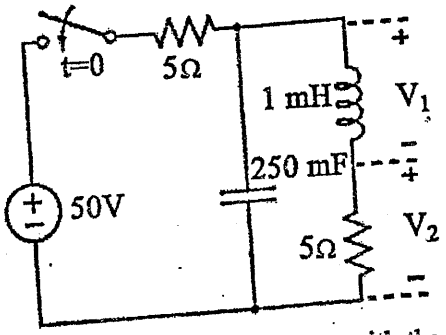
Exam.	Back		
Level	BE	Full Marks	80
Programme	BEL, BEX, BCT	Pass Marks	32
Year / Part	II / I	Time	3 hrs.

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

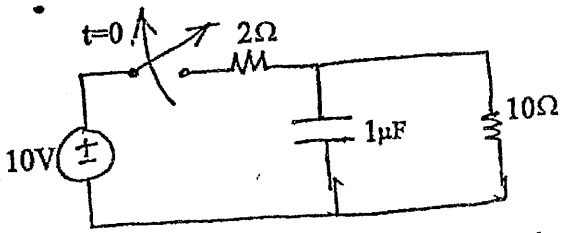
- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt <u>All</u> questions.*
- ✓ *The figures in the margin indicate <u>Full Marks</u>.*
- ✓ *<u>Semi log graph will be provided.</u>*
- ✓ *Assume suitable data if necessary.*

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

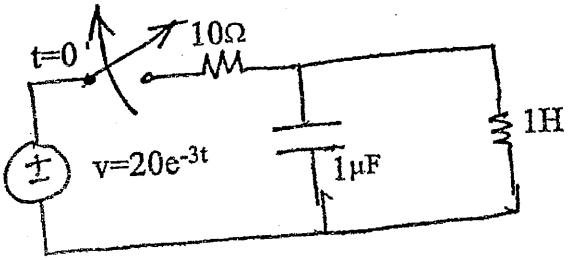
   b) In the circuit shown in figure, switch is closed at t=0 with zero capacitor voltage and zero inductor current, find the following. [8]
   i) v_1 and v_2 at t=0+
   ii) dv_1/dt and dv_2/dt at t=0+
   iii) d^2v_2/dt at t=0+



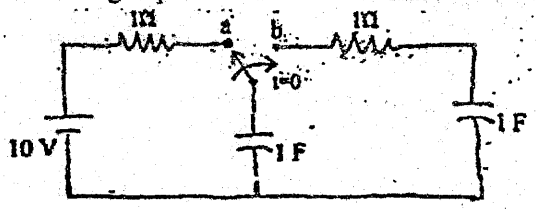
2. a) The circuit shown in figure is in the steady state with the switch S closed. The switch is opened at t=0. Determine current and voltage of all elements for t>0 using classical method. [8]



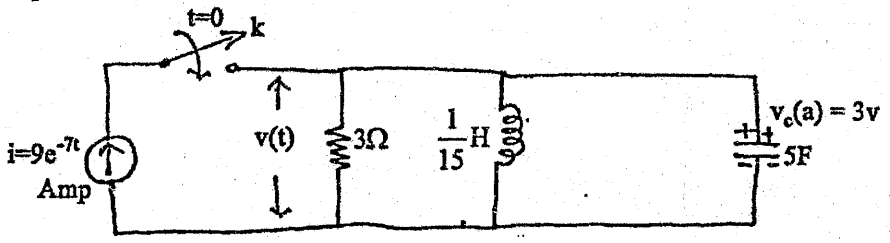
   b) Using Classical method, find the expression for current and voltage of capacitor for t>0 in the circuit shown below. [8]



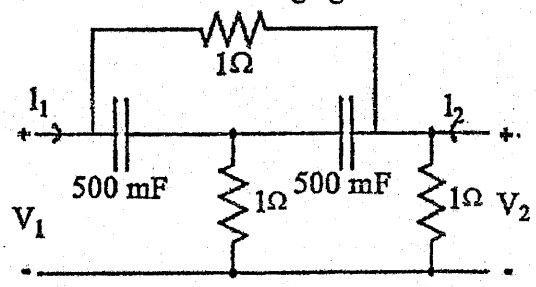
3. a) Keeping the switch at position 'a' for a long time, if the switch is moved to position 'b' at t = 0 in the circuit shown in figure below, find expressions for current through and voltage across capacitor using Laplace transform method. [8]



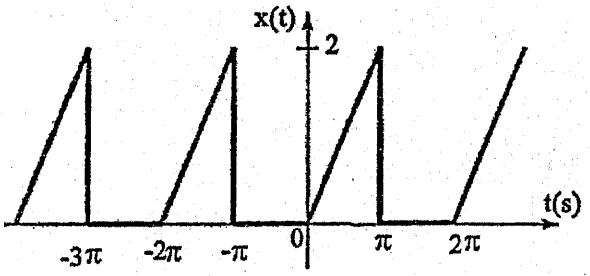
b) In the given network of figure below, both the energy storing elements are initially reached to steady state, before application of current source. The switch K is closed at t=0. Find complete expression for voltage v(t) across the network, for t>0, using Laplace transformation. [8]



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



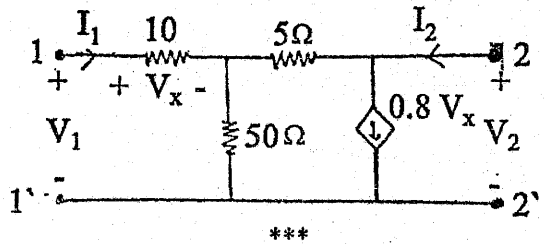
b) Find the trigonometric fourier series for the waveform shown in figure below. [8]



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

$$H(s)=\frac{(s+5)}{s(s^2+21s+20)(s^2+2s+100)}$$ [8]

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



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TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2075 Chaitra

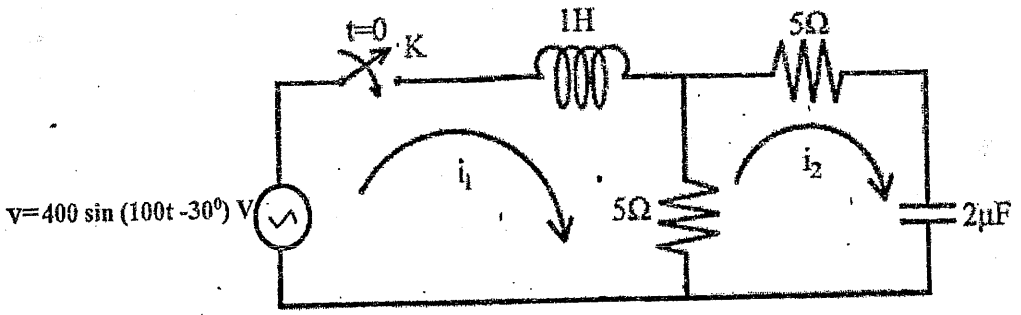
Exam.	Regular / Back		
Level	BE	Full Marks	80
Programme	BEL, BEX, BCT	Pass Marks	32
Year / Part	II / I	Time	3 hrs.

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

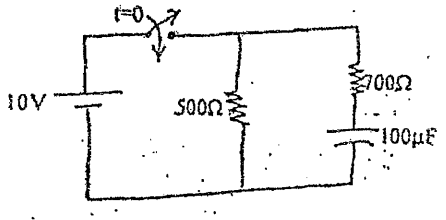
- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ ***Semi log graph will be provided.***
- ✓ *Assume suitable data if necessary.*

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

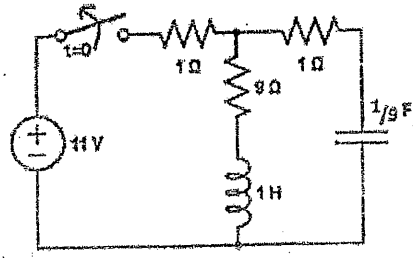
   b) In the given network of figure below, both the energy storing elements are initially relaxed ie. no current is flowing through the inductor and no charge is accumulated across the capacitor before application of voltage. The switch K is closed at t=0. Find the values of i_1, i_2, $\frac{di_1}{dt}$,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



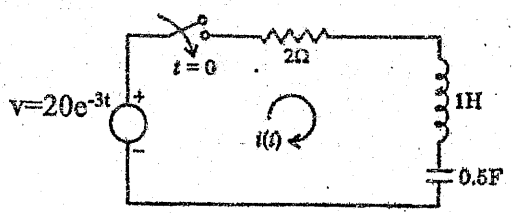
2. a) Using classical method, find the expression for the current supplied by the source in the network shown in figure. Also find the time taken by the source current to reach 25 mA. [8]



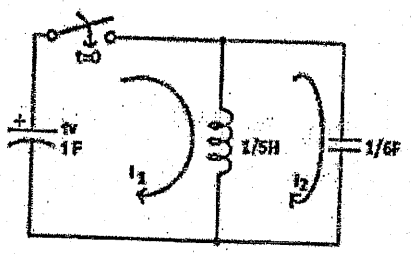
   b) Using classical method, find the expression for the current and voltage of inductor and capacitor respectively for t>0 from the circuit shown in following figure. [8]



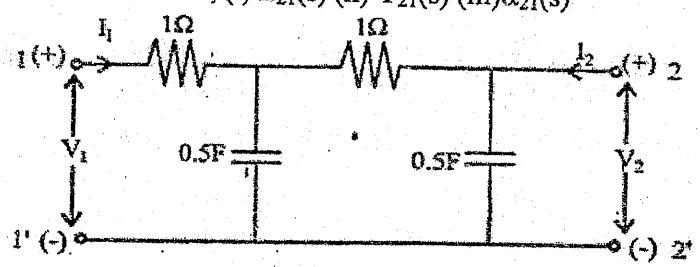
3. a) In the series R-L-C circuit shown in figure, there is no initial charge on the capacitor. If the switch S is closed at t=0, determine expression of current and voltage for all elements for t>0. [8]



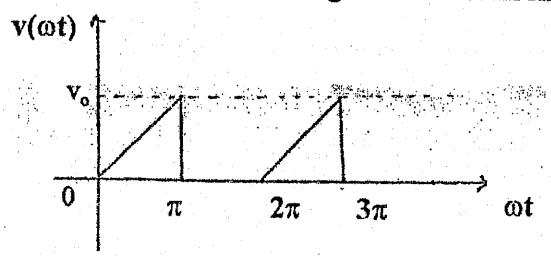
b) Using Laplace transform method, find the loop current i_1 and i_2 for t>0 in the figure shown below. [8]



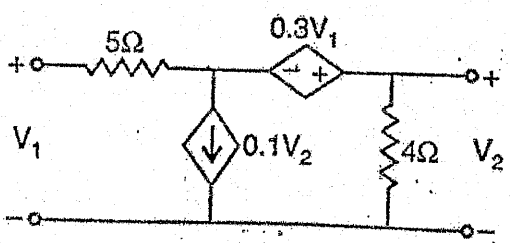
4. a) For the given two port network, determine the driving point impedance. If this network is terminated at port 2 with 1F capacitor, find the following network function for this terminated network, (i) $Z_{21}(s)$ (ii) $Y_{21}(s)$ (iii)$\alpha_{21}(s)$ [8]



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



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



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

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

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14 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2075 Ashwin

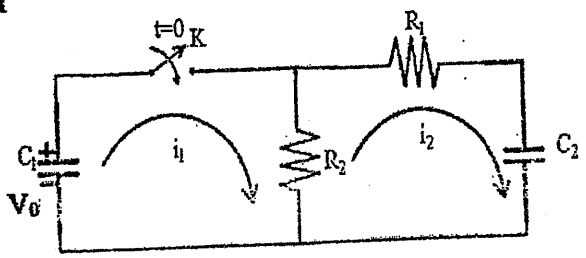
Exam.	Back		
Level	BE	Full Marks	80
Programme	BEL, BEX, BCT	Pass Marks	32
Year / Part	II / I	Time	3 hrs.

Subject: - Electric Circuit Theory *(EE501)*

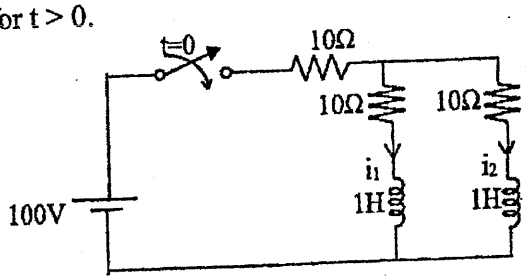
- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All questions.***
- ✓ *The figures **in the margin indicate Full Marks.***
- ✓ ***Semi log paper should be provided.***
- ✓ *Assume **suitable data** if necessary.*

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

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

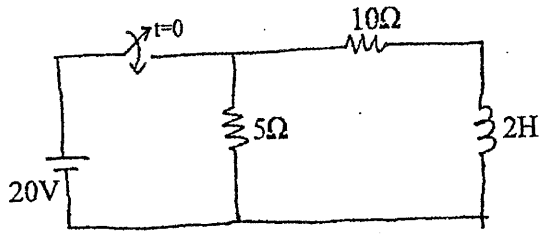


2. a) In the network shown, the switch is closed at t = 0, with the network previously unenergised. For the element values shown on the diagram, find $i_1(t)$ and $i_2(t)$, by classical method for t > 0. [8]



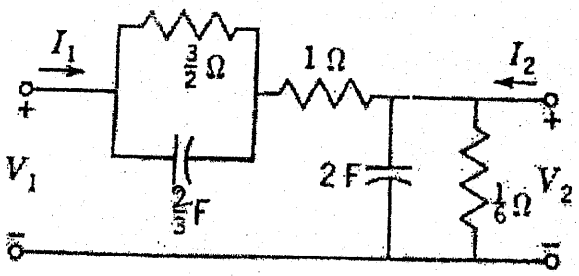
   b) Find the time expression for current for t > 0 in RLC series circuit with R = 10 ohm, L = 1H and $C = \frac{1}{9}F$, if the circuit is supplied by v = 10sint at t = 0. Assume that capacitor and inductor are initially de-energized. Use classical method. [8]

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



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

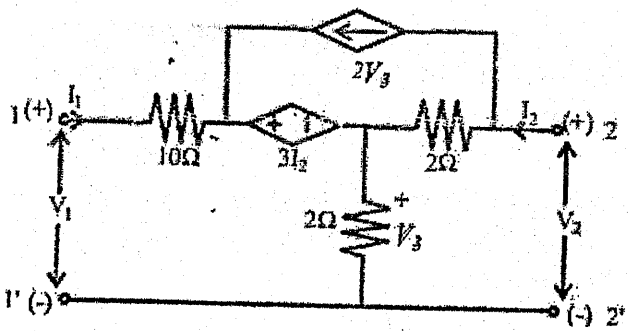
4. a) Find the voltage ratio transfer function of the two port network shown in figure below, if the port 2 is terminated with 2H inductor. [8]



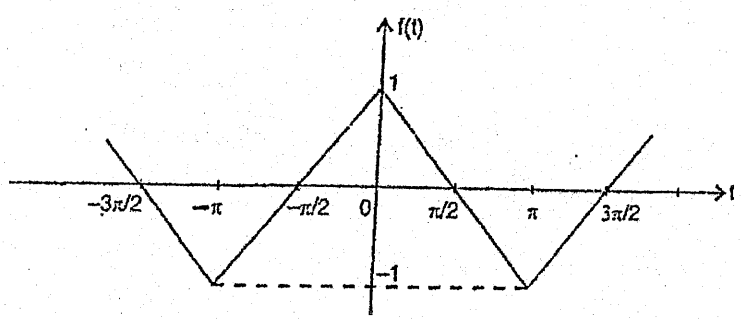
b) Sketch Bode Plot for the following transfer function. [8]

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

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



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



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14 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2074 Chaitra

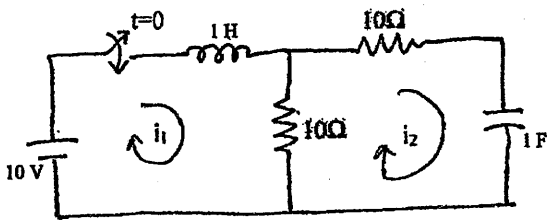
Exam.	Regular		
Level	BE	Full Marks	80
Programme	BEL, BEX, BCT	Pass Marks	32
Year / Part	II / I	Time	3 hrs.

Subject: - Electric Circuit Theory *(EE501)*

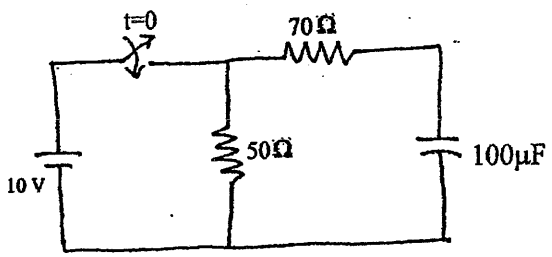
- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ ***Semi log paper should be provided.***
- ✓ *Assume suitable data if necessary.*

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

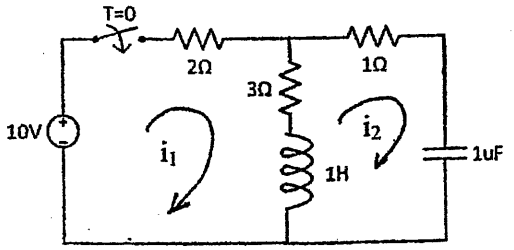
   b) Obtain the value of i_1, i_2, di_1/dt, di_2/dt, d^2i_1/dt and d^2i_2/dt^2 at $t = 0^+$, if the switch is closed at $t = 0$ in the circuit shown in figure below. [8]



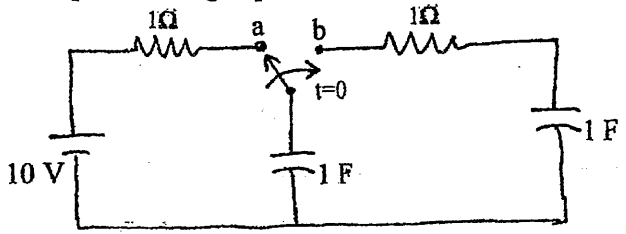
2. a) In the circuit shown in figure below, if the switch is closed at $t = 0$, find the time when the current from the battery reaches to 500mA. Use classical method. [8]



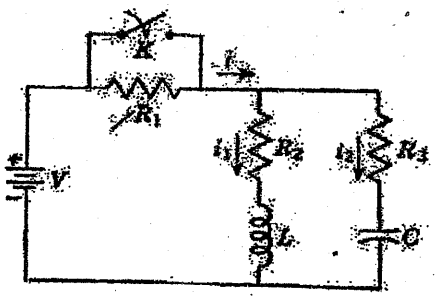
   b) Find the time expression for loop currents for $t > 0$ in the given circuit using classical method. [8]



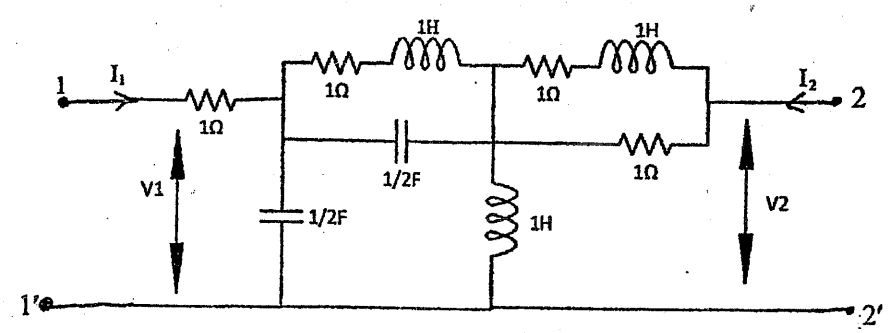
3. a) Keeping the switch at position 'a' for a long time, if the switch is moved to position 'b' at $t = 0$ in the circuit shown in figure below, find expressions for current through and voltage across capacitor using Laplace Transform method. [8]



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



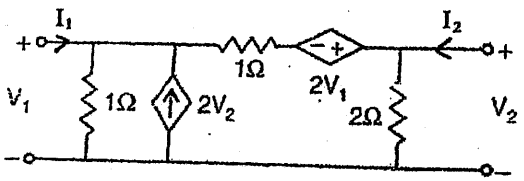
4. a) Find the forward voltage ratio transfer function $G_{21}(s)$ and forward transfer admittance $Y_{21}(s)$ in the following circuit. [8]



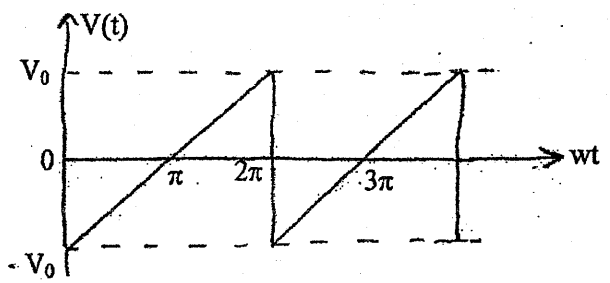
b) Sketch the Bode Plot for the transfer function given by

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

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



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



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24 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2073 Chaitra

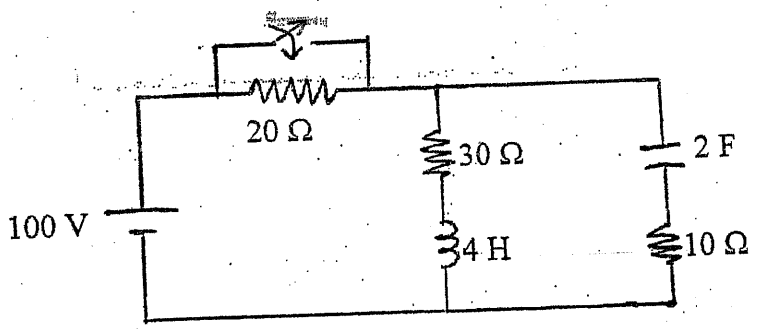
Exam.	Regular		
Level	BE	Full Marks	80
Programme	BEL, BEX, BCT	Pass Marks	32
Year / Part	II / I	Time	3 hrs.

Subject: - Electric Circuit Theory *(EE501)*

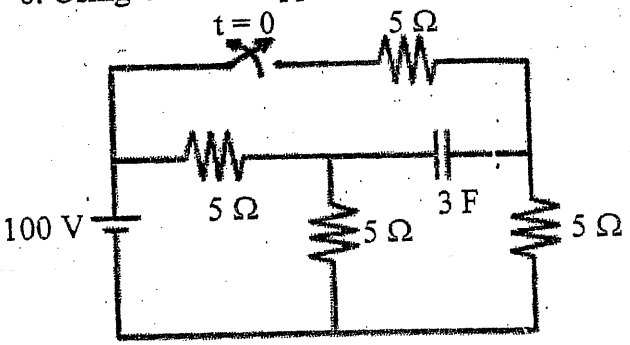
- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Semi log paper will be provided.*
- ✓ *Assume suitable data if necessary.*

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

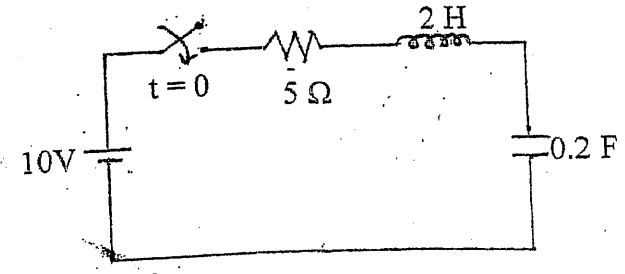
   b) After being open for a long time, if the switch in the circuit shown in figure below is closed at t = 0, find current through inductor, voltage across capacitor, current and voltage across each resistor at $t = 0^+$. [8]



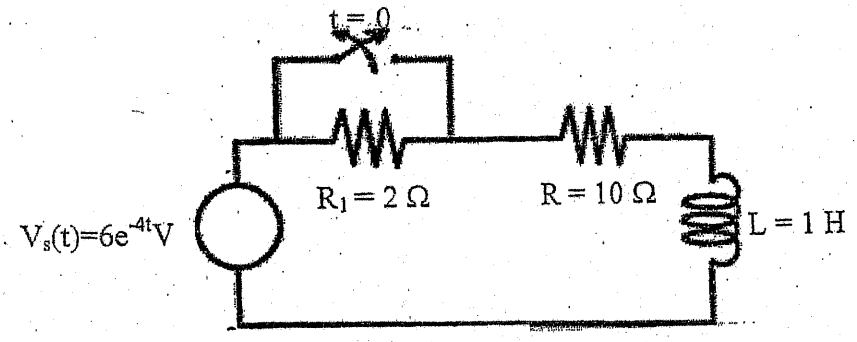
2. a) For the circuit shown in figure below, find the current through and voltage across the capacitor for t > 0. Using Classical approach. [8]



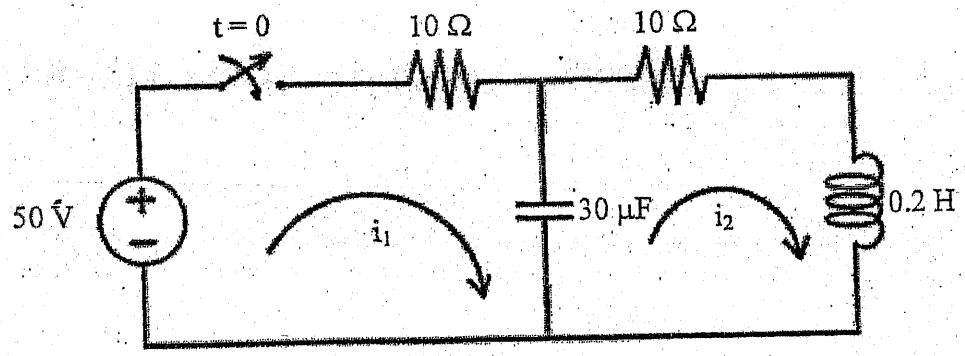
   b) Switch is closed at t = 0, find the expression for circuit i(t), for any time 't', and calculate the value of current at t = 0.1 sec. Also, find the time for current reach maximum value and corresponding maximum value of current. Use Classical method. [8]



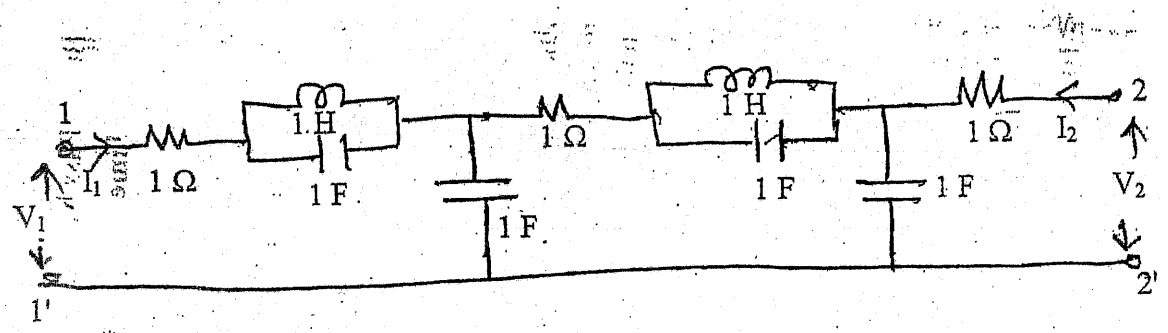
3. a) Find the expression of the current flowing through resistor R of the circuit in following figure and also find the voltage across the inductor for $t > 0$, when the switch is opened at $t = 0$. Use Laplace Transform method. [8]



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



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

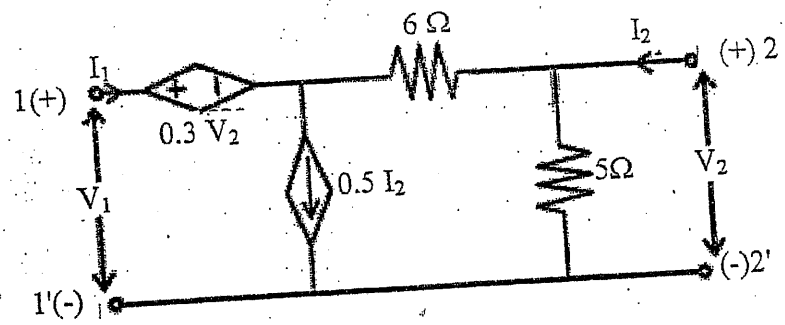


b) Sketch the asymptotic bode plots for the transfer function given by: [8]

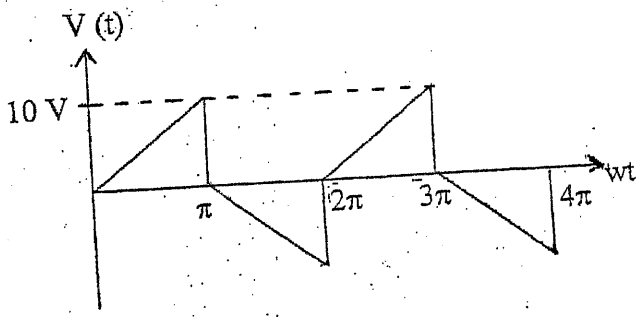
$$G(S) = \frac{5S^2(S+100)}{(S+20)(S^2+20S+100)}$$

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

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



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



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24 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
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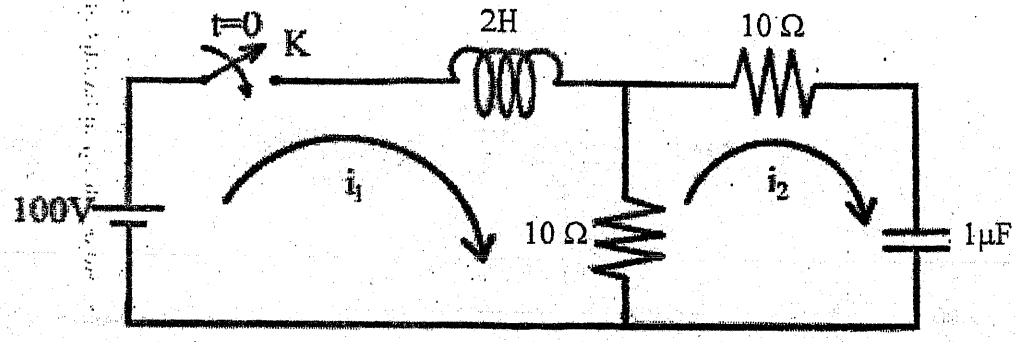
Exam.	Back		
Level	BE	Full Marks	80
Programme	BEL, BEX, BCT	Pass Marks	32
Year / Part	II / I	Time	3 hrs.

Subject: - Electric Circuit Theory *(EE501)*

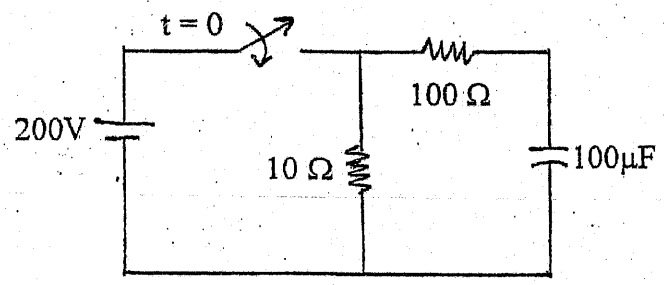
- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Semi log paper will be provided.*
- ✓ *Assume suitable data if necessary.*

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

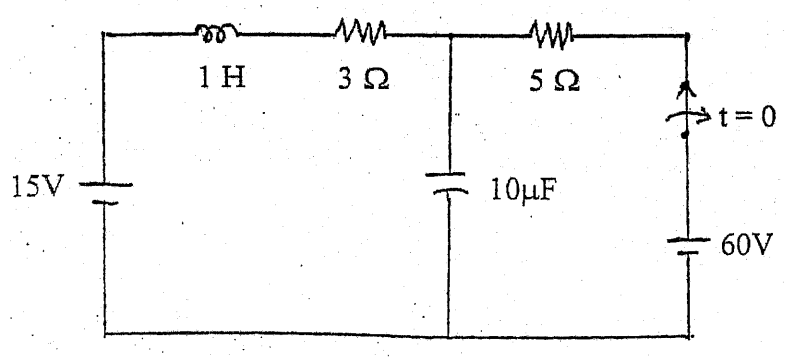
   b) In the given network of figure below, both the energy storing elements are initially relaxed i.e. no current is flowing through the inductor and no charge is accumulated across the capacitor before application of voltage. The switch K is closed at t = 0. Find the values of $i_1, i_2, \frac{di_1}{dt},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



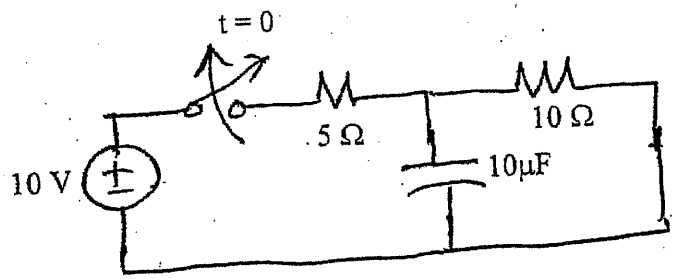
2. a) In the circuit shown in figure below, if the switch is closed at t = 0, find the expression for voltage across capacitor using classical method. [8]



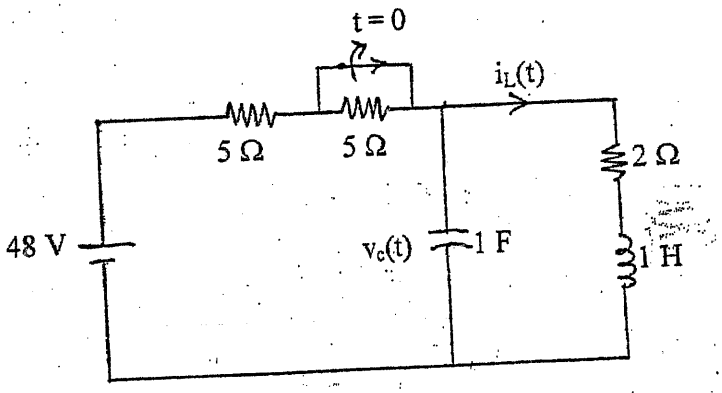
   b) Keeping the switch closed for a long time, if the switch is opened at t = 0 in the circuit shown in figure below, find expression for voltage across capacitor using classical method of solution. [8]



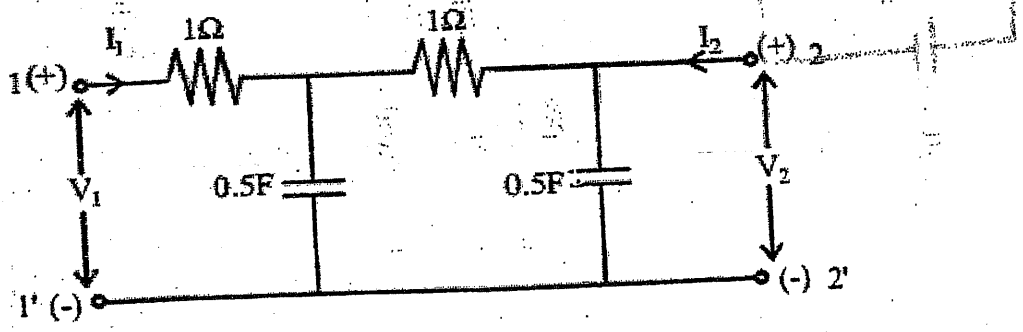
3. a) For the circuit shown in figure below, Find the current and voltage of capacitor for $t > 0$ using Laplace Transform method. [8]



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



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

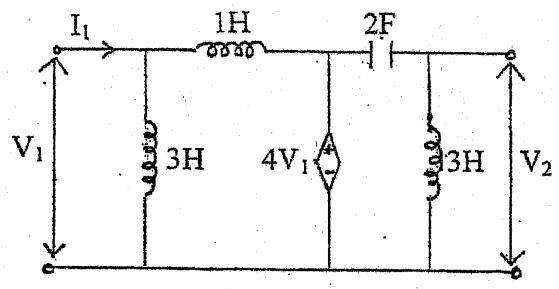


b) Sketch the Bode Plot for the transfer function given by [8]

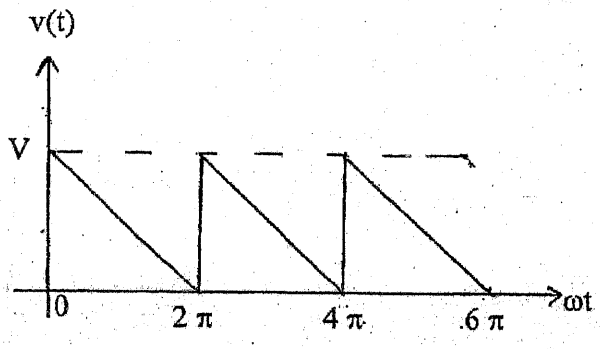
$$H(S) = 200(S+1)/[S(S+5)(S^2+2S+100)]$$

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

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



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



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27 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2073 Shrawan

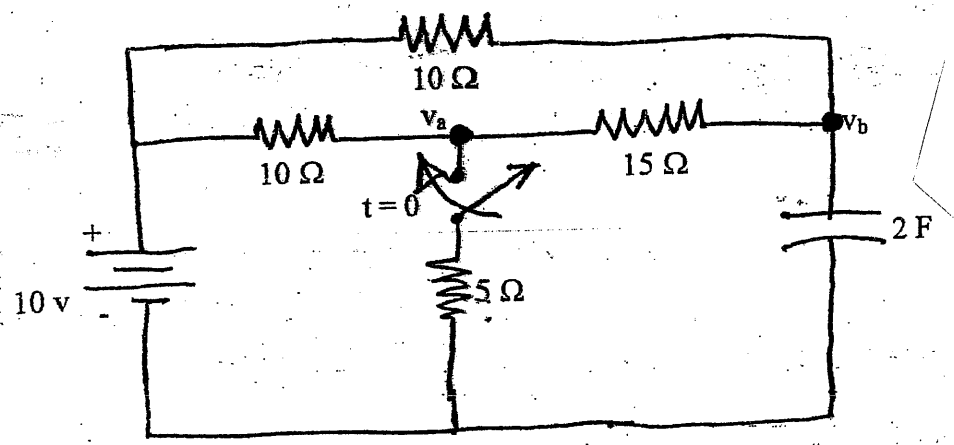
Exam.	New Back (2066 & Later Batch)		
Level	BE	Full Marks	80
Programme	BEL, BEX, BCT	Pass Marks	32
Year / Part	II / I	Time	3 hrs.

Subject: - Electric Circuit Theory *(EE501)*

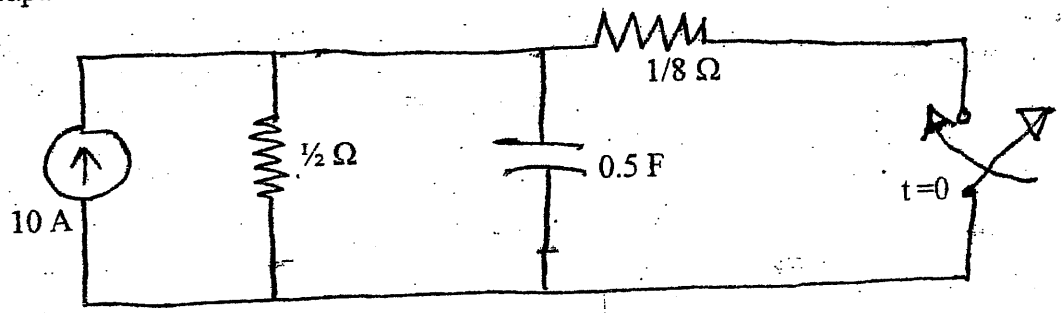
- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ ***All** questions carry equal marks.*
- ✓ ***Necessary Semi-log graph paper is Provided.***
- ✓ *Assume suitable data if necessary.*

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

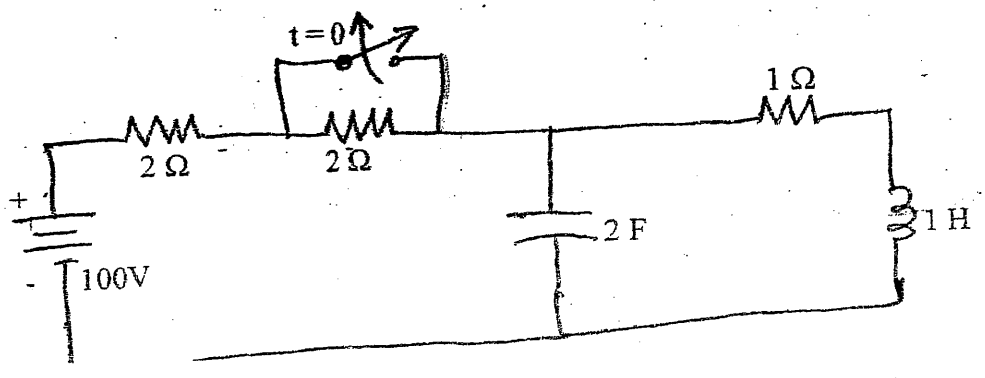
   b) In the network shown in figure below a steady state is reached with the switch open. At t = 0, the switch is closed. Determine the value of $u_a(0^-)$ and $u_a(0^+)$.



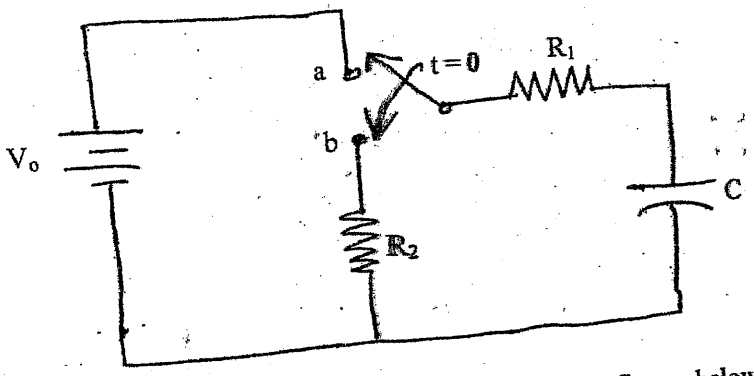
2. a) Using classical method in the circuit shown in figure below. Find the voltage across capacitor for t > 0.



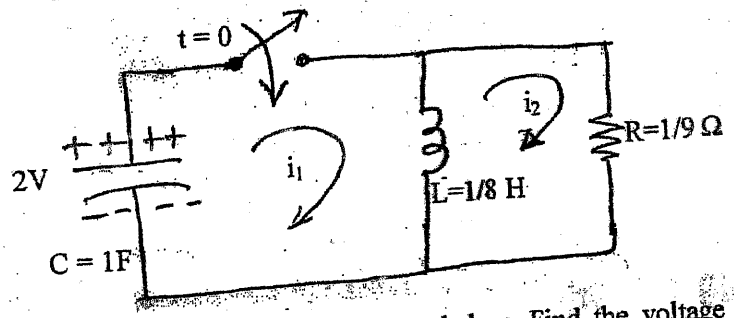
   b) Using classical method, in the circuit shown in figure below. Find the current through inductor and voltage across capacitor for t > 0



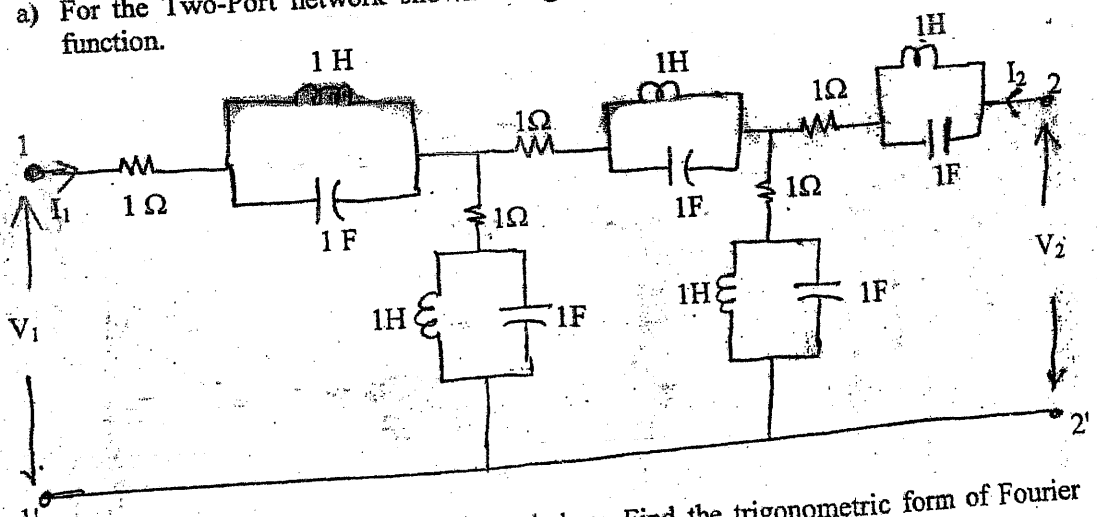
3. a) Using Laplace Transform method in the circuit shown in figure below find the voltage and current of capacitor for $t > 0$



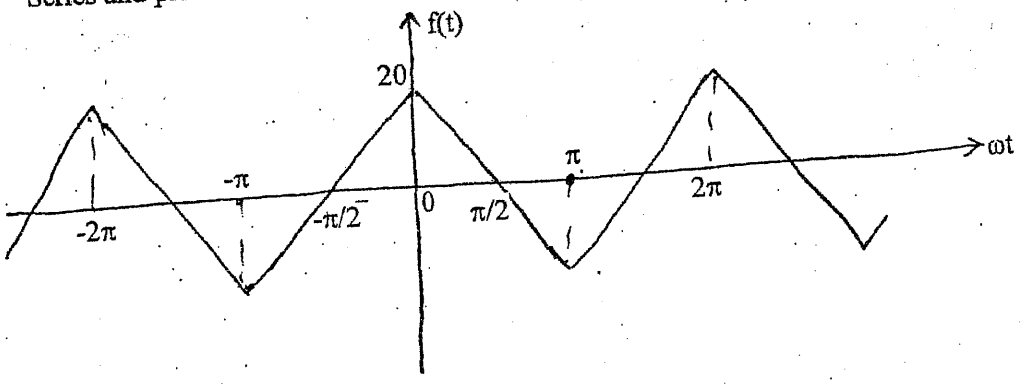
b) Using Laplace Transform method in the circuit shown in figure below. Find the current i_1 and i_2 for $t > 0$.



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



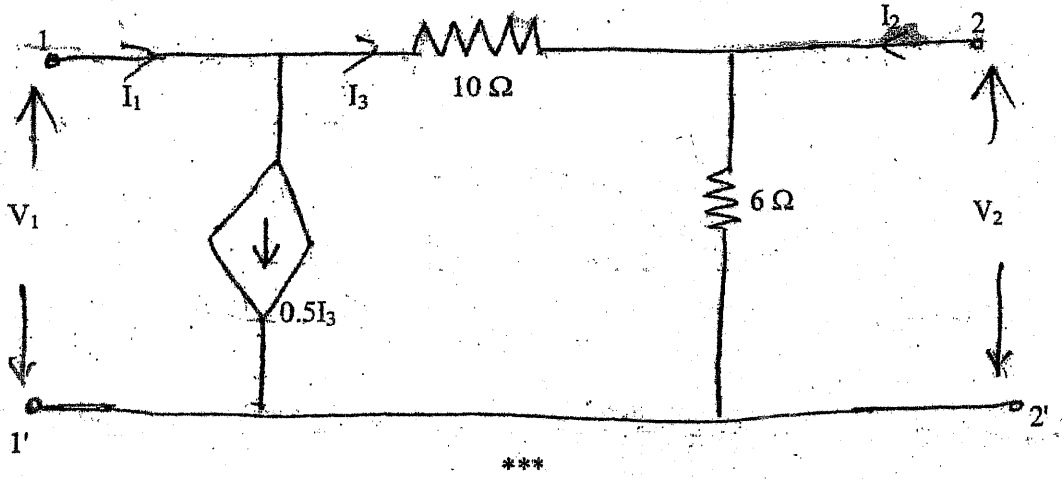
b) For the Waveform shown in figure below. Find the trigonometric form of Fourier Series and plot the line spectrum.



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

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

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



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24 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2072 Chaitra

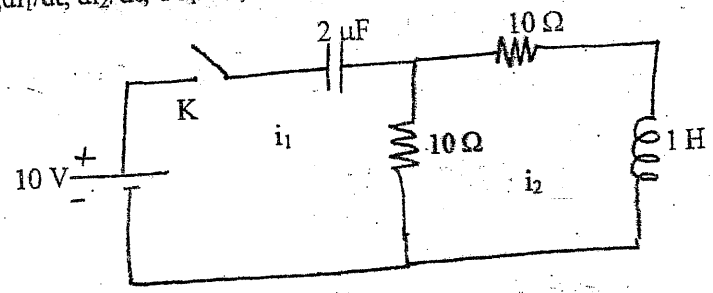
Exam.	Regular		
Level	BE	Full Marks	80
Programme	BEL, BEX, BCT	Pass Marks	32
Year / Part	II / I	Time	3 hrs.

Subject: - Electric Circuit Theory *(EE501)*

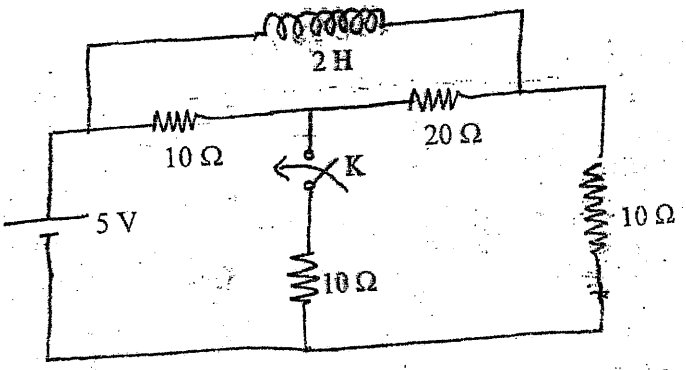
- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Assume suitable data if necessary.*

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

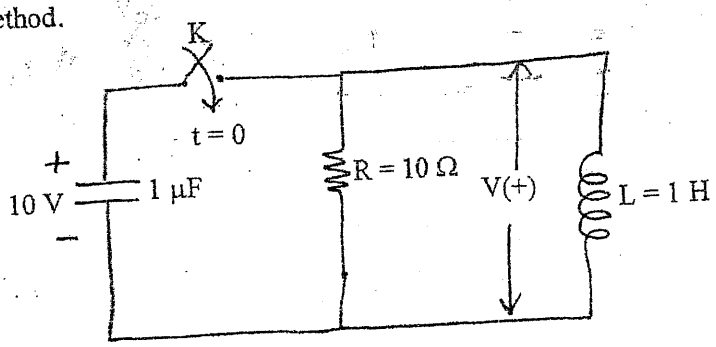
   b) In the circuit shown in figure below, switch K is closed at time t = 0. Find the values of i_1, i_2, di_1/dt, di_2/dt, d^2i_1/dt^2, d^2i_2/dt^2 at t =0+. [8]



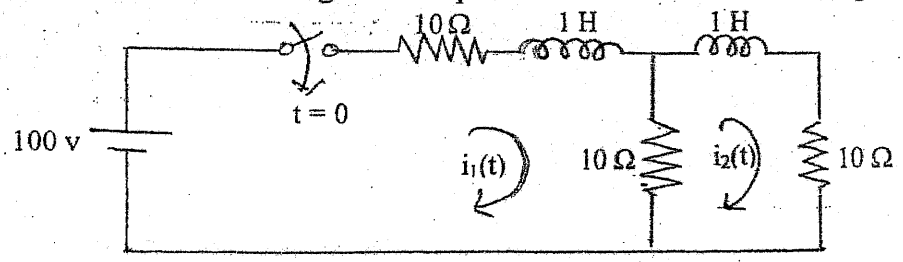
2. a) In the circuit of the figure below, the switch K is open and the circuit reaches a steady state. At t = 0, K is closed. Find the current in the inductor t > 0. Use classical method. [8]



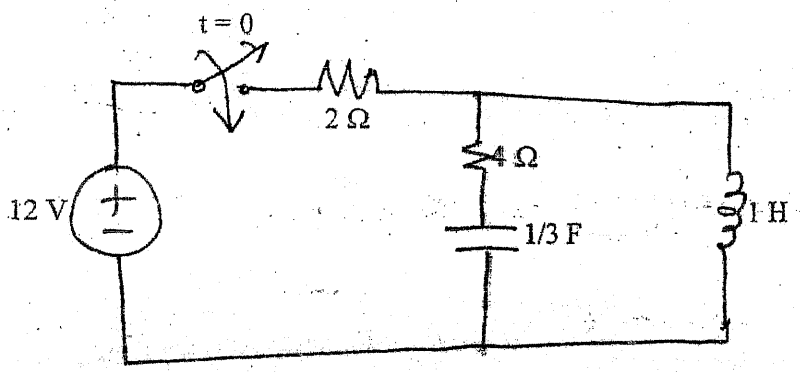
   b) In the circuit shown in figure below capacitor C has an initial voltage V_C = 10 volts and at the same instant, current through the inductor L is zero. The switch K is closed at t = 0. Find out the expression for the voltage V(t) across the inductor L using classical method. [8]



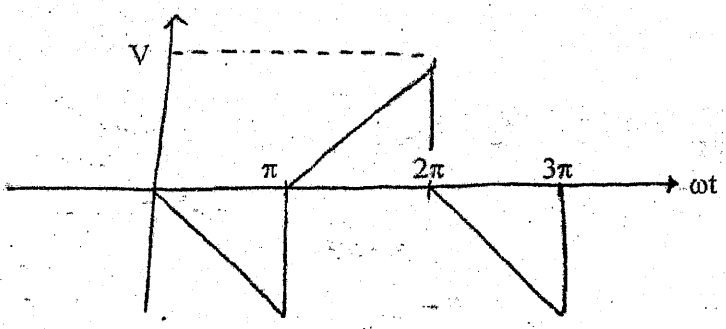
3. a) Using Laplace transform method find the expressions for $i_1(t)$ and $i_2(t)$ in the given two mesh network shown in figure below provided that the network is unenergised. [8]



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



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

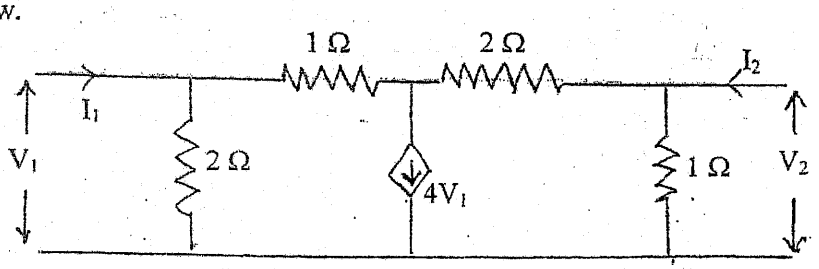


b) For the network shown in figure below find the voltage ratio transfer function and transfer impedance. [8]

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

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

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



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

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24 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2072 Kartik

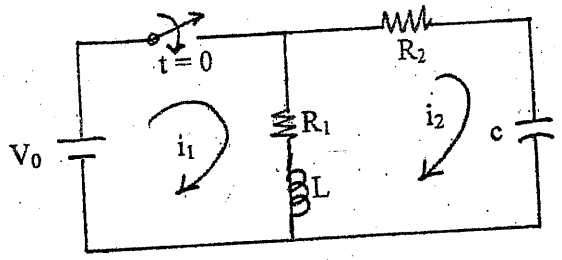
Exam.	New Back (2066 & Later Batch)		
Level	BE	Full Marks	80
Programme	BEL, BEX, BCT	Pass Marks	32
Year / Part	II / I	Time	3 hrs.

Subject: - Electric Circuit Theory *(EE501)*

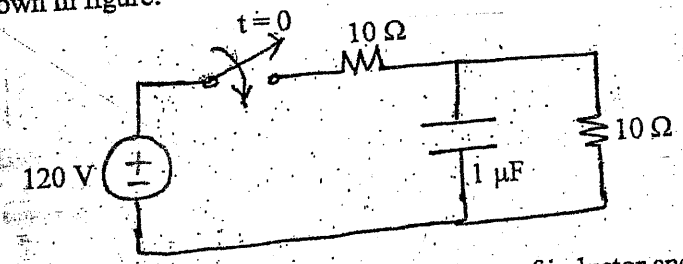
- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Assume suitable data if necessary.*

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

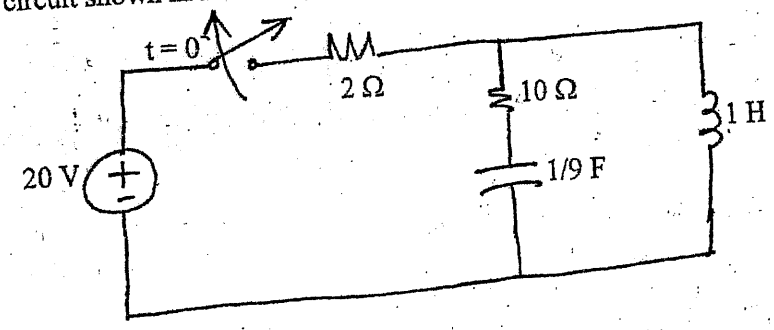
   b) If the switch is closed at t = 0 in the circuit shown in figure below, Obtain the value of $i_1, i_2, di_1/dt, di_2/dt, d^2i_1/dt^2$ and d^2i_2/dt^2 at $t = 0^+$ [8]



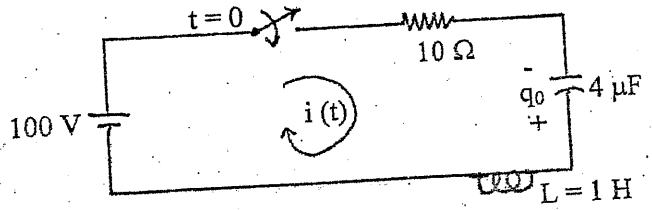
2. a) Using classical method, Find the current and voltage of capacitor for t > 0 in the circuit shown in figure. [8]



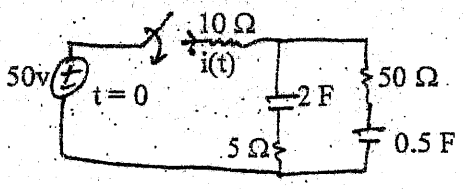
   b) Using classical method, find the current and voltage of inductor and capacitor for t > 0 in the circuit shown in following figure. [8]



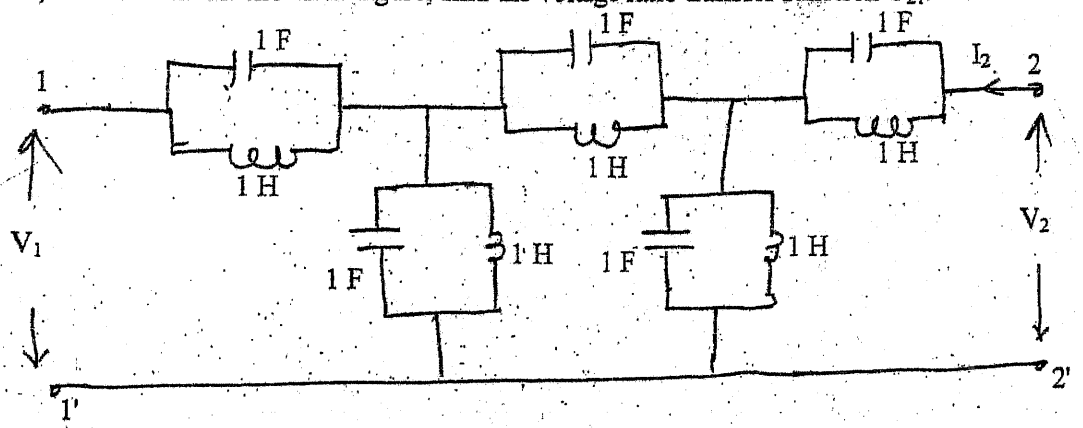
3. a) In the circuit shown in figure below, the capacitor has an initial charge of $q_0 = 800\ \mu C$ with polarity shown in the figure. Find current i(t) if the switch is closed at t = 0 using Laplace Transform method. [8]



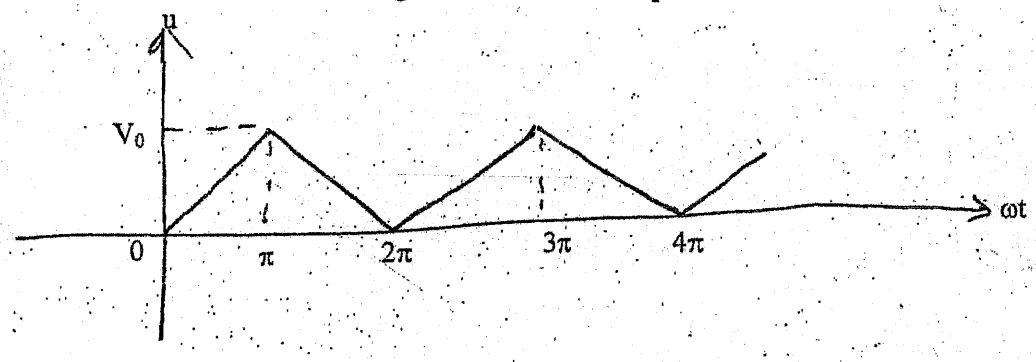
b) Solve for i(t) for t > 0 by using Laplace transformation. The switch closes time t = 0. Assume zero initial charge across the capacitors. [8]



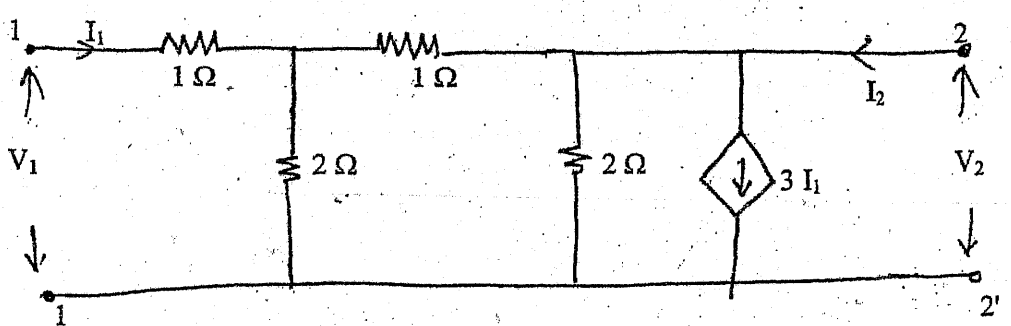
4. a) For the circuit shown in figure, find the voltage ratio transfer function G_{21}. [5]



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



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



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

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

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

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24 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2071 Chaitra

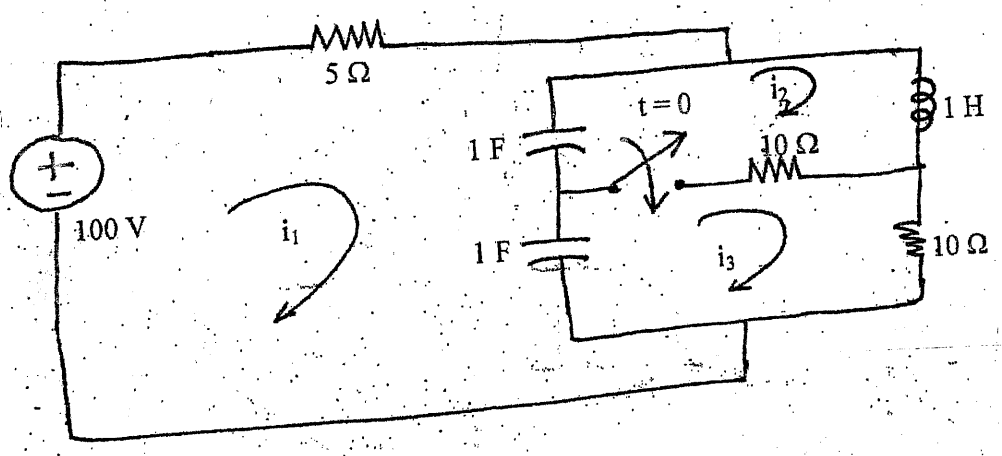
Exam.	Regular		
Level	BE	Full Marks	80
Programme	BEL, BEX, BCT	Pass Marks	32
Year / Part	II / I	Time	3 hrs.

Subject: - Electric Circuit Theory *(EE501)*

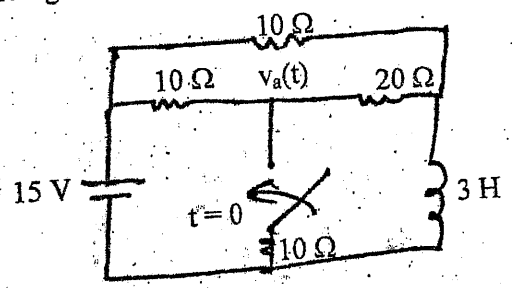
- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Assume suitable data if necessary.*

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

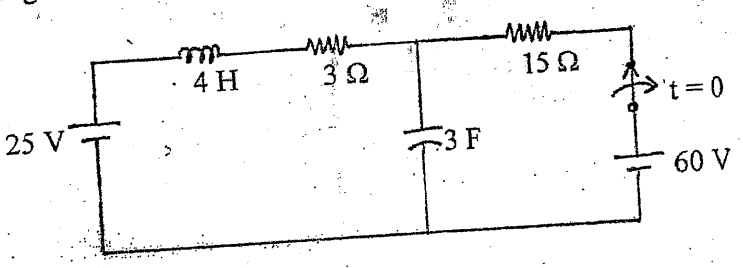
   b) In the circuit shown in following figure, find the loop currents i_1, i_2, i_3 at $t = 0^+$. [8]



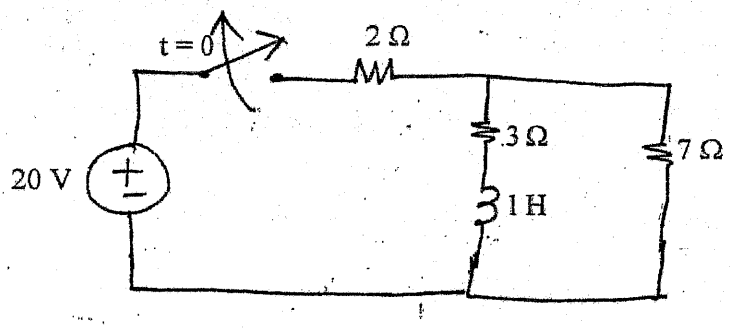
2. a) Find $v_a(t)$ for $t > 0$ in the figure below using classical method. [8]



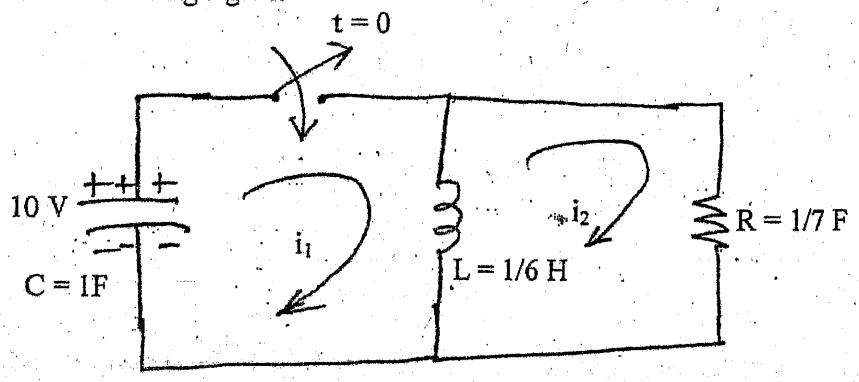
   b) Keeping the switch closed for a long time, if the switch is opened at t = 0 in the circuit shown in figure below, find expression for voltage across capacitor in the circuit shown in below using classical method of solution. [8]



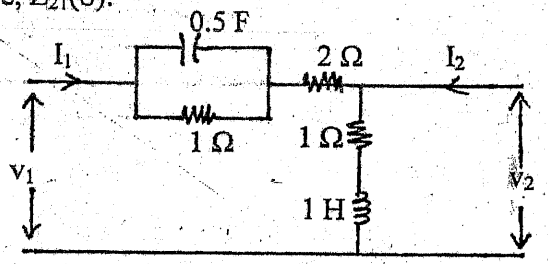
3. a) Using Laplace Transform method, find the current and voltage across inductor for t > 0 in the circuit shown in figure below. [8]



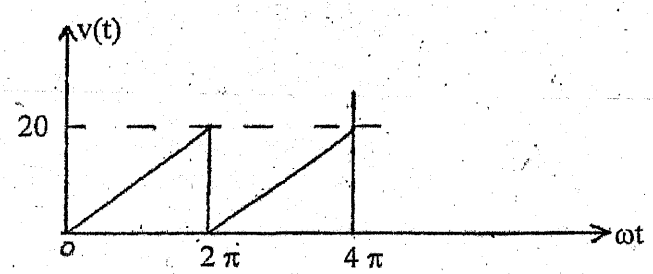
b) Using Laplace transform method, find he loop currents i_1 and i_2 for t > 0 in the circuit shown in the following figure. [8]



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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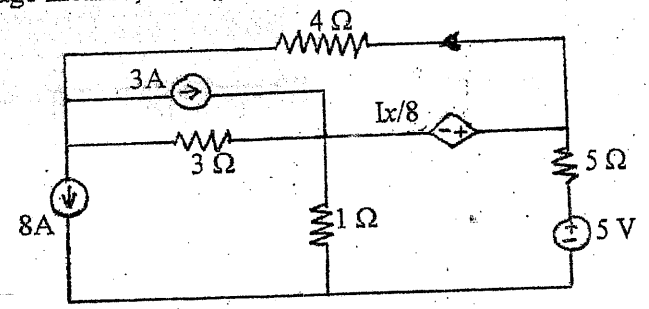
27 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2071 Shawan

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

Subject: - Electric Circuit Theory *(EE501)*

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

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

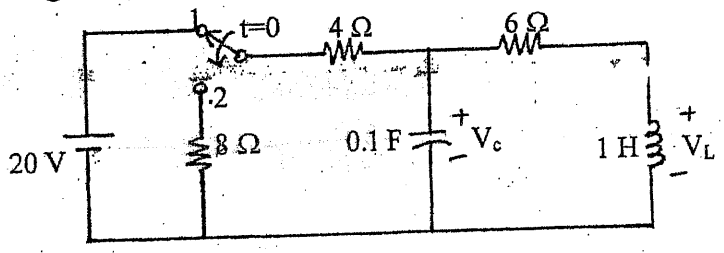


b) A 10Ω resistor is placed in series with a coil of self resistance R_L and inductance L a pure capacitor 'C' across a 50 V variable frequency supply. The current is maximum and has value of 1 A when the frequency is 500 HZ, At this frequency, voltage across the capacitor is 300 Volts, Calculate (i)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

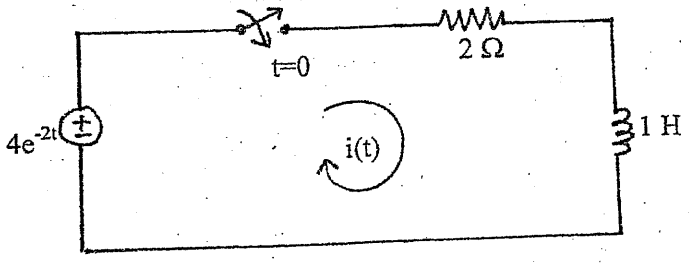
c) Define bandwidth of a series RLC circuit. How the quality factor changes with the change of R. [2+2]

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

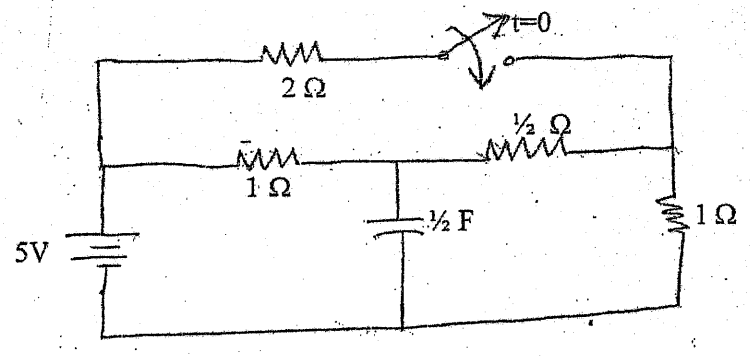
b) Keeping the switch at position 1 for a long time in the network shown in figure below, if it is changed to position 2 at t=0, find i_1, i_2, V_L, V_C, di_1/dt and dv_c/dt at $t=0^+$. [6]



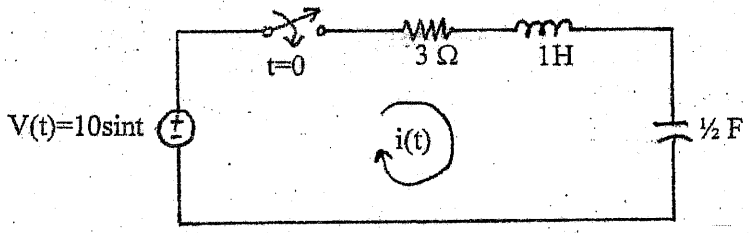
c) In a series RL circuit shown in figure below, if the switch is closed at t = 0, find particular solution for i(t) using classical method. [6]



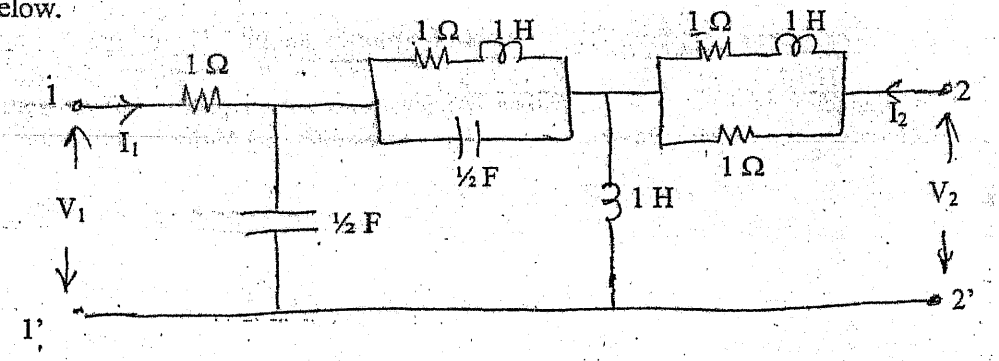
3. a) Using classical method, find the current through capacitor for $t > 0$ in the network shown in figure below. [8]



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



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

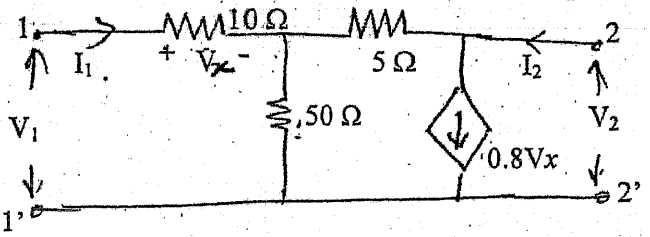


b) Sketch the Bode Plot for the transfer function given by:

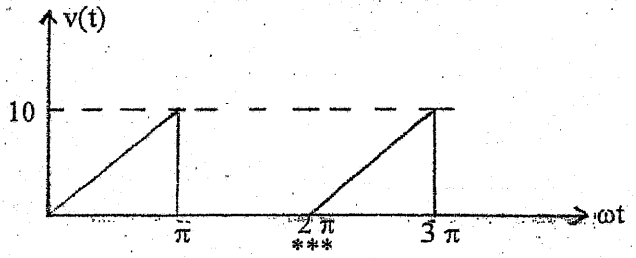
$H(S) = 80(S+20)/[(S^2+5S)(S^2+20S+1600)]$. [10

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

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



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



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TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2080 Bhadra

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 *(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. Using the properties of determinant, prove the following identity. [5]

$$\begin{vmatrix} a & b & c \\ b+c & c+a & a+b \\ a^2 & b^2 & c^2 \end{vmatrix} = -(a-b)(b-c)(c-a)(a+b+c)$$

2. Define transpose of a matrix. Prove that every square matrix can be expressed as a sum of symmetric matrix and skew-symmetric matrix uniquely. [1+4]

3. Define rank of matrix. Find the rank of matrix $\begin{bmatrix} 3 & 1 & 4 \\ 0 & 5 & 8 \\ -3 & 4 & 4 \\ 1 & 2 & 4 \end{bmatrix}$ by reducing to normal form. [1+4]

4. State Cayley-Hamilton Theorem and verify it for the matrix. [1+4]

$$A = \begin{bmatrix} 1 & 0 & 2 \\ 0 & 2 & 1 \\ 2 & 0 & 3 \end{bmatrix}$$

5. Prove that the integral $\int_A^B \vec{F}.d\vec{r}$ is independent of the path joining any two points A and B in a region if and only if $\int_c \vec{F}.d\vec{r} = 0$ for any simple closed curve C in the region formed by arcs joining the points A and B. [5]

6. State Green's theorem in plane and apply it to evaluate $\int_c [(2x-y+4)dx + (5y+3x-6)dy]$ around a triangle in the xy-plane with vertices at (0,0), (3,0), (3,2). [1+4]

7. State Gauss' divergence Theorem. Evaluate $\iint_S \vec{F}.\hat{n}\,ds$ where $\vec{F} = x\,\vec{i} + y\,\vec{j} + z\,\vec{k}$ and S is the surface of the sphere $x^2 + y^2 + z^2 = 1$ by using Gauss' divergence theorem. [1+4]

8. Evaluate $\int_C (xydx + xy^2dy)$ by stoke's theorem where C is the square in the xy-plane with vertices (1,1), (-1,1), (-1,-1) and (1,-1). [5]

9. Find the fourier series of the function f(x) = xsinx as a fourier series in $-\pi \le x \le \pi$. Also deduce that $\frac{1}{1.3} - \frac{1}{3.5} - \frac{1}{7.9} \ldots\ldots\ldots = \frac{\pi - 2}{4}$. [4+1]

10. Find half range Fourier sine series for $f(x) = x - x^2$ in $0 < x < 1$. [5]

11. State the condition for a function to exist its Laplace transform. Find the Laplace transform of : [1+2+2]

a) $\frac{1}{t}(e^{at} - \cos 6t)$

b) $f(t) = \begin{cases} \sin t, & \text{for } 0 < t < \pi \\ t & \text{for } t > \pi \end{cases}$

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

a) $\tan^{-1}\left(\frac{1}{s}\right)$

b) $\frac{1}{s(s-4)^2}$

13. Solve the initial value problem by Laplace transform method: [5]

$y'' + y = \sin 3t;\ y(0) = 0,\ y'(0) = 0.$

14. Use the simplex method to solve the linear programming problem (constructing duality): [7]

Minimize $z = 3x_1 + 2x_2$ subject to $3x_1 - x_2 \ge -5$,

$-x_1 + 4x_2 \ge 1$, $x_1 + 9x_2 \ge 6$ and $x_1, x_2 \ge 0$.

15. Solve the linear programming problem by simplex method using Big-M method:

Maximize $F = 2x_1 + x_2$ subject to $2x_1 - x_2 \ge 2$,

$x_1 - x_2 \le 2$, $x_1 + x_2 \le 4$ and $x_1, x_2 \ge 0$. [8]

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TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2081 Baishakh

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

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

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

1. Use properties of determinant to prove: $\begin{vmatrix} (b+c)^2 & a^2 & a^2 \\ b^2 & (c+a)^2 & b^2 \\ c^2 & c^2 & (a+b)^2 \end{vmatrix} = 2abc(a+b+c)^3$ [5]

2. Prove that the necessary and sufficient condition for a square matrix A to possess an inverse is that A is non-singular. [5]

3. Define rank of a matrix. Reduce the matrix $\begin{bmatrix} 2 & -2 & 0 & 6 \\ 4 & 2 & 0 & 2 \\ 1 & -1 & 0 & 3 \\ 1 & -2 & 1 & 2 \end{bmatrix}$ into echelon form and hence find its rank. [1+4]

4. Find the modal matrix of the matrix $A = \begin{bmatrix} 1 & 0 & -1 \\ 1 & 2 & 1 \\ 2 & 2 & 3 \end{bmatrix}$ [5]

5. A vector field is given by $\vec{F} = \text{Siny}\,\vec{i} + x(1+\cos y)\,\vec{j}$. Evaluate the line integral over the circular path given by $x^2 + y^2 = a^2, z = 0$ [5]

6. State Green's theorem. Using Green's theorem, find the area of asteroid $x^{\frac{2}{3}} + y^{\frac{2}{3}} = a^{\frac{2}{3}}$ [1+4]

7. State Gauss divergence theorem. Evaluate $\iint_S \vec{F}.\hat{n}ds$ for $\vec{F} = 2x\,\vec{i} + 3y\,\vec{j} + 4z\,\vec{k}$ where S is the surface of sphere $x^2 + y^2 + z^2 = 1$ by Gauss's divergence theorem. [1+4]

8. Use Stoke's theorem to evaluate $\iint_S \left(\nabla \times \vec{F}\right).\vec{n}\,ds$ where $\vec{F} = y\,\vec{i} + x(1-2z)\,\vec{j} - xy\,\vec{k}$ and S is the surface of the sphere $x^2+y^2+z^2 = a^2$ above the xy-plane. [5]

9. Find the Fourier series of the function $f(x) = |x|$ for $-\pi \le x \le \pi$ in a Fourier series and deduce $\frac{\pi^2}{8} = \frac{1}{1^2} + \frac{1}{3^2} + \frac{1}{5^2} + \ldots\ldots$ [4+1]

10. Find half-range Fourier sine series of $f(x) = e^{ax}$ in the interval $0 \le x \le \pi$. [5]

11. Discuss the existence of Laplace transform. Find the Laplace transform of [1+2+2]
(i) te^t (ii) sinhat sinat

12. Find the Inverse Laplace transform of a) $\frac{s^2}{(s-1)^3}$ b) $\frac{s^2}{(s^2+4)^2}$ [2+3]

13. Solve the following differential equation by Laplace transform method
$y''+3y'+2y=e^t, y(0)=0=y'(0)$ [5]

14. Solve the following linear programming problem using the big M method; [7]
Maximize $P=2x_1+x_2$ subject to
$x_1+x_2 \leq 10$
$-x_1+x_2 \geq 2$
$x_1, x_2 \geq 0$

15. Use duality of simplex method to minimize, $z=8x_1+9x_2$ subject to : [8]
$x_1+3x_2 \geq 4$
$2x_1+x_2 \geq 5$
$x_1, x_2 \geq 0$

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TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2080 Baishakh

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

Subject: - Engineering Mathematics *(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. Use properties of Determinant to show $\begin{vmatrix} a-b-c & 2a & 2a \\ 2b & b-c-a & 2b \\ 2c & 2c & c-a-b \end{vmatrix} = (a+b+c)^3$. [5]

2. Show that for every complex square matrix, it can be uniquely express as the sum of a Hermitian matrix and a skew- Hermitian matrix. [5]

3. Test the consistency of the system of equations:

   $x+2y-z=0,\ 2x+3y+z=10,\ 3x-y-7z=1.$

   and solve completely if found consistent. [5]

4. Find the eigen-values of the matrix $A=\begin{bmatrix} 2 & -2 & 2 \\ 1 & 1 & 1 \\ 1 & 3 & -1 \end{bmatrix}$. [3+1+1]

   Hence use them to compute:

   a) $|A|$

   b) Eigenvalues of A^{-1}

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

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

7. State Green's theorem in plane. Apply it to find the area of the curve $x^{2/3}+y^{2/3}=a^{2/3}$. [1+4]

8. Apply Gauss' divergence theorem to evaluate $\iint_S \vec{F}.\hat{n}\,ds$ where

$\vec{F} = (2xy+z)\vec{i} + y^2\vec{j} - (x+3y)\vec{k}$ and v is the region bounded by the surface of the planes $2x+2y+z = 6$, $x = 0$, $y = 0$, $z = 0$. [5]

9. Obtain a Fourier series to represent $x + x^2$ for $-\pi \le x \le \pi$ and

Deduce that $\frac{\pi^2}{6} = \frac{1}{1^2} + \frac{1}{2^2} + \frac{1}{3^2} + \frac{1}{4^2} \ldots\ldots\ldots\ldots$ [5]

10. Define periodic function. Find the Fourier series of the function [2+3]

$f(x) = 2x - x^2$ in the interval (0,2)

11. State existence condition for Laplace transform. Obtain the Laplace transform of [1+2+2]

a) $\frac{1}{\sqrt{t}}$

b) $\frac{1-\cos 2t}{t}$

12. Obtain a Fourier series to represent x+x2 for $-\pi \le x \le \pi$ and

Deduce that $\frac{\pi^2}{6} = \frac{1}{1^2} + \frac{1}{2^2} + \frac{1}{3^2} + \frac{1}{4^2} \ldots\ldots\ldots\ldots$ [5]

13. Solve the initial value problem by Laplace transform method:

$y''-3y'+2y = 4x + e^{3x}$; $y(0) = 1$, $y'(0) = -1$. [5]

14. Solve the following Linear programming problem by using simplex method Max $p = 15x+10y$, subject to $2x+y \le 10$, $x+3y \le 10$ and $x, y \ge 0$. [7]

15. Solve the Linear Programming Problem by Big M method: [8]

Maximize: $P = 2x_1 + x_2 + 3x_3$

Subject to: $x_1 + x_2 + 2x_3 \le 5$

$2x_1 + 3x_2 + 4x_3 = 12$

and $x_1, x_2, x_3 \ge 0$.

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TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2079 Bhadra

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Maximize: $Z = 10x_1 + x_2 + 2x_3$

Subject to: $x_1 + x_2 - 2x_3 \le 10$

$4x_1 + x_2 + x_3 \le 20$

and $x_1, x_2, x_3 \ge 0$.

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

Maximize $Z = 3x_1 - x_2$

Subject to $2x_1 + x_2 \ge 2$

$x_1 + 3x_2 \le 2$

$x_2 \le 4$; $x_1, x_2 \ge 0$.

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TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2079 Baishakh

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

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

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

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

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

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

4. State Cayley-Hamilton theorem and use it to find the inverse of the matrix: [5]

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

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

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

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

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

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

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

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

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

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

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

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

Maximize, $P = -x_1+2x_2$

Subject to :

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

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

Maximize, $P = 2x_1+5x_2$

Subject to :

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

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TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2078 Bhadra

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Maximize, $P = x_1 + x_2$

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

$x_1 \le 6$

$x_2 \le 10$

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

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

Minimize, $C = 21x_1 + 50x_2$

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

$3x_1 + 7x_2 \ge 17$

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

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TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2078 Kartik

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

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

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

1. If $\begin{vmatrix} a & a^2 & a^3-1 \\ b & b^2 & b^3-1 \\ c & c^2 & c^3-1 \end{vmatrix} = 0$; where $a \neq b \neq c$, apply the properties of determinants to show $abc = 1$. [5]
2. Define an orthogonal matrix. Prove that the product of two orthogonal matrices of the same order is also orthogonal. [5]
3. For the matrix $= \begin{bmatrix} 5 & 4 \\ 1 & 2 \end{bmatrix}$, find the modal matrix and the corresponding diagonal matrix. [5]
4. State Cayley-Hamilton theorem and verify the theorem for the square matrix $A = \begin{bmatrix} 1 & 3 & 7 \\ 4 & 2 & 3 \\ 1 & 2 & 1 \end{bmatrix}$. [5]
5. Prove that "for any simple closed curve C, the line integral $\int_A^B \vec{F}.d\vec{r}$ is independent of the path joining the points A and B in the region if and only if $\int_C \vec{F}.d\vec{r} = 0$. [5]
6. State Green's theorem in the plane. Using Green's theorem find the area of the hypocycloid $\left(\frac{x}{a}\right)^{2/3} + \left(\frac{y}{b}\right)^{2/3} = 1$. [5]
7. Evaluate $\iint_S \vec{F}.\vec{n}\,ds$ by Gauss' divergence theorem, where $\vec{F} = x\,\vec{i} - y\,\vec{j} + (z^2-1)\,\vec{k}$ and S is the cylinder formed by the surfaces $x^2 + y^2 = 4$, $z = 0$, $z = 1$. [5]
8. Verify Stoke's theorem for $\vec{F} = (x^2 - y^2)\vec{i} + 2xy\vec{j}$ taken over the rectangular bounded by the lines $x = 0, x = a, y = 0, y = b$. [5]
9. Define Laplace transform of f(t). Find the Laplace transform of:
   a) $t\,e^{-t}\cosh t$ b) $\frac{\sin t \sin 5t}{t}$ [1+1.5+2.5]
10. Find the inverse Laplace transform of:
    a) $\log\frac{s}{s+1}$ b) $\frac{1}{(s-2)(s^2+1)}$ [2.5+2.5]
11. Solve the initial value problem $y'' + 4y' + 3y = 0$, $y(0) = 3$, $y'(0) = 1$ by using Laplace transform. [5]
12. Find the Fourier series of $f(x) = 2x - x^2$ in $(0, 2)$. [5]
13. Obtain the half range sine series for $f(x) = e^x$ in $0 < x < 1$. [5]
14. Use Simplex method to solve following LPP: [7]

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

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

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TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2076 Chaitra

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

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

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

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

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

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

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

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

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

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

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

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

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

10. Find the inverse Laplace transform of:

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

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

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

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

14. Use Simplex method to solve following LPP:

Maximize, $P = 30x_1 + x_2$

Subject to : $2x_1 + x_2 \le 10$

$x_1 + 3x_2 \le 10$

$x_1, x_2 \ge 0$ [7]

15. Use Big M method to solve following LPP:

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

Subject to : $3x_1 + x_2 \ge 27$

$-x_1 - x_2 \le -21$

$x_1 + 2x_2 \ge 30$

$x_1, x_2 \ge 0$ [8]

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TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2076 Ashwin

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

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

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

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

2. Prove that the necessary and sufficient condition for a square matrix A to possess an inverse is that $|A| \neq 0$. [5]

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

4. State any two properties of eigen values of a matrix. Obtain eigen values and eigen vectors of the matrix $\begin{bmatrix} -2 & 2 & -3 \\ 2 & 1 & -6 \\ -1 & -2 & 0 \end{bmatrix}$ [1+4]

5. Prove that the line integral $\int_A^B \vec{F}.d\vec{r}$ is independent of path joining any two points A and B in the region if and only if $\int_C \vec{F}.d\vec{r} = 0$ for any simple closed curve C in the region. [5]

6. State Green's Theorem and use it to find the area of the curve $\left(\frac{x}{a}\right)^{2/3} + \left(\frac{y}{b}\right)^{2/3} = 1$. [1+4]

7. Use Gauss' divergence theorem to evaluate $\iint_s \vec{F}.\hat{n}ds$ where $\vec{F} = (2xy+z)\vec{i} + y^2\vec{j} - (x+3y)\vec{k}$ and S is the surface bounded by the plane 2x+3y+z=6, x=0, y=0, z=0. [5]

8. Verify Stoke's Theorem for the vector field $\vec{F} = (2x-y)\vec{i} - yz^2\vec{j} - y^2z\vec{k}$ over the upper half of the sphere $x^2+y^2+z^2=1$ bounded by its projection on xy-plane. [5]

9. Find the Laplace transform of: [2+3]
   i) $t^2\cos at$
   ii) $\frac{1-\cosh(at)}{t}$

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

i) $\frac{e^{-\pi s}(s+1)}{s^2+2s+2}$

ii) $\tan^{-1}\frac{2}{s}$

11. Solve the differential equation $y''+3y'+2y=e^{-t}$, $y(0)=y'(0)=0$ by applying Laplace transform. [5]

12. Find the Fourier Series of the function $f(x)=|\sin x|$ for $-\pi \le x \le \pi$. [5]

13. If $f(x) = lx-x^2$ in $(0,1)$, show that the half range sine series for $f(x)$ is $\frac{8l^2}{\pi^3}\sum_{n=0}^{\infty}\frac{1}{(2n+1)^3}\sin(2n+1)\frac{\pi x}{l}$. [5]

14. Find the maximum and minimum values of the function $z=20x+10y$ subject to: $x+2y\le 40$, $3x+y\ge 30$, $4x+3y \ge 60$, $x,y\ge 0$ by graphical method. [5]

15. Solve the following linear programming problem using big M method:

Maximize $P=2x_1+5x_2$

subject to : $x_1+2x_2 \le 18$

$2x_1+x_2 \ge 21$

$x_1, x_2 \ge 0$. [10]

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TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2075 Chaitra

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

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

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

1. If $\begin{vmatrix} a & a^2 & a^3-1 \\ b & b^2 & b^3-1 \\ c & c^2 & c^3-1 \end{vmatrix} = 0$, where $a \neq b \neq c$ show that abc=1. [5]

2. If A is a square matrix of order n, prove that A(adj. A) = (adj. A)A = $|A|I_n$, where I_n is a unit matrix having same order as A. [5]

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

4. State Cayley-Hemilton Thorem and verify it for the matrix $A=\begin{bmatrix} 1 & 0 & -1 \\ 1 & 2 & 1 \\ 2 & 2 & 3 \end{bmatrix}$ [1+4]

5. A vector field is given by $\vec{F} = \sin y\vec{i} + x(1+\cos y)\vec{j}$. Evaluate the line integral $\int_c \vec{F}.d\vec{r}$ over the circular path c given by $x^2+y^2=a^2$, z=0. [5]

6. State and prove Green's Theorem in plane. [1+4]

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

8. State Stoke's theorem. Evaluate $\oint_c (xydx + xy^2dy)$ by Stoke's theorem taking c to be a square in the xy-plane with vertices (1,0),(-1,0),(0,1) and (0,-1). [1+4]

9. Find the Laplace transform of : [2+3]
   i) $te^{-t}\sin t$
   ii) $\dfrac{\cos 2t - \cos 3t}{t}$

10. Find the inverse Laplace transform of : [2+3]
    i) $\dfrac{s+2}{(s+1)^4}$
    ii) $\cot^{-1}(s+1)$

11. Solve the differential equation y"+y=sin3t, y(0)=y'(0)=0 by using Laplace transform. [5]

12. Define Fourier Series for a function f(x). Obtain Fourier series for $f(x)=x^3$; $-\pi \le x \le \pi$. [5]

13. Express $f(x)=e^x$ as the half range Fourier Sine series in $0<x<1$. [5]

14. Find the maximum and minimum values of the function $z = 50x_1 + 80x_2$ subject to: $x_1 + 2x_2 \le 32$, $3x_1 + 4x_2 \le 84$, $x_1x_2 \ge 0$; by graphical method. [5]

15. Solve the following Linear Programming problem using big M method: [10]
    Maximize $P= 2x_1+x_2$
    Subject to : $x_1+x_2 \le 10$
    $-x_1+x_2 \ge 2$
    $x_1,x_2 \ge 0$

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02 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2075 Ashwin

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

Subject: - Engineering Mathematics III *(SH501)*

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

1. Define the determinant as a function and using its properties. Show that

$$\begin{vmatrix} b+c & c+a & a+b \\ q+r & r+p & p+q \\ y+z & z+x & x+y \end{vmatrix} = 2\begin{vmatrix} a & p & x \\ b & q & y \\ c & r & z \end{vmatrix}$$ [5]

2. If A and B are orthogonal matrices of same order, prove that the product AB is also orthogonal. [5]
3. Test the consistency of the system $x-2y+2z=4$, $3x+y+4z=6$ and $x+y+z=1$ and solve completely if found consistent. [5]
4. For a matrix $A=\begin{pmatrix} 5 & 4 \\ 1 & 2 \end{pmatrix}$, find the modal matrix and the corresponding diagonal matrix. [5]
5. Prove that line integral $\int_A^B \vec{F}.d\vec{r}$ is independent of path joining any two points A and B in the region if and only if $\int_C \vec{F}.d\vec{r}=0$ for any simple closed curve C in the region. [5]
6. Verify Green's theorem in the plane for $\int_C [(3x^2-8y^2)dx+(4y-6xy)dy]$ where C is region bounded by $y=x^2$ and $x=y^2$. [5]
7. Evaluate $\iint_S \vec{F}.\vec{n}\,ds$ where $\vec{F}=6z\vec{i}-4\vec{j}+y\vec{k}$ and S is the region of the plane $2x+3y+6z=12$ bounded in the first octant. [5]
8. Evaluate using Gauss divergence theorem, $\iint_S \vec{F}.\vec{n}\,ds$ where $\vec{F}=x^2y\vec{i}+xy^2\vec{j}+2xyz\vec{k}$ and S is the surface bounded by the planes $x=0, y=0, z=0, x+2y+z=2$. [5]
9. Obtain the Fourier Series to represent $f(x)=x-x^2$ from $x=-\pi$ to $x=\pi$ and deduce that

$$\frac{\pi^2}{12}=\frac{1}{1^2}-\frac{1}{2^2}+\frac{1}{3^2}-\frac{1}{4^2}+\ldots\ldots$$ [5]

10. Obtain the half range Fourier Sine Series for $f(x)=\pi-x$ in the range $0<x<\pi$. [5]
11. State the conditions for existence of Laplace transform. Obtain the Laplace transform of: [1+2+2]

(i) $e^{2t}\cos^3 2t$ (ii) $\frac{\cos 2t-\cos 3t}{t}$

12. Find the inverse Laplace transform of:

(i) $\frac{1}{(S-2)(S^2+1)}$ (ii) $\cot^{-1}(S+1)$ [2.5+2.5]

13. Solve the following intial value problem by using Laplace transform:

$y'' + 4y' + 3y = e^t$, $y(0) = 0; y'(0) = 2$ [5]

14. Graphically maximize $Z = 7x_1 + 10x_2$

Subject to constraints:

$$3x_1 + x_2 \leq 9$$
$$x_1 + 2x_2 \leq 8$$
$$x_1, x_2 \geq 0.$$ [5]

15. Solve the following linear Programming Problem by simple method:

Maximize: $Z = 3x_1 + 5x_2$

Subject to:

$$3x_1 + 2x_2 \leq 18$$
$$x_1 \leq 4,\ x_2 \leq 6$$
$$x_1, x_2 \geq 0.$$ [10]

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01 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2074 Chaitra

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

Subject: - Engineering Mathematics III *(SH501)*

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

1. If $\begin{vmatrix} a & a^2 & a^3-1 \\ b & b^2 & b^3-1 \\ c & c^2 & c^3-1 \end{vmatrix} = 0$ where $a \neq b \neq c$; apply properties of determinant to show $abc = 1$. [5]

2. If A be an $n \times n$ matrix, prove that
$$\text{Adj}(A) \cdot A = A \cdot (\text{Adj}A) = |A| I \text{ where I is an } n \times n \text{ unit matrix.}$$ [5]

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

4. Find the modal matrix for the matrix
$$A = \begin{pmatrix} 2 & 1 & 1 \\ -2 & 1 & 3 \\ 2 & 1 & -1 \end{pmatrix}$$ [5]

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

6. Find the total work done in moving the particle in a force field given by $\vec{F} = \text{Siny}\,\vec{i} + x(1+\cos y)\,\vec{j}$ over the circular path $x^2 + y^2 = a^2,\ z = 0$. [5]

7. Evaluate $\iint_S \vec{F}.d\vec{s}$ where $\vec{F} = x\vec{i} - y\vec{j} + z\vec{k}$ and s is the surface of the cylinder $x^2 + y^2 = a^2, 0 < z < b$. [5]

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

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

10. Express $f(x) = e^x$ as a half range Fourier Cosine Series in $0 < x < 1$. [5]

11. State existence theorem for Laplace Transform. Obtain the Laplace transform of

a) $te^{-t}\sin t$ b) $\dfrac{e^{-at} - e^{-bt}}{t}$ [1+2+2]

12. Find the inverse Laplace transform of:

a) $\frac{1}{s^2-5s+6}$ b) $\tan^{-1}\frac{2}{s}$ [2+5.+2.5]

13. By using Laplace transform, solve the initial value problem:

$y'' + 2y = r(t)$, $y(0) = y'(0) = 0$
Where $r(t) = 1$, $0 < t < 1$
$= 0$, otherwise

[5]

14. Graphically maximize $Z = 5x_1 + 3x_2$ Subject to constraints

$x_1 + 2x_2 \leq 50$
$2x_1 + x_2 \leq 40.$
$x_1, x_2 \geq 0$ [5]

15. Solve the following Linear Programming Problem by simple method:

Maximize : $Z = 4x + 3y$

Subject to : $2x + 3y \leq 6$
$-x + 2y \leq 3$
$2y \leq 5$
$2x + y \leq 4$
$x, y \geq 0.$

[10]

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01 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2074 Ashwin

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

Subject: - Engineering Mathematics III *(SH501)*

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

1. Use properties of determinant to show [5]

$$\begin{vmatrix} x^2 & x^2-(y-z)^2 & yz \\ y^2 & y^2-(z-x)^2 & zx \\ z^2 & z^2-(x-y)^2 & xy \end{vmatrix} = (x-y)(y-z)(z-x)(x+y+z)(x^2+y^2+z^2)$$

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

3. Define eigen values and eigen vectors in terms of linear transformation with matrices as operator. Find eigen values of the matrix. [2+3]

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

4. Test the consistency of the system $x+y+z=3,\ x+2y+3z=4,\ 2x+3y+4z=7$ by using rank of matrix method and solve if consistent. [5]

5. If $\vec{F}$ is the gradient of some scalar point functions ϕ i.e $\vec{F}=\nabla\phi$, prove that the line integral is independent of the path joining any two points in the region and conversely. [5]

6. Evaluate $\iint_S \vec{F}.\vec{n}\,ds$, where $\vec{F}=xy\,\vec{i}-x^2\,\vec{j}+(x+z)\vec{K}$ and S is the region of the plane $2x+2y+z=6$ bounded in the first quadrant. [5]

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

8. Apply Gauss' divergence theorem to evaluate $\iint_S \left[(x^3-yz)\vec{i}-2x^2y\,\vec{j}+2\vec{K}\right].\vec{n}\,ds$, where S is the surface of the cube bounded by the planes $x=0,\ x=a,\ y=0,\ y=a,\ z=0,\ z=a$. [5]

9. Expand $f(x) = x \sin x$ as a Fourier series in $-\pi \le x \le \pi$. [5]

10. Obtain half range cosine series for $f(x) = x$ in the interval $0 \le x \le \pi$. [5]

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

    i) $t^2 \cos at$

    ii) $\dfrac{\sin t}{t}$

12. State convolution theorem for inverse Laplace transform and use it to find the inverse Laplace transform of $\frac{S}{(S^2+4)(S^2+9)}$ [1+4]

13. Solve the following initial value problem by using Laplace transform: [5]

$y''+2y'-3y=\sin t,\ y(0)=y'(0)=0$

14. Graphically maximize [5]

$Z=7x_1+10x_2$

Subject to constraints,

$3x_1+x_2\leq 9$

$x_1+2x_2\leq 8$

$x_1,x_2\geq 0$

15. Solve the following LPP by simplex method using duality of: [10]

Minimize Z = 20x+50y

Subject to:

$2x+5y\geq 12$

$3x+7y\geq 17$

$x,y\geq 0$

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01 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2073 Chaitra

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

Subject: - Engineering Mathematics III *(SH501)*

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

1. Distinguish a matrix and a determinant. Use property of determinant to prove:

$$\begin{vmatrix} a+b+2c & a & b \\ c & b+c+2a & b \\ c & a & c+a+2b \end{vmatrix} = 2(a+b+c)^3$$

2. Prove that the necessary and sufficient condition for a square matrix to posses an inverse is that it is non singular. [5]

3. Find the rank of the matrix: [5]

$$\begin{pmatrix} 1 & 0 & -5 & 6 \\ 3 & -2 & 1 & 2 \\ 3 & -2 & -9 & 14 \\ 4 & -2 & -4 & 8 \end{pmatrix}$$ by reducing it to normal form.

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

5. Find the work done by the force $\vec{F} = yz\,\vec{i} + zx\,\vec{j} + xy\,\vec{k}$ in displacement of a particle along the straight segment C from point (1,1,1) to the point (3,3,2). [5]

6. State Gauss divergence theorem and apply it to evaluate $\iint_s \vec{F}.\vec{n}\,ds$, where $\vec{F} = x\,\vec{i} + y\,\vec{j} + z\,\vec{k}$ and S is the surface of the cube bounded by the planes x = 0, x = a, y = 0, y = a, z = 0, z = a. [5]

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

8. Verify stokes theorem for the vector field $\vec{F} = (2x - y)\,\vec{i} - yz^2\,\vec{j} - y^2z\,\vec{k}$ over the upper half of the surface of $x^2 + y^2 + z^2 = 1$ bounded by its projection the xy-plane. [5]

9. Find the Fourier series to represent $f(x) = x - x^2$ from $-\pi$ to π. [5]

10. Find the half range Fourier sine series for $f(x) = e^{2x}$ in $0 < x < \pi$. [5]

11. Define Laplace transform of a function and state criteria of existence of a Laplace transform of a function. Find the Laplace transform of $f(t) = \frac{1 - \cos 2t}{t}$ [1+1+3]

12. Find inverse Laplace transform of [2+3]

(i) $\frac{1}{s(s+2)}$ (ii) $\tan^{-1}\left(\frac{1}{s}\right)$

13. Solve the following initial value problem using Laplace transform: [5]

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

14. Use simplex method to solve the following LPP: [10]

Maximum $z=50x_1+80x_2$

Subject to,

$+2x_2 \le 32$

$+4x_2 \le 84$

15. Graphically maximize [5]

$z=7x_1+10x_2$

Subject to,

$3x_1+x_2 \le 9$

$x_1+2x_2 \le 8$

$x_1, x_2 \ge 0$

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01 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2073 Shrawan

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 II *(SH501)*

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

1. Use properties of determinants to prove: $\begin{vmatrix} a^2 & bc & ac+c^2 \\ a^2+ab & b^2 & ac \\ ab & b^2+bc & c^2 \end{vmatrix} = 4a^2b^2c^2$ [5]

2. Prove that the necessary and sufficient condition for a square matrix A to posses an inverse is that the matrix A should be non singular. [5]

3. Find the rank of the matrix $\begin{pmatrix} 1 & 3 & -2 & 1 \\ 1 & 1 & 1 & 1 \\ 2 & 0 & -3 & 2 \\ 3 & 3 & -3 & 3 \end{pmatrix}$ [5]

   by reducing it into normal form.

4. Find the eigenvalues and eigenvectors of the matrix $\begin{pmatrix} 2 & 1 & 1 \\ 1 & 2 & 1 \\ 0 & 0 & 1 \end{pmatrix}$ [4+1]

   Give an example showing importance of eigenvectors.

5. Show that $\vec{F} = (2x+z^2)\vec{i} + Z\vec{j} + (y+2xz)\vec{K}$ is irrotational and find its scalar potential. [5]

6. State and prove Green's Theorem in plane. [5]

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

8. Evaluate $\int_c xydx + xy^2dy$ by applying stokes theorem where C is the square in xy-plane with vertices (1,0), (-1,0), (0,1), (0,-1) [5]

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

   i) $te^{2t}\sin 3t$

   ii) $\dfrac{e^{-t}\sin t}{t}$

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

i) $\frac{s+2}{s^2-4s+13}$

ii) $\log\left(\frac{s+a}{s-a}\right)$

11. Solve the following initial value problem using Laplace transform: [5]

$x''+4x'+4x=6e^{-t}, \quad x(0)=-2, \quad x'(0)=-8$

12. Find the Fourier series representation of $f(x)=|x|$ in $[-\pi, \pi]$ [5]

13. Obtain the half range Fourier Sine Series for the function $f(x)=x^2$ in the interval (0, 3). [5]

14. Apply Graphical method to maximize, [5]

$Z=5x_1+3x_2$

Subject to the constraints:

$x_1+2x_2 \le 50$

$2x_1+x_2 \le 40$

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

15. Solve the following Linear Programming Problem by Simplex method: [10]

Maximize: $Z=15x_1+10x_2$

Subject to: $x_1+3x_2 \le 10$

$2x_1+x_2 \le 10$

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

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01 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2072 Chaitra

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

Subject: - Engineering Mathematics III *(SH501)*

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

1. Use properties of determinants to prove: [5]

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

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

3. Test the consistency of the system $x+y+z=3, x+2y+3z=4$ and $2x+3y+4z=7$ and solve completely if found consistent. [5]

4. State Cayley-Hamilton theorem and verify it for the matrix; $A=\begin{pmatrix} -2 & 2 & -3 \\ 2 & 1 & -6 \\ -1 & -2 & 0 \end{pmatrix}$. [1+4]

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

6. State Green's theorem and use it to find the area of astroid $x^{2/3}+y^{2/3}=a^{2/3}$ [5]

7. Evaluate $\iint_s \vec{F}.\vec{n}\, ds$, where $\vec{F}=x^2\vec{i}+y^2\vec{j}+z^2\vec{k}$ and 's' is the surface of the plane $x+y+z=1$ between the co-ordinate planes. [5]

8. Apply Gauss' divergence theorem to evaluate $\iint_s \vec{F}.\vec{n}\, ds$ where $\vec{F}=(x^3-yz)\vec{i}-2x^2y\vec{j}+2\vec{k}$ and 's' is the surface the cube bounded by the planes $x=0, x=a, y=0, y=a, z=0, z=a$. [5]

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

i) $t\text{Sin}^2 3t$

ii) $\dfrac{\text{Sin}2t}{t}$

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

i) $\dfrac{1}{s^2-3s+2}$

ii) $\dfrac{1}{s(s+1)^3}$

11. Apply Laplace transform to solve the differential equation: [5]

$y''+2y'+5y=e^{-t}\sin t,\ \ x(0)=0, x'(0)=1$

12. Find a Fourier series to represent $f(x)=x-x^2$ from $x=-\pi$ to $x=\pi$. Hence show that

$$\frac{1}{1^2}-\frac{1}{2^2}+\frac{1}{3^2}-\frac{1}{4^2}+\ldots\ldots=\frac{\pi^2}{12}$$ [5]

13. Develop $f(x)=\sin\left(\dfrac{\pi x}{l}\right)$ in half range Cosine Series in the range $0<x\leq l$. [5]

14. Graphically maximize, [5]

$Z=7x_1+10x_2$

Subject to constraints,

$3x_1+x_2\leq 9$

$x_1+2x_2\leq 8$

$x_1\geq 0, x_2\geq 0$

15. Solve the following LPP using simplex method. [10]

Maximize: $P=50x_1+80x_2$

Subject to: $x_1+2x_2\leq 32$

$3x_1+4x_2\leq 84$

$x_1\geq 0, x_2\geq 0$

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01 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2072 Kartik

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

Subject: - Engineering Mathematics III *(SH501)*

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

1. Prove that $\begin{vmatrix} (a+b)^2 & ca & bc \\ ca & (b+c)^2 & ab \\ bc & ab & (c+a)^2 \end{vmatrix} = 2abc(a+b+c)^3$ [5]

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

3. Find the rank of the matrix: [5]
$$\begin{pmatrix} 1 & -1 & -2 & -4 \\ 2 & 3 & -1 & -1 \\ 3 & 1 & 3 & -2 \\ 6 & 3 & 0 & -7 \end{pmatrix}$$

4. Find the eigen values and eigen vectors of the matrix.
$$\begin{pmatrix} -2 & 2 & -3 \\ 2 & 1 & -6 \\ -1 & -2 & 0 \end{pmatrix}$$

5. Prove that the line integral $\int_A^B \vec{F}.d\vec{r}$ is independent of path joining any two points A and B in the region R, if and only if, $\int_C \vec{F}.d\vec{r} = 0$ for any simple closed path C in R. [5]

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

OR

Apply Stoke's theorem to evaluate $\int_C (x+y)dx + (2x-z)dy + (y+z)dz$ where C is the boundary of the triangle with vertices (2,0,0), (0,3,0) and (0,0,6). [5]

7. State Green's theorem in plane and hence apply it to compute the area of the curve $x^{2/3} + y^{2/3} = a^{2/3}$. [5]

8. Apply Gauss divergence theorem to evaluate $\iint_S \vec{F}.\vec{n}\, ds$ where $\vec{F} = x^2\vec{i} + z\vec{j} + yz\vec{k}$ taken over the cube bounded by $x = 0, x = 1, y = 0, y = 1, z = 0, z = 1$. [5]

9. Find the Laplace transform of the following: [2.5×2]

   a) $\dfrac{\cos 2t - \cos 3t}{t}$

   b) $\sin^3 2t$

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

   a) $\dfrac{1}{s^2 - 5s + 6}$

   b) $\dfrac{s+2}{(s^2 + 4s + 5)^2}$

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

   $x'' + 2x' + 5x = e^{-t}\sin t;\ x(0) = 0,\ x'(0) = 1$

12. Obtain Fourier Series for the function $f(x) = x - x^2$ from $-\pi$ to π and hence show that: [5]

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

13. Obtain the half range sine series for the function $f(x) = x^2$ in the interval (0,3). [5]

14. Graphically maximize and minimize [5]

   $Z = 5x_1 + 3x_2$ Subjected to constraints

   $3x_1 + 5x_2 \le 15$

   $5x_1 + 2x_2 \le 10, x_1, x_2 \ge 0$

15. Use simplex method to solve the Linear Programming problem: [10]

   Maximize $Z = 15x_1 + 10x_2$

   Subject to $2x_1 + 2x_2 \le 10$

   $x_1 + 3x_2 \le 10$

   and $x_1, x_2 \ge 0$

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01 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division

2071 Chaitra

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

Subject: - Engineering Mathematics III *(SH501)*

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

1. Using the properties, evaluate the determinant: [5]

$$\begin{vmatrix} 1 & a & a^2 & a^3+bcd \\ 1 & b & b^2 & b^3+cda \\ 1 & c & c^2 & c^3+abd \\ 1 & d & d^2 & d^3+abc \end{vmatrix}$$

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

3. Test the consistency of the system: [5]

$x-6y-z=10,\ 2x-2y+3z=10,\ 3x-8y+2z=20$

And solve completely, if found consistent.

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

5. Using the line integral, compute the workdone by the force [5]

$\vec{F}=(2x-y+2z)\vec{i}+(x+y-z)\vec{j}+(3x-2y-5z)\vec{k}$

when it moves once around a circle $x^2+y^2=4; z=0$

6. State and prove Green's Theorem in plane. [5]

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

8. Evaluate $\iint_S \vec{F}.\vec{n}\ ds$ where $\vec{F}=(2xy+z)\vec{i}+y^2\vec{j}-(x+3y)\vec{K}$ by Gauss divergence theorem; where S is surface of the plane $2x+2y+z=6$ in the first octant bounding the volume V. [5]

9. Find the Laplace transform of the following: [2.5×2]

   a) $te^{-2t}\cos t$

   b) Sinhat.cost

10. Find the inverse Laplace transform of : [2.5×2]

a) $\frac{1}{S(S+1)}$

b) $\frac{S^2}{(S^2+b^2)^2}$

11. Solve the differential equation $y''+2y'+5y=e^{-t}\sin t, y(0)=0, y'(0)=1$, by using Laplace transform. [5]

12. Expand the function $f(x) = x \sin x$ as a Fourier series in the interval $-\pi \le x \le \pi$. [5]

13. Obtain half range sine series for the function $f(x)=x-x^2$ for $0<x<1$. [5]

14. Graphically maximize and minimize [5]

$z = 9x + 40y$ subjected to the constraints

$y-x \ge 1, y-x \le 3, 2 \le x \le 5$

15. Solve the following Linear Programming Problem by Simplex method: [10]

Maximize, $P = 20x_2 - 5x_1$

Subjected to, $10x_2 - 2x_1 \le 5$

$2x_1 + 5x_2 \le 10$ and $x_1, x_2 \ge 0$

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01 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2071 Shawan

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

Subject: - Mathematics III *(SH501)*

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

1. Show that: $\begin{vmatrix} (b+c)^2 & b^2 & c^2 \\ a^2 & (c+a)^2 & c^2 \\ a^2 & b^2 & (a+b)^2 \end{vmatrix} = 2abc(a+b+c)^3$ [5]

2. Prove that every square matrix can be uniquely written as a sum of Hermitian and Skew-Hermitian matrices. [5]

3. Find the rank of the matrix by changing it into normal form: $\begin{pmatrix} 3 & 1 & 4 \\ 0 & 5 & 8 \\ -3 & 4 & 4 \\ 1 & 2 & 4 \end{pmatrix}$ [5]

4. Find the eigen value and eigen vector of the matrix: $\begin{pmatrix} 2 & 1 & 1 \\ -2 & 1 & 3 \\ 2 & 1 & -1 \end{pmatrix}$ [5]

5. Using Green's theorem, evaluate $\int_C (y^3dx - x^3dy)$ where C is the boundary of the circle $x^2 + y^2 = 4$. [5]

6. Show that $\vec{F}(x,y,z) = y^3\,\vec{i} + (3xy^2 + e^{2z})\,\vec{j} + 2ye^{2z}\,\vec{k}$ is conservative vector field and find its scalar potential function. [5]

7. Find the surface integral $\iint_S \vec{F}.\hat{n}\,ds$ where $\vec{F} = x\,\vec{i} + y\,\vec{j} + z\,\vec{k}$ and S is the upper half of the sphere $x^2 + y^2 + z^2 = 1$. [5]

8. Verify Stoke's theorem for $\vec{F}(x,y,z) = (2x - y)\,\vec{i} - yz^2\,\vec{j} - y^2z\,\vec{k}$ where S is the upper half of the sphere $x^2 + y^2 + z^2 = 4$ and C is its boundary. [5]

OR

Evaluate using Gauss divergence theorem,
$\iint_S \vec{F}.\hat{n}\,ds$ where $\vec{F}(x,y,z) = x^2y\,\vec{i} + xy^2\,\vec{j} + 2xyz\,\vec{k}$ and S is the surface bounded by the planes $x = 0$, $y = 0$, $z = 0$ and $x+2y+z = 2$ [5]

9. Find the Laplace transform of (i) $\sin 2t \cosh 4t$ (ii) $te^{2t} \sin 4t$. [5]

10. Using the Convolution theorem, find the inverse Laplace transform of $\frac{3s}{(s^2+4)(s^2+1)}$ [5]

11. Solve the following initial value problem using Laplace transform: [5]

$$y''+4y'+3y = e^t, y(0) = 00, y'(0) = 2$$

12. Obtain the half range Fourier sine series of $f(x) = \pi - x$ in the range $0 < x < \pi$. [5]

13. Obtain the Fourier series of $f(x) = e^{3x}$ in $0 < x < 2\pi$. [5]

14. Graphically maximum $Z = 5x_1 + 3x_2$ subject to constraints [5]

$$x_1 + 2x_2 \leq 50, 2x_1 + x_2 \leq 40 \text{ and } x_1 \geq 0, x_2 \geq 0$$

15. Solve the following linear programming problem by simplex method constructing the duality: [10]

Minimize: $P = 21x_1+50x_2$
Subject to $3x_1+7x_2 \geq 17$
$2x_1+5x_2 \geq 12$
$x_1, x_2 \geq 0$

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TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2080 Bhadra

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

Subject: - Digital Logic *(EX 502)*

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

1. Define Gray Code. Design 3-bit binary to gray code converter circuit with necessary truth table and circuit diagram. [2+3+1]
2. Define positive and negative logic. Realize X-NOR gate using NAND gates only. [2+4]
3. Simplify the Boolean function F (A, B, C, D) = Σ m (0,1,2,4,7,8,9,10,12,15) and don't care condition (5,11,13) using K-Map and implement by only NOR gates. [4+2]
4. Realize the following logic function using a single 1:8 demultiplexer and necessary logic gates. [6]

   Y (A, B, C, D) = Σ_m (0, 2, 3, 5, 7, 8, 10, 13, 15)
5. Design the full-subtractor circuit using decoder and required logic gates. What is a combinational logic circuit? [4+2]
6. Show logic diagram, excitation table and characteristic equation of SR flip-flop. [1+2+3]
7. Explain the operation of 4-bit serial in –serial out shift register with a clear circuit and timing diagram with a positive edge-triggered clock. [4+2]
8. Define a ripple counter. Design an asynchronous mod-11 up-counter with negative edge triggering clock. [2+6]
9. Design a mod-5 synchronous counter using JK flip-flops. [7]
10. Define the propagation delay time. Draw the schematic diagram of a 2-input TTL NAND gate and explain its logic operation. [2+6]
11. Design a sequential machine that has one serial input X and one output Z. The machine is required to give an output Z = 1, when the serial input X contains the message 1010. Use T flip –flop. [10]
12. Sketch the block diagram of the digital frequency counter and describe its operation. [5]

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TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2081 Baishakh

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

Subject: - Digital Logic *(EX 502)*

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

1. Convert decimal 39 into Gray code and Excess-3 code. Use 2'S complement method to perform the following addition $(-28+17)_{10}$. [2+2+3]
2. What is the importance of De-Morgan's laws? Show how a two-input XOR gate can be constructed from a two-input NAND gate with required expressions. [2+3]
3. Implement the following function using K-Map.$F(A,B,C,D)= \Sigma(0,2,4,5,11)+d(3,7,12,15)$. Implement the function using NOR gate only. [4+2]
4. What is a priority encoder? Find out the simplest logic circuit for "e" and "f" segments of the BCD –to-seven segment display decoder. [2+3+3]
5. Design 5×32 line decoder using 3×8 line decodes and necessary logic gates. [5]
6. Design and explain the circuit to add the following bits 1011 and 1100 using block-diagrams. [5]
7. With the help of RS flip-flop, realize JK flip-flop with using excitation table and required expressions. [6]
8. Differentiate between synchronous and asynchronous counter. Design 3-bit synchronous down counter using JK flipflops. [2+6]
9. Describe the operation of 4-bit parallel-in serial-out (PISO) shift register with timing diagram of 1011 data input. [3+3]
10. Design a sequential machine that has a single input 'x' and single output 'y'. The machine is required to 'give high output (y=1) when it detects the serial sequence of x = 1101 message. Use T flip-flops only. [12]
11. Explain the characteristics of CMOS gates and explain logic operation of CMOS 2-input NOR gate circuit with its truth table. [3+5]
12. Describe the operation of frequency counter. [4]

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TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2080 Baishakh

Exam.	Back		
Level	BE	Full Marks	40
Programme	BEL, BEX, BCT	Pass Marks	16
Year / Part	II / I	Time	1 ½ 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. Perform the following

   (i) $(1110)_{gray} = (\ )_{BCD}$

   (ii) $(1430)_{10} = (\ )_{excess\text{-}3}$

   (iii) Use 2'S complement method to perform the addition (-28 +17). [2+2+4]

2. State and prove De-Morgan's theorems with necessary diagrams. Realise Ex-OR Gate using NAND Gate only. [5+3]
3. Realize Full Adder Circuit using a 2×4 decoder and using logic gates. [8]
4. Draw the simplest logic circuit for "a" segment of the BCD-to – seven segment display decoder and realize the simplest logic expression using only NOR gates. [4+3]
5. What is the Setup time and hold time of a flip-flop? With the help of excitation table and K-map, convert SR flip-flop into JK flip- flop. [2+6]
6. Explain the operation of 4 bit serial in serial out (SIPO) register with timing diagrams for the given data pattern 1010. [7]
7. Design mod-5 Gray code synchronous up-counter with negative edge triggering clock system. (Use JK flip-flops). [8]
8. Draw and explain the schematic diagram of TTL NOR gate and explain about CMOS characteristics. [4+3]
9. Explain the operation of frequency counter with the help of a block diagram. [6]
10. Design a sequential machine, that has one bit serial input (X) and one output (Z). The machine is required to give an output Z = 1, when the input contains the message 1011. Design the machine using T flip flop. [13]

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TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2079 Bhadra

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

Subject: - Digital Logic *(EX 502)*

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

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

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

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TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2079 Baishakh

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

Subject: - Digital Logic (*EX 502*)

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

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

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TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2078 Bhadra

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

Subject: - Digital Logic *(EX 502)*

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

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

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TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2078 Kartik

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

Subject: - Digital Logic *(EX 502)*

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

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

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TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2076 Chaitra

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

Subject: - Digital Logic *(EX 502)*

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

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

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TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2076 Ashwin

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

Subject: - Digital Logic *(EX 502)*

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

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

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TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2075 Chaitra

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

Subject: - Digital Logic *(EX 502)*

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

1. a) Explain excess-3 code with suitable examples.
   b) Define combinational logic circuit. [2.5]
2. Simplify the function using K-map $F=\Sigma(0,1,4,8,10,11,12)$ and $D=\Sigma(2,3,6,9,15)$. Also convert the result into only NAND gates. [2.5]
3. Design the operation of octal priority encoder with neat diagram. [6]
4. Design a simplest logic circuit for 'b' segment of the BCD-to-7 segment display decoder. [7]
5. Explain the operation of JK flip flop showing its logic diagram, characteristic table and then derive its characteristic equation and excitation table. [6]
6. Draw a 4 bit PISO shift register and explain its operation along with timing waveform with 1101 data load in input. [6]
7. Explain the working principle of 4 bit down asynchronous counter with neat timing diagram using negative clock edge triggering. [6]
8. Design a mod-6 synchronous counter using T Flip-Flops with timing diagrams. [7]
9. Describe the voltage profile of TTL. Explain the working principle of tristate TTL inverter. [2+6]
10. Design a synchronous sequential machine such that it gives output Z=1 if input contains the sequence of message 011 and it retains in its own state in other condition giving output zero. Use RS-Flip-Flop. [11]
11. Draw the circuit diagram of 3 input CMOS gate and explain its operation. [6]
12. Illustrate time measurement circuit with block diagram. [6]

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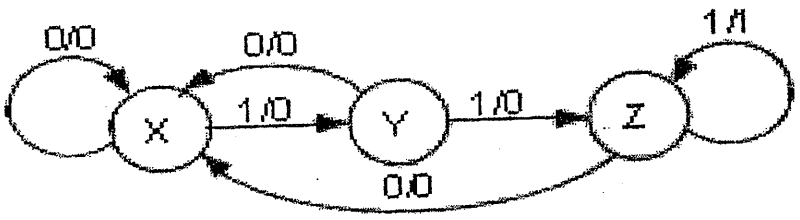
17 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2075 Ashwin

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

Subject: - Digital Logic *(EX502)*

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

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



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

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17 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2074 Chaitra

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

Subject: - Digital Logic *(EX502)*

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

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

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27 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2074 Ashwin

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

Subject: - Digital Logic *(EX502)*

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

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27 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2073 Chaitra

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

Subject: - Digital Logic *(EX502)*

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

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

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

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

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073/4/A

24 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2073 Shrawan

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

Subject: - Digital Logic *(EX502)*

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

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

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01/13

27 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2072 Chaitra

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

Subject: - Digital Logic *(EX502)*

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

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

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7/21 Morning

27 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2072 Kartik

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

Subject: - Digital Logic *(EX502)*

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

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

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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: - Digital Logic *(EX502)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
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1. What is weighted code and non-weighted code? What will be the BCD, Excess-3 and Gray code for the decimal number 15? [2+3]
2. Perform the following addition using 2's complement -5+12 [4]
3. Implement Exclusive OR gate by using NAND gates only. [3]
4. Simplify the following function using K-map and implement the result using only NOR gates. [4+3]

   $F(A, B, C,D) = \sum m (0, 2, 3, 5, 6, 8, 9) + d (10, 11, 12, 13, 14, 15)$
5. Design a 32:1 MUX using only 8:1 MUX. Use block diagrams. [5]
6. Design a combinational logic circuit with 3 input variables that will produce logic high output when more than one input variables are logic low. [4]
7. Show with design that a full-adder can be implemented using two half-adders. Subtract $(16)_{10}$ from $(14)_{10}$ using 2's complement method. [6+2]
8. Derive characteristic equation of a JK flip flop. How do you make it a toggle flip flop? Draw the input and output wave form of JK flip flop. [3+2+2]
9. What is a Shift Register? What are its various types? List out some applications of Shift Register. [5]
10. Differentiate between synchronous and asynchronous counters. Describe the operation of asynchronous 3-bit binary down counter. [2+6]
11. Design a sequential circuit with two D flip flops and two inputs, P and Q. If P = 0, the circuit remains in the same state regardless of the value of Q. When P = 1 and Q = 1, the circuit goes through the state transitions from 00 to 01 to 10 back to 00, and repeats. When P = 1 and Q = 0, the circuit goes through the state transitions from 00 to 10 to 01 back to 00, and repeats. The circuit is to be designed by treating the unused state (s) as don't care condition(s). [12]
12. Discuss the following TTL parameters: [2×4]

    i) Propagation delay
    ii) Worst-Case input voltages
    iii) Fan-out
    iv) Power dissipation
13. Explain clearly the operation of frequency counter with necessary block diagram and timing diagrams. [4]

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INSTITUTE OF ENGINEERING
Examination Control Division
2071 Shawan

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

Subject: - Digital Logic *(EX502)*

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

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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**.*
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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
2070 Ashad

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

Subject: - Digital Logic *(EX502)*

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

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

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25 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2069 Chaitra

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

Subject: - Digital Logic *(EX502)*

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

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

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TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2080 Bhadra

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

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

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

1. Define the pros and cons of object oriented programming over procedural programming language. With a program code show the concept of object oriented programming in C++. [4+4]
2. Write a program to show the working of different types of constructors and destructor. Explain which object is calling which constructor and how objects are destroyed in your program. [2+6]
3. Differentiate the benefits of C++ over C. What is a namespace? Write a program with .a namespace showing its use. [4+1+3]
4. What do you mean by Dynamic Memory Allocation? How it is done in C++? Explain inline function in C++ with example. [2+2+4]
5. What is operator overloading in C++ and how does it allow you to entend the behavior of operators for user-defined types. List the operator that can't be overloaded. Write a program to overload the insertion (<<) and extraction (>>) operators to read and display data objects. [2+1+5]
6. What are the advantages of inheritance? Consider a class liquid with data member specific _ gravity and a class fuel with data member fuel. Now from these two base classes derive a class petrol as derived class. Assume necessary method required in different classes. Which type of inheritance is used in above program? [3+4+1]
7. What do you mean by dynamic binding? Explain how it is implemented? Discuss how Run-Time Type Information can be achieved in C++. [1+2+5]
8. Draw and explain the stream class hierarchy of Console Input/ Output. Write a program that uses a file for a car manufacturing company to add the record and display the list of record in the console. [2+6]
9. What is a template in C++ programming? Provide an example scenario where templates can be used. What are the key components of the Standard Template Library (STL) ? Show the use of vector container in C++. [1+2+2+3]
10. Why it is necessary to handle exception? Explain exception handling mechanism. Write any program to handle multiple exception. [2+2+4]

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TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2081 Baishakh

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

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

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

1. What are limitations of C programming? Explain what makes OOP a new paradigm. [8]
2. What do you understand by default arguments? How can you relate default argument function with function overloading? Write a program to find volume of different 3D shapes using function overloading. [2+2+4]
3. In which condition can a class be made friend? Explain with example. Write a suitable program to show use of dynamic memory allocation for creating array of objects. [4+4]
4. What are the properties of Constructors? Create a class called volume that uses three data members (length, width, height) in terms of feet and inches to model the volume of a room. Read the three dimensions of the room and calculate the volume it represent, and print out the result. The volume should be in (feet) from i.e. you will have to convert each dimension into the feet and fraction of foot. For instance, the length 12 feet and 6 inches will be 12.5 ft). [8]
5. What are the advantages of operator overloading? What are the rules of operator overloading? Write a program to overload the binary operator to add complex numbers. [2+6]
6. Explain different types of inheritance. Explain with example how member function overriding is handled in inheritance. [4+4]
7. What are the different types of polymorphism? Explain pure virtual function. Create an abstract class polygon with length and height as its data members. Make area( )a pure virtual function and redefine it in derived classes triangle and rectangle to calculate respective area. Your program should demonstrate run time polymorphism. [2+2+4]
8. Explain stream class hierarchy. Write a program to store information of 10 students in a file and display them on console. [3+5]
9. What are templates? Explain with example how we can overload ordinary function with template function. [3+5]
10. What is the advantage of having exception handling in the program? Explain about multiple handler in exception handling mechanism with suitable example. [2+6]

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TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2080 Baishakh

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

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

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

1. Is Object Oriented Programming is better than Procedure Oriented Programming? Support with your appropriate logic. Explain the features of object oriented programming in brief. [3+5]
2. Explain relationship between default argument and function overloading with suitable example. Define inline function. Write the conditions when inline function doesnot works. [4+2+2]
3. What is a constant function? What is its relation with constant object? Write a meaningful function that shows the use of constant object and constant function. [2+2+4]
4. Why do we need constructor? Create a class called 'time' with data member hour, minute, second and day. Initilalize all the data member using constructor. Write a program to add two 'time' object using necessary member functions and display the result in main. [2+6]
5. Why do we need explicit constructor? Write a program to convert object from a class that represents Weight of gold in Nepal, tola, to object of a class that represents international gold measurement of weight in gram scale.(1 tola = 11.664 gram) [2+6]
6. Explain the constructor and destructor invocation order in single and multiple inheritance. Write a program to create classes to represent student, actor and leader from the base class person. Use proper members in the classes to make your program meaningful. [4+4]
7. Why we need virtual function? Explain with example, how you implement run time polymorphism. [2+6]
8. How a file can be opened in C++? Explain with a suitable example and Syntax. Write a program to write the Information of 10 employee in a file named " employee. dat". And also scan the data from the file and display their details in console. [3+5]
9. What are the use of Function template? Write a program to create a derive class which is a non- template class from a base class which is a template class. [3+5]
10. How is exception handling different than the traditional error handling? Explain the exception handling construct. Write a program to demonstrate exception handling with "catch all". [2+2+4]

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TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2079 Bhadra

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

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

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

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

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TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
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2079 Baishakh

Exam.	Back		
Level	BE	Full Marks	80
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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.
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1. What are the drawback of procedural programming and advantage of object oriented programming. With a program code differentiate between procedure oriented programming and object oriented programming. [3+5]
2. Explain the order of constructor and destructor invocation with example. When do we use static data member and static function in a class? Explain with example. [4+4]
3. Write down the brief history of C++. Compare C with C++ with example. [4+4]
4. Explain how function selection is done in function overloading? Where can enumerated data types be used in C++ programming. [5+3]
5. How do you convert one class type to another class type? Write a program to overload the relational operators(>and==)to compare two distance objects using non-member function. [3+5]
6. Explain multipath and multiple inheritances. Write a program to demonstrate example of Hierarchical inheritance. [3+5]
7. How can you eliminate member function overriding in virtual function? Consider a book shop which sells both books and video-tapes. Create a class known as media that stores the title and price of a publication. Then create two derived classes, one for storing the number of pages in a book and another for storing the playing time of tape. [2+6]
8. Explain how do you achieve random access to file? Write a program to store and retrieve 'n' records of items (item_ID, name, price, mfd_date, company) in Inventory system. [3+5]
9. What are the use of Function Template? Explain the case when all the template parameters are not used in function arguments. Write a program that illustrates the overloading of two function template. [2+2+4]
10. Explain exception along with exception handling mechanism. Write a program to demonstrate example of rethrowing exception. [3+5]

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TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2078 Bhadra

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

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

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

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

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TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2078 Kartik

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

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TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2076 Chaitra

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

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

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

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TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2076 Ashwin

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

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

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

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

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TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2075 Chaitra

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

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

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

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

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15 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2075 Ashwin

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

Subject: - Object Oriented Programming *(CT501)*

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

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

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15 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2074 Chaitra

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

Subject: - Object Oriented Programming *(CT501)*

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

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

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25 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2074 Ashwin

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

Subject: - Object Oriented Programming *(CT501)*

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

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

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25 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2073 Chaitra

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

Subject: - Object Oriented Programming *(CT501)*

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

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

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22 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2073 Shrawan

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

Subject: - Object Oriented Programming *(CT501)*

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

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

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25 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2072 Chaitra

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

Subject: - Object Oriented Programming *(CT501)*

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

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

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25 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2072 Kartik

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

Subject: - Object Oriented Programming *(CT501)*

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

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

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25 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2071 Chaitra

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

Subject: - Object Oriented Programming *(CT501)*

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

1. Explain the advantages of OOP over traditional procedure oriented programming. What are the characteristics of OOP? Write a program to perform addition of two metric distances which takes object as argument an also returns object as argument. [2+3+5]
2. What is literals and identifier? What is function overloading? Write a program to find the area of circle, rectangle and square using function overloading. [4+2+4]
3. List down the difference between constructor and destructor. Write a class that can store Department ID and Department Name with constructors to initialize its members. Write destructor member in the same class and display the message "Object goes out of the scope". Your program should be made such that it should show the order of constructor and destructor invocation. [3+7]
4. Explain how you overload relational operator using member function and non-member function. Write a program to convert currency from dollar to rupees and vice versa (assume suitable data). [4+6]
5. What do you mean by access specifier? Explain how different specifiers can be used in the inheriting features of base class members. Write syntax for each one of them and Write a program to support your explanation. [1+3+7]
6. Explain class hierarchy for console and file I/O with diagram. What are different ios class functions and flags that are used for formatted I/O operation? Write a program to read and write the information of 10 students in a file. [3+3+4]
7. What is pure virtual function? Write a program to demonstrate runtime polymorphism in C++. [4+6]
8. What is rethrowing exception? Write a program using template to add two integers, two floats and one integer and one float respectively. Display the final result in float. [9]

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22 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2071 Shawan

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

Subject: - Object Oriented Programming *(CT501)*

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

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

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22 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2070 Chaitra

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

Subject: - Object Oriented Programming *(CT501)*

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

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

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23 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2070 Ashad

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

Subject: - Object Oriented Programming *(CT501)*

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

1. Write down the limitations of procedural programming. Compare procedural and object oriented programming. Write program to find prime number in procedural and object oriented ways. [2+2+6]
2. What do you understand by friend functions and classes? Explain with example. Write a program to add members of objects of two different classes. [4+6]
3. What do you mean by namespace? Explain how namespace can be used. Write a program that uses pass by reference to change meter to centimeter using pass by reference along with the namespace. [2+2+6]
4. Explain the binary and unary operator overloading along with their syntax and example. Write a program to add two matrices by overloading the + operator. [4+6]
5. Explain the constructor and destructor invocation order in single and multiple inheritance. Also show how a parameterized base class constructor is called when derived class object are created. Write a program to create classes to represent student, teaching staffs and non-teaching staffs from the base class person. Use proper members in the classes to make your program meaningful. [4+6]
6. What do you mean by manipulators? Explain different manipulators available in C++. Write a program that stores information of a students in a file and display the file's content in descending order according to their marks obtained. [1+3+6]
7. What are virtual functions and pure virtual functions? Explain abstract class and its use. Write a program having student as an abstract class and create derived class such as Engineering, Science and Medical. Show the use of virtual functions in this program. [2+2+6]
8. What do you understand by function template? Write down the syntax and use of function template. Write a program that will find the sum and average of elements in an array using function templates. [2+2+6]

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23 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
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 aclass 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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